ECAD-MCAD CO-DESIGN LEADS TO FIRST-PASS SUCCESS

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THE CHALLENGE: FIRST-PASS SUCCESS

First-pass success in the engineering domain is generally defined as the ability of a product to function as designed after the first pass of fabrication and assembly. By achieving first-pass success, costly design iterations needed to address issues are minimized or even eliminated. Reducing the number of design iterations not only reduces product development cost but, more importantly, it helps ensure that the product launch goal is achieved.

In a recent survey conducted by the Aberdeen Group, 56% of companies cite the need to launch products quickly as their top pressure for improving the design process, ahead of pressures to reduce product cost and improve quality (Figure 1).

The survey also noted that best-in-class companies are 49% more likely to meet product launch targets. Clearly, achieving first-pass success is a key component of launching products quickly and, thereby, of meeting or exceeding the product launch target.

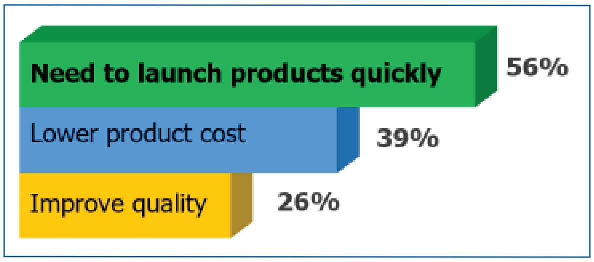

Figure 1: Top pressures to improve the design process

Although first-pass success is a crucial goal for every design team, the increasing electro-mechanical complexity and density of today's products, especially in the consumer and wearable space, are making this goal more and more elusive. This paper discusses how an efficient ECAD-MCAD co-design process can be an enabler for design teams to eliminate costly electro-mechanical issues during new product development and, in so doing, to increase the probability of achieving first-pass success.

WHY CO-DESIGN?

The impact of electro-mechanical complexity and density on first-pass success can be significant. It is estimated that 50% of complex products require at least one additional design iteration to address electro-mechanical issues. In fact, 68% of corporations cite ECAD-MCAD design synchronization as a significant product design challenge.

The smaller-denser-faster mantra associated with today's designs is magnifying the significance of ensuring that electro-mechanical compatibility is addressed prior to first fabrication. Waiting until fabrication to validate ECAD and MCAD compatibility is not an option for today's companies that need to launch products quickly. The compatibility of the printed circuit board and all associated electrical components, with the enclosure and all associated mechanical hardware, must be 'designed in' using a correct-by-construction methodology.

Given the need to launch products quickly and the impact of ever-increasing electro-mechanical complexity, how do companies adjust their product-development process in order to achieve first-pass success? One adjustment, found in 82% of best-in-class companies, is to utilize a system that allows for ECAD and MCAD design data to be exchanged incrementally throughout the design process (Figure 2).

These companies realize that synchronization of electrical and mechanical information is essential to ensuring that no physical violations occur when the PCB is placed within the enclosure and/or the entire system.

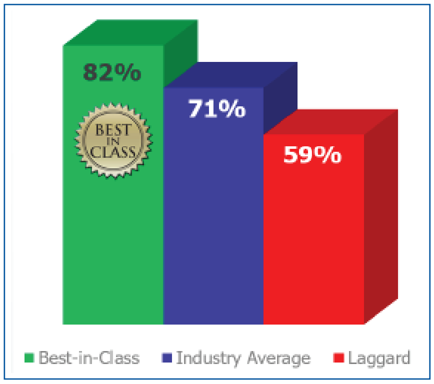

Figure 2: Companies that incrementally exchange ECAD and MCAD data

These companies have also determined that the incremental exchange of data during design is fundamental to ensuring ECAD-MCAD compatibility and therefore:

- Reduces time to market
- Creates more-robust designs
- Increases productivity
- Is an enabler to achieving first-pass success.

For the laggards, the impact of poor collaboration can be significant. Poor collaboration has been shown to impact all stages of product development, from concept through to fabrication, as a result of:

- No consistent, continuous communication to keep the ECAD and MCAD data synchronized
- No 'what-if' evaluations to avoid costly and time-consuming design iterations
- No process to negotiate proposed changes between the ECAD and MCAD domains
- No methodology for validating design intent early and often.

The bottom line is that processes that facilitate collaboration across disciplines, especially the ECAD and MCAD disciplines, are vital to the success of today's smaller-denser-faster products (Figure 3).

