DASSAULT SYSTEMES

SOLIDWORKS

IMPROVE MECHATRONICS DEVELOPMENT WITH THE SOLIDWORKS ECOSYSTEM

White Paper

OVERVIEW

Increasing numbers of new products—as well as the manufacturing machinery and systems used to produce them—require mechatronics: the integration of electronic, electrical, mechanical, motion control, and information-processing components, assemblies, and subassemblies to create a functional electromechanical system. The development of mechatronics-based products and systems has historically involved separate and distinct design and engineering workflows and tools, with integration of the various systems addressed near the end of the development process. This traditional approach is both slow and costly, and today's mechatronics manufacturers need solutions for streamlining development by integrating electrical, electronic, and mechanical design as a single collaborative process. As the ONLY fully integrated electronic, electrical, and mechanical design platform, the SOLIDWORKS® 3D product development ecosystem enables your organization to implement a more efficient, cost-effective, and unified multi-disciplinary approach for efficiently creating successful mechatronics products and systems.

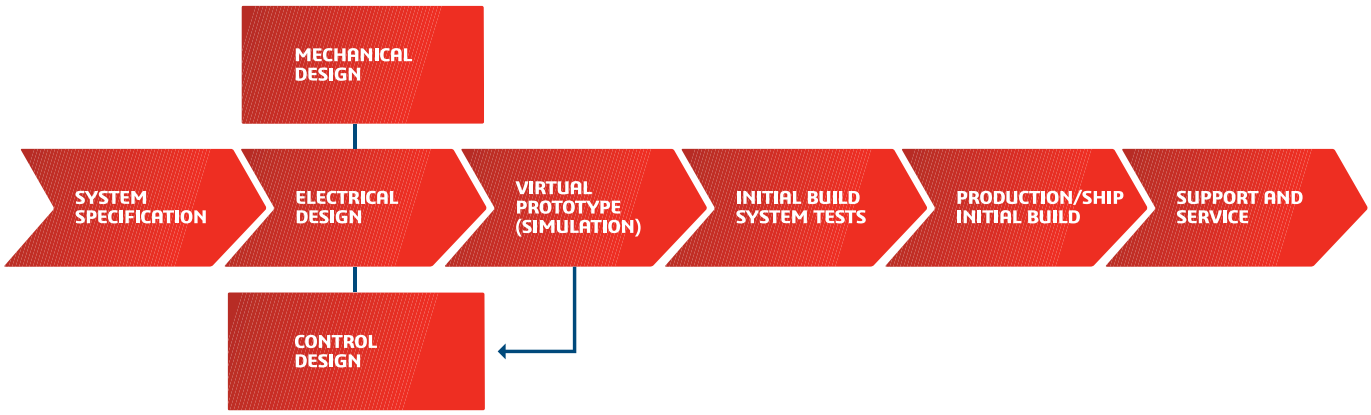
STREAMLINING MECHATRONICS DEVELOPMENT IMPERATIVE FOR COMPETING SUCCESSFULLY IN A GLOBAL MANUFACTURING MARKET

We now live in a mechatronics world. From the smartphones that have become a necessary part of daily life in less than a decade to the emerging product categories based on the Internet of Things (IoT), such as intelligent thermostats, lighting controls, and personal fitness systems, the development of a growing number of products not only require mechatronics, but also a more efficient, streamlined, synergistic approach to mechatronics development that improves quality, accelerates time to market, and fosters innovation.

While the growth of mechatronics products is obvious in consumer markets, a similar trend is transforming the development of manufacturing machinery and systems. Production technology is trending towards mechatronics-based systems in response to market demands for shorter manufacturing lead times, improved quality, and greater innovation. Electronic sensor-driven manufacturing and robotics are supplanting older technologies—like the use of pneumatics and mechanical cams on production lines—to achieve the automation and efficiencies required to compete successfully in a global market.

However, attempting to utilize traditional product development approaches, through which electronic, electrical, and mechanical designs are completed by different departments following separate workflows, the products of which are cobbled together prior to production using file transfers and data conversions, can be shortsighted and self-defeating. As a mechatronics systems developer, you face increasing pressure to shorten times to market by reducing design iterations, minimizing prototyping, increasing design reuse, and improving mechatronics assembly design. In addition to shortening development cycles, you must simultaneously improve quality to minimize field failures and warranty claims.

