

Comparing the Capabilities of Autodesk Inventor Professional 2011 and SolidWorks Premium 2010 Using TechniCom's Delphi Expert Technique

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Quite frankly, I was astounded by the results. Inventor rated higher than SolidWorks in every one of the fifteen categories.

Inventor Professional functionality has reached or exceeded SolidWorks Premium functionality in all of the areas we studied.

We compared 15 functional areas using 161 questions asking about functionality. Experts rated the functional performance from 0 to 5.

Executive Summary

TechniCom compared 15 functional areas of Autodesk Inventor Professional 2011 versus SolidWorks Premium 2010 using a technique called Delphi Expert Analysis. We compared 15 major functional areas using a questionnaire with 161 functional questions. Both products were rated on each question by a team of four experts for each software product who rated how well each product performed for that functional question. TechniCom's analysts independently selected the questions. In my estimation, the functional questions do not favor any specific vendor or product.

Quite frankly, I was astounded by the results. Inventor rated higher than SolidWorks in every one of the fifteen categories. This was completely unexpected!

We attribute this to the breadth of the product offerings from the Inventor family. During the past several years Autodesk has expanded the Inventor product line enormously, both by buying promising technology and developing technology internally. Examples are the acquisitions of Algor and Moldflow. More than acquisitions, these products are continually being merged into the Inventor core product. The results provide Inventor with a diverse solution set. Inventor led by a wide margin in BIM, plastic part design, mold design and tooling, routed systems, and mechatronics. Inventor still led, although by a narrower margin in interoperability, documentation, mixed modeling, visualization, and design automation. The systems were almost tied in the remainder of the areas: part modeling, data management, simulation, sheet metal, and assembly modeling.

We conclude that Inventor Professional has reached or exceeded SolidWorks Premium functionality in all of the areas we studied. We believe that this is the case both because Inventor has neatly consolidated many of its acquired technologies into the Inventor product line and that Autodesk continues to aggressively pursue and incorporate new technologies. Yet, neither product is perfect; there are opportunities for both products to improve in many areas.

Given these results, users should definitely consider Inventor Professional in their evaluation of a product development system.

Background

Our client for this project, Autodesk, wanted an independent analysis of how Autodesk Inventor Professional 2011 functionally compared with SolidWorks Premium 2010. To limit the scope of the project we decided to compare 15 functional areas. We employed a technique called Delphi Expert Analysis, whereby we organized, prepared for, hired, and supervised, a team of four experts for each software product. See more about the details of our Delphi Expert Analysis on the next page. These experts replied to an in-depth questionnaire of 161 functional questions by providing their opinion of how well the product met each function along with an explanatory comment.

Readers might ask how unbiased this analysis is, since it was sponsored by the author of one of the products being compared. While we admit to some bias in selecting the functions to be compared, particularly as it relates to the mechanical interest in BIM, all the functional areas selected for comparison are important. Once the functional areas were decided upon, TechniCom's analysts

For user organizations needing assistance in how to go about an MCAD system selection, refer to "TechniCom's Guide to Selecting a Mechanical CAD System for Small and Medium Businesses (SMB)" published May 2010, and available on www.cad-portal.com.

About TechniCom's Delphi Expert Analysis

Our experience using this approach shows that this is a solid way to achieve the desired results. Instead of a simple feature and function analysis, the Delphi expert approach relies on the opinions of independent external expert users who rate and comment on a series of questions prepared by TechniCom. Developing the most appropriate questions ensures that our analysis is correct. We recruited four experts for each of the two systems being evaluated. Both groups of experts were similar in their backgrounds. We submitted the questions to each of the experts, closely monitoring their progress and worked with them to insure similar levels of evaluation to those of the other experts. Each expert had a final pass at their evaluation after receiving a report showing the results of their peers. This proved highly effective in normalizing the results.

The 161 functional questions were each rated subjectively, with a justification comment for each rating. The scores range from 0 to 5, with 5 being the best, and 0 depicting no capability. A rating of 5 could be considered perfect -- the question being evaluated meets all requirements and can expand to meet future needs. Very few 5's are awarded.

independently selected the questions with virtually no interference from Autodesk. After all, we were performing an independent assessment of the products. In our estimation, the questions do not favor any specific vendor or product.

We further reduced bias among the experts by the nature of the Delphi Method, whereby each of the experts, after their initial rating, had the chance to compare his ratings and comments with those of his peers.

