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Ingenuity for life

Addressing three main challenges of modeling complex assemblies

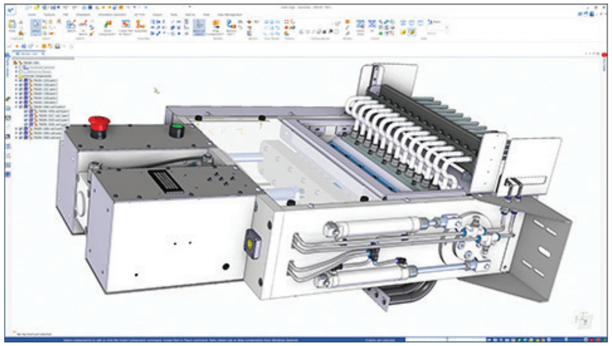
Understanding market trends and defining product development capabilities

Siemens Digital Industries Software

How do manufacturers deliver increasingly complex product designs in less time to maintain a competitive edge and gain market share? In this eBook, we examine cross-industry trends driving companies to pursue increasingly advanced assembly modeling capabilities, the primary challenges of complex assembly modeling and how to address those challenges through modern technology and tools.

Trend dynamics in development of large and complex assemblies

Mechanical designs are changing. Thanks to advances in manufacturing techniques and rising demand for better aesthetics, product complexity is increasing at an unprecedented rate. Many companies cannot cope with this rising complexity; their existing design technologies cannot match the pace of innovation. However, under the constraints of shrinking project lifecycles and budgets, engineers must bring complex products to life to help companies retain or gain a competitive advantage. The need to model large and complex assemblies is also changing. Several trends are driving companies to pursue increasingly advanced assembly modeling capabilities to realize productivity gains, reduce costs and accelerate their time to market. We'll examine the following cross-industry trends:



Increasing size and complexity of products

One factor driving the need for advanced assembly modeling is the increasing size and complexity of today's products. One way of addressing this issue is to model only subassemblies, never opening top product-level assemblies. While this strategy avoids opening the largest assembly model, it is also flawed. It defeats the fundamental purpose of digital prototyping: to check a complete design before building it in the real world.

Instead, engineers should be able to open top-level assemblies, so that they can check for clearance, interferences, center of gravity and many more model-based measures inherent in a digital prototyping approach. This allows engineers to design in context within the full product, providing the required level of design flexibility to optimize products, their assemblies, components and subassemblies within the digital domain.

Increasing importance of aesthetically driven designs

Another factor driving the need for advanced assembly modeling is that many of today's products are aesthetically driven, increasing design complexity further. A single styled surface is often used to represent the product fascia and is then broken into many individual components. All the components produced from that single surface must not only fit together, but also work together to create a fully functional and styled product. This is a difficult task, requiring the coordination and skills of engineers to bring everything together in the final design.

Complexity of movement and motion

The need to model and capture motion within industrial equipment complicates the design of large assemblies. Such movement can inadvertently cause interference and clashes within machinery. In some cases, it can result in overbalancing or momentary peak loads that cause wear and failures. Modeling such behaviors has rarely been easy, as engineers were required to create motion connections between components that were completely unrelated to how the assembly was put together.

