

Solid Edge Broadens Use of Synchronous Technology

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Collaborative Product Development Associates, LLC
for
Siemens PLM Software*

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Solid Edge Broadens Use of Synchronous Technology

The new software release **SOLID EDGE WITH SYNCHRONOUS TECHNOLOGY 2** from Siemens PLM Software continues to deliver aftershocks to the PLM industry by introducing new uses of synchronous technology, the history-less solids modeling approach first launched a year ago. In April 2008, Siemens rocked the industry with one of the most important, groundbreaking technical advancements in 3D solids modeling in over twenty years. Synchronous technology proved to be a history-free, feature-based modeling approach that combines the best of dimension- and constraint-driven techniques for full control and repeatability, with the flexibility of explicit modeling. Now, Solid Edge unveils additional advancements in the use of synchronous technology.

Many of Solid Edge's modeling enhancements are focused on users just now moving to 3D CAD from a pure 2D world or on those who must import 2D drawings and build 3D models as a major ingredient in their business process. The release adds an element of maturity to the use of synchronous technology in part and assembly modeling. A major advancement is the expansion of synchronous technology into the Solid Edge intelligent sheet metal design application. Sheet metal poses a unique set of issues in that certain edits trigger additional model changes, including modifications to the topology. The interweaving of synchronous technology with these intelligent algorithms bolsters its power and reputation as a stable new modeling methodology.

The enhancements in Solid Edge, coupled with the introduction of a new mid-range finite element analysis (FEA) application, Solid Edge Simulation, and continued improvements to Solid Edge Insight™ for single site data management tied to the latest Microsoft SharePoint platform, are positioned to help drive innovation and increase the competitiveness of Siemens PLM Software's customers in today's challenging marketplace.

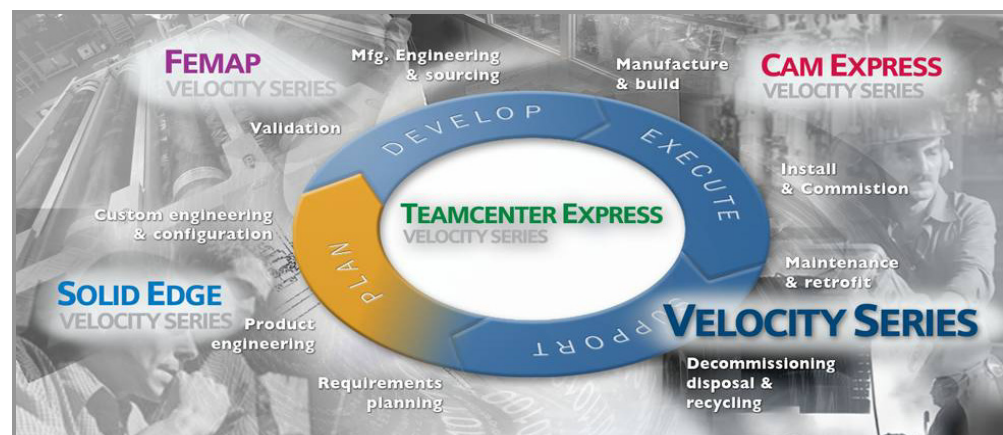
VELOCITY SERIES

Solid Edge is a constituent of the VELOCITY SERIES from Siemens PLM Software, a portfolio of pre-configured, design, analysis, manufacturing, and data management solutions specifically targeting the needs of the mid-market small- to medium-sized product manufacturing businesses. This mid-range market can be characterized by companies that have a small (or non-existent) IT staff, must deal with a transition from 2D design approaches to full 3D, and that have limited (or non-existent) documented processes. Such companies also lack resources for re-engineering and training. In addition, they must constantly minimize risk and maintain a low cost of tool ownership in order to remain competitive. In these difficult economic times, adopting such a platform can make a difference in a company's survival.

The VELOCITY SERIES (Figure 1) offers:

- **SOLID EDGE** for product model creation
- **FEMAP** for finite element analysis modeling
- **CAM EXPRESS** for manufacturing machine tools with NC programming solutions
- **TEAMCENTER EXPRESS** for a unifying pre-configured collaborative product data management (cPDM) solution

FIGURE 1
VELOCITY SERIES



Courtesy of Siemens PLM Software

Siemens packages the VELOCITY SERIES as modular, integrated solutions, preconfigured with industry best practices, which allow customers to select only those products needed for their particular business. The solutions are all based on native Microsoft platforms in order to keep total cost of ownership low and to provide ease of use.

