



# **PDM to PLM: Growth of An Industry**

**A CIMdata Market Report**



# **PDM to PLM: Growth of An Industry**

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# About CIMdata

CIMdata, a leading and independent worldwide strategic consultancy is dedicated to maximizing an enterprise's ability to design and deliver innovative products and services through the application of PLM solutions. CIMdata works with both industrial organizations and suppliers of technologies and services seeking competitive advantage in the global economy.

CIMdata helps industrial organizations establish effective PLM strategies, identify requirements and select PLM technologies, optimize their operational structure and processes to implement solutions, and to 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 including product data management (PDM), visualization, collaboration, digital manufacturing, computer-aided design/manufacturing (CAD/CAM), and numerical control (NC). CIMdata also provides expertise in the integration of PLM with other business solutions such as customer relationship management (CRM), supply chain management (SCM), and enterprise resource planning (ERP).

In addition to consulting, CIMdata provides industry education through international conferences in the US, Europe, and Japan that focus on PLM. The company also conducts research, provides PLM-focused subscription services, and produces several commercial publications. CIMdata serves clients worldwide from locations in North America, Europe, and Asia Pacific.

To learn more about CIMdata's services, visit our website at [www.CIMdata.com](http://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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# 1. Introduction

This report describes the evolution of the Product Data Management (PDM) market of the 1980's and early 1990's to the comprehensive Product Lifecycle Management (PLM) market of today. The purpose of the report is to provide a coherent record of the beginnings and growth of this important software industry and the extent to which PLM is being utilized today. This document includes a revenue history of the collaborative Product Definition management (cPDm) segment of the PLM market during this evolution. However, it does not include a forecast of estimated future industry revenues. The report discusses the issues that triggered the initial investments in the industry and shaped its growth. Examining these issues, in conjunction with the revenue history, provides insight into why PLM has evolved into the mission-critical enterprise solution that it is today.

Understanding this evolution will help both end user organizations and PLM solution providers. Executives, managers, and staff of companies investing, or planning to invest, in PLM solutions will gain insight as to why PLM is important to their organizations. It also provides an understanding of how PLM solutions have evolved from their engineering roots into broad enterprise-level solutions. Finally, the market data illustrates which industries have invested the most and, therefore, have achieved the broadest benefits from PLM.

Executives and program managers of PLM solution suppliers will gain an understanding of how the PLM market has developed – by industry and geography – that can help them plan their program strategies and development.

Other readers will learn more about PLM, and how the market and industry has grown, and evolved to meet changing business needs to deliver true enterprise solutions for business success. A complementary CIMdata white paper, “Product Lifecycle Management – Empowering the Future of Business” provides an in-depth definition of PLM and is available at [www.cimdata.com](http://www.cimdata.com).

## 2. Defining the PLM Market Space

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 from concept to end of life – integrating people, processes, business systems, and information. PLM creates and manages the digital product or plant (i.e., a company’s intellectual assets) and provides an information backbone for a company and its extended enterprise. It is composed of multiple elements including: foundation technologies and standards (e.g., XML, visualization, collaboration, and enterprise application integration), information authoring and analysis tools (e.g., AEC, MDA, FEA, EDA, CASE, and technical publishing), core functions (e.g., data vaults, document and content management, workflow management, classification management, and program management), applications (e.g., configuration management), and business solutions built on the other elements (e.g., an automotive supplier solution or a plant inspection and maintenance solution).

For market research and analysis purposes, CIMdata divides the PLM market into two software and services portions—applications that support the authoring and analysis of product definition information (e.g., MDA, EDA, CASE, analysis, and technical publishing) and solutions that focus on collaboration, management, and sharing of product definition information (i.e., cPDM solutions). cPDM addresses managing the complete product or plant definition lifecycle, including all of the mechanical, electronic, software, and documentation components. Effectively managing these intellectual assets is essential to creating a true competitive advantage and achieving bottom line business benefits. In addition, cPDM solutions are also used to manage manufacturing and support processes used during the lifecycle. Essential PLM enabling technologies such as product data management (PDM), collaboration, visualization, enterprise application integration (EAI), component supplier management (CSM), and others address the extended product or plant definition supply

chain of OEMs, sub-contractors, suppliers, partners, and customers.

cPDM solutions are not just technology. They support the PLM strategic business approach that includes multiple types of technologies, methods, and best practices. cPDM focuses on management and use of digital intellectual assets throughout the complete product definition lifecycle.

cPDM business solutions are focused on solving specific business problems, such as “managing the change process across the intellectual supply chain of an electronics manufacturer” or “supporting the project management activities across the extended enterprise.” These solutions are delivered through a combination of foundation technologies and core functions (e.g., PDM), enabling applications, established methods and processes, and implementation approaches.

While the industry started with CAD data management and PDM, PDM is now considered a core component of a comprehensive PLM solution. PDM includes the following basic elements of PLM solutions:

- Data vault and document management
- Product structure management
- Workflow management
- Classification management
- Program and project management

The next section provides more details on how the market and PLM solutions evolved over the last twenty years.

## 3. From CAD Data to Lifecycle Management

### 3.1 The Fundamentals

PDM systems were first developed within large corporations as “home grown” systems used to manage CAD files related to product designs. In the early 1980’s Control Data Corporation (CDC) released the first commercially available CAD file management system, EDL – the Electronic Data Library. The emergence of digital design systems created the need for systems like EDL. The change from designing product and plants using manual drawing boards to using a computer terminal or workstation and a CAD application resulted in an explosion of digital data. Because those design applications created many digital files, it became increasingly difficult to effectively capture, manage, and control the output of those systems. Users had more and more difficulty locating needed information and companies were losing control of the change processes associated with that information.

This problem became more widespread during the mid 1980’s, as design systems became ever more comprehensive and complex, and more engineers began to use standalone workstations. More companies began to offer products to address these data management issues, including Sherpa, Computervision, and SDRC.

Originally, PDM was focused on solving the problems of CAD file management by providing a good data vaulting facility, and was typically limited in scope to an engineering department or workgroup. This solution was based upon foundation technologies that handled data and communications requirements. Additional functions were quickly added to this base, expanding the core capabilities of PDM systems. As the industry evolved, the scope expanded beyond engineering departments. By the early 1990’s, industry demanded more sophisticated applications to address issues such as product structure, change control, configuration management, and others. A host of related technologies, such as visualization, began to appear and were

quickly used to enhance the capabilities and value of PDM implementations.

As this evolution continued, the term PDM also evolved. Users expected PDM to encompass more capabilities and functionality in support of product development. PDM, which initially focused on CAD and engineering file management, became a term that also included process management using workflow, and shared information using visualization and collaboration. Since each supplier used different terminology to describe the product space and their solution, users struggled to understand what these new management systems offered and why they should invest in deploying them.

Thus, throughout the mid 1980’s to early 1990’s, there was confusion as to what to call product-related information, particularly engineering information with confusing acronyms such as PIM, EDM, TIM, and TDM all in use. As the data came to be referred to generically as product data, the term product data management (PDM) emerged. Both users and solution providers embraced PDM and used the term for many years. In fact, PDM remains a foundation component of PLM. However, in the mid to late 1990’s, new acronyms again created confusion in the market as people began to consider the product lifecycle and collaboration—PDM, cPDM, CPC, and others. These terms overlap and carry multiple meanings. However, with the start of the new millennium, PLM emerged as the term used to describe this market space. As with PDM, different solution providers define PLM differently. As described in Section 2, CIMdata defines PLM a business approach for the creation, management, and use of product-associated intellectual capital and information throughout the lifecycle.

Thus, there has been a continuous evolution of this market space; an evolution that has expanded the capabilities and lifecycle focus of the enabling technologies, methodologies, and processes.