Capturing and maintaining design intent

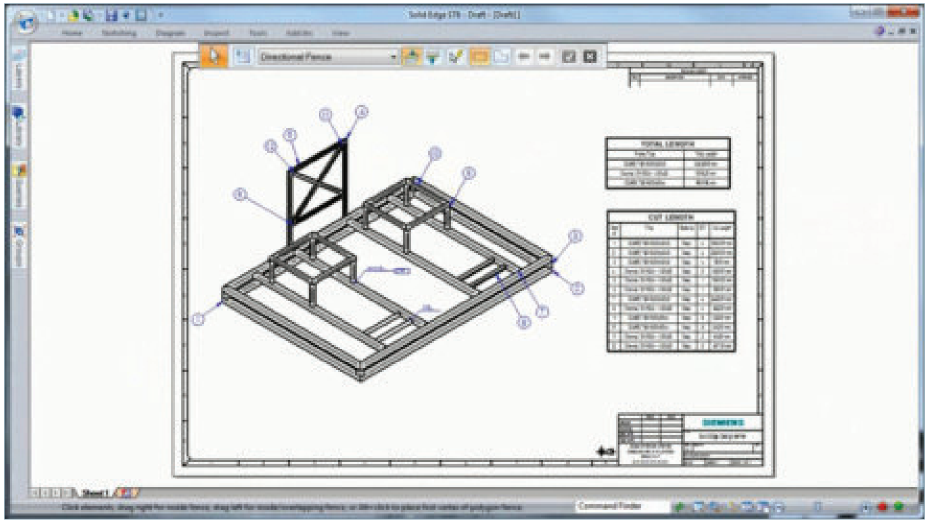
Yet another factor is the need to capture and maintain complex design intent in large assembly models, even when large pieces of products are re-used from project to project. The re-use of such models must be intelligently adapted to reference the context of a new product. Furthermore, some re-used models may be newly configured, or used without any changes. Such capabilities provide the ideal means to optimize advanced, multi-component assemblies and get everything working together right the first time, every time.

Shrinking development schedules

Companies gain a competitive edge by shrinking development schedules. Whether organizations want to disrupt the market with new product offerings or keep pace with the market as fast followers, today's engineering teams must increase their productivity.

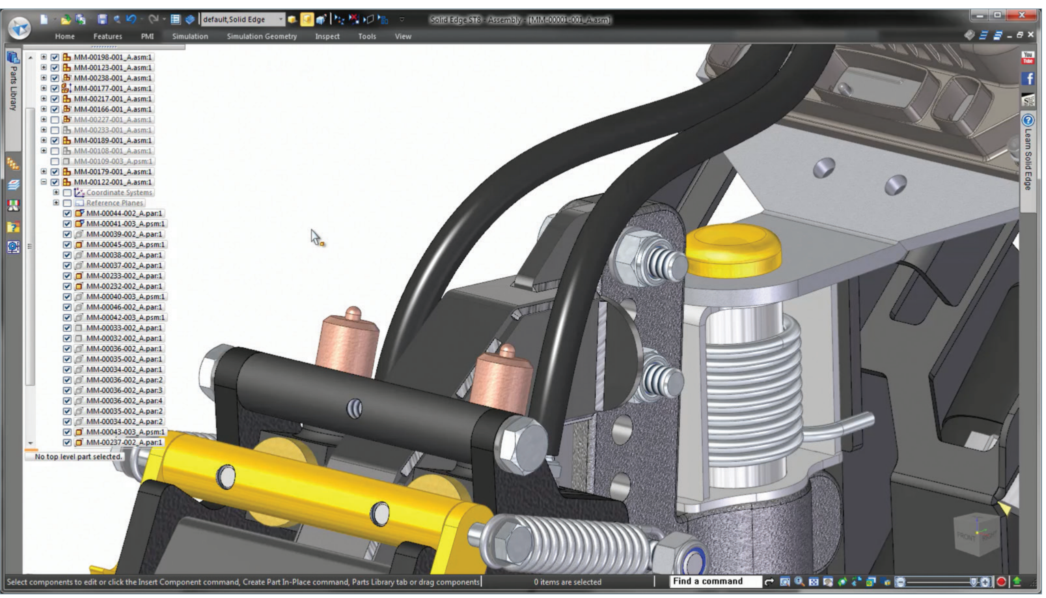
The need for lightning-quick product development creates demand for increasingly advanced assembly modeling capabilities. These capabilities allow mechanical engineers to achieve more in less time, while dealing with incredibly large and complex products. Swift execution of assembly modeling operations makes this possible. It allows engineers to maintain the design intent and relationships while meeting tight project deadlines.

As part of the effort to get more done, it is also imperative to eliminate non-value-added activities during design processes, including the manual management of large models with hundreds (if not thousands) of parts. When dealing with very large models, the responsiveness and usability of computer-aided design (CAD) applications suffer, slowing down engineers in their day-to-day modeling tasks. These points must also be addressed to allow CAD applications to keep up with the fast pace of development that engineers now face, and to allow engineers to seamlessly work with increasingly complex applications.