SOLID EDGE MODELING

Solid Edge with synchronous technology provided design authoring with its major breakthrough of history-less CAD. Many in the PLM industry were skeptical of synchronous technology when it was first introduced in 2008. At that time Collaborative Product Development Associates (CPDA) did an in-depth technical review and predicted its success. Today, the advantages being touted by users of the technology confirm the validity of CPDA's assessment.

In an interview with Scott Christensen, founder of Summit Tool Design (www.summitsedge.com) in Rockford, Illinois, he states, "Without question, we have attained benefits from Solid Edge with synchronous technology, especially working with CAD data created in other systems." Scott gives an example of importing a competing application's native CAD model as a "single solid body with no intelligence such as features or sketches that we can easily modify, revise, and make into other components." He indicates that "With history-free synchronous technology, files are smaller, open and save faster, recalculate faster versus heavier history-based files, all leading to important time savings."

Similar opinions were voiced by Cory Goulden, CAD Administrator at National Steel Car (www.steelcar.com). Cory states that, "When we first heard about synchronous technology from Siemens PLM Software, we were concerned and hoped that our investments in the more traditional design approach weren't being replaced." After learning the new user interface, Cory says, "We picked up how to create our initial parts with synchronous technology in one week. In one month, we were confident in its benefits to National Steel Car." Cory describes the example of "a model from an outside supplier that we needed to edit. In the previous release V20 of Solid Edge, it took hours because we had to cut off the ends of the model and recreate them. With Solid Edge and synchronous technology, we exported then re-imported in Parasolid format and made the model changes in less than five minutes."

CPDA views these end user comments as validation of synchronous technology as a modeling approach. We are confident there is potential to take the technology even further. Indeed, synchronous technology may reinvent how design is done.

PART AND ASSEMBLY MODELING

Basic part and assembly modeling constitutes the bulk of CAD. Siemens' implementation of synchronous technology is pervasive throughout the design process. While at first glance it might seem that synchronous technology is solely focused on design edit operations, one need only look closely at how the typical CAD designer creates. This often involves the rough drawing of a shape, followed by both drag/reposition operations or an update of the controlling dimensions – which are both effectively edit operations.

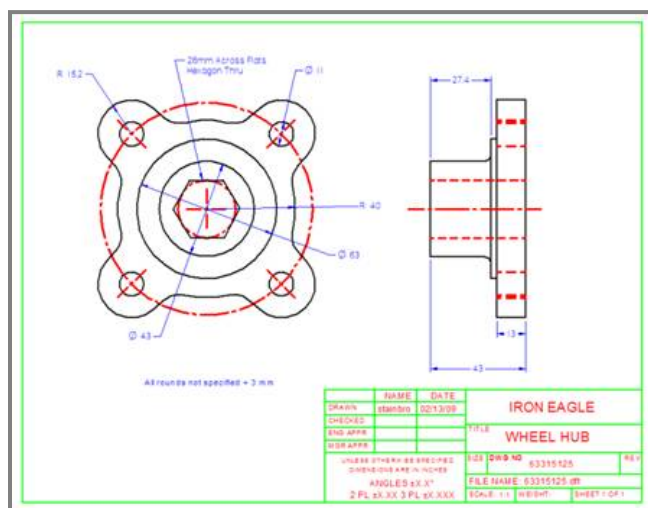
In this release of Solid Edge, Siemens expands upon a number of important design operations for both create and edit tasks, with special emphasis on users coming from a 2D environment as well as users from both history-based 3D and explicit modeling systems. The release introduces new modeling procedural features and the ability to edit by making changes to a procedural feature's underlying sketch. In addition, Solid Edge supports the ability to turn unintelligent 2D drawing dimensions into 3D model driving dimensions, and a new user interface approach for 3D edit using 2D model cross sections similar to other implementations gaining growing acceptance in the CAD community.

MIGRATE 2D DRAWING DIMENSIONS INTO 3D

One common task designers must perform repeatedly in a mid-range business is to import a 2D drawing generated in a competing application such as AutoCAD, which is then used to create a 3D model from the drawing. Solid Edge offers a number of highly productive tools to facilitate this process.