## 3.2 The Change of Focus

Fifteen years ago, custom CAD data management system implementations focused on precise applications primarily wrapped around engineering design data, see Figure 1 below. In the late 1980's, the major emphasis was on how to manage engineering drawings, with limited scope solutions primarily sold to managers in engineering departments.

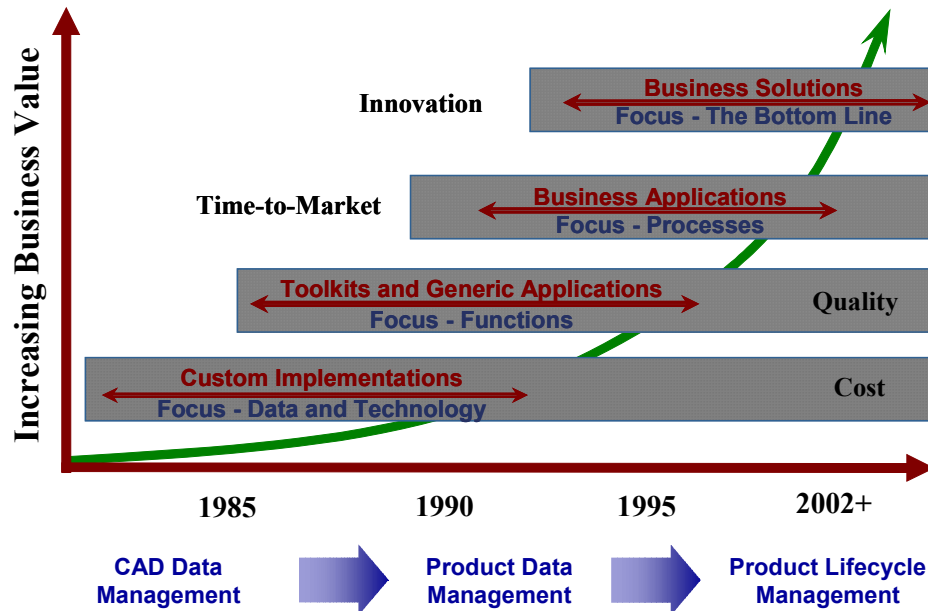


Figure 1. The Evolution of PLM

Custom implementations evolved into toolkits and generic applications that automated some typical functions, such as file check in and check out procedures. Custom implementation, toolkits, and generic applications helped reduce design and development costs and contributed to improved product quality. As the solution providers gained experience implementing their tools in different industries, their offerings evolved into delivering focused business applications which continued to address cost and quality and added a focus on time to market. These applications provided standard data models, predefined workflow templates, and other functions necessary to solve specific business problems. Today, the focus is on complete business solutions that address top and bottom line issues, and enable innovation. These solutions incorporate best practices to allow organizations to migrate their busi-

ness processes toward de facto industry standards. This evolution has changed not only the level of managers that buy these solutions, but also the issues that are driving these investments and, more importantly, the manner in which these solutions are acquired and implemented.

As part of this evolution, the scope or definition of the “product lifecycle” has also changed. Fifteen years ago, the “lifecycle” focused on the design engineering activity, as the tools concentrated on CAD data management. In the late 1980's, that perspective began to expand to include workflow and processes across the product lifecycle, i.e., to share information and processes among different design activities. That expansion continues today with PLM solutions touching many different business functions and organizations beyond traditional engineering

and design departments.

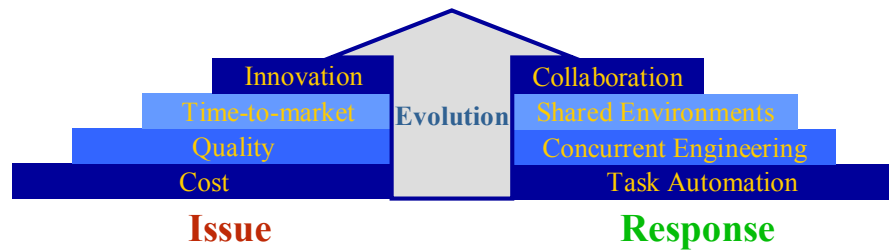
As a result of users understanding both the need and benefits available, first from PDM and now PLM solutions, they continued to invest and to grow their investments in these enabling technologies and solutions. As the scope of solutions has broadened, new suppliers continue to develop products and services for this market space, which in turn continue to drive user investments.

Over the past five years, visualization and collaboration solutions have emerged. They solutions have greatly expand the number of users able to easily access and use product information previously available only to design engineers who had access to high-end design tools. Adoption of internet-based technolo-

gies and computing paradigms has made PLM solutions easier to implement and deploy across distributed enterprises. While the need for services required to tailor or customize the base products has been reduced, other implementation services (e.g., integration with other business systems, and cultural change and business process re-engineering consulting) associated with deployment of new capabilities and working paradigms has increased the scope and effectiveness of PLM deployments.

In the past decade, many business investments, such as those related to Enterprise Resource Planning (ERP), were made to improve operational efficiency. Today, one of the primary drivers is a focus on the product and product innovation, i.e., how to bring an innovative product to market sooner and more efficiently. The pressures of reduced time, improved product quality, and lower costs aren't new, but they are being reaffirmed and folded into programs that focus on the product. Another major change that has occurred during the last several years is increasing product complexity, not just in terms of a product's physical or mechanical configuration, but complexity in terms of all the electronics and software that are also part of the delivered product or plant. These drivers put increasing pressure on organizations to invest in solutions that include technologies, methodologies, and best practices that can help them improve their ability to focus on product innovation, leverage their business partners, and compete more effectively in the global market place.

While this focus on product innovation is new, it is built on previous activities or initiatives that sought to improve various business aspects. Over the last fifteen years, there have been a series of initiatives, each of which addressed the important business issues of that time. During the 1980's, businesses wanted to achieve cost reduction and cost control. The response was to focus on task automation technologies and methods to



**Figure 2. Evolution of Responses to Business Drivers**

improve efficiency and shorten information access times.

In the early 1990's the focus shifted to how to improve product quality. One response was concurrent engineering (CE). CE was basically an attempt to involve a broader set of people or teams of different perspectives (e.g., manufacturing and service) into the product design process and get their needs and ideas incorporated into the product design early, resulting in improved overall quality. However, the focus on quality did not ignore cost; cost control was an assumption at that point in time; quality was just built upon it.

In the late 1990's, the primary driver became time-to-market; how to respond to market pressures more effectively, and how to get quality products to market sooner. The response was to focus on creating effective shared environments across diverse organizations. The use of Web-based technologies to facilitate sharing information began to have a significant impact on the development of new solutions. Each of these drivers has fueled investments in various technologies and approaches now included within the PLM industry, resulting in a continually growing market for PLM technologies, products, services and more importantly, solutions.

Growth of the PLM industry has been, and continues to be, driven by several factors. In the early days, as discussed previously, CAD file management was the initiator for the development of tools and applications to address the need to manage digital product design data. At the same time, electronic document management tools were also coming into common use. However, just managing digital product data, while providing

benefits to departments and individuals, was not a compelling reason for companies to invest in broader lifecycle management solutions. Over time, as the solutions have expanded (see Figure 1) to meet the challenges and needs of businesses to address the issues illustrated in Figure 2, PLM, and PDM before it, have demonstrated bottom line value for companies that deploy and utilize PLM solutions.

In response to the requirements of their customers, suppliers continue to expand the scope of their product vision, putting much more emphasis on the concepts of collaboration and management of product definition, rather than on just managing product data. Additionally, comprehensive PLM technology suppliers continue to develop prepackaged solutions that address both horizontal functionality and industry-specific requirements. These prepackaged solutions are easier to install and provide faster return on investment, and in turn this has spurred PLM adoption in the middle market - the small- to medium-sized businesses found throughout multiple industry sectors.

