EMBRACE YOUR PASSION FOR DESIGN: BEST PRACTICES FOR PCB DESIGN TOOLS

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Report Highlights

Aberdeen looks at how top performing PCB designers leverage PCB design tools to achieve both successful engineering and successful business outcomes, all while embracing their passion for design and maintaining the joy of engineering.

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Engineering is about the joy of creation. Therefore, utilize PCB design tools that maximize creative productivity and minimize the time spent on necessary but tedious non-engineering tasks.

"We try to optimize quality, delivery, cost savings, and supplier/customer specifications."

-Product Development Staff,

Sub-PCB Supplier to Various Industries

Engineering is all about the joy of creation. However, the reality is that you find yourself spending most your time on non-engineering tasks. This report explores how Best-in-Class practitioners use PCB design tools to meet business needs while simultaneously rekindling their central passion: the creative process that drives them as engineers.

PCB Design Pressures and Challenges

Today's engineering environment is filled with both external business challenges and internal pressures. Regardless of the type or size of a PCB design project, you risk getting bogged down by both design details and complexities, as well as by necessary but mundane non-engineering tasks. Further, these risks come at the expense of your primary motivator: the joy of creation.

As shown by past Aberdeen research, cost and speed to market are the top drivers causing companies to invest in improving their PCB design process (see sidebars for quotes from engineers in companies of all sizes). However, over the past few years, the secondary pressures have started to shift across the industry. In particular, the need to introduce differentiated, feature-rich products has increased. Also, product differentiation through performance is key to being an industry leader.

Along with these business challenges, rising product complexity is the top internal challenge in PCB design; 63% of respondents cited increasing product complexity as one of their top three internal challenges. Frequent design changes are also a top challenge (Figure 1 below).

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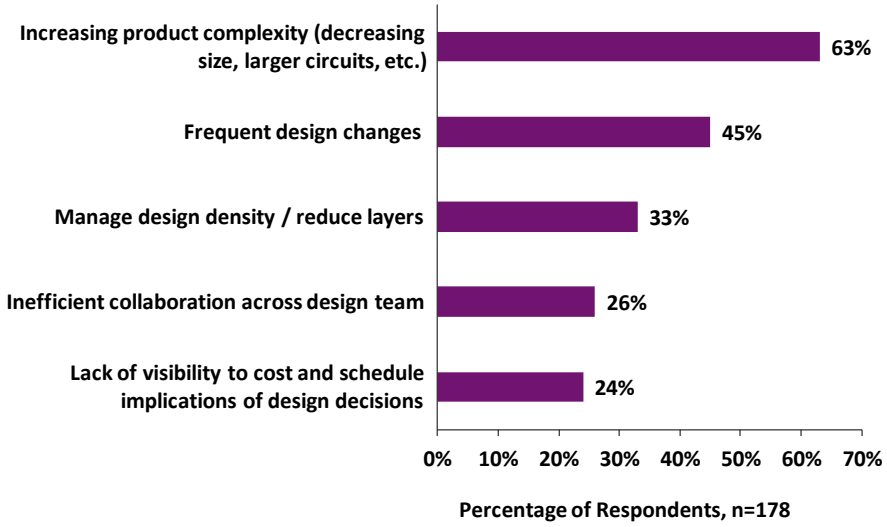
"Our quality and success is dependent on how well a product is designed to achieve high yield, low cost, and efficiency."

-Product Development Staff,

An EMS Company

Figure 1: Internal Challenges of PCB Design



Source: Aberdeen Group, 2015

In light of these realities, how can engineers spend more of their time on the creative process that attracted them to engineering in the first place? The answer is: via the effective selection and use of PCB design tools. Therefore, it is incumbent upon PCB design leaders to utilize PCB design tools that both maximize creative productivity and minimize the time spent on necessary but tedious non-engineering tasks.