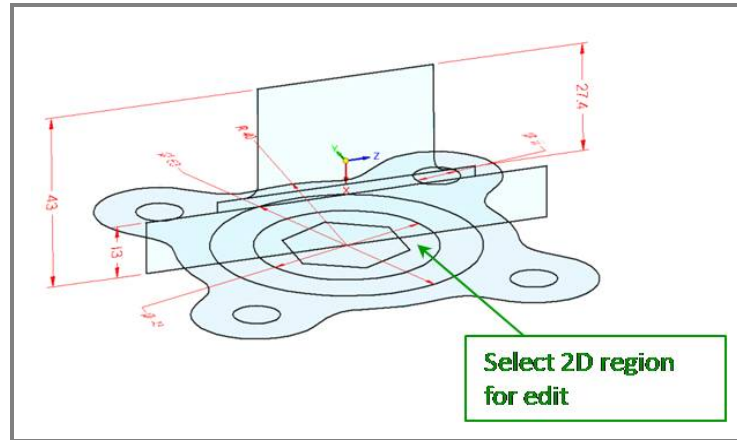
FIGURE 2
Import a 2D Drawing

Using sophisticated tools, the user first imports a 2D drawing into Solid Edge (Figure 2). Numerous drawing formats can be accessed, including DXF, AutoCAD, ME10, and others. Once the drawing appears in Solid Edge the user can invoke a Create 3D command and choose the desired views and dimensions, which are then copied to sketches in



Courtesy of Siemens PLM Software

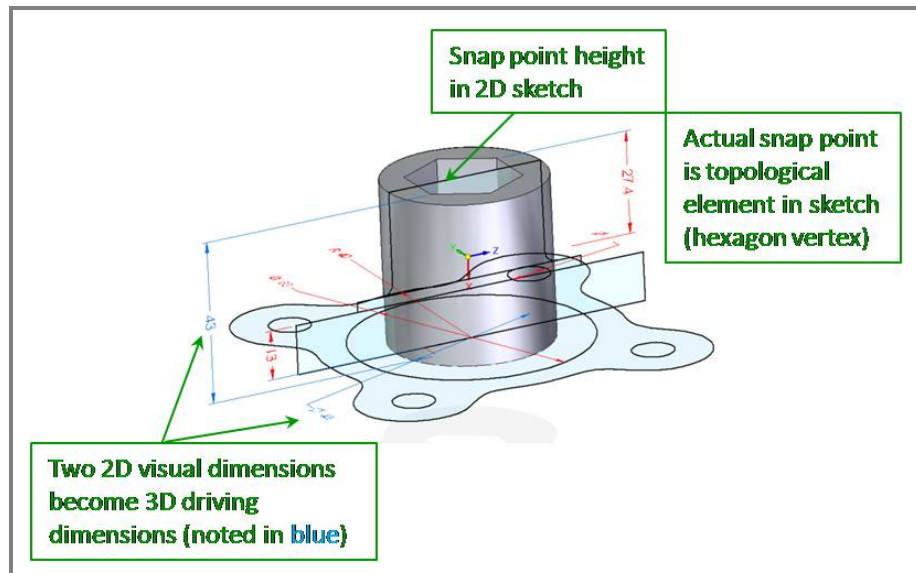
FIGURE 3
Create 3D in
Two 2D Sketches



Base Image Courtesy of Siemens PLM Software

As noted in the figure above, within a 3D sketch model the user may select a 2D region bounded by inner circle and hexagon, and extrude it upward.

FIGURE 4
Extrusion
Automatically Converts
2D Visual Dimensions into
3D Driving Dimension



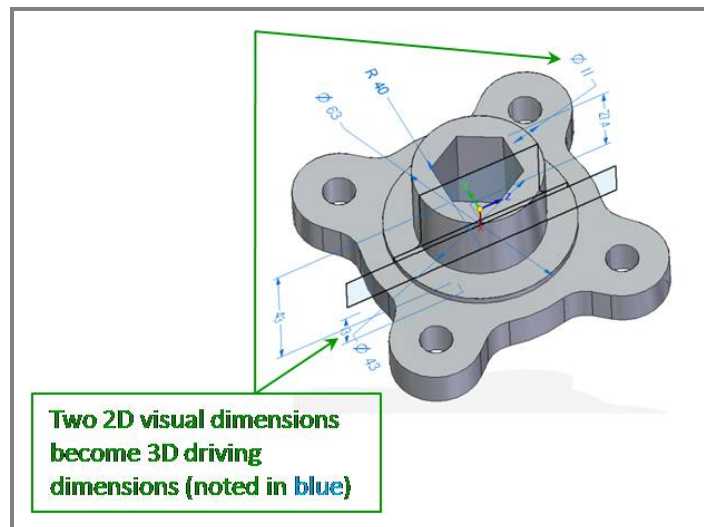
Base Image Courtesy of Siemens PLM Software

The user terminates the dragging of the extruded shape at a snap point in a sketch. In this example, the snap point height is determined by releasing the mouse near the line boundary pointed to by the annotation in Figure 4; although the actual snap point is the closest topological element. In this case that is a vertex on the hexagon. As the user terminates the extrude operation, the

unintelligent dimension(s) suddenly become intelligent 3D driving dimensions, as noted in blue.

