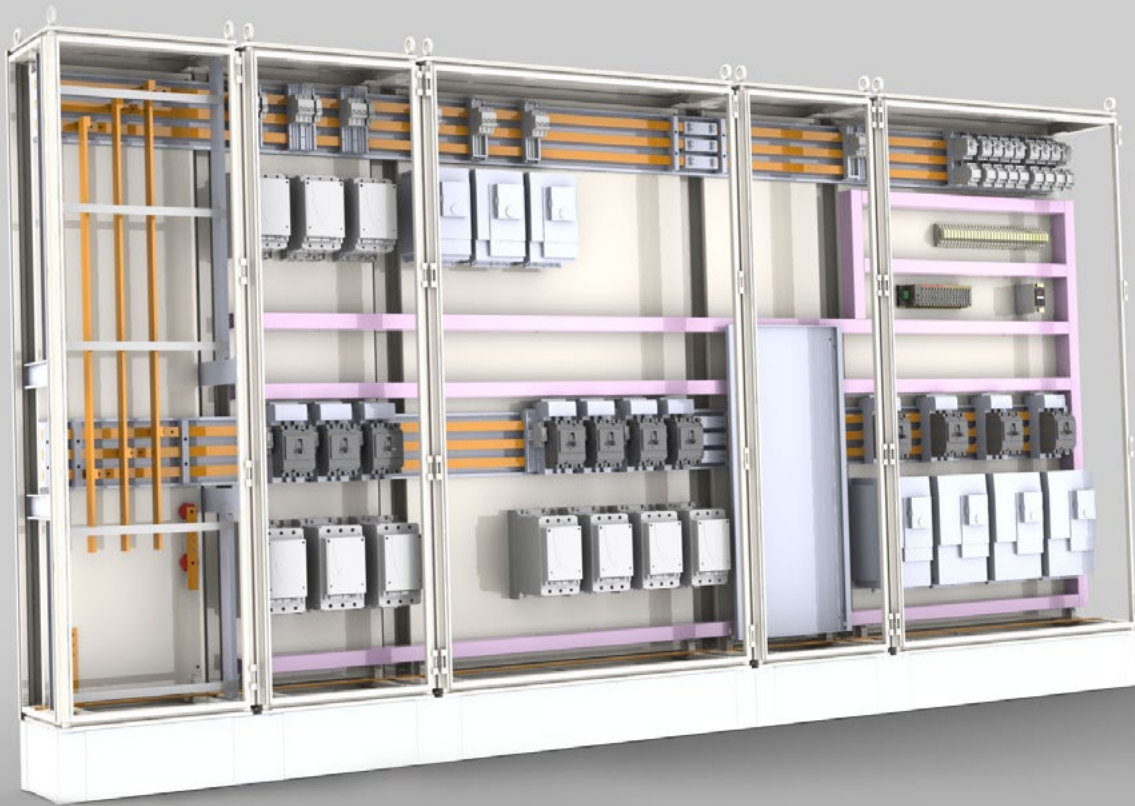


# ELECTRICAL DESIGN

BOOST PRODUCTIVITY AND IMPROVE QUALITY BY  
INTEGRATING ELECTRICAL AND MECHANICAL DESIGN IN 3D  
White Paper



## SUMMARY

The productivity gains related to using 3D CAD technology for mechanical design are now obtainable for electrical design through integration of electrical and mechanical development on a single 3D platform. Instead of relying on slow, non-integrated 2D tools to develop electrical schematics, control panel designs, and electrical system layouts, or manual techniques for routing wires, cables, and harnesses, manufacturers can take advantage of SOLIDWORKS® Electrical 3D technology to fully integrate the electrical and mechanical aspects of machine and product design, resulting in time and cost savings, as well as quality improvements. Whether you need to create schematics, design electrical systems, select electrical components, automate wire and cable routing and harness design, or simply share electrical and mechanical design data, this paper will help you understand how integrating electrical and mechanical design with SOLIDWORKS Electrical software solutions will help you achieve your product development goals.

