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Achieving first-pass success

Leveraging ECAD-MCAD co-design to eliminate costly electromechanical issues during product development

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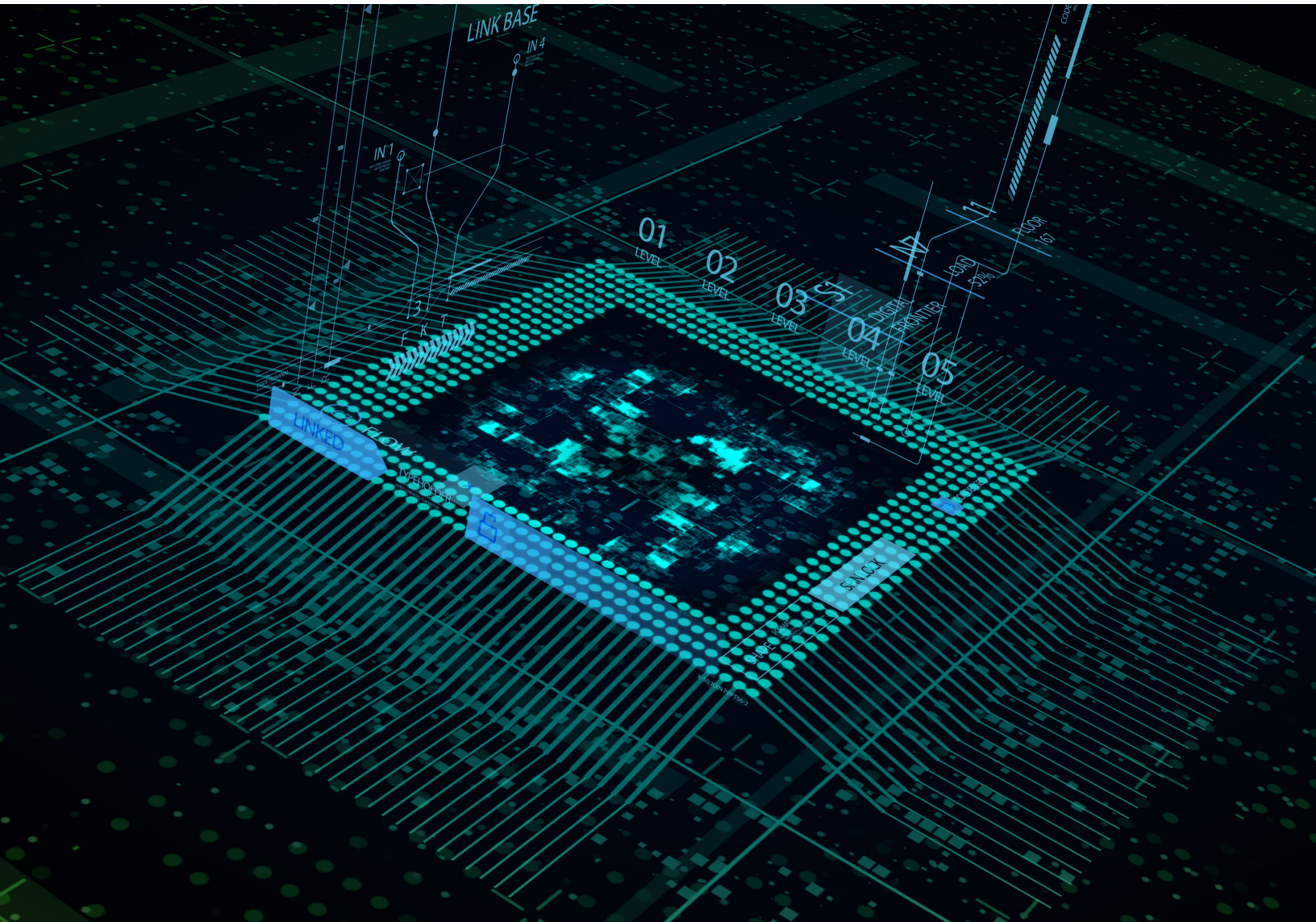
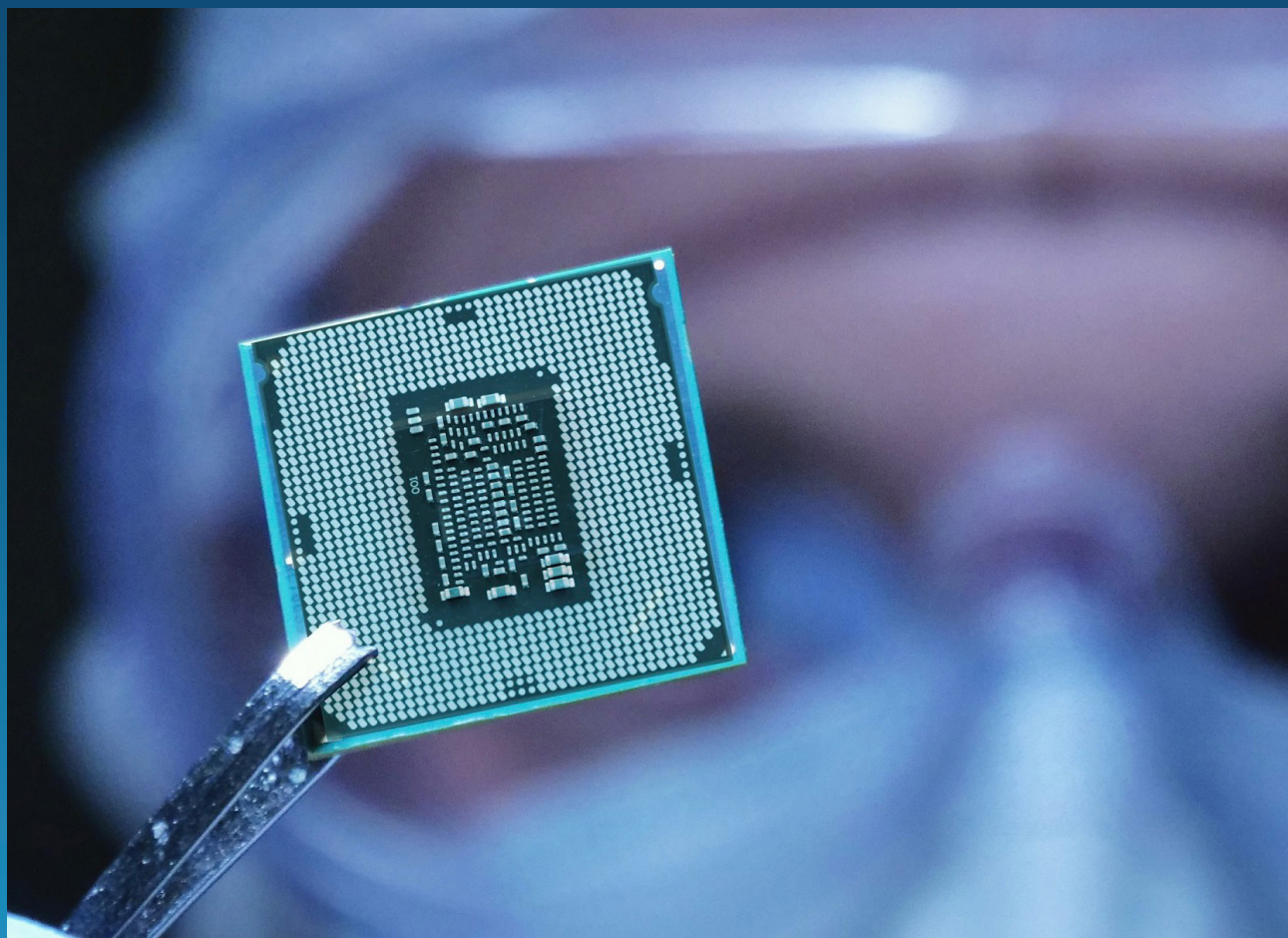


