



**mySAP™ Product Lifecycle  
Management cPDM Program**

*“Driving Product and Process Innovation through  
Product Lifecycle Management”*

**A CIMdata Program Review**



# **Program Review of SAP's mySAP Product Lifecycle Management cPDM Program**

**October 2001**

**Prepared by  
CIMdata, Inc.**

**CIMdata<sup>®</sup>**

<http://www.CIMdata.com>

CIMdata, Inc.

3909 Research Park Drive

Ann Arbor, MI 48108

Tel: +1 (734) 668-9922 Fax: +1 (734) 668-1957

CIMdata is a registered trademark of CIMdata, Inc.

Copyright © 2001 by CIMdata, Inc. All rights reserved.



# Contents

Introduction .....	6
Summary of mySAP PLM .....	8
cPDM Background .....	10
SAP PLM: Program Assessment .....	11
SAP PLM: Product Assessment .....	13
Summary .....	43

# mySAP PLM Product Lifecycle Management

## "Driving Product and Process Innovation through Product Lifecycle Management"

### Introduction

This review provides an overall description and our assessment of SAP's mySAP™ Product Lifecycle Management (mySAP™ PLM) program for the collaborative Product Definition management (cPDm) market. The review focuses on both the product's technology and the program SAP has developed to support it through sales, marketing, and development.

SAP positions mySAP PLM as an integral part of their overall mySAP.com® e-business offering. mySAP PLM is positioned as one of the five "pillars" of SAP's future direction: enterprise portals, private and public exchanges, supply chain management (SCM), product lifecycle management (PLM), and customer relationship management (CRM).

At mySAP PLM's core is a set of Product Data Management (PDM) functionality. This functionality is supplemented with other technologies that provide additional capabilities, such as visualization and collaboration, and a set of applications and business solutions that leverage SAP's industry knowledge related to supporting the product definition lifecycle and its integration with the product production and operations support lifecycles. It is targeted at "enterprise-class" implemen-

tations where SAP positions it as the strategic cornerstone to support the entire product development lifecycle and to provide seamless and transparent access to distributed information to meet the demands of expanding industrial globalization.

An enterprise's need to implement a cPDm solution is driven by major initiatives focused on improving competitive position through the strategic management of the enterprise's intellectual assets, which need to be leveraged throughout the product definition lifecycle. Traditionally, enterprises have emphasized quality improvement, cost reduction, and increased productivity. Today, new market pressures are forcing enterprises to fundamentally review how they do business. The primary driving factors for investment include: the increased complexity of products; global operations with distributed work teams including supply chain management though extended enterprise; increased competition with pricing pressures; and the demands of supporting e-business and other "e" initiatives.

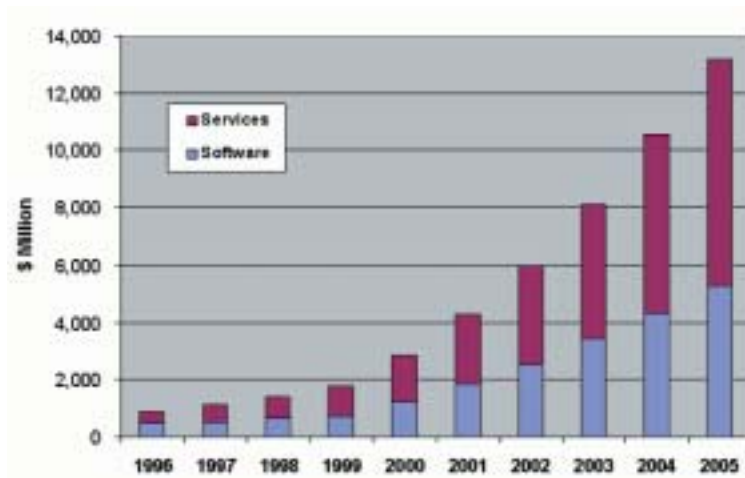


Figure 1-2000 cPDm Market Investment

cPDm is a strategic business approach that enables enterprises to bring innovative and profitable products to market more effectively, especially in the evolving e-business environment. cPDm enables enterprises to harness their innovation process through effective management of the full product definition

lifecycle throughout their extended enterprise. A cPDM environment is comprised of a combination of best practices and technologies, such as PDM, collaboration, visualization, Collaborative Product Commerce (CPC), Enterprise Applications Integration (EAI), Component Supplier Management (CSM), and others. cPDM is rapidly transitioning from a competitive advantage to a competitive necessity, and is an essential element for enterprises to successfully compete in the evolving new world of e-business. Investment in cPDM solutions is growing quite rapidly. The cPDM market grew 62% to reach \$2.86 billion (software plus software-related services) in 2000, and is expected to grow to \$13 billion by the year 2005 (see Figure 1).

SAP has leveraged its strength in manufacturing and overall leadership in the ERP and e-business market to gain, almost instantly, very high visibility in the cPDM market through its mySAP PLM solution. Their rapid rise in the cPDM global revenue ranking has been almost ignored by many of their competitors, who now find themselves competing against a very strong cPDM solution. SAP's mySAP PLM software-plus-service revenues for calendar year 2000 rose significantly to \$223 million from \$74 million in 1999, an increase of more than 300% (see Figure 2). This placed them first among the top ten cPDM technology suppliers in the world.

The mySAP PLM solution is primarily a "production oriented" cPDM solution. In the industry there are many suppliers of cPDM solutions, each with their own particular "bias" based on their background. In the case of SAP, their background and strength derives from a long history of providing solutions to support production operations. They are relatively new to the engineering design community. As a result, their system tends to prioritize a tight integration with production operations over the support of highly flexible and ad-

hoc activities that frequently occur in the earlier stages of conceptual design. This is not either right or wrong; it is just the approach taken by SAP to solve the problem.

Consistent with mySAP PLM's "production" orientation, the strength of this solution is its complete integration with the full mySAP environment as well as its openness toward third-party applications. SAP has consistently positioned their system as an end-to-end business process solution that communicates with supporting business systems. SAP has had a major impact on the cPDM market since their announcement of cPDM support over three years ago. Many companies around the world have committed to implementing mySAP PLM, and SAP's visibility in the "executive offices" of these companies is quite high. Due to their overall

company image and reputation, SAP's announcement regarding cPDM created an awareness of cPDM with many industrial company executives (particularly CIO's) who had not previously been interested in cPDM. This has been good for the industry as more executive management begin to get acquainted with cPDM and investigate its impact on their businesses.

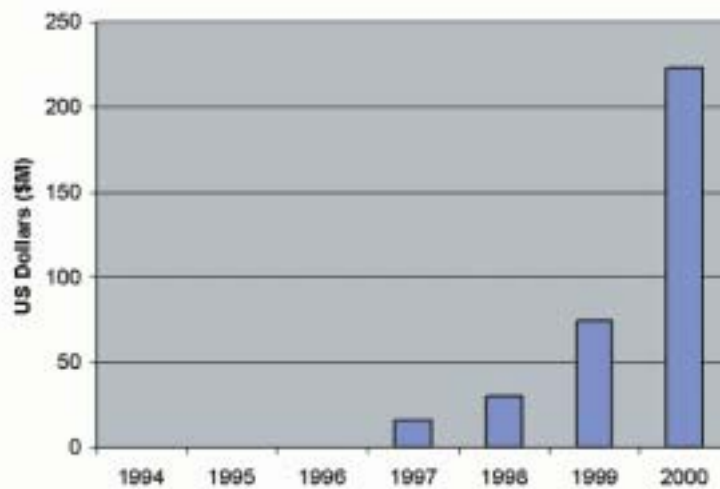


Figure 2-SAP's 2000 cPDM Sales (software and services)

SAP is currently the worldwide revenue leader in e-business solutions. Their strong expertise in providing integrated business systems with a broad range of functionality is highly leveraged in their cPDM solution. The mySAP PLM solution provides a number of specific applications and functionality integrated together with established mySAP capabilities, such as SAP's Business Workflow, and Material and Product Structure Management. mySAP PLM has been specifically developed using the mySAP.com architecture to maintain their philosophy of providing all business solutions as part of a single integrated, yet open system.

This review is based on mySAP PLM Version 4.6C and add-on applications as well as information about SAP's development plans for this and subsequent releases.

mySAP PLM's initial release in late 1996 represented a major step for SAP in the cPDM market by establishing a formal cPDM solution program. Prior to this date, SAP offered several of the functions provided by PDM systems (e.g., document management, workflow, and others) as part of their ERP solution. Since then, SAP has undertaken a serious and comprehensive evolution of its cPDM enabling capabilities. Therefore, they must be considered one of the leading e-business vendors who understand the true benefits provided by cPDM.

SAP's focus is on providing an integrated engineering to manufacturing solution to handle product information across the entire product lifecycle. mySAP PLM can be deployed independently from existing ERP installations as a separate set of functionality in support of engineering-focused organizations. For many organizations either currently using R/3 or those considering a replacement of an existing ERP system, and who need a cPDM solution, SAP's mySAP PLM offering should be given serious consideration.

## Summary of mySAP PLM

Since its introduction, mySAP PLM has been emerging as a major cPDM product offering. SAP is a leading supplier of enterprise business systems and has established itself and its e-business platform, mySAP.com, as the market leader in e-business solutions. It is one of most visible e-business platforms available and is widely supported by third-party system integrators.

SAP's support of a cPDM solution provides users of mySAP PLM the ability to extend their business management into the product development environment, and bridge the gap to supply chain management and customer relationship management processes. SAP's entry into the cPDM market has had a major impact. Most, if not all, existing SAP customers investigating cPDM solutions are including mySAP PLM in their reviews of potential cPDM solutions. The addition of this formidable competitor has adversely affected other cPDM solution providers by increasing competition and delaying purchasing decisions. This has contributed to the growing confusion in the cPDM market for organizations that are trying to understand

the merits of the different approaches being offered by the CAD, ERP, and traditional PDM system suppliers.

SAP has clearly defined their cPDM philosophy along with a technical infrastructure to integrate these capabilities across its entire mySAP.com solution set. In 1999, recognizing the need for integration to third-party products, such as CAD, office automation, analysis packages, and other systems, SAP decided to take a more active role driving a number of integrations. Since that time, SAP has made significant improvements with regards to its support of integrations, especially those to the major 3D CAD systems.

SAP's aggressive move into the cPDM industry has not only forced the traditional PDM suppliers to rethink their strategies but also the ERP suppliers, such as Oracle and J.D. Edwards. In turn, some of these competitors have announced cPDM functionality within, or cPDM solutions integrated with, their systems.

Despite the fact that cPDM is a fairly young business concept, SAP has established a stable and growing European mySAP PLM business with a number of larger scale implementations in Switzerland, France, and Germany. This customer list includes Deutsche Bahn AG, Schuler Pressen GmbH & Co. KG, Heidelberger Druckmaschinen AG, Siemens Power Generation, Siemens Medical, Fincantieri, Volvo Aero Corporation, Beiersdorf AG, and Schindler Elevators, to name just a few. A number of projects have also been launched in North America, including implementations at Anheuser Busch, Cooper Cameron, Compaq Computer, Kraft Foods, and Storage Technology Corporation. Asian customers include Mando Climate Control Corp., ISU Chemical Co., Ltd, and Samsung Electronics Co., Ltd in Korea. SAP's industry-focused industry business sectors for discrete industries (including Automotive, High Tech, Aerospace & Defense, Engineering & Construction), Process Industries (including Mill Products, Mining, Oil & Gas, Chemicals and Pharmaceuticals), Public Services, and Services Industries, Consumer Industries (including Consumer Products & Goods, Retail) and Financial Services have included PLM into their industry-specific solutions and are increasing their dedicated cPDM knowledgeable specialists.

We expect to see SAP continue to educate its sales and consulting force on the benefits of its cPDM solution and how it can solve business problems faced by its existing customer base. The SAP organization is very

supportive of the mySAP PLM initiative, which has been plainly illustrated by the company's statement that it is one of its five strategic "pillars." In addition, it has established dedicated European and American consulting groups who are focused solely on mySAP PLM implementations. SAP in the Americas has also established a dedicated Solution Management Organization in addition to their application and base consulting teams. They also use a variety of consulting partners, such as Hewlett-Packard, PricewaterhouseCoopers, IBM Global Services, Atos Origin, Inc., IDS Prof. Scheer, KPMG, SAP SI, and Siemens Business Services to provide implementation services. The development of these relationships was very slow to start; however, recent activities indicate that significant progress has been made over the last year or so.

The mySAP PLM solution squarely places SAP in the cPDM market against other comprehensive cPDM solution providers. This has provided, and will continue to provide, SAP the opportunity to market a cPDM solution to customers who either have, or are planning to implement one or more components of SAP's mySAP.com solution set.

mySAP.com has an underlying technology architecture that SAP continues to enhance to enable it to provide distributed solutions, such as mySAP PLM, while retaining their integrated capabilities. Their cPDM focus is to leverage this integrated architecture by delivering cPDM capabilities that seamlessly traverse system boundaries to deliver end-to-end business processes as part of a comprehensive e-business solution.

mySAP PLM is provided as a stand-alone solution or as part of the mySAP.com e-business platform. It makes good use of other well-established SAP business applications, such as workflow and product structuring. Existing applications have been enhanced and integrated into the overall mySAP PLM offering. mySAP PLM is not built around a core PDM engine, as are most other cPDM solutions. SAP offers mySAP PLM in the same fashion as the other mySAP.com solutions, which are essentially a set of applications and tools built using SAP's development environment. These applications can be customized (adjusted to specific company needs without programming) for specific users by either SAP's global consulting organization, the customer themselves, or SAP partners.

mySAP PLM has addressed a number of areas where limitations existed regarding the flexibility of its data

model, however, there are still a number of restrictions. For example, the definition of certain meta-data field lengths is strictly controlled to support the migration from one release to the next. Since mySAP.com e-business solutions can be configured during implementation, SAP has taken a careful approach to control meta-data definitions in order to minimize impact for users. This limited flexibility to define key field lengths and other fixed data within mySAP PLM is a weakness in comparison to other major cPDM solutions that offer more flexible definition capabilities and tools to support version upgrades. However, this approach ensures maintainability in large-scale implementations of mySAP.com solutions.

Recognizing these limitations, SAP started the development of new capabilities, such as its integrated Product and Process Engineering (iPPE) functionality, based on a flexible object paradigm. This has allowed SAP to provide a more flexible data model within the scope of recently released solutions. We expect SAP to continue this approach as other mySAP.com solutions are released.

Over the last few years, Web technology has had a major impact on the cPDM industry, especially for enterprise-focused solutions that are intended to provide support to "mass users" in a distributed enterprise environment. SAP's introduction of extensive Web capabilities to foster intra- and inter- company collaboration has provided a major enhancement to their product and provides e-business solutions that embrace the cPDM business approach.

The recent announcement and release of enterprise portal functionality (see Figure 3) as an integral part of mySAP PLM greatly enhances its ability to reach all internal and external people involved in the product definition lifecycle. All content that is necessary to get the job done or to stay informed about individual fields of interest is delivered through an easy-to-use, role-based enterprise portal, ensuring maximum work satisfaction and productivity any time, anywhere, via Internet or mobile devices. The tight integration of mySAP PLM into mySAP Exchanges-powered private and public marketplaces further illustrates SAP's commitment to enable e-business across intranets, extranets, and the Internet.

The inclusion of quality management, environment, health and safety, as well as asset lifecycle management capabilities completes SAP's cPDM offering.

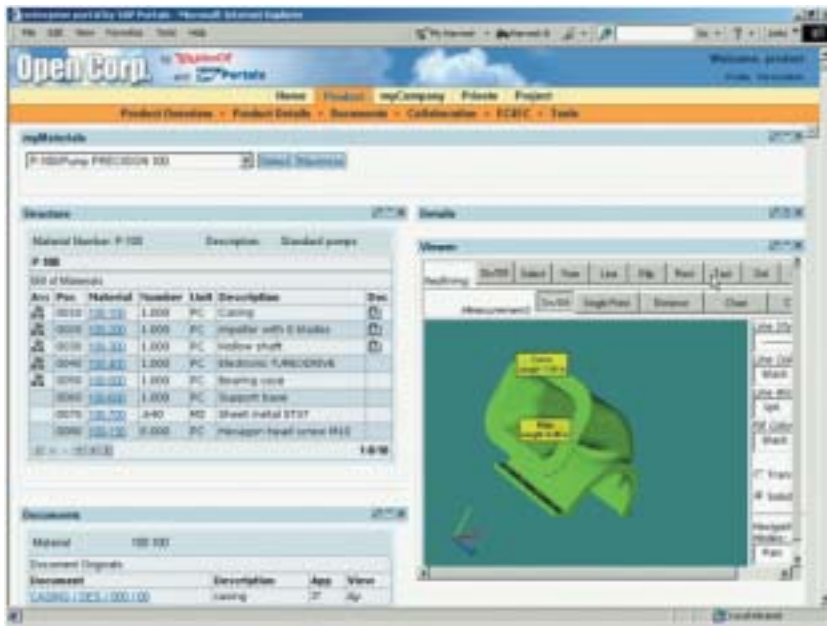


Figure 3-mySAP PLM Portals

These capabilities have been designed to support preventive maintenance, facility management, quality management, and the compliance to governmental regulations in product development, production, and maintenance. It also serves as the cornerstone for guaranteeing high service and maintenance levels for goods manufactured.

CIMdata is impressed with the approach SAP has taken to extend the capabilities of its cPDM solution. SAP has recruited experienced professionals knowledgeable in the cPDM domain and who understand the disciplines of the engineering design process.