In short, achieving your mechatronics development goals requires better tools for design collaboration and communication at every stage of the development process—from initial proposal development though design and documentation preparation. What today's design organizations truly need during the transition to mechatronics-based product development and manufacturing are integrated solutions that save time, control costs, and improve quality. This paper explores the limitations of traditional development methods, examines the benefits of an integrated mechatronics design platform, and demonstrates how the integrated SOLIDWORKS 3D product development ecosystem can help you achieve your mechatronics product and system development goals.



WHY TRADITIONAL APPROACHES TO MECHATRONICS DEVELOPMENT PUT YOU AT A COMPETITIVE DISADVANTAGE

Although conventional, non-integrated approaches to mechatronics system design produce finished products, they limit how quickly, cost-effectively, and accurately you can design, validate, manufacture, and assemble them. More importantly, traditional methods—with electronic PCB board design, electrical schematics and wiring layouts, mechanical housing and component design, and control systems development completed separately—inhibit multi-disciplinary collaboration and stifle design innovation.

Longer Development Cycles

The rapid pace of the market for mechatronics products and systems requires design and manufacturing cycle reductions. These reductions are virtually impossible to realize using traditional approaches. Because data exchanges between electrical, electronic, motion control, and mechanical design tools are generally time-consuming and error-prone, non-integrated methods suppress multi-disciplinary collaboration and promote the operation of different disciplines as separate islands of automation. While you may believe you do your job faster than ever, the automation that you experience is not really speeding up the entire cycle because it takes more iterations and additional time to bring all of these disparate concepts together into a single cohesive whole. Non-integrated development systems contribute to time-consuming checking of bill of materials (BOM), slow engineering change order (ECO) processing, and looser revision controls, all of which contribute to project and time-to-market delays.

Greater Cost

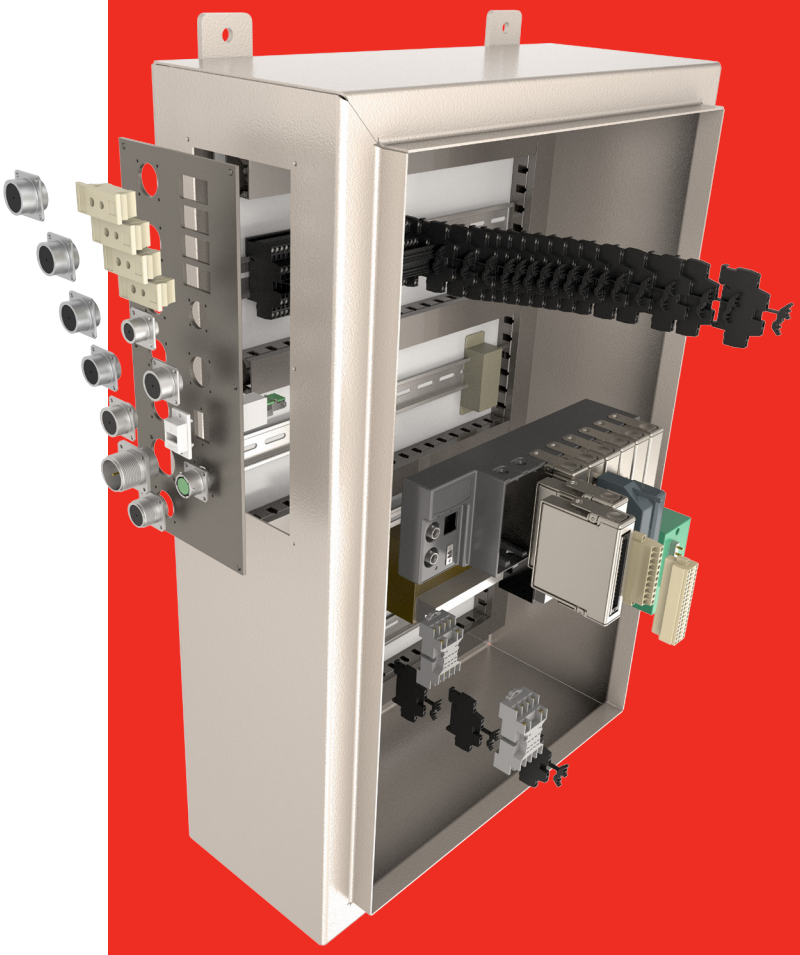
In addition to extending design cycles, the use of conventional, non-integrated development environments for mechatronics design costs more. Because electronic, electrical, motion control, and mechanical designs take the form of different data formats, organizations rely too heavily on iterative physical prototyping cycles—to validate the structural and thermal performance of mechanical enclosures and electronic systems—instead of leveraging less costly simulation tools. Cost overruns related to replacing obsolete components, sourcing new suppliers, and increasing the number of ECOs to address undetected errors are also common when using non-integrated tools. But perhaps the greatest cost to your organization lies in its inability to leverage simplified and unified electronic, electrical, motion control, and mechanical 3D design data throughout your development and manufacturing processes, limiting design visualization, simulation, and validation, while simultaneously requiring manual processes for wiring and harnessing, BOM generation and checking, and user manual and documentation preparation.