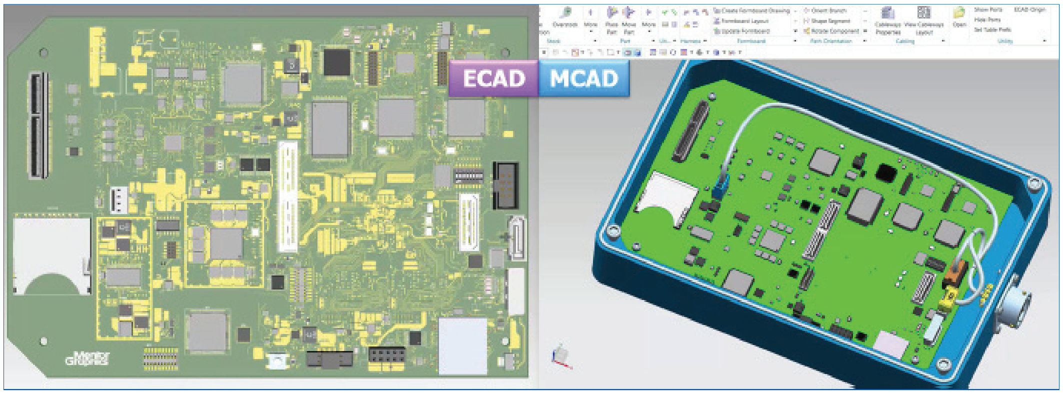

Figure 3: ECAD-MCAD co-design using Xpedition and Siemens NX.

IMPLEMENTING EFFECTIVE ECAD-MCAD CO-DESIGN

PCB designers and mechanical engineers alike can attest to the many potential impediments to ECAD-MCAD collaboration. First and foremost is the traditional separation that has existed between the two disciplines. PCB designers and mechanical engineers typically work with completely different tool sets and have completely different vocabularies. Many times they even reside in different physical locations.

Compounding these impediments is the fact that, in many cases, previous efforts to collaborate have met with limited success. These previous ECAD-MCAD collaboration efforts utilized everything from electronic documents, to sticky notes, to email, to technology that was specifically intended to enhance collaboration but fell short for various reasons. As a result, a lot of product development teams have resorted to internally developed software and processes for collaboration that, in turn, must be tested and verified with each new release of the underlying ECAD and MCAD tool suites. These locally developed software and processes are costly to maintain and, in most cases, not as efficient and effective as the innovative solutions that are available in the latest software technology.

Given these impediments to collaboration, how can teams move towards an effective ECAD-MCAD co-design process? Part of the answer lies in the data format used to communicate between the domains. Today, many companies still utilize the Intermediate Data Format (IDF) that was first developed in 1992 to transfer information between electrical and mechanical systems. Although the format has evolved over the years, it is still a static file transfer of the entire design database. While it does work, it is extremely difficult to know what and where something changed just by reviewing the imported file. As a result, it is often necessary to also provide written documentation and/or marked-up drawings to ensure the changes are clearly communicated and that nothing is lost during this process.

In 2010, the Interdomain Design Exchange format (IDX) was introduced. It is an XML messaging format that is based on the ProSTEP ECAD Design and MCAD Design (EDMD) open schema for the incremental exchange of information between ECAD and MCAD tools. With this latest format, designers are able to synchronize their data more efficiently and collaborate more effectively on critical design items between domains, thereby ensuring that the design intent is properly implemented (Figure 4).

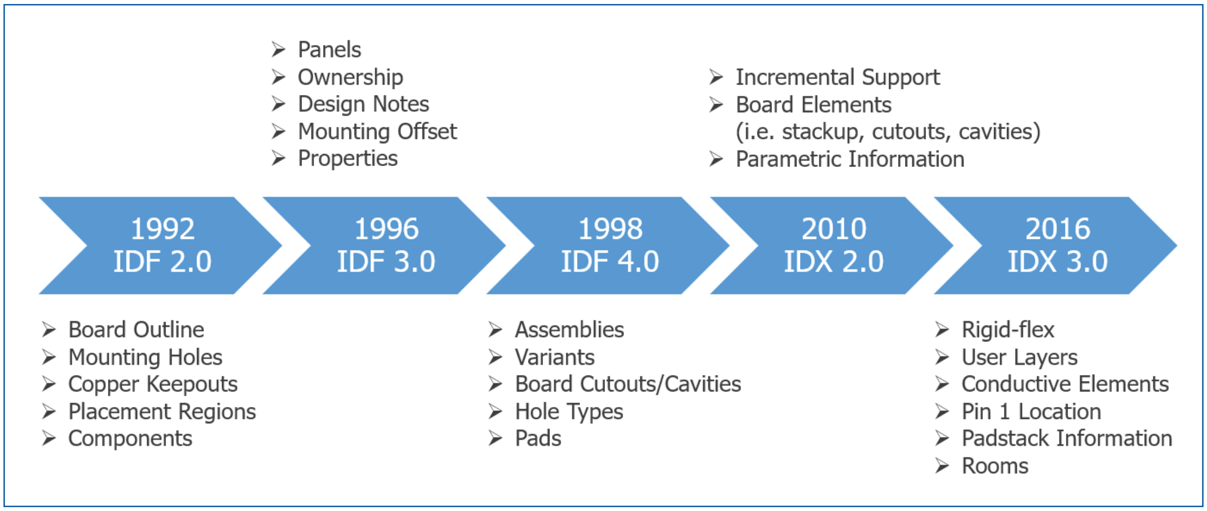

Figure 4: History of data formats for ECAD-MCAD collaboration

The reasons that the IDX format allows designers to collaborate and identify issues much more effectively throughout the design process, as compared to the previous IDF format, include:

- IDX supports the establishment of a "baseline" set of data. Once the baseline is established, all subsequent exchanges of information will include only the incremental changes.
- IDX data are represented in a single file whereas IDF data are split across two files.
- IDX provides the ability to evaluate proposed changes prior to accepting. Additionally, the acceptance or rejection of proposed changes is not an all-or-nothing proposition. Instead, it is done on an object-by-object basis.
- IDX offers the ability to include notes documenting the justification for any proposed changes.

Together, this ensures traceability for all changes, specifically what, who, why, and when.

HOW DOES IT WORK?

At a high level, a flow using IDX to exchange data between the ECAD and MCAD domains can be described as follows (Figure 5):

1. First, the mechanical engineer creates the board outline including mounting holes and any part and/or route restrictions. Critical components such as board-to-board connectors or parts that interface with the enclosure are also placed. The mechanical engineer then exports a 'Baseline' IDX file to the ECAD designer. The baseline file is imported and accepted by the ECAD designer and the two domains are now in-sync.
2. The ECAD designer then places components and sends an incremental IDX file to the mechanical engineer for review. The MCAD engineer reviews the component placement and either Accepts or Rejects the proposal. A response file is then sent back to the ECAD designer. The ECAD designer accepts the response file and the two domains are once again in-sync.
3. The process continues as the ECAD designer performs ECOs and updates the component placement. A new incremental IDX file is sent to the mechanical engineer for review. As before, the MCAD engineer reviews the updated component placement and either Accepts or Rejects the proposal. A response file is then sent back to the ECAD designer. The ECAD designer accepts the response file and the two domains are once again in-sync.

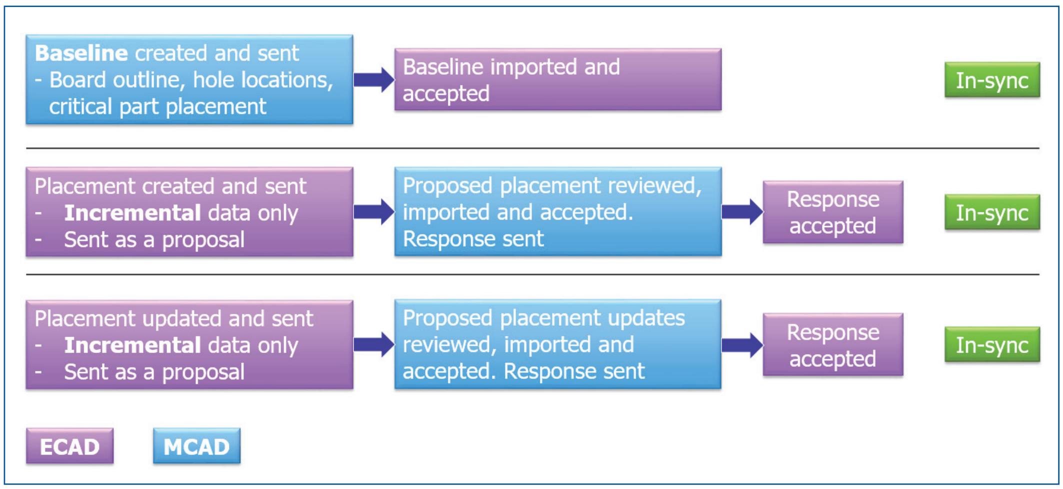

Figure 5: Typical ECAD-MCAD co-design process flow using IDX

Recall that any accepts or rejects by the ECAD designer or the mechanical engineer are not all-or-nothing but rather are done on an object-by-object basis. In the case of rejections, the objects that were not accepted are clearly conveyed to the originator and the process loops until the ECAD and MCAD domains are once again in-sync. In the Xpedition® flow, the MCAD collaborator guides the user through the process flow by automatically managing file names, tracking history, and clearly conveying the status of the proposal and response loop.

Also recall that the IDX format is based on the industry-standard EDMD XML format for the incremental exchange of information between ECAD and MCAD tools. The format was designed in conjunction with leading MCAD vendors and is adaptable to a company's workflow in either a synchronous or an asynchronous use model. ECAD-MCAD co-design using IDX allows PCB designers and mechanical engineers to each work in their native environments; there is no need to learn new tools.