In summary, mySAP PLM is a major solution and program in the cPDM industry. The mySAP PLM solution is a fully functional cPDM solution and it is one of the few in the cPDM market that supports substantial configuration management features, which are leveraged from mySAP.com's e-business solutions. SAP has continued to make significant progress in its cPDM enabling product offering and has achieved a significant number of sales successes in a very short period of time. In addition, SAP continues to place significant effort behind their cPDM program and sees it as a strategic offering in their suite of e-business solutions. This in itself is impressive from a company as large as SAP.

The release of mySAP PLM version 4.6C provides a number of significant developments in its cPDM capabilities with major enhancements in the areas of inter- and intra-company collaboration, and what SAP calls product innovation management. This includes several new functionalities, such as cFolders for collaboration and structured document and information exchange across organizational boundaries, recipe management to support product innovation in process industries, and new product development and introduction processes, including requirements management for discrete industries, to name just a few. For current SAP users, the mySAP PLM solution has to be considered a candidate in any major cPDM acquisition program.

## cPDM Background

Collaborative Product Definition management (cPDM) is a strategic business approach applying a consistent set of business solutions that collaboratively manage the product definition lifecycle across an extended enterprise. cPDM enables enterprises to bring innovative and profitable products to market more effectively, especially in the evolving e-business environment.

cPDM focuses on the complete product definition, including all mechanical, electronic, software, and documentation components, and the processes that are used throughout a product's entire lifecycle. It is an approach that incorporates a full suite of best-practices methods and technologies such as product data management, collaboration, collaborative product commerce, visualization, enterprise application integration, component supplier management, and others. It addresses the extended product definition supply chain of OEMs, sub-contractors, suppliers, partners, and customers.

The need to manage product definition and associated processes is growing even more acute because of increasing complexity across an extended enterprise. The globalization of companies has dispersed employees, products, services, and partners around the world.

Additionally, product content can take on a variety of forms that take much more effort to manage than their predecessors. In addition, Internet and Web-based technologies are making information from both inside and outside of the organizations quickly available to widely-dispersed operations.

cPDM solutions are useful for many types of products. cPDM solutions are applicable to any discrete manufactured products, such as automobiles, aircraft and defense systems, machine tools, and telecommunications equipment. In addition, cPDM solutions are used in the process industry to provide recipe management. The plant and asset management capabilities can be used in any industry in which maintenance costs and equipment reliability directly affect profitability.

cPDM solutions are useful for managing many types of product information and processes. Examples of such information include:

- Project plans
- Part definition and other design data
- Geometric models and CAD drawings
- Engineering analysis models
- Scanned images
- Specifications
- Recipes
- Safety and regulatory requirements
- Audiovisual annotations
- Workflows for change management, notes, correspondence, document & part release, etc.
- Hardcopy and electronically stored documents
- Product configuration
- Manufacturing process plans, results, and routings
- NC part programs
- Maintenance and service records

cPDM solutions are not just for engineering and manufacturing enterprises. The principles of cPDM can be applied to publishing, software development, financial services, and any other enterprise that can benefit from controlled, organized, integrated information.

Just about everyone in an organization can use and benefit from a solution that enables the cPDM approach. Chief executive officers, technical directors, chief engineers, engineering managers, engineers of every discipline, heads of information technology or services, design managers, CAD/CAM/CAE managers, production engineers, project managers, operations and maintenance managers, estimators and purchasing offi-

cers, marketing and sales managers, shop floor personnel, and many others. Along with these end users, administrators can install and tailor the cPDM environment to meet the enterprise's needs.

## SAP PLM: Program Assessment

This section reviews the overall program for mySAP PLM, including SAP's company background, their position in the cPDM market, their technology strategy, product packaging, and their programs for marketing, sales, support, and development.

### SAP's Background

SAP (Systems, Applications and Products in Data Processing), which was founded in 1972, is headquartered in Walldorf, Germany. It is one of the most well-known and recognized suppliers of e-business solutions around the world. They are physically present in more than 50 countries, and established third-party support and service resources are available around the world from major Information Technology (IT) systems integrators including the major international consulting firms.

SAP, which employs over 23,700 people, is the largest supplier of e-business solutions in the world and the world's third largest independent software supplier. In 2001, SAP reported mySAP PLM revenues of approximately \$223M (software and services).

SAP's mySAP PLM program has been in existence since 1996, with its initial market announcement in late 1996. This program is continuing to increase the quality and market acceptability of its offerings, and is gaining support within SAP's field sales and support organizations around the world. As with other strategic software development, the mySAP PLM program office is located at SAP's headquarters with additional business and development support in North America.

SAP's corporate business operations, development, marketing, sales, and support are largely based out of its headquarters in Germany. They have direct marketing, sales, and support operations in more than 50 countries worldwide. SAP has also established subsidi-

aries for its enterprise portal and business intelligence offerings, SAP Portals as well as SAP Markets, to focus on the private and public exchange business. Additionally, SAP runs regional development centers in the USA, Canada, France, Japan, and India, to focus on technology research and development.

## Market Position and Program Strategy

SAP positions mySAP PLM as a best-in-class cPDM solution that can be purchased and operated stand alone or as an integral part of their overall mySAP.com platform. It is positioned as one of the five strategic "pillars" that will drive SAP's future direction. These pillars include enterprise portals, private and public exchanges, supply chain management (SCM), product lifecycle management (PLM), and customer relationship management (CRM). mySAP PLM is further positioned by SAP to provide a completely integrated and consistent set of cPDM enabling applications in an open and secure environment available via the Web. Significant emphasis is being placed on providing e-business solutions to address the needs of consumers of product information across the entire value network. mySAP PLM is clearly focused on supporting the collaborative processes for product innovation, faster ramp-up to production and maintenance.

Over the last two years, SAP has embraced the e-business paradigm. This direction has been backed with action, such as the release of mySAP Enterprise Portals and mySAP Exchanges in the support of private and public marketplaces. SAP is clearly committed to enable e-business activities across intranets, extranets, and the Internet. CIMdata expects that SAP will continue to refine its solutions to meet the ever-changing market conditions.

SAP's mySAP PLM program along with other vendors announcing cPDM capabilities has had a major impact on the cPDM market over the last few years. Organizations that have committed to large ERP solutions are reevaluating their cPDM programs. This situation is clearly true for many of SAP's customers. The announcement and release of the mySAP PLM solution has provided an additional expansion opportunity for the mySAP.com e-business platform. Many IT organizations are greatly interested in maintaining consistency in their systems and reducing the integration requirements that continue to plague them. The success of this program strategy is clear; SAP finished with the highest cPDM revenue in the year 2000.

## Marketing, Sales, and Support

### Programs

The predominant focus of the SAP sales force is to sell e-business solutions and provide consulting services through established third-party partners, such as the major international consulting firms. SAP also provides direct consulting services. SAP has a formal mechanism for coordinating these groups to support large international customers whose operations span geographic regions.

SAP's key cPDM sales strategy is to sell into the existing SAP customer base and to go after new accounts that are looking for a fully integrated e-business solution that can support the entire product lifecycle – from product innovation, engineering and design, production ramp up, and the management of ongoing engineering changes to maintenance management.

Focus industries for mySAP PLM include Discrete Industries (Automotive, High Tech, Aerospace & Defense, and Engineering and Construction), Process Industries (including Mining, Oil & Gas, Chemicals, and Pharmaceuticals), Consumer Industries (including Consumer Products & Goods, and Retail), Public Sector, and Service Industries.

To help speed the implementation of SAP's solutions, it defined and rolled out the AcceleratedSAP (ASAP) Roadmap. This is a five-phase system implementation methodology. The first phase, Project Preparation, is basically where the implementation team is identified and trained. During the second phase, entitled Business Blueprint, business requirements are documented, including required interfaces and conversions. The third phase, Realization, is where the mySAP.com solution is prototyped, interfaces are developed, and unit testing is executed. The fourth phase, Final Preparation, is where the production environment is made ready. The main activities of this phase include user training and integration testing. The final phase, Go Live & Support, is where SAP turns system control over to the customer for day-to-day support and continuous improvement.

Over the last two years, SAP's management has been very focused on mySAP PLM. The program is clearly on track to continue to provide additional cPDM capabilities well into future. SAP continues to place cPDM emphasis on providing a completely integrated and

consistent set of key capabilities that work in a common environment to address business needs of the different users of product information throughout the entire product lifecycle.

SAP has set up a group of cPDM specialist consultants in each of their country operations. So far, this program has leveraged the existing SAP consulting partner channels as well as SAP's own consulting force. SAP also has developed relationships with a number of key engineering systems integrators to provide mySAP PLM consulting support, such as HP, PricewaterhouseCoopers, IBM Global Services, Atos Origin, Inc., IDS Prof. Scheer, KPMG, SAP SI, and Siemens Business Services.

The SAP mySAP PLM program is established, with a significant number of sales successes in Europe and North America, such as SIEMENS Power Generation, Heidelberger Druckmaschinen, Fincatieri, Compaq, and Cooper Cameron. CIMdata has been impressed with SAP's progress over the last two years, especially its increase in revenue. SAP's investment in the program to date has been significant and continues to grow. SAP's visibility in the cPDM industry is increasing and we expect SAP's cPDM program to have a major impact in the market and anticipate that they continue to be one of the top cPDM industry revenue leaders well into the future.

## Development Program

mySAP PLM development is primarily based at offices located in Walldorf, Germany. Some additional related development is performed at the SAP Labs located in Foster City, California, USA and India. The mySAP PLM development team was established at the end of 1996 as part of the SAP Logistic Development group. This organizational change proved to be a significant step for SAP in validating that a cPDM solution is a core function in their overall solution development strategy.

The cPDM development group currently includes more than 250 people (including developers, translators, documentation specialists, project managers, and development support personnel) and it is expected to continue to grow. The group is augmented with additional resources from SAP's global development team, focused on technology development, including database, ABAP/4, workflow, user interface, Internet security, and SAP Web Application Server, just to name a few.

Interfacing and customization capabilities of mySAP.com solutions are substantial and are provided through the use of Internet standards, such as SOAP and XML, SAP's Business Application Program Interface (BAPI), and the ABAP 4GL-development environment. SAP also provides system access through its standard Remote Function Call (RFC) APIs enabling external applications to directly call SAP screens and dialogs. SAP provides approximately 1,000 BAPIs representing methods for more than 250 Business Objects. SAP also provides support for a number of industry standard technologies, which includes COM/DCOM/COM+, CORBA, RPC, XML, DTD, HTML, STEP, Java, and .NET.

Over the last few years, mySAP PLM has become a key catalyst for changes in the SAP mySAP.com architecture. In the not too distant future, CIMdata expects to see a number of significant developments offering more flexible data models within the overall integrated, distributed mySAP.com environment.

## SAP PLM: Product Assessment

mySAP PLM is provided as a suite of pre-developed, but customizable (adjustable to a specific company's needs without programming) functional capabilities that address all major areas of the product definition lifecycle. Key functional areas include lifecycle data management, program and project management, quality management, asset lifecycle management, environment, health, and safety as well as lifecycle collaboration.

mySAP PLM is intended to provide the link between CRM and SCM activities in the enterprise (see Figure 4), by specifically supporting the product development phase, and sharing product related information and processes throughout the entire product lifecycle. This includes support for the full set of cPDM functional requirements and additional functionality required to provide an extended enterprise collaborative environment.

SAP's integrated cPDM strategy is to offer a complete cPDM solution enabling companies to manage their product development environment as an integral part of the mySAP.com solution. Managing the development

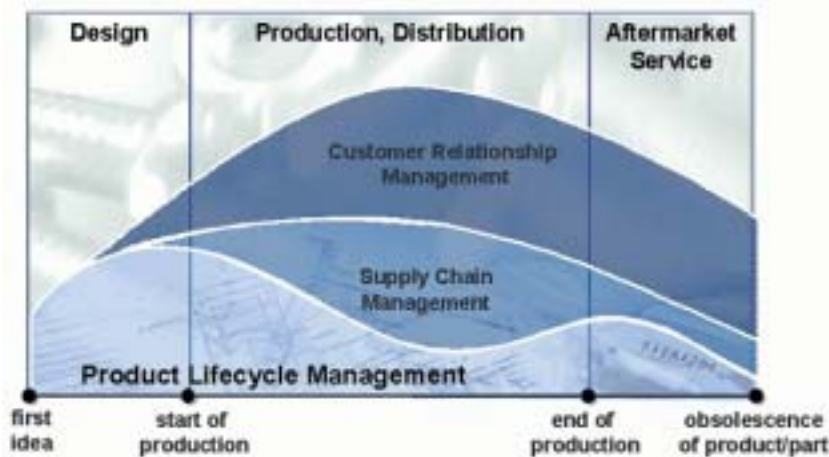


Figure 4-mySAP Product Lifecycle Management (PLM) Positioning

process within a company's e-business platform can allow an organization to leverage their investment in the mySAP.com solution. In addition, this approach supports many corporate information technology (IT) desires to manage all their business and engineering operations with a single, comprehensive solution for planning, developing, controlling, monitoring, and delivering products.

Since its launch in 1996, SAP has constantly improved its cPDM solution by addressing a number of initial product weaknesses. By incorporating role-based enterprise portals to provide people with easy-to-use, centralized access to all relevant content to get the job done via the Internet or mobile devices, adding a breath of cPDM enabling functionality, addressing the need for distributed data management and bringing some innovative ideas that address the globalization aspects of data management, SAP has crafted the mySAP PLM solution into a comprehensive and very effective solution in the cPDM market.

In addition to the core cPDM functionality as defined by CIMdata, SAP has also included functions to support quality management, asset lifecycle management, and environment health and services in their mySAP PLM portfolio. For manufacturing companies, it becomes increasingly essential to also provide maintenance services around their products. Quality management, including the feedback loop from manufacturing into development, is important for companies to get products right the first time. For process industries, especially in chemicals or pharmaceuticals, the compliance to governmental regulations and product safety issues becomes increasingly important. These capabilities are described within the section entitled "Applications."

A dynamic data model is still an area where development work is required. However, SAP has not been standing still in this area. Over the last few years, SAP has introduced new data modeling capabilities in its newer solutions, such as those that support product variant configuration via iPPE. mySAP PLM and other solutions have adopted the underlying dynamic data model. It is our understanding that SAP plans to continue its introduction of a more flexible data model into other mySAP.com solutions. As experience is gained from their users, we expect to see

refinements to their new Web-based enterprise portal work environment and a trend toward removing some of the complexities that exist in the use of the product. A good example is the fully Web-centric cFolders application that supports design collaboration processes across heterogeneous environments.

mySAP PLM is positioned at the same level as the mySAP.com solutions that support CRM and SCM. mySAP PLM is comprised of a number of cPDM enabling capabilities found in most enterprise proven cPDM solutions. These applications currently include:

- Document Management
- Product Structure Management
- Variant Configuration
- Integrated Product and Process Engineering
- Order Change Management
- Change Management
- Workflow
- Project Management
- Classification System
- Engineering Workbench
- Distribution
- CAD Integration
- Asset Lifecycle Management
- Quality Management
- Environment Health & Safety

SAP has recently added a series of new features and functional support that are detailed in this paper. Among them, and of special interest, are:

- Collaboration Folders (cFolders)
- Product Designer for requirements management
- Recipe management
- Lifecycle analytics
- Enterprise portals for PLM

mySAP PLM functionality is available as part of the mySAP.com e-business platform, or as a stand-alone solution.

This assessment of mySAP PLM is divided into individual sub-sections that address the major areas of cPDM solution as defined by CIMdata's world-class cPDM Business Solution Model (see Figure 5). These areas are consistent with product comparisons used in CIMdata's other program assessments.

The breakdown of this section is as follows:

- Product Packaging
- Core cPDM Functions
- cPDM Foundation Technologies
- Applications
- Business Solutions
- User environment
- Operating environment

Each of these areas is addressed individually in the following sections.

## Product Packaging

mySAP PLM is an extensive, packaged set of cPDM enabling applications and business solutions supported by a set of core cPDM functions and foundation technologies. It is not built around a separate PDM engine. SAP offers PLM in the same fashion as the other e-business solutions, as a set of applications and tools built on SAP's 4GL-development environment. These applications are then customized to match specific company needs.

The initial release of version 4.6 of mySAP PLM (Summer 1999), previously entitled R/3 PDM, marked a significant milestone for the product offering – the release of a new and greatly enhanced user interface. SAP made significant changes to the interface to improve ease of use. These changes included the incorporation of modern GUI elements, such as product structure browsers, tab information panels, product visualization panels, workbench environments, on-line dynamic help as well as the introduction of enterprise portals to allow for easy-to-use, context-driven access to all relevant content via the Internet or mobile devices.

As previously mentioned, the mySAP PLM solution is divided into six key functional areas (see Figure 6). These are further described as follows:

- Asset Lifecycle Management manages physical assets and equipment over the complete lifecycle of an asset to improve plant performance and equipment availability.
- Lifecycle Data Management includes document management, product structure management, routing and resource data, recipe management, CAD integrations, change and configuration management, and related technical documentation.
- Program and Project Management supports planning, managing, and controlling the product development process.
- Lifecycle Collaboration supports collaborative engineering and project management using XML to



Figure 5-CIMdata's World-Class cPDM Business Solution Model

communicate information, such as project plans, documents, and product structures across virtual development teams.

- Quality Management provides integrated quality management for all industries, throughout the entire product lifecycle to provide the right quality from the beginning to production.
- Environmental, Health, and Safety enhances business processes to comply with governmental environmental, health, and safety regulations.

