Cyon Research™

A Fresh Look at the Value Proposition of High-End Mechanical CAD

A Cyon Research White Paper

July 13, 2007

Cyon Research Corporation
8220 Stone Trail Drive
Bethesda, MD 20817-4556 USA

301-365-9085
cyonresearch.com

A Fresh Look at the Value Proposition of High-End Mechanical CAD

A Cyon Research White Paper

Executive Summary

The purpose of this white paper is to examine the conclusions of our 2003 white paper, *The Value-Proposition of High-End Mechanical CAD*, in order to determine if they are still relevant. The four years since the white paper was released have seen massive changes in the capabilities of all CAD systems. While high-end systems are still high-end, they no can no longer be differentiated from mid-range systems solely based on geometry creation tools.

Both classes of systems have evolved. They remain distinct, but not in terms of the same qualities that distinguished them four years ago. The features and functionality of what have been termed "mid-range" systems in the past are no longer inferior to those of what were called "high-end" systems. Since the terms "high-end" and "mid-range" no longer describe the differentiation between the classes, we propose that those terms be dropped in favor of the terms "**specialized** MCAD" and "**mainstream** MCAD," respectively. We believe that both categories still serve real user needs, and will continue to do so.

Of interest (but not a differentiator) is that "specialized MCAD" is typically a corporate decision implemented from the top down[1] and "mainstream MCAD" is typically implemented at a department level or with a bottom-up approach.

The user considering the acquisition of an MCAD system has more choices than ever before. No longer are firms restricted to one class or the other based on scale or scope. Today, enterprises of all scales and scopes have before them a choice with respect to which class of software to use. Regardless of that choice, Cyon Research recommends that firms should consider a balanced approach that involves both bottom-up implementation and top-down planning.

[1] This does not to imply that engineering is not involved in the decision.

A Fresh Look at the Value Proposition of High-End Mechanical CAD

A Cyon Research White Paper

The purpose of this white paper is to examine the conclusions of "The Value-Proposition of High-End Mechanical CAD," published in 2003, in order to determine if they are still relevant. The four years since the white paper was released have seen massive changes in the capabilities of all CAD systems. While high-end systems are still high-end—at least in the sense of price—the systems that were considered mid-range then have added many advanced capabilities that were formerly the sole domain of the high-end[2]. We feel there is reason to re-examine the questions raised in the original white paper, in light of some of these changes—specifically, it seems that in some areas of feature and functionality, those "mid-range" systems now equal or surpass those that were called "high-end" systems.

The world of mechanical computer-aided design (MCAD) software is relatively mature. Technical and market barriers to entry make it unlikely that upstarts[3] will easily displace major players—yet there is constant flux. Advances in CAD software, as well as in computers, are important influences; so, too, are the language and intentions of those who market the software.

When MCAD first became commercial software back in the 1970s, it required the resources of the largest computer systems that were then available. As computers developed, MCAD was able to move to minicomputers, then to UNIX workstations, and finally—in the 1990s—to personal computers. In parallel, the operating systems under which MCAD ran moved from in-house proprietary, to vendor proprietary, to UNIX, and finally to Microsoft Windows.

As the platforms on which MCAD resides have changed, there has been a stratification of MCAD software. In the 1970s and early 1980s, the MCAD market was split into two clearly defined segments—the high end, which comprised MCAD running on mainframes and minicomputers in "glass houses," and a less-expensive set of offerings that ran outside the "glass house"—initially on 16-bit minicomputers and later on workstations.

1982 was a watershed year, with the addition of a new low end to the MCAD market—PC-based, general-purpose CAD drafting software (of limited capability).

From 1982 to 1994, systems evolved and market boundaries shifted. The former minicomputer- and workstation-based products were pushed out of the market almost entirely, and the formerly low-end products started to provide more tools targeted at MCAD.

---

[2] We do not wish to imply that the high-end has been sitting idly by in the intervening years. The high-end vendors have continued to "raise the bar." For example, in 2003, high-end MCAD could create any design part and today the products that we now refer to as "specialized MCAD" can also morph that same design into all downstream versions, with guaranteed full associativity and quality. Similarly, in 2003, high-end systems could create class-A surfaces and today they can make large-scale changes and still maintain the quality of those surfaces.

[3] Even such well-regarded and well-funded startups as SpaceClaim face enormous barriers.

