BlueStar PDM/PLM for Microsoft Dynamics AX

"Delivering PDM/PLM from within an ERP Environment"

April 2008

A CIMdata Program Review

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This CIMdata-authored BlueStar PDM/PLM Program Review describes PDM technology's BlueStar PDM/PLM solution and the benefits that result from it being developed on top of an enterprise resource planning (ERP) solution's information technology (IT) platform. This paper looks at the business reasons why companies in particular industries are being driven by and benefiting from the development and implementation of tight business process and IT integrations between their development environment and ERP system(s). In addition, the paper contains a program and product assessment that is based on BlueStar PDM/PLM (BlueStar) version 4.0; an engineering-centric PLM solution developed on top of Microsoft Dynamics AX's ERP platform, formerly known as Microsoft Business Solutions Axapta (see Microsoft Dynamics AX sidebar).

1. Executive Summary

Product Lifecycle Management (PLM) has proven its value as a critical strategic business strategy to improve communication and cooperation between diverse individuals, groups, departments, and organizations; help organizations restructure their product development processes; and institute initiatives such as concurrent engineering and collaborative product development in conjunction with complete lifecycle product support.

Since the early days of PLM enabling solutions and technologies, e.g., Product Data Management (PDM), pioneering software suppliers have continued to advance PLM methods, technologies, and their capabilities. During the early years, due to implementation costs, primarily large organizations invested in PLM. For some years now, the PLM industry has been applying this experience to more affordable solutions targeted at smaller organizations. New PLM solution suppliers are also entering the market with economical approaches aimed specifically at small- to medium-sized companies wanting to get PLM up and running as quickly and inexpensively as possible. The technology has moved into the mainstream of industry as an expanding range of companies implement PLM.

This movement to more cost-effective systems has been good news for end-users at all levels. However, the increased competition has created conflict in the industry as alternative technology approaches collide and solution suppliers desperately try to differentiate and position themselves in the fiercely competitive market. The problem has been compounded by the growing number of different types of approaches and technologies used in building solutions.

Often companies confuse the concept of PLM with a specific software solution offered by one individual supplier. Time has proven that no single supplier can today fully deliver a complete PLM solution to all levels of the enterprise for the full product lifecycle. Rather, companies typically blend components from multiple suppliers to achieve their vision. This may include a primary PDM system along with capabilities in areas such as visualization, legacy data access, applications integrations (e.g., to ERP), component supplier management, project management, and more. Integrating these various elements is becoming increasingly complicated as more solution suppliers launch a widening array of different products.

Fundamentally, companies need to ask themselves what data and processes they are seeking to manage with today's PLM solutions. They also must understand that an integrated and collaborative effort is required to create the seamless product lifecycle needed to bring innovative products to market effectively. This is because enterprises face several challenges:

- Developing an improved focus on product development and definition, learning to best capitalize on its intellectual assets
- Enabling integration and collaboration of its people, business functions and applications, and organizations across the three enterprise lifecycles—product definition, product production, and operational support (see Enterprise Lifecycles sidebar)

Microsoft Dynamics AX

Microsoft Dynamics AX (formerly AX) is a multi-language (45 currently supported), multi-currency Enterprise Resource Planning (EPR) solution. The AX solution was originally developed by the Danish company Damgaard Data A/S, which merged with the Danish software firm Navision Software A/S in 2000. The solution, initially released in March 1998, became part of Microsoft's software portfolio when Microsoft acquired Navision A/S in the summer of 2002 for, according to published reports, approximately US$1.45 billion in stock and cash. As a result of the acquisition, the Navision organization became part of Microsoft's Business Solutions group. This group, which includes number of Microsoft-developed and acquired systems (e.g., AX and Great Plains), provides a range of business systems to the market designed to support small- and medium-sized enterprises, and their various business process automation needs (e.g., finance, distribution, accounting, human resources and payroll, manufacturing, and supply chain management).

Like the other Microsoft Dynamics solutions, AX has been designed to be a fully functional ERP solution that supports small- to medium-sized manufacturing enterprises. AX provides a three-tier architecture based on what is called the AX Object Server. AX's MorphX, AX's embedded integrated development environment (IDE), allows custom development and modification of the implemented system. MorphX contains various tools such as a debugger, code analyzer, and query interface. This IDE resides in the same client application that a normal user accesses. As a result, development can take place on any instance of the client. The development language used in AX is X++.

