Speeding product development for robotic devices

Solution brief

Manufacturers of robotic devices and systems are facing several challenges, including an increasing demand for flexible automation and intelligent machines, increasing complexity of robotic devices due to the amplified use of electronics and sensors and increasing focus on performance and reliability.

In the industrial, commercial and consumer sectors, demand for robotic devices and systems is growing around the globe, moving from steady to rapid growth. More than 2.4 million industrial robots currently operate in global factories, especially in China, Japan, the United States, South Korea and Germany. Industrial robots are used extensively in the automotive, aerospace and electronics industries.

One area that is influencing this growth is an emphasis on global health concerns. Robots can be used to replace workers performing risky, arduous tasks, and are increasingly used for moving items in labs, hospitals and warehouses and for cleaning and disinfecting these facilities. However, this is just one example.

Not only is the number of robots increasing at an exponential pace, robots are also increasingly complex devices, requiring more sensors and electronics than ever before. Research from industry analyst *Tech Clarity* shows that products have grown in complexity with no end in sight. The five dimensions of product complexity report states, "Manufacturers must address complexity challenges or suffer from poor quality products, delayed time-to-market, and high lifecycle costs."

The Solid Edge advantage:

- Communicate value of new products using photorealistic images, animations and augmented reality
- Create 3D digital models of products and use them throughout the product development lifecycle
- Make customer and regulatory requirements easily visible to designers and track fulfilment of requirements
- Design complex parts and assemblies quickly and flexibly using synchronous technology
- Re-use proven, existing components and catalog parts to reduce design time and improve reliability
- Integrate electrical and mechanical design to create electromechanical products
- Route wires, cables and tubing around robotic systems
- Validate and improve performance of moving components

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Solution focus

- Analyze stress and dynamic response in components and systems
- Manufacture parts accurately and efficiently using both traditional machining and new additive manufacturing technologies
- Manage everyday processes including engineering changes and release to manufacturing efficiently and accurately using built-in data management capabilities
- Collaborate with suppliers and customers with easy-to-use cloud-based file viewing, markup and synchronization

Key solution components:
- *Solid Edge Mechanical Design* for 3D part and assembly design using synchronous technology: Accelerates robot design, speeds revisions and improves the re-use of proven components in new designs
- *Solid Edge Electrical Design* for the design of wiring circuits and wire harnesses and integration into mechanical CAD assemblies: Enables true electro-mechanical co-design collaboration
- *Solid Edge Simulation* for digital validation of critical components and systems: Reduces the need for physical prototypes, lowers material/testing costs and improves reliability and durability
- *Solid Edge Manufacturing* for definition of accurate machining, fabrication and assembly processes: Improves overall efficiency for both additive and sub-tractive manufacturing processes
- *Solid Edge Technical Publications* for creating illustrations and technical documents: Communicates manufacturing, installation and maintenance procedures globally
- *Solid Edge Data Management* for searching, managing and sharing product data: Improves collaboration within the design team and with other departments, suppliers and customers
- *Solid Edge Cloud Collaboration* enhances online multi-CAD management, viewing and collaboration
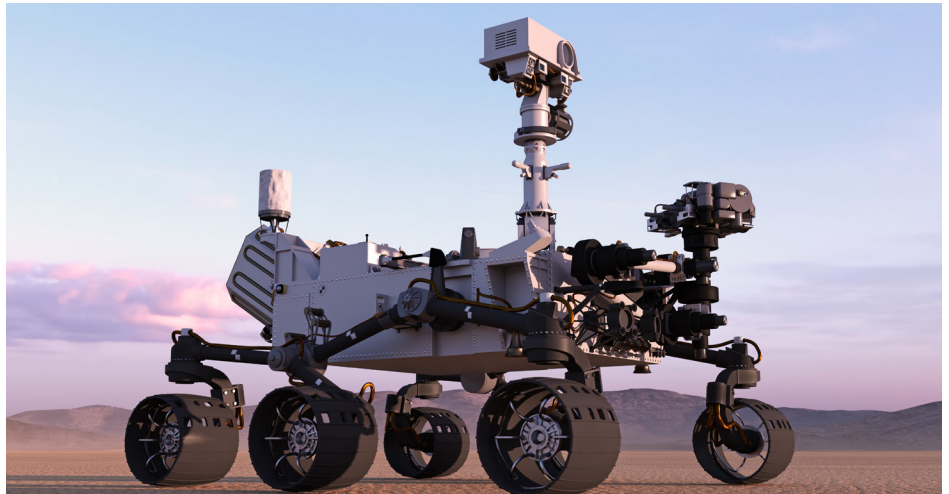
An example of this can be seen in emerging robotic architecture. Common robotic characteristics include electromechanical assemblies, sensors and control systems. Smaller control devices that regulate sensors and provide basic control information are now often placed inside the robot instead of being routed to a large, remote controller. This may require more radio frequency (RF) communication devices and right-sized, optimized drives and local controllers to also be located in the robot.

