Reengineer Your ECAD-MCAD Design Process

The pervasiveness of electromechanical products brings new challenges to product development companies.

Just about every useful gadget that you touch today – your cell phone, your digital camera, your LCD TV, your MP3 player, your global positioning system – along with a growing list of other consumer and industrial products – demonstrates the increasing merger of electronics and software in physical products. When you see flashing lights in children’s sneakers, or microprocessors in credit cards, or radio frequency identification (RFID) chips embedded in a host of other products, it’s clear that the marriage of electronics and software is spawning an entirely new generation of innovative products.

For consumers, the integration of mechanical, electrical and software features – or what some call Electromechanical Design – can be a hidden blessing or an outright pleasure. But if you’re part of a design team for a product development company, the emergence of electromechanical design can be a nightmare. The reason: advanced product capabilities are here to stay, but the processes for collaboration across disciplines are still, for many companies, archaic and inefficient.

In most product development organizations, electrical and mechanical engineers are still using separate and disparate systems for electrical computer-aided design (ECAD) and mechanical computer-aided design (MCAD), making collaboration time-consuming and difficult.

What’s needed is a means of bringing mechanical and electrical design teams together early in the product design cycle, and giving them a way to efficiently share incremental design changes when a problem is identified, instead of delaying it to the next design hand-off.

This white paper details the challenges that mechanical and electrical design engineers are facing today, and how the latest software tools are providing a powerful solution for making the most of ECAD-MCAD collaboration.
Design Collaboration Today: A Broken Process

The core challenge for most product development companies is this: MCAD and ECAD are separate disciplines, with different product development origins, making collaboration difficult. Electrical and Mechanical engineers work in separate, yet parallel silos, communicating ideas, designs, and questions often through email, phone, or in person. This type of personal collaboration can’t keep up with the challenges of tighter time-to-market cycles, the global dispersal of engineering teams, and the pressures of improving functionality while making the product smaller. In today’s world of global product development, communicating through email, phone, and face-to-face conversations produces, at best, a minimum level of collaboration with inadequate processes for design tracking.

Engineers often cannot be certain that they are working on the current design. In many cases, they can’t even tell whether the changes they’re making to their designs will even work when the product gets to manufacturing.

A Typical ECAD–MCAD PCB design phase

For many of today’s manufacturers, the electromechanical detailed design process is to blame for the lack of collaboration. Typically, ECAD and MCAD teams work together on an early physical bill of materials (BOM) and each team has the same understanding of what the printed circuit board (PCB) should look like mechanically. The Mechanical Engineer begins to define the board shape, including locations of mechanical holes and placement of mechanically driven components, while the electrical engineer is simultaneously defining the schematic, including component packaging, net lists and performance-driven interconnect constraints.

Once the mechanical team completes the definition, it is then transferred—typically in IDF format—to the ECAD team as a baseline for the electronically driven place and route. Although the ECAD and MCAD teams still have the same understanding of what the PCB should look like, without each group visually and electronically signing off on the baseline, there may already be a conflict between the domain-specific design constraints.

As the MCAD team continues to develop the mechanical aspects of the product, the ECAD team—working on a completely separate track—continues to update detailed place and route. At this point, it is likely that the ECAD and MCAD teams have a slightly different view of what the board looks like mechanically, and both teams will need to rely on design exchanges and design reviews to update the design in each domain. Worse yet, because the MCAD engineer is primarily focused on MCAD issues, and the ECAD engineer is primarily looking for ECAD issues, neither is actually optimizing the overall design. Although the design exchanges and reviews are necessary to ensure uniformity of the design, they are also time-consuming and cumbersome.

In practice, the process requires a good deal of early and ongoing interaction between the two disciplines before the integrated ECAD-MCAD model is fully optimized and ready for production.
Detailed Designs Going Unexamined

In today’s competitive market, the aforementioned process is less than adequate for several reasons. For one, detailed designs require a higher level of design collaboration between the ECAD and MCAD domains in order to handle the complex interdependencies between them. For another, the available data exchange tools have made meaningful collaboration difficult. An example: the standard formats are limited to sending all the existing data and the updates, rather than incremental updates.

Because of the time it takes to apply changes using the standard format, ECAD and MCAD engineers typically wait as long as possible before implementing changes from the other domain or before disclosing their own changes. This can be detrimental to the other engineer’s comprehension of the extent of the new changes, and it can also mean that the other engineer, not having received a complete update, may be proceeding with a design that is already obsolete.

