



The High-End MCAD and cPDM Market Segments of the PLM Industry

**A CIMdata Market
Segment Spotlight**

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**Prepared by
CIMdata**

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1 Introduction

This paper provides a focused review of two of the primary market segments within the overall Product Lifecycle Management (PLM) market: 1) High-End Mechanical Computer-Aided-Design (High-End MCAD) and 2) collaborative Product Definition management (cPDm) for the discrete manufacturing industries. Although these two market segments certainly do not comprise all of PLM, they are fundamental components of PLM and have provided an essential role in the evolution of the overall PLM industry.

PLM is one of the most critical initiatives in manufacturing industries today, and is an essential strategy for any industrial company that is serious about improving their ability to compete effectively. Demand for PLM is driven by a focus on improving a company's ability to cost-effectively produce high quality products in a timely manner, and by an increasing recognition that innovation has become a primary differentiator between those companies that succeed and those that fail. While product innovation is essential, innovation of the processes used to design, produce, and support products is equally critical in establishing a winning program.

PLM is not just a collection of technologies. CIMdata defines PLM as:

A strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination,

and use of product definition information across the extended enterprise, and spanning from product concept to end of life—integrating people, processes, business systems, and information.

PLM forms the product information backbone for a company and its extended enterprise and is essentially a process-driven approach used to transform an enterprise's product-related business operations. It is delivered through new processes and practices that are enabled by multiple technologies; technologies that continue to evolve and provide ever-greater capabilities to develop and manage the "virtual" (or "digital") product.

PLM addresses a company's complete product, including all mechanical, electronic, and software components and all related processes and documentation. CIMdata uses the term "product" in a broad context that includes discrete products such as automobiles, toys, medical devices, and airplanes as well as large-scale plants and facilities such as oil rigs, petrochemical facilities, and factories. Other examples of products to which PLM can be applied include food and beverages, pharmaceuticals, packaged goods (e.g., diapers, shampoo), apparel, airports, roadways, telecommunication grids, and other infrastructure entities.

Two segments of PLM have contributed substantially to driving the development and evolution of PLM as we know it today: these are High-End MCAD and cPDm. In this paper, each of these market segments is individually addressed to provide a more complete understanding of that

segment, including a clarification of the market scope, the level of industry investments, key trends, major suppliers and their overall revenues, and other key information to help better understand these important segments of the PLM industry.

2004 was a solid year for the PLM industry. The market continued to expand, and that growth accelerated during the last half of the year. We anticipate increased growth in 2005, and increased competition among suppliers as each focuses attention on sectors of the industry that offer the most opportunity. Of course, that overall level of PLM growth was not consistently experienced across all of the related segments. For example, the cPDM market segment experienced quite good growth during 2004, while the High-End MCAD segment had relatively low growth. More details about, and insights into each of these segments will be provided in the subsequent sections of this paper.

2 High-End MCAD Market

2.1 High-End MCAD Market Description

This section of the paper is focused on the high-end segment of the MCAD market. However, there are a number of solution segments that make up the complete MCAD market today. It is important to understand their roles in the overall industry to put the High-End MCAD segment in perspective. The major levels of the MCAD market present users with a continuum of capabilities from 2D drafting through comprehensive product design, analysis, and manufacturing, all contained in a managed environment. The four segments defined below are not precisely separate, with the capabilities in each overlapping with the capabilities of its neighbors. However, each of these segments is unique enough to be identifiable and

to be a focus for analysis. The four segments of the overall MCAD market are:

- **High-End**—Full-function CAD/CAM systems that support drafting, 2D and 3D geometric modeling, solid modeling, surface modeling (including Class A surfaces for automotive), constraint- and feature-based design (or similar functionality such as relational design), integrated engineering analysis, integrated CAM including Numerical Control programming (NC), and other product development capabilities. They can be used to design very large assemblies (tens of thousands of parts) made up of complex parts. Their CAD/CAM solutions are integrated with data management (cPDM) solutions capable of supporting enterprises including supply chains as well as managing data produced by other product development and manufacturing solutions. Prices for High-End MCAD solutions range from below \$7K per user to well over \$20K per user depending on the number and types of capabilities needed. The suppliers of the High-End MCAD solutions are among the top PLM revenue earners.
- **Mid-Range**—Relatively robust design systems that support drafting, 2D and 3D geometric modeling, solid modeling, surface modeling (not including Class A surfaces), constraint- and feature-based design (or similar functionality). They tend not to have a portfolio of integrated analysis, CAM, and specialty applications—which have to be acquired from third parties. They are suitable for designing assemblies of hundreds up to a few thousand parts. They also have integrated local data managers that typically manage only their own data and are much less capable than enterprise cPDM solutions. The mid-range MCAD solutions are priced from less than \$5K per user to about \$7K per user depending on the capabilities included.

- **Low-End**—These systems' capabilities may resemble those of mid-range systems but are typically limited to 2D and 3D wireframe geometric modeling and drawing. They usually do not have any integrated applications other than geometric modeling and drafting. They do not have significant built-in data management capabilities. They can be used to design small assemblies and individual parts. They are used in both large and small organizations whose business processes are based around the use of drawings, and particularly building land floor plan layouts as well as by architects. They are sometimes used to create drawings in companies that use high-end or mid-range MCAD for product design. Their per-seat cost is significantly lower than that of their higher-end cousins, ranging from \$1K per user to over \$4K per user.
- **Personal Systems**—These applications typically provide basic 2D and 3D wireframe modeling and drafting and are sold shrink-wrapped, without training. They are generally not capable of designing parts in the context of assemblies. They usually cost less than \$1K per user and typically are used by architects and for technical publications and general drawing by individuals or in very small companies.

CIMdata considers the High-End MCAD market to include only those few CAD solution providers that deliver very comprehensive computer-aided design and analysis capabilities that are also tightly integrated with an enterprise-capable cPDM solution from the same supplier. Within the last few years, the tight integration with cPDM capabilities has become an essential differentiator for the high-end systems, and is typically required to support some of the most complex design capabilities such as assembly modeling, digital mockup, etc. These solutions are used in a broad PLM context aimed at the mechanical manufacturing and related markets (i.e., excluding Architecture, Engineering, and Construction (AEC),

and Electronic CAD). By this definition, the primary High-End MCAD solution providers are:

- Dassault Systèmes with CATIA and either SMARTEAM or ENOVIA
- PTC with Pro/E Wildfire and Windchill
- UGS with NX (including I-deas and Unigraphics) and either or both Teamcenter Enterprise and Teamcenter Engineering

Another characteristic is that these suppliers provide products and services worldwide through both direct sales forces and partners. Other CAD suppliers are not included among this group for a number of reasons. The most important reason is that none of the others provide suites of overall product development solutions that are as broadly encompassing in nature and support the high-end requirements of the manufacturing industry market segments (as further described below). In addition, the others do not provide tightly integrated cPDM capabilities, and they do not have a similar level of worldwide presence in terms of sales and support capabilities and established bases of customers.

Relative to the breadth of the capabilities of these High-End MCAD suppliers' solutions, they all provide systems that are fully integrated and associative and include 3D design, surface design, 2D drawing, various types of structural and functional analyses, piping design, cable layout, CAM (NC), and many other more esoteric capabilities. Each also provides tightly integrated, enterprise-capable cPDM solutions to manage all of the data (in particular, large, complex assembly interrelationships and configurations) generated by their own suite of products as well as data from other product development systems. The three are competitors in the cPDM market as well as the MCAD market. However, the integration with cPDM capabilities provides some variations and challenges as well.

In addition to being tightly integrated with their own cPDM offerings, integrations to the High-

End MCAD products are also provided to cPDM solutions from their High-End MCAD competitors as well as those from non-MCAD-based suppliers such as Agile, MatrixOne, SAP, and others. The depth of these integrations often varies substantially, typically due to the amount of knowledge and effort that has been applied to developing these “third-party” integrations, but also somewhat based upon the degree of openness of the APIs that are provided by the MCAD system suppliers for developing integrations to their products. Depth and openness of the APIs significantly impacts the ability to develop integrations to the applications that provide user interfaces that achieve good user acceptance.

Dassault Systèmes and UGS also extend their product development reach by providing comprehensive Digital Manufacturing solutions that are integrated with their MCAD and cPDM offerings. These overall suites of PLM capabilities are often provided within industry-specific process-oriented packages that include “best practices” and special capabilities tailored to each particular industry, e.g., body-in-white for the automotive industry.