The increasing complexity of products in terms of their electromechanical content can slow the product development process and result in delayed time-to-market, lost revenue, project budget overruns and poor product quality. By implementing software tools specifically developed to enable electrical and mechanical engineers to work together, both disciplines can actively collaborate during the design process. Using software tools that exchange data between disciplines make it easy to see and react to changes as the design progresses.

Finally, there is an increasing focus on performance and reliability. End users demand that robots support fast cycle times, be low maintenance and have high safety standards. Manufacturers may address these concerns by implementing a comprehensive digital twin strategy with their product development process. A digital twin, a detailed 3D digital model of a proposed robot, adds data to a design as it progresses, then leverages this data to achieve product improvements such as optimizing the performance of both individual components and complete systems.

Investing in a digital transformation across all areas of product development can have a big impact on product development processes, especially in improving collaboration between engineering and manufacturing, responding faster to customer demands and bringing new products to market faster. The Solid Edge® software portfolio enables small and medium-sized manufacturing firms to rapidly digitalize their product designs and development processes.

Manufacturers of robotic devices use Solid Edge, which is part of the Xcelerator™ portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, to improve product development performance in these 12 key areas:

Visualize new robot designs for sales and marketing

Create high-end visuals and animations of proposed products to bring them to life. Solid Edge includes integrated photorealistic rendering that can be used to create amazing product images and animations, which let you stand out from the crowd with superior and customizable marketing materials that clearly demonstrate
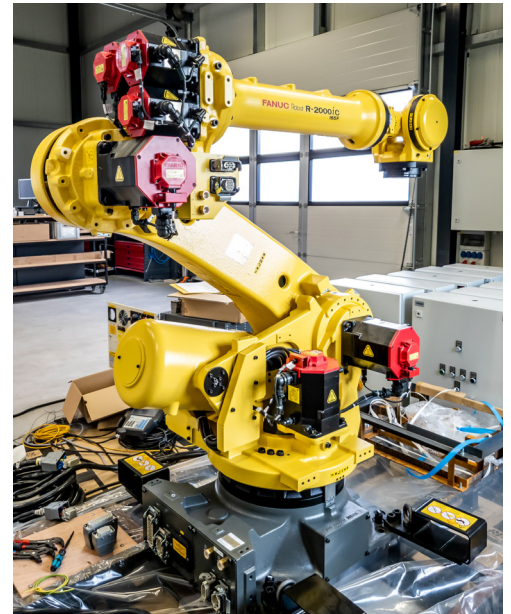
innovations. Mobile viewing applications and augmented reality (AR) capabilities highlight the use of the latest design technology.

Manage customer and regulatory requirements

Ensure customer satisfaction by delivering robots that meet customer requirements and comply with industry regulations. Solid Edge allows requirements to be documented, linked to product designs and tracked throughout the development process. Easy-to-use tools such as Solid Edge Requirements Management make requirements easily accessible to all involved in product development. It may also be used to capture and track compliance with relevant industry regulations.