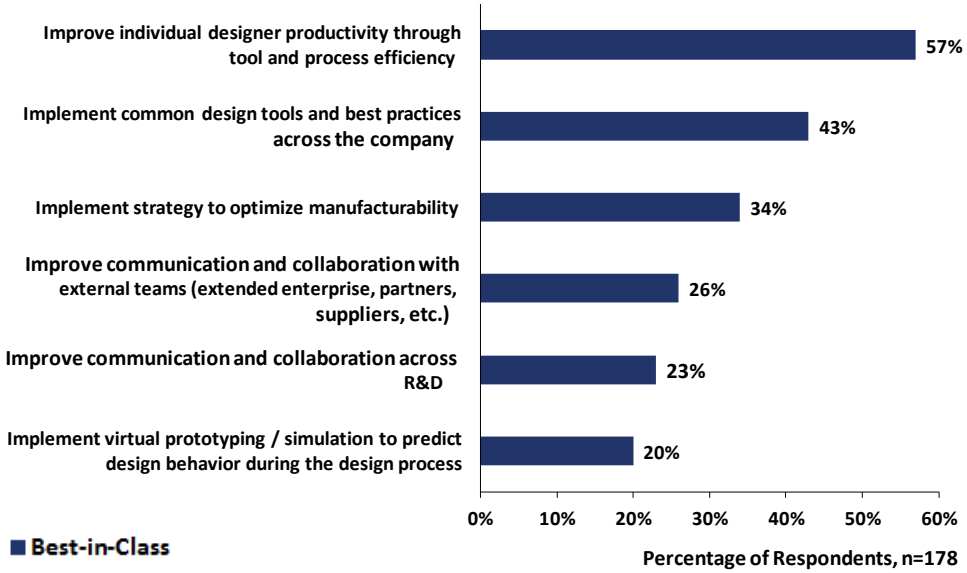
Best-in-Class Actions for PCB Design Success

To understand how top performers achieve the twin goal of maximizing creative productivity and minimizing non-design time, Aberdeen looked at top performing PCB designers and how they leverage PCB design tools to achieve both engineering and business success.

Best-in-Class engineers focus first and foremost on *"Improving individual designer productivity through tool and process efficiency*." Secondarily, as you can see in Figure 2 below, they

focus on "*Implementing common design tools and best practices across the company.*"

Figure 2: Top Performers Improve Design Productivity



Source: Aberdeen Group, 2015

This illustrates an important point: Again and again, Aberdeen research data finds that the Best-in-Class refuse to accept the status quo in their quest for excellence, and they remain open to the fact that others may be doing things differently. For instance, the Best-in-Class are 16% more likely to pursue tool and process efficiency. And while large organizations may be just as hungry, survey comments indicate that small and medium businesses are looking to new design technology and better ways of doing things to "level the playing field" between their organizations and larger businesses.

"We are trying to overcome the fact that we are a small company with a small budget trying to design products that are comparable in terms of technology used and capabilities to those designed by companies with much larger budgets."

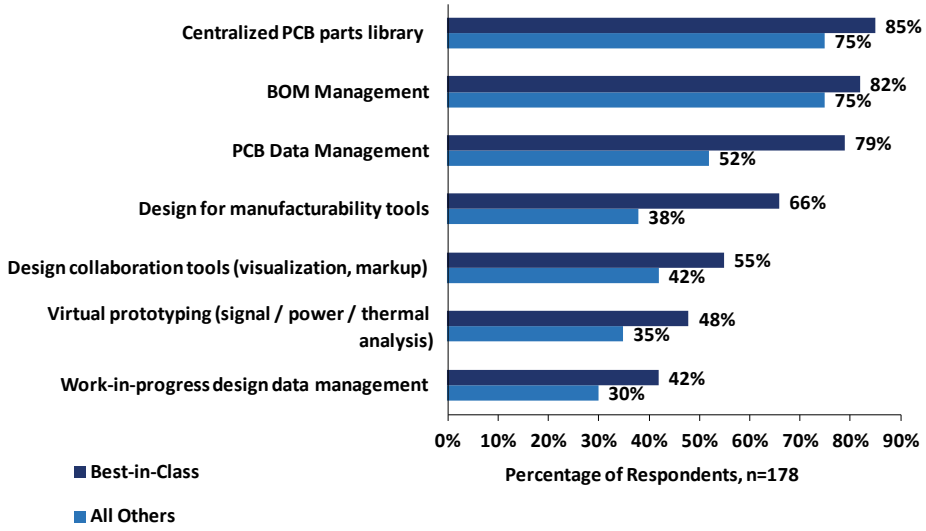
-Product Development Staff,

SMB survey respondent

Technology Enablers for PCB Design

Technology enablers cut to the heart of the matter at hand: maximizing creative productivity while automating necessary but mundane tasks (see Figure 3).

