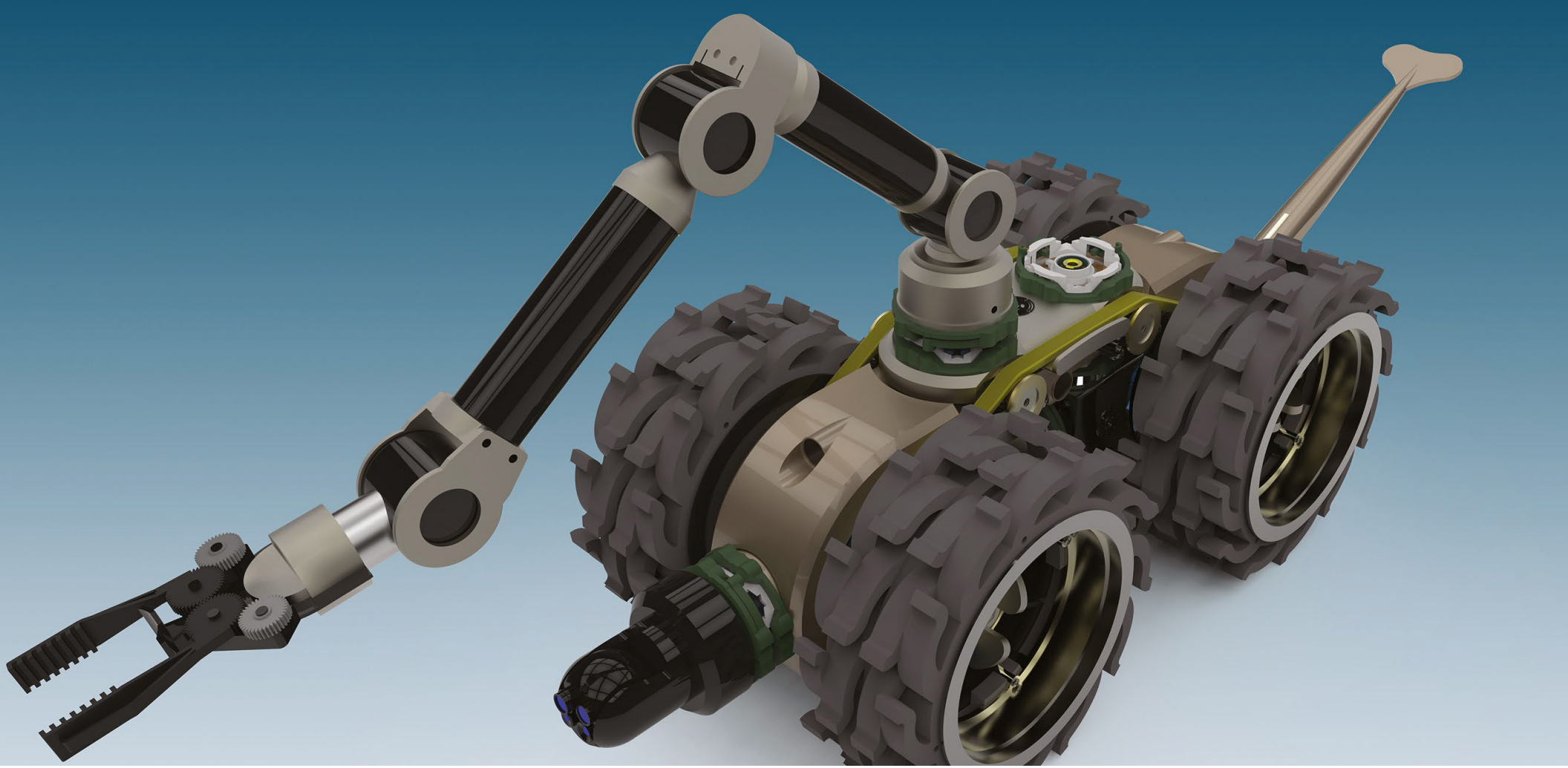

DIGITAL INDUSTRIES SOFTWARE

Three trends influencing robotics development

Leveraging new techniques to improve operational efficiency and product quality

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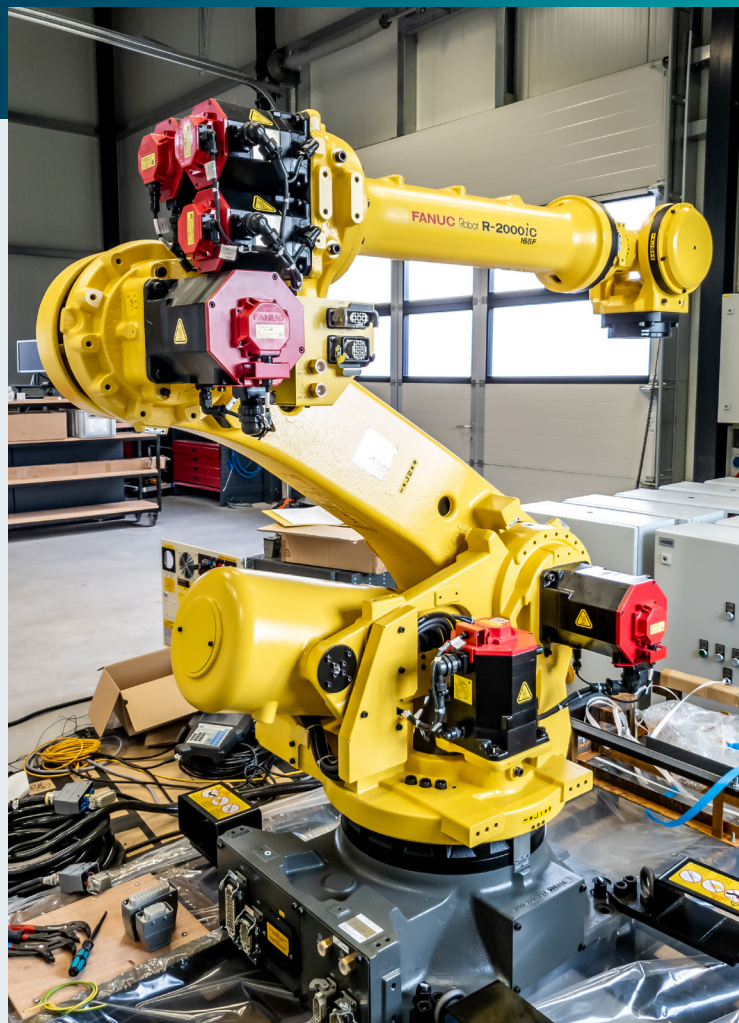
Manufacturing is changing and designers and engineers developing robotics are having to change with it. In the past few years, consumer demand and the emergence of smart products have pushed manufacturers to explore radical new ways to create value. They are harnessing robotics to automate their factory floors and relieve pressure on human resources. Robotics and automation aren't new concepts, but they remain a core technology for modern factories.

The deployment of robots is not just increasing in manufacturing; it is increasing in materials handling, warehousing, inspection, exploration and particularly in healthcare. However, designers and engineers can't approach robotics development in the same old way. Instead, they are leveraging new techniques to meet today's challenges. This ebook discusses three trends and the resulting product development needs for robot devices and systems.

Trend one: Smart factory initiatives

Manufacturers are constantly looking for new, automated ways to improve operational efficiency and increase product quality. They need to be able to react quickly to changing market demand, and even offer personalized products to meet customer requirements. Robotics is a good solution for these needs.

Robotics on the factory floor is part of a larger trend: the smart factory or industry 4.0. Companies are optimizing production with digitization initiatives that also encompass advanced manufacturing, ubiquitous connectivity, artificial intelligence (AI) and advanced analytics technologies.



Trend two: Automation addresses global health concerns

Global health concerns have accelerated movement towards automation in manufacturing in the healthcare industry and many other sectors. In fact, companies are finding it easier than ever to pursue long-term plans for automation solutions.