Affects Quality

None of the engineering disciplines involved in developing today's mechatronics systems takes place in a vacuum. Whether you design electronics, lay out electrical schematics, create motion control systems, or develop mechanical enclosures, your work will affect and be affected by the work of colleagues from other engineering disciplines. No matter how diligent you are in trying to resolve inevitable conflicts, the fact that you use non-integrated design tools, which all speak different languages, decreases the extent of collaboration you can pursue and increases the likelihood of design errors and manufacturing defects creeping into the process. Failure to use simulation technology to check how well a design manages thermal, structural stress, vibration, motion, and fatigue effects at the system level, as well as poor revision control or the inability to make quick design changes in an integrated fashion, can also contribute to less than desirable quality. Lastly, errors related to file transfers and data conversions are a fact of life when using a non-integrated approach.

Limits Innovation

Perhaps the greatest limitation associated with using non-integrated design tools to develop mechatronics systems is the suppressive effect that complacency has on innovation. The unique approaches, out-of-the-box thinking, and breakthrough concepts that are the hallmark of innovation generally don't come about from doing things the same way that they've always been done, but typically emanate from the fresh insights and novel ideas that accompany collaboration. Electronic, electrical, motion control, and mechanical engineers who use non-integrated tools can develop a tunnel-like perspective based on their particular engineering discipline. Lacking a common, integrated development platform and design language, it's difficult for everyone involved to expand his or her perspectives and engage in the more extensive collaboration that often sparks innovation. The lack of a common development environment, and the additional work it creates whenever someone wants to make a change, also inhibits the exploration of new approaches, methods, and ideas, particularly late in the development process.



...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.

Read the full story here: GLSV, Inc. Case Study.

HOW INTEGRATED MECHATRONICS DEVELOPMENT PROVIDES A COMPETITIVE EDGE

Using an integrated, single platform like the SOLIDWORKS 3D product development ecosystem to develop mechatronics-based products and systems provides a wide range of benefits. You can leverage an integrated approach to shorten design cycles, improve quality, and facilitate manufacturing and assembly, while simultaneously encouraging the multi-disciplinary, collaborative approach—with electronic design, electrical schematics and wiring, motion control system, and mechanical housing and component design completed in an integrated manner—that fosters new ways of thinking and sparks innovation.

"Because parts and assemblies update automatically in an integrated, parametric system, you can quickly and easily make design changes, which ripple across all related data, without suffering the penalty of creating unnecessary "busy-work" and associated delays."

Shorter Development Cycles

Developing products within a fully collaborative mechatronics design environment means there's no time wasted on file transfers or data exchanges, nor do you need to spend time updating designs in separate systems to iterate or make design changes. Because parts and assemblies update automatically in an integrated, parametric system, you can quickly and easily make design changes, which ripple across all related data, without suffering the penalty of creating unnecessary "busy-work" and associated delays. With an integrated mechatronics development platform, you can merge separate, disjointed, and parallel electronic, electrical, and mechanical design workflows into a single, concurrent, and collaborative approach that speeds up, automates, and simplifies the entire process. You can save additional time by automatically generating unified BOM information, reducing the number and accelerating the processing of ECOs, and eliminating the possibility of wasting time working on the wrong revision.

