THREE CHALLENGES IMPACTING THE EFFICIENCY OF PCB ENGINEERING TEAMS

WHITEPAPER

Mentor Graphics®

PCB DESIGN

www.mentor.com

INTRODUCTION

We live in an era of rapidly accelerating design complexity, with designs often doubling in performance and/or capacity between board revisions. At the same time, we're seeing a shift in the workforce, particularly in the older design markets of the United States and Europe. Finally, we live in an era where everything's a system—the days of standalone, single-board projects are gone. Consider these trends together, and you will see a significant need to change the way individual designers and engineers operate, as well as the ways in which engineering teams collaborate together.

This white paper will begin by taking a deeper look at these trends before moving on to propose methods for adapting to the rapidly changing environment of PCB design.

THE THREE CHALLENGES

While there are certainly more than three challenges that PCB development organizations face, many of them fall under one of the three general categories listed below.

ACCELERATING DESIGN COMPLEXITY

Ultimately, many of the challenges the industry faces come down to increasing complexity. Complexity is being driven in a number of ways: smaller device footprints with increased functionality, higher electronics content in vehicles, higher speeds, advances in packaging, and so forth. Looking at customer designs submitted to Mentor Graphics Technology Leadership Awards competition over the last five years, layer counts have dropped 12%, board area has dropped 35%, and densities have gone up by 15% .

Then there's the competitive business environment where time-to-market, cost, and quality pressures are very real challenges that can add to the complexity of the design process. Managing the trade-offs among all of these variables can be nearly impossible.

WORKFORCE CHANGES

A research project conducted by the Aberdeen Group in 2013 revealed that with more engineers reaching retirement age — and with fewer candidates emerging from engineering schools — companies are finding that the hardest positions to fill are the ones that are most needed. The engineering pipeline is running dry.

A unique trend has risen in the PCB design community. As today's PCB designers retire, they are increasingly being replaced by engineers taking over the layout role. This is being driven by several factors, including a shrinking availability of traditional trade schools, but it is also a result of the aforementioned increase in design complexity. Layout designers must consider more aspects during the layout process than ever, including signal performance, mechanical enclosures, and manufacturability. There is certainly a demand for people who understand both the physical challenges of a layout as well as the performance requirements associated with it.

We believe that the two workforce changes together will result in fundamental transformations in organizational approaches to product development and the way design automation tools are used and deployed. With engineers increasingly moving away from specialization and beginning to wear more hats, so to speak, the tools they use must evolve with them to simplify design complexity, increase individual and team productivity, and enable engineering organizations to realize the full potential of their workforce's skills.

SYSTEMS-AWARE ENGINEERING

Design teams are telling us that they increasingly seeing their development projects as a systems-based project, not as discrete PCB design projects. This shift, like the change in the workforce, is being driven in part by increased complexity—the traditional black-box approach to design of individual electromechanical components has given way to a top-down, integrated, and more collaborative design process.

This paper focuses mostly on product development from an electronic systems point of view, but there are other disciplines involved in the product development process as well, such as mechanical engineering and software development.

All of these disciplines are connected through business systems, such as ERP or PLMs. We must enable collaboration in multiple dimensions across the systems design space — from concept to manufacturing for PCB designs; from silicon to multi-board systems; and from electronics systems to mechanical and software development.