Functional areas and the questions asked

We did not weight the importance of the fifteen functional areas; users making similar analyses might find certain functional areas more important than others for their organization and choose to assign weights to each area.

Critical to this analysis was the list of 161 questions focusing on product functionality. These functional questions were submitted to a total of eight experts for their opinion, four experts for each system. These questions were divided into the 15 functional areas shown in Chart 2. We decided not to add more functional areas to keep the study length reasonable. We believe that these functional areas represent a broad and objective assessment of a CAD system's capability.

What we compared

Since each of these systems offer a wide variety of add-ins and third party products, we designated specific products and packages as shown below. Beyond these we limited software to those normally included "out-of-the-box." A list of these is discussed below.

The Autodesk software considered includes: Inventor 2011 Professional Suite with Inventor Fusion, Autodesk Vault for Workgroups, AutoCAD Electrical, Inventor Publisher, and Showcase.

The SolidWorks Software considered includes: SolidWorks 2010 Premium, SolidWorks Workgroup PDM, SolidWorks PhotoView 360, and 3DVIA.

No third party products were included. In addition, neither ease-of-use, cost or software beyond the above list was not evaluated.

Our approach

To develop the ratings for both software systems, we recruited four experts to complete the questionnaires for each of the two systems being evaluated. Each expert rated only one system. TechniCom reviewed the expert opinions and worked with the experts to assure all used similar levels of evaluation for each question. Allowable ratings ranged from zero to five, with five being the highest rating. Importantly, each rating included a justification comment. After collating and developing an interim report we re-submitted the evaluations to the experts for their review, but this time allowing all experts to see the other expert ratings for the software product they rated. This proved to be highly successful in normalizing some of the results.

There was no industry orientation for this evaluation. The experts were selected by TechniCom primarily based on their experience with the product and secondarily with the MCAD industry in general.

Summary of the results

Shown below is a chart of the final scores. These results average the ratings of the experts who voted for each line item and average the results of the questions in each functional area for all four raters for each product.