At the same time, high-end MCAD vendors moved their software from mainframes and minicomputers to UNIX workstations. The transition from proprietary systems to the more open UNIX was not easy. Many companies, including Computervision, stumbled in the process. During this period, a new vendor took the high-end MCAD market by storm. That vendor was PTC, which, in 1989, brought parametric solid modeling to the customer, and aggressive no-holds-barred sales tactics to the market.

The next watershed year was 1994, when Microsoft's introduction of Windows NT opened the door to high-performance computing on Windows-based PCs. This led to two related changes that shifted the landscape of the CAD market forever. First, existing vendors, which had weathered the transition from proprietary systems to UNIX, were faced with an unavoidable transition from UNIX to Windows. (Intergraph—one of the biggest CAD vendors of the time—dropped its internally-developed UNIX-based workstations in favor of developing PC-compatible systems running Windows NT.) Second, the PC-based vendors—both existing and startup—started developing a new generation of moderately-priced MCAD products, to take advantage of industry-standard PCs.

From that point, through the beginning years of this decade, the MCAD market has evolved into three classes:

- high-end systems, such as CATIA, NX, and Pro/E[4];
- mid-range systems, such as SolidWorks, Inventor, and Solid Edge[5]; and
- low-end systems, such as TurboCAD and AutoCAD LT.

In 2003, when Cyon Research first published its report on the value-proposition of the high-end products, the classes could be ranked in terms of *what could be designed* with the products from each class. Products in the high-end class were more capable than products in the mid-range, which in turn were more capable than products at the low end. Some projects *required* the use of high-end systems for their design. While the mid-range products were quite capable, some projects could only be done with high-end systems.

In the last four years, that clear differentiation has disappeared. The products in the class formerly referred to as "mid-range" can today create almost any design that the systems formerly referred to as "high-end" can.

The terms "high-end," "mid-range," and "low-end" no longer accurately describe the differentiation among the systems. In fact, since the software is no longer clearly distinguishable based on features and functions, perhaps it is more appropriate to distinguish among the vendors

---

[4] We discuss (below) the fact that Pro/E has shifted its classification and now is positioned firmly in a different MCAD class.

[5] Also included in the mid-range category are the MCAD systems from CoCreate, think3, and IronCAD, Kubotek's KeyCreator, as well as other modeling tools, such as Rhino and form-Z.

on the basis of their focus, as described below. We propose *specialized MCAD* for CATIA and NX, and *mainstream MCAD* for SolidWorks, Solid Edge, Inventor, and Pro/E. (Pro/E has repositioned itself in recent years; while it does have some characteristics of specialized MCAD, it more broadly fits the category of mainstream MCAD[6])

MCAD *specialized*[7] vendors are differentiated from *mainstream* vendors in several ways, but the chief distinctions today are best understood by understanding their focus—how the companies plan their R&D, how they price the products, how they license their products, and how they go to market with them.

In 2003, geometry-creation capabilities constituted an important differentiating factor between high-end and mid-range MCAD systems. Today, that is no longer the case. Cyon Research believes that today the key points of differentiation between the classes are:

- **R&D Focus**. Specialized vendor R&D focuses on providing end-to-end solutions for companies with difficult problems. Often those problem sets involve top-down processes and collaboration among large numbers of globally distributed users. For the specialized MCAD vendor, the integration of new functionality into existing software suites is a primary concern, as is providing solutions for difficult high-leverage problems for small sets of customers, such as turbine blade optimization, or manufacturing design to account for spring-back in large-panel cold-press stamping.

  Mainstream vendors focus their R&D efforts on features and functionality that benefit their broad user base. While top-down processes and collaboration are important to customers of mainstream MCAD, their users do not rely on their MCAD tools as the primary source for implementing top-down processes and collaboration. Mainstream vendors rely heavily on third-party software developers to meet the special needs of smaller groups of users. It is integration with this "software ecosystem" that, along with the overall usability and effectiveness of their software, rank as their highest priorities.
- **Pricing.** The classes used to be strongly differentiated by price. While there is still a difference, it is smaller than it was when we looked in 2003. Today, most of the specialized vendors have a base offering that is within range of the mainstream. What remains, however, is a big price difference for more complete configurations. The table below shows the base prices (top set) and the price of a configuration with linear FEA and motion (bottom set).

---

[6] We have also considered a finer classification that more clearly shows the position of the product lines: specialized MCAD with a PLM focus (CATIA and NX); mainstream MCAD with a PLM focus (Pro/E and CoCreate); and mainstream MCAD with a product focus (Solid Edge, Inventor, and SolidWorks). We have chosen the simpler characterization in order to make this paper's thesis more clear. A later paper has been proposed to address this finer distinction.

