THE DESIGNER'S GUIDE TO

PCB DATA MANAGEMENT

EMA Design Automation®

DESIGN DATA MANAGEMENT
IS A COMPLEX SYSTEM

Designing a PCB is a multi-step process with many design iterations, reviews, and reversions to previous changes. This process hopefully ends with sending a working board to manufacturing (on time).

Keeping track of your PCB data as it changes is challenging to say the least. Miscommunication can quickly happen, whether a missed update or forgotten substitution for obsolete parts. Mistakes are often found far down the line when they are harder to fix, and there are many consequences that result from poor design data management, including delayed time-to-market and field failures. There are many situations where unmanaged data causes unnecessary headaches and wasted effort due to the rechecking of entire designs and regeneration of crucial manufacturing files.

According to research by the Aberdeen Group, designers spend roughly 24% of their time correcting data integrity issues. It becomes apparent with even a simple change, such as when a component becomes obsolete or is no longer available. Changes will need to be made throughout the design beginning with the schematic, which snowballs into correcting problems for all interrelated files. This includes the BOM, Intelligent PDF, and PCB modifications which will require new manufacturing documentation to be generated and packaged. Changes and correct file revisions then need to be communicated to the appropriate teams or stakeholders to guarantee successful component purchasing, PCB manufacturing, etc.

Keeping track of your project's progress and design changes becomes even more difficult as designs require multi-team collaboration; add in remote work, and data integrity can feel downright impossible to manage. Properly managing design data through the creation of a centralized file and library system empowers teams to effectively collaborate and avoid any miscommunication issues typical with manual processes through integrated revision and documentation management.

> "DESIGNERS SPEND ROUGHLY 24% OF THEIR TIME CORRECTING DATA INTEGRITY ISSUES."

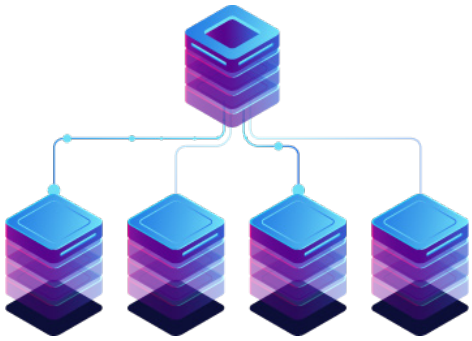
BREAKING IT DOWN

WHAT IS DESIGN DATA MANAGEMENT (DDM)?

The main objective of data management is to provide access to meaningful data for all users in order to avoid miscommunication, unnecessary respins, and manufacturing delays due to manual data tracking and storage.

For the design process to be as efficient as possible, streamlining access to PCB design data and utilizing automation is essential. In fact, research by the Aberdeen Group shows that Best-in-Class companies are 43% more likely than their peers to put each data element on the PCB under version control. They are also more likely to ensure the schematics, layouts, and BOM are synchronized.

Design data should be managed holistically, as this is the only way to ensure data integrity. Each data type affects one another; if one is out of sync, so are the rest. If a part is obsolete, another revision of the bill of materials must be created with the correct information. Then, to prevent the manufacturing package from being out of sync and containing the wrong BOM, it too must be repackaged.



Furthermore, if a drop-in replacement cannot be found, then the design may need to be modified and requalified.

If the right data (ie. part lifecycle status, supply chain information) is presented upfront, communicated, and tracked with proper data management as a part of the design process, the above situation can be easily prevented. Adopting a management system that takes every data point into consideration from the outset and manages them in real-time is the only way to break an ineffective design cycle.

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QUESTIONS, QUESTIONS
ASKING THE RIGHT ONES (AND WHY IT MATTERS)

Regardless of the data management system in place, there are several questions engineers must ask themselves throughout the design process:

1 **Is My Data Accurate?**

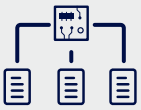
2 **Do I Have All the Data I Need to Make Good Design Decisions?**

3 **Has Anything Changed? If so, What?**

Asking these questions can prevent engineers from working on the wrong revision, selecting a non-approved part, or submitting an incorrect file version to manufacturing. While mistakes can (and will) be made in a manual process, the best way to ensure a smooth design flow is to communicate clearly and concisely with your team when design changes occur.