PLM solution suppliers have incorporated web and internet-based technologies and operating paradigms to create expanded solutions that are enabling increasing numbers and types of users to participate in both the definition and use of product and plant information. Entry of new suppliers, technologies, and solutions into the industry has continuously expanded the scope of lifecycle and business support, and the market for them.

Comprehensive PLM solution suppliers, such as EDS, IBM, and SAP, have placed a major business focus on PLM by making it a line of business within their corporations. Additionally, major systems integrators and consulting firms have established worldwide practices focused on PLM as well as relationships with key PLM solution providers. This combination has reinforced the importance and viability of PLM in the minds of corporate executives. The increasing role and impact of system integrators, consulting firms, resellers, and Value Added Resellers (VARs) in both sales and PLM solution development has expanded the scope and acceptance of PLM solutions. In addition, it has helped tailor

solutions to address industry-specific requirements and has broadened the market penetration of PLM.

## 4. Measuring the Market

For the past several years, CIMdata has conducted the most extensive cPDM/PLM market revenue analyses in the industry. CIMdata currently surveys more than 250 technology suppliers, resellers, systems integrators, consultancies, and solution providers to gather information on their PLM-related revenues, breakouts of their revenues by geography and industry, and other pertinent market data. After filtering and compiling this information, CIMdata uses a market model to estimate the current size of the PLM market in two segments – the cPDM segment and the authoring and analysis tools segment – and forecasts the growth of each segment over the next three to five years.

CIMdata uses a number of assumptions to analyze the cPDM market segment. Our measurement of this market segment includes:

- The software and services revenue of the comprehensive cPDM technology suppliers, (e.g., Agile, EDS, PTC, MatrixOne, IBM/Dassault Systèmes, SAP, etc.) including royalty payments from other companies that use and sell their products, e.g., systems integrators and resellers. That royalty is assumed at 50% and that revenue is divided between the partners to avoid double counting.
- The software and services revenue of systems integrators, resellers, and VARs attributable to developing, installing, and implementing cPDM solutions. This includes:
  - Strategy and vision development but not overall business marketing and direction strategy
  - Process design and re-engineering
  - Deployment
  - Supplier evaluation and selection
  - Implementation and customization
  - Integration with other business systems
  - Integration with extended enterprise
  - Training and education

- Ongoing support and maintenance, if applicable
- Cultural change management
- Metrics definition and measurement
- Program management.
- Revenues for document and content products, tools, technology, and solutions as used in the manufacturing and process industries to support the product definition lifecycle. Revenues for suppliers such as FileNet and Documentum does not include their sales and service for industries such as finance.
- Selected revenue of other suppliers such as those having some products that address a specific portion or phase of the product definition lifecycle. It does not include revenue from products and services that address other aspects of their business, such as supply chain integration at the procurement and production level.
- ERP revenues from suppliers that have multiple product programs, such as SAP, are not counted.

It is important to note that revenues (software licenses, software maintenance, and services) from authoring and analysis tools are not included in the revenue history presented in this report as they are not part of the cPDM segment of the PLM market.

## 5. PLM Industry Revenue History

This section presents a historical perspective of the growth of the PDM/cPDM segment of the PLM market from 1989 through 2001. This is a historical review and perspective, not an in-depth analysis of the market/industry growth. Detailed analysis of the PLM market and market forecasts are presented in CIMdata's yearly *PLM Market Analysis Report*.

### 5.1 Segmentation by Functionality

The cPDM market segment of PLM is divided into three primary sub-segments: comprehensive technology suppliers, system integrators-resellers-VARs, and focused application suppliers, including visualization and collaboration, component supplier management, and content management. The comprehensive cPDM technology suppliers (e.g., Agile Software, Cyco, EDS PLM Solutions, Eigner, IBM PLM Solutions, PTC, SAP, etc.) provide core cPDM functional capabilities, and often include visualization and collaboration tools

and solutions within their product suites, as well as consulting and implementation services. Independent systems integrators, resellers, and VARs (e.g., Accenture, Bearing Point, Braxton Consulting, CENIT, gedas, T-systems, etc.) often sell both cPDM solutions and provide related services, such as implementation support and process re-engineering support. The third sub-segment, focused application suppliers, includes firms such as Documentum, FileNet, i2, and Sopheon, as well as a number of third-party visualization and collaboration suppliers, such as Centric Software, CoCreate, and Spicer.

Category 1 suppliers form the *hub* of the PLM market, developing the core technologies upon which PLM solutions are built. Category 2 suppliers are the *delivery* mechanism, creating and/or implementing those solutions for a specific customer. Category 3 suppliers *enhance* the capabilities provided by Category 1 technology suppliers in two ways. They *enable* many more users to view and collaboratively work with product and plant information, and *extend* PLM solutions to

Category	Title	Description
1	<b>Comprehensive cPDM Technology Suppliers</b>	Suppliers that provide a full range of PLM capabilities, have demonstrated scalability, whose products can be applied to multiple solutions, and have a track record of selling their products for use throughout an enterprise.
2	<b>System Integrators, Resellers, and VARS</b>	Suppliers focused on selling and/or implementing PLM solutions. Suppliers in this category do not develop core PLM technology. However, they may integrate multiple products and technologies and add their specialized expertise, i.e., industry knowledge, to create focused PLM business solutions.
3	<b>Focused Applications</b>	Software products that typically are integrated within broader-based PLM solutions. Examples of these applications are: <ul style="list-style-type: none"> <li>• View and markup packages, popular 3D visualization products that operate in heterogeneous CAD environments, and products that enable collaborative work sessions. They do not include a full range of PLM core functionality but may provide some limited other capabilities</li> <li>• Document and content management systems whose capabilities have been expanded into collaborative design management. Only the portions of a vendor's business that can be tracked to the management of product information and processes are counted as revenues for PLM.</li> <li>• Component supplier management (CSM)</li> <li>• Configuration management (CM)</li> </ul>

**Table 1. cPDM Market Category Descriptions**

additional areas of a business and its extended enterprise.

Prior to calendar year 2000, the focused application supplier and system integrator/reseller segments were too small to be reported separately. The rapid growth in the PLM market in recent years brought more companies offering specialized products and services, and necessitated this expanded industry segmentation. Figures 3 and 4 illustrate the partitioning of these three sub-segments within the cPDM market in calendar years 2000 and 2001.

Comprehensive suppliers (e.g., EDS, IBM/Dassault Systèmes, MatrixOne, PTC, SAP, etc.) comprise the largest portion of the cPDM segment of the PLM market. Suppliers in this segment continue to evolve and enhance their product suites and to grow their service business.

Independent systems integrators, resellers, and VARs (e.g., Accenture, Braxton Consulting, gedas, etc.) comprise the second-largest portion of the cPDM segment and continue to experience growth as both the scope and pace of implementations has expanded dramatically. The market share drop in 2001 is somewhat misleading, since the decrease is primarily attributable to consolidation in the industry and services revenue being transferred to PLM lines of business within companies that are also comprehensive suppliers, e.g., EDS PLM Solutions absorbing much of EDS' previously separate PLM systems integration work.

Focused application suppliers comprise the smallest portion of the cPDM segment. This segment includes suppliers (e.g., Documentum and Sopheon) as well as a number of third-party visualization and collaboration suppliers (e.g., CoCreate and Spicer). These suppliers continue to grow as those technologies become more deeply embedded in and enhance PLM solutions.