[7] The term "specialized" as we use it does not imply a small market. By our estimate, Siemens and Dassault Systemes combined have more than 735,000 users of their specialized MCAD systems.

Product	Base Configuration	License Fee	Annual Subscription
Specialized MCAD			
CATIA	CATIA PLM Express	$10,000	$1,800
NX	NX Mach 1 Design[8]	$8,500	$1,275
Mainstream MCAD			
Inventor	Inventor Suite	$5,295	$1,095
Pro/E	Pro/E Foundation XE	$4,995	$1,500
Solid Edge	Solid Edge Foundation	$3,995	$1,296
SolidWorks	SolidWorks	$4,995	$1,295

Product	Base + Linear Analysis + Motion	License Fee	Annual Subscription
Specialized MCAD			
CATIA	CATIA PLM Express + Generative Structural Analysis + Animated Product Review	$29,000	$5,220
NX	NX Design	$20,000	$3,000
Mainstream MCAD			
Inventor	Inventor Professional	$7,945	$1,295
Pro/E	Pro/E Enterprise XE[9]	$24,995	$5,080
Solid Edge	Solid Edge Classic[10]	$ 5,495	$1,499
SolidWorks	SolidWorks Office Premium	$7,995	$1,995

The top table above shows only basic system prices. Adding applications, whether to the specialized systems or mainstream systems, adds cost. In general, the cost of add-ons to mainstream packages is lower than those of add-ons to specialized systems.

- **Channel**. Specialized MCAD vendors know precisely who their customers are, and bring new solutions directly to them. Channel penetration by specialized MCAD vendors is limited[11]. Mainstream MCAD vendors reach their customers via their VAR channels, and provide support for third-party developers to do the same.

---

[8] NX Mach Advantage is available only to existing customers at $5,500.

[9] PTC has a range of products that would put its pricing at $9,995 rather than $24,995, but the FEA option is only available in its packaged offerings as part of the Enterprise XE package. PTC may be able to match our configuration at a significantly lower price point.

[10] Solid Edge Classic includes linear analysis and motion, but does not include other functions that are included in both Inventor Professional and SolidWorks. With those other functions included, the price as configured is comparable to Inventor Professional and SolidWorks.

[11] Although 35% of Siemens' license revenue comes from the UGS VAR channel, the majority of that revenue is from either Teamcenter or Siemens' Velocity series--the amount of NX revenue from the channel is still small when compared to Siemens' direct sales. Also, the evolving Dassault Systemes-IBM relationship is historically unique and

Other points of comparison:

- **Functionally equivalent**. Mainstream MCAD and specialized MCAD can no longer be differentiated solely on their ability to create the basic virtual product model. Scale is also no longer the exclusive domain of specialty MCAD[12]—both classes are equipped to handle problems of any scale. Much of the extended functionality of the specialized MCAD system is available to the mainstream MCAD user through third-party software, some of which is tightly integrated into the mainstream systems[13].

  Specialized MCAD vendors have, however, invested heavily in areas such as database structure, in support of a vision for a system that will support the different uses of MCAD data—design, analysis, manufacturing, marketing, and so on. Each of these requires different degrees and types of detail, and synchronization among them is a high priority of the specialized MCAD vendor. Mainstream MCAD vendors are less focused on such "top-down" concerns because their customers place less of a priority on these areas.

  The vision of specialized MCAD vendors is that their applications can be more thoroughly integrated than mainstream MCAD, since they come from a single vendor on a platform designed for such integration. We believe in the vision. This integration can provide benefits beyond the simplification of training and a common user interface. Our experience has been that while such integration is found in many applications from the specialized MCAD vendors, in reality it is a work in progress and not yet completely implemented.

  It bears noting that an area of focus for specialized MCAD systems has been refining the geometric representation to accommodate synchronization among different types of models used in the engineering and manufacturing process. For example, a design model may include the refinements required to cut a usable plastic mold. And if there is a need to understand the shape changes a product may undergo after manufacturing—say, shrinking or warping—it can be useful to have a model that will retain parity among these different representations. Mainstream MCAD systems have not at this time encountered a market demand for this level of representational integration.

- **Diminishing differentiation**. Distinguishing the two classes in the future will become more difficult, as mainstream MCAD vendors are able to field more integrated solution-oriented suites. There are now several analysis, simulation, and knowledge-capture tools

---

significantly complicates the channel picture. Dassault Systemes has only five direct accounts where IBM is not involved, and 55% of Dassault Systemes revenue comes from accounts where IBM is not the primary VAR.