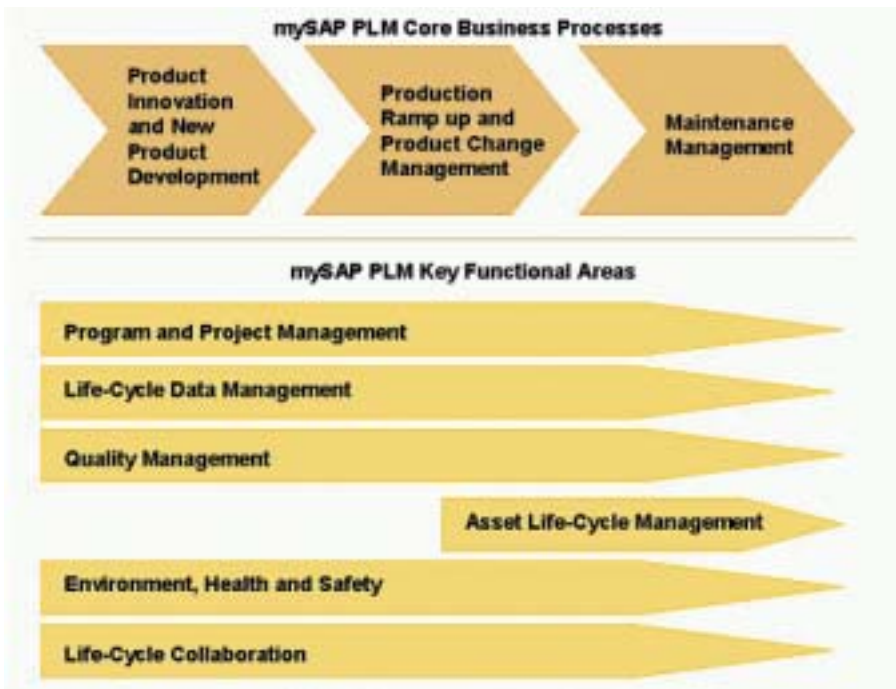


Figure 6-Key Functional Areas of mySAP PLM

mySAP PLM is sold using two licensing schemes. Companies can choose to purchase mySAP PLM licenses on a named user basis or it can purchase access to the entire suite of mySAP.com solutions by purchasing licenses for the mySAP.com platform. This provides the company with the right to use all of mySAP.com e-business solutions. SAP reports that a majority of its clients are purchasing licenses in this manner.

## Core cPDM Functions

In general, core functions found in a cPDM solution can be described under five major headings:

- Vault and Document Management
- Workflow and Process Management
- Product Structure Management
- Classification Management
- Program and Project Management

mySAP PLM supports all of these functions in some fashion. SAP plans an aggressive release schedule to add capabilities and customer requested enhancements. The capabilities, which are provided by the mySAP PLM solution, support each of the major functional areas are described in the following sections.

## Data Vault and Document Management

This area of core cPDM functionality addresses the capabilities of the data vault. This includes security authorizations for access to information, support for versioning and revisions of parts (material masters) and documents, definition and maintenance of relationships among parts and documents and the files that are used to define the parts, and other related data.

mySAP PLM provides good capabilities to support this critical functional area, including document distribution using its Application Linking and Enabling (ALE) technology. This technology also supports the creation and controlled maintenance of electronic documents in a distributed network environment. Documents, such as CAD drawings, NC programs, and word-processing files, can be secured in the mySAP PLM document repository or in a third-party archive application, such as optical mass storage units.

Documents within mySAP PLM can relate to electronic file formats, which are considered simply as collections of binary data. The internal contents of the files are not generally created or maintained by the application itself, but rely on other authoring tools for these functions.

Documents within mySAP PLM can relate to electronic file formats, which are considered simply as collections of binary data. The internal contents of the files are not generally created or maintained by the application itself, but rely on other authoring tools for these functions.

Document types are customer-definable and mySAP PLM creates and maintains a document info record for each document version. Documents can be related to other objects defined in the mySAP PLM solution. Currently there are 40 different objects integrated with document management. For example, a document can be related to a material or work breakdown structure. Many-to-many relationships are possible, but if required, relationships can be restricted to either one-to-many or many-to-one.

All key fields in the mySAP PLM solution are fixed in length. For example, document versions are two characters long. mySAP PLM cannot currently support customers that require more length without substantial customizations (modifications) to the data model that would introduce the potential for incompatibility with

future versions of mySAP PLM. However, the document management system allows user-specific attributes to be defined by using the classification system without the need for customization. This is usually defined during the implementation process.

Document management in mySAP PLM supports its own status network system. This system is used to manage the release of documents within a predefined approval process. The document management status network is more flexible than the status network used by other system managed objects. Customers can define the status network (sequence) that each document type needs to follow and at what status level audits will be tracked and maintained.

Document management functionality has been integrated with SAP's workflow system. This functionality allows for the automated distribution and management of tasks relating to document management. A document can assume any state as defined for its specific document type. Support is also provided for multiple language status values. Each change of state is logged and records user, date, and time information. In this way, the network of assigned status values for a document can be tracked over time. Status changes can be connected to workflows to trigger specific actions. Access to user exit programs is also available (e.g., to run an external program designed to convert a document from one format to another).

Document revisions can be related to status changes where Engineering Change Notices (ECNs) are used to control revisions by date. Revisions are considered to be the released version of a document that has been changed and approved from its previous revision. Incremental changes to a document, during the process of revision approval, are tracked as versions. Many activities within the system default to the latest released version or revision for simplicity. However, all revisions and versions are accessible if required.

Document info records (meta-data) contain the document type, description, status, and other control data. They also support brief and full descriptive texts capable of handling multiple languages. The mySAP PLM classification capabilities can be used to describe classes and groupings of documents. This feature enables documents to be classified into categories and to be searched for by class-related characteristics. Documents can also be structured into either a docu-

ment hierarchy (only one parent) or into document structures (any number of predecessors) effectively providing a bill of documents (BOD) capability.

The user interface to document management offers push buttons for important operations, tab strips for related information, and panels showing document lists, relationships and the currently selected document's contents. Support is also provided for embedded viewing of files related to a document, such as a TIFF or VRML file.

The features and capabilities of the user interface are derived from the access rights assigned to the group to which the user belongs. For example, specific functions can be restricted and other features enabled, such as storage locations and automatic check-in depending on the user's assigned group.

A document can have multiple originals (electronic source files) related to it. The originals (files) can be stored in the file system, in defined vaults, in the managed database, or in external archive systems. Multiple vaults can be defined as part of the overall system's logical "vault." These can be distributed as desired around the network, however, upon check-in of a document, the specific vault to manage this document must be defined by the user or it can be derived from the user's assigned group. Multiple physical types of vaults (e.g., UNIX file repository, etc.) can be mixed into a single implementation as required.

Documents are placed into the vaults and retrieved from them through standard check-in and check-out functions. Users can search for documents by means of queries, class listings, document numbers, etc. Search parameters can be saved and reused at any time.

Capabilities are provided to define access permissions to data and documents known to the system. Access permissions can be assigned to individuals, groups, or roles. Individuals can be assigned to multiple groups or roles. Documents are owned by users until they have completed their work, whereupon the document becomes "ready" and can be assigned to another individual for additional work or for release approval.

mySAP PLM also supports the concept of documents that are "managed" by the system, but not actually "controlled" by it. In other words, documents that are known to mySAP PLM, but which are not physically secured in one of its electronic repositories. These are

tracked as normal, but their security is left to the user to manually maintain. This type of flexibility reflects a system that has been used to support real implementations.

A number of relationships can be established between documents and other objects within mySAP PLM. These include:

- Document-to-document (hierarchical or peer-to-peer relation)
- Document-to-part (one to many and many to many relations)
- Document-to-other SAP objects

These relationships are used to link product data and documentation to the change management and product definition process. For any document, a user can query for "where used" information about the document, to see all of the references that have been established to it. Documents can be collected together into what are called "Configuration Folders" that are provided with the Configuration Management application and are used to assemble data to be baselined.

Full text retrieval (FTR) and index searches are available from mySAP PLM, either from SAP or partner solutions, such as from Verity. Users can also search document meta-data for documents based on description fields, Boolean textual equations, and "match codes" (patterns), or keyword searches. mySAP PLM supports a Web-based document search capability that returns lists of found documents as hyperlinks. The user can navigate to the required documents directly via the Web browser (see Figure 7).

A topic of contention and concern for many companies considering electronic document management relates to the authentication of document approvals (i.e., electronic signatures). Although there is much work still to be done in this area, various technologies are becoming available to support signature authentication. These include digital signature chips, retina scans, and pressure tablets, to name but a few.

mySAP PLM has embraced various electronic signature techniques and provides interfaces to digital signature chip readers and other electronic devices, and can trigger a document status change on successful authentication. This initiative has been taken to support its customers in the medical equipment and pharmaceutical industries.

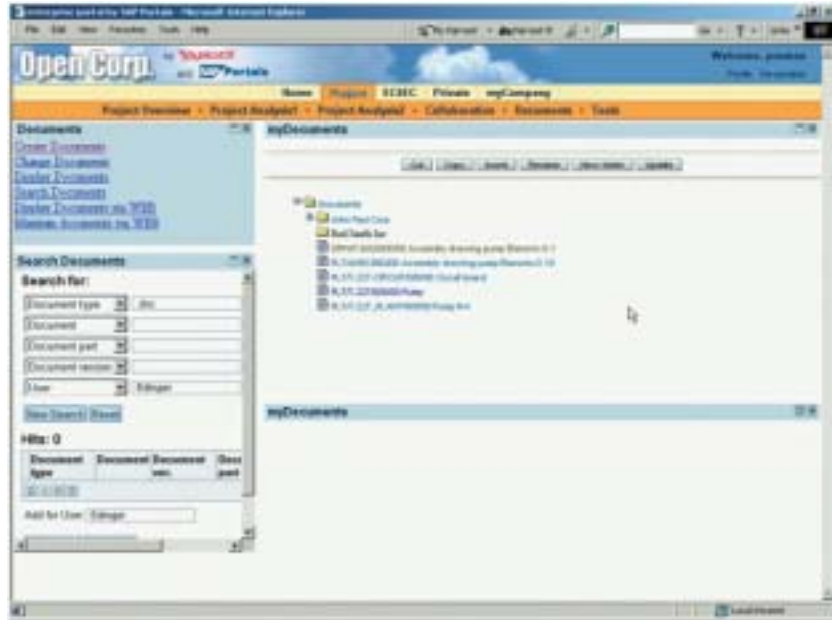


Figure 7-Web-Based Document Management

mySAP PLM supports three different document distribution scenarios:

- Distribution of documents internally and externally to customers and suppliers
- Distribution across different instances of SAP installations using ALE techniques
- Document replication (caching of data)

The distribution function also supports packaging of information to be distributed to single addresses. All distributions are recorded in history logs and mechanisms are in place to monitor electronic distributions for failures and will re-send as needed.

## Workflow and Process Management

Workflow (or process) management is a critical part of managing product definition information and the processes used to create, change, and leverage it. This includes defining the ordered steps in the processes, the rules associated with the steps, the rules for approval of each step, and the assignment of people to provide

approval support. Process management provides the mechanisms to actually enforce the defined processes and approval authorizations.

Within mySAP PLM, change processes are supported through the Workflow application and Engineering Change Management (ECM) module. The principle component of ECM is the Engineering Change Master. This could be a simple Change Number or an Engineering Change Request (ECR) for complex change processes with different approval steps, to document the changes, review, approve, and release (or rejection) the proposed change. The Workflow application supports the creation and downstream processing of engineering change requests (ECRs) and change orders (ECOs). It also provides pre-defined ECR/ECO templates for the approval process. Workflow allows for formal processes to be defined and manages the task assignments within mySAP PLM.

The Workflow engine is an object-oriented system and represents an integral part of core SAP technology. Workflow includes a graphical workflow builder, which is used to either customize (modify) SAP delivered workflow process templates or to build individual business processes based on the various building blocks delivered with the workflow repository (business objects, methods, events, tasks, roles, etc.). Multiple wizards can be used to guide the user step-by-step through the necessary tasks required to create or modify a workflow. These wizards provide the ability to define the responsible user, on an ad-hoc basis, for the next step in the workflow. The users can be selected from a distribution list, an organizational unit, a work center, or other user lists. This capability extends the ad-hoc functionality provided by the workflow system.

The Workflow module is a cross-functional application of the complete mySAP.com e-business platform and as a result, it can interface and manage tasks associated with all the solutions. SAP's Workflow also supports interfaces with external systems, such as external workflow and GroupWare systems. This enables external users to participate in mySAP PLM workflows. External legacy applications can be integrated into the Workflow environment using the Control Broker, an enterprise application interface provided through a SAP partnership with Actional or through XML-based direct communication links. This enables external applications to participate in mySAP workflow processes using the concept of a proxy object. A full history of the workflow can be maintained by the system.

SAP is a foundation member of the Workflow Management Coalition (WfMC94) and it supports the standardized workflow API (WAPI). In particular, SAP supports the open Wf-XML interface for Internet Process Collaboration.

Since early 2001, SAP has been a member of BPMI.org. This Business Process Management Initiative (BPMI) has been created to develop, publish, maintain, and promote a common meta-language. It is hoped that this initiative will enable all participants involved in process design, deployment, execution, maintenance, and optimization to manage activities in a process-oriented fashion, while preserving the integrity of end-to-end business processes over their entire lifecycle. The Workflow architecture is structured in four levels or models: Organizational, Process, Object, and Workflow Builder.

The Organizational model describes all organizational elements participating in a business process: job or roles, workgroups and departments, job descriptions and associated tasks and responsibilities, reporting, and management relationships or structure, etc.

The Process model can consist of sequential or parallel steps. The process is diagrammed using a graphical editor, which supports conditional states, nested processes, and multiple types of process loop backs. The steps of a workflow are not defined through a program (transaction, report, etc.), but by referencing a task of the organizational model, thereby providing a process that can adjust to changes in the organization. Tasks are sent to users, based on their defined role, for them to start work. Once an individual accepts a task, that task becomes associated with the name of the individual thereby ensuring that even if the individual role or position changes, the work started can be completed or assigned to a new individual. Others with similar roles are then automatically "locked-out" to prevent duplicate tasks being initiated. Additionally, the workflow allows for the individual definition of substitutes to manage a longer absence of the original task owner.

The Object model provides a unified interface to the existing application data and programs inside and external to the mySAP.com e-business solutions that are involved in a business process. The Object model supports the definition of object types and their attributes, events, or methods to be performed by the workflow system.

Workflow supports the Easy View style of graphical interface providing the user with an environment that presents all the needed information for a user to complete a given task. The user interface shows the steps in a workflow that have already been carried out, the steps that remain to be done, and an area for navigating around large process workflows.

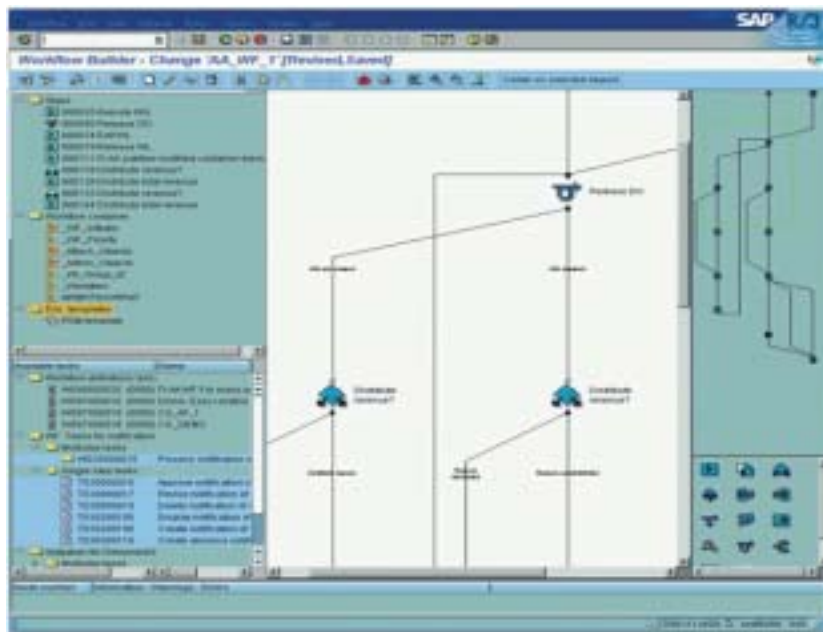
The Workflow Builder provides a graphical overview (see Figure 8) of the process and is used to create and change workflow definitions. New tasks can be created by using wizards or directly by selecting from a pre-defined task list. Improved diagnostics are provided that check the integrity and validity of a workflow.

A key concept that supports process management is provided in the form of triggers that can automatically launch a task (e.g., notification, process launch, etc.) based on some system activity. In mySAP PLM's, workflow, this is known as the event-driven process chain (EPC). A conditional test is available for event creation in the workflow module, which provides the ability to check not just a document's status, but also any other related attribute. These conditions are evaluated and used to trigger workflows. This might be simply to advance the document to the next task in the workflow process or to activate an external process. This is a good approach and is consistent with other major cPDM solutions.

SAP provides a centralized workflow inbox, which is an integrated environment to manage and display workflow notifications, mails, folders, and other messages. It includes the e-mail sub-system, which presents users with their tasks and messages dynamically upon logging into the system. The dynamically-maintained worklist ensures that users are provided with the most up-to-date view of outstanding tasks, regardless of whether they are mySAP PLM-related or triggered through other solutions. Web inboxes accessible via an enterprise's extranet or mySAP Enterprise Portals are also available.