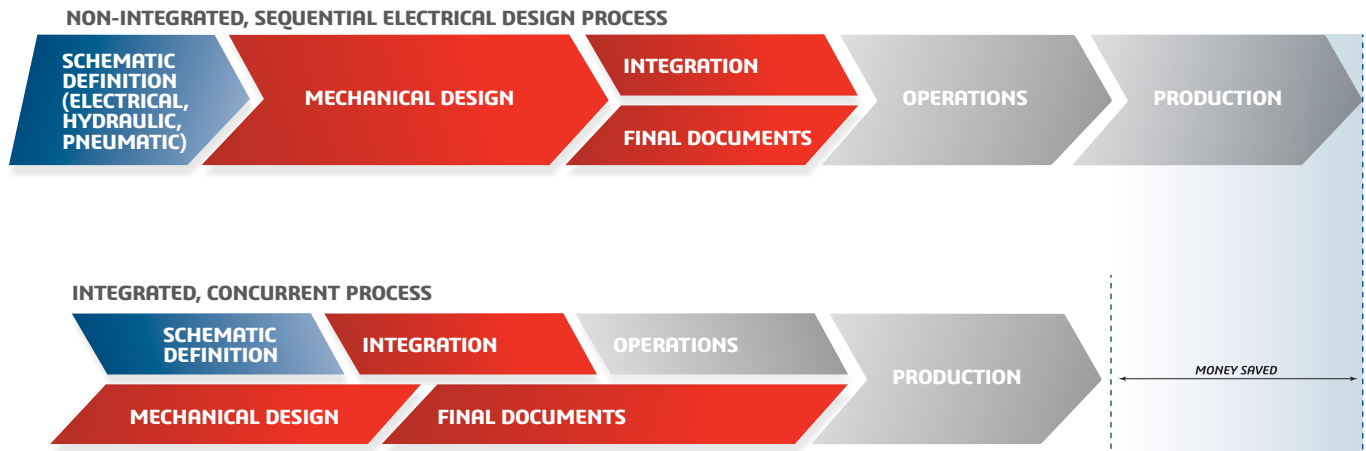
## EFFECTIVE ELECTRICAL DESIGN DEMANDS STREAMLINED INTEGRATION INTO THE 3D DESIGN PROCESS

Over the past two decades, a time span during which 3D CAD technology has revolutionized mechanical design, electrical design has languished in the world of 2D. The proven benefits of 3D design—shorter design cycles, reduced development costs, higher product quality, increased design innovation, and faster times-to-market—have escaped electrical design because of its historical reliance on non-integrated 2D diagramming tools. Manufacturers have traditionally treated electrical design and the routing of wires, cables, and harnesses, as afterthoughts, separating electrical design from investments in 3D technology and holding back progress toward electrical/mechanical design integration and collaboration.

However, continuing to give electrical design short shrift by not integrating it into more efficient and productive 3D mechanical design workflows carries a host of disadvantages that can hinder a manufacturer’s competitiveness in an increasingly competitive global market. Traditional, non-integrated 2D approaches to electrical design typically take longer, requiring the generation of separate, manually created bills of materials (BOMs), for example, which slows time-to-market. Plus, non-integrated electrical schematics lack the critical information contained in 3D design data, creating the potential for inaccuracies, misunderstandings, and quality issues. Because electrical designers generally utilize a different design platform than their mechanical design colleagues, the lack of integration discourages collaboration, limits design reuse, and impedes efforts towards increased innovation and greater automation.

Most importantly, traditional, non-integrated 2D approaches to electrical design end up costing more. In many cases, a prototype build is necessary to manually route wires and cables and create the harnesses that bundle and protect them. Non-integrated electrical design methods generally require more manual effort for manufacturing planning and the development of assembly documentation and user/service manuals. Lastly, non-integrated, manual approaches to electrical design raise the probability of having quality issues enter the process through human error, which can increase costs dramatically.