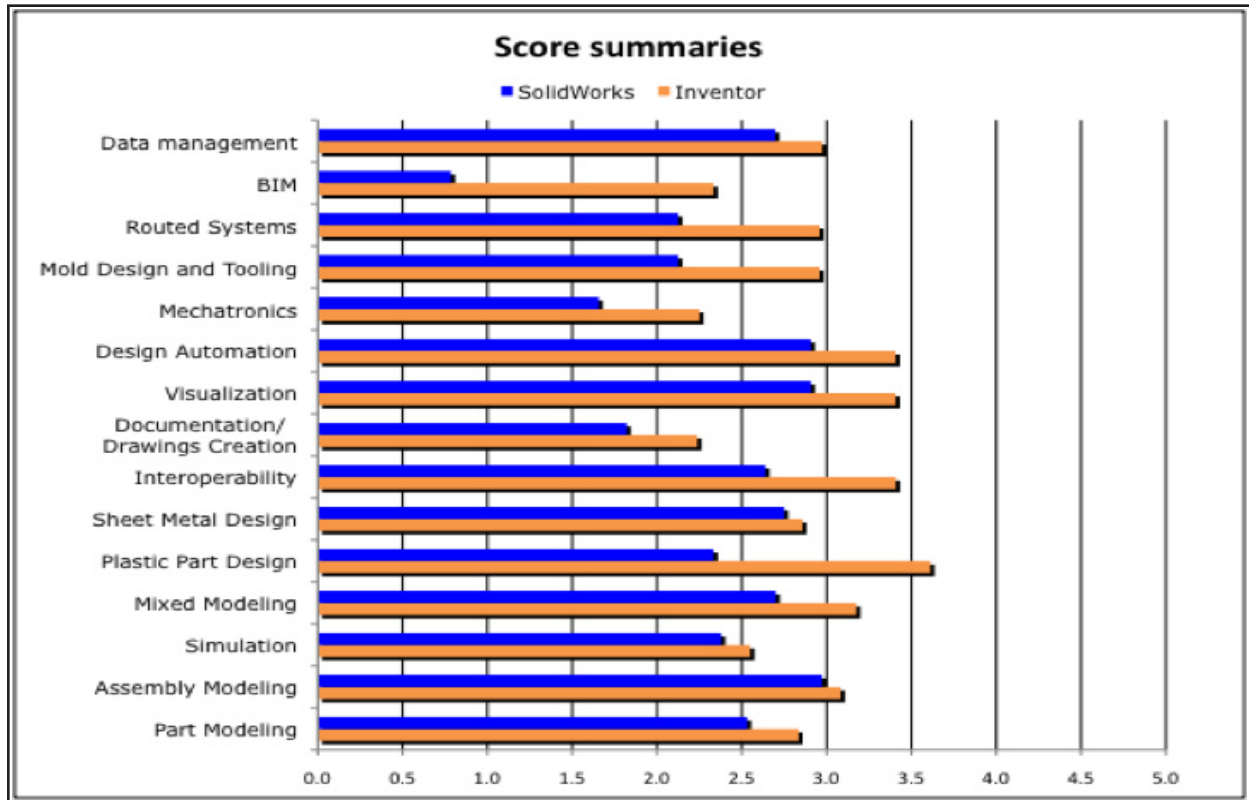


Chart 1 – Score summaries

The results were very surprising. Inventor leads SolidWorks in every category. This was completely unexpected and was not visible until all the results were tabulated from the detailed ratings.

We attribute this to the breadth of the product offerings from the Inventor family. During the past several years Autodesk has expanded the Inventor product line enormously, both by buying promising technology and developing technology internally. Examples are the acquisitions of Algor and Moldflow. More than acquisitions, these products are continually being merged into the Inventor core product. The results provide Inventor with a more diverse solution set. This is evident by the scores in Plastic part design (5), Simulation (3), and Mold design and tooling (12). The internally developed and radically different approach for mixed modeling (Fusion - combining both parametric and direct modeling) seems well received. Inventor Fusion Technology, Autodesk's approach to mixed modeling, originated from Autodesk Labs and is now beginning to be fully incorporated into Inventor.

Inventor greatly exceeds SolidWorks in the areas of Plastic Parts Modeling and BIM (functional areas 5 and 14). The result for BIM (Building Information Modeling) is to be expected since SolidWorks offers no solution for this primarily architectural area.

In terms of the opportunity for improvement, it is interesting to consider those areas where no vendor exceeded a rating of 3 or above. This represents a gap in function for both vendors (an opportunity for

substantial improvement). We found that opportunity gaps exist for functional areas: 8 - Documentation and drawings, 11 - Mechatronics, 13 - Routed systems, and 14 - BIM. Inventor was most successful in the area of 5 - Plastic part design. Next most successful were sections: 9 - Visualization, 10 - Design automation, 12 - Mold design and tooling, and 14 - Data management. SolidWorks ranked a very competitive second place in functional areas: 1 - Part modeling, 2 - Assembly modeling, 3 - Simulation, 6 - Sheet metal design, and in

Functional area	Inventor Professional score	SolidWorks Premium score	IP and SW Close (<12%)	IP Better (12-30%)	IP Much better (>30%)
14. BIM (Building Information Modeling)	2.3	0.8			X
5. Plastic Part Design (Molded part design and analysis)	3.6	2.3			X
12. Mold Design and Tooling	3.0	2.1			X
13. Routed Systems	3.0	2.1			X
11. Mechatronics/Multi-Disciplinary Collaboration (between Electrical and mechanical designs)	2.3	1.7			X
7. Interoperability	3.4	2.6		X	
8. Documentation/ Drawings (Creation of documentation and technical publications)	2.2	1.8		X	
4. Mixed Modeling (using both parametric and direct)	3.2	2.7		X	
9. Visualization	3.4	2.9		X	
10. Design Automation	3.4	2.9		X	
1. Part Modeling	2.8	2.5	X		
15. Data management and Collaboration	3.0	2.7	X		
3. Simulation (Design verification and analysis)	2.6	2.4	X		
6. Sheet Metal Design	2.9	2.8	X		
2. Assembly Modeling	3.1	3.0	X		

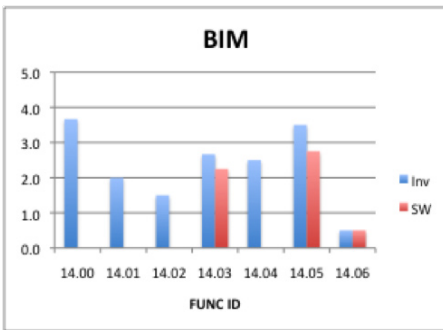
Chart 2 – Table of scores, ranked by percentage difference of the high score from the lower score

15 - Data management.

