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Putting Leading Solid Modelers to the Test

MIDDLE-RANGE MODELERS ARE SPORTING POWER AND FEATURES THAT HAVE HIGH-END CAD VENDORS TAKING NOTICE. THE WEALTH OF CHOICES IN THE MIDDLE-RANGE ALSO HAS USERS SCRATCHING THEIR HEADS. HERE'S A BENCHMARKING LOOK AT FOUR LEADING SOLID MODELERS.

As analysts and consultants following the Mechanical Cad market, we strive to understand how the latest solid modeling software compares. But how does one compare such complex software? TechniCom has worked for years in this arena, consulting with users and vendors and publishing reports on related topics. The data in this article is extracted from our recent reports and experiences.

Since we often advise customers how to select a system that best fits their needs, we decided to use a similar process in a continuing benchmark to understand how today's hot mid-range CAD systems compare. The process is simple, but deceptively hard to follow: first identify the needs, then test alternatives for the best fit. Politics, unfortunately, often intervene. The methodology outlined in this article helps make the process more objective. At the end of this article we'll share the results of our latest round of mid-range modeling testing.

We'll skip the usual hype about the needs for solid modeling and assume that if you are reading this article you are already convinced of the need and advantages of solid modeling, as compared to other alternatives. We'll also assume that you are not comparing solid modeling systems. If you are, these are called explicit systems. Such systems can no longer compete with variable driven design systems' productivity and impact on future design changes. Like computer programmers who envision a future where reusable code modules lead to rapid designs, so too can mechanical designers foresee a similar future. Reusable designs, based on parts using variables and features will revolutionize today's design techniques and must be an integral part of every long-term plan for new mechanical design automation (MDA) systems.

Evaluating Business Needs

Before we examine our benchmark testing results, let's go over what precedes technical comparisons. Remaining competitive is the key to success in today's fast paced, ever-changing marketplace. Evaluating what you need to keep your edge is a constant challenge, or should be. A wise business continually examines its design-through-manufacturing processes and the associated tools

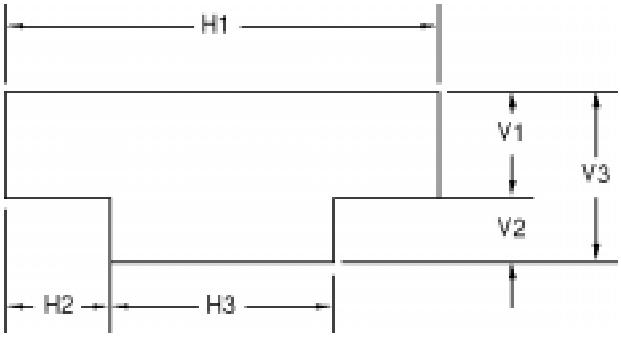

Figure 1. Test 1 benchmarking begins with the above sketch.

to insure working smarter to decrease costs while increasing profits. Critical areas of the business not meeting competitive challenges may be in part due to the tools being used for product development.

If so, the process of evaluating and selecting the right tools can be a time consuming and costly endeavor. However, making the right decision is often crucial to your company's ongoing success. A well chosen MDA system facilitates successful product development by promoting a development process in which design, drafting, analysis, support and manufacturing departments work concurrently to bring a product to market. It simplifies communication between members of the product development team, makes product iterations and revisions easy to handle, has powerful modeling capabilities, yet is user-friendly and intuitive for the engineers using the software. In summary, it makes your design-through-manufacturing process quick and efficient, minimizing the time and cost required to optimize a product design and bring the product to market.

How do you determine which MDA system has the capabilities required by your organization? There are a multitude of mechanical design products on the market, all claiming to be the best system for your needs. It can be difficult to cut through the advertising hype and industry jargon and decide what system really can do for your company.

Latest Evaluation Benchmark

Within the past two years the MCAD market experienced explosive growth fueled by mid-range (mainstream) software, with the entries generally offering variable driven solid modeling, drafting and assembly modeling for less than $7,000 (U.S.). Such systems seem to promise a lot-variable driven solid modeling software that costs less than high-end systems, fully integrated drafting and assembly modeling, using less expensive, Windows-based hardware and easier to use systems. Software in this price range usually runs on Windows NT and utilizes commercial modeling kernels developed by third-party vendors. Most are designed to be Windows centric, relying on Windows for their menuing system and making extensive use of OLE.

Since we are analysts, not really product designers, we need to simulate our needs. The benchmark described next successfully meets most of the above issues and continually evolves as our needs and the software change. The information in this article is based on the data in our latest benchmark report, published in July 1998 and an update in progress.

