

3D MCAD Benchmark Study

An Independent Modeling Benchmark Study From [tool,Inc.](#)

Digital Model: The DNA of a Great Product

The essence of good product development begins with the creation of the virtual model. The digital model is the pure design element from which the final product emerges. All 3D CAD vendors claim their modeling capabilities are top-notch, but even the most rudimentary modeling exercises reveal stark differences that impact the overall product development outcome.

Pro/ENGINEER® excelled in two of the three key areas of usability in the benchmark study – Including fastest time to completion

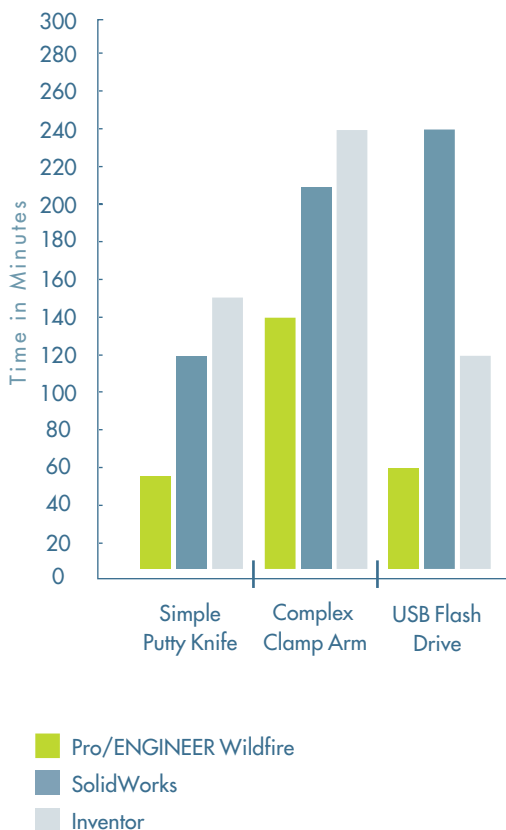
tool., Inc., a Marblehead, Massachusetts product design and development firm, uses a wide variety of competitive product design software in the work it performs for a diverse range of clients. As a result, tool., Inc.'s designers are skilled at making competitive design solutions perform at maximum capability.

Each year, tool., Inc. designers perform a comprehensive benchmark test of various product design software to decide which package will be its standard application. And each year, PTC's Pro/ENGINEER tops the list. As a result, when tool., Inc. chooses the design software for a client project, it is Pro/ENGINEER every time. This year's benchmark test shows PTC and Pro/ENGINEER continuing its winning record.

This new benchmark study of the modeling capabilities of three leading CAD packages highlights what is required for superior modeling design performance and what pitfalls await developers working with inferior and self-limiting design products. Reading the results of this study will show you the importance of ease-of-use and intuitive design capabilities in the development of products, from the simple to the complex.

Experienced product developers evaluating 3D CAD solutions know that ease-of-use is an essential requirement for superior design work. The ideal CAD package is unobtrusive in its interface between user and model. The technology does not impede the creative process.

This timely benchmark study uncovers the strengths and weaknesses of three leading CAD packages in the market today. Read the results and learn why PTC's Pro/ENGINEER Wildfire 2.0 is the fastest, most responsive and easy-to-use 3D CAD package available.



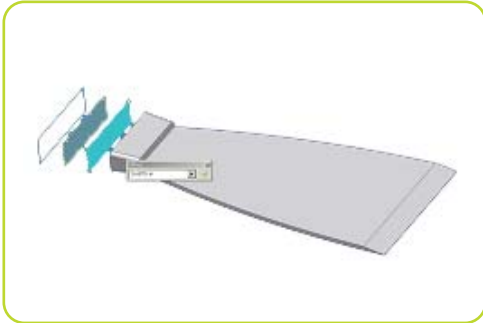


Image of scraper from Inventor shows creating the sculpted handle using multiple sketches