Figure 5 shows the completed 3D solid with an extrusion of the base shape. Note that all 2D visual dimensions are now 3D driving dimensions.

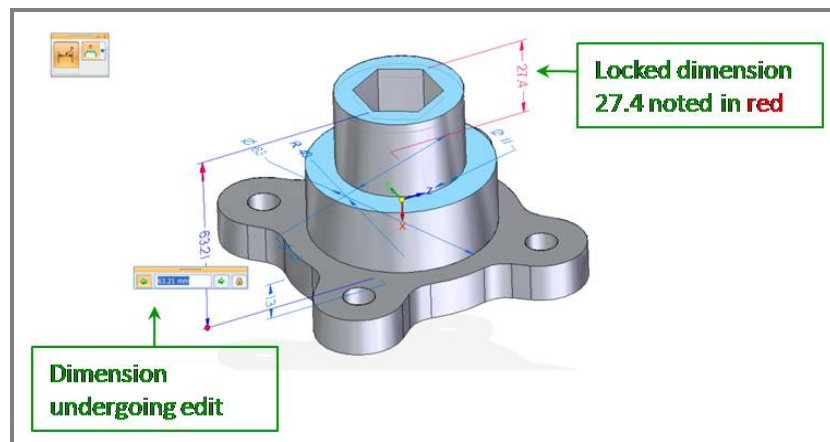
FIGURE 5
Final Extrusion to
Complete the 3D Solid



Base Image Courtesy of Siemens PLM Software

The power of synchronous technology can now come into play. As illustrated in Figure 6 below, the user can lock a dimension as noted in red for the upper cylinder height, and vary a different 3D driving dimension as shown by the display of a text box for its value.

FIGURE 6
Synchronous Technology
Preserves Locked
Dimension under
Edit to the Model



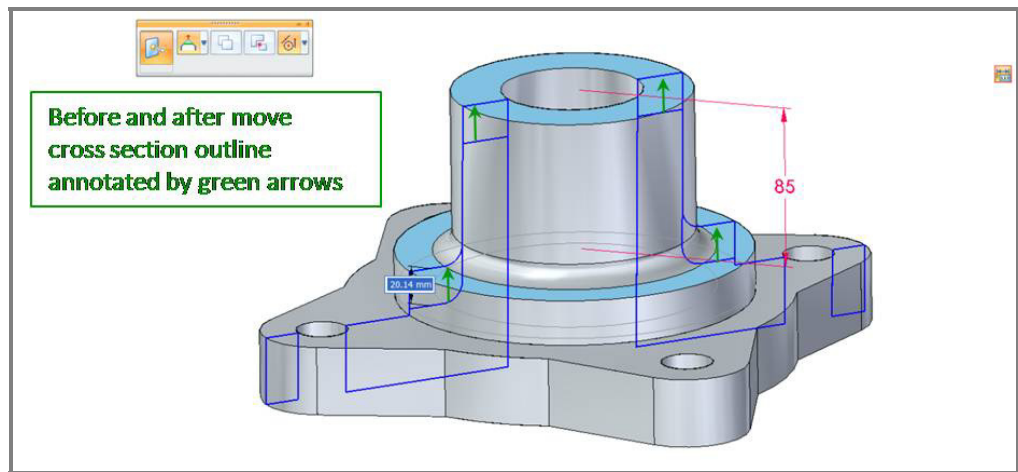
Base Image Courtesy of Siemens PLM Software

As the driving dimension for the height of the lower cylinder varies, the upper cylinder stays in lock-step with it at a constant height of 27.4. This level of control would be very difficult to construct in a history-based modeler, if not impossible.

LIVE SECTIONS FOR 2D CROSS SECTION EDITING

Siemens introduces a new user approach for the interface in this Solid Edge release that allows for solid model edits through direct changes to a 2D cross section of the 3D model. This general approach is gaining popularity in the CAD community because of its ease of use, given how intuitive it is for CAD users accustomed to 2D CAD. **LIVE SECTIONS** are 2D cross sections that can be cut anywhere in a 3D part. Users can drag the 2D elements into new positions or change them with dimensional controls. In Figure 7, a section is added from the center points of the mounting holes and main journal.

FIGURE 7
Live Sections



Base Image Courtesy of Siemens PLM Software

As the user moves the top of the lower cylinder upward by using the value box of a driving dimension, the upper cylinder moves in concert, maintaining a fixed height of 85 denoted in red as a locked dimension.