Case in point: Companies are harnessing robotics to enable social distancing and protect the health of their workforce. They are also looking to lower the risks involved in operating a manufacturing environment with human workers. The goal is to mitigate disruptions in production and supply chains.

Beyond manufacturing, robots have proven increasingly useful in other areas of everyday life. One can now find them cleaning and disinfecting surfaces in offices, stores, hospitals, airports and other public places. Organizations are also deploying robots in warehouses, labs, distribution centers and similar facilities for the movement of goods. As robotics become more common in other aspects of everyday life, their adoption in manufacturing will only increase.

Trend three: Shifting robot architecture

From a technology perspective, the fundamental architecture of robotics is changing. Traditionally, all actuated components of a robot were connected to a single central controller. The controller held all logic and programming for operating these components. Now the programming logic is distributed, running on a smaller controller located on each actuated component. This means modern robotic platforms are less centralized, making them more modular and customizable.

Furthermore, modern robotic systems are becoming more intelligent. They no longer blindly follow a linear programming routine. Instead, they use sensors and vision systems to gather feedback from their environment. They also use machine learning to augment their capabilities and adjust behavior. These features have led to the development of a new class of collaborative robots (or cobots) that can work alongside humans.

Finally, robots are becoming more dependable and come equipped with redundant systems. This means they can operate more reliably in new or harsh environments and continue working even if something goes wrong.

Critical capabilities to address a changing industry

Engineers need certain capabilities to develop new robotic solutions. These capabilities include requirements management, design of mechanical assemblies, integration of catalog components, integrated electromechanical design, simulation and analysis and others. This section explores these critical features.

Requirements management

Modern robotic solutions are getting more complicated. The engineering team must be able to understand and manage customer and regulatory requirements while developing these solutions. Engineers must also track what aspects of their design fulfill each of the requirements. For this reason, a requirements management feature is a key piece for any design solution.

Design of mechanical assemblies

Robots may be integrated into large-scale, automated manufacturing systems, or may need to be packaged in a small envelope. Engineers need access to strong assembly design tools that can be used for concept design of robotic systems, and that perform well when designing assemblies of thousands of components. They also need to support the needs of engineers who are required to package many components into a small space while meeting clearance and cooling requirements.

Integrating catalog components

Off-the-shelf components are common in robotic systems. These include motors, sensors, drives, controllers and other components that power movement, sensing and more. Engineers need a streamlined process to find, access, download and integrate such components into their designs.

Integrated electromechanical design

Electronics and electrical systems are crucial aspects of robotic solutions, especially when they offer advanced sensing functionality such as a vision system. Design solutions must allow mechanical and electrical engineers to bridge the electromechanical complexity divide, allowing electrical and mechanical engineers to evaluate design aspects collaboratively. Then they can identify and resolve integration issues far earlier in the development process, avoiding late-stage delays and unexpected costs.

Simulation and analysis

Simulation capabilities allow engineers to verify the design requirements are satisfied. For robotic systems, analyzing the dynamics and kinematics of moving components is especially important. The design solution must offer dedicated tools for this purpose. Engineers can then verify range of motion and design modular robots with actuated components that can be mounted onto different systems.

Mechanical stress and excitation analysis allow teams to verify the structural performance of the robot. Modern tools also offer optimization functionalities to create lightweight, energy-saving component designs.