The very high level of integration of these offerings distinguishes them from other MCAD applications such as Dassault Systèmes SolidWorks; UGS Solid Edge; Autodesk Inventor, Mechanical Desktop, and AutoCAD; Toyota Caelum; AVEVA Tribon; think3 thinkdesign; and numerous others. Typically, these lower-cost and less feature-rich solutions have similar capabilities for 3D design and drafting with some associated applications. However, many of the more advanced design capabilities as well as high-end surface design, engineering analysis, CAM, and cPDM capabilities have to be acquired from third-party specialty suppliers. Third-party solutions may not be as tightly integrated with the MCAD system (data does not flow associatively within the combined products) and often do not have the high level of capability as those provided in the High-End MCAD solutions. Of course, this is not

always the case—some specialty solution providers are technology leaders in their own product niche and may be used by High-End MCAD users as well. Very tight integration, cost, and availability from a single source are often the key distinctions that drive users to decide when to use third-party solutions. The mid-range and low-end CAD suppliers also do not provide a broad range of industry-specific solutions, if any at all.

The High-End MCAD suppliers all have extensive data management facilities as well as many other solutions that fit into a comprehensive PLM environment. These may include requirements management, engineering analysis and test, digital manufacturing, project management, visualization, digital mockup, collaboration, and other tools related to product definition. This allows these companies to provide highly integrated solution environments that span the lifecycle of product development for manufacturing companies. See the descriptions of each supplier’s offerings in the following sections.

A large number of factors play a role in how and why companies select their MCAD solutions, just as they do for cPDM solutions or any other important purchase. Price is only one factor. Although mid-range MCAD solutions may appear to be less expensive for similar capability, sophistication of the integration across the totality of MCAD capabilities in high-end MCAD systems can be much more important and provide a much more productive product design environment. Integrated cPDM capabilities can also tip the scale towards the high-end solutions. Process-based templates and models of use are also key differentiators that favor high-end solutions.

Many companies choose to use more than one MCAD solution. This choice may be dictated by the need to be able to communicate easily with their customers and suppliers or to provide CAD data to customers in the customer’s selected CAD format. Some companies end up with multiple

systems because of acquisitions. Some choose to use different systems to support different types of product lines or different needs throughout their organization. For instance, it is not unusual to find companies using a high-end or mid-range CAD system for product design and a low-end system for drafting. While this may seem counter-intuitive, price and ease-of-use can play roles in these decisions.

2.2 High-End MCAD Target Industries

The High-End MCAD suppliers try to service all subsets of the discrete manufacturing industries and in some cases, process plant design as well. However, each has strengths in specific industries. These strengths are evident in the marketing strategies of each company. The primary industrial segments pursued by the High-End MCAD suppliers are described below.

Automotive and Other Transportation

The automotive industry is characterized by needing a very broad set of MCAD capabilities from design through manufacturing engineering. The industry is dominated by about 20 OEMs (e.g., General Motors, Ford, Toyota, Daimler-Chrysler, Nissan, BMW, Renault, etc.) that design and assemble cars using various MCAD solutions. The OEMs drive the industry financially by providing the end user with the final product and reaping the bulk of auto industry revenues. They work with a large number of suppliers in a tiered hierarchy—some providing components designed by their customers and some participating as partners in the design process. Typically, there are three to four tiers of suppliers from Tier 1 companies that design and deliver complete car subsystems such as seats or drive trains, down to Tiers 3 or 4 who supply components such as forged parts or fasteners.

The structure of the industry leads to some particular issues. First, product design is distributed throughout the tiers of suppliers among companies that use MCAD systems from many different suppliers, not limited to the High-End MCAD solutions. This results in portions of each car being designed in different CAD systems and the need for CAD data translation, still an issue with which the industry struggles and for which no complete solution exists today. Second, the OEMs' demands on their primary MCAD systems are very broad. For example, Class A surface modeling is supported in only a few MCAD systems (e.g., CATIA, NX, Pro/Engineer) and specialty solutions such as ICEM¹. Similarly, many MCAD solutions do not handle very large assemblies to the extent needed. Historically, many of the major OEMs and some others had developed their own MCAD systems (e.g., Ford's PDGS, Toyota's Caelum) to assure that they had the functionality needed.

Due to these issues, the three high-end providers dominate MCAD in automotive, with Dassault Systèmes and UGS having major roles throughout the OEMs and Tier 1 suppliers in all process areas. PTC is quite strong in powertrain design and in the supplier companies. Toyota's Caelum product was developed internally and has mostly been used in Toyota's supply chain and is slowly being retired in favor of the High-End MCAD systems. Many of the mid-range MCAD systems, particularly SolidWorks and Solid Edge, are used in the lower level tiers.

Aerospace and Defense

The market dynamics for MCAD in aerospace are very similar to those for automotive with a few important distinctions. Like automotive, aerospace is dominated by a few very large OEMs worldwide and has similar supply chain issues.

¹ ICEM was originally part of CDC, then purchased by PTC, and ultimately spun off as an independent surface modeling technology provider.

However, aircraft and aircraft (jet) engines are typically much more complex products than are automobiles and machinery. They have many more parts and much more complex subsystems such as piping and cabling. These characteristics put an emphasis on the MCAD system to be capable of supporting very large assemblies and relationships among parts. This is a barrier to the use of anything but High-End MCAD systems.

Another distinction for aircraft is that the products tend to have a longer in-service life that is generally greater than 40 years and can exceed 50 or 60 years, which requires an extended spare parts supply and does not allow companies to change MCAD systems readily since they need to access and work with original design data for long periods of time. In fact, long-term support for design data access and use is a serious problem for these industries. In this sector, Dassault Systèmes and UGS are generally considered to be the leading suppliers, with Dassault Systèmes being more visible in airframe design and UGS more visible in aircraft engines. However, PTC also generates substantial business from this sector and has a solid presence in some other areas of the overall A&D market.

Electronics and Telecommunications

Electronics and telecommunications include consumer and high tech products such as computers, telephones, medical devices, and many other types of products. Design of these products is not as complex in terms of numbers of parts, but it does demand good surface design (although not Class A) and special applications such as molded parts design and integration of data for electronics and software. Industrial design of moderately complex to very complex surfaces is a required capability. CAD solutions for this market need to have accessible user interfaces and rapid design capabilities since design cycles are much shorter than those for automotive and aerospace. PTC has historically been strong in this market. However,

Dassault Systèmes (with both CATIA and SolidWorks), UGS (with both NX and Solid Edge), and a number of mid-range MCAD suppliers also have a substantial presence in this market. The number of companies in this sector is very large and their size varies from small to very large while the complexity of their products vary considerably as well, so the industry is not dominated by one range of MCAD solution.

Fabrication and Assembly

This sector includes machinery, heavy equipment such as machine tools, cranes, assembly lines, etc. It also includes many consumer products such as appliances, toys, hand tools, building supplies (e.g., windows), etc. This sector has many of the same large assembly design issues as those faced in automotive. This segment's products are typically large assemblies made up mostly of prismatic and turned parts. Complex configurations lead to issues managing variations and versions of designs. All three High-End CAD systems support this market along with the mid-range systems. The number of companies in this sector is very large and their size varies from small to very large while the complexity of their products vary considerably as well, so the industry is not dominated by one range of MCAD solutions.

Shipbuilding

This is a very specialized, relatively small market that comprises ship design and construction. There are only a few dozen major shipbuilding companies in the world and perhaps a hundred smaller shipyards and design offices. However, this industry has received substantial visibility because of its challenging requirements, and the subsequent desire of the MCAD suppliers to showcase their developments and solutions.

In shipbuilding, the designs are extremely complex, combining complex (although not as refined as Class A) surfaces with many structural

elements and lots of piping, ducts, and cabling running throughout the ship. The assemblies are extremely large with many parts. The structural parts are often curved as well as the skin of the hull and the areas through which subsystems have to run are very complex. There are also many rules that have to be followed in how the connections between, and penetrations through structural elements are designed. Ships remain in-service for very long periods, often in excess of 60 years, and have to be supported, maintained, and upgraded throughout their useful life. This means that shipbuilders have to maintain access to older CAD data that was generated during the development of the original ship design process.