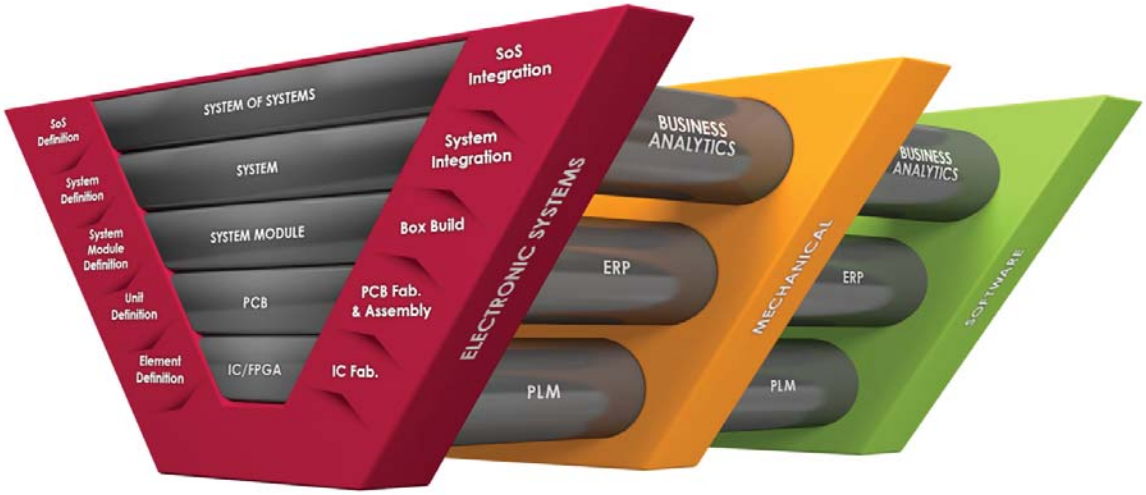

Figure 1: Almost every product requires integration of multiple disciplines.

HOW TO ADAPT TO AN EVOLVING INDUSTRY USING XPEDITION

Recognizing industry challenges is one thing, but finding practical solutions to the challenges is another. The solutions hinted at thus far present all types of new challenges, and the right tools haven't been available to address the needs presented in this paper. Until now.

Mentor Graphics has recently introduced Xpedition®. You'll notice a slight shift in our brand spelling, which is intended to convey the continuity between releases of the past until today. But we believe that this release brings revolutionary new technology to address today's most significant challenges. Below you will find our proposed solutions to the challenges presented above, as well as the features included in Xpedition that will help you accomplish these goals.

REDUCE THE LEARNING CURVE FOR NEW USERS WITH INTELLIGENT USER INTERFACES.

The increasing complexity of PCB design might require an increase in the capabilities of PCB design tools—but this doesn't mean those tools need to become increasingly difficult to learn. With Xpedition, the focus has been on ease-of-use across the flow to achieve very high individual and team productivity, while at the same time addressing the complexity of modern use-case paradigms.

CONTEXT-SENSITIVE LAYOUT

Time-to-productivity is a rough measure of the time it takes to learn a new tool, and on today's multi-tool desktop it also applies to the time to re-learn an occasionally used tool. We've improved our user interfaces to minimize this ramp-up time.

The entire layout environment in Xpedition is more intuitive than ever with a simplified command structure that's consistent and logical. Users can easily personalize the toolbars, dialogs, and display for maximum productivity. To increase efficiency, a new context-sensitive mode is available that enables functions based on the selected object. Xpedition provides default placement, routing, and editing actions relative to the object selected; there is no need to change modes to edit any object. For dense designs, object types can easily be filtered to ensure accurate selection.

EMBEDDED TOOLTIPS

Tooltips in Xpedition have been improved across the flow to provide a better idea of a command's purpose and method of operation, allowing designers to get help when and where they need it.

Tooltips are available in both the design capture and layout environments. With tooltips, the designer gets basic descriptions of a command if they mouse over an icon. If they hover the mouse a little longer, the tooltip will expand with additional information which, in many cases, includes a video of the command's operation. With these embedded tooltips, designers have quick access to the most common use models for features that might not be used frequently, reducing their learning curve.