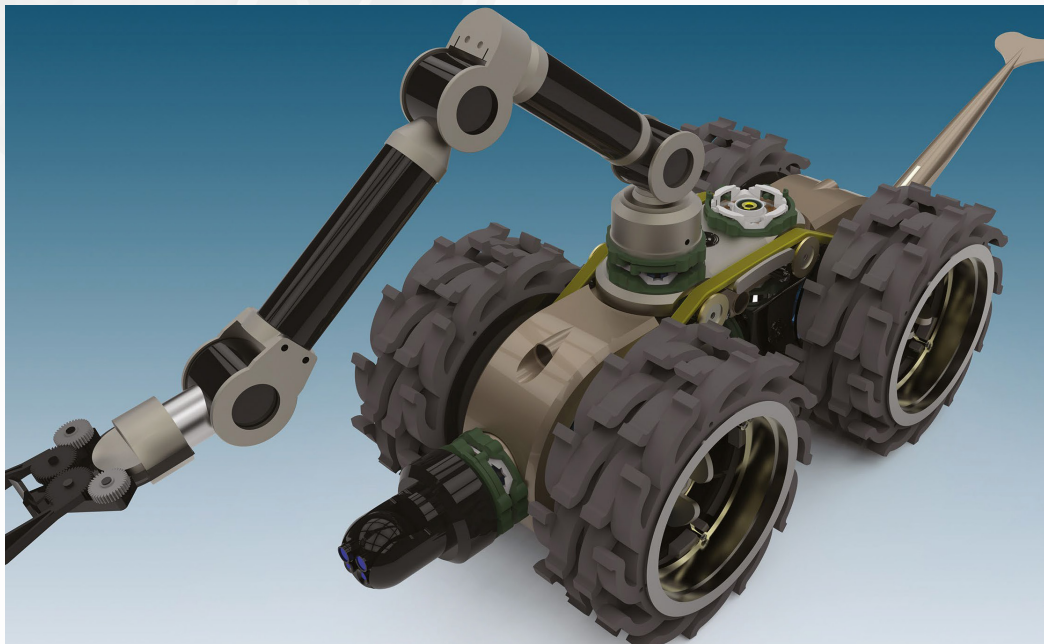
Fluid and thermal simulation analysis capabilities are key for heat management of the electronic components. This ensures the electronics remain cool enough to function even when they are located throughout the body of the robot.

Machining and additive manufacturing

Robots are produced in both large and small quantities. Different manufacturing technologies are better suited for specific production volumes. Engineers need to streamline and facilitate production, whether using traditional processes such as machining, casting and injection molding or new manufacturing technologies like additive manufacturing (AM).

Photorealistic rendering and technical publications

Companies need to be able to create realistic photo renderings and animations of the robotic solution for a variety of reasons. They may be needed at the concept design stage to excite potential customers and when the product is fully available so it can be used for sales and marketing. Detailed documentation and technical publications, like installation instructions and service procedures, are also important to ensure the product performs as required so customers are satisfied. Engineers need tools that streamline these important business needs.



Key takeaways

Key trends, including the rise of smart factory initiatives, automation and shifting robot architecture, are driving engineers to leverage new techniques and technologies in the design and development of robots and robotic systems. Any design solution must increase the productivity of the engineers using it. Efficient robotic systems development requires not only the specific capabilities mentioned above, but it requires these capabilities to be in an integrated suite. This way, the engineering team does not lose time while shifting designs, diagrams and other deliverables between disparate applications and solutions.

For best results, the design solution should allow engineers to create a comprehensive digital twin, or a virtual model of the robotic system. Members of an engineering team can rely on this digital twin as a single source of truth, tracking versions and improvements throughout the development process. During the design optimization and validation, the use of a comprehensive digital twin reduces the need for physical prototyping.

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.

Using Solid Edge to solve robotic challenges

Solid Edge® software, which is part of the Xcelerator™ portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, offers a complete and affordable portfolio of integrated product development tools. It includes capabilities not only for mechanical computer-aided design (MCAD), but also for electrical CAD, simulation, manufacturing, technical publications, data management and cloud collaboration. Manufacturers of robotic devices use Solid Edge to improve product development performance. This section provides an overview of the functionalities of Solid Edge that are critical to the development of robotic systems.

Solid Edge requirements management

This capability allows engineers to link and track requirements from design to manufacturing during the product development process. Its dashboard-like tab structure supports traceability and makes the relevant requirements easily visible to designers. It also facilitates communication by enabling commenting and linking of related work items, such as documents or PDF files.

Solid Edge assembly design

Solid Edge helps users quickly and easily create and manage even the largest assemblies. Exact representations of all components used in robotic systems, including tubes, wires, printed circuit boards (PCBs), motors, plastic parts and sheet metal components, can be included in a complete digital mockup. This allows for more accurate design and analysis. Solid Edge helps engineers detect and fix clash and interference issues, generate assembly instructions and conduct customer reviews, reducing the need for costly prototypes.