Seeking first-pass success

First-pass success, which 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, is a critical objective for every design team. However the increasing electromechanical complexity and density of today's products, especially in the consumer and wearable space, make this an increasingly challenging goal.



By achieving first-pass success, expensive design iterations needed to address issues are reduced or even eliminated. Cutting the number of design iterations not only reduces product development cost, but more significantly, it helps make sure the product launch goal is achieved.

This ebook discusses how an efficient electronic computer-aided design (ECAD)-mechanical computer-aided design (MCAD) co-design process can enable teams to get rid of costly electromechanical issues during new product development and enhance the probability of achieving first-pass success.

In a recent survey conducted by the Aberdeen Group, 56 percent 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 percent more likely to meet product launch targets. Clearly, achieving first-pass success is a key component of launching products quickly, thereby meeting or exceeding the product launch target.

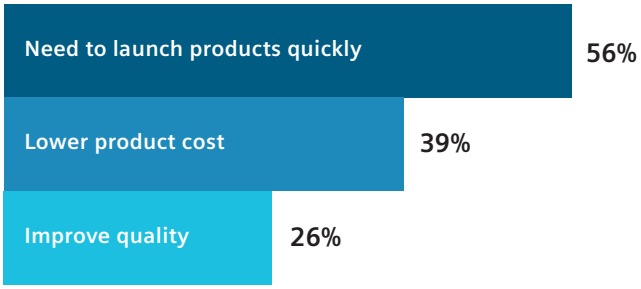
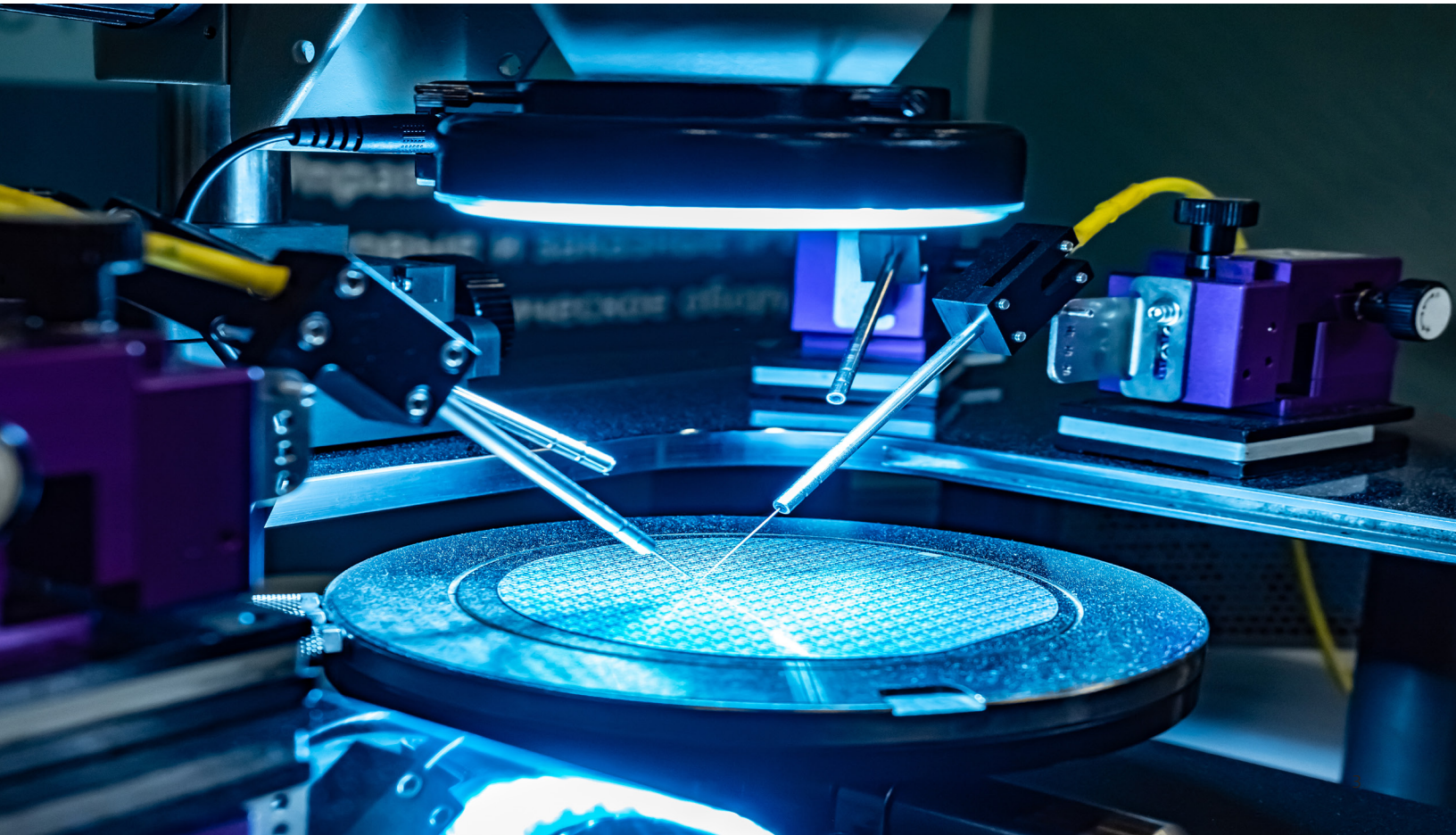