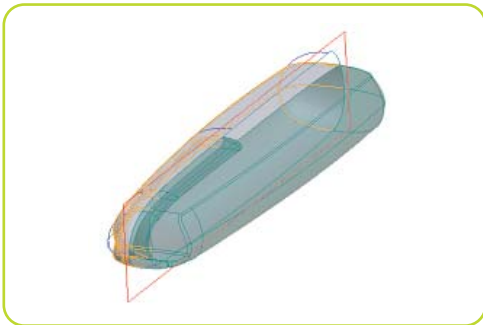
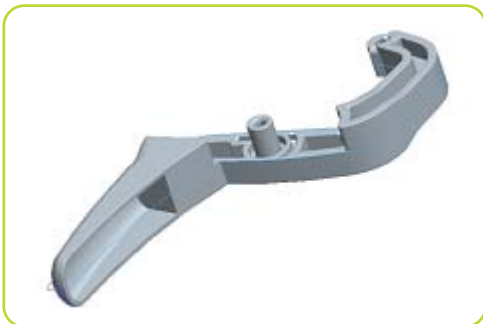


Image of the USB Flash Drive from Pro/ENGINEER Shows mirroring the surface model



The Final version of the clamp model in Pro/ENGINEER

Overview

The purpose of this document is to outline the process of modeling a set of parts, ranging from moderate to complex, using a variety of industry CAD tools. The parts—a putty knife, clamp arm and USB flash drive case, were chosen for the range of CAD features needed to create the parts. All features are consistent with what any baseline MCAD application should be able to perform. The parts selected are ordinary components that feature both simple geometric shape and organic form. As the models were created, tool., Inc., Inc recorded mouse travel, mouse clicks, and keystrokes. Part size and feature count were also documented for comparison.

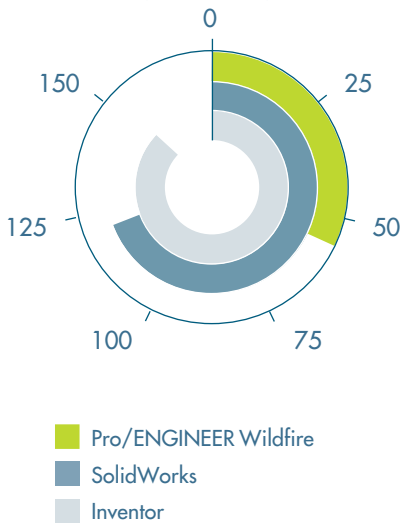
Modeling – The Essence of Superior Product Development

Ease-of-use in 3D modeling translates into speed that is, the ability to create superior models quickly and comprehensively. Achieving that speed demands ease-of-use, and intuitive tools and features that don't slow down the process or leave you puzzling over which work-around will overcome limitations of the design tool you are using. Works-arounds not only cost precious time, they also compromise design by preventing the user from completing any given task.

Winning designs demand CAD tools that are simple and intuitive, without forcing you to compromise your product vision, design processes or peoples' talents. While many CAD packages promise those attributes, few actually deliver. Most packages sacrifice depth and breadth of functionality to achieve ease-of-use. In the end, they fall woefully short of what is required for leading edge product design and development.

As this latest benchmark confirms, Pro/ENGINEER Wildfire 2.0 is the fastest and easiest 3D design tool available. As with previous benchmarking tests, design engineers using Pro/ENGINEER accomplish a broad variety of tasks and processes much faster than the competition, without compromising either functionality or ease-of-use.

Time to Complete Simple Putty Knife (in minutes)



Benchmark One: Design a Simple Putty Knife

The first benchmark test involved designing a basic putty knife – a simple static part. In Pro/ENGINEER Wildfire, the designer utilized basic extruding and surfacing features to sketch the top and side profiles of the grip, and the Style feature to surface them together. He found the style feature provided tight control of sketched curves to constrain the surface creation.

Next, the design engineer mirrored the surfaces and merged them together before solidifying the quilt and rounding out the appropriate edges. Pro/ENGINEER’s new round feature was very adaptive, allowing for multiple rounds of varying radii and transitional constraints, all consolidated into a single round feature. Finally, he extruded the blade and plastic bezel, and added associated chamfers.