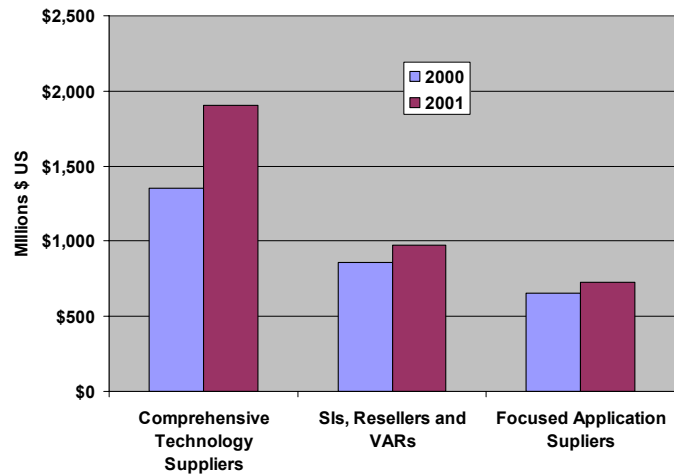


Figure 3. cPDM Market Segmentation 2000 – 2001

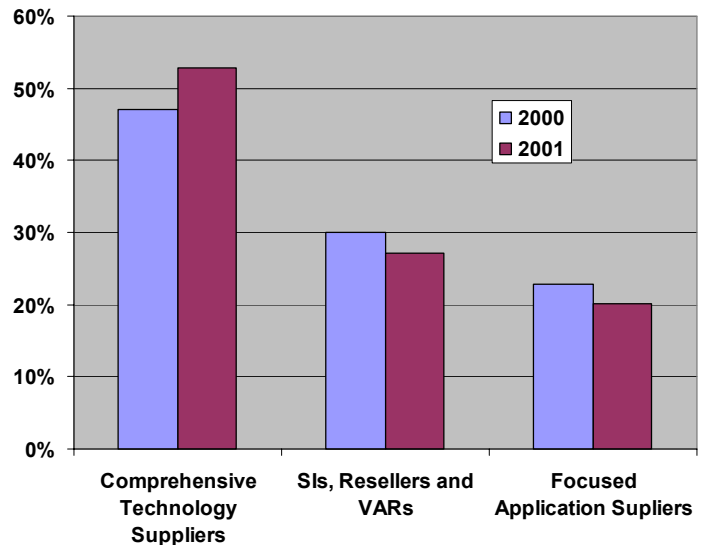
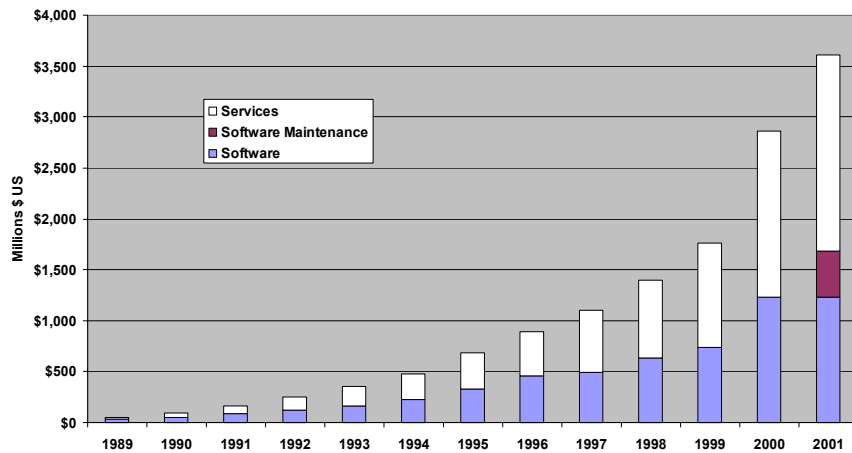


Figure 4. Share of cPDM Market by Segment

## 5.2 cPDM Market Growth

Investments in cPDM enabling technologies and solutions have consistently increased since CIMdata began tracking the market in 1989. Figure 5 presents the overall cPDM market revenue history.



**Figure 5. cPDM Market Revenue History**

Note: Software Maintenance was not measured separately until 2001

An important impact on revenue growth is the sale of new licenses. New license sales drive future services and maintenance revenues, leading to continuing overall growth. In the past, some suppliers reported software maintenance as software revenue while other reported it as maintenance. Reporting software maintenance separately provides a more accurate understanding of true new license sales versus the ongoing revenue provided by licenses under maintenance

The market growth shown in Figure 5 was driven by several factors, including increased investment by industrial companies in cPDM solutions to improve their business effectiveness, an increased number of large-scale implementations in recent years (e.g., many 2,500+ seat implementations and some implementations in excess of 40,000 and 50,000 seats), and deployment of cPDM core technologies across extended enterprises and supply chains. Figure 6 presents the growth of cPDM software, software maintenance, and services

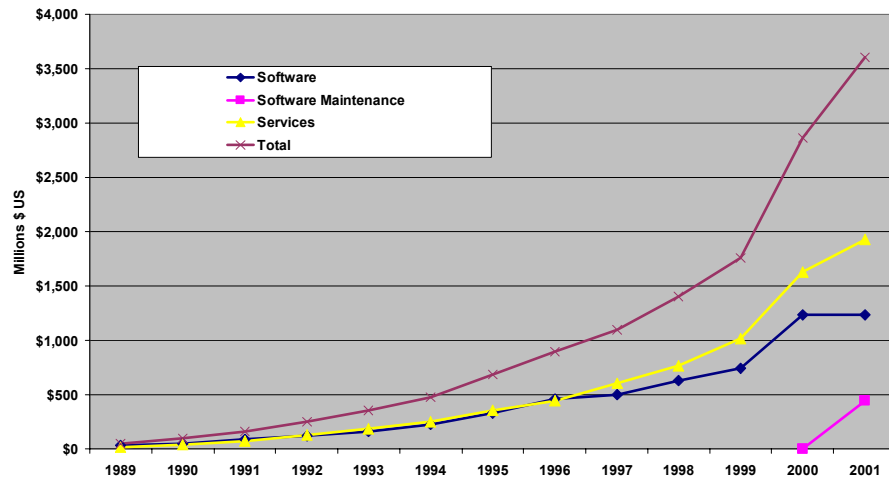
revenues during the reporting period.

Note that software maintenance was not separately measured prior to 2000 and that revenue was generally included in software sales. Thus, while software sales appear to be flat, the overall software revenues did increase during 2001.

To put cPDM in perspective of the overall PLM market, in 2001 CIMdata

estimated the PLM market to be approximately \$12 billion, with cPDM accounting for approximately \$3.6 billion, or 30%. For the past several years, cPDM has been the fastest growing segment of the PLM market and CIMdata expects that trend to continue for the next several years.

As cPDM programs have grown, so have the services associated with implementation of those programs. This is a result of expanding scope of cPDM solutions and integration with other elements of the extended enterprise. The service and software shares of the market have been stable at approximately 55% to 45%



**Figure 6. Software and Services Growth History**

respectively for the last several years, as shown in Figure 7.

While the services share of the market declined slightly over the past two years, the services share of the cPDM market is expected to remain the largest individual segment as cPDM solutions expand to touch more of the extended enterprise. Services growth will continue to be strongest in large extended enterprise implementations, but less in the mid-market as small to midrange companies cannot afford significant service fees, and as a result are more likely to implement packaged cPDM solutions focused on specific functions and/or industries.

Figure 8 presents the revenue growth rate history for cPDM.

The large spike in growth during 2000 was the result of a combination of large-scale deployments of basic cPDM technologies, the maturing and acceptance of visualization and collaboration applications, expanded project management capabilities, the ramp up of significant systems integrator and consultancies practices focused on PLM, and the implementation and incorporation of cPDM principles and technology into solutions that support extended enterprises.