Workflow also supports a number of pre-defined interfaces with external e-mail systems, including Microsoft Outlook and Lotus Notes. This helps lever-

age the functionality and benefits of a common inbox for distributing tasks and messages. These interfaces provide a relatively intuitive working environment. For example, a mySAP PLM task, such as a change request, is sent to a Microsoft Windows-based client where the user can view and execute the change request in their MS Outlook Inbox. Upon selecting the item, the change request is opened and its contents displayed. These capabilities also support URL links to specific screens in mySAP PLM within the e-mail address itself.



**Figure 8-Graphical Workflow Builder**

The concept of using the mySAP PLM engineering change notice (ECN) object is essential to be able to support change management processes. The ECN is used to maintain relationships to other managed objects, such as documents, parts (material masters), routings, etc., to which the change applies. The graphical product structure browser can be used during the creation or modification of an engineering change to select and relate objects affected by the intended change.

In mySAP PLM, ECNs define a product change and the activities necessary to implement the change. An approved ECR will be converted into an ECO that is used to authorize product data for subsequent modification and its eventual approval to its next revision level. Multiple ECRs can be grouped into one Engineering Change Leader (see also Change Hierarchies).

Significant features are available in three areas of ECN, namely effectivity parameters, release keys, and change hierarchies.

**Effectivity Parameters** – An ECN supports effectivity based on date, serial number, or any other configurable parameter (e.g., "customer number," "airline name," etc). The provision of parameter-based effectivity is important as it enables the validity of an object to be based on one or more attribute values.

**Release Keys** – By using a release key on an ECN, it is possible to individually release changes to enable, for example, simulation, costing, planning, and production to be carried out without having to wait for the complete product structure to be released. This capability is useful, for example, when the change in question has no impact on procurement or production, yet may take a long time before all objects in the product structure have been checked, modified, and released.

**Change Hierarchies** – These can be used to ease the structuring of dependent ECNs. A change hierarchy is defined by a "change leader," which is made up of multiple "change packages." These change packages can represent technical or organizational issues. The change leader controls the release of all subordinate change packages. Therefore, it is possible to ensure the common release of dependent changes for production.

The ECN controls changes to documents, parts (material masters), BOMs, routings, plans, classification, and configuration profiles.

mySAP PLM uses a status system for controlling the change management process. Status ranges can be configured for each document type as well as an unlimited number of status values. For a given document type, this implies that a specific set of status levels apply. These status levels can be used within the context of the workflow to determine how the document is processed. Change management functions are controlled in mySAP PLM through the user's authorization profile. Additionally, digital signature can be used for each approval activity. This restricts access to users in the

appropriate authorization group to promote a change to its next state.

mySAP PLM's ECM functionality is a specific implementation of a change management philosophy. While we would not expect this to fit all organizations perfectly, it does provide a good starting point for most implementations, and a number of good templates are provided from which more elaborate workflows can be constructed. mySAP PLM workflow provides the ability to version control tasks, processes, and the workflows themselves. This is important, as many companies will wish to phase out processes and procedures, and introduce new ones to keep pace with their changing business models and organizational structures. Many cPDM solutions also allow revision control to be applied to workflows. This is an important area that SAP should consider and we would recommend that mySAP PLM be further developed to include this feature.

Many cPDM solutions claim to support impact analysis capabilities. This supports the ability to determine which documents, CAD files, specifications, etc., are affected by a potential change to a given item (i.e., document, part, etc.). The benefits of this are significant. However, where many cPDM solutions fall short is in their inability to identify the commercial and manufacturing documents (e.g., sales orders, purchase orders, production orders, and routings) as these are traditionally managed and maintained in ERP systems.

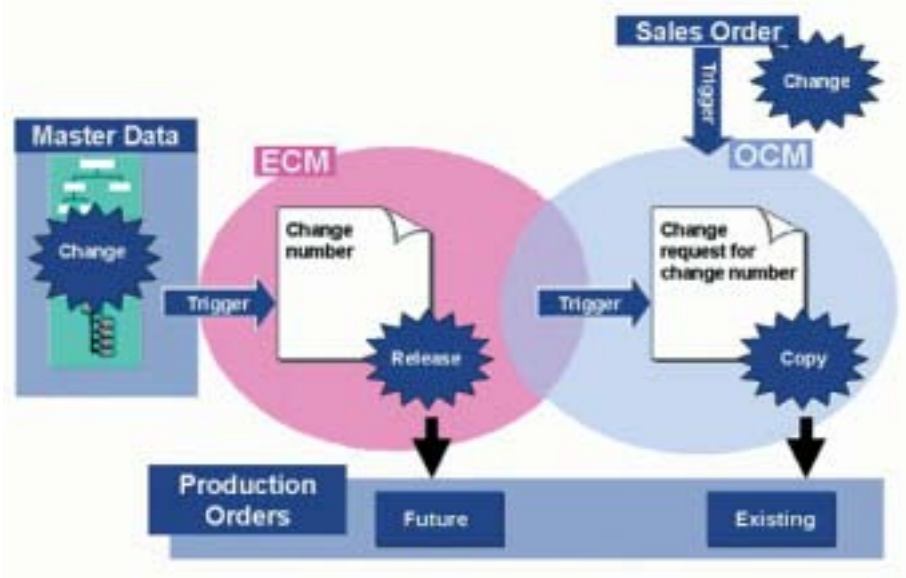


Figure 9-Order Change Management (OCM)

SAP has taken advantage of the integrated nature of mySAP PLM by providing the Order Change Management (OCM) module, a solution originally developed for the E&C and Aerospace market, which is now generally available for all engineering-to-order and made-to-order businesses.

Essentially, OCM extends the existing change management capabilities of mySAP PLM to provide automated modifications to production or purchase orders and planning information. The process is triggered either by a change raised by a customer, which will effect the sales order, or coming from an engineer which will cause a change to master data (see Figure 9).

OCM manages this situation in the following steps (e.g., for complex change management):

- An ECR is created
- The ECR will be approved and converted to an ECO
- Objects will be changed and the ECO will be released
- A search is made for effected production orders, which generates a change request production order
- The nature of required changes to any active production orders is determined, the change steps are defined, any active production orders that are effected are blocked
- The derived changes (insert and delete) are checked for conflicts and a report indicating warnings, errors, or no conflict situations is generated
- The required changes are made to blocked active production orders
- Change requests are closed and the change process steps are deleted
- A history of the changes made is maintained on the production order
- Production orders can be changed and processed many times over

OCM is an advanced feature enabling integrated change management processes between engineering and manufacturing. This type of functionality is not readily found in most cPDM solutions. Benefits are shorter ramp-up to production, more cost-effective changes, and the ability to react better to last-minute change requests especially in made-to-order environments.

mySAP PLM also offers Change Notifications with its release 4.6C services. Notifications are used in many areas of the mySAP PLM solution (e.g., for quality notifications, claims, or within change requests).

Via the Web interface, a company's customers can issue change notifications or claims (see Figure 10), which are routed directly to the corresponding project manager via Workflow. Project managers can perform cost impact analysis and then trigger the corresponding follow-up actions, such as the creation of an ECR. This functionality can be used as a generic change request before a formal ECR is created.

### Product Structure Management

One of the major strengths of mySAP PLM is its product structure management capabilities. These capabilities can be divided into four primary functional areas:

- Material BOM Management
- Configuration Management (CM)
- Integrated Product and Process Engineering (iPPE)
- Internet Pricing and Configurator

To describe these capabilities, this section is divided into four subsections, each focusing on a specific level of mySAP PLM product structure management functionality.

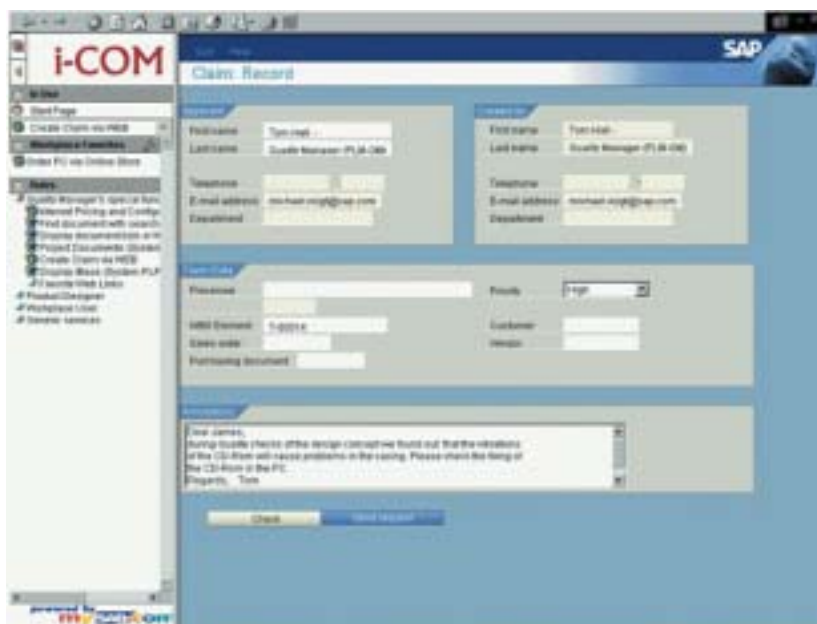


Figure 10-Web-Based Notification (Claims)

Each of these levels in the mySAP PLM product-structuring scheme builds on the capabilities of the lower level. This section describes each of these levels starting at the bottom (Material BOM Management) and working our way up to the top level (Sales Configuration Engine). This organization is purely for ease of explanation and does not imply restrictions in the usage of each of the modules.

### **Material BOM Management**

When looking at a cPDM solution's product structure management capabilities, many systems appear equivalent in their basic features. However, it is important to understand whether the capabilities offered are actually implemented within the solution, or if the solution is just a toolkit for the customer to use as a base to develop their own product structure management applications.

mySAP PLM provides solid product structuring capabilities in an application built on the core SAP material BOM management capabilities. This comes from its ERP history, and allows mySAP PLM to offer one of the most robust product structure management applications available.

Due to mySAP PLM's background, the term and concept of a "part" is referred to in the mySAP PLM solution as "material," however, to remain consistent in the cPDM industry we will continue to use the term "part" in this assessment.

mySAP PLM provides support for users to develop structures of parts (mySAP PLM material masters), routings, and documents. These structures can be related to each other and enable a given product to be fully defined. Users can browse either "down" the product structure, or "up" the structure as part of a "where used" evaluation. Changes to product structures can be set through the use of date, serial, or parameter effectivity controls. Product structure modeling capabilities include:

- **Part (material master) revision levels** – users can create and maintain multiple revisions of parts and BOMs through the ECN revision control capabilities.
- **Configuration effectivity** – effectivity is provided to manage the incorporation of changes to the product structure. Date and serial effectivity can be used as well as user-defined parameters, and traceability support is provided to track these changes.

- **Configuration control** – product configurations can be defined and their effectivity managed in conjunction with the ECN and Workflow-driven processes. The ECN must be manually linked to each of the sub-assembly structures and each related document within the product structure.
- **Product options, features, and variants** – product options, features, and variants can be defined, and grouped into valid configurations for product selection and packaging. Special "packages" can be defined that include combinations of sets of options. These are referred to as variant configurations in mySAP PLM.

The different variants of a configured product are identified using options. Classification system characteristics can be used to define product features. The product options include the possible values that can be used. mySAP PLM manages the dependencies between characteristics and values to allow validity checks to be carried out on proposed configurations.

mySAP PLM's capabilities to model and manage product configurations are a major strength of the solution. Configuration management can be provided through a combination of both modeling and management features. The system is fully integrated with the manufacturing capabilities of mySAP Supply Chain Management (mySAP SCM). Product and document structures can be displayed graphically, with full visibility of relationships through the product structure browser. Different revisions of parts, assemblies, and documents can be accessed. Different views of product structures can be displayed and browsed. These views are independent of each other. It is also possible to have one master BOM with different views, such as "engineering" or "manufacturing" views. A flag on the BOM item defines the applicability for a given view. These can include data held on the "relationships" between the parts and documents. An example of this is the "quantity" of components used in an assembly. This attribute is held on the relationship between the assembly and the called-out parts. This approach is good, and is utilized by all of the better cPDM solutions available today.

In Engineer-to-Order businesses, BOMs can appear to be different for each sales order. This would result in a tremendous amount of new parts/assemblies being created over time, and maintenance would become costly and time-consuming. In many cases, especially for sales orders, it is only required to change, for example,

the material within one assembly. Order BOMs provide the capability to manage this type of situation where the sales order number becomes part of the order BOM key. Order BOMs have the same appearance and are managed using the same transactions as standard BOMs.

The fully integrated product structure browser can be used to display and to navigate through product structures. The browser uses an indented structure layout to present users with information. It displays information associated with the product structure, including item data, associated documents, classification data, and other related objects. Navigation to referenced information is provided from within the structure browser. In addition, product structures from distributed instances of mySAP PLM can also be accessed and displayed. Filtering capabilities to view structures are available as well. Users can select an item, such as a part, and explode the related links to that item, e.g., links to documents and other parts. This approach is consistent with other cPDM solutions, and is viewed as generally intuitive and user-friendly.

Another strength of the mySAP PLM solution is its ability to support transfer of configuration data to multiple organizations (including engineering and production) and different manufacturing locations. This includes an ability to define "usage" for each manufacturing location that specifies what portions of a configuration are applicable to that facility. Once this is established, change releases will automatically ensure that each location receives only the information that is applicable to it. These views are physically different and must be maintained separately. mySAP PLM also allows a generalized single BOM to be defined and used throughout the enterprise and at multiple manufacturing locations while still allowing different views to be defined at the item level.

Features are provided to support part number assignment and synchronization across an organization. Part numbers can be automatically generated on a system-wide basis. A user exit is provided when creating a part to allow implementers to write custom code to generate part numbers as needed. Authorization for changes to parts and BOMs is controlled; however, the system cannot automatically increment a revision number for a part or BOM. This must be done through the use of an ECN. An authorized user must decide on the rules for incrementing revisions of a part and BOM, which would typically relate to changes in form, fit, or function.

mySAP PLM also provides the ability to load product structure data into the system at initial system startup and for bulk migration of data from legacy systems. This is a major concern for cPDM implementations, and often requires substantial customization and services. SAP appears to provide good support in this area.

With mySAP PLM, Version 4.6A, SAP introduced a new environment, known as the Engineering Workbench. The Engineering Workbench comes with a user interfaces that enables BOMs and routings to be maintained in one logical transaction, whereas in previous releases it would have required several individual transactions in order to complete a task.

The Engineering Workbench covers object types used in BOMs and routings and includes classifications, quality inspection characteristics, and object dependencies. Specific views can be defined to meet the needs of different user roles, such as designers and work schedulers. Filters allow data to be presented according to individual user requirements. The user can view and edit BOMs and their corresponding routings simultaneously. In addition, the Engineering Workbench provides the ability to work on different ECNs relating to the same product at one time. Using the ECN effectivity controls, different views and configurations of the product can be explored and worked on. Product structures or routings being "actioned" are locked at the item level, not at the assembly level, as was the case in previous versions. This means that more than one engineer can be working on different parts of the same structure at the same time.

mySAP PLM comes with a high level of application functionality to support product structure and configuration management for manufacturing organizations. While SAP's implementation of these capabilities may not match directly with all companies' processes and procedures, these pre-developed capabilities are robust and a major start for most implementations. The variant configuration capability of mySAP PLM is one of the most complete in the industry. We are particularly impressed with this aspect of the system. It provides capabilities that allow a company to define and manage product structures, documents, and manufacturing routings that are very powerful and robust.

## Configuration Management

Although the use of an ECN to track changes, define revisions, and control effectivity is a useful feature, it is only one element of a complete configuration management solution. SAP considers configuration management, which follows the ISO 10007 standard, to consist of four primary areas:

- **Configuration identification** identifies the functional and physical characteristics of the items to be configuration-controlled.
- **Configuration control** provides the mechanism to control the configuration items.
- **Configuration status accounting** provides the detailed history of changes.
- **Configuration audit** ensures that the procedures for configuration management are being followed.

The Configuration Management functionality, as introduced in release 4.6C, allows the control of product configuration for defined lifecycle phases, such as "as-designed," "as-planned," "as-maintained," etc. It manages the relationships among items, products, documentation, changes, activities, and baseline information. It controls the synchronization of data relating to products, processes, and resources (via the baselines) throughout the product lifecycle (i.e., across design, production, and maintenance). This is intended to ensure data integrity and product consistency by managing the control of all changes to product configurations.

To maintain baseline information, mySAP PLM uses an object known as the "Configuration Folder." Within the folder, items are defined and collected. These collections are defining a product. A baseline, which is created for a folder, captures all data for describing the product per structure explosion. The Folder Header object is integrated into the mySAP PLM solution to enable it to form relationships to other key change management objects and modules, including:

- ECM
- Effectivity controls
- The status network
- Classification module
- Workflow
- Document management system

Configuration management functionality within mySAP PLM provides enhanced consistency and accuracy of information across the complete product lifecycle. It also provides the backbone for configured product and document distribution.

## Integrated Product & Process Engineering (iPPE)

Possibly one of SAP's most significant developments, originally introduced with Version 1.0 of the Automotive Industry Solution, is the integrated Product and Process Engineering Environment (iPPE), which introduces a new and more flexible data model (than in previous versions of mySAP PLM) for product and process structure management.