To be successful, there are certain data types that must be effectively managed. These are:

CAD Files
Consists of schematic and PCB design files.



Derivative Data
Includes all data created from design files such as BOMs and PDFs.

Supply Chain Information
Includes vital information such as part availability, lead times, counterfeit risk, obsolescence, and more.

Libraries and Models
Libraries consist of symbols, footprints, 3D Models, and Spice Models both at the company and project level.

Component Parametrics
Includes vital information such as part number, manufacturer, values, tolerance, and more.

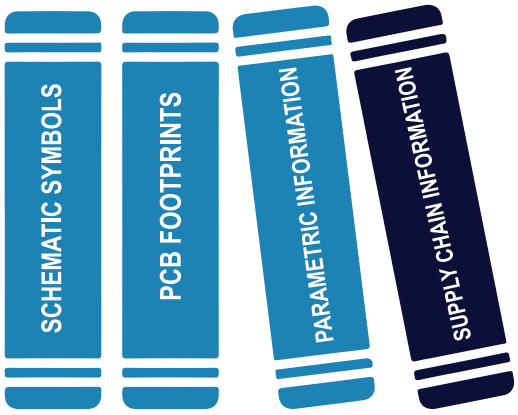
Manufacturing Packages
Consists of the files required for PCB fabrication and assembly including artwork, drill files, IPC-2581, and more.

Many of these data types may appear obvious, especially the schematic and layout files. However, considering the extremely fast pace in which designs evolve, if any one of these data types are not kept current or get out of sync, they can have disastrous effects on overall project success.

LIBRARIES
YOUR DESIGN BUILDING BLOCKS

Component libraries are the foundation of every design. Like building a home, one crack in the foundation could lead to a whole myriad of issues, the same goes for libraries. In PCB design, libraries consist of:

- **Schematic Symbols**
- **PCB Footprints**
- **Parametric Information**
- **Supply Chain Information**



Errors within any of these aspects (ie. mismatched pin names and numbers within symbols, incorrect PCB footprints, and out-of-date supply chain information) will have a detrimental effect on overall project success.

Manually maintaining libraries is difficult enough and when new symbols and footprints are required for designs (which is often), manual new part introduction processes present a new set of challenges. Typically, each engineer would conduct extensive component research to select a new part that adheres to parametric and purchasing requirements. Once a component is selected, they must create and verify the corresponding schematic symbols and PCB footprints as well as manually enter the parametric and purchasing information. Implementing a centralized repository of approved parts brings with it numerous benefits:

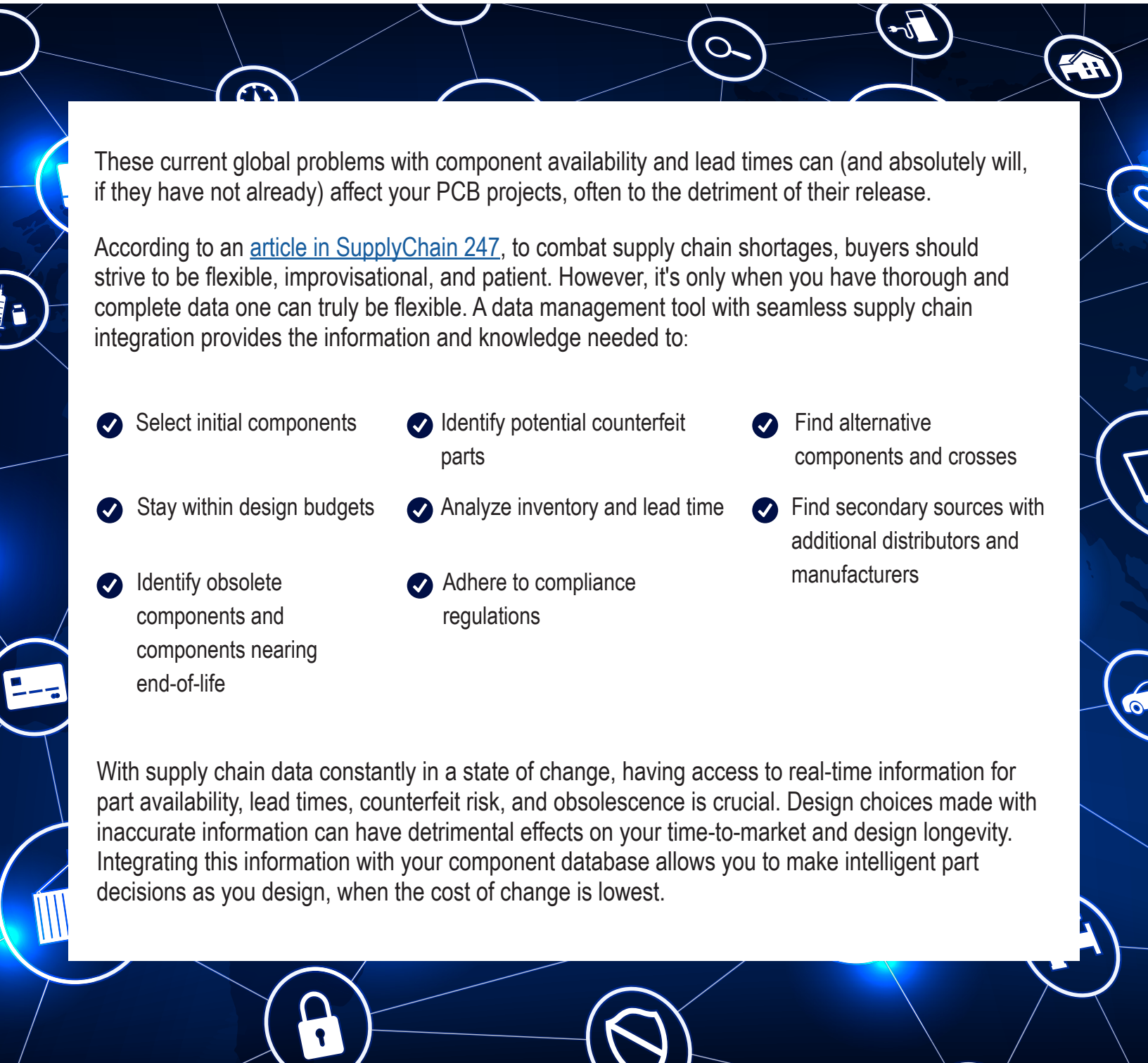
- New introduction process only completed once per part
- Parts can easily be reused by other team members for subsequent projects
- Ensures only verified and approved parts are used
- Keeps libraries in-sync with supply chain and guarantees components can be purchased.
- Keeps components used in designs in-sync with library
- Tracks component modifications and history

Without a proper data management system in place, manually maintaining and managing all the components needed for designs can lead to preventable errors. Errors can then snowball throughout the process, from the schematic to the PCB, due to design decisions made based on outdated or faulty data.

SUPPLY CHAIN-DRIVEN DESIGN

CUT SUPPLY CHAIN ISSUES OFF AT THE SOURCE

It is no secret the world is currently experiencing extreme supply chain shortages. Due to this supply-chain and purchasing information is in a constant state of change.



These current global problems with component availability and lead times can (and absolutely will, if they have not already) affect your PCB projects, often to the detriment of their release.

According to an article in SupplyChain 247, to combat supply chain shortages, buyers should strive to be flexible, improvisational, and patient. However, it's only when you have thorough and complete data one can truly be flexible. A data management tool with seamless supply chain integration provides the information and knowledge needed to:

- Select initial components
- Stay within design budgets
- Identify obsolete components and components nearing end-of-life
- Identify potential counterfeit parts
- Analyze inventory and lead time
- Adhere to compliance regulations
- Find alternative components and crosses
- Find secondary sources with additional distributors and manufacturers

With supply chain data constantly in a state of change, having access to real-time information for part availability, lead times, counterfeit risk, and obsolescence is crucial. Design choices made with inaccurate information can have detrimental effects on your time-to-market and design longevity. Integrating this information with your component database allows you to make intelligent part decisions as you design, when the cost of change is lowest.