Figure 1. Top pressures to improve the design process.



Why choose co-design?

The impact of electromechanical complexity and density on first-pass success can be meaningful. According to independent research 59 percent of complex products require at least two additional design iterations to address electromechanical issues. In fact, 68 percent of companies cite ECAD-MCAD design synchronization as a significant product design challenge.

The smaller-denser-faster approach associated with today's designs is magnifying the significance of ensuring that electromechanical compatibility is addressed prior to first fabrication. Waiting until fabrication to validate ECAD and MCAD compatibility is not an option for enterprises that need to rapidly launch products. The compatibility of the printed circuit board (PCB) 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 electromechanical complexity, how do companies adjust their product development process to achieve first-pass success? One adjustment, found in 82 percent of best-in-class companies, is to use 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.These companies have also determined 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
- Enables achieving first-pass success

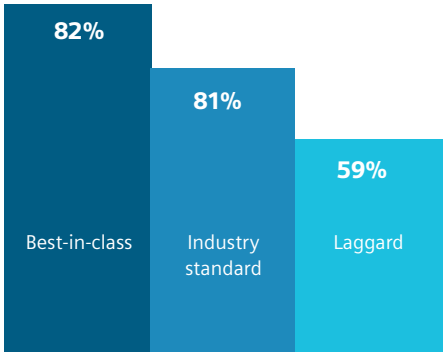


Figure 2. Companies that incrementally exchange ECAD and MCAD data.

For the laggards, the impact of poor collaboration can be significant. Poor collaboration has been shown to affect all stages of product development, from concept through fabrication and as a result there is no:

- Consistent, continuous communication to keep the ECAD and MCAD data synchronized
- Evaluation procedure to avoid costly and time-consuming design iterations
- Process to negotiate proposed changes between the ECAD and MCAD domains
- Methodology for continuously validating design intent

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

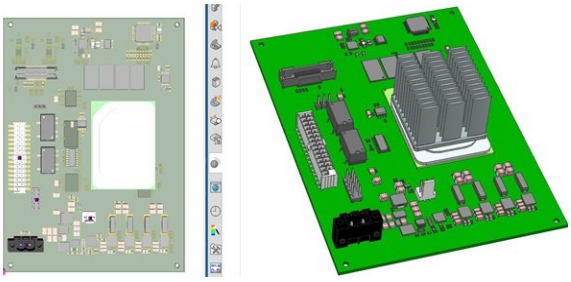


Figure 3. Using XPEDITION and NX for ECAD-MCAD co-design.

Executing valuable ECAD-MCAD co-design

PCB designers and mechanical engineers can attest to the many potential impediments to collaborating on ECAD-MCAD. Traditionally, the disciplines have been separated. PCB designers and mechanical engineers typically work with different tool sets and have different vocabularies. Many times they work in separate physical locations.

Compounding these impediments is that in many cases, previous efforts to collaborate have met with limited success. These previous ECAD-MCAD collaboration efforts used everything from electronic documents, sticky notes and email to technology that was specifically intended to enhance collaboration but fell short. Consequently, many product development teams have resorted to using internally developed software and processes for collaboration, which 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 are frequently not as successful as the innovative solutions that are available in the latest software technology.

Given these impediments to collaboration, how can teams move toward 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 count on 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 decades, it is still a static file transfer of the entire design database. Although it works, it is 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 nothing is lost during this process.

In 2012, 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 the design intent is properly implemented (figure 4).