Although the well-established material BOM management capabilities of mySAP PLM are very capable, they can prove to be less than optimal when representing complicated products that have a wide range of variants. In some instances, unclear relationships to assemblies that are used in multiple configurations arise and can make the system difficult to use.

With the introduction of iPPE, SAP launched an enhanced approach to the way mySAP PLM manages product structures. This approach addresses the requirements of organizations that need to manage a large variety of complex product configurations. Although initially developed to meet the needs of the automotive industry, SAP have found that iPPE is of interest to mechanical and plant engineering, aerospace, electronics, and other high-tech companies as well as automotive. iPPE is the foundation for new applications, such as Product Designer to manage product features and requirements structures within the early engineering phases of a product and for its new Recipe Management application to support the product development for process industries as described in the Applications section of this document.

The organization of data within the iPPE system is structured in three main components (see Figure 11):

- The Product Variant Structure (PVS) to enable a continuous step-by-step product definition
- Process structure with the activities that relate to the corresponding product structure items and the corresponding factory layout structure
- Factory layout structure, including the work stations in an assembly line

The product structure with PVS is composed of three levels as described in the following paragraphs.

**Product Description Level** is at the top. This level is used to define the products within the organization, which are typically organized into hierarchies where

each class is described through a number of technical characteristics. These characteristics are inherited down to the product's sub-classes.

**View Level** is the next level in PVS. This enables the product, as defined in the Product Description level, to be viewed in a number of different ways. For example, this is where the specific design, production, and maintenance views can be defined.

**Structure Level** is the third and final level. This level represents the central area of the product structure and is composed of the product variant structure for configurable products and the assembly for nonconfigurable products. Fundamental to the Structure level is what is called the node. A node is used to represent a component or function of the product structure. The actual component variants of the product are assigned to these nodes. ECN records can be applied to component variants to track the changes in the variants that are created and consequently control which variants are valid, based on standard ECN effectivity controls.

It is possible to link Structure level nodes to the headers of material BOMs. When a structure is exploded, the component nodes call out the material BOM items. It is

possible to attach documents to nodes and other objects that describe the node and how it can be used. In addition, PVS enables documents to be applied to the actual component variants related to the nodes. It is also possible to apply variant consistency checks for completeness and checks for ambiguity (i.e., when more than one solution is generated).

Dependency relationships are applied between the nodes and the variants (see Figure 12), and are evaluated when processing a user query against a given set of parameters for validity in the selection result. Nodes can be compared on a multi-level basis. In addition, the full integration of document management has been incorporated into the iPPE along with a comprehensive Web interface.

CIMdata is interested in the approach being taken by SAP with its iPPE functionality, as it appears to offer a flexible and more robust architecture for a complete and comprehensive solution to the management of product structures along with process information. What is also of significance is that the iPPE functionality has been built using principles and standards as defined by the STEP initiative. This will enable product structures to

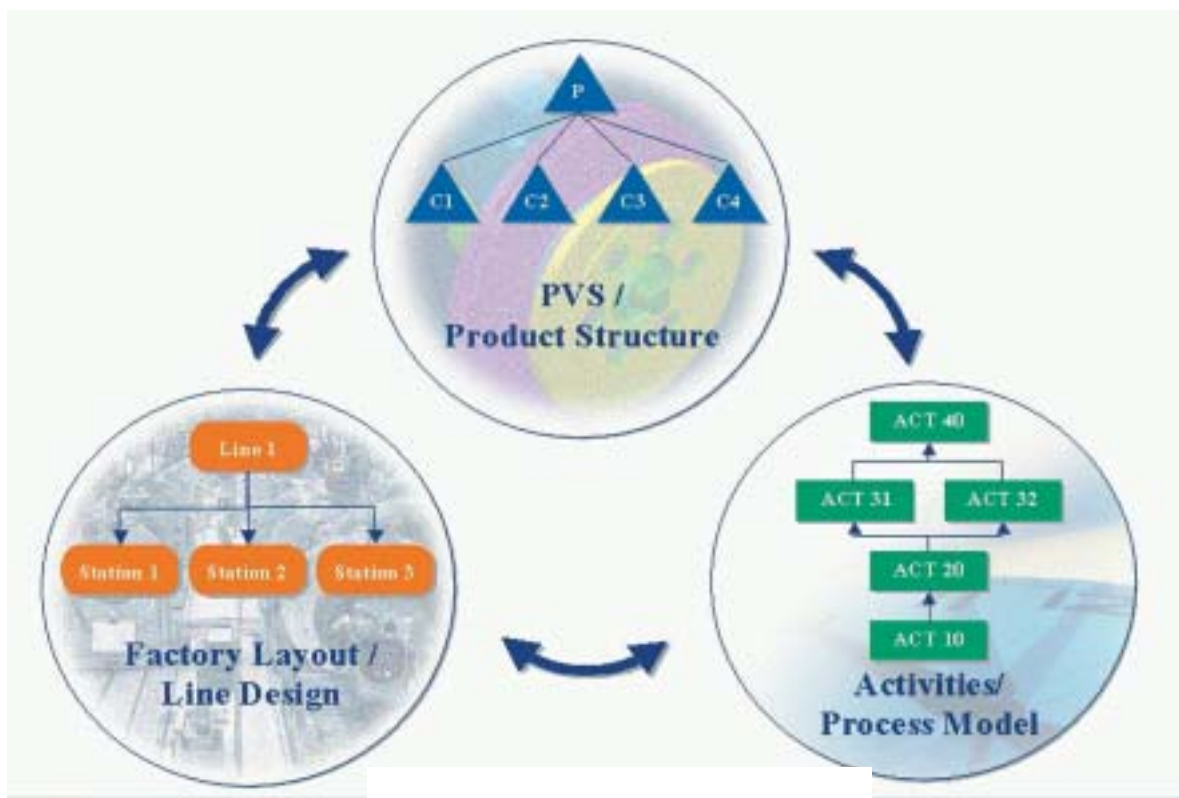


Figure 11-iPPE Application Objects

be exported to other STEP-compliant systems. This has obvious relevance to the automotive and aerospace industries, as well as the process-related industries.

*SAP Internet Pricing and Configurator (IPC)*. A number of key technologies (e.g., Internet, intranet, extranet, and mobile devices) are now available and enable applications to be built that exploit their benefits. These applications are starting to rely heavily on the capabilities offered in a typical cPDM solution to provide controlled access to data and configuration and option management. SAP has gained experience in the provision of sales configuration tools within its mySAP.com e-business solution offering. Now with its cPDM capabilities, it can provide a means for a company's sales representatives to download to a laptop computer, product structures, rules, and classification data they need to take with them when discussing sales opportunities.

Because of SAP's end-to-end business process integration, the SAP Internet Pricing and Configurator has access to product structures, documents, and pricing information that can be downloaded to either a Web site or enterprise portal for access over the Internet, or onto a laptop for the mobile sales force, allowing for extended customer relationship (CRM) capabilities.

Not only are the data provided, but also the rules defining permissible sales configurations and pricing information. The creation and management of product configurations enable features and modules to be established along with the rules that govern the permissible configurations and dependencies that are available.

An offline scenario for the use of IPC is as follows:

- Master data such as products, classes, characteristics, values, and dependencies are created and downloaded to a notebook PC under the control of mySAP PLM.
- Product configuration then takes place on the PC and provides consistency of product and pricing.
- Modifications can be made to the attributes that are displayed on the user interface of the SAP IPC.
- Graphical representation of products and components can be integrated to the information presented to the customer.
- The sales engineer is able to create and change configurations, determine order items, calculate variant prices, and provide alternative quotations and configurations.
- When completed, the quotations and order information can be uploaded to mySAP PLM.

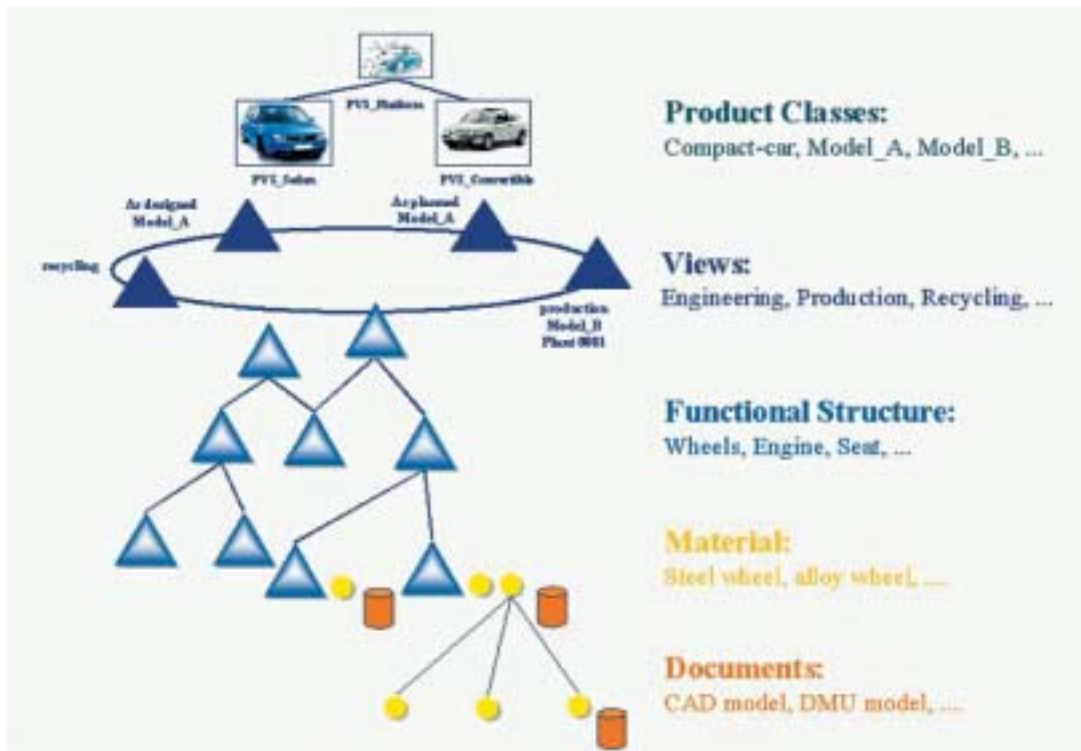


Figure 12-PVS as Bills-of-Materials within iPPE

- Once loaded back into mySAP PLM, the capabilities of the Order Change Management module (see previous description of OCM) can be employed to reconcile sales and production order details.

This solution is also accessible via the Internet using the SAP IPC from within mySAP CRM, which is tightly integrated with mySAP PLM in order to allow for a non-interrupted business process flow. SAP IPC allows end-users to choose product options and obtain price quotations that can be confirmed as orders. SAP IPC is a good example of how cPDM solutions are providing key capabilities to enable e-business applications.

## Classification Management

Locating information within a cPDM-enabled environment can be based on the values of attributes defined and managed for a particular item or object. Attributes can include those that are standard when the system is installed as well as additional, user-defined attributes created for specific object types.

Classification and retrieval are basic capabilities for managing parts (material masters) and components. mySAP PLM provides one of the most robust classification systems in the industry. Parts, documents, routings, and many other objects in mySAP PLM have classification values. These classification values and types are used throughout the solution. From searching for documents of a certain type to finding all ECNs effecting changes to BOMs, classification plays an important role.

Flexible capabilities to define and manage part family hierarchies provide a solid approach to classification and present a mechanism that plays a substantial role in assisting the usage of standard parts, purchased parts, proprietary parts, etc. Users can manage hierarchical structures for classification schemes. The classification scheme itself can be changed, although there are authority rules and restrictions. Any changes that are made can be tracked and approved using the Engineering Change Management (ECM) module. When creating new class hierarchies, mySAP PLM performs consistency checks to ensure that the structure does not already exist. This enforces the benefits of eliminating unnecessary redesign of existing products.

mySAP PLM provides strong search algorithms. The types of classification searches that can be carried out

may be determined by the user's profile, which employs groups and roles to assign specific privileges to each user. In this way, specific views of the classification hierarchy can be made available to different user groups. For example, the purchasing department will have certain areas of the product classification structure that are of interest to them, while others (e.g., design and manufacturing) will have other specific views, such as routings, jigs, and fixtures that purchasing has no requirement to view.

Results of a classification query can be saved for manual or automatic comparison with other queries to be performed at a later date. It is also possible to navigate from a specific class characteristic to a related document and to view its content, which might include text, design graphics, sound, or video data.

mySAP PLM supports hierarchical class structures into which part families can be grouped. The mySAP PLM classification schema is capable of being extended to include customer-specific categories and enables the importing of externally defined schemas or custom-developed hierarchies for standard models such as DIN 4001.

## Program and Project Management

Program (project) management capabilities provide mechanisms to define a work breakdown structure; a hierarchical network of tasks and sub-tasks necessary to complete a project. We expect a comprehensive cPDM solution to provide advanced mechanisms to develop such networks, a powerful support of the workflow between its tasks, and interfaces between these tasks and proprietary project management systems. mySAP PLM features program and project management capabilities to develop schedules, carry out critical path analyses, manage budgets and resources, and other capabilities that are needed for effective project management. In addition to that, project baselining and versioning as well as progress tracking can be performed.

The important issue for a cPDM solution is to provide effective interfaces to project management systems so that knowledge and historical information, managed within the cPDM solution, can be more effectively used to support the project management process. Some cPDM solutions provide limited direct support of program management functionality.

SAP supports project management through its mySAP PLM Program and Project Management capabilities. This key functional area is not only intended for large-scale, complex, project-oriented manufacturers. There is a growing realization in engineering-to-order, manufacture-to-order, and research and development organizations, that project management and its relationship to the management of the product definition lifecycle are important.

The mySAP PLM project management system is robust and supports the major features that are expected from a project management system. It is fully integrated with other mySAP.com e-business solutions. A number of interesting features are available including:

- **Project Builder** offers a flexible drag & drop environment for constructing projects plans. Besides the clearly structured navigation, direct and easy access to further project management capabilities is provided. Objects available include pre-defined templates, work breakdown structures (WBS), milestones, and tasks.
- **Project Planning Board** is used to visualize the project plan in a graphical view with access to all project data like worklists, resources, materials, etc.
- **Easy Cost Planning** is a new approach to provide a highly flexible and template-based way of calculating the project cost plan. It provides access via an easy-to-use HTML user interface.
- **Project Information System** offers a large number of role-based and flexible information reports. Additional reports can be built to fit specific needs of a project management organization.

The mySAP PLM program and project management is made up of Work Breakdown Structures (WBS) and a Network (process-oriented representation of organization, milestone dates, resources, and costs). WBS and its networks can be defined and used as templates. From the Planning Board, it is possible to jump to any object assigned to the project to obtain further information such as a task description, a resource name, or machine specification. Resources can be people, materials, machines, services, documents, etc. Due to the integrated nature of mySAP PLM within the mySAP.com e-business platform, it is possible to navigate from a task to the resources it uses, such as a document or a material and to search these using the appropriate browser (e.g., document management system or product structure system). An additional strength is the seamless integration to the mySAP Finance solution.

A point of interest is that it is possible, by making a project activity a milestone, to associate it to a task in SAP's workflow system. Project plans can be version controlled and used as a baseline. It is also possible to take a copy of a plan and perform "what-if" simulations before committing changes to a revised plan. Surprisingly, it is not possible to link sub-projects to a master project; however, it appears that constraints between different projects can be realized as relationships. Further, powerful project reporting can be carried out across a number of projects. The system also provides a range of standard planning reports including:

- Earned value analysis calculations
- Milestone trend analysis
- Cost forecasts
- and many others

It is also possible to download and upload the mySAP PLM project directly into MS Project or to a neutral format file, which can be imported to other planning tools. This is in keeping with SAP's approach to openness. The mySAP PLM project plan could be downloaded to a notebook or a hand-held device and taken off-site for reference for mobile workers.

In addition to these important project management capabilities, CIMdata expects a comprehensive cPDM solution to provide additional capabilities that support a company's need to strategically manage its product portfolio. Continuous adjustments to a product portfolio are influenced by various parameters associated with a company's environment and its market position. To be successful in managing the product portfolio (see Figure 13), the company must be provided with decision support tools. Project management capabilities provide mechanisms to put program management decisions into action, so that people within the organization will "Do the right things" and "Do the things right."