Here is another way of examining the same data. The rows are sorted by decreasing differential percentages between Inventor Professional (IP) and SolidWorks Premium. Shown in columns 2 and 3 are the average scores for each function. The number shown in the left column (1) refers to the functional area as shown in Chart 1.

A SAMPLING OF THE DETAILED RESULTS

We have excerpted comments from the full project report so that we can share some of the more meaningful details with you. This section



is organized similar to chart 2; from the largest score differential to the closest (or from Much Better to Close). In the interest of brevity, not all functions are included in this section.

INVENTOR MUCH BETTER THAN SOLIDWORKS

BIM (Building Information Management)

Because Autodesk is a leading BIM vendor, one might expect that an Inventor to BIM integration would be tight and extensive. Inventor leads SolidWorks in this capability. SolidWorks has very limited integration capabilities. Questions 14.00 - 14.02 focus on exporting mechanical data with its attributes and maintaining associativity with BIM applications.

Plastic part design

The recent enhancements to Inventor in plastic part design are apparent from these scores. Inventor leads overall by a wide margin in the following questions:

- 5.02 - Enables evaluation and selection of approved materials,
- 5.03 - Support for the plastics manufacturing process), and
- 5.04 - Provides input for the mold tooling and moldbase design).

Moldflow’s acquisition added substantial capability in material properties and its close connection to the manufacturing process.

Routed systems

While both systems offer capabilities to route wire, cabling, and tubing, Inventor excels in its ability to actually understand the electrical function in the case of wiring.

In question 13.05 (System is aware of electrical and piping constraints when building harnesses), one Inventor expert noted, “Inventor allows constraints to be added during the routing creation process. If constraints are defined, Inventor recognizes them for avoiding violations.”

Several SolidWorks experts stated that it “does not possess this capability.”

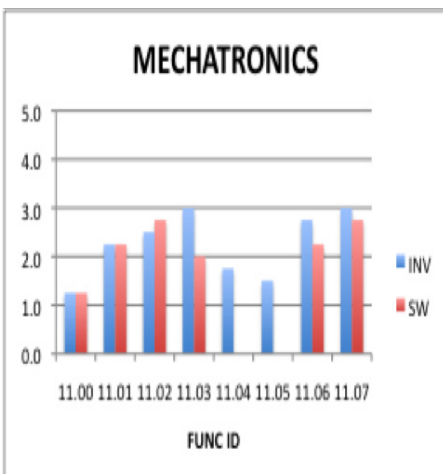
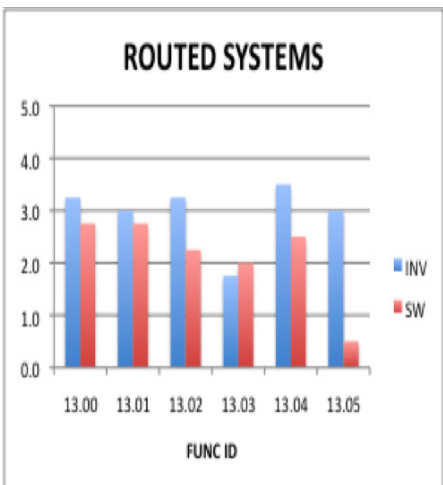
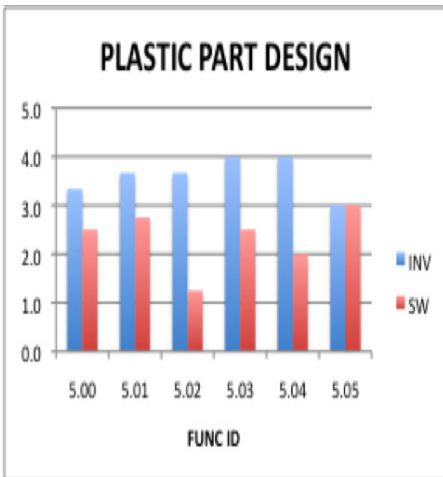
Mechatronics

Question 11.04 is a clear differentiator, asking about “Providing special procedures and assistance with control systems design; supports PLC’s; supports reading of electrical wiring designs and aids in the placement of mechanical connectors, PLCs and busses, and switches as needed”.