[12] Cyon Research has seen unpublished research that leads us to believe that there are several areas where mainstream MCAD may be significantly faster than specialized MCAD on very large models. We are discussing with vendors a benchmark that Cyon Research will be able to publish that documents how the various software products respond with scale.

[13] We don't mean to imply that all third-party software is well-integrated.

as well-integrated with mainstream MCAD software as similar capabilities in specialized systems[14]. Hitherto, these areas made the classes easy to distinguish.

- **Out-of-date viewpoints**. Today, both classes of products are so deep and rich that users are hard-put to stay on top of the latest developments—many users hold strong opinions based on impressions that are several years out of date. Indeed, even industry experts hold on to outdated notions of the relative capability of the product classes. This is to be expected, as we have reached the point where it is beyond our capacity to determine the viability of solutions without being an expert user.[15]

The major conclusion of our 2003 paper was that high-end products had quantifiable strengths over their mid-range competitors, and that the specific areas of strength fell into these categories:

1. Integration with other enterprise software
2. Knowledge-based engineering
3. Advanced surface design
4. Specialized design tools
5. Large/complex-project management tools
6. Continuous software innovation
7. High-value services

Each of these points was claimed as a benefit of high-end—i.e., specialized—MCAD systems over the mainstream MCAD systems—i.e., SolidWorks, Inventor, Solid Edge (and now Pro/E).

Let's consider each of these points.

1. Integration with other enterprise software

Integration of CAD with enterprise systems is a large and complex subject. In our original paper, we addressed this area by summarizing it in bullet-point fashion as one in which "high-end"

---

[14] Specialized MCAD vendors make the case that the level of such integration of their solutions gives their systems capabilities well beyond those of mainstream systems, particularly in iterative round-trip scenarios, such as tying meshing and optimization back to drive geometry. They concede that the raw capabilities to accomplish this are not exclusive to specialized MCAD—it can be accomplished with mainstream MCAD. The primary issue is that with specialized MCAD these capabilities are built-in, while with mainstream MCAD they are not; work is involved in automating these tasks. Our point is that the ability to do it is no longer a differentiator—the differentiator has become "buy it" (specialized) or "build it yourself" (mainstream).

[15] Our research for this white paper was not focused on testing of the systems in question. Instead, we base our research on extensive conversations with vendors, our peers in the analyst community, and users of the software and systems. Our conversations with vendors included not only the major vendors mentioned in this paper, Autodesk, CoCreate, Dassault Systemes, PTC, and Siemens, but also the significant third-party vendors and component software vendors. Most importantly, we had extensive conversations with a wide range of users representing firms of various sizes and industries, including those who are representative of best-in-class and typical users.

systems were unequivocally superior to "mid-range" systems. We believe this is no longer the case, for two reasons: Firstly, there are now off-the-shelf third-party products that facilitate integration of mainstream systems with PDM and ERP. Secondly, the mainstream MCAD vendors now have consulting groups of their own, which address—among other issues—integration challenges.

Dassault Systemes, one of the leaders of the specialized class, has historically[16] distinguished between "process-centric" and "design-centric" to differentiate the market domains of CATIA and SolidWorks. One key aspect of process-centric systems, according to Dassault Systemes, is integration with enterprise software, such as ERP.

Today, Inventor, Pro/E, SolidWorks, and Solid Edge can be seamlessly integrated with enterprise software. Each offers more than one method for interconnecting with ERP and other enterprise applications. Matt Hagerman, director of consulting services for Hagerman & Co. notes that "with all modern ERP systems and general-purpose MCAD packages (AutoCAD, Inventor, SolidWorks, etc.), this is really a non-issue. From a technical standpoint, all mainstream MCAD software (and their associated data-management tools) can communicate with all modern ERP systems."

A variety of third-party applications facilitate integration of mainstream systems with ERP; examples include:

- BWIR's SolidWorks-ERP Bridge is a one-stop solution for CAD-ERP integration. The application allows the search, creation, and update of assembly and part information from within the SolidWorks interface. The kernel of the SolidWorks-ERP Bridge has been designed with an architecture that is both CAD- and ERP-system agnostic. It can be used to integrate any CAD system to any ERP system by developing the necessary connectors.
- Elmo's AgniLink offers live, bidirectional, "hot" CAD-ERP integration for Inventor, SolidWorks, and others.
- Cideon provides a product called CAD Desktop that enables integration of Inventor with SAP.