REVISION CONTROL

FOSTERING COLLABORATION IS KEY

A main concern in data management is managing change among teams and team members regardless of their location.

Manually searching designs for changes is time-consuming and often creates extra work for designers. Slight changes are easily overlooked and relying on emails or word of mouth to communicate changes is error-prone, especially in large designs.

Incorporating user roles is a great way to maintain data integrity among teams while aiding collaboration. User roles allow you to think about how each team member should engage with the project so engineers are editing only necessary files or specific schematic pages. Intellectual property is kept safe and design reviews are simplified with the ability to create read-only access. This lowers the risk of overwritten files and fosters innovation through increased team collaboration. In fact, it has been shown that best-in-class companies are also 40% more likely than all others to control access to PCB design data based on role. This oversight allows for much more effective and in-context collaboration between all involved.

Implementing a system where files or design pages are checked in/out guarantees only one user is making changes on a design, or portions of a design, at a time. Activity logs and detailed version history keeps your finger on the pulse of the design and allows you to easily manage, track, communicate, and review design changes. Automatic design comparison takes this a step further with notification of changes within the design, eliminating time wasted by manually scanning for design differences.

> "BEST-IN-CLASS COMPANIES ARE **40% MORE LIKELY THAN ALL OTHERS** TO CONTROL ACCESS TO PCB DESIGN DATA BASED ON ROLE. "

INTEGRATION
AND CROSS-FUNCTIONAL COLLABORATION

Producing a successful PCB (and product) often includes a number of stakeholders throughout the organization.

Stakeholders are often consumers of the PCB data you generate. Keeping them in the loop as well as enabling them to make you aware of updates in real time (like changes to the mechanical housing for example) enables a fast and efficient design process. Some of these roles include:

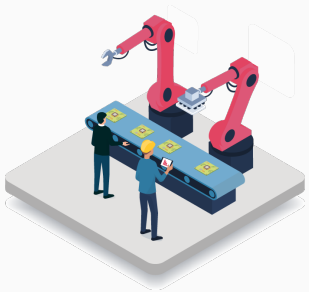
- **Purchasing**
- **Marketing**
- **Software**
- **Mechanical**
- **Compliance**

Enabling collaboration and data sharing upfront empowers engineers to make informed design decisions when change is easiest to implement.The ability to automatically update a data management system every time a change occurs means everyone is on the same page, and there is no chance of error or oversight. With cross-functional collaboration built into your data management process, you can ensure a smooth overall product development and delivery process, improve company-wide collaboration, and shorten the overall design cycle.

RELEASE-TO-MANUFACTURING

DEPLOY WITH CONFIDENCE

With multiple revisions of the PCB design come multiple versions of manufacturing files and derivative data.



Without proper data management, it can be easy to select and include an incorrect file version in the manufacturing package. If this is sent to your manufacturer, the fabrication process will either be stalled waiting on the correct files or continue and produce an incorrect board.

An integrated approach to design data management creates a structured and verified process for releasing a PCB to manufacturing. A centralized location with automatic revision control for the PCB design, derivative data, and manufacturing files simplifies the process of packaging files for production. This eliminates any ambiguity and ensures the most up-to-date files are selected. Some PCB data management solutions will even automatically assemble and zip the manufacturing package, reducing additional steps and any errors that can be introduced with the typically manual process. This manufacturing package is then added to the centralized repository, allowing for easy tracking and management with revision control, time stamps, and a full version history. Simply put, intelligent data management leads to a confident release-to-manufacturing process.

IMPLEMENTING TECHNIQUES

HOW IS IT DONE?

Implementing the right PCB data management system requires some planning and coordination. Adopting the wrong process can lead to even more data integrity issues. The uncertainty of securing intellectual property, managing permissions, wasting time maintaining data, and preserving the engineer's flexibility and creativity are often factors that stall or derail a PCB data management implementation.

Individual Machines

Each stakeholder has their own step in the process, and each one is done on their own machine. While this gives the individual creative control over their part, it also increases the likelihood of miscommunication and data loss.