Historically, ship designers have used CAD systems that were developed specifically to support ship design, and several are still in broad use including AVEVA Tribon, PTC CADD5, Intergraph IntelliShip, and Intergraph ISDP. In the last few years and based on a long history in this industry, Dassault Systèmes has developed a new solution based on CATIA and ENOVIA targeted at shipbuilding, and this relatively new solution is being well received. Dassault's presence is being facilitated by IBM's relationships with a number of the largest US shipbuilders. PTC's CADD5 product has historically been very heavily used in ship design, but while still being maintained, it is based on quite old technology and is slowly being supplanted by a number of newer solutions. UGS has not been as heavily engaged in shipbuilding CAD to date, although they have made some recent moves in this direction and Teamcenter is used by a number of ship builders. Tribon and ISDP, while important in the shipbuilding industry, have little use in any other industrial sector.

2.3 Barriers to High-End MCAD Market Entry

As described in the previous sections, each of the major industries has some unique requirements

that drive the suppliers of High-End MCAD systems. To satisfy customers in these various industries, suppliers of MCAD systems must develop specific capabilities to make their offerings more valuable to companies in those industries. These special capabilities often create barriers for entry of new competitive suppliers, but can also create impediments for those suppliers to support additional industries themselves. There are a number of issues that make it very difficult and expensive for CAD suppliers to enter new industry segments.

First, finding people with deep knowledge in a particular industry segment to drive the development of product and marketing programs is difficult. They have to have a strong understanding of the industry's technical requirements as well as an understanding of the market forces that drive the industry. They also need to possess knowledge of what is available in comprehensive PLM solutions today as well as what is possible to implement at reasonable cost. They need to understand the dynamics of the market for PLM and CAD in the particular market segment. The people best suited to this task are found either in other PLM suppliers or in industrial companies. In either case, they are most likely to be very highly valued by their employers and expensive to acquire.

Second, developing the specialized product capabilities needed to support a particular industry is a time-consuming and expensive process. The development is not limited to particular technological capabilities, but also includes defining functional and business processes and embedding best practices into the solution. The amount of effort required to develop a new solution depends on the type of solution, the supplier's knowledge and experience in the area, as well as other factors. Of course, it varies considerably. Over the years, all of the MCAD suppliers have had to build new industry-targeted applications into their solutions as the MCAD market has matured and broadened. These efforts are typically focused on

either new applications targeted at process threads in industries that the supplier already serves (i.e., broadening their suite of offerings), or new applications targeted at new industries. The addition of tightly integrated cPDM applications has been a clear example of the development of broadened suites of offerings. This activity continues as the market changes.

In addition, sales forces need to be trained, and marketing materials such as brochures and other sales collateral must be developed. These need to be industry- and process-specific and define appropriate ROI factors and benefits that only come with experience in the particular market area, which are not insignificant and can take some time.

Overcoming competitors' leads can be very daunting. Typically, the earliest competitor in a segment has a distinct time and market penetration advantage. Mid-range and smaller suppliers are even more challenged by not having the magnitude of resources required to enter new markets, although once the technology and market programs have been developed, most suppliers will continue to try to maintain a market presence in that area.

From the users' perspective, changing High-End MCAD solutions is an expensive proposition for which a viable business case may be difficult to create. The transition to a new solution can be very costly in terms of user re-training and length of time to regain full productivity. A major cost arises from the investment of significant amounts of time, effort, and money in converting large sets of legacy data from the previous system to the new system. The cost of converting legacy CAD data depends on the amount of fidelity a company wants or needs to maintain. Some CAD conversions (such as exporting IGES or STEP formats) are relatively automatic for generating basic solid models, but result in the loss of all of the design knowledge embedded in the design through the

use of parametric, feature-based design and other modern techniques. The most rigorous data translations are essentially based on re-creating the design in the target CAD system. This can be very expensive since it is labor intensive. CAD data exchange almost always results in the loss of embedded knowledge created during design so that extra effort has to be dedicated to re-designing in order to have useable CAD models for continuing design efforts. These investments can be quite large and often deter companies from adopting new technologies. The penalties associated with design data exchange can be extreme: "...*imperfect interoperability imposes at least \$1 billion per year on the members of the U.S. automotive supply chain. By far, the greatest component of these costs is the resources devoted to repairing or re-entering data files that are not usable for downstream applications. This estimate is conservative because we could not quantify all sources of interoperability costs.*"² While the cost to the U.S. automotive sector is high, the overall cost associated with moving design data for all industries worldwide must be staggering by comparison.

2.4 High-End MCAD Market Size

The MCAD market has been growing and evolving for more than thirty years. Its growth has been driven by companies seeking to improve their ability to design and develop the most attractive products in the most effective manner. This market has experienced tremendous evolution over the years as the technologies provided by suppliers have been improved greatly and have evolved to become a major factor in today's broad PLM initiatives in industry.

Investments in MCAD solutions have grown substantially from several years ago, but the focus of

² S. Brunnermeier and S. Martin, *Interoperability Cost Analysis of the U.S. Automotive Supply Chain*, Research Triangle Institute, March 1999

spending has shifted somewhat from high-end systems to mid-range offerings. More recently, investments in MCAD solutions have slowed considerably, and the growth of High-End MCAD offerings has been impacted the most. The next few figures illustrate the investments in High-End MCAD solutions, and the relative distribution of those investments across both major geographies and industries.

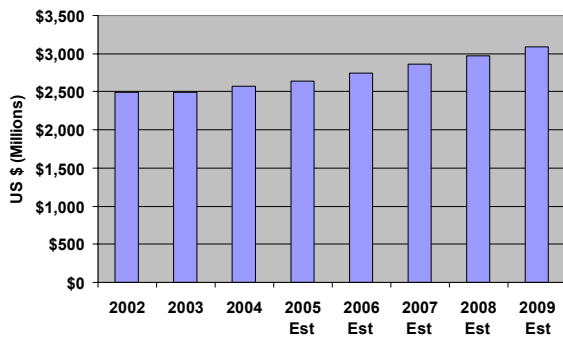


Figure 1—High-End MCAD Revenue Forecast—2002 through 2009
Revenues include software + maintenance + services

The total MCAD market for 2004 is estimated to be \$4 billion worldwide; including all MCAD suppliers regardless of size. This revenue includes a combination of software, software maintenance, and services. The High-End MCAD suppliers comprised of Dassault Systèmes (with their primary partner IBM), PTC and UGS³, represent \$2.5 billion or 65 percent of the total. MCAD revenues are growing more slowly than the cPDM market and the projected growth of High-End MCAD revenues over the next 5 years is 3.8 percent CAGR. Figures 1 through 3 present CIMdata’s forecasts for High-End MCAD revenue growth for the next five years.

³ Note: In the recent past, UGS revenues were reported as EDS revenues. This is because UGS did not exist as a separate company until 2004.

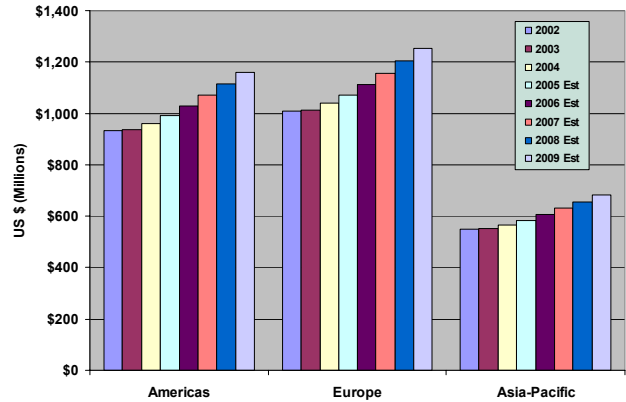


Figure 2—High-End MCAD Revenue Forecast by Geographic Region—2002 through 2009
Revenues include software + maintenance + services

As can be seen in Figure 2, High-End MCAD revenue shows moderate growth in all regions of the world. Europe leads the overall High-End MCAD market, with a high rate of adoption of high-end products. Asian companies still use a large quantity of mid-range and low-end MCAD, including 2D design systems, and thus lag behind the rest of the world in high-end CAD adoption.

As illustrated in Figure 3, High-End MCAD has been heavily adopted in aerospace and defense where the products are very complex⁴. The other leading industrial segments that use High-End MCAD also have complex assemblies and products that are difficult to design.

⁴ While shipbuilding also has complex products, adoption of the high-end MCAD systems has been relatively low due to the long-term use of specialized shipbuilding CAD systems.