In the Xpedition flow, ECAD-MCAD collaboration using IDX is supported with Siemens® NX, PTC® Creo®, Dassault® Solidworks® and Dassault CATIA®. Siemens, PTC, and Dassault are all members of the ECAD/MCAD Collaboration Implementer Forum.

BEST PRACTICES AND BENEFITS

A design team's adherence to ECAD-MCAD co-design best practices will maximize the many benefits that can be realized through the utilization of this key enabler in achieving first-pass success. Those best practices include:

- Utilizing the IDX data format instead of the IDF data format to establish a baseline set of data and ensure that all subsequent exchanges of information only include incremental changes.
- Driving the baseline from the MCAD domain, defining not only the board outline but also the location of mounting holes, restricted areas, and critical components.
- Utilizing the IDX notes functionality to improve the communication and documentation of changes and to improve traceability. This is especially important to help convey the reasoning when a proposed change is rejected.
- Leveraging the co-design process to synchronize electrical and mechanical data early and often, ensuring ECAD-MCAD compatibility throughout the product development process.

The benefits of an efficient and effective ECAD-MCAD co-design process (Figure 6) can be summarized as:

- Increased productivity by enabling what-if scenarios, allowing ECAD and MCAD designers to co-design in their native environments and providing more time for design teams to work on new projects as a result of fewer iterations.
- Improved design robustness by facilitating the optimization of today's ever-shrinking form factors, thus ensuring higher product quality and providing a process that is inherently less error-prone and therefore reduces risk.
- Increased collaboration and efficiency by supporting consistent iterative communication that accelerates decision making and allows for the left-shifting of 3D collision and clearance checking into the ECAD domain.
- Achievement of first-pass success by avoiding re-work due to electro-mechanical issues because design intent is verified throughout the product-development process.

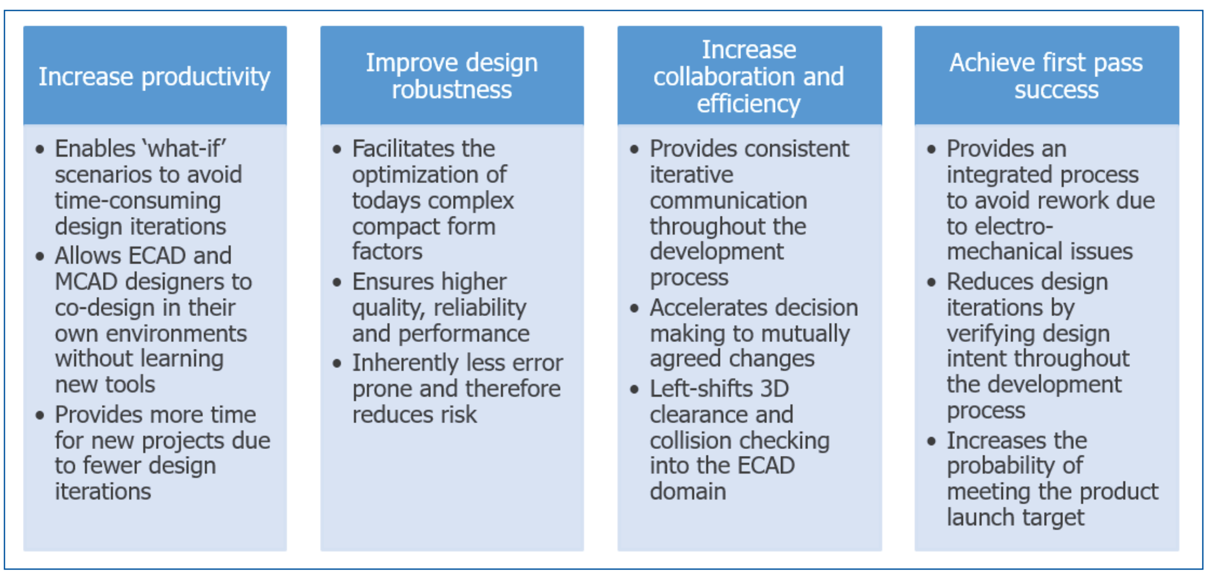

Figure 6: Benefits of ECAD-MCAD collaboration

SUMMARY

ECAD-MCAD co-design has long been recognized as a potential enabler to increasing productivity and ensuring a robust design. However, many companies struggle with implementing an effective and efficient collaboration process. With the IDX data format, designers are able to synchronize their data more efficiently and collaborate more effectively on critical design items between domains, thereby ensuring that the design intent is properly implemented.

Xpedition supports this advanced format via the MCAD collaborator which guides the user through the IDX process flow by automatically managing file names, tracking history, and clearly conveying the status of the proposal and response loop. With Xpedition, ECAD-MCAD co-design using IDX provides a key enabler for design teams to eliminate costly electro-mechanical issues during new product development and increase the probability of achieving first-pass success.

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