The next section extends the analysis to focus on geography and the adoption of PLM technologies in different end user markets.

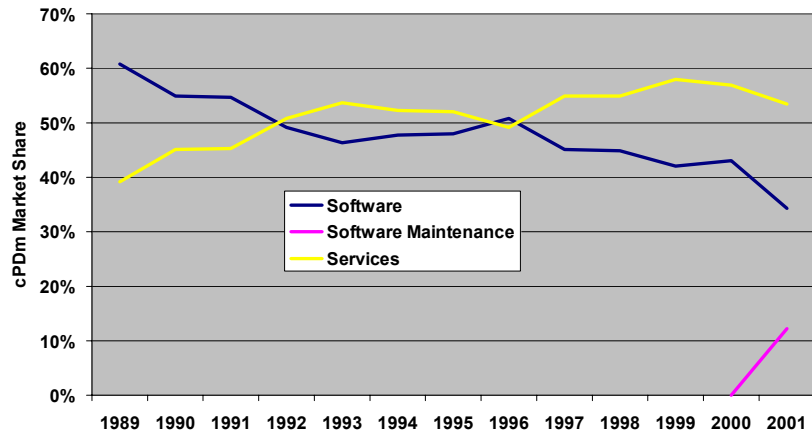


Figure 7. Market Share of Software and Services

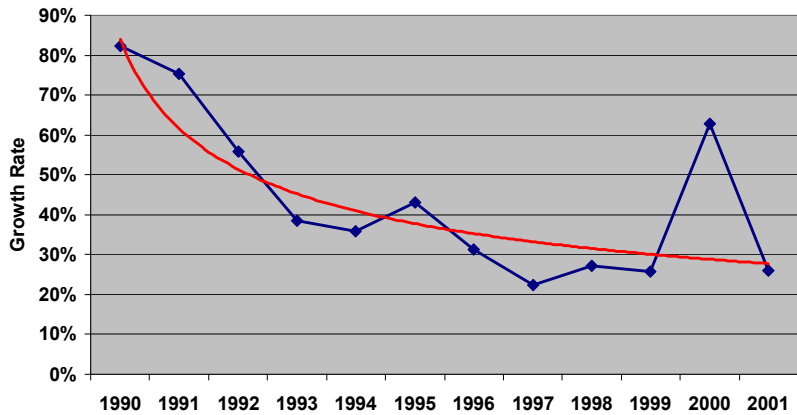


Figure 8. cPDM Market Revenue Growth History

# 6. Geographic and Industry Revenue Histories

This section presents cPDm revenue distributions by geography and industry.

## 6.1 Geography Revenue History

CIMdata segments cPDm revenues into four geographies: the Americas, Europe, Asia-Pacific, and the Rest of the World.

The Americas includes the United States (U.S.), Canada, Central, and South America. The U.S. dominates this market segment. Canadian companies are also adopting cPDm but the installed base is much smaller than that in the U.S.. Central and South America have had a relatively small level of PLM activity.

The European region is divided as follows: Benelux (The Netherlands, Belgium, Luxemburg), Central (Germany, Austria, Switzerland), France, Italy, Scandinavia (Norway, Sweden, Denmark, Finland), Spain, the United Kingdom, and the Rest of Europe. The Central region, primarily Germany, has been the major adopter of PLM in Europe.

Asia-Pacific includes Australia, China, India, Japan, South Korea, Taiwan and the Rest of AP.

North America was the initial market for PDM as the early suppliers were all North American, primarily based in the United States. As European companies began to adopt PDM and then PLM, European-based suppliers have emerged. Over the last several years, the North American and European markets have begun to reach parity.

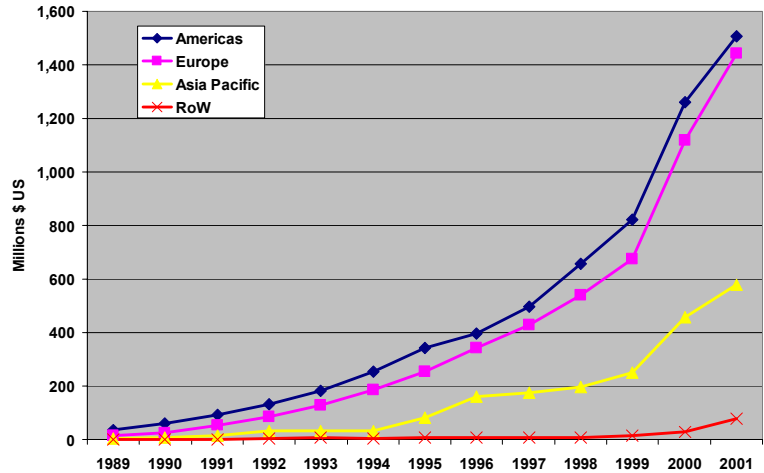


Figure 9. cPDm Revenues Geography History

Growth has been slower in Asia-Pacific, but that region has continued to gain momentum.

Figure 9 presents a combined view of the revenue histories of the geographic regions.

Figure 10 presents a view of market share by geographic region. The relative market shares of the three major geographies have remained approximately the same for the last two years.

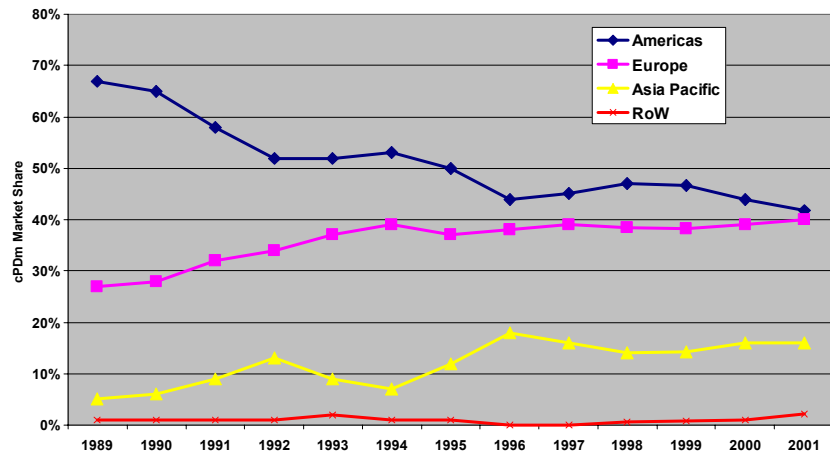


Figure 10. Geographic Market Share History

As shown above, the Americas and European markets have been similar in overall revenue size since 1996 and continue to move toward parity. The Americas, primarily the U.S., has been and continues to be a strong market with cPDM solution implementations across all major industries. Most cPDM technology suppliers have their headquarters, primary development, and largest sales organizations located within the United States and thus have had their greatest focus on that geography. However, the major suppliers have continued to increase their presence and marketing in Europe and Asia-Pacific. As a result, they are improving their sales in these areas.

Business in Asia-Pacific has primarily been in Japan, followed by South Korea. The emergence of China, India, and other countries is driving increased investments in this region. Central and South America have had limited adoption but have begun to make investments. Brazil, Argentina, and Mexico are best positioned for adoption of cPDM solutions.

## 6.2 Industry Revenue History

This section provides an overview of cPDM revenues by industry. CIMdata tracks cPDM revenues for the following industry segments:

- Transportation
- Electronics
- Telecommunications
- Aerospace and defense
- Mechanical machinery
- Other discrete manufacturing
- Petrochemical
- Utilities – including energy
- Other process industries
- All other industries

Discrete or mechanical consumer products, e.g., toys, appliances, etc., are included in Other Discrete Manufacturing while process-focused consumer packaged

goods such as food and beverage, and liquids are included in Other Processes.