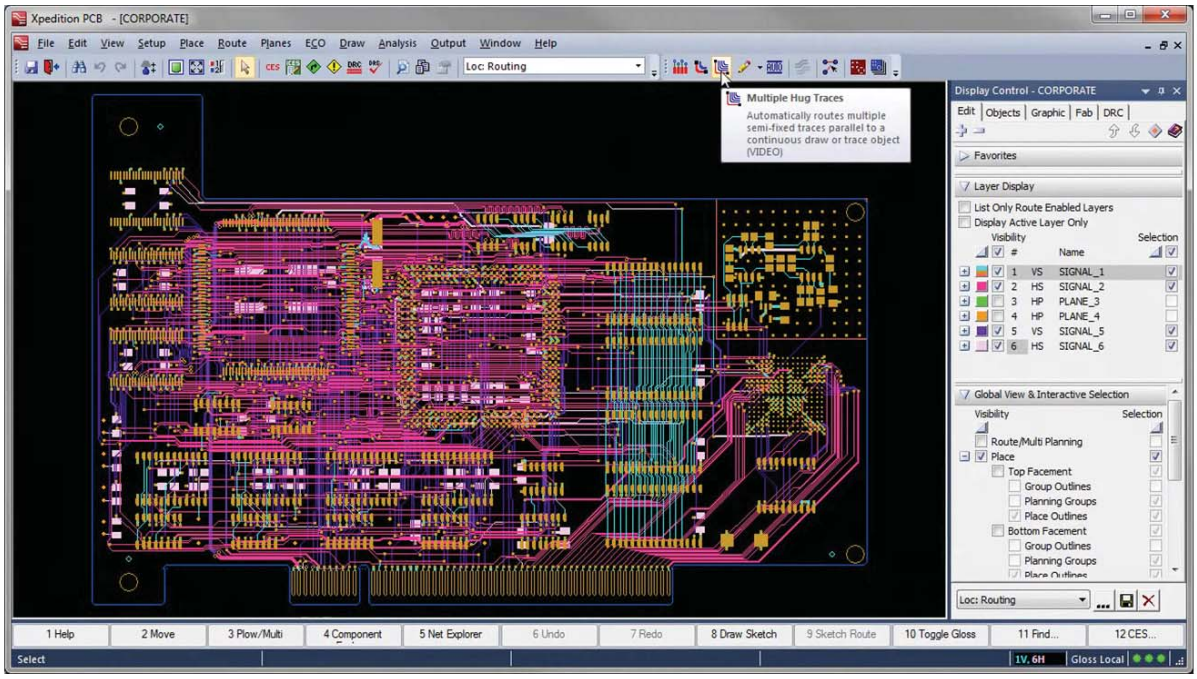

Figure 2: Embedded tooltips progressively disclose information (including video) to enable faster time to productivity.

SKETCH ROUTING

High-density designs drive designers toward manual editing processes, extending the layout time. Within the layout environment, one of the biggest new features you'll notice is sketch routing. It combines the power of automation with the skill and control of a designer to create fast, high-quality routes in dense designs.

The Xpedition sketch router provides a variety of user controls for the path of a set of routes. The designer can provide coarse or detailed directions, with or without via patterns or breakouts, in tightly packed or loose patterns. In more dense areas, the speed of the router is evident, while still maintaining high quality. In comparisons with interactive routing, the sketch router can be more than 30 times faster.

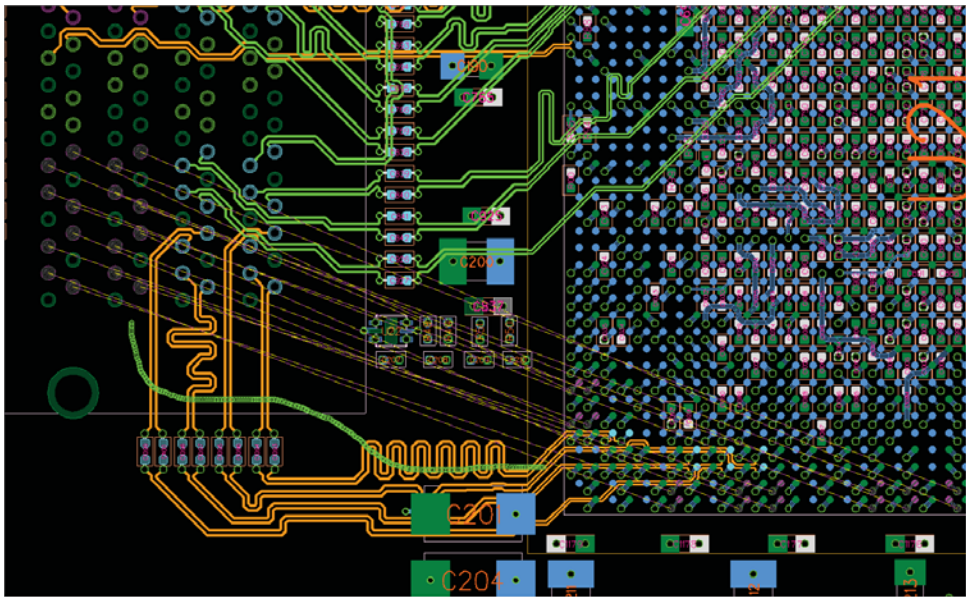

Figure 3: The user sketches a path for the router to follow (green path near the bottom left).