Cost Reductions

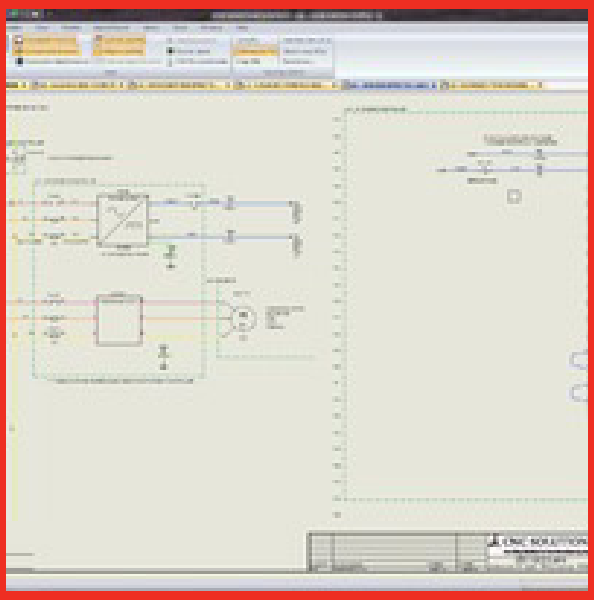
While integrating, accelerating, and automating electro-mechanical design cycles alone will enable you to decrease and better control development costs, there are a host of additional cost-saving benefits associated with an integrated mechatronics design platform. You will be able to reduce prototyping requirements and costs because you can validate fits and clearances—as well as enjoy greater opportunities to simulate and optimize electronic design performance—without needing to produce a physical prototype. An integrated development environment also helps you avoid cost overruns by unifying supplier management and enabling greater detection of design errors early in the development process, thereby reducing the number of ECOs required. Most importantly, an integrated development system allows you to leverage complete 3D product design data for all downstream functions, including design visualization; design validation/optimization; automated wiring, cable routing, and harnessing; automated and unified BOM generation; motion control system simulation; and automated and unified documentation preparation.

Improved Quality

When electronic, electrical, motion control, and mechanical engineers use an integrated electro-mechanical development platform to collaborate closely on mechatronics systems design, there are fewer surprises, misunderstandings, and missed errors that make it into production or released products. Integration also gives you easier access to simulation technology—to better manage thermal, structural stress, vibration, motion, and fatigue effects—so you can fully validate performance of the entire system and minimize field failures. With tight revision controls and the elimination of errors related to file transfers and data conversions, an integrated environment establishes the workflow parameters you need to consistently improve quality. And, because it's quick and easy to make design changes without incurring delays or costs, there's less aversion to making changes late in the process, resulting in the inclusion of quality improvements at any time.

Increased Innovation

Innovation is the application of better solutions—a new way of doing things or breakthrough changes to an existing product, idea, or field—that meet new requirements, unarticulated needs or wants, or existing market demands. When electronic, electrical, motion control, and mechanical engineers use an integrated electro-mechanical development platform to collaborate closely on mechatronics systems design, they not only expand their perspectives beyond their specific engineering discipline but also engage and interact more extensively, creating the collaborative environment in which innovation is born. Using the same integrated development platform and design language facilitates the understanding, teamwork, and synergies that can spark breakthrough ideas. With no downside to exploring new approaches—due to the agility and flexibility of an integrated system—you and your colleagues will be free to unleash your creativity, experience, and knowledge in ways that are unworkable in a non-integrated system.



...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.

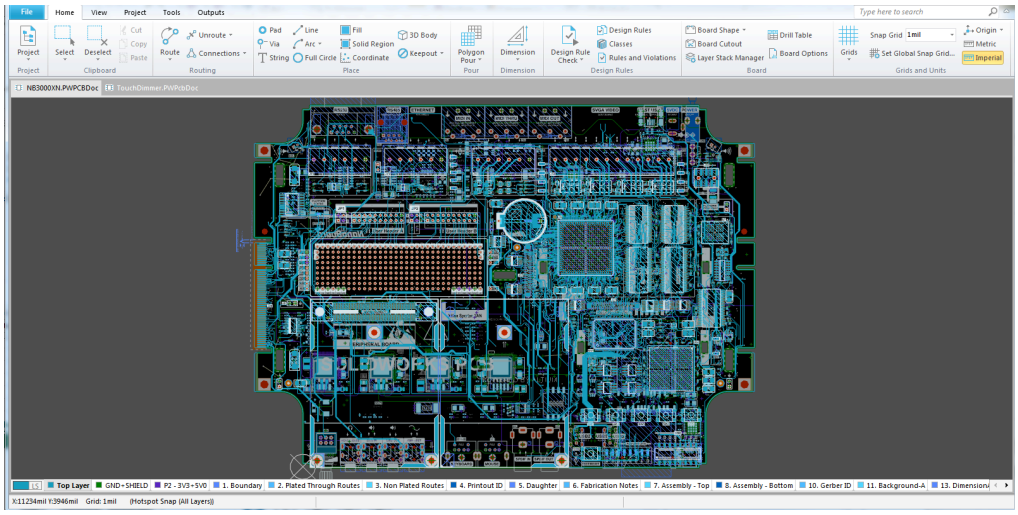
Read the full story here: CNC Solutions LLC Case Study.