TechniCom Benchmark Description

During seven tests comprising a total of 64 steps, we exercised key modeling aspects of the systems, including solid modeling, drafting and assembly modeling. We didn't test for FEA (finite element analysis) or manufacturing, nor did we test large assemblies, concurrent engineering, data exchange or data management. The solid modelers tested to date include: Artisan Series 3, Helix V4, Mechanical Desktop V3, MicroStation Modeler V5.5, PT/Modeler V2, Solid Edge V5 and SolidWorks 98.

The vendors supplied the operators, assuring us that we had skilled personnel *driving* the software. They received most of the tests in advance.

Test 1 evaluates the ability to create 3D objects from profiles, shelling of solids, creation of draft angles, filleting and chamfering of pockets and the creation and retention of rib features and feature patterns.

We start with the sketch shown in Figure 1. Then, we extrude the profile, add fillets, shell the solid, add ribs and continually test the response to changes in driving variables.

Test 2 evaluates the associativity of the solid model with drafting, including two-way associativity cross sections, offset sections and isometric views. We build the part shown in Figure 2. Then we construct an associative drawing from the solid, and change both the model and the drawing to test two-way associativity.

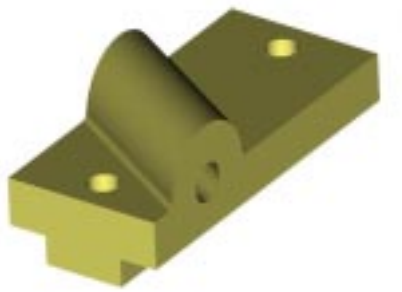

Figure 2. Test 3 evaluates simple parameters and the associativity of the solid model with drafting

Test 3 evaluates the ability to alter the features of the solid model in rather complex ways and correctly update the model and

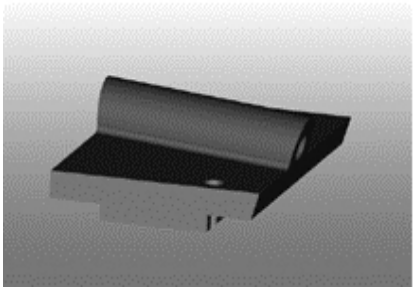

Figure 3. Test 3 focuses on the shelling capabilities of the solid modeler.

the associated drawings. We start with the Tee block from Test 2. After many alterations and measurements, we end with the result shown in Figure 3. Shelling then further tests the modeling capabilities.

Test 4 builds parts for the assembly evaluation of Test 5. We also test the ability to correctly perform complex blends, as

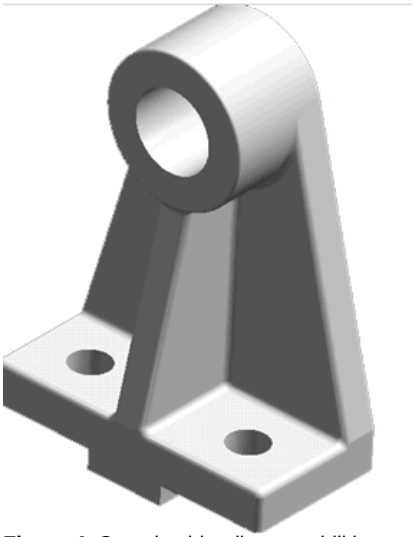

Figure 4. Complex blending capabilities are measured in test 4.

shown in Figure 4.

Test 5 evaluates assembly management functions: assembling parts, building and altering parametric relationships between parts in the assembly and interpart relations that drive the

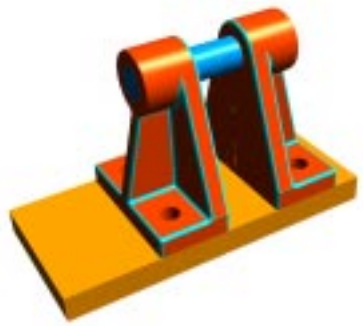

Figure 5. Assembly management functions are evaluated in Test 5.

assembly from part parameters. We use the previous part to build this assembly, then we alter both part and assembly parameters that drive the final assembly, as shown in Figure 5.

Test 6 develops a more complex assembly where parts of the assembly relate to other parts for their position and parameter values. An example is shown in Figure 6.

Finally, Test 7 examines the ability of the systems to develop complex revolved surfaces, to add features to the surface and to shell the result, as shown in Figure 7.