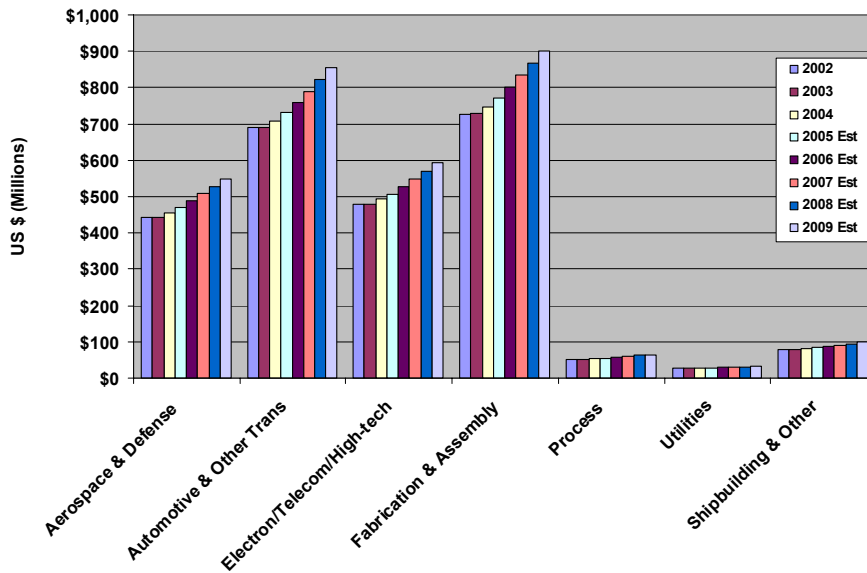


Figure 3—High-End MCAD Revenue Forecast by Industry—2002 through 2009
Revenues include software + maintenance + services

and Unigraphics, but do not include any of their Solid Edge, E-factory, or Teamcenter revenues. For IBM+DS, the High-End MCAD revenues primarily include their CATIA offerings, and do not include revenue from SolidWorks, ENOVIA, SMARTEAM, or DELMIA. For PTC, High-End MCAD revenues are primarily Pro/ENGINEER (including Wildfire) although some CADDs revenue is still included, but do not include any Windchill-based revenues.

2.5 High-End MCAD Supplier Revenues

The High-End MCAD suppliers provide their products and services worldwide, either through direct sales or through their partners. Note that IBM+DS is used in the charts to indicate the effective market results for the “IBM + Dassault Systèmes” operation. In this partnership, IBM is the primary marketing and sales force behind the worldwide sales of Dassault Systèmes’ products. IBM also provides many services associated with those sales. This is a unique relationship in the MCAD market (indeed, in the overall PLM market as well), with IBM providing marketing and services in support of Dassault Systèmes’ products, whereas PTC and UGS provide the majority of their own High-End MCAD marketing and services directly. Also, note that revenues shown for UGS in years prior to 2004 represent the revenues for the UGS business unit that was then a part of the EDS Corporation.

For UGS, the High-End MCAD revenue numbers primarily include their NX line including I-deas

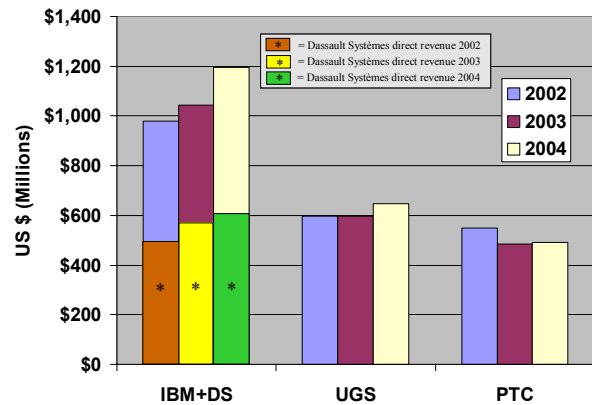


Figure 4—High-End MCAD Supplier Revenues—2002 through 2004

Revenues include software + maintenance + services
Revenues presented are CIMdata estimates

Please note that the revenues shown in Figure 4, and in all subsequent figures in this report that depict revenues from various suppliers, include all relevant revenue from each supplier, including software, software maintenance, and services. If considering software-only revenues, the revenues would be lower. Also note that from 2002 to 2003, currency fluctuations were substantial and

did have an impact on the reported revenues from the various suppliers.

The revenue split for the major High-End MCAD suppliers by geographic region for 2004 is shown in Figure 5. Note that IBM+DS has a relatively heavy portion of their revenues generated from Europe. This can be attributed to the fact that Dassault Systèmes was founded in Europe, is headquartered in Europe, and has a very long history of selling into the European market space along with IBM. Both UGS and PTC have experienced more even revenue levels between Europe and North America, even though both were founded and are headquartered in North America. All three of these suppliers generate considerable revenues from Asia-Pacific as well, although none of them are headquartered in that region.

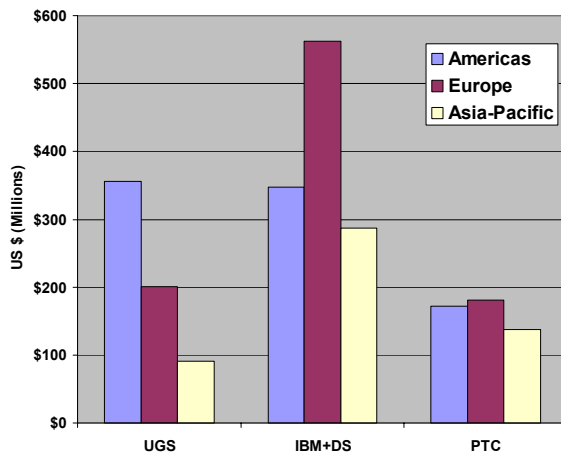


Figure 5—High-End MCAD Supplier Revenues by Geographic Region in 2004

*Revenues include software + maintenance + services
Revenues presented are CIMdata estimates*

The High-End MCAD suppliers are all active in a number of different markets. Their revenue split by industrial segment for 2004 is shown in Figure 6. One notable observation on the industrial segments is IBM+DS’ High-End MCAD revenue leadership in fabrication and assembly and in automotive.

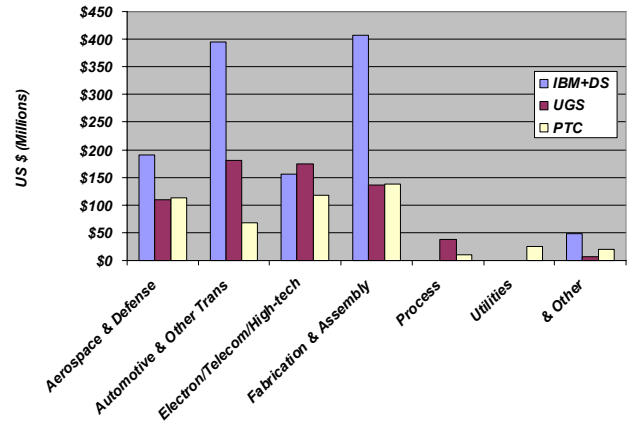


Figure 6—High-End MCAD Suppliers Revenues by Industry Segment in 2004

*Revenues include software + maintenance + services
Revenues presented are CIMdata estimates*

3 cPDM Market Review

3.1 cPDM Market Size

collaborative Product Definition management (cPDM) is the segment of PLM that addresses managing the complete product or plant definition lifecycle (i.e., the “virtual” or “digital” product), including all of the mechanical, electronic, software, and documentation components and the processes that are used during the lifecycle including planning, designing, manufacturing, in-service operation and maintenance, and end-of-life retirement. Effectively supporting the collaboration, management, and sharing of these intellectual assets (that comprise the “virtual” product) is essential to creating a true competitive advantage and achieving both the top and bottom line business benefits that cPDM promises. Essential PLM enabling technologies such as product data management (PDM), collaboration, visualization, digital manufacturing, enterprise application integration (EAI), and others address the extended product or plant definition supply chain of OEMs, sub-contractors, suppliers, partners, and customers. These technology areas provide the foundation of cPDM offerings from various suppliers, and are clearly focused on information manage-

ment; in this case, managing the information that defines the “virtual” product.

The cPDM market has been growing steadily for almost 20 years and is forecast to be the fastest-growing segment of the overall PLM industry. cPDM growth has been driven by increased investment by industrial companies to improve their business effectiveness, an increased number of large-scale implementations, and deployment of cPDM core technologies across extended enterprises and supply chains. cPDM technologies and methodologies enable expansion of collaboration both within an enterprise and across the supply chain. Further, the cPDM footprint is increasing as new capabilities such as digital manufacturing and portfolio management are being developed and deployed.