In addition to time, cost, and quality disadvantages, non-integrated 2D electrical design approaches can hamper a manufacturer’s ability to respond to and take advantage of market and industry trends, such as reducing factory footprints, right-sizing control panels, or achieving miniaturization in consumer products. Effective electrical design requires much more than schematics development and increasingly demands a 3D integrated design environment. With an integrated solution like SOLIDWORKS Electrical 3D software, electrical design can drive efficiency improvements, serve as a catalyst for innovation, and support business growth.



## **THE BALL OF STRING — THE LIMITATIONS OF TRADITIONAL ELECTRICAL DESIGN SCHEMATICS**

When someone mentions a “ball of string,” most people think of associations like their grandmother knitting a sweater, a cat playing with a ball of yarn, or a child flying a kite. However, for electrical designers, the dreaded “ball of string” and its companion, “the tape measure,” signify the primary means for routing wires or cables through an assembly prototype build. You run a string from one lead or contact to another, measure the length of the string with a tape measure, making sure the route doesn’t expose the wire or cable to heat or other sources of potential damage, and then document the piece of string’s length and path. The “ball of string” routing method is emblematic of the way many manufacturers view electrical design—as an afterthought—and serves as a perfect metaphoric symbol of both the shortsightedness and limitations of traditional approaches to electrical design.

### **More than an Afterthought**

Manufacturers should give electrical design the same amount of attention and focus as they place on mechanical design. When treated as the final step in the process, non-integrated electrical design essentially becomes an afterthought, its limitations go unnoticed, and its potential for productivity improvements remains hidden. Electrical design is much more than a postscript to the design process and provides a range of opportunities for improving workflow processes that increase innovation through collaboration, automation through digitization, and quality through accuracy. By integrating electrical and mechanical design onto a single 3D platform, these opportunities for improvement become readily apparent. Instead of having electrical designers playing with a ball of string, they could be communicating accurately and collaborating effectively in 3D.

### **Delays Timely Response to Customer/Market Demands**

Because customer needs are changing more frequently and market dynamics are shifting more quickly, manufacturers need effective tools for responding to changing customer/market demands, whether they are requests for new features or capabilities, or paradigm-shifting advances in innovation. Non-integrated 2D approaches to electrical design impede an organization’s ability to respond quickly to evolving industry trends and market requirements. For example, most manufacturers strive to reduce the size of electrical system footprints to save factory floor space and consume less material. However, electrical designers need to be able to balance these needs against other demands for improving control panel access, maintenance, and serviceability. Electrical designers need integrated 3D design tools in order to right-size systems and components to satisfy potentially conflicting requirements.

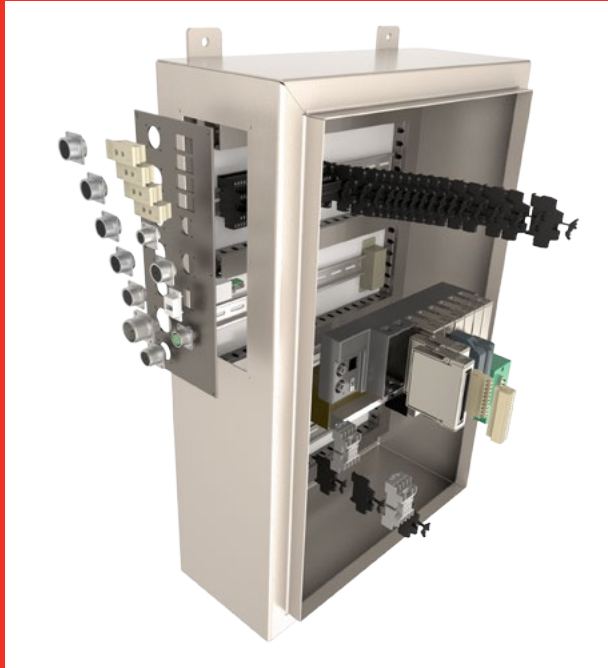
### **Prevents Collaboration Between Electrical and Mechanical Designers**