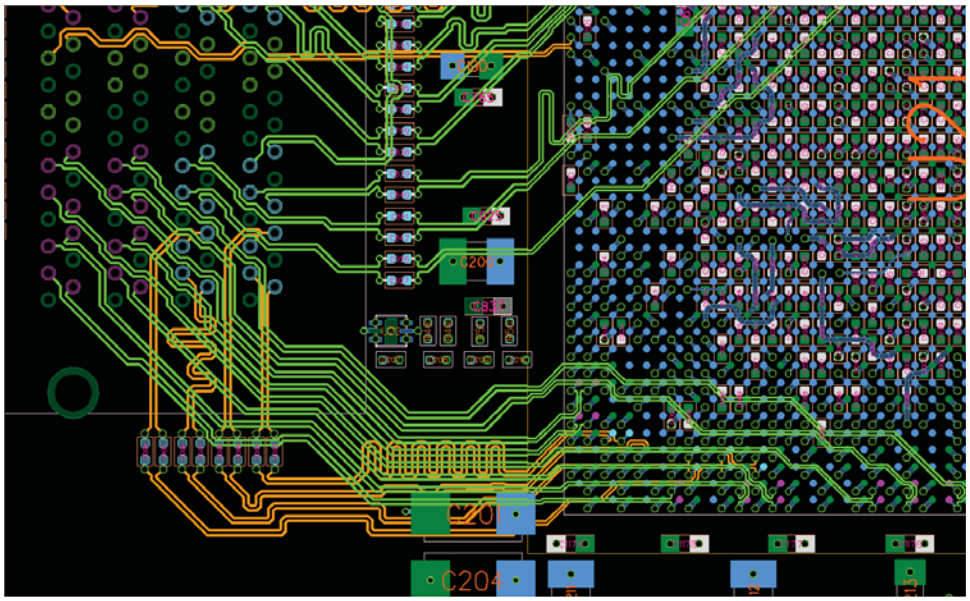

Figure 4: The Sketch Router automates the routing and breakout intent that the engineer defines.

EMPOWER DESIGNERS WITH THE ABILITY TO COLLABORATE ACROSS MULTIPLE DESIGN DOMAINS.

Tighter integration of analysis tools can facilitate dynamic validation as the design is being edited. In Xpedition, the concept of virtual prototyping, which originally started with signal integrity analysis, has been extended throughout the design process to cover areas like power integrity, thermal, design rule validation, and design for manufacturing. Layout can also be done in photo-realistic 3D, minimizing iterations with the mechanical team.

3D DESIGN

Collaboration between ECAD and MCAD environments is critical for optimized system design — but all too often the process involves multiple iterations because one discipline may not be able to visualize the context of the other discipline. With 3D built into the layout environment, designers can make better decisions about placement relative to other components and mechanical objects. The net result is an optimized layout achieved with minimal MCAD iterations.