Figure 7 presents a history and forecast of external investments by industrial companies worldwide for cPDM software and services (i.e., money spent to purchase cPDM software and services from cPDM suppliers). For the period 2005 through 2009, cPDM investments worldwide are forecasted to grow at a 15 percent CAGR (compound average growth rate).

During 2004, investments in all major geographies continued to grow and Figure 8 presents the

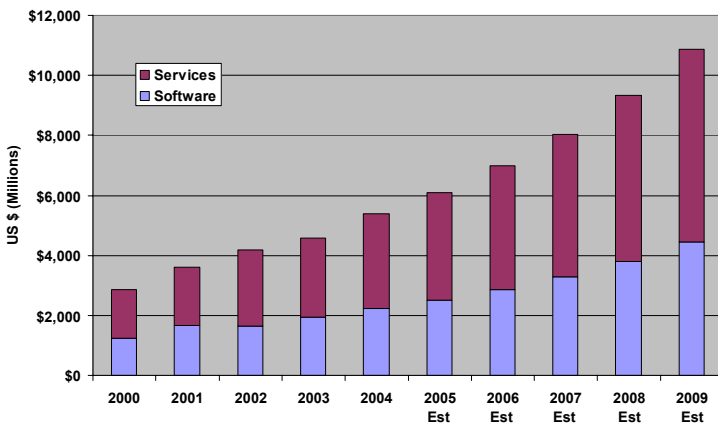


Figure 7—cPDM Revenue History and Forecast—2000 to 2009
Revenues presented are CIMdata estimates

geographic distribution of cPDM investments during 2000 to 2004 and forecasts for 2005 to 2009. In 2004, for the third year in a row, Europe invested the most in cPDM, Asia Pacific continued its strong growth, and the Americas sustained solid growth. As can be seen, Asia-Pacific is forecasted to have the highest overall growth rate of investments over the coming five years.

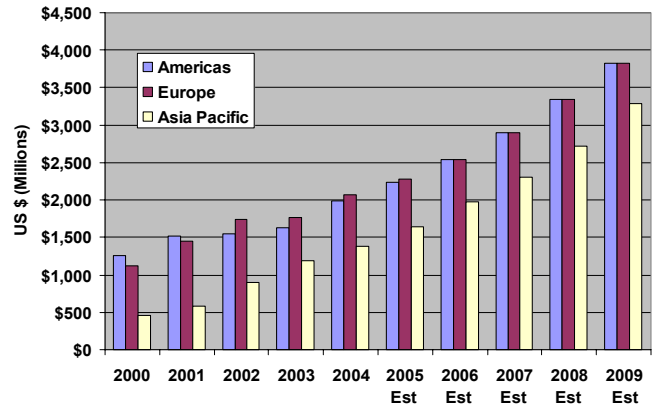


Figure 8—cPDM Revenues by Geography—2000 through 2004, forecast to 2009

Revenues include software + maintenance + services

Figure 9 illustrates the relative investments by industry over the past five years, along with forecasts through 2009. The dominant industrial sectors for cPDM were automotive, electronics-telecommunications-high tech, fabrication & assembly, and aerospace. Taken together, these sectors comprised almost 82 percent of the cPDM market in 2004. In 2004, automotive provided 28 percent of the overall cPDM market investment while electronics and telecommunications (including high tech and medical devices) provided 21 percent.

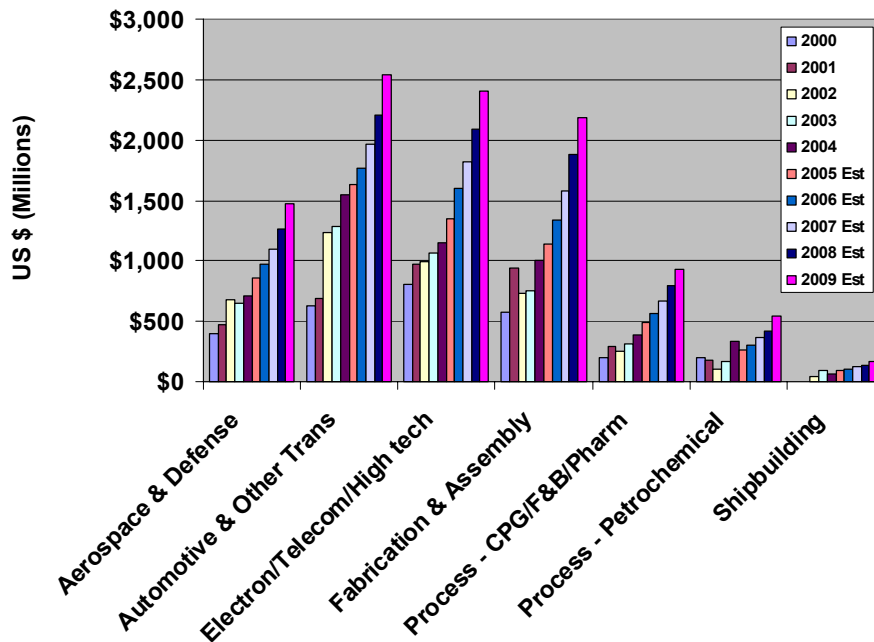


Figure 9—cPDM Revenues by Industry—2000 through 2004, forecast to 2009
Revenues include software + maintenance + services

Over the coming years, electronics and telecommunications, automotive, and aerospace will continue to be major influences. During the forecast period, cPDM solutions will begin to permeate middle-market companies and there will be larger growth in fabrication and assembly and the process and utilities areas, particularly consumer packaged goods and pharmaceuticals, as well as other discrete manufacturing segments such as consumer products and retail.

Note that the fabrication and assembly (F&A) estimates for years prior to 2002 are the aggregation of the mechanical machinery and other discrete segments reported during those years.

3.2 cPDM Market Trends and Events

The scope of the cPDM, along with the broader PLM market, continues to expand as industrial companies around the world seek to address the full product lifecycle in their strategy.

Accordingly, companies seek to better address areas of their product lifecycle that have not been previously supported very well, or have been supported with initiatives that have been isolated and not well integrated into other product lifecycle support solutions. Of course, as industrial companies have raised their priorities for these areas, suppliers have responded by focusing on development of expanded solutions to meet these new market requirements. A few of these areas are particularly interesting as they

are driving development of more complete and comprehensive cPDM, and overall PLM solutions including:

- Digital Manufacturing
- Service after sales—including maintenance, maintenance-repair-overhaul (MRO), and warranty programs
- Portfolio and requirements management
- Asset management within discrete industries
- Total product management (i.e., total systems engineering)—including tighter, more comprehensive integration of electronic design automation systems and software management systems into the overall cPDM and PLM solutions

In addition to trends related to the expanding perspective of the product lifecycle, there are a number of general industry trends that are significantly impacting the suppliers of cPDM solutions, and thus impacting industrial companies seeking

to take advantage of cPDM. Some of the most significant trends include:

- Mid-market customer investments
- Changing pricing and sales models
- Pre-packaged solutions for industries and business functions (a continuing trend)

Each of the trends and issues introduced in this section are individually addressed in more detail in the following paragraphs.

Digital Manufacturing

Digital Manufacturing allows industrial companies to transform the way they define the manufacturing processes that will be used to produce their products by creating an environment in which manufacturing process definition is conducted in collaboration with product design activities. Digital Manufacturing provides the mechanisms to describe, simulate, optimize, and finalize these process definitions as part of the process of product definition, not just after-the-fact reporting of how production was done.

Digital Manufacturing represents a major expansion of the scope of PLM. Many companies that have invested in Digital Manufacturing over the past several years have done so with a view of Digital Manufacturing as a “point solution” that was separate from their overall PLM strategy. Today, companies have begun to incorporate digital manufacturing as an integral part of their overall PLM strategy—those companies are receiving the greatest return on these investments.

Service After Sales

Integration of PLM components such as product data management (PDM) and change management with component supplier management, customer relationship management, maintenance and operations systems, and logistics systems creates environments that improve support and operational efficiency. Having access to accurate, up-

to-date product definition information is a key factor in improving customer service and maintenance. Such information is also used to develop and execute service and logistics plans and functions.

Under the PLM umbrella, service becomes an integral part of the product definition improvement lifecycle, utilizing current information for maximum efficiency and effectively providing knowledge regarding customer requirements and serviceability for new products. Suppliers are beginning to offer solutions for service after sales support. This will be a major new market for PLM technology and service suppliers for the next several years.