3Dfindit.com integration

3Dfindit.com is an engineering components search engine that is embedded in Solid Edge. It offers access to millions of 3D and 2D CAD files of catalog components that have been verified by manufacturers. Depending on the catalog, the digital parts are enriched with

additional metadata, including kinematics information, center of mass, material, environmental protection standards and order number.

Solid Edge electrical design

Solid Edge includes a set of tools that simplifies the design of electromechanical components and promotes collaboration between the electrical and mechanical engineering teams. It includes dedicated modules for wiring, harness design, PCB collaboration and electrical routing. It also offers features that facilitate the communication of design intent between electrical and mechanical CAD users of Solid Edge.

Solid Edge simulation

Solid Edge comes equipped with tools for simulating individual parts, assemblies and complete systems. It includes a built-in finite element analysis (FEA) tool for structural and thermal simulations, as well as an embedded computational fluid dynamics (CFD) package. The solution also offers a pre- and postprocessor for managing, evaluating and re-using simulation and mesh data.

Solid Edge CAM Pro and additive manufacturing

Solid Edge CAM Pro features a rich set of tools to help engineers prepare CAD data for machining processes. It supports a wide range of traditional machining processes, such as computer numerical control (CNC) cutting, bending, milling and turning. It is integrated with Solid Edge to retain data associativity and pass product manufacturing information (PMI) from the mechanical engineering team to the manufacturing team. Using Solid Edge also enables you to support output of data for AM using in-house 3D printers or external additive manufacturing service companies.

Solid Edge technical publications

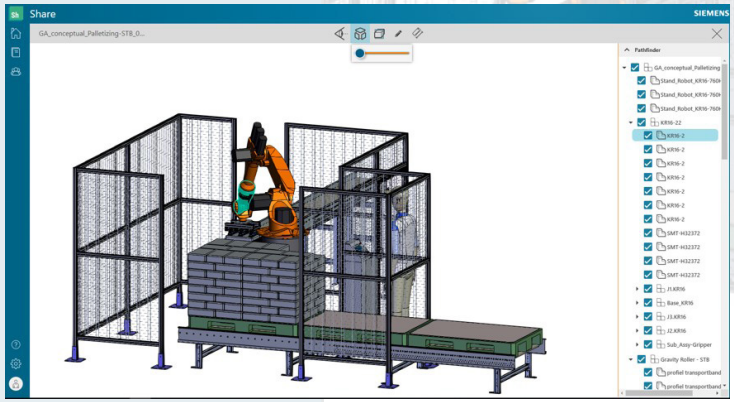
Solid Edge technical publication solutions allow designers to create attractive illustrations and interactive technical documents in-house, reducing the need for external technical authors. It can be used to create technical documentation for manufacturing, installation, product manuals, illustrated parts catalogs and training or workshop instructions.

KeyShot capabilities in Solid Edge

KeyShot offers the ability to create high-quality renderings, animations and interactive visuals. Users can launch it directly from the Solid Edge environment and transfer assigned material and appearance data. It also supports live linking, which allows updates to the geometry or appearance in Solid Edge to be automatically passed to KeyShot.

Xcelerator Share

Solid Edge offers scalable CAD data management solutions to meet the varying needs of small to large manufacturing organizations. Data management solutions range from capabilities included in Solid Edge to Teamcenter® integration for comprehensive, industry-leading product lifecycle management (PLM).



Xcelerator Share improves cross-organizational collaboration throughout the product development lifecycle. The cloud-based solution seamlessly connects designers with other departments, external suppliers and customers, ensuring everyone has the most up-to-date information to manufacture the right parts with the right specifications.

A project-based collaboration tool, Xcelerator Share is available on both desktop and mobile applications, supports data in multiple CAD formats and features 3D model markup and augmented reality capabilities. It is excellent for facilitating collaboration between engineering teams and nontechnical customers or other stakeholders.

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