Microsoft currently provides four different AX packages or editions—Business Essentials, Business Essentials Additional Components, Advanced Management, and Advanced Management Enterprise. The Business Essentials edition focuses on providing financial and supply chain management functionality. The Business Essentials Additional Components includes a set of add-on modules, such as Human Resources, Additional Languages, and configuration and development tools (e.g., access to AX's IDE). The Advanced Management edition includes a set of advanced financial and accounting capabilities. The fourth package is the Advanced Management Enterprise. The functionality included in this package extends the Advanced Management edition by providing a set of advanced supply chain management, field service, configuration, manufacturing, and development capabilities.

- Effectively sharing product definition information throughout the extended enterprise for the entire life of the product
- Seamlessly integrating with its suppliers to make them a logical extension of the enterprise for maximum collaboration

Management of the product definition lifecycle and its close integration with other major lifecycles is not a new concept, but it is one with which companies have struggled for many years. Over the last several years, industry's ability to achieve this concept has improved dramatically with the availability of a wide range of new PLM enabling technologies and approaches that facilitate collaborative work efforts across extended enterprises. PDM technology (www.pdmtechnologygroup.com) is clearly providing one such approach as illustrated by their BlueStar PDM/PLM solution for Microsoft Dynamics AX ERP.

From the beginning, PDM technology set out to create something different; a PLM solution that would be tightly linked to an enterprise ERP solution. For companies in the Fabrication & Assembly (F&A) industry, e.g., machine builder, or another company that displays engineering- as well as manufacturing-centric characteristics, PDM technology offers a fairly unique PLM solution on top of the Microsoft Dynamics AX platform. In general, F&A companies need to seek a solution where their PLM and ERP functionality are tightly integrated so that collaboration and interaction between the data and processes managed by both are optimized and streamlined for total product lifecycle support.

From the beginning, PDM technology asked, "Why can't there be a hybrid solution that tightly integrates the advantages commonly found in an engineering-centric PLM solution with a manufacturing-centric ERP solution's robust enterprise platform capabilities?" Their answer was the development and delivery of a hybrid solution—an engineering-centric PLM solution developed and delivered on top of an ERP platform. By doing so, BlueStar has achieved an extremely high level of integration and collaboration between the product definition and product production processes. For companies who have implemented or are thinking about implementing Microsoft Dynamics AX, BlueStar should definitely be considered.

2. Introduction

Today's PLM solutions seek to enable product lifecycle environments that foster innovation in all product related

areas—design, development, production, and service. They have steadily evolved from engineering-centric solutions focused on engineering data management to extended enterprise intellectual asset management solutions that support the collaborative creation, management, dissemination, and use of product definition information. The key to these solutions is their ability to unlock an organization's knowledge by capturing and sharing it with all those who require it throughout the entire value chain.

CIMdata defines PLM as *a strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise, and spanning from product concept to end of life—integrating people, processes, business systems, and information. PLM forms the product information backbone for a company and its extended enterprise.*

There is no doubt that PLM has become a powerful business and technology approach shown to deliver substantial benefits to organizations taking advantage of it. But PLM is not an end in itself. It is an essential component of an overall enterprise IT architecture that often includes ERP, Customer Relationship Management (CRM), and other business process enabling technologies. Through the proper implementation of a PLM strategy within an enterprise framework, a company can significantly enhance its ability to innovate its products as well as its manufacturing, product development, and service related business processes.

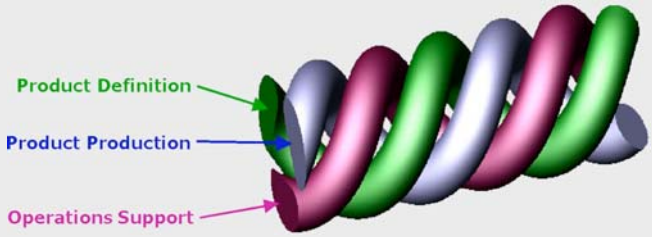
Over the years, PLM solutions have proven that they can support a broad range of "products." Examples of "products" include manufactured products, such as automobiles, machine tools, computers, refrigerators, mobile phones, toys, and airplanes. Most products today

Enterprise Lifecycles Defined

An enterprise's overall product lifecycle is comprised of three primary, **tightly** intertwined functional lifecycles: Product Definition, Product Production, and Operational Support. Each functional lifecycle encompasses the processes, information, and people involved in delivering the related business functions. For an enterprise to succeed, **there must be close coordination and communication among all three lifecycles**.