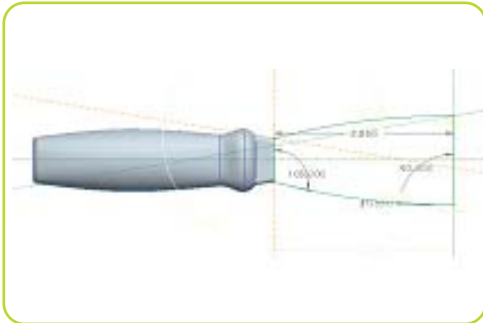
Overall, the Pro/ENGINEER designer found the putty knife to be a very simple part to create using Pro/ENGINEER Wildfire 2.0. In particular, the style feature’s ability to create 3-sided surfaces and obtain surface tangencies with relative ease made the work easier.

In SolidWorks, designing the putty knife was also relatively straightforward, but the square shape of the first section of the handle near the blade holder required that it be modeled as a separate feature. As the designer created sketches to loft the handle, he had trouble getting the correct “dome” on the end of the handle in one feature and had to create two separate lofts, one for the body of the handle and one for the end dome.

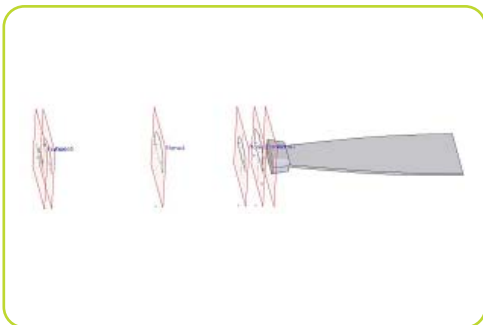
The AutoDesk designer found the Inventor sketch mode rather cumbersome and not very intuitive. For example, existing geometry and datums are not accessible for dimensioning. The package offers a loop offset, but not a use edge command. There is, however, a way to use the edge with a project command which appeared very difficult and time-consuming.

	Pro/ENGINEER	SolidWorks	Inventor
Time	55 minutes	120 minutes	150 minutes
Features	15	16	16
Size	714 KB	1075 KB	350 KB
Mouse Travel	740 ft	1649 ft	3215 ft
Keystrokes	498	132	51
Mouse clicks	1278	1813	2586

Pro/ENGINEER excelled in four key areas of this benchmark study.



creating the blade sketch for the scraper in Pro/ENGINEER

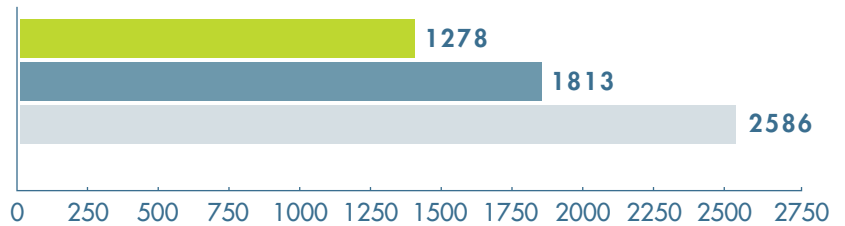


Creating the handle of the scraper in SolidWorks



The finished handle of the scraper from Pro/ENGINEER. This image would precede the blade sketch image

Mouse Clicks to Complete Simple Putty Knife



- Pro/ENGINEER Wildfire
- SolidWorks
- Inventor

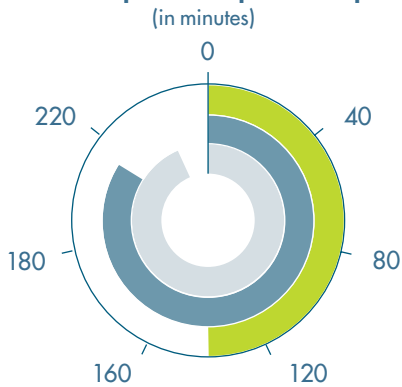
Once the sketch was complete, the blade model was done and the chamfered edge tip was applied with a cut. The extrude tool allows the Inventor user to move from cut to extrude.

In Inventor 9, due to the lack of any surfacing capabilities, the handle needed to be lofted. First task was setting up the sketch to be lofted. Inventor allows the user to select a surface for creating a datum and dragging the datum to position. This is a time-saver when creating quick sketches. Once the sections were set up, the loft tool was used to loft through the handle sections.

Next was the end cap. A loft through two sections worked best. In fact, this section could have been lofted in the original loft. However, loft does not give the control that boundary surface would allow. The rails did little to improve the shape, and the spine tool was not very effective and proved difficult in manipulating the points.