Portfolio and Requirements Management

Requirements management addresses the gathering of requirements for new or improved products and plants while portfolio management addresses managing the family of products under development, production, and service. Effective requirements management ensures that the “voice of the customer” is captured. This enables a company to design, build, and deliver products and services that meet or exceed their customers’ needs and expectations.

Portfolio management helps a company manage product families starting with the “ideation” phase (gathering and evaluation of ideas for new or improved products), and determining which of the many ideas and potential products best fit with their business and marketing strategies. Portfolio management then enables a company to track what products are in development and production, how those products are interrelated, and to optimize the resources available to develop, market, sell and service a product family. As with requirements management, several suppliers have developed standalone portfolio management solutions. The major PLM suppliers are either integrating one of these applications with their

product suite or are developing their own capability to provide portfolio management.

Asset Management Within Discrete Industries

Asset management is a major function in process industries. Managing the physical assets of a plant, oil rig, or other facility is critical to the success of those businesses. Recently, companies have begun applying asset management solutions within the discrete manufacturing industry to manage the facilities used in production. PLM solution providers are developing and expanding asset management capabilities and tailoring them to each industry sector's specific needs. Further, for the discrete manufacturing industry, asset management is a key component of an overall digital manufacturing solution. Without knowledge and detailed asset information it is not possible to digitally simulate the manufacturing processes that will be used to produce a product.

Total Product Management

PLM has traditionally been used to handle information and processes associated with mechanical design, but these same systems are an effective tool for managing electronic and software components embedded in manufactured products and plants. Electronics and software are important parts of most products produced today. Growing recognition of the importance of managing the "complete" product or plant has led the comprehensive cPDM suppliers to expand their capabilities for managing electronic design and related software along with mechanical components. Also, several of the leading EDA suppliers have begun to develop and deliver cPDM capabilities that not only manage the EDA environment but also provide an integration point to the cPDM solutions of the comprehensive suppliers.

Mid-Market Customer Investments

The mid-range cPDM market consists of industrial companies with revenues of less than \$1.5 billion with the "sweet spot" or major opportunity area in companies between \$500 million and \$1 billion in revenue. Mid-range solutions are still primarily engineering-centric and are often built on Product Data Management (PDM) technology foundations designed to solve data management issues from an engineering point of view. Typical functionality includes CAD integrations and CAD management, bill-of-material (BOM) and bill-of-information (BOI) creation and management, visualization of documents and CAD files (usually some combination of 2D and 3D viewing is provided), and workflow management capabilities that can be used to automate various engineering processes (e.g., engineering change, BOM release to manufacturing, and configuration control).

Key factors for PLM adoption by mid-market companies has been, and is expected to continue to be, the development and delivery of best-practice-based out-of-the-box applications and solutions that support an enterprise's engineering data and process management requirements. Mid-range solutions are generally used within an enterprise to: 1) organize, access, and control all data (e.g., CAD assemblies, documents, part records, BOMs, etc.) related to its products, and 2) manage the lifecycle of that product definition information. Mid-range cPDM solutions need to provide access and security controls, maintain relationships among product definition information, enforce the rules that describe data flows and processes, and perform notification and messaging functions.

Changing Pricing and Sales Models

Driven by the requirements of mid-range companies, but moving into the larger enterprises, are new sales and packaging models. For years, most suppliers have used a one-time license purchase (for either named or concurrent users) plus a

recurring maintenance fee model. Today, recurring fee models, subscriptions, and right-to-use are emerging as options for licensing PLM technology and solutions. This model allows the use of licenses based upon an annual right-to-use fee. With this model, the licenses remain the property of the solution provider. Concurrent, as well as named user licensing schemes, can be accommodated. Maintenance is normally included within the right-to-use fee and is not a separately priced charge. Additionally, some suppliers are providing application hosting services which relieve the buyer of having to provide hardware and operations support for the PLM environment and applications.

Pre-Packaged Solutions for Industries and Business Functions

As competition among suppliers has increased throughout the industry, suppliers have continuously sought ways to provide their offerings that are more attractive to potential customers. One of the primary focuses has been to provide solutions that are more easily understandable by potential customers (thus, easier to sell) and that are more easily implemented (thus, quicker to achieve production implementations and business value). To achieve this, all of the major suppliers are providing solutions that are more and more focused on addressing specific industry problems. These solutions are developed with industry-focused processes and terminology pre-built into them; an example being the APQP offerings targeted at automotive suppliers. As a result, potential customers more easily understand the value and use of supplier solutions. Also, since many basic processes are pre-built into the solutions, customization, tailoring, user training, etc., are reduced and the implementations tend to progress more quickly and effectively. All of this yields more rapidly successful implementations and more effective business operations for customers. This trend is accelerating, and is expected to

continue to differentiate suppliers in the various industries over the coming years.

3.3 cPDM Supplier Revenues

A wide range of companies provides many different types of technologies and services in the cPDM market. These suppliers can be segmented into three major categories: comprehensive technology suppliers, systems integrators / resellers / VARs, and focused application providers. When reviewing the cPDM market, the comprehensive technology suppliers are the companies that are considered to be the industry's leaders. They have generally achieved this recognition based on:

- Their focus on providing the “information management backplane” to support an overall cPDM (and often PLM) environment
- Their technology and thought leadership in the cPDM (and the broader PLM) market

Figures 10 and 11 present the cPDM revenues and market shares of the leading comprehensive cPDM suppliers over the past three years. Note that all three of the High-End MCAD suppliers (UGS, IBM+DS, and PTC) are members of this group, as well as MatrixOne, Agile, and SAP that also are recognized worldwide for their high-end cPDM solutions.

As with the previous figures illustrating High-End MCAD supplier revenue, revenues shown for UGS in years prior to 2004 in the following figures represent the revenues for the UGS business unit that was then a part of the EDS Corporation. Also, note that IBM+DS continues to be the entity used to depict the IBM and Dassault Systèmes partnership in the cPDM market segment (see Sections 2.4 and 2.5). Also, note that MatrixOne for the year 2004 in the following figures represents the combined revenues of MatrixOne and Synchronicity, which MatrixOne acquired in August of 2004.

As was mentioned previously, please note that the revenues shown in Figure 10, and in all subsequent figures in this report that depict revenues from various suppliers, include all relevant revenue from each supplier for software, software maintenance, and services. Also note that from 2002 to 2003, currency fluctuations were substantial and did have an impact on the reported revenues from the various suppliers.

For Figures 10 and 11, the bars overlaid on IBM+DS present Dassault Systèmes direct cPDM revenues and market share respectively. This provides an illustration of the size of these two technology supplier organizations' revenues as stand-alone businesses.

Figure 10 includes direct cPDM revenues for the top six suppliers of comprehensive cPDM solutions (previously defined). In this figure, we have only included the top six suppliers because of their dominance in the cPDM market revenue statistics. After these top six suppliers, the next largest revenue achievements were generated by companies that are mostly restricted to supplying customers in limited geographic regions of the world. The top ten cPDM revenue suppliers also

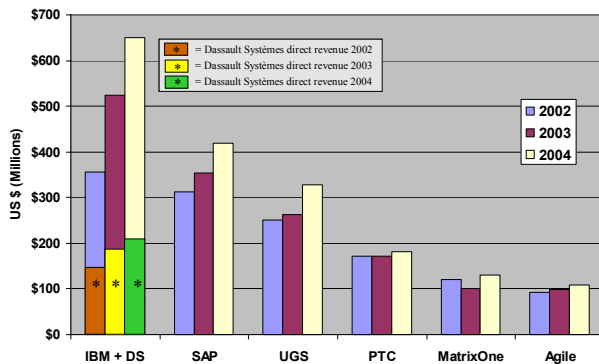


Figure 10—Comprehensive cPDM Technology Suppliers Revenues—2002 through 2004
Revenues include software + maintenance + services
Revenues presented are CIMdata estimates

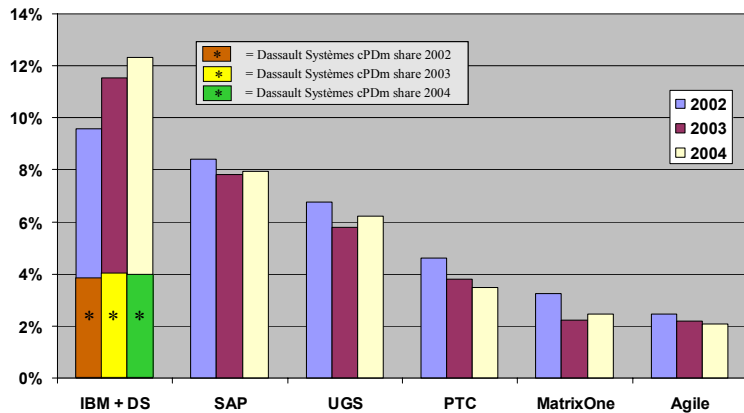


Figure 11—Comprehensive cPDM Technology Suppliers cPDM Market Share—2002 through 2004

Revenues include software + maintenance + services
Revenues presented are CIMdata estimates

include IFS, NEC, Fujitsu Ltd., and Zuken. With the exception of IFS, these suppliers are focused solely on Japan, and all of them generated significantly less cPDM revenues than any of the top six suppliers. Thus, we have focused on the top six cPDM revenue suppliers in this paper.