Figure 3: PCB Technology Enablers



Source: Aberdeen Group, 2015

The Best-in-Class are more likely to have implemented software-based technology enablers into an integrated PCB design environment. Examples include a centralized PCB parts library, Bill-of-Materials (BOM) management, and PCB data management.

- ➔ A centralized PCB parts library enables designers to make informed part selections using only approved components. The addition of real-time supplier links (at design time), connecting the designer to trusted suppliers, is also a desirable feature. By enabling the organization to manage all approved components and supply chain data in one central, shared location, such a library frees up the engineer to focus on the creative task at hand.

- ➔ BOM management ensures that the most current product revisions are seen by all members of the production team. When it comes to building a product, the bill of materials is the single most important deliverable that an engineering team hands off to a manufacturing team. With the advent of software-based BOM management, users are no longer

forced to use ad hoc processes (e.g., use of Excel to manage BOM). Previously, users were forced to "go ad hoc" due to an inconsistent look and feel as well as poor interoperability between user interfaces.

➔ PCB data management provides a single, centralized database for components, design specifications, documentation, and revisions, so everyone can work off the same file set. This makes data easier to find and, since everyone is using the most accurate and up-to-date data revisions, it greatly enhances data integrity. Aberdeen research indicates that the Best-in-Class waste 50% less time correcting PCB data integrity issues.

PCB data management also supports version control, enabling the organization to maintain a complete version history and to retain all templates and reference designs from successful past projects. To avoid costly rogue revisions, it is critical to understand exactly who made changes to your design. Complete version histories allow you to do this. The ability to easily reuse proven elements from previous designs leverages past successes for future products.

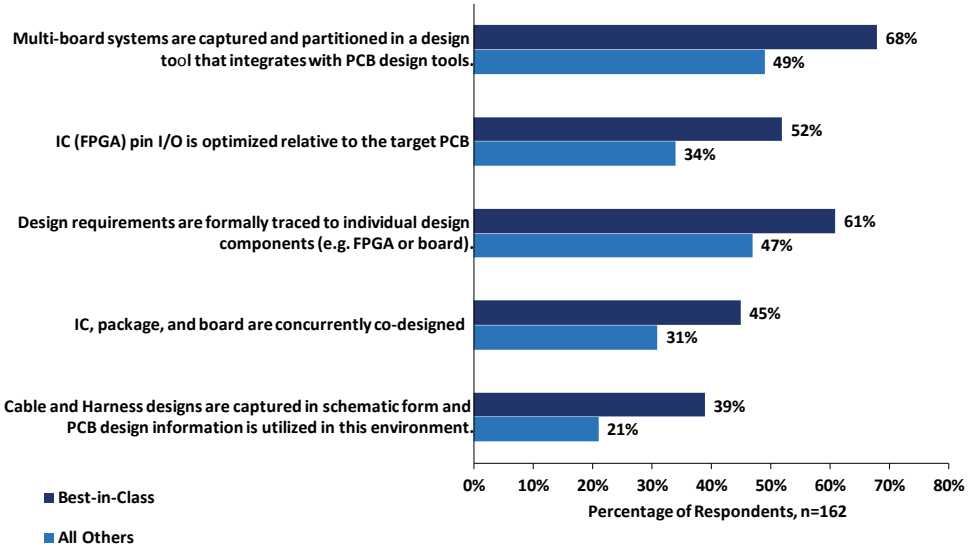
Frequent design changes make all three of these software technology enablers a necessity today. Deploying a centralized PCB parts library along with BOM management and PCB data management in a single unified platform eliminates the quality and design time issues associated with manual workarounds (that is, ASCII database manipulations). For designs that are too large or complex to complete in a desired time frame, software-enabled team design enables collaboration across geographically dispersed and/or functionally organized PCB design groups, further maximizing productivity and dramatically shortening time-to-

market. In the end, a unified PCB design platform lets engineers spend more time designing, which is what really counts.