The result:

- Mechanical and electrical designers have limited visibility into each other’s work-in-progress between file exchanges;
- It’s difficult to review a change before it is implemented in the design;
- In many cases it’s not possible to trace the origin of a change – who made it, when, and why;
- Disconnects between the MCAD and ECAD designs may not be discovered until very late in the design process and therefore become more expensive to correct;
- Designs fail to achieve the optimum efficiency.

Managers Making Risky Decisions

For managers, challenges arise due to lack of project visibility. The manager, asked to approve a mechanical design, might not realize that the design doesn’t include the most recent ECAD changes. Or, the manager might release the finished design to Manufacturing, unaware that the software engineer had just shipped a security patch to fix a bug in the current release. Mistakes and failures such as these can have a dramatic impact on sales, profits, costs, and delivery schedules.

In a 2006 survey, PTC found, because of poor integration among electrical, mechanical, and software disciplines:

> 66% of respondents had missed development and manufacturing milestones;
> 80% had incurred additional development and manufacturing costs;
> 40% had missed product-launch schedules.
What's Needed: Integrated, In-process ECAD-MCAD Collaboration

The best solution to the challenges of ECAD-MCAD collaboration is to integrate the software solutions used by the ECAD and MCAD engineers.

With integrated software, MCAD-ECAD engineers have the ability to cross-highlight changes between their electrical and mechanical designs, with full visibility between the two design teams. In practice, each of their display screens will display a view from both domains – the PCB layout and the 3D CAD model, side by side – where one view is the active 3D MCAD design and the other reflects an agreed-to state of the ECAD domain as a reference (or vice versa).

When a Mechanical Engineer adjusts one component on the MCAD model, it will automatically show the effect on the ECAD layout, and vice versa - thereby visually exposing issues that otherwise would not be immediately obvious. Integrated ECAD-MCAD software can keep track of all changes, enabling the engineers to first verify each others' changes, and then review, if necessary, the origins of a particular change. In addition, this solution helps project managers and other design team members know that they’re working with the current versions of the designs at any given moment.

To make this solution even more valuable for the entire organization, your ECAD-MCAD software and data should also be integrated with the company’s Product Data Management (PDM) or Product Lifecycle Management (PLM) solution. This integration provides an added measure of certainty that enables other people in the company – in Purchasing, Marketing, Finance, etc.– to access the current versions of the product designs. Lastly, the PLM repository will perform tracking and version control of the related software, therefore giving management a single place – the PLM repository – to look for the complete status of the product-to-be.

PTC’s Approach to Electromechanical Product Development

PTC offers an integrated ECAD-MCAD collaboration solution – Pro/ENGINEER ECAD-MCAD Collaboration Extension (ECX), which provides full ECAD-MCAD visualization tools through the company’s ProductView™ 9.0.

This combination of solutions enables faster collaboration and provides the industry’s most advanced capabilities to help you modernize your electromechanical, detailed design process. By leveraging new capabilities in Pro/ENGINEER Wildfire, as well as PTC’s InterComm™ Expert, ProductView ECAD Compare, and ProductView Validate products, you can collaborate more efficiently by seamlessly proposing, identifying, managing and retracing the history of changes across mechanical and electrical disciplines.

Universal Visualization and Markup

With Pro/ENGINEER ECX, engineers can view and mark up ECAD and MCAD models, easily identifying incremental changes, and add comments and other annotations as they work. With more effective communication tools, ECAD and MCAD designers are fully aware of any changes, while ensuring accuracy of the other downstream deliverables such as manufacturing and purchasing information. This solution minimizes the need for frequent, full-design transfer between ECAD and MCAD teams, thereby maximizing speed and efficiency. By eliminating frequent full-design translations, you also eliminate the risks of overwriting data, which is time-consuming and error-prone.
Automatic Change Identification

Pro/ENGINEER ECX automates change identification in several ways. First, it can compare PCB designs and highlight the changed portions, using attributes or graphics for display. Second, it highlights ECAD changes on the MCAD model instantly. Third, when integrated with PTC’s Windchill® software, it automatically compares ECAD designs when they are checked in, then shows the latest changes, and then sends a change report to the MCAD engineer and/or the project manager for review. Lastly, it is open to integration with other ECAD tools because of its reliance on the ProSTEP design collaboration model, an open industry standard for incremental data exchange.

A Better Process

PTC software gives manufacturing companies of all types and sizes the tools to improve their product development processes by optimizing ECAD-MCAD collaboration. Rather than relying on fractured, random engineer-to-engineer and manager-to-manager communications, PTC products allow the design and engineering teams to work in parallel, with the confidence that their time and effort aren’t being wasted on incomplete or obsolete designs or information. The result is a product development process that can meet the electromechanical design challenges of today, and support the newer challenges and opportunities that are certain to arrive tomorrow.