The reasons the IDX format allow designers to collaborate and identify issues much more effectively throughout the design process 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 them. 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
- IDX also allows the exchange of external data such as copper traces, silkscreen, solder mask and even flex bend data, providing a rich dataset

This ensures traceability for all changes, specifically what, who, why and when. The IDX format is actively being updated with industry leads contributing.

The Siemens Digital Industries Software solution leverages IDX to offer advanced capability in collaboration for rigid, rigid-flex and flex PCBs resulting in rarely matched collaboration capability.

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

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 synchronized.

2. The ECAD designer then places components and sends an incremental IDX file to the mechanical engineer for review. The ECAD designer can also propose changes to the mechanical placed items if needed. 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 synchronized.

3. The process continues as the ECAD designer performs engineering change orders (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 synched up.

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 are not accepted are clearly conveyed to the originator and the process loops until the ECAD and MCAD domains are once again synched up. In the NX™ software flow, this will happen between NX and the ECAD package in use. In the XPEDITION™ software 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 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 ECAD and 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 NX, PTC Creo, Dassault SOLIDWORKS and Dassault CATIA. Similarly in the NX environment, collaboration is possible with all major ECAD applications including tools from Zuken, Cadence and Altium. Siemens, PTC and Dassault are all members of the ECAD/MCAD Collaboration Implementer Forum that helps to drive the definition and implementation of the IDX standard. The advantages do not stop there as XPEDITION and NX have layered additional functionality into the IDX process for an even richer collaboration experience.

XPEDITION and NX are part of the Siemens Xcelerator open digital business platform of software, hardware and services.

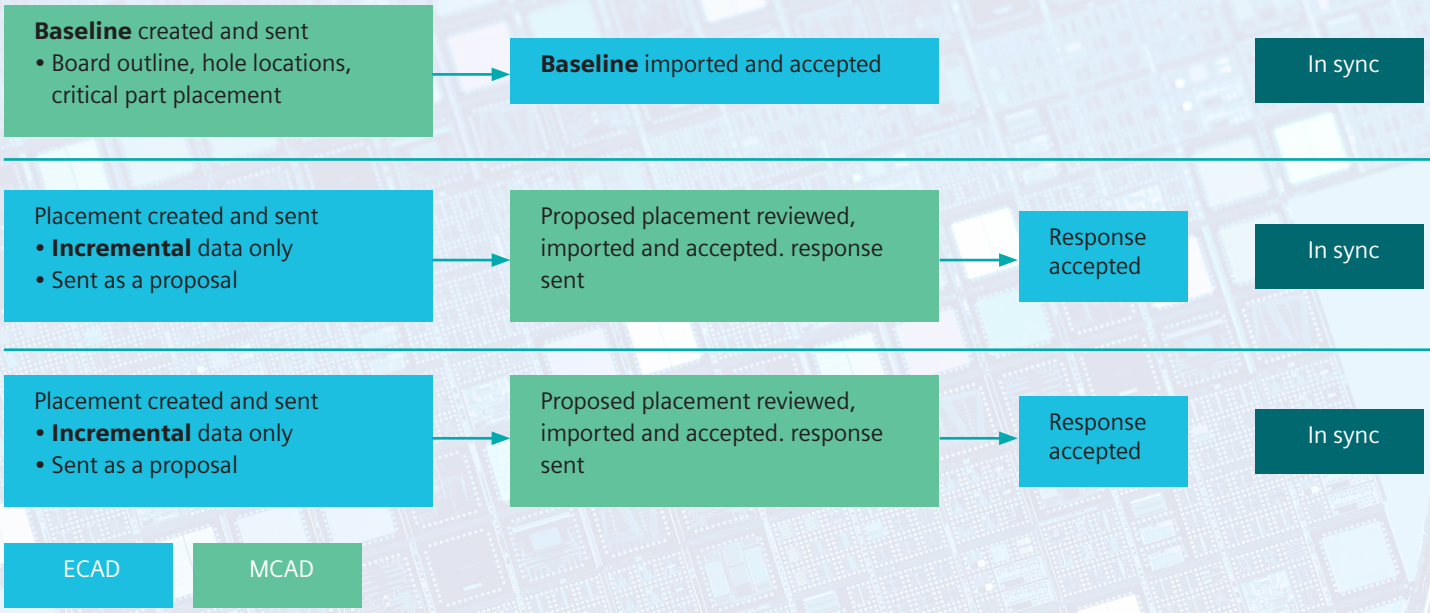


Figure 5.Typical ECAD-MCAD co-design process flow using IDX.