PCB Design Integration with System Design

The Best-in-Class are also integrating PCB design into their overall system design process, as can be seen in Figure 4.

Figure 4: Top Performers PCB/System Design Integration Practices



Source: Aberdeen Group, 2015

What's needed is a single environment for multi-board applications, that is, a system design tool that defines and partitions electronic systems from the logical abstract level to the PCB. Best-in-Class companies are 39% more likely than All Others to use such a software enabler. In addition, top performers are also more likely to formally trace requirements to individual design components.

Before such integration was possible, designers used antiquated software tool workarounds such as Microsoft Visio or Excel to conceptualize the multi-board product, each board's functionality,

"Keeping a central library of components has proven [to be] a good move, saving time and enabling reuse of designs."

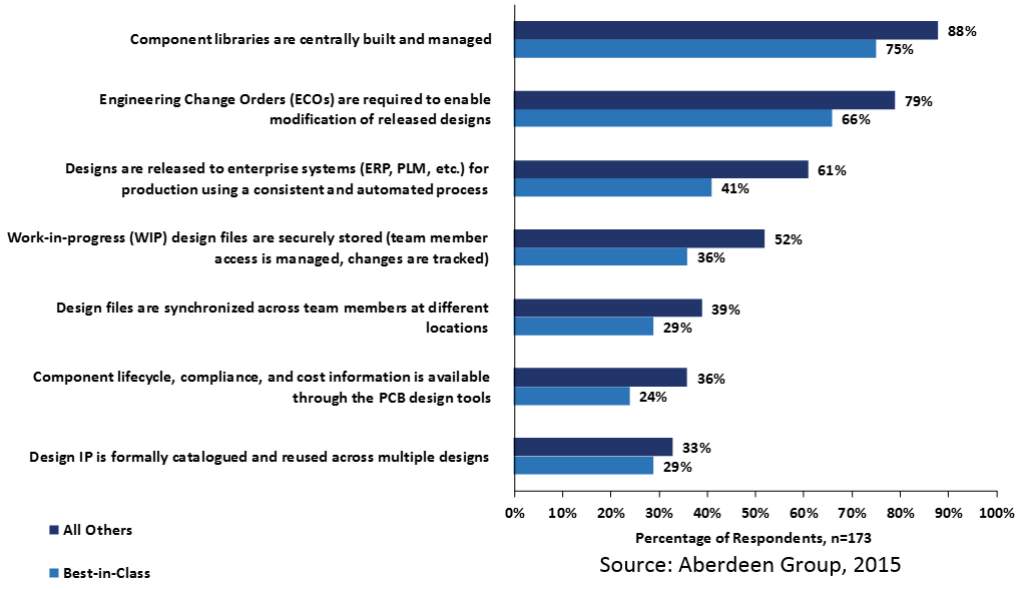
-Product Development Staff, Survey respondent

and their interconnects. However, this approach falls flat when rising product complexity runs board connections into the thousands and frequent product changes make manual data entry impossible. Today, the Best-in-Class have integrated PCB tools with system design to create a central source of information, making it easier for designers to find information and complete tasks.

Design Data Management Best Practices

The top Best-in-Class design data management best practice today is centrally built and managed component libraries (see Figure 5).

Figure 5: Design Data Management Best Practices



Source: Aberdeen Group, 2015

Droves of highly dynamic data are generated during the design process. Given its size and complexity, managing this data is not an easy task. An often used but ineffective workaround is manual curation – putting all the data on a network drive and hoping for the best. However, ad hoc manual curation fails to ensure the consistency and data integrity required in product development. More importantly, manual curation is time-consuming, and as

design data changes, time spent on curation skyrockets, ultimately becoming unmanageable. To eliminate this extra step, Best-in-Class companies are more likely to use a single repository to store all relevant information.