Speed 3D mechanical design

Deliver new products sooner and with lower business risk. Comprehensive 3D computer-aided design (CAD) solutions enable faster and more efficient design; re-using proven components and catalog parts speeds design and reduces costs. With industry-unique synchronous

technology, Solid Edge provides the freedom to design naturally and iteratively with ease, streamlining and simplifying the process of finding 3D models with integrated cloud-based catalog options, such as those from 3Dfindit.com. This tight integration runs in Solid Edge to give designers immediate access to millions of manufacturer parts.

Design electrical circuits and wire harnesses

Manage the increasing number of electrical components and the complexity of electrical systems by quickly and easily creating electrical wiring schematics and wire harnesses. Solid Edge Wiring Design is used to quickly design and optimize the performance of wiring circuits with automated functions that aid the selection of wire gauges and fuses. Electrical circuits are checked during the design process, validating electrical circuitry. Solid Edge Harness Design automates the complete design-to-production flow to achieve greater wire harness manufacturing efficiencies.

Integrate electrical components into mechanical designs

Overcome the electromechanical design challenges that result from routing wiring circuitry or packaging printed circuit boards (PCBs) in confined spaces. Using Solid Edge Electrical Design software minimizes the need to create physical prototypes by handling issues earlier in the design process, reducing problems during installation. Solid Edge Electrical Routing provides semi-automatic routing of wiring and wire harnesses around complex 3D models and can establish correct wire lengths. Solid Edge PCB Collaboration is used to integrate PCB designs into electromechanical assemblies quickly and accurately.

Optimize kinematic and dynamic performance

Simulate kinematic behavior to optimize motion characteristics of robotic devices and systems by helping you understand the true dynamic function of a design. By identifying potential issues early in the design cycle, you are able to resolve them prior to manufacturing, resulting in a significant drop in cost and time to delivery. Solid Edge Simulation provides integrated analysis of kinematics and dynamics of Solid Edge assemblies.

Analyze stress, vibration and cooling

Simulate vibration levels using harmonic response analysis to ensure designs successfully overcome resonance. Solid Edge Simulation delivers structural simulation results, finding the natural frequencies of vibration or determining buckling loads of a design. Both steady and transient heat transfer analysis validates cooling performance by gauging the temperature distribution of the model. Digital analysis can resolve problems prior to manufacturing, minimizing the cost and time required to build physical prototypes. When high performance analysis is needed, Simcenter™ Femap™ software can be used to solve the toughest engineering problems.

Design robot work cells and motion paths

Visualize and validate how a complete manufacturing work cell will function. Animations created by CAD systems can help in evaluating the suitability of a robot, then easily change out the robot if required using online models that can be imported into your CAD model. Solid Edge 3D assembly design enables the user to visualize how elements will work together, ensuring parts don't interfere with one another.

Manufacture accurately and efficiently

Improve manufacturing productivity for both traditional machining and additive manufacturing (AM) technologies, reducing errors and reworking while optimizing designs. Solid Edge CAM Pro can be used to create tool paths that are associative to a CAD model and can be automatically updated when the design is changed. Solid Edge also supports output of part models
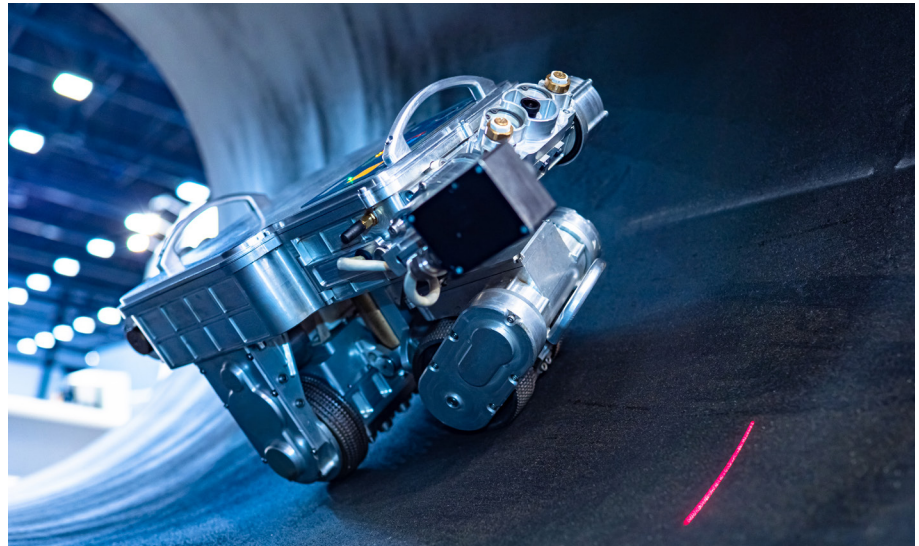
to in-house 3D printers and external additive manufacturing services. Further, 3D printing can minimize the need to stock large quantities of spare parts. Solid Edge also gives you access to a cloud-based bureau for quoting and manufacturing of parts in a variety of materials.