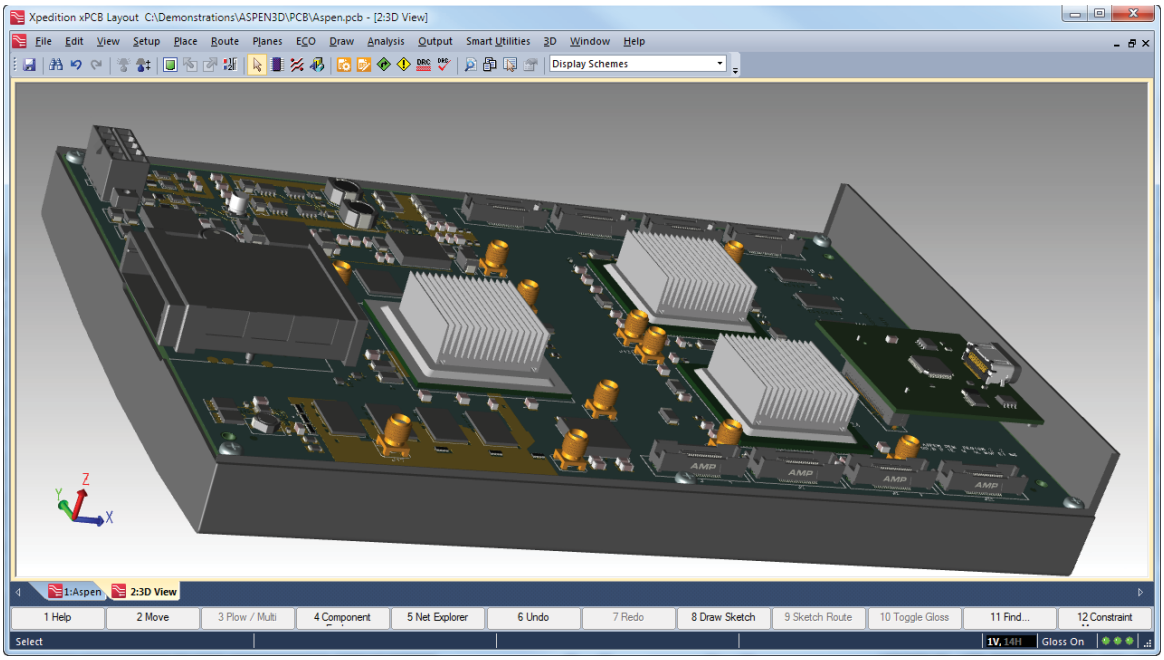

Figure 5: Using a 3D photo-realistic representation enables the PCB team to visualize and edit the design in the context of the larger system.

INTEGRATED DESIGN FOR MANUFACTURING

To minimize iterations with manufacturing, Xpedition is designed with improved integration between layout and DFM validation tools. You can check and fix DFM errors before handing off to manufacturing. You can launch Valor® NPI directly from layout, quickly run an analysis, view areas for improvement, and cross-probe directly with layout so that appropriate edits can be made. DFM errors have also been added to the traditional hazard listing within layout so that you can easily review issues within one environment.