STREAMLINE MECHATRONICS SYSTEM DESIGN AND MANUFACTURING WITH THE INTEGRATED SOLIDWORKS 3D PRODUCT DEVELOPMENT ECOSYSTEM

Manufacturers of mechatronics products and systems requiring the development and integration of electronic, electrical, motion control, and mechanical designs into a single electromechanical system can save time, control costs, improve quality, increase collaboration, and boost innovation by implementing the integrated SOLIDWORKS 3D product development ecosystem. By using integrated SOLIDWORKS electronic design, electrical schematics, mechanical design, simulation, product data management, communication, documentation, and visualization solutions, and partner control system development and simulation tools, you will realize the greater efficiencies, cost reductions, quality improvements, effective communications, and increased collaboration that are essential to the development of innovative products.

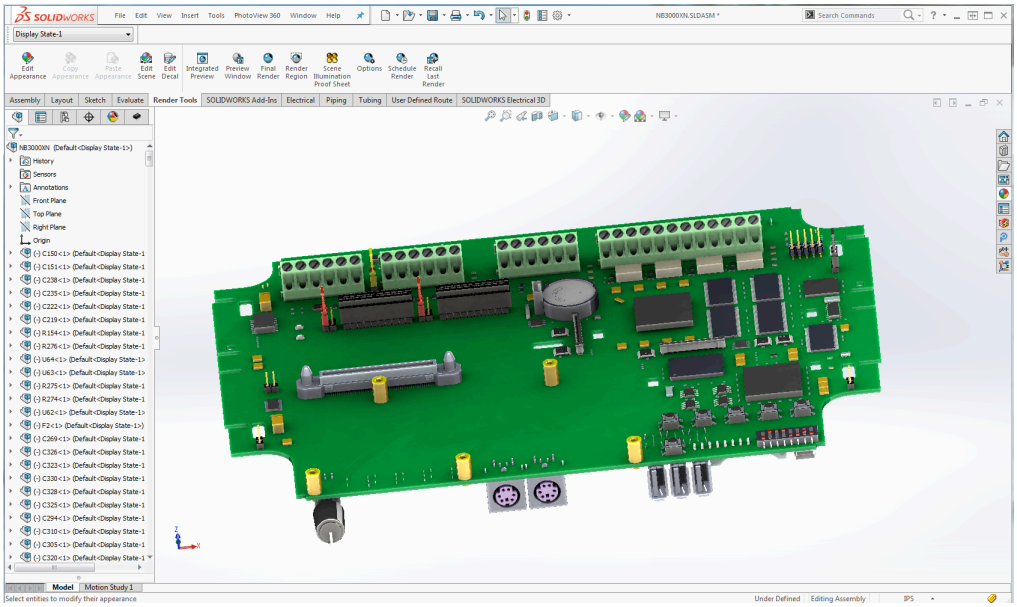
Electronic Design – SOLIDWORKS PCB Powered by Altium

SOLIDWORKS PCB Powered by Altium software is a standalone electronic/mechanical design package jointly developed by Dassault Systèmes SOLIDWORKS Corporation and Altium, both leaders in the development of mechanical and electronic design solutions. SOLIDWORKS PCB combines the power of Altium® PCB design technology with SOLIDWORKS mechanical design solutions. This first-of-its-kind, integrated electro-mechanical design solution allows you to automatically keep your electronic and mechanical designs synchronized, as well as facilitate change order processing through use of the software's distinct workflows. By providing proven electronic design technology and a streamlined schematics editor within a unified electro-mechanical design environment, SOLIDWORKS PCB is the common, integrated development environment that you need to collaborate and innovate. Manufacturers already using Altium Designer and SOLIDWORKS software can obtain on-demand, bi-directional collaboration and synchronization with SOLIDWORKS PCB Connector software.