Coordination of models and deliverables in large assemblies

The coordination of models and deliverables for very large assemblies is another key trend that drives the need for increasingly advanced assembly modeling capabilities. Models of today's products contain large numbers of individual parts, each with their own derived deliverables such as analyses, drawings, tooling models, manufacturing models, toolpaths and much more. These items bloom into an incredibly large, interconnected network. Yet, they must all be managed together, requiring manufacturing companies to keep all assembly versions and states in sync with any subsequent design changes, regardless of their size and the compute load. Manually managing such deliverables requires significant effort, if it is possible at all. Many companies are implementing initiatives to build, track and maintain this digital thread of their products, allowing them to keep the entire network of deliverables up to date and ensure their accuracy.



Three main challenges of complex assembly modeling

Today's key advanced assembly modeling challenges fall into three main categories, each of which engineers must address in order to build and visualize their product designs quickly and cost effectively.

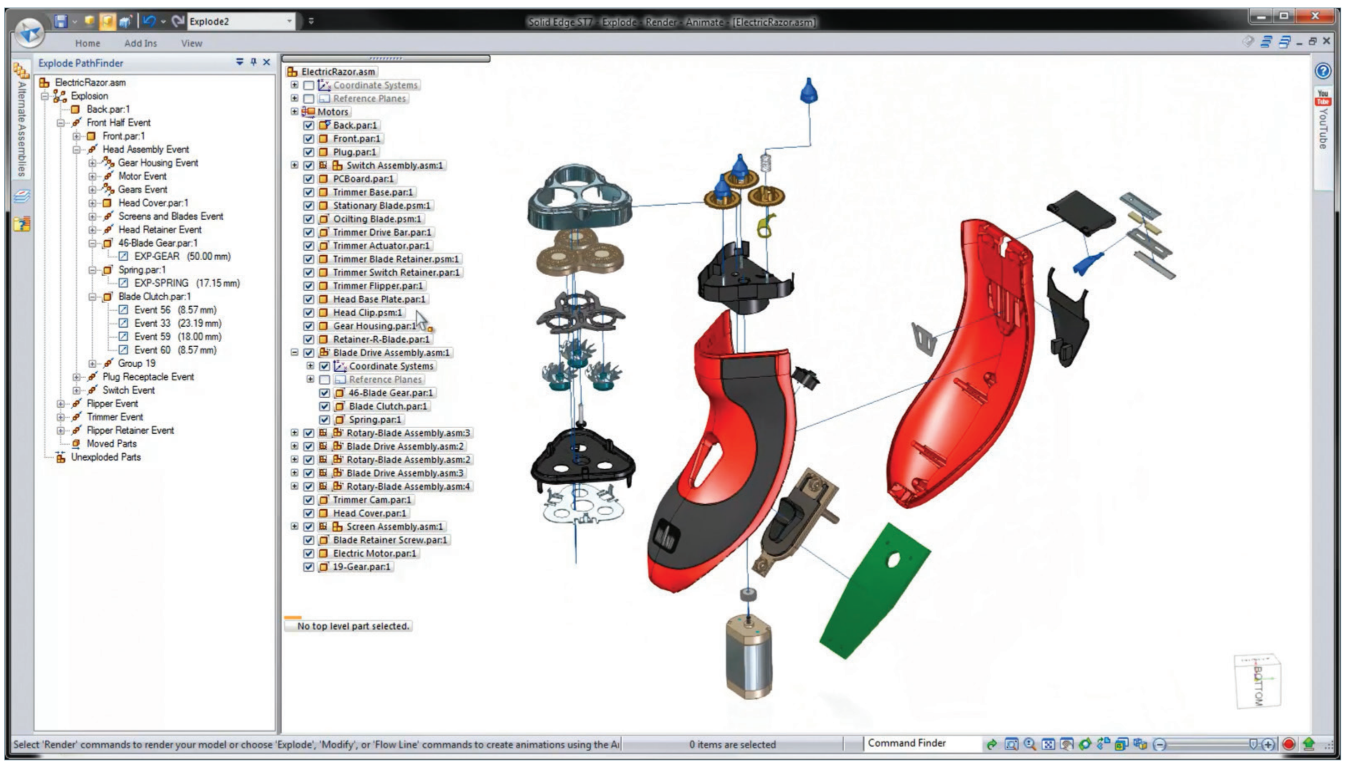
Challenge #1: Performance

The responsiveness of CAD applications is an important attribute, as they must open, load, and continue to operate with responsiveness, even during computationally intensive activities such as visualizations of massive assemblies.

To achieve this performance, engineers need smart selection tools to effortlessly select the best components to work with and, more importantly, switch off unneeded parts that are not required for the task at hand. Applications save valuable computational resources by removing these graphics and unloading all undisplayed parts from the memory. This allows massive assemblies to be opened in seconds and gives the engineers the design flexibility to choose which parts or subassemblies they want to work on before loading any 3D model data.

For example, smart selection tools can automatically select any component that is identical to the selected part, or select parts according to their size, visibility in the active window, and so on. These structured storage techniques not only simplify the assembly in the here and now, but also allow the display states of the assemblies to be stored and saved for quick, easy access at any other time.