An Inventor expert noted “AutoCAD Electrical aids in the design of electrical schematics. It does not interface with Inventor to allow you to physically model these electrical enclosure components. AutoCAD Electrical has a large library of PLCs as well as other components for placement within a drawing. Electrical can also take a spreadsheet exported out of the PLC programming software and use this to create the appropriate drawings automatically. Any changes to physical parts in electrical is updated in the model.”

SolidWorks has no comparable functionality.

The astute reader will also notice that no vendor scored higher than average in mechatronics. There is much room for improvement by both vendors.



While SolidWorks has a fascinating connection to National Instruments for simulating electrical processes within a mechanical system, in our opinion, most designers are more interested in “connecting” with control systems which are prevalent in virtually every mechanical system.

INVENTOR BETTER THAN SOLIDWORKS

Interoperability

While Inventor leads in all categories, SolidWorks scores are very close to Inventor's, also offering a high degree of interoperability, except for question 7.08.

Question 7.04 asks - Can the system easily operate with heterogeneous models? Inventor rated more easily able to read other system's data. One Inventor expert reported that “All data is converted into Inventor readable data (either smart features or dumb solids). I have had little trouble dealing with imported data.”

Question 7.08 was loaded, specifically asking about associativity with BIM (Building Information Modeling). SolidWorks has no BIM offering and has not partnered with another vendor to offer it, while Autodesk is the dominant vendor in BIM.

Most of the SolidWorks experts pointed out the lack of a CATIA translator. This definitely harmed the scoring as compared to Inventor.

Mixed modeling

Mixed modeling means mixing both direct and parametric modeling in the same design of a part. Question 4.02 displays a wide gap between the two vendors. The question asks whether “Modeling can start with either paradigm (history or non history).” One expert noted, “Inventor can begin either way depending on if you use Fusion or Inventor. Either type can be used to start a part that is based on sketches.” SolidWorks edges ahead in functions 4.04 and 4.07, where the experts seem to prefer that constructs all be kept in the history tree.

4.04 - Parametric models with direct modeling constructs all kept in history tree

4.07 - Models may contain both parametric and direct modeling features.

We anticipate that as Inventor Fusion Technology makes its way into the base product, its unique approach of converting direct model results into parametric features, will favor Inventor even more. SolidWorks has not yet embraced the idea of direct modeling. One SolidWorks user noted, “Available, but not an effective way to use SolidWorks.”

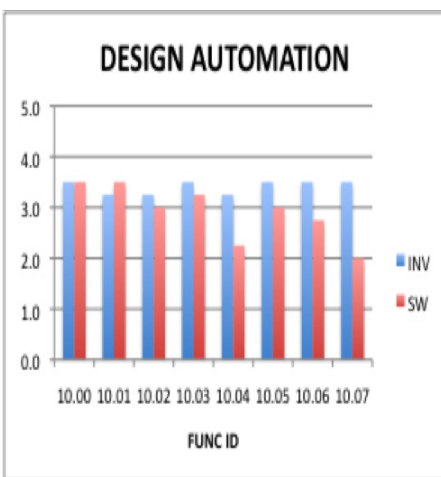
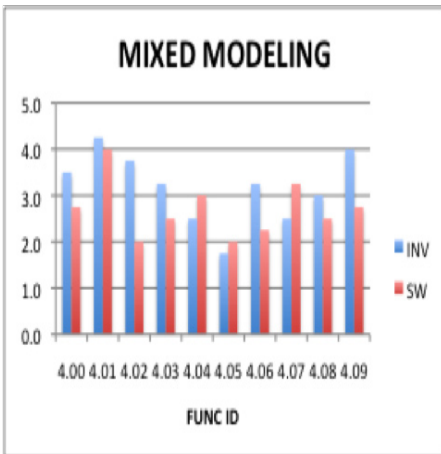
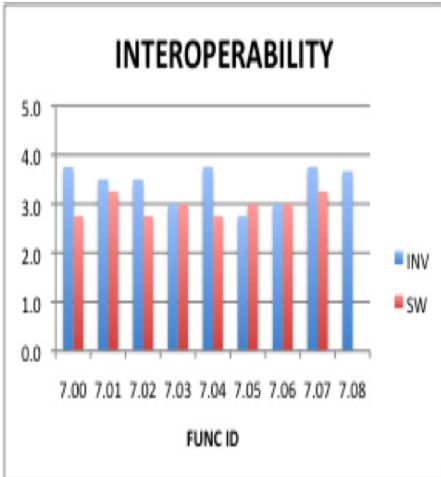
Design automation

Questions 10.04 and 10.07 show the widest gap between the two products.