Once the end cap was applied to the knife, the designer attempted to round the edge. On every occasion, however, the software would not apply the round.

Time to Complete Complex Clamp Arm



- Pro/ENGINEER Wildfire
- SolidWorks
- Inventor

Benchmark Two: Design a Complex Clamp Arm

Moving up the scale in complexity, the second benchmark test involved designing a clamp arm. The Pro/ENGINEER Wildfire engineer created a sketch of the part's overall profile. Since the part is symmetric until a certain point of the build, he modeled one side to be mirrored. Then, he extruded the sketch from step 1, and extruded two additional cuts.

The next step was to create the handle portion. This was done by projecting curves on the existing surfaces and using the Style feature to connect them. He paid careful attention to the tangency of the features in relation to the planer surfaces they referenced. He then merged them to the main body's extrusion.

To create the "cored out" section of the handle, he offset the applicable exterior surfaces and created a horizontal surface for merging before using the solidify tool to cut the handle using the new quilt.

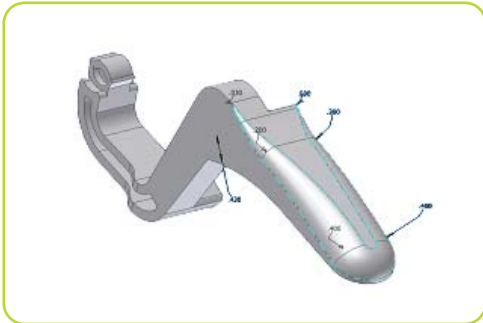
The designer then mirrored the geometry that was symmetrical and added the appropriate cuts. Pro/ENGINEER Wildfire's new extrude feature proved very user-friendly and helpful in visualizing what he was trying to achieve.

Finally, he added rounds to all of the pertinent edges, and the part was complete.

Throughout the creation of this part, the designer found Pro/ENGINEER's new "preview" tools very helpful. The condensed extrusion tool allowed the designer to toggle through surfaces, solids, cuts and protrusions with great ease, allowing for quick modifications and design changes when needed.

	Pro/ENGINEER	SolidWorks	Inventor
Time	140 minutes	210 minutes	240 minutes
Features	36	28	29
Size	2643 KB	1911 KB	899 KB
Mouse Travel	1923 ft	2893 ft	4726 ft
Keystrokes	902	214	62
Mouse Clicks	2821	3165	3567

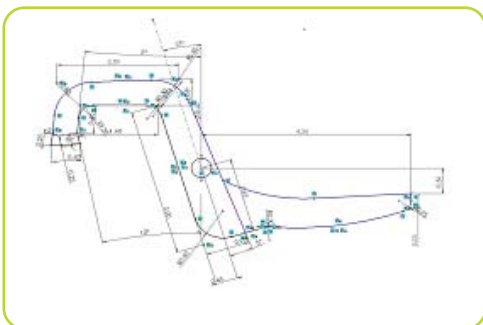
Pro/ENGINEER excelled in three key areas of this benchmark study.



Adding the handle rounds to the clamp in Inventor

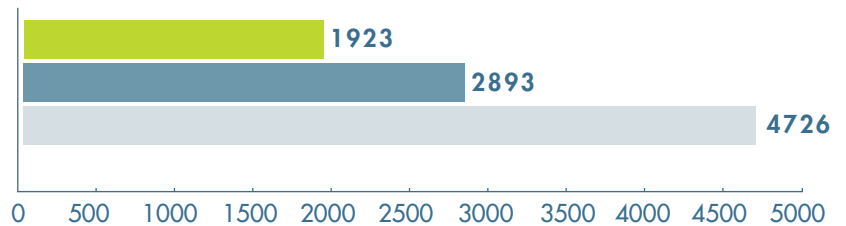


Final version of the clamp model in Pro/ENGINEER



The clamp primary sketch in SolidWorks

Mouse Travel to Complete Complex Clamp Arm (in feet)