Automatic simplification of large assemblies and fast drawing view performance can also help make the most efficient use of the available computational resources. Not all design concepts lend themselves to being solved entirely in 3D. Fast and productive 2D drawing views afford engineers the speed and control of 2D drawing view generation as well as the detailing of the most complex of assemblies. Such capabilities speed up design processes by freeing up system memory and allowing graphics displays to work more efficiently. This has subsequent effects, allowing applications to quickly create production-ready drawings and expediting the design and documentation of digital mockups.



Challenge #2: Usability

The usability of CAD applications directly impacts the productivity of the engineering teams. Engineers require a broad range of functionality from the applications to successfully develop complex assembly models. However, CAD applications must balance this complex functionality with exceptional usability to enable the seamless development of massive assembly models. For example, the engineer should be able to locate inactive components and cut-and-paste/assemble multiple parts in the same file or different files to expedite design processes. The application must be easy to explore and progressively expose users to increasingly advanced functionality, allowing them to learn on the job and providing them with the right capabilities at the right time.

Another critical component of usability lies in designing and modifying multiple components in an assembly. In many cases, engineers need to change many parts simultaneously, whether to add a hole, a cut, or extending geometry that requires the context of the whole product.

Challenge #3: Productivity

Engineers are under more pressure today than ever before. They need the right tools to create complex assembly models within the tight time and financial constraints of each project. In short, engineers need productive tools that work effortlessly with assembly models.

For example, CAD applications must allow engineers to identify the right part in the model, even if it is buried beneath many layers of complexity. Visually searching for the right part is not a productive strategy. Instead, engineers need access to subassemblies, which also incorporate the original intelligence of the model. Engineers need to perform frequently used operations in an automated and accelerated manner. Assembly modeling capabilities include cutting, pasting, and assembling multiple parts into the same assembly model or a different one, while maintaining the internal relationships, for example. This strategy not only allows the engineer to re-use internal components, including constraints, but also to retain their relationships, resulting in massive productivity gains.

When CAD applications lack the performance levels, usability and required level of productivity gains, engineers don’t just waste their precious time. They cannot build and visualize the complex assemblies required for tomorrow’s products.