The second most important design data management best practice today is the use of Engineering Change Orders (ECOs) to enable modification of released designs. In past research, Aberdeen Group found that the average ECO cost $1,984 in development. However, once that design was released to manufacturing, that cost skyrocketed 5.4 times to $10,625.

Given this reality, Aberdeen recommends that engineers choose a PCB design tool with built-in ECO capabilities so they can propagate and document design changes with the push of a button, providing automatic visibility to the entire team. Paper-based or manual ECO processes do not accomplish this. The creative productivity payback of a software-based ECO strategy is immediate, as Aberdeen has found that ECOs consume up to one third to one half of engineering capacity.

Last, but not least, 33% of the Best-in-Class formally cataloged their design intellectual property (IP), and reused it across multiple designs. In past research, Aberdeen found that the Best-in-Class was 78% more likely to use a design reuse methodology which directly contributed to their ability to achieve quality targets at a 22% better average than the industry mean and meet their product launch goal 92% of the time.

Taken together, these design data management best practices contribute to a repeatable release process, providing accurate design output data/documentation, the ability to retrieve, modify, and re-release designs, and an efficient, accelerated design process. These best practices sustain the passion for design, allowing engineers to focus on the creation process that they love.

What do you consider the most beneficial thing your company has done to improve PCB design?

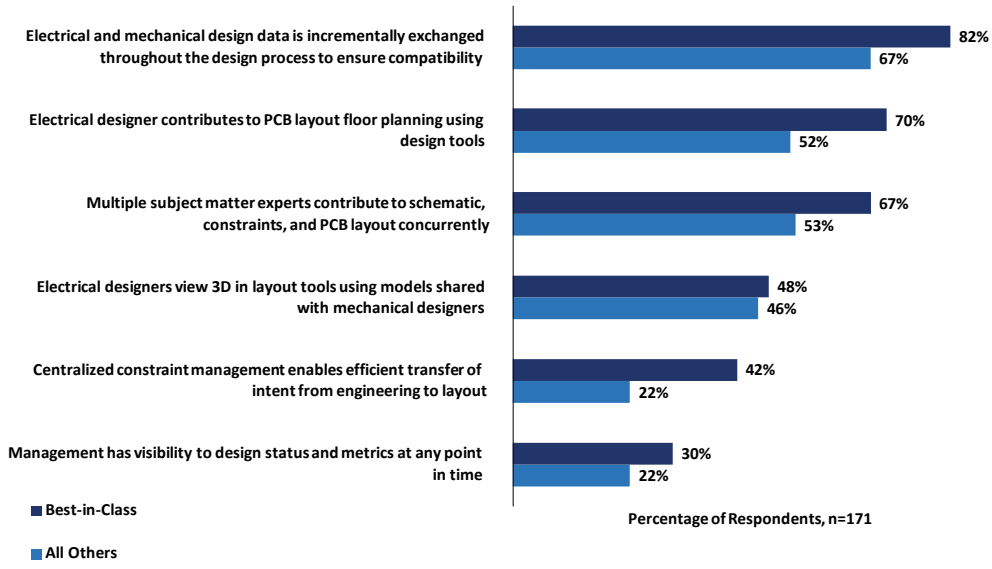
"3D models and integration with mechanical software."

-Product Development Staff, Survey respondent

Design Collaboration Best Practices

Besides organizing design data, the biggest challenge when it comes to designing advanced PCB products is breaking free of the tradition of designing in isolation (see Figure 6).

Figure 6: Design Collaboration Best Practices



Source: Aberdeen Group, 2015

What PCB design challenge have you overcome?

"Efficiently having multiple designers work on the same board to accelerate schedule."