Working in a separate electrical design application inhibits collaboration between electrical and mechanical designers. Such collaboration not only can prevent design errors and performance issues from entering the development process but also can lead to product innovation and improvement. Because electrical and mechanical designers work on separate, non-integrated design platforms, they speak different languages with little opportunity for cross-disciplinary professional development. Rather than working together to produce a collaborative design that satisfies both electrical and mechanical design requirements, most electrical and mechanical designers create distinctly separate designs that are then cobbled together in production. The electrical designer may ask how much space is available within a housing for the electrical system, or a mechanical designer may ask how big the control panel needs to be. The fact that they work in separate packages squelches the collaboration that’s imperative for optimizing electro-mechanical designs.

### **Non-Integration Stifles Workflow Efficiencies, Carries Disadvantages**

When electrical and mechanical designers work in different design packages, non-integration of design data creates a myriad of workflow challenges and bottlenecks simply because of the need to support two different types of design data in downstream processes. The generation of different BOMs, cut lists, and documentation for the production of electrical and mechanical assemblies leads to duplication of effort to support other functions, whether it be in procurement, production planning, or manufacturing and assembly. In addition to slowing time-to-market, increasing costs, and raising the probability of errors, using separate, non-integrated design systems can also feed internal biases against new ideas and ways of doing things and cement an over-reliance on existing approaches, stifling both workflow efficiencies and innovation in product development.

GLSV Electrical Cabinet -  
Exploded Rendering from  
SOLIDWORKS Electrical



### ...a case in point

GLSV, Inc., leverages its extensive noise and vibration engineering experience in the defense, marine, automotive, off-highway, and recreation vehicle markets as the go-to firm for solving acoustics, vibration, and shock-related design problems. GLSV's expertise supports its development and fabrication of sophisticated noise/vibration test systems, which customers use to identify and address noise and vibration issues in their products.

GLSV has relied on SOLIDWORKS Professional and SOLIDWORKS Premium software for the mechanical design of its noise/vibration test systems since 2004. However, according to Project Engineer Ryan Helminen, who handles electrical design of GLSV systems, the company needed a more efficient solution for developing electrical system schematics and generating bill of materials (BOM) information than the Microsoft® Visio® 2D software that it formerly used.

The company chose SOLIDWORKS Electrical 3D software because it's easy to use, automatically generates BOM data, improves the quality of 3D electrical schematics, and integrates directly with SOLIDWORKS mechanical design solutions. "SOLIDWORKS Electrical software is to electrical design what SOLIDWORKS software is to mechanical design," Helminen says. "Because we already used SOLIDWORKS software, we expected the integration provided by SOLIDWORKS Electrical to both save time and improve quality, which it has."

By implementing SOLIDWORKS Electrical 3D software, GLSV cut electrical design time by 50 percent, reduced electrical cabinet sizes by 25 percent, improved the quality of electrical schematics, and reduced errors through automated BOM creation.

## INTEGRATED ELECTRO-MECHANICAL DESIGN DEVELOPING HIGHER QUALITY PRODUCTS FASTER AND MORE COST-EFFECTIVELY

Replacing non-integrated electrical design tools with a fully integrated electrical design package like SOLIDWORKS Electrical software will simplify the development of schematically driven electrical systems and wire/cable harnesses in 3D, which in turn will enable you to create higher quality products faster and at less cost. In addition to simplifying design, working on the same electro-mechanical design platform fosters cooperation and collaboration between electrical and mechanical designers, as well as between design, engineering, and manufacturing personnel.

### Beating the Competition to Market

The benefits of an integrated electro-mechanical design platform enable electrical and mechanical designers to develop designs more quickly, contributing to faster product times-to-market. Moreover, the benefits of using an integrated electro-mechanical design platform extend beyond shortening design cycles to provide additional productivity gains related to streamlined development workflows—during both design and downstream processes. An integrated electro-mechanical platform lets you eliminate data import, export, and conversion requirements; consolidate and automate BOM generation, procurement, and preproduction into a single effort; and reduce manufacturing planning and documentation requirements, all of which help manufacturers introduce new products faster than their competitors can.