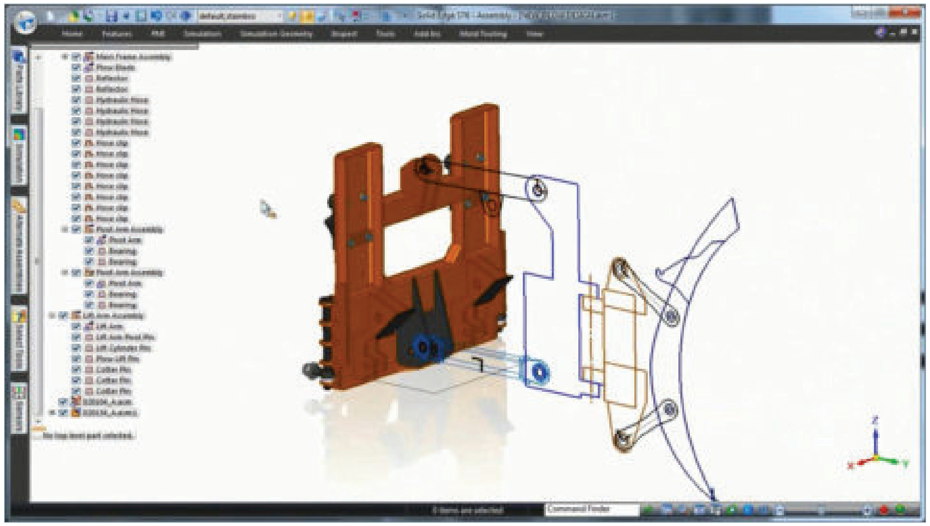
Solving assembly challenges with Solid Edge

Solid Edge® software addresses the requirements of complex assembly modeling, providing the advanced capabilities to expedite today's product development process. Using Solid Edge, engineers can create complete digital mockups that include all the components required for assemblies. The software enables them to create more accurate designs through analysis and reduces their reliance on costly physical prototypes.

Solid Edge can handle massive assembly sizes, optimizing the required level of compute power by only activating the relevant parts. It does this with intelligence, capturing and adding mechanical and physical properties to accurately reflect the real world. This allows for a top-down design process, providing the flexibility to create a product structure and allowing engineers to seamlessly bring together the 2D and 3D worlds. Finally, standardized version and state tracking gives engineers a holistic view of assembly models, providing the required level of accuracy and performance for tomorrow's products.

Powerful assembly modeling capabilities of Solid Edge include:

- **Performance:** A decrease in memory load time results in significant productivity performance increases. Solid Edge achieves this automatically using a variety of computer resource management tools (display performance settings, automatic part loading, etc.), allowing engineers to focus on design rather than running the application and managing the computer. Auto-simplification of large assemblies, paired with fast drawing view performance, also enables the fast design and documentation of digital mockups.
- **Usability:** Solid Edge allows engineers to locate inactive components and cut-and-paste/assemble multiple parts in the same file or different files. This improves assembly performance using low memory loads and improves usability by reducing the need to activate parts when performing certain assembly actions. Solid Edge's synchronous technology is present in both part and assembly design so that you can modify several parts simultaneously. You can select a hole or a face of adjacent components, move them together, or stretch multiple parts simultaneously. With synchronous technology, you can eliminate the reliance on inter-part associativity that makes your parts regenerate each time. What's more, Solid Edge brings the 2D and 3D worlds together, enabling fast productive 2D drawing views and detailing for complex assemblies.
- **Productivity:** Solid Edge comes with a range of productivity enhancements, including its move/copy/rotate assembly command, which allows engineers to cut, paste, and assemble multiple parts into the same assembly model or a different one, while maintaining internal relationships. This allows the re-use of internal components, including constraints. Solid Edge also comes with support for a simplified assembly mode, which provides faster file opening, reduces display and drawing production time, and can protect intellectual property details. Engineers can also skip or cycle through parts for assembly and view the relationship status between different parts.



Solid Edge allows companies to deliver increasingly complex product designs in less time, allowing them to maintain a competitive edge and gain market share. It achieves this by simplifying even massive assemblies and using structure-only navigation combined with fast drawing production. As a result, engineers can create full-size digital mockups, without the time or expense of relying on physical prototypes.

To try the assembly modeling capabilities of Solid Edge for yourself, visit https://www.plm.automation.siemens.com/store/en-us/trial/solid-edge.html to download the full version of Solid Edge to try free for 30 days.

To learn more about Solid Edge assembly modeling and management, and hear stories from real customers addressing complex assembly management challenges, visit solidedge.siemens.com/en/solutions/products/3d-design/assembly-modeling-and-management.

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