Such edits are not feasible in a history-based CAD application. The user would first have to explore the model history and from it determine where an edit must be applied in order to modify the solid to their requirements. In this release of Solid Edge, synchronous technology allows the user to cut a cross section at any time, anywhere through the solid, apply a dimension and change the dimension's value to perform an edit. Because of synchronous technology, the user can in effect "dimension the design" as they see fit, rather than applying edits in only limited and specific locations allowed by an embedded history.

SKETCH-DRIVEN PROCEDURAL FEATURES

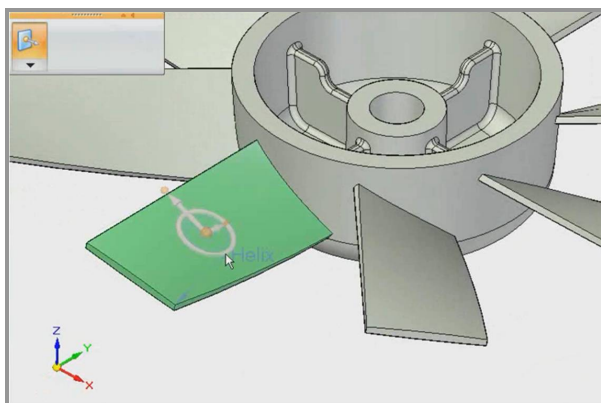
The initial release of synchronous technology in 2008 introduced **PROCEDURAL FEATURES**. These type of features are specifically designed to operate in a system where no ordered solve takes place. In effect, a feature must be able to *regenerate*

itself to be considered a procedural feature. The release of Solid Edge with synchronous technology 2 now allows for editing of procedural features through changes to their defining sketches. Additional geometric forms, such as the helix, are also understood.

In the following example, the fan blade defined from a helix sketch is modified through changes to the sketch geometry. Because of synchronous technology the blade updates, as well as its patterned copies, without forcing a model regeneration of all subsequent geometry in the model.

FIGURE 8

Sketch-Driven Procedural
Feature Edit:
Feature Selection



Courtesy of Siemens PLM Software

The next two figures depict the modification of the sketch (helix) that defines the feature on the left, followed by the regenerated feature geometry on the right.

FIGURE 9 (L)

Sketch-Driven Procedural
Feature Edit:
Sketch Edits

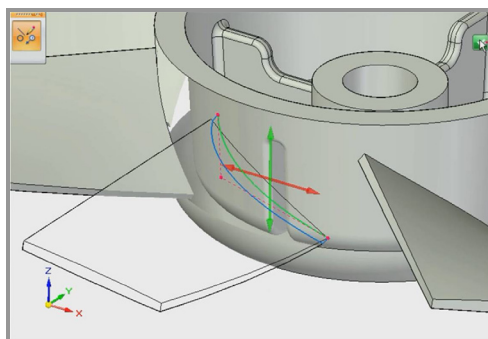
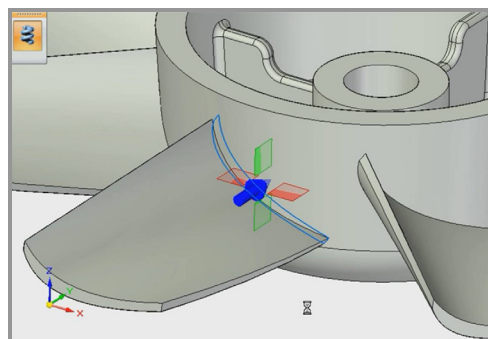


FIGURE 10 (R)