Pros:

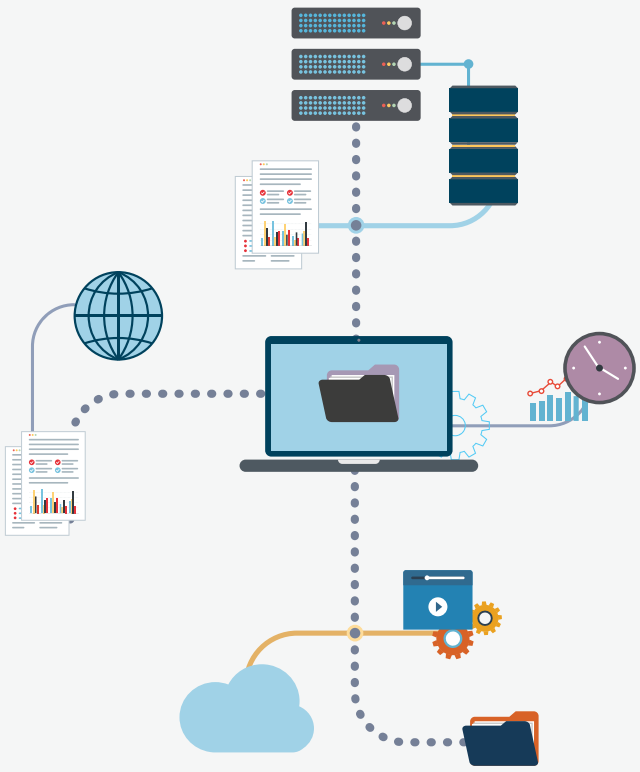
- Easy to no setup
- Low to no cost

Cons:

- Complicated design reviews
- Poor team collaboration
- Cumbersome file sharing and communication through email and word-of-mouth
- Multiple versions of the same design file on different machines
- Inconsistent libraries and models
- Inefficient data storage and backup
- No access or ability to integrate 3rd party data (supply chain, etc.)

Shared Drives

Teams utilize shared network drives to communicate, share files, and collaborate on designs. While this makes team collaboration easier due to centralized access to data, the lack of control over data integrity creates new problems. Sometimes multiple people are editing and updating files at the same time which leads to confusion over which version is truly the correct one to move forward with.



Pros:

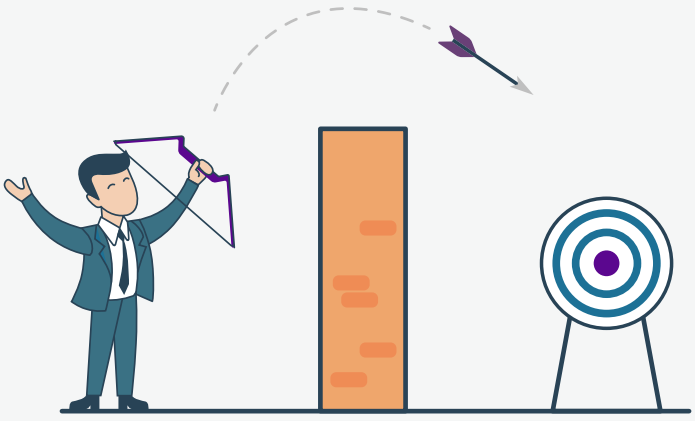
- Centralized access to design and library files for everyone
- Easier design reviews with direct access to design data
- Streamlined team collaboration
- Team members can access data

Cons:

- Increased likelihood of overwritten files
- Inconsistencies with versioning
- No user permissions
- Unapproved files and models can be added
- Only internal users can access data
- Blind team collaboration
- Delayed file syncing
- Complications with user access
- No access or ability to integrate 3rd party data (supply chain, etc.)

Piecemealed Revision Control Systems

Companies tend to piecemeal multiple data management methods to create some semblance of a data management flow. This can be a combination of email, SVN, cloud backups, shared drives, manual tracking in a spreadsheet, and more. This piecemealed revision-control process can result in a "throw it over the wall" approach when collaborating with multiple disciplines. It is ineffective since there is no control over the data–if you receive an outdated or incorrect file, your designs will also be incorrect, no matter what management systems you have in place.Without the ability to manage data in one centralized location, automate revision control, and keep a detailed version history, maintaining data through a combination of methods becomes a lesson in futility.