- Pro/ENGINEER Wildfire
- SolidWorks
- Inventor

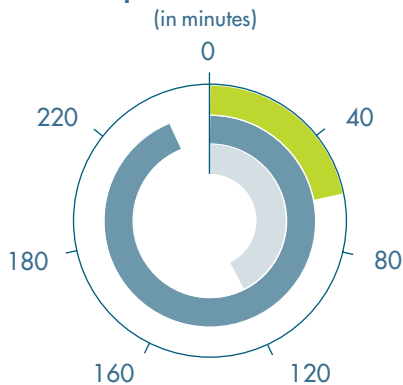
The Solidworks designer laid out a complex sketch of the outline. Although not recorded for this test, significant time was required to measure the part and edit this sketch to accurately capture design intent. He began extruding various sections and had difficulty shelling out the handle once it was attached to the rest of the body. As with the putty knife above, he had trouble getting the correct “dome” on the end of the handle. He noted that SolidWorks 2005 has an excellent fillet dialog box.

The Inventor designer found that the main sketch took some time to create, and that the Inventor sketcher is not very intuitive, making it difficult to achieve the results being attempted. Without the ability to have a reference plane, the sketch is very difficult to control. After much frustration attempting to create the main sketch, a first circle sketch needed to be created to have a size reference.

Once the sketch was created, the extrusion tool, Inc. was used to extrude the shape. The designer chose to extrude the shape .500” to one side assuming that he could apply a split draft at a later time. Next, the other half sections were built up and some cuts on the clamp pads were made. This was very frustrating due to the fact that there appears to be no edge tool, Inc. There is a project tool that takes the entire shape of the protrusion and places it on the sketch datum. The sketch itself from the previous feature could not be used, only the extruded shape edges. It is not possible to select edges separately on full perimeters of the shape.

Next, cuts defining the arm section were completed. The part is split-drafted. However, there is no split draft feature in Inventor. There is an edge drive and plane driven draft. The designer felt that Inventor has a powerful round feature dialog box which, because Inventor lacks surfacing capabilities, had to be used to blend the edge shape needed.

Time to Complete USB Flash Drive Case



- Pro/ENGINEER Wildfire
- SolidWorks
- Inventor

Benchmark Three: Design a USB Flash Drive Case

The first step for the USB Flash Drive creation with Pro/ENGINEER Wildfire was to sketch the three profiles. Next, using the Style feature, the designer connected the profiles with tangent surfaces. He was unable to create a composite curve to replace the segmented profile curves to ease the Style creation. As a result, he had to put more cross-sectional curves in the feature at the segmented curves, start and end points.

Next, he extruded the cutting surface, merged it to the main body surface, and added the appropriate rounds. Finally, he mirrored all geometry over the neutral plane, then merged and solidified it for completion.

The SolidWorks designer modeled curves to define the profile edge, and then defined surfaces based on these curves. However, he spent considerable time struggling to get SolidWorks to generate the surfaces required. Typically, each half could be done at once and mirrored across the center plane. Unfortunately, the designer was forced to piece these halves together.

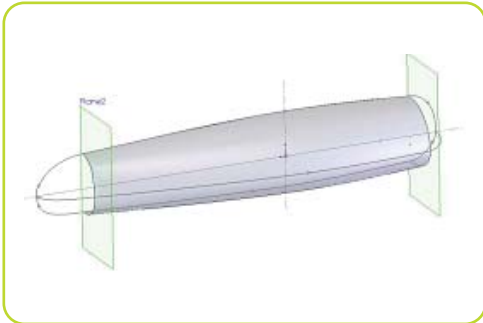
Once the SolidWorks designer was able to successfully generate this half-surface, he was able to mirror across the center plane and thicken into a solid. Finally, he was able to add a simple extruded cut for the clip detail, but was unable to complete the round at the blunt end.

While the Flash Drive was a relatively simple surface model that would take any experienced PTC user using surfacing very little time to complete, the lack of any surfacing in Inventor means that only lofting is at the user's disposal to create a complex organic shape such as the flash drive. The first task was setting up the sketches for the loft feature.

	Pro/ENGINEER	SolidWorks	Inventor
Time	60 minutes	240 minutes	120 minutes
Features	11	15	10*
Size	808 KB	2145 KB	633 KB
Mouse Travel	955 ft	3162 ft	3125 ft
Keystrokes	710	241	31
Mouse Clicks	1611	3618	1215

Pro/ENGINEER excels in two key areas of this bench mark study.