In general, integration of CAD with enterprise software is not "shrink-wrapped"—neither for specialized nor for mainstream vendors. It requires a combination of software and services, which can be obtained from a large variety of sources.

- **PDM**. Teamcenter, as an example, has native integrations for most major CAD programs, including AutoCAD, MicroStation, Inventor, Solid Edge, SolidWorks, Pro/E, NX, CATIA, and more. It is designed to work in a hybrid environment, and be "CAD

[16] Recently, Dassault Systemes has dropped this distinction and moved to use the term "3D mainstream" for its SolidWorks product line.

agnostic." Similarly, ENOVIA, Smarteam, and Windchill have a large number of integrations.

While the corporate line in the large PLM companies may be that customers should use their entire range of solutions, including CAD and PDM, the vendors on the PDM side are pleased to work with customers using nearly any competitors' CAD products.

- **3D Publishing and ECM (Enterprise Content Management).** Adobe, Seemage, Cimmetry, and others provide publishing tools which support most major CAD programs. A number of CAD vendors have partnered with one or more of these.

2. Knowledge-based engineering

Both Dassault Systemes and UGS (now Siemens[17]) have long emphasized knowledge-based engineering (KBE) as an important feature of their respective CAD systems.

A careful examination of third-party products such as DesignRules and RuleStream, as well as Autodesk's Intent, shows that they provide mainstream MCAD products with significant KBE capabilities, and reveals that they have caught up with the offerings of Dassault Systemes and Siemens, from the point of view of capabilities—and have exceeded them in ease of use and openness.

One major aerospace user of KBE told us:

> *"For parts and assemblies to which KBE techniques are applicable, MCAD is not a central part of the process; it is simply an output facilitator. So it is distressing to me that Dassault Systemes' KnowledgeWare and Siemens' Knowledge Fusion are so tightly integrated with CATIA V5 and NX, respectively. That's why I prefer to use RuleStream, which is CAD-independent, and does not make my CAD preference a constraint."*

Moreover, the benefits of KBE are available to any engineering effort, regardless of choice of CAD system. For example, http://lean.mit.edu/index.php?option=com_docman&task=doc_download&gid=599 reports on a study showing carefully measured ROI benefits of thousands of percent over non-KBE methods in the implementation of the DD(X) Enterprise program by contractors Northrop Grumman and Raytheon on behalf of the US Navy. From the report:

> *"The Customer Stakeholder is demanding a historical product from the DD(X) enterprise; A revolutionary warship of significant scope, complexity and diversity that requires the critical mass of intellectual assets and "know how" from over 100 organizations for success.*
>
> *Results:*

[17] Since we began our research, UGS has been acquired by Siemens. For the remainder of this paper we will use the new company name: Siemens.

- *NGSS realized an estimated ROI of 2376% for the 6-month period from KM tool roll-out and adoption (Jun 04) to data collection (Jan 05).*
- *Also, an estimated ROI of 3469% for the 18-month period of June 04 to December 05.*

These benefits are a direct result of the capital investments made in the KM tools due to:

- *Reduction in process cycle times (46% of benefit)*
- *Reduction in process re-work waste (33% of benefit)*
- *Reduction in NGSS travel expenses (22% of benefit)"*

The tools and techniques had nothing to do with the choice of CAD system, and would have applied to any software system. [18]

While the in-house KBE systems of specialized vendors can have access to a level of detail in the vendor's database that may not be available to external products, they must sacrifice openness and interoperability for it. We believe KBE for specialized MCAD and KBE for mainstream MCAD both provide a rich set of effective KBE tools; and while there are differences, one is not inherently superior to the other.

3. Advanced surface design

Discussions with users reveal that pure surface design and management, as opposed to surfaces in the context of solids, are quite as advanced among producers of software that integrates with SolidWorks, Inventor, Pro/E, and Solid Edge as they are within CATIA and NX. For example, AeroHydro's SurfaceWorks produces surfaces for shipbuilding that compete favorably with what CATIA is able to produce[19]. Other mainstream products, such as Rhino and Autodesk's DesignStudio[20], are able to generate class-A surfaces.

For surfaces that are fully integrated in solid modeling, and for some specialized surface types of math (such as would be used in some aerospace applications), the specialized MCAD vendors have an edge over Solid Edge, Inventor, and SolidWorks, but not necessarily over other mainstream MCAD systems such as think 3, IronCAD, Pro/E, and Ashlar-Vellum's Cobalt.