Pros:

- "Defined" data management process
- Revisions are being managed

Cons:

- Multiple data management methods to be maintained
- Increased likelihood of overwritten files
- Inconsistencies with versioning
- Ineffective multidisciplinary collaboration ("throw it over the wall" approach)
- Difficulty maintaining permissions
- Unapproved files and models can be added
- Manufacturing package accuracy is questionable
- Tracking errors due to manual processes
- Blind team collaboration
- Delayed file syncing
- Complications with user access

CAD-Specific Systems

Many of the problems that arise from the previous methods can be fixed with implementation of an automated CAD-specific data management system. With a CAD-specific system, work-in-progress designs can be managed in one centralized location, preventing issues that may arise due to mismanaged data. CAD-specific systems know the file types used throughout the PCB design process and are built to manage them efficiently.

Pros:

- Customizable user permissions with read-only access.
- Access to libraries and data in a centralized location
- Easy check-in/out processes
- Able to integrate additional data (supply chain information, PLM data, etc.)
- Automated versioning
- Files are synced in real-time
- Multiple ways to access data (desktop, website, software-integrated, etc.)
- Ability for non-engineering roles to access data and get notified of updates
- Easily delegate design responsibilities through schematic page assignments and user roles
- Accurate manufacturing package output
- Seamless verification and approval of library models

Cons:

- May require upfront investment to setup and roll-out.

When you take control of your design data, you gain peace of mind knowing you are communicating accurate information across the board and working with up-to-date revisions and data.

CAD-INTELLIGENT DDM

A RECIPE FOR SUCCESS

Keeping files in sync is no easy feat when manually coordinating and executing a PCB design project. Each aspect of the design process has a codependent relationship with the others:

Schematic and PCB

The schematic and PCB have a bi-directional relationship. Any changes made in either must be communicated.

Parametrics and Library

Component purchasing information including price, availability, and lead time change throughout the design process. Synchronizing a component library with accurate parametric data will guarantee components can be purchased within the project timeline and budget.

Design and Libraries

The design must be checked against component libraries to guarantee up-to-date symbols and footprints are used and there are no part discrepancies.

Design and BOM

The schematic contains all the components needed for the design which are compiled in a Bill of Materials (BOM) including purchasing and assembly information.

Design and Manufacturing Files

Manufacturing files are generated from the design; therefore, if any changes are made, new manufacturing files are required for a successful production.

The complexity of PCB data combined with the rapid pace of changes means there are too many opportunities for data inconsistencies. While individual relationships can be maintained fairly easily, they cannot be maintained in total isolation, as each one affects the others. This makes data management anything but straightforward. A CAD-intelligent data management tool integrates across all your platforms to seamlessly merge data and supply chain information into a shared environment, providing comprehensive insights and eliminating any late-stage surprises.

CONCLUSION

OPTIMIZE YOUR DESIGN PROCESS WITH INTEGRATED DDM

PCB design data is dynamic and in a constant state of change throughout the entire design process. Managing all the files associated with an evolving PCB design only intensifies as different stakeholders become involved.

Even the best efforts at manual data organization and management can still introduce errors into the process. Automated design data management tools can make file management an integrated part of your design process, ensuring seamless maintenance of design files across multiple locations and keeping your project on time.

Integrated Design Data Management (DDM)

- **Fosters Collaboration**
- **Increases Innovation**
- **Drives Confident Release-to-Manufacturing**

While implementing an integrated process can seem intimidating to some, the ability for all users to access work-in-progress designs, a complete revision history, verified component models, parametric data, and all associated documentation in one place makes the initial setup time worth it; especially as design teams grow and remote work becomes the norm.

Work more efficiently and effectively than ever with scalable design data management solutions from OrCAD, which allows access to an integrated, centralized repository for all design data and libraries. With customizable user permissions, real-time supply chain insights, automatic design comparison, detailed version history, automated release-to-manufacturing, and PLM integration options, design data management solutions from OrCAD help you make intelligent design decisions and guarantee data integrity throughout the PCB design.

More Information on Our Integrated Design Data Management Solutions

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