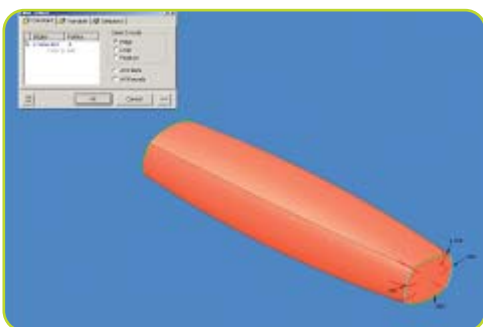
* Did not capture design intent.



The Flash Drive surface being created in SolidWorks

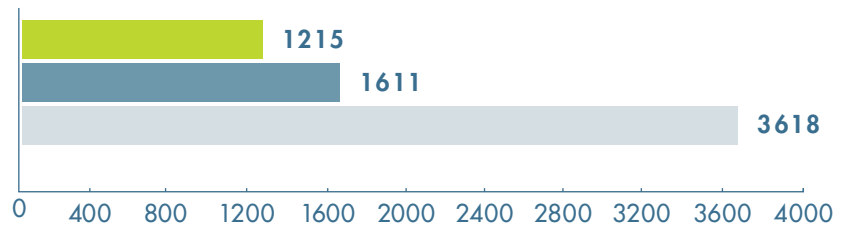


Analyzing the final surface model of the Flash Drive in Pro/ENGINEER



Adding the rounds to the Flash Drive in Inventor

Mouse Clicks to Complete USB Flash Drive Case



- Pro/ENGINEER Wildfire
- SolidWorks
- Inventor

After creating the base body loft, the Inventor engineer attempted to round the tip. Although the actual product has a smooth rounded tip, Inventor has no ability to surface, so the approach was to loft, then round. Inventor has difficulty with rounds on complex curvatures, and this failed with every attempt to create the round geometry.

To create the soft rounded sides of the Flash Drive, the designer added rounds to all the crisp edges that Inventor could round. This approach does not capture the design intent and only remotely matches the shape of the actual product.

Summary

The experience of modeling the three common objects in this benchmark test vividly demonstrates the exceptional capability and speed of Pro/ENGINEER Wildfire. While competitive products force designers to compromise design integrity or construct awkward, unwieldy work-around solutions to simple design requirements, Pro/ENGINEER anticipates those requirements and seamlessly facilitates their execution, leaving the designer free to concentrate on achieving the best design possible.

With its intuitive new user interface and streamlined modeling tools, Pro/ENGINEER is clearly the industry's most powerful 3D product design solution.

Benchmark Specifications

Pro/ENGINEER Wildfire 2.0 Test

Machine

Pentium 4 2.53 GHz with 512 MB of RAM
Nvidia Quadro4 900 XGL card
40 GB hard drive
21" Maxvision monitor

Software

Windows XP Pro SP4
Pro/ENGINEER Wildfire 2.0 F000

Memory Usage

System - 523 MB
Pro/ENGINEER Wildfire

SolidWorks 2005 Test

Machine

Dell M50 Laptop
Pentium 2200 MHz
528 MB
64 Mb Nvidia Quadro4 500 GoGL
21" Sony CRT when docked

Software

Windows 2000 SP 4
SolidWorks 2005 SP 0

Memory Usage

System - 523 MB
SolidWorks - 140 MB

AutoDesk Inventor 9 Test

Machine

Dell M6 Laptop
Pentium M 1600 MHz
1047 MB
128 MB Nvidia Quadro to Go 700 FX
21" Dell CRT when docked

Software

Windows 2000 SP 4
AutoDesk Inventor 9 Build 096c Release 9 RTM

Memory Usage

System - 464 MB
Inventor 9 - 588 MB

Test subjects: Three engineers performed the test on three separate machines. The level of MCAD experience varied per engineer. The SolidWorks 2005 and Pro/ENGINEER Wildfire 2.0 users were more experienced in their test application than was the Inventor 9 user. In today's environment, Pro/ENGINEER and SolidWorks tend to be used much more frequently than Inventor 9, therefore more expertise in PTC and SolidWorks products is customary.

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