Nonetheless, the ability to create and edit sophisticated surfaces has become one that is available independent of CAD system choice. For example, while Gehry Partners, a leading world-class

---

[18] The DD(X) program mentioned in the quote makes extensive use of CATIA V5 and V5 Knowledgeware. Our point is that in their discussion of value of their KBE, Northrup-Grumman does not even mention CAD.

[19] There is a small class of problems for which the dynamic range of scale is an issue. For these problems, the number of decimal places of precision typically found in mainstream MCAD is insufficient. Today, the domain of those problems is still one that only specialized MCAD addresses.

[20] Autodesk's DesignStudio shares geometry-creation and geometry-editing tools with its specialized MCAD siblings, Autodesk Studio and Autodesk AutoStudio, which are used by most of the world's automotive companies.

architectural design firm, still relies on CATIA for its design documentation, it now uses Rhino[21] in early stages of design for exploration of design alternatives. Recently announced FreeDesign has introduced a new method of interaction with class-A surfaces. Aerospace legend Burt Rutan's company, Scaled Composites, uses CATIA for composite design. But for the subtleties and complexities of conceptual design, it relies on Ashlar-Vellum Cobalt.

The sophistication required for surfaces is no longer a reason to choose a specialized MCAD vendor's products over those of mainstream MCAD vendors. At the same time, mainstream MCAD systems in conjunction with third-party applications often still challenge users with multiple user-interface paradigms and less-than-perfect data associativity.

4. Specialized design tools

While CATIA and NX offer dozens of specialized design tools for specific industries, third-party applications for Inventor, SolidWorks, Pro/E, and Solid Edge cover a similar range, though perhaps not yet with the same level of richness, depth, and breadth of range. Many of these applications are now integrated within their respective host products, so that they appear no less uniform than CATIA and NX.

What differentiates the classes here is that the specialized MCAD vendors continue to develop valuable tools to meet the needs of narrow bands of very demanding [22]customers. Any of those tools could be delivered to work with mainstream MCAD software systems, but the economics of that class make it less likely that such tools will be brought to market.[23]

It is feasible for Siemens or Dassault Systemes to make their specialized tool libraries accessible via Solid Edge and SolidWorks. Indeed, Siemens has started to walk down this road with some of Siemens' CAM tools.

Here are some examples of specialized design tools that are CAD-independent:

- **Functional Modeling.** Several years ago, Dassault licensed functional modeling technology from Atilio Rimoldi's ImpactXoft company. Last November, Autodesk similarly licensed technology from Rimoldi. (See the Dec 12, 2006 CADCAMNet, http://www.newslettersonline.com/user/user.fas/s=63/fp=3/tp=47?T=open_article,949994&P=article.)

---

[21] Interestingly, Rhino and ICEM, recently acquired by Dassault Systemes for advanced surfacing, shared the same source for their surface mathematics.

[22] Once again, we want to be clear that "narrow bands" in this context refers to the width of the market segment, not the dollar value of the needs of those customers.

[23] At some point in the future there may be a component business model for these specialized tools. See the Cyon Research white paper: *"The Innovator's Dilemma" in the context of CAx and PLM vendors – The case for an engineering software components market* .

- **Body in White (BIW) design tools.** These are generally a combination of KBE and CAE applications. For example, http://www.mscsoftware.com/success/details.cfm?Q=285&sid=281. The capabilities that distinguish these products in the automotive world, are not related to aesthetic surfaces, but rather their offering of a solution including many specialized applications, including BIW templates.

  There is nothing that prevents auto manufacturers from developing their own BIW templates, using any KBE system. The knowledge to do this is not the exclusive domain of Dassault or Siemens. For example: http://taylorandfrancis.metapress.com/content/90kxgwy6k7uxux68/ and http://adsabs.harvard.edu/abs/2005AIPC..778..484Z

- **Composite design.** The best-known software in this area is FiberSim, a product available only for CATIA, NX, and Pro/E. But other composite design programs include CDS, from the University of Delaware (http://www.ccm.udel.edu/Tech/CDSindex.html), used by many major defense contractors, which can interact with any CAD system. The NASA COSMIC collection (http://www.openchannelfoundation.org/cosmic/) includes a number of composite design and analysis programs.

5. Large/complex-project-management tools

The three primary areas of concern for large and complex projects are model size, data management, and digital mockups.