SAP's solution supports strategic product decisions with its strong Program Management capabilities along with its integration to Strategy and Enterprise Management applications that support business planning and simulation as well as the mySAP Business Intelligence solutions for reporting and analysis:

- **Strategic Program Management** – providing methods like Balance Scorecard Analysis or Product Portfolio Analysis
- **Lifecycle Profitability Management** – Measures and optimizes the lifecycle of a product across various aspects of lifecycle cost management (see Figure 14)

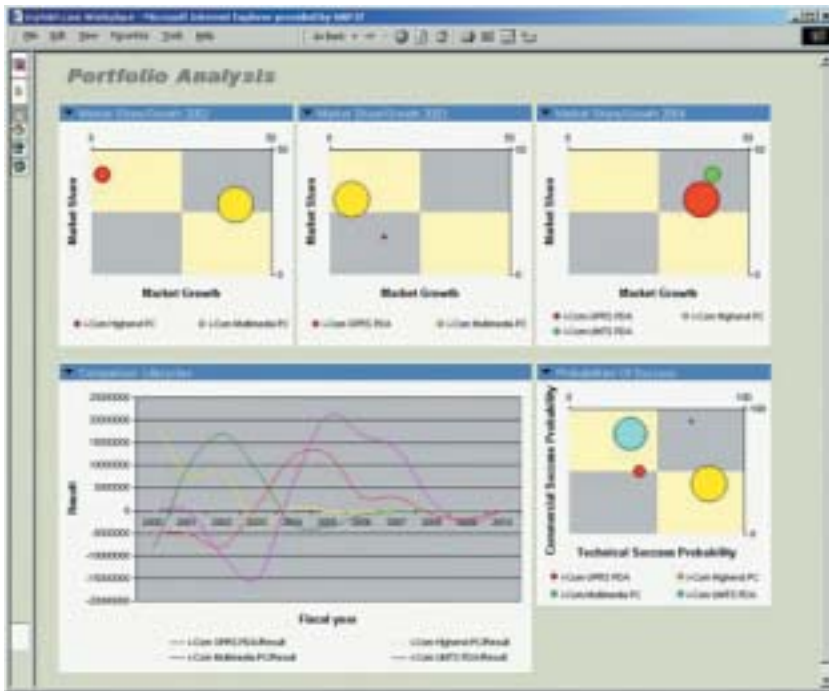


Figure 13-Portfolio Management

Thanks to direct integration between these capabilities and the other mySAP solutions, as well as mySAP.com's openness toward other data sources, advanced monitoring mechanisms can provide the necessary tools for a solid portfolio management strategy.

mySAP.com's multifaceted program and project management capabilities are very impressive with the ability to support complex projects and a company's portfolio management needs. The introduction of the Project Builder and Planning Board makes the system more accessible and easier to use, and the inclusion of portfolio management capabilities is impressive. With its integration to workflow and other mySAP PLM modules, SAP has provided a powerful and ambitious approach to the issues of program planning integrated with a solid cPDM solution.

## cPDM Foundation Technologies

cPDM foundation technologies provide support to the core cPDM functions. Foundation technologies interface with the operating environment and insulate the user from the low-level cumbersome functions. cPDM foundation technologies include:

- Data Transport and Translation
- Communication and Notification
- System Administration

- Visualization
- Collaboration
- Enterprise Application Integration

These underlying technologies may not be visible to many users, but they are necessary to allow mySAP PLM to operate efficiently. They enhance the flexibility of mySAP PLM, allow it to move data among supported applications, and allow users to find and view managed information.

## Data Transport and Translation

Moving data among users and storage locations in a cPDM solution is enabled by data transport mechanisms. mySAP PLM automatically retrieves and delivers files and documents to users regardless of their

location on the network. Both on-demand transfers, such as requests for files from users (pull) and automatic distribution (push) of documents are available in mySAP PLM. This has been discussed earlier in the Data Vault and Document Management section.

Documents can be distributed by using the document distribution capabilities as discussed earlier. In addition, SAP's Application Link Enabling (ALE) technology allows the controlled replication of documents (meta-data and original files), material masters, BOMs, plant-related BOMs, classes, characteristics, class hierarchies, SCE knowledge base, variants, object dependencies, and other managed items.

Administrative functions are available to track who, what, why, and when data was sent or received. In addition, recovery mechanisms are available should the connection to the remote system be broken.

Distribution can be defined on several levels dependent on the business process to be supported. Single objects along with their object dependencies can be distributed, triggered (e.g., by a change) or by a certain relationship to another object. SAP just released advanced capabilities to enable the distribution of complete product configurations by using an ECN. The ECN includes a list of objects that can be distributed to another system on the release of the engineering change master.



Figure 14-Lifecycle Profitability Management

The mySAP PLM advanced distribution capability addresses specific problems relating to what data should be given to which site, how complete the data needs to be (e.g., the remote site may already have some of the information), and what configuration base-lines need to be managed.

Although the concept of controlled distribution managed by a cPDM solution is not new, CIMdata is impressed with the approach taken by SAP as they have positioned it within the configuration management domain.

Data translation facilities allow data that was created in one application to be converted automatically for use in another application given that the appropriate translators are available. These translations can be event based (i.e., triggered by the workflow system).

mySAP PLM's Business API's (BAPIs) and the CAD Interface are available to receive and import data from any source (please refer to the section on Application Integration for additional information). This allows an external program to communicate synchronously and asynchronously with an mySAP PLM instance by packaging objects, including parts (material masters), documents, notification objects, etc., in the appropriate format and transferring them to and from the mySAP PLM solution.

mySAP PLM provides support for the STEP standard. SAP has implemented STEP Application Protocol 214 with the conformance class AP214 CC6 Automotive – product data management without shape definition. In addition, SAP ensures compatibility with the PDM Schema 1.1 as defined by PDES Inc. and ProSTEP GmbH.

CIMdata is pleased to see that SAP is providing support for STEP; furthermore, we are impressed that they have built mySAP PLM applications, such as the Product Variant Structure (PVS), using a data model that supports STEP. STEP holds the promise of reducing the need for point-to-point translators between applications in the future. Many cPDM solution providers and secondary suppliers to the cPDM industry are very active in researching this topic and are starting to deliver STEP AP-based interfaces.

### Communication and Notification

In many cases, it is convenient and efficient to have the cPDM solution automatically send messages to users when certain types of events occur. Examples of these events include:

- Notification of when data, copied from a vault by a user, has been changed by another user
- Automatic reminder to a checker that the review of a document is overdue
- Indicating to a group of users when a new version of design information has been released

mySAP PLM supports a number of communication mechanisms which are integrated across the mySAP.com e-business platform. The most notable mechanisms include SAP's workflow system, the capabilities found in the new distribution and mobile engineering modules, and the automatic content push capabilities supported by the enterprise portal solution.

Mail features also take benefit from the Easy View interface approach where inbox, outbox, message logs, errors, and viewing panels are combined into one screen. mySAP PLM provides its own internal e-mail

system and also provides the ability to interface to other mail systems, such as Lotus Notes, Web mail interfaces, and MAPI clients, which includes MS Outlook.

## System Administration

A system administrator normally handles the operation and maintenance of the cPDM solution. This individual or group of individuals look after the configuration of the solution and its various components, defining its users, assigning permissions to users, and maintaining the database(s).

mySAP PLM provides many administrative capabilities to manage a number of activities such as:

- Security and access control
- Tool definition and management
- User registration
- Group and role definition

In addition, mySAP PLM provides extensive customization capabilities to configure the solution to user-specific needs. These include:

- Definition of user profiles
- Network definition
- Numbering conventions for automatic ID generation (e.g., for item numbers, document numbers, etc.)

The integration of enterprise portal capabilities and the use of a role concept allows for easy-to-use and context-driven assignment of work-related content. To make the implementation of mySAP PLM a fast moving process, SAP delivers its mySAP PLM solution with pre-defined user roles, such as an ECM reviewer or designer. Task- or user-specific menus and access authorizations can be interactively defined and linked to the organizational structure. Wizards have been introduced in some areas (e.g., in SAP's Internet-based workflow system). However, mySAP PLM does not provide Wizards for all administrative areas today. All of these are defined and are, with the exception of class data, dynamically modifiable without disrupting production operations. Changes to attribute field lengths and data models are not permitted in the mySAP PLM solution. These restrictions are enforced to ensure that a migration path across mySAP PLM releases is available. These restrictions are normally not as strictly enforced in other cPDM solutions, especially core PDM systems. Most modern PDM systems are built using object-oriented programming with a focus on dynamic data dictionaries and models that support interactive changes.

However, mySAP PLM implementers can append to existing mySAP PLM tables, establish customer specific tables, and create new objects in the mySAP PLM data model.

Security controls in mySAP PLM include mappings for users, groups, and roles according to various security levels (authorization groups) and according to various classes of data. mySAP PLM supports the specification of those activities valid for an object. Each user has a user authorization profile that contains their authorization objects (activities they can perform in the system). In addition, mySAP PLM supports special security attributes that can be utilized on each "instance" of an object. This security attribute can be activated for special cases to enhance the normal security controls.

In general, mySAP PLM is a negatively biased system. In other words, the general assumption is that features and data are not available to users unless the security controls are established to indicate otherwise.

mySAP PLM provides administrator-controllable facilities for archive and backup beyond those provided by the operating environment or the underlying relational database management system. Interfaces are available to external vaults or repositories that can perform their own backup and archival functions on data files.

## Visualization

The typical image and visualization services that are found within many cPDM-enabled environments are document viewing engines that allow CAD and other 3D and 2D data to be viewed, annotated, and redlined. mySAP PLM provides direct 2D and 3D viewing capability through the integration of Vis products from UGS. There are also numerous third-party application providers that claim to have integration capabilities with mySAP PLM. SAP has a complementary software program where third-party providers can have their interfaces certified for use with mySAP PLM.

The current release of mySAP PLM supports the direct and two-way interactive link between the product structure viewer and the associated visualization. This allows a user to select a part on the product structure and for it to be automatically selected on the visualization and visa versa. This link has been created through an integration development partnership between SAP and UGS. To enable this, mySAP PLM manages the

appropriate JT files (i.e., file format for the VisView product) and 3D positioning information created by the CAD system.

## Collaboration

The extended enterprise, which includes supply chain participants, now requires that companies operate across geographically distributed sites and across multiple time zones. Collaborative technologies are designed to enable teams to synchronously work together in real time without the need to be co-located.

Collaboration involves a number of different technologies that include:

- e-mail and the Web to communicate messages between team members
- Audio conferencing to provide verbal communication
- Teleconferencing to enable real-time video picture exchange
- Collaborative visualization tools for synchronous 2D and 3D view and markup
- Data translation to enable CAD data to be imported into the collaboration tools
- System administration tools to control access and manage collaborative data and relationships

mySAP PLM currently supports a number of collaborative mechanisms beyond those provided as part of the asynchronous notification system that distributes Engineering Changes Orders and other product-related information among virtual team members. In early 2000, SAP introduced their Collaborative Engineering and Project Management application, which was developed with various customers. These developments include the ec4ec marketplace, an integrated sourcing and collaborative design exchange for plant engineering companies.

mySAP PLM's new collaboration folders (cFolders) capabilities support intra- and inter-company collaboration through the use of a number of different mechanisms. Basically, collaboration folders allow virtual teams to use the Internet in order to work on common projects with the right combination of ease of access, sharing of data, and security control. For example, design teams can use this functionality to provide each other with a structured view of their current CAX drawings and other related documents. This allows for large portions of the design process to be done in parallel.

mySAP PLM collaboration folders can also be used to structure technical RFP/RFQ information and make the incoming offers comparable for better vendor selection. This greatly improves a company's strategic sourcing capabilities. To support this kind of sourcing scenario, collaboration folders can be broken down into individual participant areas. This means that all users can view the general information (i.e., word documents, technical drawings, etc.) that was posted but not the replies from the different participants. In general, the functionality of collaboration folders can be used in any area that calls for the structured collection of information that needs to be shared with other internal or external parties. The collaboration folder capabilities of mySAP PLM are further described in the Applications section of this document.

As an extension of the traditional cPDM solution, SAP is very well positioned with mySAP PLM to support the extended enterprise. Through mySAP Exchanges, SAP provides an environment where multiple partners can collaborate within private or public marketplaces. Data can be shared with contractors. Reverse auctions, RFP/RFQ processes, and supplier profiles can be managed. The lifecycle collaboration services are also offered within MarketSet, the joint business platform developed by SAP Markets and CommerceOne.

## Enterprise Application Integration

Over the last several years, cPDM solutions have evolved to the point where they often incorporate Enterprise Application Integration (EAI) technology that enables them to quickly link with a variety of enterprise systems. Today, cPDM-enabling solutions are often used to connect to databases managed and populated by other systems. Sometimes the PDM system, which is usually at the core of a cPDM solution, will only reference the information and other times it will actually copy the information for internal use. EAI technologies provide a solid approach for product data access without having to replace existing systems or develop complex integrations. Many times these EAI capabilities are seen as a way to increase the usefulness of legacy systems that contain product data.

EAI encompasses technologies that enable business processes and data to communicate to one another across applications, integrating numerous individual systems into a seamless network. EAI technologies often include application servers, such as Enterprise

Java Beans (EJB), ActiveX Message-oriented Middleware (MOM), Remote Procedure Calls (RPCs), distributed objects, and many others.

The Internet-Business Framework, the infrastructure behind all mySAP.com e-business solutions, includes integration technologies at the presentation, application, and inter-company layers that facilitate collaboration among all users, including employees and external communities, and among application components, whether dynamically changing, stable, SAP, or third-party.

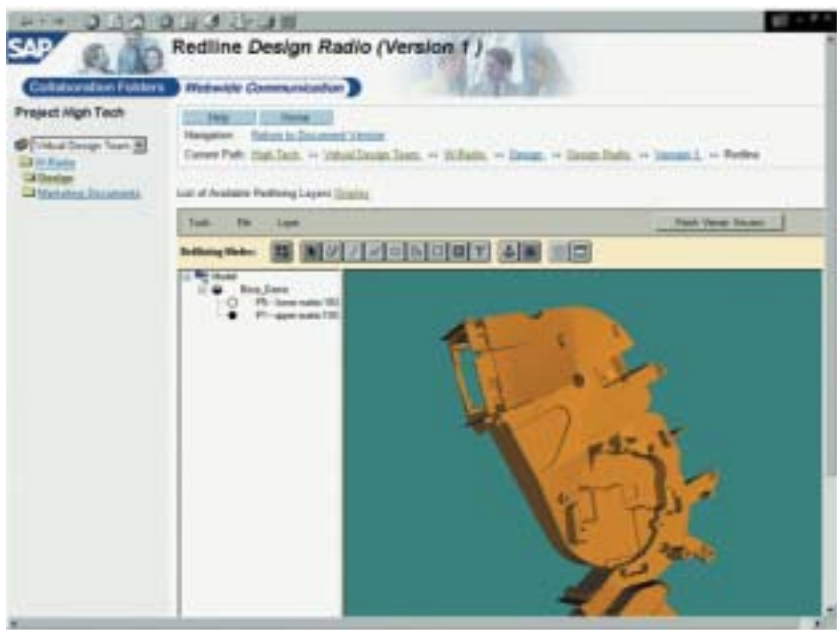


Figure 15-Design Collaboration with cFolders

Multiple integration technologies are used to bridge the gap between applications and technologies not originally designed to work together. For example, SAP incorporates technology from webMethods, Inc. for the SAP Business Connector, which provides XML-based, secure access to all business data and applications. The Internet-Business Framework provides the ability to layer applications on top of applications with full integration at the individual component and presentation levels. This allows frequently-changing applications, such as dynamic pricing, to work seamlessly with more stable applications, such as financials, all within a consistent user interface.

## Applications

As is the case with most enterprise-capable cPDM solutions, mySAP PLM offers a set of task-specific, pre-packaged applications. As with other cPDM solution providers, SAP has leveraged the industry and technology expertise that it has gained through its implementation experiences to deliver a suite of applications that are focused on addressing specific processes and tasks. SAP has taken the basic foundation and core functions of its solution and extended these capabilities by developing applications that support process planning, comprehensive configuration, and product information publishing, to name just a few. In addition to the various applications mentioned in the section entitled Core cPDM Foundation, and the ones listed under cPDM Foundation Technologies, the following details the latest applications to support new product development processes and information access for discrete and process industries.

### Collaboration Folders (cFolders)

cFolders has been introduced by SAP to cover collaboration work across the extended enterprise enabled by the Web. It allows virtual teams to work on a common project with the right combination of ease of access, sharing of data, and security control.

mySAP PLM collaboration folders provide a very user-friendly environment and many features (see Figure 15) which include:

- Collaborative and competitive scenarios
- Integration to backend systems
- Multiple views
- Authorization restrictions
- Hierarchical structures
- Versioning
- Check-in check-out mechanism for files
- Visualization and redlining
- Live discussion groups
- Data sheets for classification & comparison
- WebEx integration for real-time collaboration and conferencing

Collaboration folders can be installed stand-alone and separately from the core mySAP PLM e-business solution to accommodate any company (even non-mySAP PLM customers) at any time within the product lifecycle and allow them to access the environment and collaborate efficiently.

Encryption methods with Secure Socket Layer (SSL) provide a secure environment where Web-based collaboration is managed. Collaboration folders have been designed with separate participant areas with individual authorization settings for competitive or restricted business scenarios. Access control is provided via a role-based authorization concept that includes administration, write/change, read only, and no authorization.

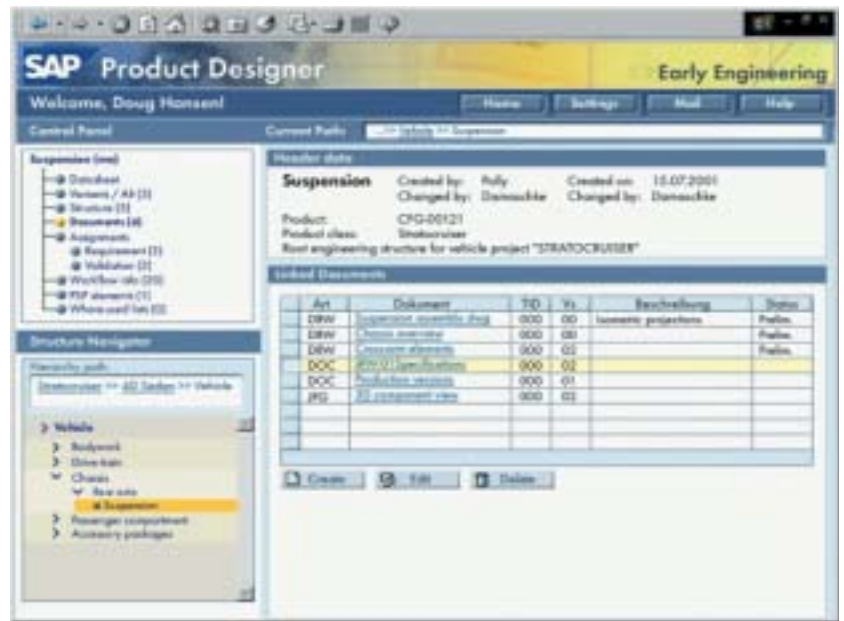


Figure 16-Product Designer

## Product Designer

Product Designer, based on SAP's integrated product and process engineering solution (iPPE), enables designers to capture product requirements in a structured way, derive concept alternatives, evaluate those alternatives against the requirements, and the creation of the product structure from it. Requirement documents can be constructed into a features and requirements structure.