### Reducing Development Costs

How will an integrated electro-mechanical design platform help manufacturers reduce and control development costs? In addition to streamlining product design and development

workflows, which saves time and boosts throughput, integrating electrical and mechanical design into a single environment will enable you to increase design standardization and reuse, eliminate prototype build requirements for routing wires/cables, and reduce design errors and manufacturing issues, lowering the volume of scrap/rework produced, reducing the number of and warranty returns, and decreasing their attendant costs. The ability to right-size cabinets, panels, systems, and components is another key benefit that will enable manufacturers to optimize material usage and reduce material-related costs.

### Improving Quality and Increasing Innovation

In addition to saving time and money, an integrated electro-mechanical design system will support manufacturers' efforts to improve quality and increase innovation. By its very nature, an integrated electro-mechanical design platform facilitates multi-disciplinary exchanges between and collaboration among electrical design, mechanical design, and manufacturing professionals. This increased ease of communication and more accurate design visualization not only results in identifying quality issues prior to production, it also sets the stage for the implementation of new ideas and innovative approaches. When collaboration replaces assumptions, everyone involved can clearly visualize the complete electrical and mechanical design in 3D, which supports high levels of quality and innovation.

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CNC Solutions Robotic Work Cell,  
created with the use of SOLIDWORKS  
Electrical technology



### ...a case in point

CNC Solutions LLC designs, fabricates, and builds factory automation and tooling solutions for leading manufacturers. The company's core business is electrical and mechanical systems integration and automation for a variety of original equipment manufacturers (OEMs) and end users requiring quality industrial automation and manufacturing engineering services.

The company has utilized SOLIDWORKS mechanical design software for several years, enjoying a range of productivity improvements, and sought to realize additional efficiency gains in electrical design by replacing the AutoCAD® 2D tools it had used to develop schematics for its electrical cabinets and control systems, according to Controls Engineer Shawn Eckhardt.

"In addition to accelerating electrical design and schematics development, we were interested in looking at our electrical cabinets in 3D to automate wire and cable routing, as well as streamline the generation of bill of materials (BOM) information and facilitate more effective collaboration between our mechanical and electrical engineers," Eckhardt says. "Implementing SOLIDWORKS Electrical 3D software has improved collaboration, increased efficiency, and allowed us to size our cabinets better.... By completing electrical design faster, we can handle more projects, leading to accelerated production and increased throughput.

By implementing SOLIDWORKS Electrical 3D software, CNC Solutions cut electrical design time by 50 to 75 percent; reduced BOM generation time from hours to minutes; enhanced the quality, accuracy, and appearance of electrical schematics; and improved mechanical/electrical design collaboration.

## SOLIDWORKS ELECTRICAL – EXTENDING THE BENEFITS OF 3D BY INTEGRATING ELECTRICAL AND MECHANICAL DESIGN

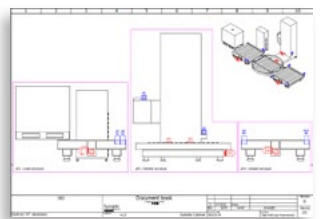
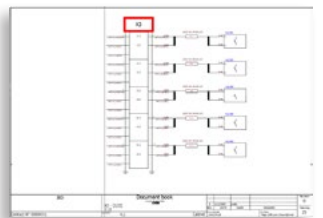
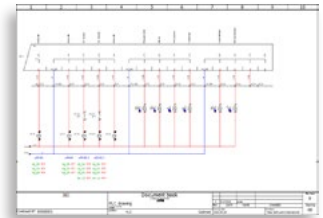
To help manufacturers reap the benefits of integrating electrical and mechanical design in 3D—including quality, cost, and efficiency gains—Dassault Systèmes SolidWorks Corporation has developed SOLIDWORKS Electrical design software solutions. These integrated electrical design solutions are packaged to parallel the four primary stages of electro-mechanical design integration, which range from the collaborative sharing of electrical (ECAD) and mechanical (MCAD) design data to fully immersive, 3D electro-mechanical design through the total integration of both disciplines in a single design platform.