At the time of our 2003 paper, the mid-range products were not yet at the point where they could keep up with their high-end counterparts when models became very large. That is no longer the case. Pro/E, Solid Edge, SolidWorks, and Inventor have demonstrated themselves capable of handling models and assemblies that more than meet the needs of very large projects. Moreover, each has more than one PDM system that supports large and complex projects. We believe that some mainstream MCAD software products may actually outperform specialized MCAD products on "super-sized" projects.[24]

In the course of our research, we confirmed that the propagation of PLM continues to be a top-down affair in manufacturing firms. The concept is sold to top management, and the systems are imposed on the organization[25]. By contrast, many engineering workgroups acquire workgroup-level tools, such as product-data-management systems, that provide them with visible benefits, without the complexity of the PLM systems. There seems to be a market opportunity for mainstream MCAD vendors to build on department-level satisfaction to grow incrementally into enterprise-wide implementations.

---

[24] See footnote 12.

[25] PLM, by its very nature, requires top-down planning.

Former limitations on the PDM products that prevented them from scaling into enterprise systems are quickly disappearing. Mainstream MCAD is in tune with current notions of openness and scalability. Of course, openness and scalability are as desirable for large firms as for SMBs.

Perhaps one of the most challenging applications for CAD is the area of digital mockups. Scaling factors prevented software products from competing effectively with those of special-purpose vendors in the past. But today, both the ability of software products to handle models as large as those that used to be the exclusive province of CATIA and NX, as well as the existence of third-party multi-CAD software (such as that of Seemage – see http://www.seemage.com/eng/products/seemageMockup.html) means that that world of digital mockups is now open to mainstream MCAD.

6. Continuous software innovation

The resources dedicated to the support and evolution of MCAD systems is not necessarily greater for specialized MCAD than for mainstream MCAD. The difference is on the focus of how they deploy their R&D teams. At the mainstream MCAD vendors, most of the effort goes to providing as much value as possible to as broad a spectrum of customers as possible. When it comes to areas outside the mainstream, the mainstream MCAD vendors look to their third-party software developer community to balance out the picture. Specialized MCAD vendors must dedicate a significant portion of their resources to meeting the broad needs and more of their development effort on the hard problems of their existing customer base, and therefore have a correspondingly smaller percentage of their R&D budget to devote to providing broad value across their customer base.

Sun Microsystems founder Bill Joy said,

> *"Innovation will happen. But it won't happen here. Most of the bright people don't work for you - no matter who you are. You need a strategy that allows for innovation occurring elsewhere."*

So while the specialized MCAD vendors may have larger in-house development teams than do the mainstream vendors, the open nature of the CAD software third-party development community is likely to capture as much or more of the available innovative capacity.

Specialized MCAD vendors continue to broaden and deepen their approach to the automation of the manufacturing process as a whole; mainstream vendors focus on the improvement of tasks and ease-of-use per se. The real differentiation between the classes in terms of software innovation is that it is likely to occur faster for users of mainstream MCAD software products; in niche areas it is more likely to occur through the third-party channel.

We expect to see high levels of innovation from the specialized MCAD vendors in two domains—automation infrastructure and functionality that relate to the manufacturing process as

a whole; and high-productivity automation in narrow[26] areas of focus for large automotive and aerospace customers.

7. High-value services

Our 2003 white paper listed the following as high-value services and capabilities offered by special-purpose vendors:

- Needs assessment;
- Data migration expertise;
- In-house customization services;
- Best-practices consulting;
- Advanced training;
- Global presence, and
- The capability to manage a complete solution

These offerings have evolved, and are even stronger today than they were four years ago. Meanwhile, some of the mainstream system vendors have developed their own consulting organizations to support the sale and deployment of their products.

These services are not strictly in the realm of MCAD; they are consulting services, offered by MCAD vendors. Some vendors are providing this service directly, others through their VAR channel. In either case, the providing of high-value services and capabilities in and of itself is no longer a differentiator between the two classes.

Interestingly, specialized MCAD system vendors have developed a market that is much lower in terms of seat volume growth[27] that that of mainstream MCAD systems. As a concomitant of service-intense implementations, project costs tend to be high for specialized-system implementations, accommodating typically broad ranges of training and technical assistance. Vendors of mainstream MCAD systems are much more accustomed to compete on price and to justify every dollar. This has tended towards leaner and more efficient implementations, with clearer payback, than for specialized system implementations.

---

[26] Again, narrow here refers to scope, not the size of the market segment.