High tech (i.e., telecommunications and electronics), transportation, and aerospace are the largest industry segments. This is because these three segments have been the early adopters of these solutions, particularly aerospace and transportation. These segments continue to grow in overall market size but with significantly lower growth rates. High tech was particularly affected by the dot.com bust and the overall economic slowdown. Mechanical machinery and other discrete manufacturing (e.g., consumer goods, life sciences, etc.) are increasing their market size and growth rate, in part due to the suppliers providing more cost effective solutions (e.g., faster, less costly implementations, etc.) needed to sell into smaller companies.

### 6.2.1 Discrete Manufacturing Industries

This section presents the various sectors within the discrete manufacturing industry, including transportation, aerospace and defense, electronics and telecommunications, mechanical machinery, and other discrete.

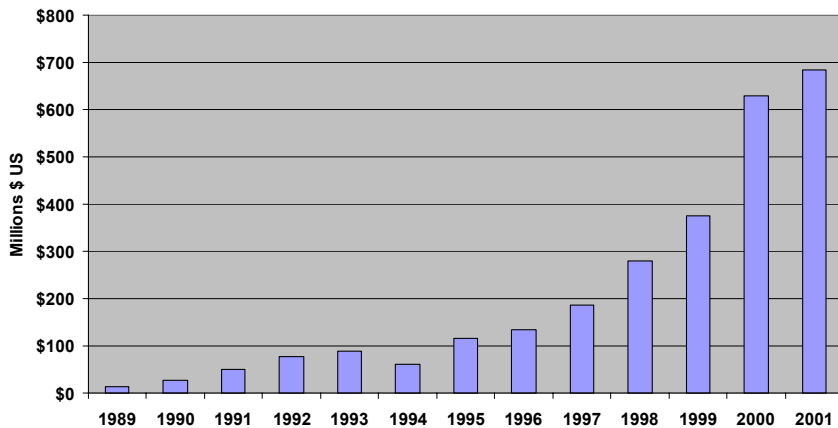
#### *Transportation*

There are two major segments of the Transportation market:

- OEMs
- Systems and parts suppliers

These segments are interdependent, sharing the same business pressures and the same needs for PLM. The business pressures can be summarized by four overall trends:

- Globalization of markets
- The need to innovate faster and more cost effectively
- Mandated local production to penetrate growing markets
- Reducing total manufactured vehicle cost



**Figure 11. Transportation Revenue Growth History**

These have led to the adoption of PLM solutions and provide the impetus to broaden PLM adoption both in the OEM and supplier industries. PLM solutions are being widely adopted to enable this globalization of design and the management of the design chain. Virtual design teams span continents, and PLM solutions and technologies enable team members to access design information and status regardless of their location. Likewise, suppliers and OEMs can exchange information across borders seamlessly.

Figure 11 presents the revenue growth within the Transportation industry segment.

### *Aerospace and Defense*

Aerospace and defense consists of distinct sub-segments:

- Airframe systems assemblers (OEMs)
- Aircraft engines and parts
- Missiles
- Launch vehicles
- Weapons systems

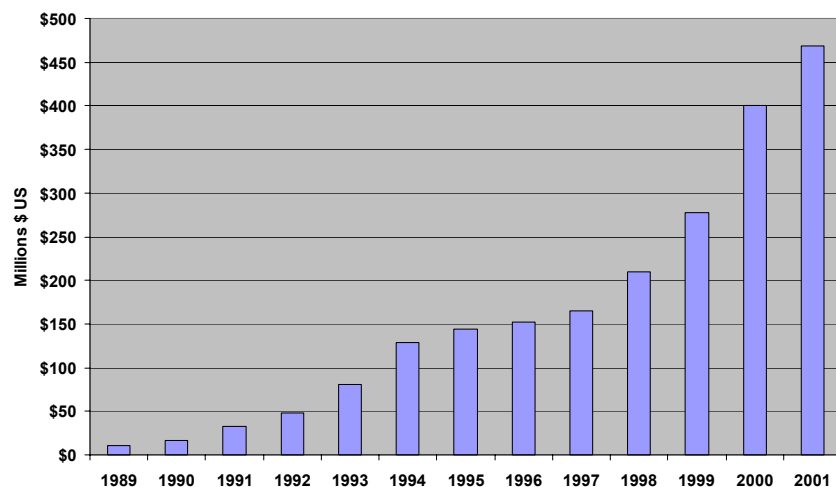
Each has extremely complex product lifecycles that must be tracked for several decades. The design of these products uses state-of-the-art technology (at the time of development) that must be documented precisely to

ensure that the intended performance is achieved. Testing and validation of designs and materials are crucial parts of the process. High accuracy is required throughout. The high volume of engineering changes must be reliably executed and communicated to all affected organizations to ensure correct execution.

The need for PLM is crucial. ERP systems provide much assistance to procurement and manufacturing operations, but

PLM is the only solution suitable for managing the product lifecycle—both in its breadth and depth. Document control, security, engineering change management, and product structure management are all necessary functions, and can help reduce overall development time. In addition, PLM offers companies the ability to coordinate the design process among hundreds of contractors/suppliers throughout the world, and to provide a coordinated approach for the use of standard components and approved suppliers to decrease material and inventory costs.

Figure 12 presents the revenue growth within the Aero-



**Figure 12. Aerospace and Defense Revenue Growth History**

space industry segment.

### ***Electronics and Telecommunications***

The electronics/telecommunications industry is composed of several distinct sectors:

- Microelectronics
- Computer equipment
- Computer networking equipment
- Telecommunications and navigation equipment
- Household audio and video equipment

Common across all these sectors is the need for tight integration of EDA tools and information within the larger PLM environment. PLM solution suppliers have begun to offer capabilities to manage the EDA environment and integrate that information into larger solutions.

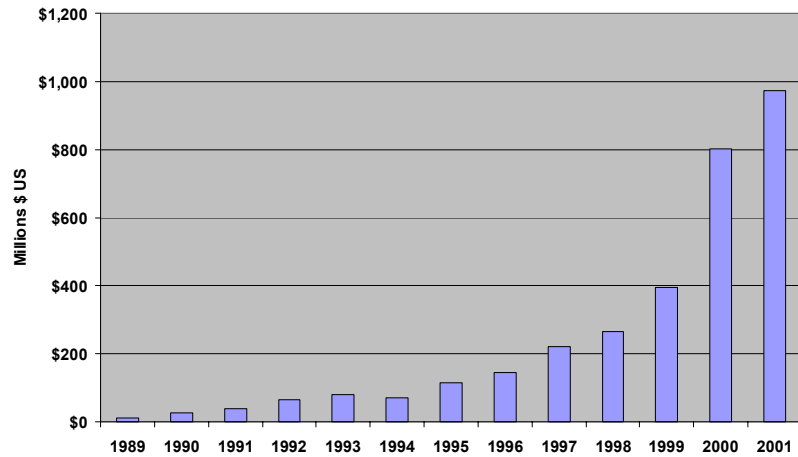
Figure 13 presents the revenue growth within the Electronics and Telecommunications industry segment.