Market presence (shown in Figure 12), the combined revenue of a vendor and their partners, is a measure of the overall impact that a supplier and their technology and products have in the cPDM market. Market presence is calculated by combining the add-on software and service revenues of systems integrators, resellers, and VARs attributable to a given supplier's products (e.g., a consulting firm such as Accenture which employs MatrixOne's or PTC's products to implement a solution for one of their clients) with the core revenue of the vendor.

The combined core and partner revenues can greatly expand the visibility and impact of a supplier on the industry, generating a significant market presence or footprint. MatrixOne is an example of a supplier that has a much greater impact on the overall market than their core revenues would suggest. Partner revenue, when added to a supplier's core revenue, can significantly change that supplier's market share and

demonstrates how its strong partner program contributes to a major increase in market visibility.

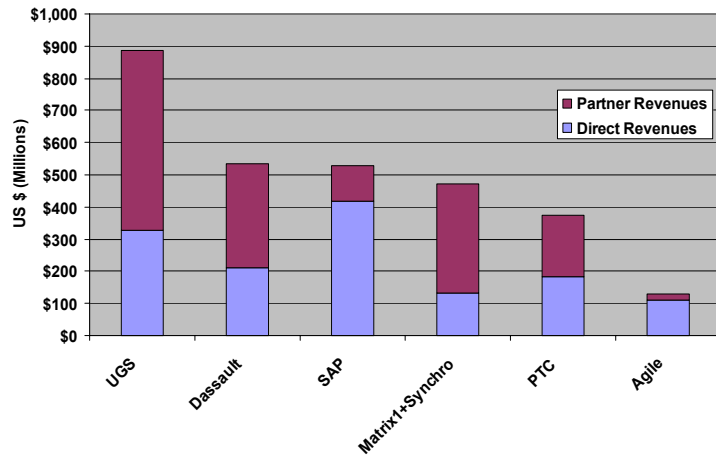


Figure 12—Market Presence Revenues of Leading cPDM Technology Suppliers in 2004

*Revenues include software + maintenance + services
Revenues presented are CIMdata estimates*

Note that for Dassault Systèmes, the market presence is based on Dassault Systèmes as they are the developer of the technologies and products, while IBM is the primary marketing and sales partner. Dassault Systèmes has limited direct end-user sales, but owns cPDM-focused companies that have their own marketing and sales programs.

One important point to note is that not all suppliers of cPDM technologies provide comprehensive solutions; some provide focused offerings targeted only at specific aspects of full cPDM solutions. An example of this is Content Management as represented by OpenText among other suppliers, which provides content management capabilities that may be used within an overall cPDM implementation, but they do not provide a full cPDM

solution. In addition, there are several service companies that generate substantial revenues from cPDM investments, but provide no software of their own. Accenture is a good example of this type of supplier.

Figure 13 presents the distribution of cPDM revenues by industry for leading cPDM comprehensive technology suppliers. Note that while each supplier has a different industry focus, most of the leaders have some level of presence in all industry segments. Also note that the cPDM revenue figures include revenues from digital manufacturing, which positively impact Dassault’s revenues (and thus the IBM+DS revenues shown), especially in the automotive industry sector.

Within each industry, the various suppliers have both a technology and a market focus. For example, both UGS and IBM+DS focus significantly on aerospace and defense and automotive OEMs and high-end Tier 1 suppliers, while MatrixOne, PTC, and Agile focus more on companies in the supply chains within those

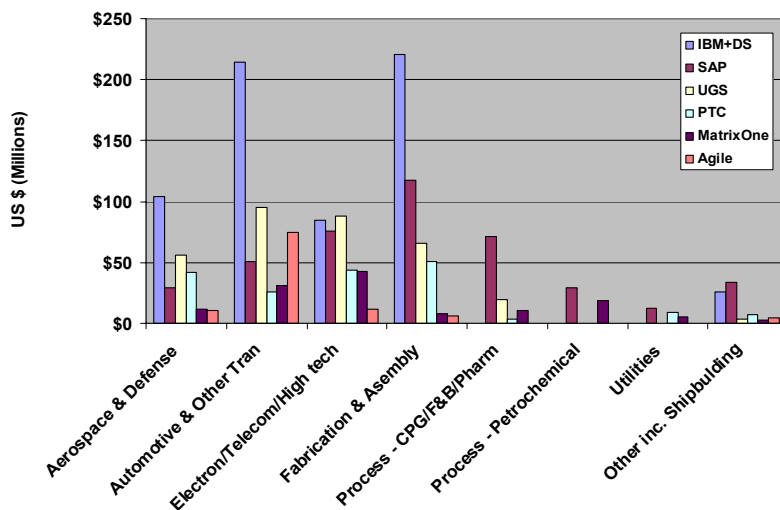


Figure 13—Comprehensive cPDM Technology Suppliers cPDM Industry Revenue Distribution in 2004

*Revenues include software + maintenance + services
Revenues presented are CIMdata estimates*

industries. MatrixOne has a major presence in high tech, along with Agile, while PTC has a strong presence in consumer products and other discrete manufacturing.

In automotive and aerospace and defense OEMs, UGS and IBM+DS dominate with their Teamcenter and ENOVIA suites respectively. For the larger enterprises in these industries, Teamcenter Enterprise and ENOVIA V5 often provide the cPDM backbone. In the supply chain, however, solutions from many suppliers are in use. MatrixOne provides its value chain portfolio of Central products, PTC provides its Links suite and Agile provides Agile e5 (based on the Eigner product) to support business-focused solutions. At the supplier level, IBM+DS uses SMARTEAM as its cPDM solution while UGS offers several of the Teamcenter products with Teamcenter Engineering as the core. For the OEM, comprehensive configuration management and collaborative, highly scaleable solutions are critical. For the suppliers, configuration management is important, but sourcing, costing, collaboration, and RFP responsiveness are critical.

For high tech and electronics and telecommunications, the primary solutions offered are similar to those used in the automotive supply chain. However, in this industry, even for the OEMs, sourcing, costing, supply chain collaboration and RFP responsiveness are solution drivers. For medical device companies, regulatory compliance and reporting are the critical requirements for a cPDM solution.

In process industries, environmental and regulatory compliance and reporting have been the critical PLM needs. However, in consumer packaged goods and food and beverage, specification management and artwork and labeling have emerged as cPDM drivers.

Across all industries, SAP provides its cPDM capacities in conjunction with its ERP modules. While addressing all industry sectors, SAP is

more heavily present in the process and F&A industries.

Figure 14 presents the geographic distributions of cPDM revenues for leading comprehensive cPDM technology suppliers.

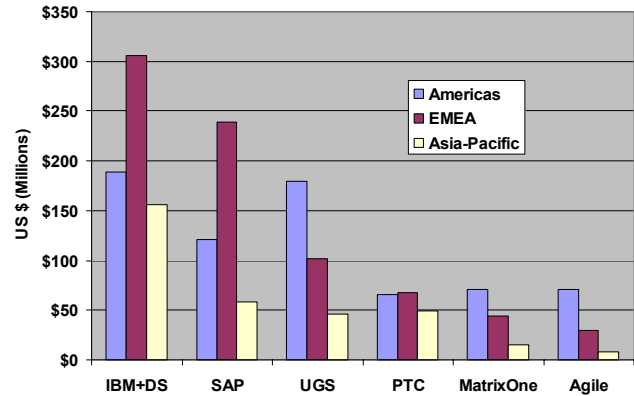


Figure 14—Comprehensive cPDM Technology Suppliers Geographic Revenue Distributions in 2003
*Revenues include software + maintenance + services
 Revenues presented are CIMdata estimates*

As can be seen in Figure 14, both SAP and IBM+DS have a relatively strong European market performance. This is primarily due to having headquarters in Germany (SAP) and France (Dassault Systèmes) respectively, their historical presence in this region, and the strong organizational presence that they continue to have in this region. UGS is respectively more present in the Americas, mostly due to historic market development strategies, while PTC has a relatively balanced geographic revenue distribution. MatrixOne’s direct revenues are primarily from the Americas, however, a significant portion of MatrixOne’s sales and services are provided through partners, particularly in Europe and Asia-Pacific and their general level of “presence” in these regions is more balanced than their direct revenue figures indicate. Agile has improved their European performance because of the acquisition of Eigner which was founded in Central Europe and had a strong presence in that region.