[27] While the growth of specialized MCAD seats is significantly slower than that of mainstream MCAD, the number of commercial licenses of specialized MCAD seats is on par with that of mainstream MCAD, due to the long head-start of specialized MCAD. Also, it is important to note that while the seat count growth is lower, the revenue to specialized MCAD vendors has yet to be surpassed by revenue from mainstream MCAD seats.

Conclusion

While the terms "high-end" and "mid-range" are no longer useful for distinguishing CATIA and NX from Inventor, SolidWorks, and Solid Edge, they still represent two distinct classes of systems.

There is no longer reason to regard Inventor, SolidWorks, or Solid Edge as implicitly less capable in the creation of geometry than CATIA or NX. However, there are two different business models, focuses, and types of customer relationships represented by these two groups. CATIA and NX are sold largely[28] directly. Sales proposals typically include a range of services, such as training, customization, and implementation consulting. The price of the software is typically only a fraction of the overall cost.

On the other hand, Solid Edge, SolidWorks, and Inventor are sold almost exclusively through reseller channels. While these VARs may propose add-on services, the transaction is typically about a certain number of seats of software, at so much per seat. PTC is transitioning its Pro/E sales from a predominantly direct model to a predominantly indirect model[29].

There are still clearly two classes of MCAD customers—those desiring comprehensive implementations and those desiring *a la carte* solutions. Specialized MCAD vendors will continue to focus on the former, and mainstream MCAD vendors on the latter— though recently, even specialized MCAD vendors have turned their attention to the *a la carte* needs of the dynamic SMB (small and medium-size business) markets.

Mainstream MCAD vendors have made strides toward closing the feature/function gap. They can compete head to head in the broad market with specialized MCAD vendors, at least matching most of their geometry-creation capabilities either in and of themselves, or in conjunction with well-integrated third-party products and services.

Moreover, global competition has caused all MCAD customers to become more cost-conscious than ever before. Especially in the growth segment of the MCAD market—small-to-medium-size businesses—customers are more inclined than ever to carefully mix and match applications and do their own integration, on a step-by-step basis, rather than calling vendor X and saying, "Give me the works."

Both classes of systems have evolved. They remain distinct, but not in terms of the same qualities that distinguished them four years ago. We believe that both classes still serve real user needs, and will continue to do so.

---

[28] See footnote 11.

[29] While PTC's current business plans call for it to drive much more of its business through its channel, and it is building its channel to accommodate the transition growth, it still plans to keep its direct sales force for its top 100 to 400 customers.

The user considering the acquisition of an MCAD system has more choices than ever before. And even large enterprises would do well to consider an approach that involves bottom-up implementation and integration of precisely the third-party add-ons that they require. The cost savings and flexibility of this approach may outweigh the benefits of putting the entire responsibility of implementation in the hands of a single specialized MCAD vendor.

The point to remember is this: The two classes of products are no longer differentiated in terms of geometry creation capabilities or in terms of the scale of the projects they can handle. Mainstream MCAD vendors and specialized MCAD vendors, given similar research and development budgets, will spend those budgets differently. Expect to see the mainstream MCAD vendors focus their efforts on providing improvement and advancement in the day-to-day lives of the average user. And the specialized MCAD vendors will split their budgets between the broad needs of the average user with the narrow-but-deep needs of their demanding large clients' niches. Both will see outstanding growth, but it is likely that only one or the other will be a strong fit for *your* firm's needs.

About Cyon Research…

Cyon Research is a consulting firm that provides design, engineering, construction, and manufacturing firms with a strategic outlook on the software tools and processes they rely on to create the world around us. Cyon Research also supports the vendor community with its unbiased insight, vision, and expertise to help them understand the complex nature of their markets and grow, by serving the needs of their customer base.

Cyon Research brings to its clients a unique combination of experience, perspective, and insight, supported by an extensive network of well-established industry relationships. Our close contacts throughout the user, analyst, vendor, and developer communities provide surprising benefits for our clients and add significant value to our services.

Those relationships are enhanced by COFES: The Congress on the Future of Engineering Software, our annual invitation-only event. COFES is an event where we can make the types of connections that just aren't possible through any other means than face-to-face.

The focus of our research within the realm of design, engineering, construction, and manufacturing is technologies and markets that are likely to become real within the next two to six years.

The domain of our research is the tools, processes, and procedures used in the design, engineering, management, and production of the built environment and manufactured goods.

Funding for this white paper was provided in part by Autodesk. Watch cyonresearch.com for additional Cyon Research white papers.

Cyon Research Corporation
8220 Stone Trail Drive
Bethesda, MD 20817-4556 USA

301-365-9085
cyonresearch.com