Sketch-Driven Procedural
Feature Edit:
Only Feature and Its
Copies Regenerate



Courtesy of Siemens PLM Software

SHEET METAL DESIGN

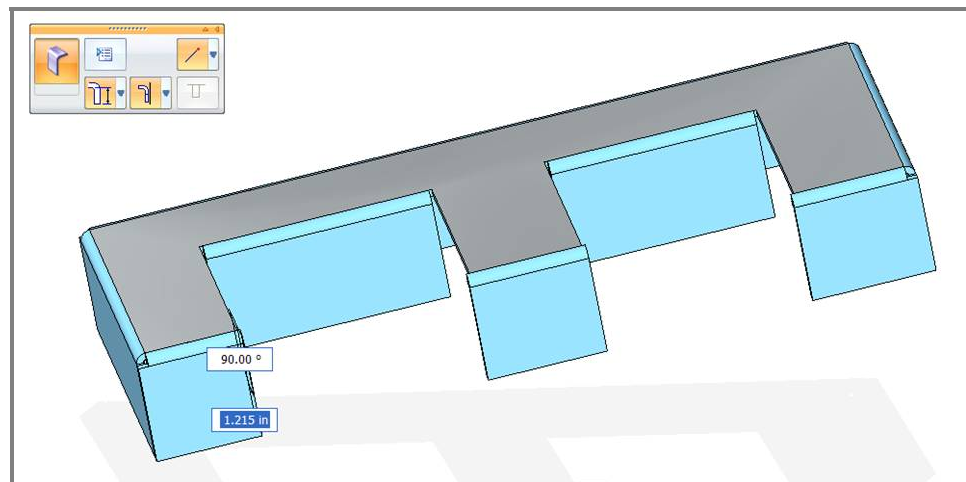
This software release incorporates the extension of synchronous technology into Solid Edge's sheet metal application. The integration of the two – synchronous technology, with its ability to localize dependencies in order to limit the need for regeneration of the model undergoing an edit; and the intelligent sheet metal

application, where edits are automatically expanded to perform additional modifications such as bending a model face while introducing new bend relief topology – would at first seem to be at odds. Siemens held off from the integration in the first release of synchronous technology in order to explore all its subtle implications in sheet metal. Understanding those design nuances, and now overcoming them, demonstrates that synchronous technology *has legs* as a sustainable design approach even in a complex modeling application.

DIRECT INTERACTION PARADIGM

Siemens PLM Software developed the Solid Edge sheet metal application using a direct interaction paradigm. That is, users manipulate geometric handles directly, rather than invoke commands, to create and edit models. For example, a user can drag a 2D region from a sketch or drawing into the part. They can select and pull sheet metal regions into tabs or corner treatments. Figure 11 illustrates a moderately complex sheet metal part that was generated first by creating an E-shaped sketch. In Solid Edge, closed sketches automatically become regions. The user then dragged the region into a sheet metal part as a flat plate. The complete part was accomplished by selecting the edges and dragging them into eight flanges with one simple mouse drag.

FIGURE 11
Sheet metal part
generated by
direct geometry handling

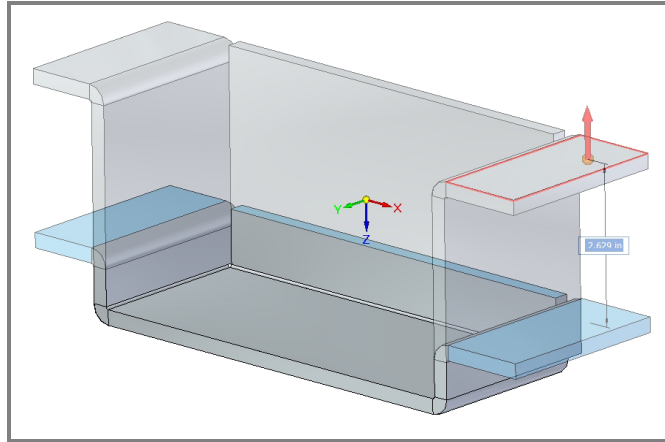


Courtesy of Siemens PLM Software

LIVE RULES

Synchronous technology's Live Rules recognize the need to preserve the geometric condition of tangent, concentric, and collinear faces as well as others. As a result, Solid Edge sheet metal models do not need to be explicitly constrained to get predictable and controllable edits. The change illustrated in Figure 12 can be made by dragging either the flange face or the back thickness

FIGURE 12
*Live Rules Recognize
Collinear Faces*



Courtesy of Siemens PLM Software

face, since collinear faces are added to the selection by the system. Synchronous technology thus adds to the overall intelligence of sheet metal design.