### ***Mechanical Machinery and Other Discrete Industries***

The mechanical machinery or fabrication and assembly market is composed of a diverse set of products. Major categories include:

- Machine tools
- Construction equipment
- Mining equipment
- Oil and gas field equipment
- Farm machinery
- Packaging machinery
- Paper industries machinery
- Air conditioning, refrigeration, and heating machinery
- Printing trades machinery
- Food products machinery
- Textile machinery

Although diverse in function, this group of products has many



**Figure 13. Electronics and Telecommunications Revenue Growth History**

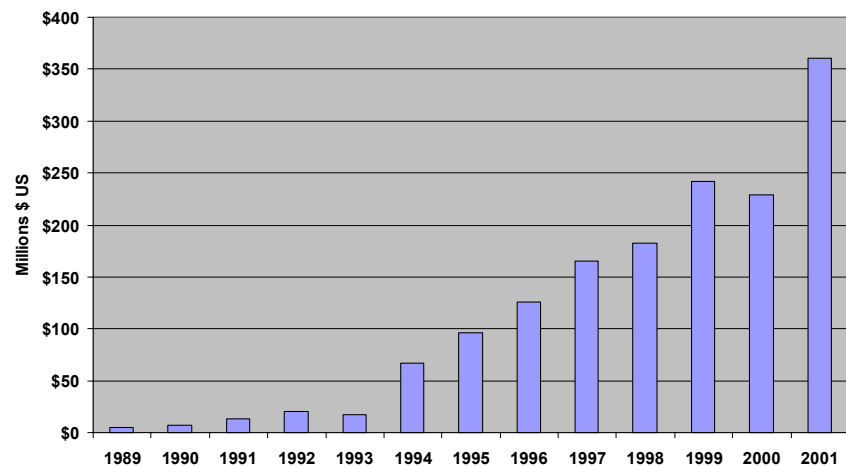
things in common, including product design, manufacturing, maintenance, and supply chain management.

Figures 14 and 15 present the revenue growth within the Mechanical Machinery and Other Discrete industry segments.

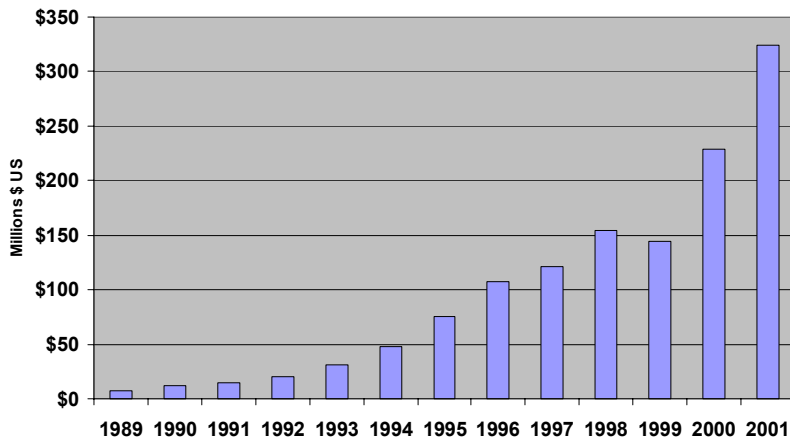
### **6.2.2 Process Industries**

The process industries are divided into three sectors; (1) energy and chemical, (2) packaged goods, and (3) utilities.

The energy and chemical sector includes:



**Figure 14. Mechanical Machinery Revenue Growth History**



**Figure 15. Other Discrete Manufacturing Revenue Growth History**

- Crude petroleum and natural gas
- Petroleum refining
- Chemicals

The facilities used within these industries are extremely capital-intensive and have major safety and environmental factors involved in their design, operation, and maintenance. PLM support of asset management is critical to each of these industries.

There are three constituencies in the petroleum and chemical process industries that are interested in PLM:

- Engineering, Procurement and Construction contractors (EPC)
- Suppliers to EPCs
- Owner/operators (OOs) of plants or facilities

PLM functionality important to plant and facility EPCs and OOs includes document management and security, engineering change management, configuration management, and program management. It enables OOs to maintain reliable records of plant design and maintenance information, thereby enabling access to that information quickly in the event of an equipment breakdown.

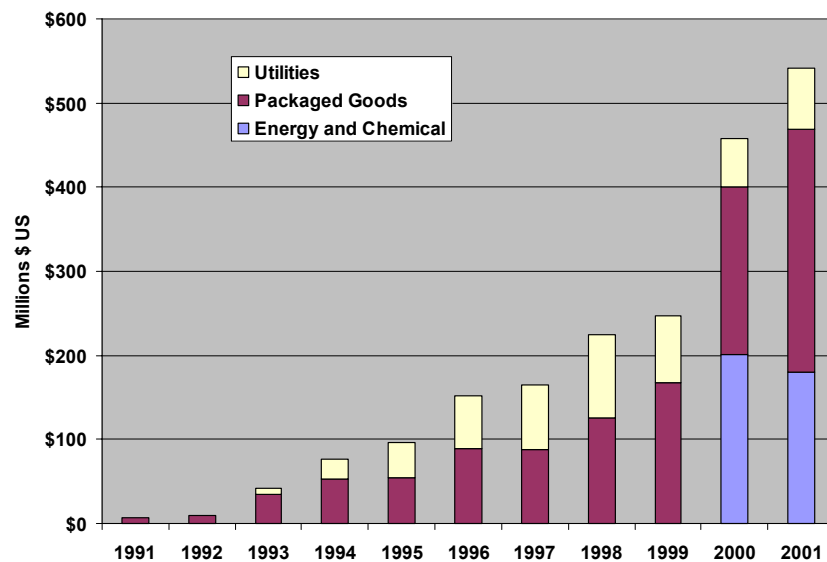
PLM also offers both EPCs and OOs benefits in the areas of writing procedures, fabrication of the plant, commissioning, and licensing. In these areas, there is a great deal of interplay among the engineering, manufacturing, and documentation functions. By providing people in all three disciplines access to the same plant information, work in each of these areas can be done concurrently, reducing the time for the new plant to come on line.

The packaged goods sector includes:

- Pharmaceuticals
- Food and beverage
- Consumer packaged goods

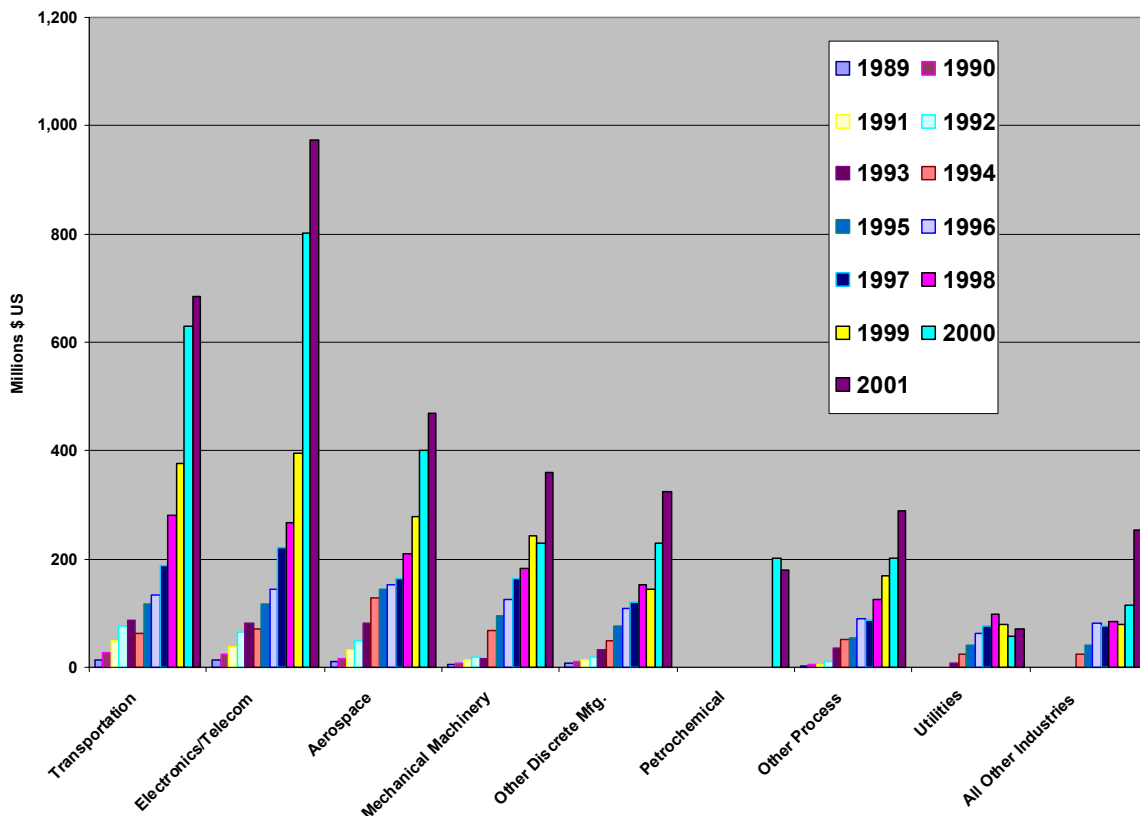
In this sub-segment the need for PLM is similar to the chemicals and petroleum refinery business in that there are needs both during plant design/construction and in managing assets after the plant is in operation.