10.04 - Provides interface and allows for custom engineering models driven by parameters and programmatic methods.

10.7 - Allows for a system of rules-based modeling.

Autodesk's use of iLogic allows a leading position over SolidWorks in this functional area. One SolidWorks expert noted, “SolidWorks requires Excel and/or the use of a hard-to-use design table.” Inventor has a much better, built-in solution for rules based modeling.



Readers should note, however, that SolidWorks has several third party offerings available at extra cost and thus not included in this evaluation, that provide excellent design automation.

INVENTOR AND SOLIDWORKS CLOSE

Data Management and Collaboration

Inventor leads SolidWorks substantially in response to questions 15.05, 15.08, 15.11, and 15.13. As an example we discuss 15.13.

15.13 - System allows for the creation of manufacturing process planning drawings and documentation based on the model. Also allows for storing this data along with the model.

An Inventor expert notes "Vault can store a drawing file type. These processes can be vaulted alongside the CAD data. The manufacturing processes do not exist inside the CAD models. These drawings are created with Inventor, but are stored in the Vault. Virtually any type of data relating to a model can be created and stored via Vault."

A SolidWorks expert notes, "SolidWorks is capable of performing some of this by using standard SolidWorks features like configurations and display states. No additional functionality exists to assist in this. Configurations, display states and alternate position views allow you to create alternative versions. There is minimal automation for process planning."

SolidWorks leads Inventor in the ratings for questions 15.09, 15.10, 15.12, 15.17, and 15.18. As an example we discuss 15.18.

15.18 - Is the system able to perform BOM management?

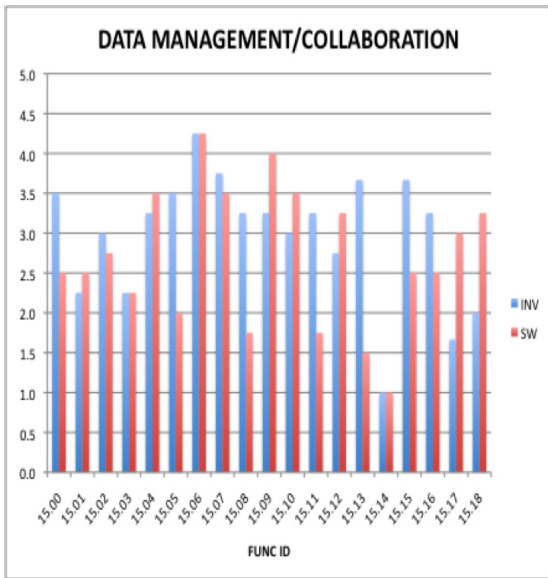
For question 15.18 (BOM Management) a SolidWorks expert noted "Workgroup PDM has extensive capabilities for managing BOMs, both computed and named, as well as other entities, such as SolidWorks drawings, weldments, and cut lists. It also supports BOM exclusion, so IP can be protected by not showing some components."

For the same question, an Inventor expert noted, "BOM Management is primarily performed using Inventor's BOM Manager, but data generated can be stored and accessed in Vault."

Conclusions

Given the complexity of the analysis and its broad scope, what can a reader conclude? Importantly, readers need to understand that this report provides a glimpse of certain expert opinions. While this was a small group considering that both products have hundreds of thousands of installations, we believe that the results are valid in assessing overall capabilities. Given that the results are valid, we conclude that Inventor Professional has reached and exceeded SolidWorks Premium functionality in most of the areas we studied. We believe that this is the case both because Inventor has neatly consolidated many of its acquired technologies into the Inventor product line and that Autodesk continues to aggressively pursue and incorporate new technologies. Yet, neither product is perfect; there are opportunities for both products to improve in many areas.

Users should use this paper to concentrate on those functional areas most important to their business. Autodesk sponsored this paper. Additional details of this project may be available through Autodesk.



About the Author

Raymond Kurland is president of TechniCom Group LLC and its principal consultant and editor. His firm, founded in 1989, specializes in analyzing MCAD and PLM systems and has been involved in reviewing and comparing such software since 1989. Ray frequently consults with both vendors and users. Ray has Bachelors and Masters degrees in Engineering from Rutgers University and from NYU. His career included stints with Bell Telephone Laboratories, IBM, and Dassault Systemes. Ray can be reached at rayk@technicom.com.

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