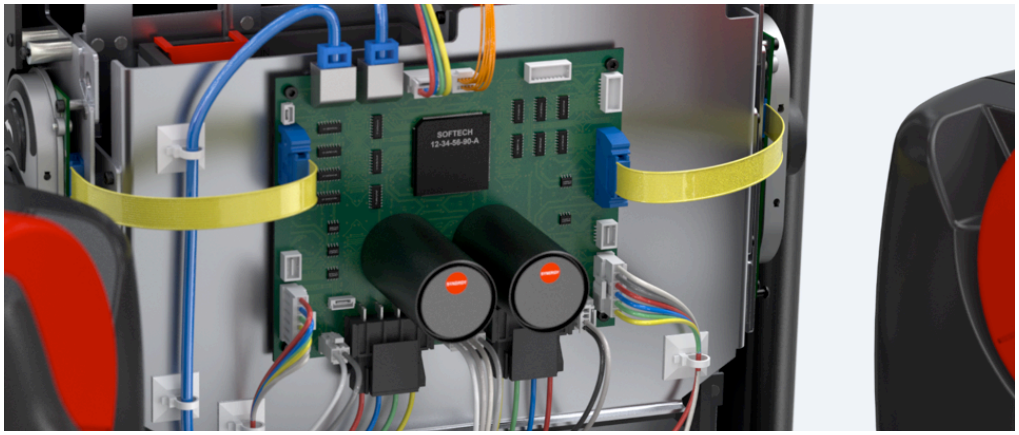
Mechanical Design – SOLIDWORKS Premium

SOLIDWORKS Premium 3D mechanical design software will help you design better, more accurate mechatronics systems more cost-effectively and rapidly—50-percent reductions in design cycles are common—allowing you to satisfy demands for shorter lead times. Because SOLIDWORKS is parametric, it updates and generates design changes to models and drawings automatically, so design changes don't create duplicative effort or delays. Industry-leading assembly, interference detection, injection-molding, and sheet-metal design tools—along with integrated simulation, design for manufacturability, and SOLIDWORKS eDrawings® communication capabilities—are perfectly suited to accelerating development. And, you can use the same SOLIDWORKS mechanical design model data to support all downstream engineering and manufacturing functions.



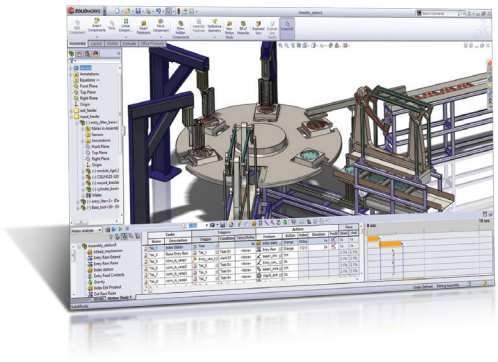
Electrical Schematics/Routing – SOLIDWORKS Electrical Schematics/Routing

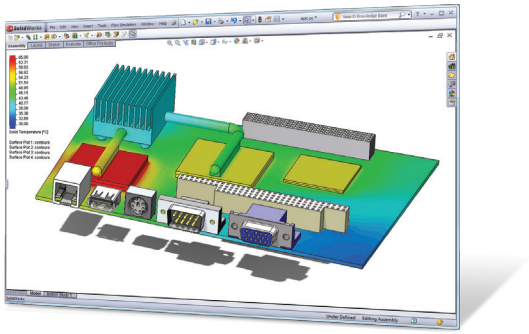
With SOLIDWORKS Electrical 3D and SOLIDWORKS Electrical Schematics software, you can finalize electrical designs and electrical schematics from within your mechanical design envelope, and then automate the placement of wiring and hydraulic/pneumatic paths, including the configuration and positioning of wire and cable harnesses. Combined with SOLIDWORKS PCB Powered by Altium software (or Altium Designer® and SOLIDWORKS PCB Connector), SOLIDWORKS Electrical 3D and SOLIDWORKS Electrical Schematics software fill out a complete mechatronics design suite, including automated routing of wiring, piping, cabling, and harnessing.