This sector also has its own unique requirements. During product development, there is a need to design packaging and labeling such as vials, bottles, and boxes; and delivery devices such as inhalers and



**Figure 16. Process Industry Revenue History**

Note: Utilities were not separately measured prior to 1993  
Petrochemical was not separately tracked prior to 2000



**Figure 17. cPDM Revenues by Industry**

catheters. The needs for cPDM in packaging and labeling design and management are quite similar to those of discrete manufacturing. Specifically, there is the need to manage documents, control engineering changes, develop product structures, and convey this information throughout global design supply chains.

Another need for PLM within all process related industries is in regulatory compliance, e.g., the product approval stage of a new drug, truth in labeling for food and beverage, or emissions controls management. For pharmaceuticals, this is driven by government regulations regarding clinical trials and the development of drug submission documentation requesting government approval. Document management is critical in this

stage, as well as throughout the life of use of a drug. For power generation, this is the tracking of emissions type and volumes.

In all process production operations, cPDM is required for keeping track of product recipes (similar to bills of materials in a discrete manufacturing operation) as well as physical production assets. Product configurations for both raw materials and intermediates need to be managed, and changes need to be controlled, reviewed, and approved.

The utilities sector includes:

- Telecommunications utilities
- Electrical utilities

Both of these sectors have a high need for asset tracking and maintenance. They serve virtually the entire population of a region and consequently have a large complex network of systems to maintain. PLM as an asset management tool is very important to both of these sectors.

The following figure presents a combined view of the process industries revenue history.

Figure 17 presents a combined view of the revenue histories of all industries. It illustrates both the relative sizes of each industry's cPDM revenues and their growth rates. Figures 18, 19, and 20 provide snapshots of industry market shares at selected points in time. Please note that CIMdata did not separately track utilities before 1993 and petrochemical before 2000.

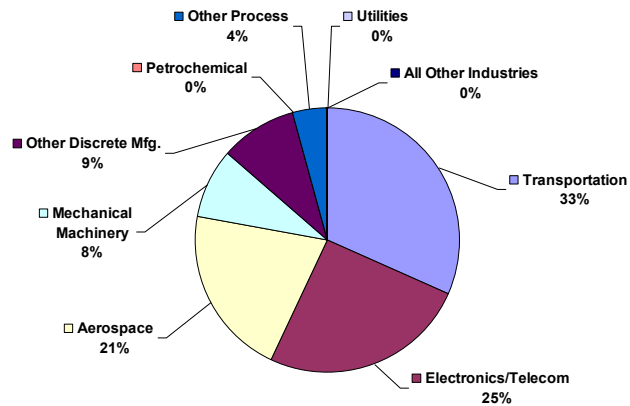


Figure 18. Industry cPDM Market Shares - 1991

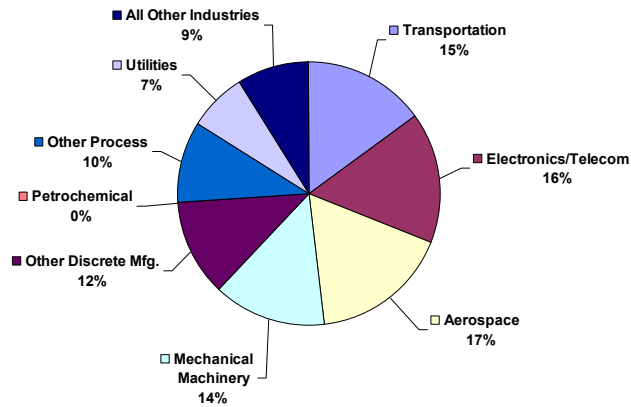


Figure 19. Industry cPDM Market Shares - 1996

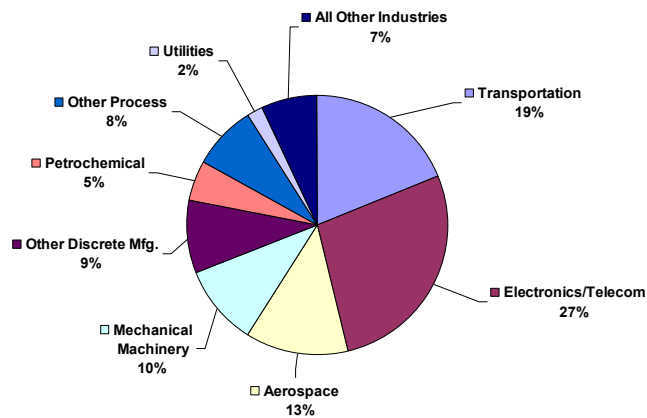


Figure 20. Industry cPDM Market Shares - 2001

## 7. Summary

PLM solutions have become broader, affecting more functional areas within a business. As they expanded beyond the walls of the engineering and design departments, PLM solutions helped many more users from across more functions to easily create, capture, access, share, and use their extended enterprise's intellectual assets, and enabled businesses in multiple industry sectors to respond to market pressures in new and innovative ways. Companies are deploying PLM strategies and solutions to address the following business trends:

- Any investment must deliver a positive impact on their bottom line
- Continuing globalization of product development, manufacturing, and service
- The need to manage all product and plant definition information - not just data - for the life and use of the product
- To improve and innovate they must manage methods and processes - not just data

Companies are looking to improve their product development activities to drive increased product innovation and time-to-market opportunities. They are willing to invest capital resources in proven solutions that address business issues they believe will increase their competitive position. As the platform for product and process innovation, PLM is increasingly viewed by corporate executives as a needed and critical investment for their business.

Today, PLM business benefits have been validated and are acknowledged to support major business initiatives. Examples include enabling collaborative design and engineering, product definition, intellectual and physical asset management, production, and service and maintenance across an extended enterprise. Further, PLM supports business process reengineering, and integration of PLM enabled process with other business processes such as Customer Relationship Management (CRM), Supply Chain Management (SCM) and service and support of delivered/installed products and plants. Ultimately, PLM enables companies to leverage their

investments in product related intellectual and physical assets.

PLM has become a vehicle to reduce cost, provide solid return on investment, and enable product and process innovation, thus delivering a positive impact on a company's bottom line. That benefit, coupled with the recognition that PLM is a strategic, enterprise-level solution, has raised awareness among C-level executives that PLM is a critical component for business success. Companies invest in PLM to either:

- Survive...“fear” drives many investments
- Win...forward-looking for future advantage

Of course, both motivations can exist and often do.

The industry continues to evolve and expand. PLM solution providers continue to prosper and grow, and new providers continue to bring new capabilities to the industry. In the evolution from PDM to PLM, companies have made significant investments. Based on CIMdata's market analysis, companies will continue to invest in these solutions into the future.



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