- Product Development Staff, Survey respondent

Design collaboration is a major hurdle both within the ECAD discipline (e.g., concurrent schematic, layout) as well as between disciplines (ECAD, MCAD, etc.). Based on this need, the Best-in-Class are well on their way to integrating their electronics design flows and mechanical design flows:

- ➔ The design process needs to happen in incremental exchanges throughout the design process to ensure compatibility, and the Best-in-Class are 22% more likely than All Others to design through incremental exchanges of electrical and mechanical design data.
- ➔ Smashing through the limits of "serial engineering" is also a goal. Currently, 67% of the Best-in-Class report that

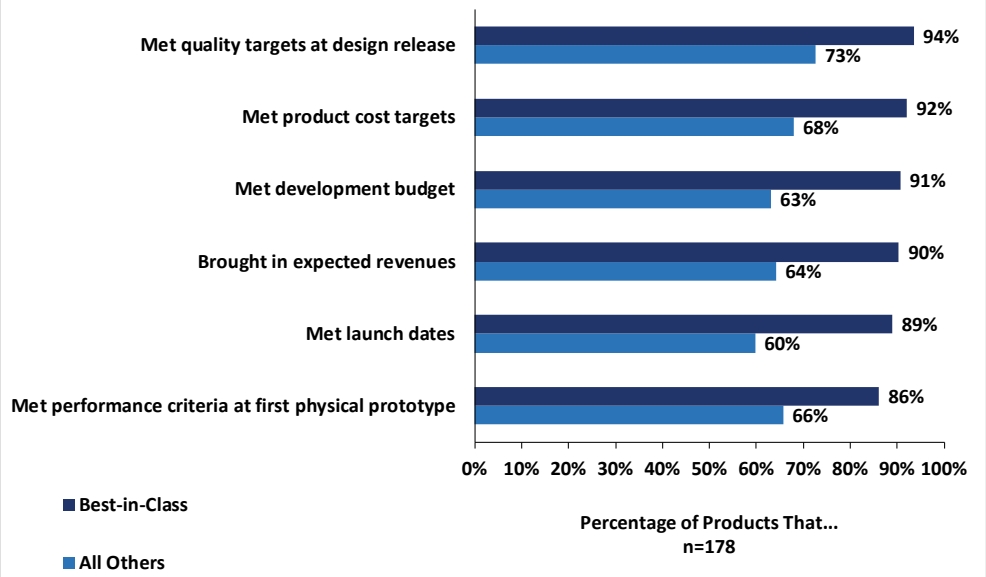
multiple subject matter experts contribute to schematic, constraints, and PCB board layout concurrently.

➔ Forty-eight percent of respondents say that electrical designers view 3D in layout tools, using models shared with mechanical designers, as a critical improvement to the PCB design process. Since ECAD-MCAD collaboration is so critical today, it is important to seek out a mature solution. For instance, the ability to support native 3D file formats removes the risk of faulty file conversion and stalled design cycles.

Best-in-Class Success Metrics

So far, we've seen how the effective use of PCB design tools (including technology enablers, design data practices, and collaboration practices) helps the Best-in-Class focus on engineering and creative productivity. Now, let's focus on product metrics to determine if this pays off (see Figure 7 below).

Figure 7: Best-in-Class PCB Product Metrics



Source: Aberdeen Group, 2015

In a nutshell, the Best-in-Class clearly outshine All Others in the six product metrics outlined above. The payoff comes in three areas:

1. *Feature Elegance Targets*. More often than not, engineers fall short of meeting the actual specification to which they are designing, and achieving feature elegance often comes at the expense of meeting release dates. Nevertheless, the Best-in-Class are 29% more likely than All Others to meet their quality targets at design release. Indeed, an impressive 94% of the Best-in-Class meet quality targets compared to only 73% of All Others.

2. *Meeting Release Dates*. Ask any engineer how often they meet their release date. Most of the time, meeting a release date happens by moving the date out to meet feature elegance goals. But Aberdeen finds that the Best-in-Class are 48% more likely than All Others to meet launch dates.

3. *Meeting Product Cost Targets*. Again, it hard to achieve this goal. But the facts are clear: The Best-in-Class are 44% more likely to meet their development budget, 35% more likely to meet product cost targets, and 41% more likely to bring in expected revenues.

In summary, with regard to product metrics, the Best-in-Class beat All Others hands down, and their PCB design tool best practices are a major contributor to this leadership. Not only do the Best-in-Class spend more time doing what they love, they actually do a better job because they eliminate needless time spent on non-engineering tasks that would mire them in details not essential to the design process.