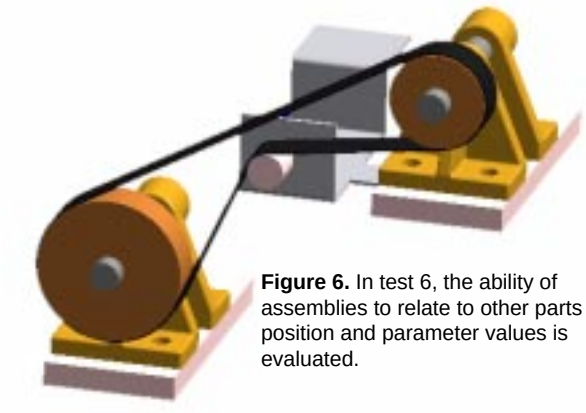

Figure 6. In test 6, the ability of assemblies to relate to other parts for position and parameter values is evaluated.

General Conclusions

For the dollars, these systems offer very robust modeling and are improving fast enough to make the more traditional high-end CAD vendors sweat. All of the vendors tested can essentially complete our entire benchmark, some more successfully than others. Each has its individual functional strengths and weaknesses.

While we did not notice a dramatic ease-of-use paradigm shift, we did find a GUI nudge. Users like Windows-centric

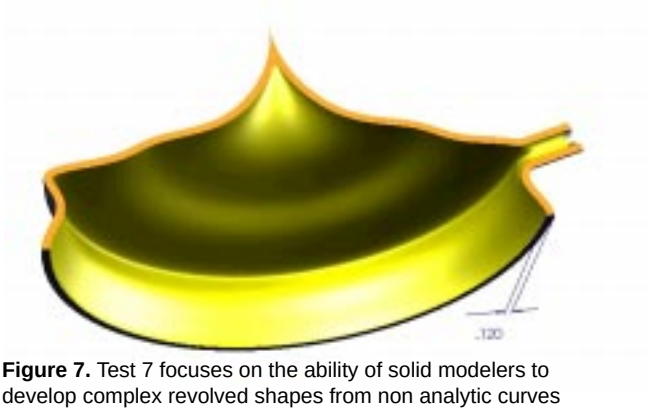

Figure 7. Test 7 focuses on the ability of solid modelers to develop complex revolved shapes from non analytic curves (splines).

systems and already are voting with their dollars. While the intelligent interface of Solid Edge comes close to the mark, none of these systems attack the real issues of mass appeal: ease of use, ease of trainability and common data exchange. They are all still too hard to use, and require significant training and knowledge of the intricate sequences of events needed to produce workable parts.

Mid-priced systems have jolted the MCAD marketplace. Last year at

Basing System Benchmarks on Business Needs

Controversy still surrounds whether to use benchmarking when trying to select software. Frankly we at TechniCom see little alternative. Who would buy a car without first test driving it? Either create a benchmark test for the software or take the time and effort to train on a few systems and install them at your facility to evaluate how well they satisfy your needs. Either way let's call this a benchmarking approach. The following are the general steps to follow in selecting a mechanical design automation (MDA) system.

Create a listing of requirements of the MDA system. Generate an initial list of MDA software products that appear to meet the needs of your company.

Construct a matrix, listing requirements in the left column and MDA systems in a row across the top. Based on the results of the completed matrix (via marketing and industry literature, vendor responses and product demonstrations), you should be able to narrow down your MDA system list to two or three candidates.

Design and conduct a meaningful software evaluation (benchmark). Designing a through and meaningful evaluation of competing MDA systems is a challenging and time-consuming task-but effort well spent. As many users quickly discover, benchmarks present their own set of difficulties. They must be hard enough to test for the desired results, while at the same time easy enough to complete in the allotted time. In addition, a rigorous set of procedures must be put in place to evaluate the performance of the software, often observed at different times and by different personnel. Based on the results of this approach to benchmarking and on pricing considerations, you can make a more informed decision about which MDA system best meets your company's business goals.

Two reports readers may find interesting and relevant are: *Selecting a Modern Mechanical Design Automation System: A How-to Guide* and *Mid-Range MCAD Benchmark Report.* For more information on these reports visit the TechniCom Web site at *www.technicom.com.*

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this time we predicted that the rapid advances in mid-range MCAD software would cause the high-end market to drastically change. Judging by all the acquisition activity, we were certainly right. By coupling this power of desktop supercomputers with advanced functions, mid-range software will continue to cause wrenching changes in the landscape of the MCAD industry. Furthermore, our prediction that by the end of 1997 half of the new MCAD seats going into small to medium sized installations would be mid-range has proven true.