### Stages of Electro-Mechanical Design Integration

- **Full Immersion/ Complete 3D Integration:** Every aspect of electrical and mechanical design—including schematic development, 3D modeling, unified BOM generation, and automated wire/cable routing—takes place in a common, completely integrated 3D design environment.
- **Integrated 3D Electro-Mechanical Design:** Only the modeling aspects of electrical and mechanical design are integrated in a common 3D design environment, including 3D modeling, unified BOM generation, and automated wire/cable routing. Schematic development takes place elsewhere.
- **Schematic-Integrated Electrical Design:** Only schematic development is integrated with the 3D mechanical design environment.
- **Collaborative Sharing of Electrical/Mechanical Design Data:** Electrical and mechanical designers can share ECAD and MCAD design data with each other utilizing an import/export approach.



SOLIDWORKS Electrical schematic design tools



### Schematic Driven Electrical Design – SOLIDWORKS Electrical Schematic

This easy-to-use set of collaborative, schematic design tools will help you drive the rapid development of embedded electrical systems for machine, equipment, and product designs. Built-in libraries of symbols, manufacturer part information, and 3D component models provide common, reusable materials that support design reuse.

### Integrated 3D Electro-Mechanical Design – SOLIDWORKS Electrical 3D

This integrated 3D electrical design application enables you to place electrical components and use advanced SOLIDWORKS routing technology to automatically interconnect electrical design elements within a 3D model. SOLIDWORKS Electrical 3D design software allows you to determine the optimal lengths for wires, cables, and harnesses, all while maintaining design and BOM synchronization between electrical and mechanical designs.

## Full Immersion/Complete 3D Integration – SOLIDWORKS Electrical Professional

This powerful, easy-to-use electrical design software combines the electrical schematic development functionality of SOLIDWORKS Electrical Schematic software with the 3D modeling capabilities of SOLIDWORKS Electrical 3D software to provide a complete, fully immersive 3D integrated electro-mechanical design solution. SOLIDWORKS Electrical Professional software supports both electrical and mechanical design integration with 3D models, schematics, unified BOM generation, and automated wire/cable routing.

## GAIN A COMPETITIVE EDGE BY INTEGRATING ELECTRICAL AND MECHANICAL DESIGN IN 3D

Extending the benefits of 3D CAD technology to electrical design requires an integrated electrical design solution. Instead of continuing to let electrical design languish in 2D and use rudimentary, manual approaches such as a “ball of string”, you can treat electrical design as a function that’s ripe with productivity-enhancing potential and gain a competitive advantage by integrating electrical and mechanical design in 3D. Integrated electro-mechanical design can provide the same proven benefits as 3D mechanical design, including shorter design cycles, reduced development costs, higher product quality, increased design innovation, and faster times-to-market, all of which can substantially improve your competitive position.

Whether you need to create electrical schematics, design electrical systems, select electrical components, automate wire and cable routing and harness design, or simply share electrical and mechanical design data, SOLIDWORKS Electrical software solutions can help you achieve your product development goals by integrating electrical and mechanical design in a 3D development environment. In addition to saving time and money, an integrated electro-mechanical design system powered by SOLIDWORKS Electrical software will drive your company’s efforts to improve quality and increase innovation.

To learn more about how SOLIDWORKS Electrical software can improve your development process by integrating electrical and mechanical design in 3D, visit [www.solidworks.com](http://www.solidworks.com) or call 1 800 693 9000 or 1 781 810 5011. To learn more about how SOLIDWORKS Electrical software can improve your development process by integrating electrical and mechanical design in 3D, visit [www.solidworks.com](http://www.solidworks.com) or call 1 800 693 9000 or 1 781 810 5011.

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