Motion Control System Development – SOLIDWORKS Partners

SOLIDWORKS Partners National Instruments (NI) and Rockwell Automation (RA)—industry leaders in motion control systems development with tools for testing, measuring, and controlling manufacturing processes—have integrated their motion controls system development tools within the SOLIDWORKS 3D design ecosystem, providing the important systems control portion of the integrated mechatronics development equation. Whether you choose to use NI's LabVIEW® package or RA's Motion Analyzer® applications, you will be able to develop motion control algorithms and use your SOLIDWORKS 3D CAD model to evaluate system behavior and performance. These partner solutions allow you to simulate, visualize, analyze, and optimize motion control system performance in a simpler, more efficient, integrated fashion.





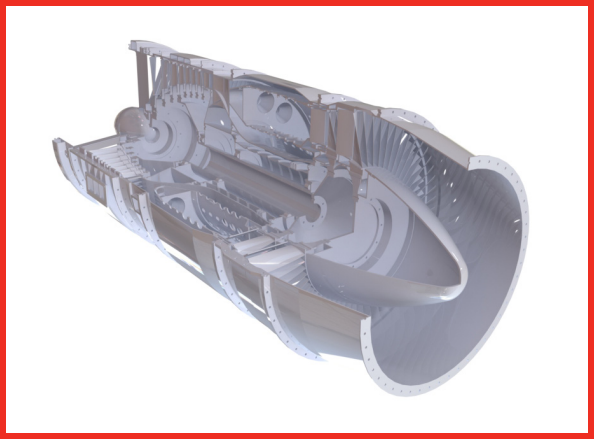
Design Validation/Virtual Prototyping – SOLIDWORKS Simulation

Integrated SOLIDWORKS Motion (Kinematics and Dynamic Motion) and the SOLIDWORKS Simulation suite of finite element analysis (FEA) software provide the tools that you need to conduct virtual prototyping of mechatronics designs early in the conceptual design phase without having to incur the delays and costs associated with physical prototyping. Whether you need to perform structural, deformation, vibration, thermal, flow, fatigue, motion, or nonlinear analysis, SOLIDWORKS Simulation packages provide the capabilities that meet your needs—all from within your 3D modeling environment. Because electronic components generate heat, you can also leverage the SOLIDWORKS Simulation Electronics Cooling Module for thermal management—either by transporting it away from sensitive areas or using fluid flows to cool critical components.

"SOLIDWORKS PDM provides fast system search capabilities, so you can find the design, assembly, PCB, schematic, or component that you're looking for with little effort."

Product Data Management – SOLIDWORKS PDM

The SOLIDWORKS PDM system does much more than manage your product design data. It allows you to fully automate your mechatronics design workflows, tightly control revisions, and encourage designers and engineers to reuse proven concepts. SOLIDWORKS PDM provides fast system search capabilities, so you can find the design, assembly, PCB, schematic, or component that you're looking for with little effort. With email notifications and electronic signatures, the system is configurable and scalable to your specific requirements. The SOLIDWORKS PDM system lets you automate your standard development workflows, ECO approval and execution processes, and any other processes related to your development effort.



...a case in point

Surface Generation Limited is a world leader in the design and manufacture of fiber-reinforced composite processing solutions. The company's patented technology can combine, compact, process, and meld composite materials more efficiently and precisely than traditional autoclave or oven processes, resulting in a paradigm shift in terms of cost, quality, and delivery at all stages of composites production.

While Surface Generation has realized productivity gains in systems development on the mechanical side for several years, it sought similar efficiency improvements in electrical design to support growth, according to Senior Software Engineer Pete Massey. Surface Generation chose SOLIDWORKS Electrical 3D design software because it's easy to use and includes the most comprehensive library of electrical components.

"Our customers are demanding that our systems take up less floor space, so an electrical control system that used to take up 10 square feet of space must now be housed in a one-square-foot cabinet," Massey says. "By integrating electrical and mechanical design, we not only produce higher quality, more accurate schematics—resulting in less rework during production—but we can also model real-world effects during the development of compact, more complex systems."

By implementing SOLIDWORKS Electrical 3D software, Surface Generation has cut rework due to schematic errors by 75 percent, shortened project cycle times by 10 percent, reduced rework-related costs by 5 percent, and supported dramatic year-over-year growth.