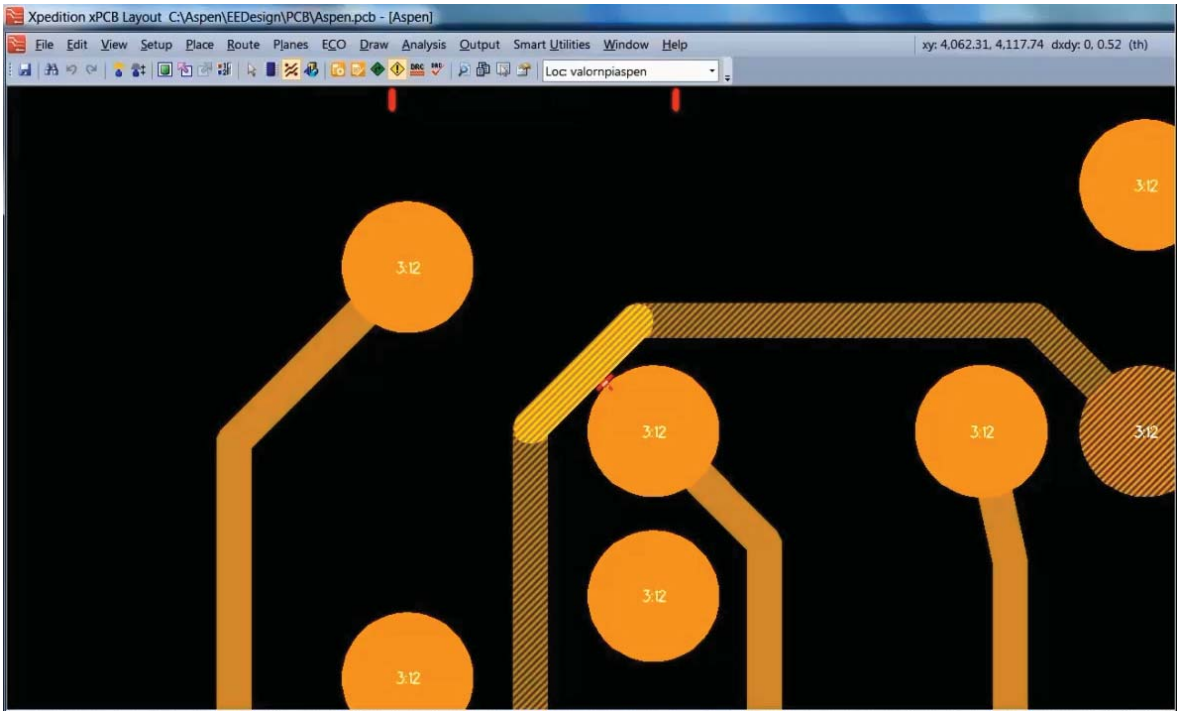

Figure 6: Integrated DFM accelerates new product introduction by enabling manufacturability analysis within the design stage.

SYSTEMS DESIGN

System definitions are often completed in Microsoft Visio or Excel, resulting in error-prone and non-optimized transfer of intent to engineering teams. With the release of Xpedition, we're offering a better way — one that enables efficient capture of logical system definitions, simplified partitioning and system optimization, and direct transfer of connectivity and intent to individual PCB projects. With our new multi-board systems design features, you can do the following:

- Create a logical system view of a design from scratch, or import one from Visio
- Manage complex systems with an unlimited number of hierarchical levels, with each level providing more refinement details
- Partition multi-board systems with ease—just group them with a box, or move them from one board to another
- Accelerate definition of wiring interconnect between functional blocks, boards, and other devices
- Add parameterized connectors on the fly from the library—connectors can be expanded by simply stretching
- Trace signals to ensure proper connectivity across the system
- Automatically extract multiple board definitions into individual Xpedition projects and manage synchronization.