4 cPDM Market Impact by MCAD Suppliers

The difficult issue in PLM today is that it is incumbent upon suppliers to provide a very tight link between CAD and other information so as to satisfy the enterprise needs of the most demanding product development companies. The High-End MCAD suppliers, all players in the cPDM market, have raised the bar concerning what is an acceptable level of tight cPDM integration with CAD and other PLM functions, although typically only with their own suite of products, however, they have not implemented integrations with processes and data for electronics and software nearly as comprehensively. Indeed, some other cPDM suppliers have concentrated more attention on providing complete solutions with regard to integration to non-MCAD environments. For instance, MatrixOne and Agile have strong ECAD integrations. Multi-MCAD integration is a requirement for all of them. Of course, the High-End MCAD suppliers would like their CAD customers to also be users of their cPDM products, indeed all of their overall PLM product suites. The tight integration of their MCAD and cPDM offerings, especially where the cPDM solution is used to manage and support assembly design, tends to entice users to select the MCAD supplier's cPDM solution. The tight coupling also makes MCAD integration more difficult, but not impossible for third-party cPDM suppliers. Given this, the High-End MCAD suppliers each provides APIs to access their CAD data. The completeness of the APIs and level of support each MCAD supplier provides to third parties (including the competing cPDM suppliers) varies.

The mid-range MCAD suppliers also have their own cPDM offerings. These are tied directly to their specific CAD solutions—forming local CAD data managers that are focused on design process work-in-process. They do not contain the broad functionality required to become enterprise-

capable cPDM solutions. These local data managers tend to complicate implementations that include an enterprise-wide cPDM solution as they open questions about where certain data will be managed during the design phase of the lifecycle.

Because of the difficulty and cost of developing CAD authoring tools, other suppliers who want to become major players in the overall PLM market space will have to build either very close ties to, or acquire CAD solutions. On the other hand, for the mid-range MCAD companies to expand into a major PLM presence, they will have to acquire enterprise-capable cPDM solutions by building them (which is also an expensive proposition), partnering very tightly with existing cPDM suppliers, or buying a cPDM solution.

Of the mid-range MCAD providers, only Autodesk is in a realistic position to move up to the high-end, since they have a substantial revenue stream from other CAD sales, particularly AutoCAD into the architecture, engineering, and construction markets. However, they have not moved into either the High-End MCAD or cPDM markets, although they recently (February, 2005) announced a data management program focused on support for mechanical engineering workgroups. SolidWorks, which is the mid-range MCAD market revenue leader, is owned by Dassault Systèmes and is unlikely to be placed in a position of competing directly against their CATIA and ENOVIA product lines. Another of the mid-range MCAD leaders, Solid Edge, which is owned by UGS, is unlikely to move up to high-end for a similar reason.

Since the High-End MCAD suppliers are revenue leaders in both cPDM and the overall PLM market, they have a great influence on how both the cPDM segment and broad PLM markets evolve. They continue to expand their offerings in all areas (CAD, cPDM, digital manufacturing, and others) to cover more of the manufactured product lifecycle. Indeed, the High-End MCAD

companies provide overall PLM offerings that encompass the broadest ranges of capabilities available today, combining MCAD, cPDM, digital manufacturing, and other solutions. This raises the competitive bar on all of the other suppliers to the PLM market. These companies, among other PLM suppliers, continue to add more process-oriented solutions as well. In some cases, such as aerospace and automotive, they are uniquely qualified to do this since they have many customers in those areas and a lot of experience and knowledge to support their developments. However, there is a growing need for cPDM solutions that can support multi-CAD (including multiple MCAD, ECAD, and engineering analysis solutions) environments combined with software engineering. The current High-End MCAD suppliers continue to work on this issue along with a number of the independent cPDM solution providers.

5 Conclusions

This paper has focused on a review of the High-End MCAD and cPDM market segments within the overall PLM market for discrete manufacturing industries. These two segments have had a major influence in the development and evolution of PLM. Historically, the cPDM market had its roots in the High-End MCAD market, and High-End MCAD suppliers have played a significant role in both the cPDM and the broader PLM industry. Of course, there are a number of other significant suppliers of cPDM solutions as well, who have driven the industry and expanded its capabilities and value.

Different industries have their own unique requirements and drive the suppliers to accommodate them. This is true for both High-End MCAD and cPDM. As a result, various suppliers have focused on developing solutions particularly aligned with industry-unique needs, and have positioned themselves as primary suppliers to those industry sectors. The automotive industry

has been a primary driver of both High-End MCAD and cPDM, and several suppliers focus on various aspects of this industry. For High-End MCAD, aerospace and defense, electronics and telecommunications, and fabrication and assembly are other industries with heavy influence. For the cPDM market, electronics and telecommunications has had as large an influence as automotive, followed by fabrication and assembly and aerospace and defense.

All major regions of the world are investing heavily in both High-End MCAD and cPDM solutions. Levels of investment in the different regions are not even, although the Americas and Europe have been relatively close for the past few years. The major change in regional investments is coming from Asia-Pacific, in which the growth rate has been higher than in the other two major regions. This will undoubtedly have an impact on development of solutions over the coming years as the Asia Pacific region demands more attention for its unique needs.

Overall, growth of High-End MCAD investments is not high. This market has experienced relatively slow growth recently, and forecasts for the next few years indicate 3.8 percent CAGR over the next five years. cPDM investments, however, are demonstrating solid growth, and most of the expansion in the overall PLM industry is expected to be fueled by cPDM, which is forecast at 15 percent CAGR over the coming five years. This growing opportunity, in combination with increasing demands for more extensive full-design environments, is driving the High-End MCAD suppliers to increasingly focus on providing robust cPDM engines as a part of their offerings. At the same time, the other major suppliers of cPDM solutions are driven to satisfy the industry by providing increasingly sophisticated integrations with design environments of all types.

In this market situation, the winners will be the industrial companies who are able to take advantage of the expanded and improved solutions from suppliers of High-End MCAD and cPDM solutions. Capabilities to facilitate collaboration across widely distributed extended enterprises are no longer dreams, but reality. The evolution of these solutions to support broad PLM initiatives has been clear. As stated earlier in this paper, PLM is one of the most critical initiatives in manufacturing industries today, and is an essential strategy for any industrial company that is serious about improving their ability to compete effectively. Demand for PLM is driven by a focus on improving a company's ability to cost-effectively produce high-quality products in a timely manner, and by an increasing recognition that innovation has become a primary differentiator between those companies that succeed and those that fail. Forward-looking companies that understand the opportunity available and invest appropriately will be the organizations succeeding in industry over the coming years. Those companies understand that PLM is a strategic business approach to empower the business, enable product and process innovation, and enhance both top and bottom-line business performance.

About CIMdata

CIMdata, a leading independent worldwide firm, provides strategic consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata works with both industrial organizations and suppliers of technologies and services seeking competitive advantage in the global economy by providing world-class knowledge, expertise, and best-practice methods on PLM solutions.

CIMdata helps industrial organizations establish effective PLM strategies, identify requirements, and select PLM technologies, optimize their operational structure and processes to implement solutions, and deploy these solutions.

For PLM solution suppliers, CIMdata helps define business and market strategies, delivers worldwide market information and analyses, provides education and support for internal sales and marketing teams, as well as overall support at all stages of business and product programs to make them optimally effective in their markets.

CIMdata provides world-class knowledge, expertise, and best-practice methods on PLM solutions. These solutions incorporate both business processes and a wide-ranging set of PLM enabling technologies.

In addition to consulting, CIMdata conducts research, provides PLM-focused subscription services, and produces several commercial publications. The company also provides industry education through international conferences in North America, Europe, and the Pacific region.

To learn more about CIMdata's services, visit our website at www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 (734) 668-9922. Fax: +1 (734) 668-1957.



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