Using Web-interfaces via the Enterprise Portal, marketing engineers can attach and describe the customer requirements (see Figure 16).

A concept structure containing alternatives can be derived from the customer requirements. Product designer enables the verification of the alternatives against the requirements in order to efficiently determine the right alternatives. From there, the actual design structure can be derived. The flexible object model of the iPPE enables the step-by-step engineering of a product by adding the different product variants, selection rules, CAD models, and finally the part master information. These capabilities should allow companies to increase customer satisfaction and responsiveness by developing products that better reflect customer and market demands.

## Recipe Management

Recipe Management (see Figure 17) capabilities are provided by mySAP PLM to address the process industry, mainly chemical, pharmaceutical, and consumer products including food processing. Recipe Management manages recipes, formulas, equipment requirements and settings, and procedures in compliance with the ISA S88 standard. These capabilities address product development, costing analysis, supply chain planning, and manufacturing execution support. Information, such as composition, or labels definition, can be automatically managed.

Product development with Recipe Management starts with the first idea for a product, such as marketing requirements. From this point, the product information can be extended with additional information about legal or internal requirements, and product properties, up to the final product description and specification.

Recipe Management also provides functions to manage the adaptation of a global recipe to local, country-specific production constraints, regulations, or to specific equipment. To develop a product, the developer needs to exchange information with a supplier about raw material properties or requirements. Using collaboration folders, information can be securely shared with suppliers and vendors with the right protection when required (e.g., sharing copyrighted formulas).

To develop a product, it is not enough to manage the product, raw materials, and packaging; it is also necessary to control and track the development process. Using project management capabilities, the development progress, resources, and cost can be controlled. The workflow functionality provides the process management to inform the right person in time about changes, approvals, or activities to be performed.

### Additional mySAP PLM Applications

In addition to the core cPDM functionality and cPDM Foundation technologies as defined previously, SAP has also included applications that support quality management, asset lifecycle management, and environment health and services in their mySAP PLM portfolio.

For manufacturing companies, it has become increasingly important to provide maintenance services along with their products in addition to maintenance management services for the operator of an asset. Quality management, including the feedback loop from manufacturing into development, is important for companies to get products right the first time. For process industries, especially the chemical and pharmaceutical industries, the compliance to governmental regulations and product safety issues have also become important.

### Asset Lifecycle Management

Asset Lifecycle Management is focused on Maintenance, Repair, and Overhaul (MRO) activities. It addresses both discrete manufacturing and process industries (e.g., utilities, oil and gas, pharmaceutical, transportation, and public sectors). Recently airlines, construction, hospitals, defense, banks & insurance, and other customers have begun to use these capabilities. The benefits expected from using mySAP PLM asset lifecycle management are:

- Optimized asset acquisition
- Increased production output
- Reduced external service cost
- Increased performance through high availability
- Projected optimum replacement date for equipment

Asset Lifecycle Management not only helps to improve asset availability, it is integrated into capital asset management. The decision when to replace an asset must take under consideration financial and technical aspects. The optimum replacement date of an asset must be figured out under the restrictions of investment budgets and the information provided from maintenance and the production side of the house.

The asset lifecycle management capabilities of mySAP PLM consist of two main applications: internal plant maintenance and external customer service. Internal plant maintenance is targeted to assist project managers and maintenance engineers to manage physical assets and equipment, from the first investment idea through the complete operational life of the plant. Customer service, formerly known as Service Management, supports helpdesk functions, such as sending spares to a customer, in-house repairs, and service calls (including on-site repair, on-site assembly, and inspection/preventive maintenance) and represents a major building block of SAP's mySAP Customer Relationship Management solution.

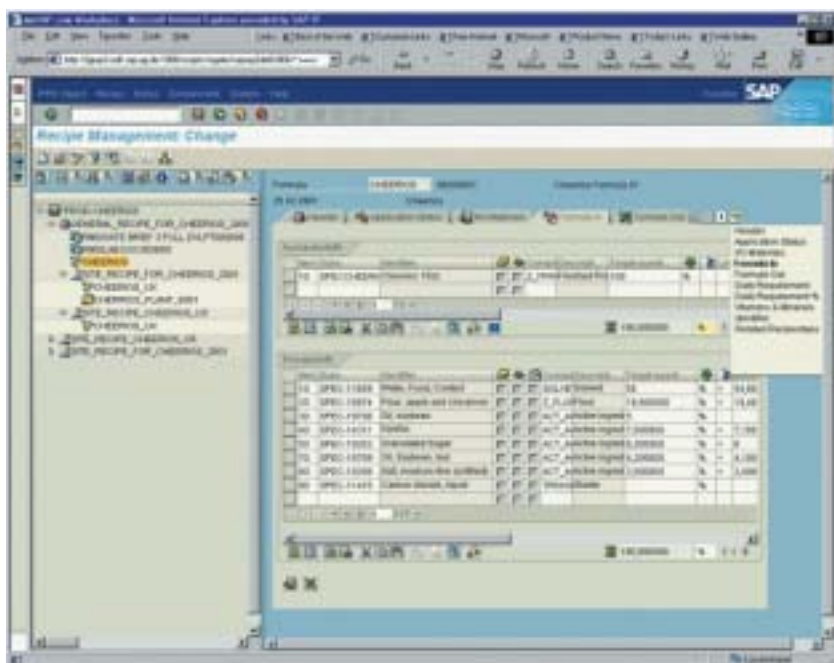


Figure 17-Recipe Management

This solution allows BOMs, specifications, and other important documents to be transferred from the design contractor to the operators for computerized maintenance management in a collaborative way. Asset lifecycle management could be of interest

to many supply chain participants, such as suppliers, manufacturers, service providers, authorities, partners, and internal personal. The application provides access for various user profiles, like the maintenance engineer on the plant operator side, the project manager on the manufacturer side, and the design engineer on the business partner side.

Assets can be represented through a location structure with actual physical position information, through a hierarchical structure, or a functional structure providing critical information required to better understand and define shutdown procedures for equipment replacement.

### ***Environment, Health, and Safety***

mySAP PLM Environment, Health, and Safety provides a business solution for environmental, health, and safety issues by enhancing business processes, complying with government regulations, managing risks, and integrating mySAP PLM EH&S capabilities, such as hazardous materials management, dangerous goods management, industrial hygiene and safety, occupational health, and waste management. This solution provides companies with the tool to optimize their business processes and enhance EH&S performance. The mySAP PLM EH&S solution is industry-independent and current users come from a variety of industries, including transportation, chemicals, electronics, pharmaceutical, mining, automotive, aerospace and defense, and oil.

mySAP PLM Environment, Health, and Safety capabilities help companies comply with national and international regulations. Its integrated architecture ensures that current data from logistics and human resources departments is always available. SAP provides these capabilities via a number of applications components.

Product Safety supports all tasks involved in safety and environmental management in business (e.g., the creation and printing or sending of mandatory documents like material safety data sheets, hazardous substance labels, and tremcards (Transport Emergency Cards)).

- **EH&S Native Language Support** allows users to print any combination of languages on one document.
- **EH&S Expert** is a rule-based tool which helps to determine the required data and enter them in the specification database.
- **Dangerous Goods Management** supports all processes connected with the distribution and transport of dangerous goods.

- **Industrial Hygiene and Safety** allows a company to take preventive care of their employees' health, manage incidents and accidents, report accidents to authorities, and perform risk assessment of a work area.
- **Occupational Health** supports occupational health physicians in fulfilling complex tasks effectively (e.g., medical examinations, by using for instance the questionnaire and question catalog).
- **Waste Management** makes it easy for waste generators to manage waste disposal processes and distribute the resulting costs or revenues proportionally among the cost centers responsible within your company.

### ***Quality Management***

Quality Management spans the entire product lifecycle and has a focus on prevention and continuous process improvement to sustain quality control. The functional areas supported are:

- **Quality engineering** (engineering workbench, product structure browser, audit management, vendor evaluation, and stability study)
- **Quality control** (monitoring of results, compare to objectives, and mobile inspection)
- **Quality improvement** (product lifecycle analytics, notifications, and quality manual)
- **Quality collaboration** (Web interface and SAP's Internet workflow, leveraging capabilities of collaboration folders)

mySAP PLM quality management application supports six pre-defined quality management roles: quality manager, quality planner, inspection planner, quality inspector, test equipment manager, and notification manager. It uses enterprise portal features to provide role-specific, context-driven access to all relevant information, such as worklists and alert functions.

Customers are mainly in highly regulated businesses, where proof of product conformance to specifications and all appropriate regulations is mandatory. Laboratory Information Requirement System (LIMS) and Computer Aided Quality (CAQ) are supported by the mySAP PLM quality management capabilities.

SAP has recently announced a tool for Audit Management. It supports any kind of audit cross industry, from planning phase through audit execution to the evaluation phase.

SAP is currently developing a new tool for planning the stage-gate processes for new product introduction. This application, called Development Projects, will address the needs in developing high-quality and complex products. It improves the development process by focusing on planning and failure prevention at an early stage in order to reduce subsequent nonconformity costs. It allows controlling the progress of the project using phases, tasks, checklists, and quality gates. Customers not only need reliable tools to store and manage the product data, but also the capability to plan, monitor, and document the product development process in a collaborative environment. In the automotive industry, the Advanced Product Quality Planning (APQP) methodology was developed for this purpose. This methodology is the basis for this new application; however, this application will be available also for other manufacturing industries.

## Business Solutions

cPDM business solutions are delivered through a combination of cPDM-based applications and foundation technologies, established methods and processes, pre-developed data model extensions, and implementation approaches that are focused on solving specific business problems. These total solutions are the means by which SAP and other cPDM solution providers are able to offer "best practice" approaches to solving specific business problems.

To provide a total "solution" to a business problem, it is not sufficient to merely provide technology that can be adapted to solving the problem. Essentially, a total solution must include all of the necessary components to get the solution implemented and into productive operation quickly and efficiently. SAP has a long history of delivering business solutions across its mySAP.com e-business platform offering; the mySAP PLM e-business solution is no exception.

mySAP.com e-business platform can be tailored to suit the requirements of many different industries. SAP's industry solutions employ the substantial industry experience SAP has acquired over decades of providing enterprise business enabling solutions. Industry solutions deploy the mySAP.com e-business platform according to the specific needs of a given industry and integrate into mySAP Exchanges, Enterprise Portals, and the cross-industry solutions of mySAP.com, including mySAP PLM. They span six major market sectors, as follows:

- **Discrete Industries** (including aerospace & defense, automotive, high-tech, and engineering & construction)
- **Process Industries** (including chemicals, mill products, oil & gas, mining, and pharmaceuticals)
- **Consumer Industries** (including consumer products and retail)
- **Services Industries** (including media, service providers, telecommunications, and utilities)
- **Public Services** (including health care, education, and public sector)
- **Financial Services** (including banking, insurance, and financial service providers)

mySAP PLM is targeted at all industries that require management of product- and project-related data, including change management and document management capabilities. Discrete industries, such as high-tech, engineering & construction, aerospace & defense, and automotive represent special opportunities for mySAP PLM. In addition, process and consumer product industries take advantage of the recipe management capabilities of mySAP PLM and service industries can benefit from its project and document management processes.

mySAP PLM Asset Lifecycle Management capabilities deliver value for all industries in which maintenance costs and equipment reliability directly affect profitability, as well as all industries that require preventive maintenance, facility management, and quality management of technical assets. These industries include discrete and process industries, such as oil & gas, utilities, chemicals, pharmaceuticals, engineering & construction, mining, and transportation.

The following two industry solutions illustrate how mySAP PLM is used.

- **mySAP Engineering & Construction (mySAP E&C)** is a comprehensive suite of integrated e-business solutions designed to meet the specific needs of the engineering and construction industry. The use of mySAP PLM allows E&C companies to track and control information throughout the extended supply chain – from investment decisions to ongoing maintenance. mySAP PLM delivers conceptual design and engineering as well as product and project estimating functions. Integration with geographical information systems (GIS), the complete manufacturing process, as well as with computer-aided design systems, manufacturing, and engineering

systems, allows users to track information at all times. Typically used applications include the full mySAP PLM solution portfolio – Project Management, Document Management System, Product Structure Management, Quality Management, and Asset Life-cycle Management.

- **mySAP Consumer Products** is a part of the suite of industry-specific solutions within the mySAP.com e-business platform. It creates a competitive advantage for consumer products goods companies by providing end-to-end consumer focus. The use of mySAP PLM enables true collaboration across different departments and ensures that all people involved in product development have secure and controlled access to current information. mySAP PLM improves the competitive situation by supporting the company in bringing the right product to market at the right time. Typically used applications are Project Management, Document Management System, and Recipe Management.

## User Environment

### User Interface

Access to mySAP PLM's capabilities is delivered via an enterprise portal. This portal provides internal and external users with an easy-to-use, centralized access to all the information, applications, and services supported by the mySAP.com e-business platform. Organizations can deploy the enterprise portal out of the box, or they can adjust it in layout and design to represent their corporate identity and branding guidelines.

To shorten implementation times, the enterprise portal includes a set of pre-defined, cPDM-specific role templates: project manager, design engineer, business partner engineer, maintenance engineer, customer, and quality manager, for example. In all, more than 300 pre-defined roles are packaged with the enterprise portal solution out of the box.

SAP's Enterprise Portals (see Figure 18) provide centralized, context-driven access to all information, applications and services needed to get a task at hand done – any time, from anywhere, through any Internet capable device. The enterprise portal serves as an open integration platform that provides users with personalized, single sign-on access to non-SAP and SAP solutions as well as to public domain content from the Internet. To ensure that the internal or external user of the enterprise portal is not overwhelmed by the amount of content available, SAP features a genuine role-concept. Each user is only presented content that is relevant to get the job done or that reflects personal fields of interest. Besides individual personalization, the proactive delivery of important information through so-called iViews is one of the key capabilities of the enterprise portal included in mySAP PLM. The set of iViews (integrated views or small windows into a particular content source; similar to an article in a newspaper) is also based on the user's role. This ensures that each user gets a work-specific view of all the content that is needed.

iViews are customizable by modifying the templates that describe it, or the program code that is made available. PLM business content (iViews) is bundled in packages which can be tailored to the needs of the individual role. PLM packages will be available for Product-, Asset-, and Project-related data as well as for collaboration processes along with cFolders. Standard

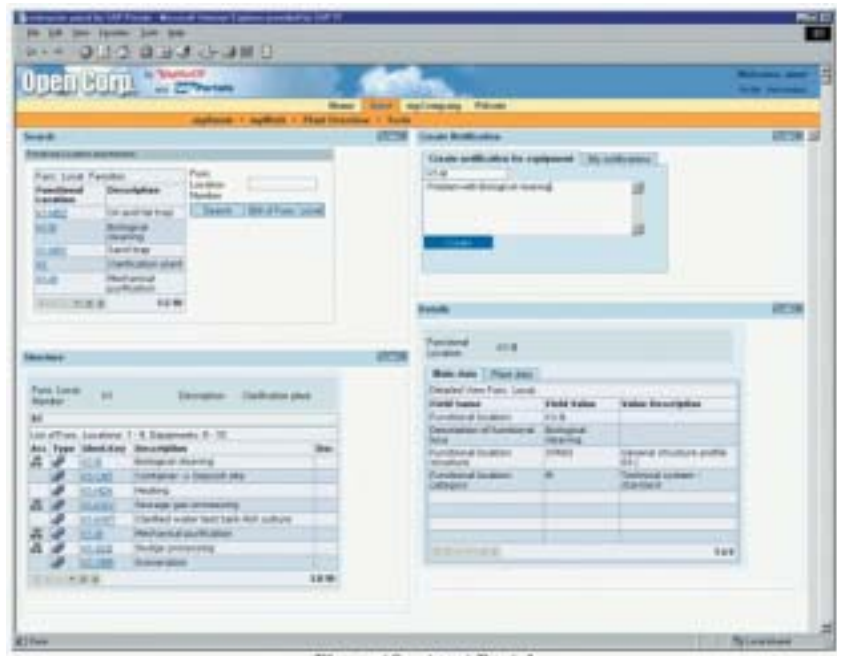


Figure 18-Asset Portal

iViews that are provided with mySAP PLM include access to parts (materials), product, asset and project structures, documents, notifications along with visualization tools to view and mark-up of 2D and 3D CAD models. Searches can also be created and saved into an iView. iViews can be linked together and changes automatically applied according to events, from one to the other. Also, iViews can be added to have access to more generic information (e.g., travel, weather, stock watch) as well as enterprise specific key indicators (e.g., production level, sales, etc.).

SAP, to provide this capability, created a new company, SAP Portals, by acquiring TopTier, and as a result of a partnership with Yahoo. This company has over 700 employees, 1,000 customers, and over six Million users. A community of users is actively creating an iViews library that is being shared among them.