Some functions that are still the domain of high-end systems are:

- Surfacing (other than lofting);
- tolerance analysis of assemblies;
- Large scale concurrent engineering;
- Large assemblies;
- Integrated data management.

How the Vendors Fared

Updated recent-release test results of the four systems we evaluated are shown in Figure 8. Helix V4 has been tested within the past 12 months; SolidWorks 98, Solid Edge V5, Artisan Series 3, and Mechanical Desktop V3 within the past few months.

Those familiar with prior test results might notice that the average score of mid-range modelers continues to improve. The first two bars represent SolidWorks and Solid Edge respectively; the two are neck and neck in the ratings. Readers can conclude that they both have few weaknesses that are revealed by our tests, with the exception of the unusual shelling done in Test 7 . SolidWorks leads in all categories but one; however, the modeling capability of both Solid Edge and SolidWorks is very close-perhaps not surprising, since they both use the Parasolid modeling kernel. While we are on the subject of kernels, the other two systems,

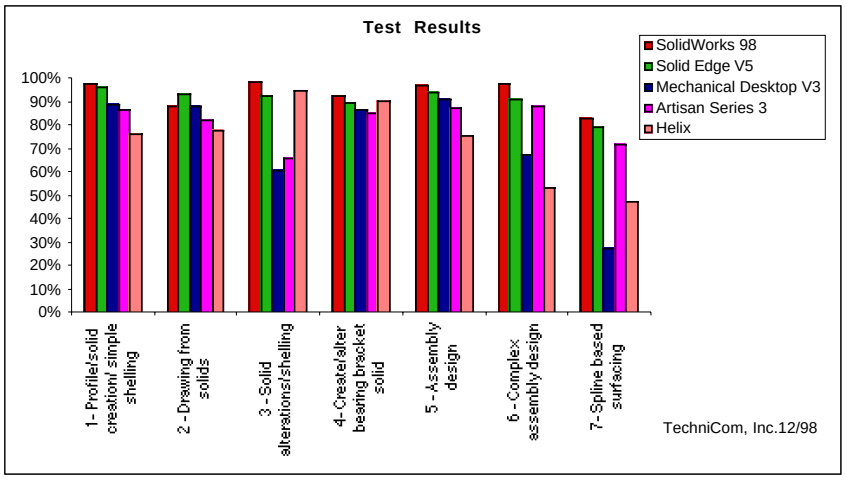

Figure 8. Overall benchmark results for five vendors.

Mechanical Desktop and MICRO-CADAM Helix use ACIS and Designbase, respectively.

Mechanical Desktop V3 began shipping early in September, and its benchmark results have improved greatly over the 1.2 version we last tested. Noticeable weaknesses can be found in complex shelling, as shown in Test 3, a lack of interpart constraints caused difficulty in Test 6, and spline-based modeling proved a real challenge in Test 7.

Helix fares well in Tests 3 and 4, and trails badly in Tests 6 and 7. Interpart assembly parameters and constraints limit its usefulness in parametrically designed assemblies. As with Mechanical Desktop, spline-based modeling also causes the system problems.

A warning about these results—the tests focus strictly on modeling functionality, testing the specific parts described earlier. Users evaluating such systems should run tests on their own parts and also consider other aspects of the software when making buying decisions.

Other Considerations

While we did not specifically test for ease-of-use, some comments are in order. Solid Edge distinguishes itself for its ease-of-use in placing features, calling its method STREAM Technology, which guides users through the microsteps needed to place such features. SolidWorks has begun exploring "feature handles," first introduced by TriSpectives. Mechanical Desktop and Helix both may be easier to use for existing 2D users familiar with their menus and key-ins, but new users will find them more unfriendly. Mechanical Desktop and Helix offer easy upgrades for their legacy users. Both, because of their heritage, enable them to produce production quality drawings.

Both Solid Edge and SolidWorks offer excellent assembly modelers. Each employs different strategies to build assemblies. SolidWorks allows parts to be most easily constrained to other parts in assemblies, while Solid Edge avoids possible circular definitions using its layout techniques.

Other Mid-Range Systems

While previous tests also included MicroStation Modeler and PT/Modeler, both results are now outdated, and in the case of PT/Modeler, no longer offered. SDRC's Artisan Series will have been tested by the time you read this. We plan to test Pro/ENGINEER Foundation and Ashlar Vellum soon. IronCAD and SolidDesigner have only limited variable driven design capabilities, thus cannot perform these tests. We expect to add an update for MicroStation and perhaps even Cad.Lab's Eureka product in the next few months.

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