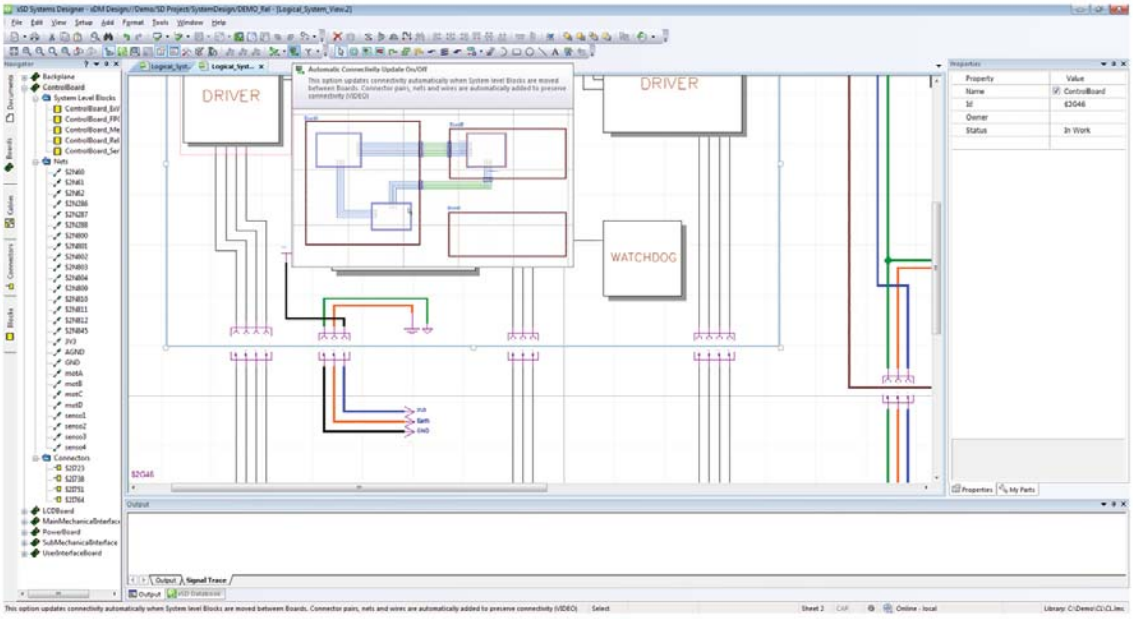

Figure 7: Systems design enables system and PCB engineers to concurrently and collaboratively define logical systems, connectivity, and function partitions for PCB designs.

DESIGN DATA MANAGEMENT

Data management relationships for PCB design are native, complex, and dynamic — you have to keep up with libraries, schematics, layout, reuse blocks, simulation models, and manufacturing constraints all within a work-in-process environment. Xpedition has introduced a solution that provides an engineering information infrastructure which eliminates custom processes and manual overhead with an innate knowledge of PCB design-level structures. With Xpedition, you can extract information and intelligence from the data to transform it into a true IP asset.

Figure 8 illustrates how collaboration can be enabled across multiple domains. In the inner circle, the "core" is the primary platform by which designs are authored within the specific context of each engineering discipline. Each of these disciplines require system awareness and collaboration whereby design data are consumed, managed, and distributed by the enterprise data management backbone (represented by the outer ring). This environment transforms discrete activities into "systems-aware" collaboration.

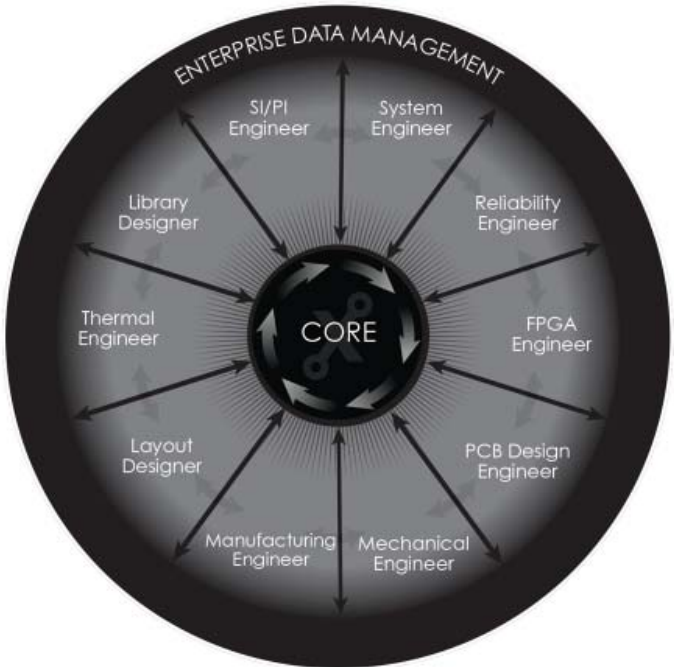

Figure 8: Efficient cross-domain collaboration enabled by an integrated, systems-aware library and work-in-progress data management.

CONCLUSION

This white paper should have shed some light on the current challenges facing the PCB development industry and how these issues might best be addressed. Mentor Graphics has long been dedicated to the task of analyzing the conditions of the industry and providing solutions that facilitate the entire PCB design process, from prototype to product.

The evolution of Xpedition began in 2005 with the first release of an integrated flow for schematic and layout. In 2007, we met the demands of enterprise IT environments by facilitating client/server architectures. Expedition Enterprise 7.9.x, in 2009, expanded mainstream deployment with a highly stable environment. Throughout this journey the industry has come to expect Mentor Graphics to deliver leadership innovation for PCB systems design.

These important milestones have helped us realize our vision to meet the demands of modern development organizations and solidify our leadership in PCB design. With Xpedition, we will continue to deliver solutions that are unmatched in our industry. This is the foundation for the next generation of proven, innovative thinking as we continue to address our enterprise customers' needs.

For the latest product information, call us or visit: www.mentor.com

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