Besides access through the Enterprise Portal, SAP provides access through the SAP GUI for HTML for occasional users. The SAP GUI for Java is available for a variety of platforms. Along with the SAP GUI for Windows, they provide the graphical front-end for power users.

Natural language support is provided for several different languages. Currently Czech, Danish, Dutch, English, French, German, Hungarian, Italian, Japanese, Norwegian, Portuguese, Russian, Spanish, and Swedish are part of the standard release of mySAP PLM. The following additional languages are available through SAP-subsiaries or partners: Chinese, Finnish, Greek, Hebrew, Korean, Polish, Romanian, Slovak, Thai, and Turkish. Native language support is a major issue for cPDM system implementations that involve sites located in different countries around the world. Localization is also supported through additional functions, such as date formats, multi-currency handling, calendars, multiple time zones, and specific country-based features. mySAP PLM has the most robust support of languages of any of the major cPDM solutions available today.

## Application Interfaces

Application interfaces are another facet of the overall user interface. They provide the means through which special types of users interact with the system through various applications, such as CAD. mySAP PLM can be integrated with all types of applications that are used

in developing products, including CAD, CAM, CAD-specific team data managers, PDM systems, word processing, structural analysis, publishing, illustration, and many others. Tools are available to migrate data from legacy systems and include the Legacy System Migration Workbench (LSMW), which supports importing data from external legacy systems into mySAP PLM.

mySAP PLM provides an open architecture that can be accessed through its Business Application Program Interface (BAPI). The mySAP PLM CAD interface has been extended by the provision of a set of BAPIs especially in the document management domain. These provide a programmatic interface to mySAP PLM methods and its object repository. This interface supports asynchronous and synchronous communications with the mySAP PLM solution to allow external applications to launch "process class methods" internally within mySAP PLM, and to receive the data resulting from those actions. This enables the creation of new objects, receiving lists of existing objects, etc. Support of COM/DCOM/COM+ is provided and gateways to CORBA are available. BAPI functions can be invoked from UNIX, Windows, and Web-based clients. SAP also provides a strategy for mySAP PLM distributed application integration that it calls Application Linking and Enabling (ALE). Additionally, SAP supports the Simple Objects Access Protocol (SOAP) Internet standard.

Most cPDM solution providers have offered a set of template application integrations. These are maintained as standard integrations that are kept up-to-date with subsequent releases of both the PDM system and the application tools. Other application integrations have been developed as projects for specific customers, and could possibly be used as "shareware" or starting points for additional development. Today, SAP offers seven standard CAD interfaces. These interfaces take advantage of the newly developed CAD Desktop (see Figure 19) to make the interfaces coherent and efficient. These integrations include AutoCAD and Inventor, Pro/ENGINEER, CATIA, Unigraphics, SDRC I-DEAS, SolidWorks, and Solid Edge.

In addition, SAP has established a Complementary Software Program (CSP) for application developers to certify their interfaces to mySAP PLM or any other mySAP.com e-business solution. The idea behind this program is to validate the ability of the interfaces to communicate successfully with mySAP PLM. Within

this program, a variety of other integrations to CAD, PDM, and Plot Management applications are available today. However, it should be noted that a certified interface does not guarantee that the interface is functionally complete.

SAP's position is that CAD tools should be directly integrated with mySAP PLM, and that all product data management-related functions should be handled by mySAP PLM. This reduces the number of interfaces among CAD tools, local data managers, and PLM, but this approach may not provide the level of control required by engineering-centric companies. A more CAD-centric way of controlling the data is provided by the mySAP PLM CAD-Desktop, which is focused on the daily task of a CAD designer. The CAD-Desktop provides a Workbench to the PLM-Systems, which offers the CAD engineer the functionality he expects in a local data management system. For departments running a high-end DMU process, SAP provides a wide range of project-specific integrations to local data management systems like ENOVIA VPM.

It is CIMdata's opinion that a finer level of CAD data control, especially when it comes to the management of constraints and features in a 3D design environment, is required. To handle this requirement, mySAP PLM will have to provide integrations to local data management systems, such as those provided by the major 3D CAD vendors. Another area of weakness is SAP's lack

of coverage for software configuration management and ECAD data management. CIMdata expects SAP to address these concerns in future releases.

SAP and Tecnomatix recently announced the integration to the Tecnomatix Manufacturing Process Management suite of applications in mySAP PLM. Process Planners will be able to leverage engineering product structures out of the integrated Product and Process Management Environment (iPPE) into the Tecnomatix eMPlanner environment in order to design the manufacturing process definition and manufacturing product structures. The resulting routings and manufacturing BOMs can then be reconciled within the Engineering Workbench in mySAP PLM for further downstream processing.

Over the last few years, SAP has expanded its approach to providing and supporting key application integrations and now offers in addition to project-specific and CSP solutions, what it calls cooperative development partnerships. SAP also provides a dedicated marketing program, with selected partners, to ensure worldwide availability for specific product integrations. The maintenance of the standard integrations offered by SAP is the responsibility of SAP with the support of the SAP customer fault reporting system.

## Operating Environment

### Hardware Platforms

mySAP PLM is installed and operated as a three-tier, client/server application. The layers are separated into database, application, and presentation. A number of different platforms are supported for the application server and database servers.

### Database Management Systems

mySAP PLM supports the several commercial relational database management systems such as Oracle, DB2, Microsoft SQL Server, Informix, and SAP DB.

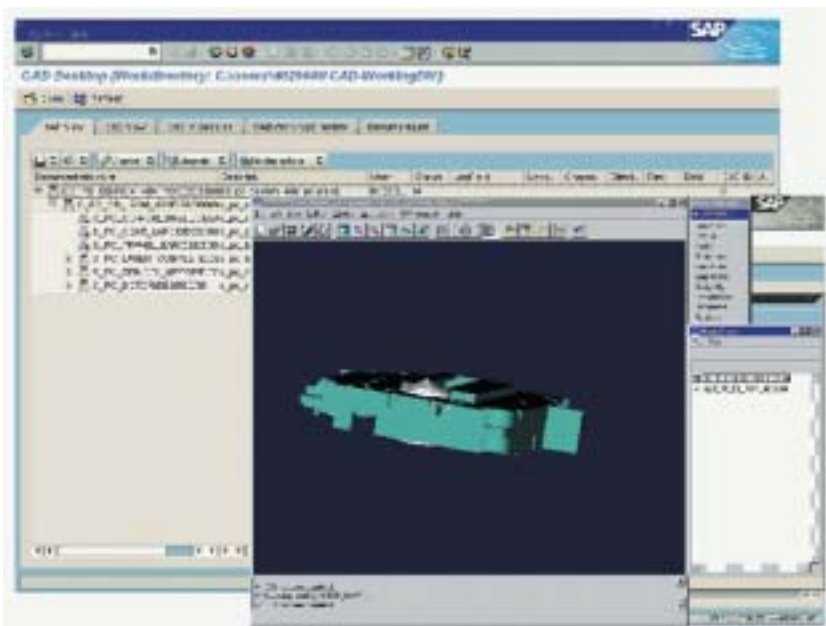


Figure 19-CAD Desktop

Most high-end comprehensive cPDM solutions are essentially designed as an "object-oriented" system, built on top of a "neutral" database layer that is then augmented for each target database platform. It appears that SAP is moving its applications forward to take advantage of object-oriented technologies, as can be seen with the workflow system, iPPE, document management, and the enhanced BAPIs. The size of SAP's customer base and the nature of its usage around the world requires SAP to carefully plan and implement new technologies to ensure the least amount of disruption to its users. Taking this into consideration and looking at the amount and quality of research and development at SAP, CIMdata feels that SAP has an excellent opportunity to make progress in this area over the next few years.

### **Distributed Architecture**

The data that is under control of mySAP PLM's vault can be stored in any location required by the administrator. Data can be controlled centrally or across a distributed set of mySAP PLM servers (see Figure 20).

Meta-data management in a distributed environment is supported through mySAP PLM's improved distribution and replication strategy provided by its ALE technology. Through the use of ALE, mySAP PLM modules can be integrated across a distributed enterprise. ALE supports the distribution of master records and vaulted data files. In addition, complete product configurations or baselines can be distributed between different SAP systems. The product structure browser is used as a general navigation tool across multiple systems. It allows, for example, direct access to the as-manufactured BOM in a specific mySAP PLM manufacturing system versus the as-engineered BOM in the engineering group's mySAP PLM solution.

ALE is SAP's technology for the interconnection of applications running on different computer systems. ALE takes the output from one business process and feeds it, as input, into subsequent business processes. Internally, ALE uses standardized intermediate documents (IDoc), similar to EDI documents, to represent the input or output of business objects. With ALE, mySAP PLM applications can be connected with other mySAP PLM, R/2, R/3, or third-party applications. ALE supports synchronous and asynchronous communication procedures. With mySAP PLM, ALE can connect to systems running on different platforms and which can have different release levels.

The basic philosophy underlying the mySAP PLM ALE approach allows subsets of meta-data to be made available to other mySAP PLM solutions. For example, a part can be distributed to another mySAP PLM solution and yet be included in a BOM maintained by another mySAP PLM solution. However, the documents related to the distributed part will be accessible to the user without requiring the document information record to be distributed to the local mySAP PLM solution. Document relationships are supported across the mySAP PLM ALE distributed systems. ALE does require that the data schemas be the same, or at least that an acceptable mapping is defined for translation. Mapping between systems is facilitated by the IDoc format. All of the systems that exchange data must provide code that translates IDoc attributes to the local system's equivalent attributes.

SAP recently published a new distribution mechanism to provide data consistency. The so-called "Data Distribution Model" allows companies to maintain master data in a central system and distribute complete product configurations, including meta-data and files, in a controlled process to other systems. This also extends the use of ALE technologies to XML messaging concepts to interface to third-party systems.

### **Tailoring and Customization**

mySAP PLM is built on SAP's fourth-generation programming language called ABAP which includes the object-oriented extensions for ABAP Objects. The SAP development platform is provided to customers and implementers. Through the use of the ABAP workbench and the Implementation Guide, the mySAP PLM solution can be modified and customized to meet specific customer requirements. Specific Internet services are built based on common Web programming languages. Some of the mySAP PLM modules also make use of Java IDEs to modify the browser's definitions. The latest version of the development platform, called Web Application Server version 6.10, is the foundation for the cFolders application. The Web Application Server provides an open environment for the development of Web-centric applications. It provides support for all major Internet standards, such as HTTP(s), XML, SOAP, and embraces Web programming models, such as server-side scripting.

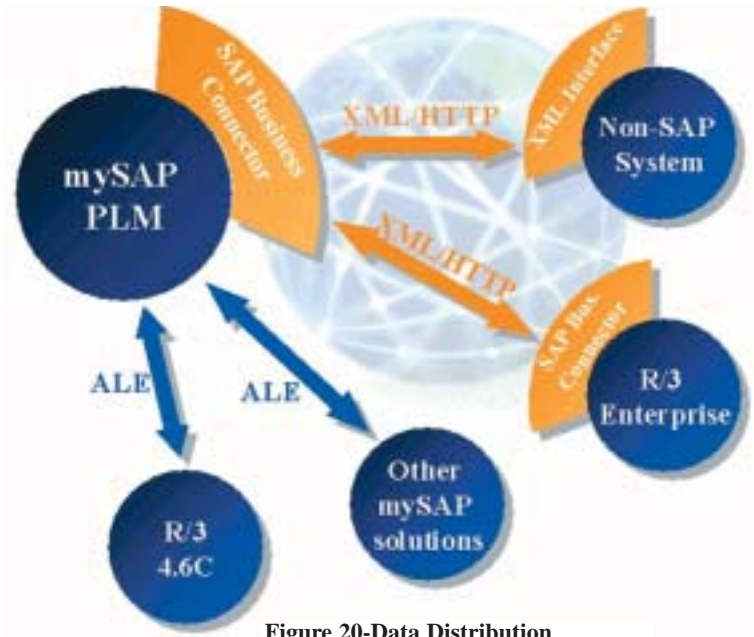


Figure 20-Data Distribution

Modifications to the program code are possible but can be a double-edged sword. On the one hand, modifications provide for the development of a system that satisfies company requirements beyond the capabilities of customization (adjustment to company specific business processes without changes to the program code). The opposite position is that the modified system is more difficult to maintain, integrate, and upgrade over time.

To ensure a long-term migration path for mySAP PLM, SAP has restricted attribute field sizes, menus, data dictionary, and other areas of the system to be customizable only by the development organization of SAP. Some of these restrictions are limitations for mySAP PLM when compared with other PDM systems. For example, many organizations have revision and version identifiers that are more than two characters in length. Currently mySAP PLM supports only two character version and revision lengths. However, as we have already stated, developments that use a more open and flexible data model are starting to appear. For the areas where the data model is more static, customers may have to adopt changes in their existing working practices if they want to use mySAP PLM. This may not be a problem for the target market of current mySAP PLM users as these customers have already come to terms with these restrictions while implementing mySAP.com as their ERP solution, although this could still be a significant issue in their engineering departments.

ABAP Workbench provides a heterogeneous development environment and supports operation on all mySAP PLM supported platforms.

SAP also provides tools to assist in maintaining consistency between releases of individual mySAP PLM e-business solutions, and in updating customizations to fit with new releases of the base product. For companies that have modified the mySAP PLM program code, tools are provided to compare versions of program code and highlight differences. So, for example, the last version of a company's own modified version of mySAP PLM can be compared with a new release of the product, and the differences identified for resolution. This is a professional

approach to ensuring that program code modifications will not cause problems as new versions are released from SAP.

## Summary

Over the last two years, mySAP PLM has emerged as the cPDM industry revenue leader. Today there is no doubt that mySAP PLM is a major solution and program in the cPDM industry. SAP has continued to make significant progress in its solution offering and has achieved a significant number of mySAP PLM sales successes in a very short period of time. This is despite the fact that SAP has just begun to build a dedicated mySAP PLM sales force. SAP has established a stable and growing European mySAP PLM business with several larger scale implementations in Switzerland, France, and Germany. A number of projects have also been launched in North America.

SAP's cPDM philosophy is to integrate these capabilities across its entire mySAP.com solution set. The mySAP.com platform has an underlying technology architecture that enables SAP to provide distributed solutions, such as mySAP PLM, while retaining their integrated ERP capabilities. SAP's cPDM focus is to leverage this integrated architecture by delivering cPDM capabilities as part of a comprehensive enterprise resource planning solution.

We expect SAP to continue to place significant effort behind their cPDM program as a strategic offering in their suite of e-business solutions. The latest release of mySAP PLM provides a number of major enhancements in the areas of collaboration, lifecycle quality management, and what SAP calls innovation management. Several new applications and business solutions are also available and include cFolders, Recipe Management, PLM Portals, and Product Designer, to name just a few.

mySAP PLM is provided as a solution of the mySAP.com e-business platform and makes good use of other well-established mySAP.com business applications, such as workflow and product structuring. Previously existing R/3 applications have been enhanced and integrated into the overall mySAP PLM offering. Not built around a core PDM engine, as are most other cPDM solutions, SAP offers mySAP PLM in the same fashion as the other mySAP.com solutions, which are essentially a set of applications and tools built using SAP's ABAP 4GL-development environment. These applications can be customized (modified) for specific users by either SAP's consulting organization, the customer themselves, or SAP partners.

SAP's mySAP.com platform and underlying technical architecture provides users of mySAP.com applications the ability to extend their business management solutions into the product development environment, supply chain management, and customer relationship management processes.

SAP's introduction of extensive Web-enabled capabilities, along with the mySAP.com initiative, has provided a major enhancement to their product and provides e-business solutions that embrace the cPDM business approach. The recent announcement and release of portal functionality and SAP Markets supporting private and public exchanges clearly illustrate SAP's commitment to enable e-business across intranets, extranets, and the Internet.

SAP continues to address previous cPDM product weaknesses with a combination of new development and enhancements to existing applications. mySAP PLM addresses a number of areas where limitations existed regarding the flexibility of its data model, however, there are still a number of restrictions with regard to data model flexibility. The limited flexibility to define key field lengths and other fixed data within mySAP PLM is a weakness compared to other major

cPDM solutions. However, this approach ensures maintainability in large-scale implementations of mySAP.com solutions. Recognizing these limitations, SAP has developed new capabilities, such as its integrated Product and Process Management (iPPE) application, which is based on a flexible object paradigm. This has enabled SAP to provide a more flexible data model within the scope of recently released modules. We expect SAP to continue this approach as other mySAP.com applications are released.

CIMdata is impressed with the approach SAP has taken to extend the capabilities of its cPDM solution and to the integration of various CAD products, a major element of most cPDM solutions. SAP has taken an active role in the development of these integrations and has recruited experienced professionals knowledgeable in the cPDM domain and who understand the disciplines of the engineering design process. SAP's position is that CAD tools should be directly integrated with mySAP PLM. This reduces the number of interfaces between CAD tools, local data managers and PLM, but this approach may not provide the level of control required by engineering-centric companies. A finer level of controlling CAD data, especially 3D data, is required.

For current mySAP.com customers, the mySAP PLM solution should be seriously considered as a candidate in any major cPDM acquisition and implementation program. Companies that are not SAP customers, but who are planning to implement mySAP.com for its SCM, CRM, or ERP capabilities should review and evaluate mySAP PLM in their cPDM selection process.



# CIMdata®

<http://www.CIMdata.com>  
CIMdata, Inc.  
3909 Research Park Drive  
Ann Arbor, MI 48108  
Tel: +1 (734) 668-9922 Fax: +1 (734) 668-1957  
CIMdata is a registered trademark of CIMdata, Inc.