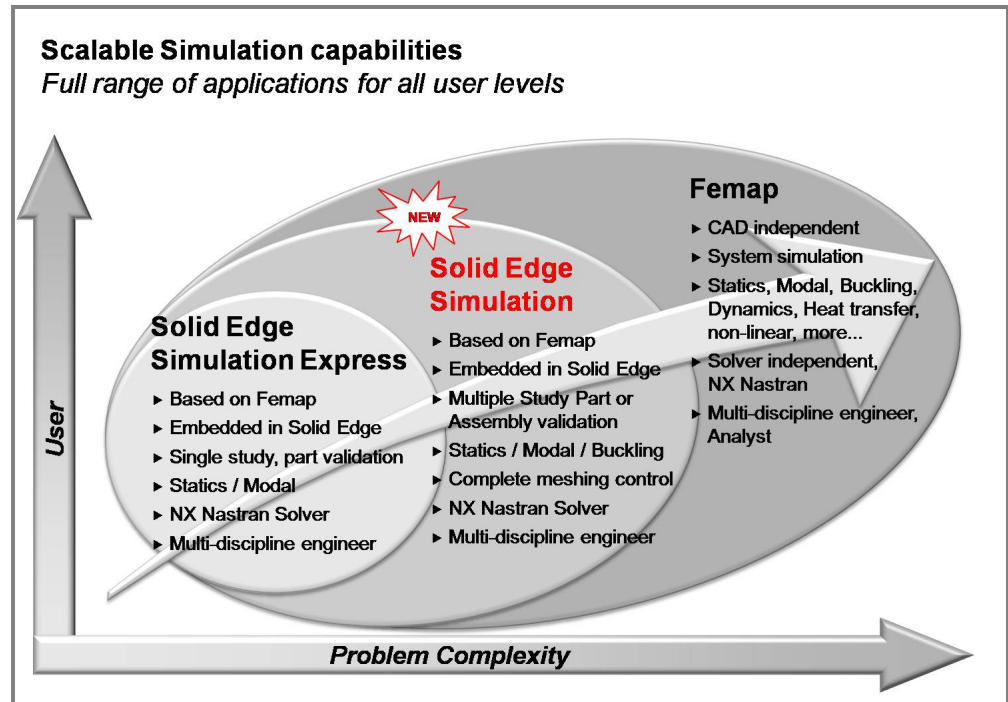
SOLID EDGE SIMULATION

For finite element analysis, Siemens PLM Software introduces a new embedded, mid-range application, Solid Edge Simulation, expanding their scalable portfolio of FEA solutions to three levels of capability based on specific end user requirements (Figure 13). The new solution reiterates the importance of an embedded solution inside of the CAD application that their existing entry-level solution, Solid Edge Simulation Express, already established. An embedded FEA capability encourages a wider use of simulation by presenting a familiar Solid Edge user interface. It also facilitates the typical iterative model-analyze loop, where changes to the model based on the results of one analysis run can be made, and then the updated model re-analyzed.

The Solid Edge Simulation solution based on FEMAP technology and integration with Siemens' standard NX NASTRAN solver expands upon its entry-level sibling, Solid Edge Simulation Express, by adding:

- Assembly validation support
- Multiple studies
- Full complement of load and constraint definitions
- Complete meshing control
- Statics, modes, and buckling solutions

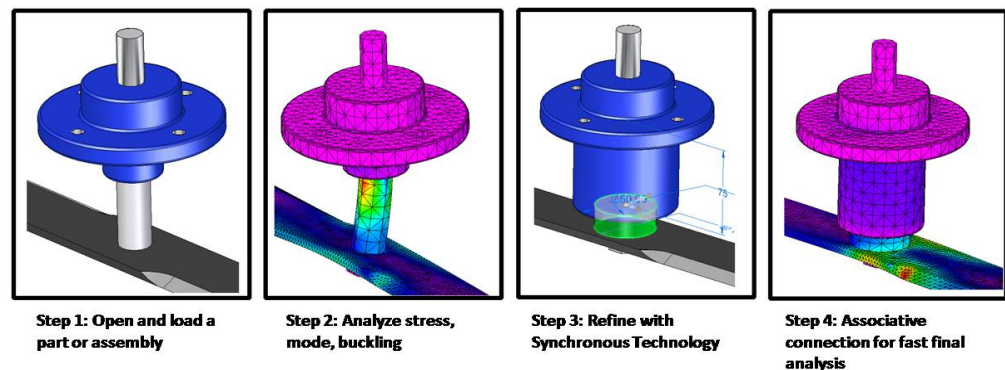
FIGURE 13
Velocity Series
FEA Solutions



Base Image Courtesy of Siemens PLM Software

Synchronous technology also plays an important, indirect role in allowing model changes more readily than in a typical history-based CAD application. As part of the iterative model-analyze loop, order-free model edits can be accomplished faster. Together with this, associative updating occurs, applied loads and restraints are maintained across the model changes, and mesh refinements are updated to changed model geometry, leading to improved product quality and faster product delivery (Figure 14).