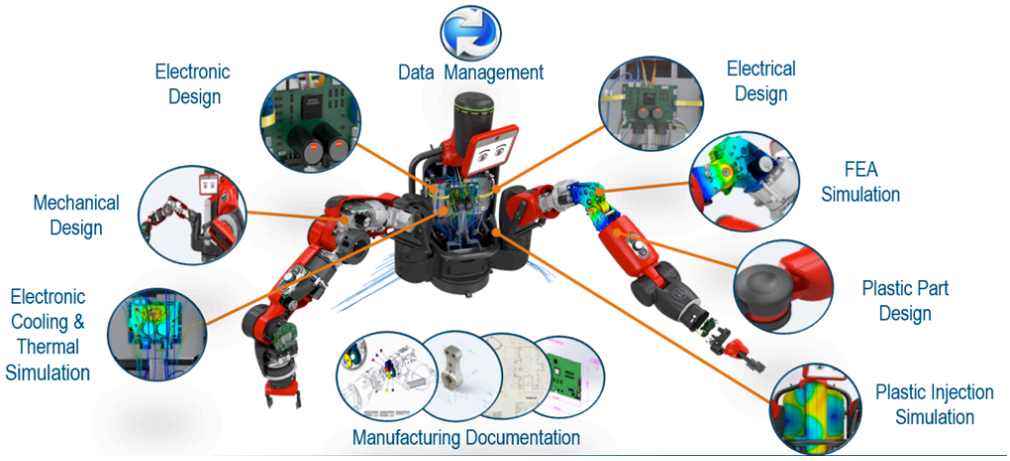
Read the full story here: Surface Generation Limited Case Study.

Transition to Manufacturing – Single BOM Generation

When it's time to transition a mechatronics design into manufacturing, the integrated SOLIDWORKS 3D design ecosystem provides a range of valuable capabilities. You can leverage the Costing module to estimate what it should cost to machine and assemble your mechatronics system, and use that information to secure and negotiate quotes using the software's unified supplier management capabilities. SOLIDWORKS Design for Manufacturability tools enable you to assess whether your current mechatronics design can actually be made or whether you need to make modifications to support manufacturing processes. The integrated SOLIDWORKS 3D design ecosystem also allows you to automatically generate production drawings and unified BOM information without the tedious effort required by non-integrated systems.

Unified Documentation – SOLIDWORKS Composer

Creating unified mechatronics documentation—for manufacturing/assembly instructions; user, maintenance, and services manuals; and digital parts catalogs—is also automated in SOLIDWORKS with the SOLIDWORKS Composer technical communications application. You can tap SOLIDWORKS Composer software to leverage SOLIDWORKS electronics, electrical, and mechanical 3D design data to automatically create visuals and illustrations for documentation purposes. Whenever a design change is made, documentation imagery updates automatically to reflect the change. You will also be able to show your mechatronics system before its made—using 2D and 3D illustrations and interactive animations—making your documentation materials more effective for your manufacturing and service teams, suppliers, and customers.



IMPROVE THE PROFITABILITY OF MECHATRONICS DEVELOPMENT WITH THE INTEGRATED SOLIDWORKS 3D DESIGN ECOSYSTEM

As a manufacturer of mechatronics products and systems, your organization faces mounting pressures to develop and integrate electronic, electrical, motion control system, and mechanical designs into a single system more quickly and cost-effectively, while improving quality and increasing innovation at the same time. Achieving these critically important goals requires greater electro-mechanical design collaboration, an objective that is compromised largely by the use of traditional, non-integrated tools to design and produce mechatronics systems, largely through separate development workflows.

Fortunately, your organization can achieve its goals and overcome obstacles to greater collaboration and innovation by implementing the SOLIDWORKS 3D product design ecosystem—the ONLY fully integrated electronic, electrical, motion control, and mechanical design platform. With SOLIDWORKS PCB Powered by Altium, SOLIDWORKS Electrical, partner motion control system, and SOLIDWORKS Premium mechanical design software, you can develop, manufacture, and introduce innovative mechatronics products and systems more quickly and cost-effectively.

Saving time and controlling costs while ramping up quality and innovation requires a more streamlined, automated approach. With an integrated 3D electro-mechanical design, engineering, and manufacturing platform like the integrated SOLIDWORKS 3D product development ecosystem, you can achieve your efficiency, cost reduction, quality, and innovation goals, and secure a real competitive advantage.

To learn more about how the integrated SOLIDWORKS 3D product design ecosystem can improve your mechatronics system development and production processes, visit www.solidworks.com, or call 1 800 693 9000 or 1 781 810 5011.

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