Manage projects and engineering changes

Optimize resources, identify critical path activities and manage changes efficiently. Integrated design management tools that include preconfigured workflow capabilities enable your team to access and track design projects and engineering change information. Siemens provides a full range of design management capabilities that range from integrated data management, that is included with Solid Edge, to comprehensive multi-CAD data management and product lifecycle management (PLM) capabilities of Teamcenter® software.

Collaborate with suppliers and customers

Reduce errors and speed the product development process with fast and controlled communication of design intent between suppliers and customers. The Xcelerator Share app provides cloud-based collaboration for CAD data in multiple formats. Sharing multi-CAD design data in a controlled way helps protect intellectual property. Augmented reality capabilities showcase designs and enable customers to view products in real-world settings.
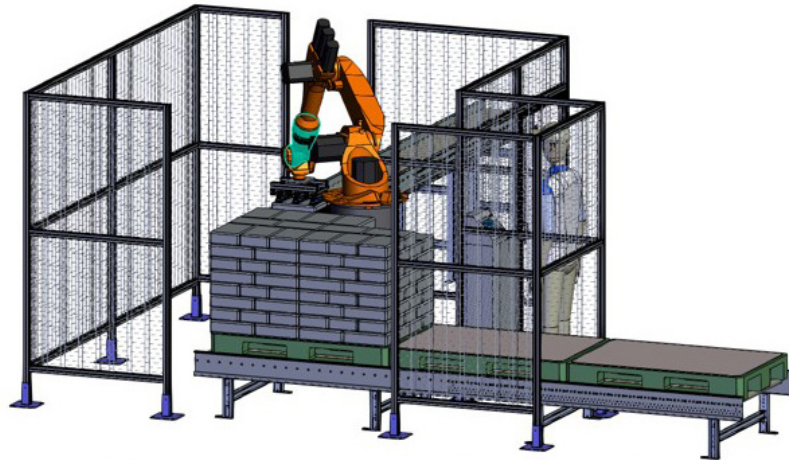
Commission, install and service

Ensure that robots are installed, used and maintained correctly to facilitate performance and reliability. Solid Edge 3D CAD provides mobile viewing of models and remote access to design data. Solid Edge Technical Publications creates graphical user guides, maintenance instructions and online spare parts catalogs. These products enable you to communicate the correct installation and service procedures using 3D interactive product information. As a result, commissioning is completed on-time and on-budget, and the manufacturer has accurate knowledge of equipment configuration at delivery and in service.

Realizing significant benefits

Designers and engineers are achieving important benefits using Solid Edge. Some examples reported by Solid Edge users include:

- Support of early marketing using high-quality rendered product images
- Save 75 percent of time on specific design tasks
- Easily develop an integrated range of components
- Achieve faster time-to-market
- Implement individual customer requirements with great flexibility
- Create products without costly and time-consuming prototyping processes
- Experience minimized risk
- Realize simplified processes
- Achieve significant time savings
- Realize error-free collaboration between development and production

For more information on this offering, see: https://solidedge.siemens.com/en/industries/robotic_devices

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