FIGURE 14
Model-Analyze
Iterative Loop

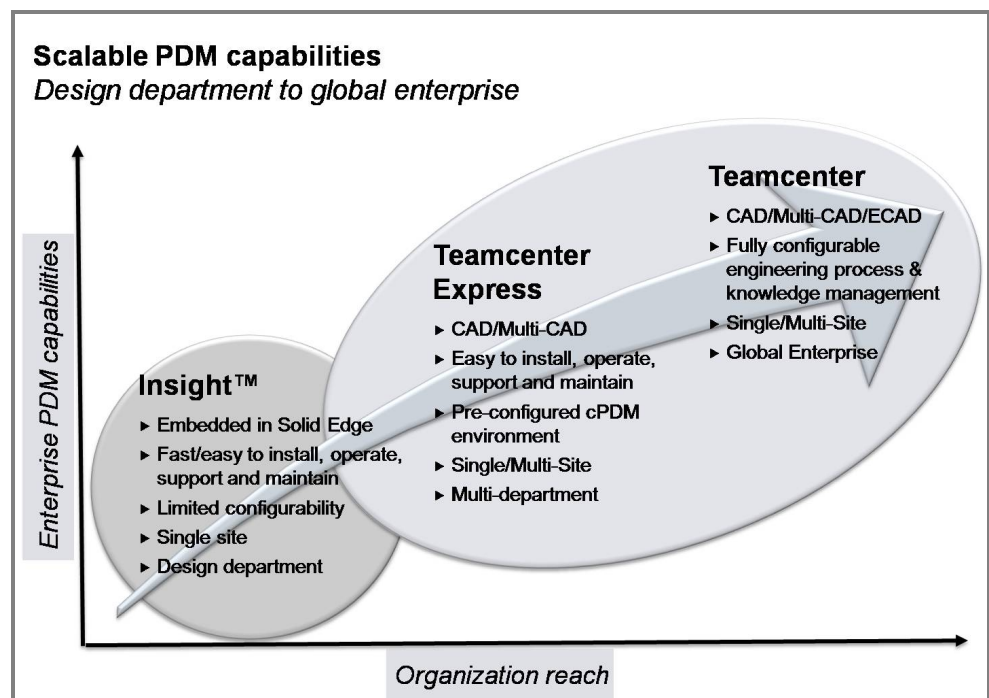


Base Images Courtesy of Siemens PLM Software

SOLID EDGE INSIGHT

Embedded within the Solid Edge application is Insight, the entry-level PDM option of the three scalable solutions that Siemens offers for the Velocity Series (Figure 15). Insight has been based on Microsoft's SharePoint technology foundation since its introduction in 2001. With this release of Solid Edge, Insight keeps pace with the latest from Microsoft.

FIGURE 15
*Velocity Series
PDM Solutions*



Courtesy of Siemens PLM Software

Insight is of particular interest because of the growing support seen industry-wide for SharePoint. The SharePoint product has seen remarkable success across all business levels, especially in the mid-range, with a reported total of over ten million licenses.

Solid Edge Insight users benefit from the fact that if they are running Windows Server 2008 (and Windows Server 2003) it includes SharePoint Services. In effect, Solid Edge users already have the technology. They can add Microsoft Office SharePoint Server for any required added services, such as content management, enterprise search, forms, and business intelligence. Further, if the user company does have an IT organization, the IT staff is likely to be very familiar with SharePoint.

With Insight users gain a seamless data management solution with no additional overhead, yet are poised to smoothly grow into Siemens' Teamcenter Express and the full Teamcenter solution as their business grows and their needs increase.

SUMMARY AND OPINION

As Siemens PLM Software continues to expand upon their Solid Edge design authoring application, it is apparent that synchronous technology evolves and matures. This current release, **SOLID EDGE WITH SYNCHRONOUS TECHNOLOGY 2**, contains numerous indicators of that rapid and impressive evolution. Its added procedural features, its ability to edit by making changes to a procedural feature's underlying sketch, as well as the new user interface approach for 3D edit using 2D model cross sections all attest to that progress.

However, CPDA takes more interest in the ability of synchronous technology to mesh smoothly together with the intelligence embedded in Solid Edge's sheet metal application. The trend to more and more intelligent modeling applications that help drive productivity should be apparent to all in the CAD industry. Siemens PLM Software should take satisfaction in the fact that synchronous technology paces that progress by leading the way.

By surrounding the central Solid Edge application with the necessary product development tools in both simulation and manufacturing in the Velocity Series portfolio of products, Siemens PLM Software offers users a well rounded, state-of-the-art solution for product development. To provide industry-leading technology in product data management, Siemens supports a three-tier set of options, ranging from dedicated Solid Edge Insight (a Microsoft SharePoint-based solution) to Siemens' own multi-faceted Teamcenter products that scale with customer needs. Overall, Siemens PLM Software has taken the extra steps to assure that its customers have best-in-class answers to the challenges they face.