Best-in-Class Organizational Performance

Lastly, consider the organizational performance of the Best-in-Class, and the time, cost, and efficiency benefits they have achieved through best practices.

	Best-in-Class	All Others
Change in Development Time Over the Past Two Years	11% improvement	10% worsening
Change in Product Cost Over the Past Two Years	3% decrease	5% increase
Change in PCB Size Over the Past Two Years	3% increase	1% reduction

Source: Aberdeen Group, 2015

The Best-in-Class experienced an 11% improvement in development time over the past two years, while All Others saw a 10% decrease. Moreover, this 21% "performance gap" is evidence of the criticality of best practices in PCB development.

The Best-in-Class also saw a decrease in product cost over the past two years, while All Others experienced an increase in product cost.

Lastly, the Best-in-Class appear to have achieved greater success in designing complex products. Over the past two years, they were able to handle larger PCB projects, while All Others' saw their capabilities shrink. Trying to do it all often leads to many things getting started and nothing getting done. By contrast, top performers achieve Best-in-Class organizational performance through a core focus on design excellence via best practices.

Take-Aways: Keep Your Eyes on the (Design) Prize

This report illustrates how top-performing PCB designers are utilizing PCB design tools to rekindle their creative passion and to

minimize time spent on mundane non-engineering related tasks. At a time when companies must develop products faster and more cost-effectively, with narrow profit margins and increasing functionality demands, this is not easy.

Aberdeen Group data presents a clear and convincing case for the engineering and economic benefits of PBC design best practices. Not only are the Best-in-Class more effective, they can focus more on their creative passions while simultaneously offloading mundane yet critical non-engineering tasks.

Despite numerous external pressures and internal challenges, Best-in-Class companies are more likely to pursue improved designer productivity through tool and process efficiency. Moreover, these organizations are dedicated to common tools and best practices across their companies.

However, behavioral differences among the Best-in-Class strongly support the notion that leading organizations became the best by not being afraid to question the status quo and by seeking out data on how others may be accomplishing tasks differently. The Best-in-Class model their excellence in several ways:

- ➔ Top performers are more likely to store and control all data in a single repository and mark any changes with strict version control. This strategy allows the engineer to concentrate on design by eliminating “excursions” that arise due to data integrity issues. Specifically, a single repository ensures that: 1) All parties are using the most current data; 2) Design changes are communicated to all parties in one place; 3) Qualified blocks are available for reuse in future designs; and 4) Release processes are clearly repeatable.

- ➔ The Best-in-Class offload and automate non-engineering tasks to software technology enablers such as PCB parts libraries, and BOM management and PCB data

management solutions. Most importantly, these enablers eliminate manual data curation and delays incurred through antiquated workarounds such as using Excel files. In the end, these manual work arounds always fail due to the dynamic nature of quickly changing data and limited human time to keep up with those changes.

- ➔ Best-in-Class design data management practices revolve around centrally built and managed component libraries and ECO systems. Specifically, these focus on lowering the considerable engineering effort spent in ECOs during the design process and eliminating costly ECOs that occur during manufacturing. All together, these best practices contribute to a repeatable release process, accurate project documentation, and IP re-usage in future projects.

- ➔ The Best-in-Class pursue a design collaboration process that maximizes integration of electronics design flows and mechanical design flows.

Following these best practices not only increases the passion-driven design focus of organizations, but pays off handsomely in business terms, positively impacting the product metrics that count: improved development time; reduced product cost; and more sophisticated product designs. Apple co-founder Steve Wozniak said it best at a talk he gave on engineering passion, when he emphasized the importance of embracing engineering, making it fun, and staying open and accessible to new technology, new ideas, and new ways of doing things.

Through PCB design best practices, the Best-in-Class achieve this goal.

For more information on this or other research topics, please visit www.aberdeen.com.

Related Research

PCB Design: Improving Profitability with PCB Design Best Practices; November 2015

PCB Design for Manufacturing: Understanding its Value; August 2015

PCB Data Management: How Industry Leaders are Managing their Data; August 2015

Managing PCB Design Data: Reducing Risk by Breaking Down Silos; April 2015

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