The previous examples assume the baseline design originates in the MCAD domain. However, the baseline could come from the ECAD side first, depending on the customer's workflow. Either case is fully supported by XPEDITION and NX products.

Leveraging the benefits

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

- Using 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, restriction areas and critical components
- Using 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 frequently synchronize electrical and mechanical data, 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 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 shift of 3D collision and clearance checking in the ECAD and MCAD domains
- First-pass success achieved by avoiding rework due to electromechanical issues because design intent is verified throughout the product-development process

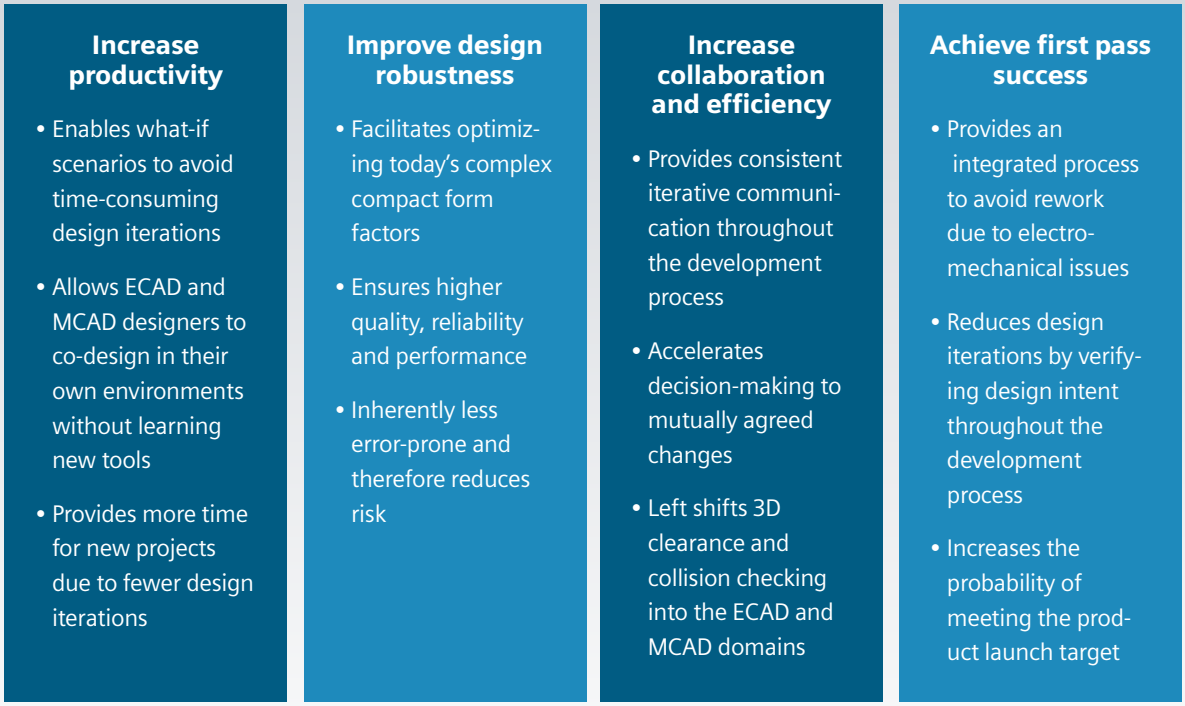


Figure 6. Benefits of ECAD-MCAD collaboration.

Increasing the probability of success

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 the design intent is properly implemented.

XPEDITION and NX support this advanced format through the XPEDITION MCAD collaborator and NX PCB Exchange, 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 and NX, ECAD-MCAD co-design using IDX provides a key enabler for design teams to eliminate costly electromechanical issues during new product development and increase the probability of achieving first-pass success.

About Siemens Digital Industries Software

Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, Siemens Digital Industries Software is where today meets tomorrow.

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