In the PLM context, the primary of these is the product definition lifecycle—the creation and management of intellectual assets. In its most basic form, this lifecycle is comprised of an organization's product development and service processes where the gathering, creation, integration, documentation, and use of product related information is performed. As with the overall product lifecycle, this lifecycle begins at the earliest point of customer requirements and product concept, and extends until the product is obsolete and field support has ceased. It includes the definition of the complete product, from mechanical and electronic components, to software and documentation—the entire set of information that defines how the product is manufactured, operated or used, serviced, and then retired and dismantled when it becomes obsolete.

Continually updated throughout the entire lifecycle, product definition information is an intellectual property of a business; an intellectual asset that must be captured, maintained, and leveraged. This information resides not just within an individual business entity, but also throughout an extended enterprise, including suppliers, business partners, and customers.



Major Enterprise Lifecycles

The second lifecycle, product production, focuses on the deliverable product—or deliverable assets, such as a car, toy, appliance, airplane, or plant. This lifecycle includes all activities associated with production and distribution of the product. ERP systems are the primary enterprise solution that addresses product production, focusing on how to produce, manufacture, handle inventory, and ship.

The third major process is the operations support lifecycle. This lifecycle focuses on managing the enterprise's core resources, i.e., its people, finances, and other resources required to support the enterprise—the enterprise's physical assets.

also contain software, firmware, and electronic components whose data must be managed. Some organizations have long-lived assets that need to be managed, such as utility distribution networks, e.g., power, telecommunications, water, gas, and cable TV, or facilities like plants, processing and assembly lines, drilling rigs, buildings, airports, harbors, railway systems, and logistics warehouses. Other "products" include bridges, highways, and other civil engineering projects. Organizations across many industries have successfully used PLM solutions to manage product information across the lifecycle of all of these "products."

While information includes all media (electronic and hardcopy), PLM is primarily about managing the digital representation of that information. In the 1990's, this lifecycle view expanded from managing primarily the mechanical elements of a product's definition to include the electronics and software elements that have become a greater portion of many products. That expansion continued to push the perception of what PLM and product information encompassed. PLM includes management of all product-related information from concept and requirements, through design, manufacturing, operations, and service. This information ranges from marketing requirements, product specifications, and test instructions and data, to the as-maintained configuration data from the field. PLM solutions link information from many different authoring tools and other systems to the evolving product configuration.

Today, PLM encompasses significant areas of process and PLM solutions help define, execute, measure, and manage key product-related business processes. It's not just program and project management processes; it's also the processes required to manufacture the product, operate it in the field, and dispose or decommission it at the end of its useful life. PLM-managed processes, and the workflow engines that control them, enable digital feedback to both users and other business systems throughout multiple lifecycle stages.

CIMdata's "World-Class PLM Business Model" (see Figure 1) illustrates the technology, management, and process components of an enterprise PLM environment. Across the bottom of the model are technology foundation components that are an integral part of any PLM solution. Solution providers use these foundation elements to construct core functions, such as design automation (e.g., the authoring and analysis tools and processes used to create, simulate and analyze a product), product structures and Bills of Materials, workflow and process management, and information and content management and vaulting. These core functions are inherent capabilities contained within comprehensive PLM solutions. PLM solution providers use core functions to build functional applications, such as workflow and configuration management. Finally, business solutions are applications that incorporate best practices, methods, and processes pertinent to an enterprise's market and specific industrial sector that can be fine-tuned to meet enterprise requirements.

The definition of PLM and the scope and use of product information continues to evolve. For example, the in-service or service-after-sales operations, maintenance, and service activities are now included within the scope of PLM. In some industries, the service component is the primary driver for PLM return on investment (ROI) and benefits. In the aerospace & defense and machine tool and equipment industries, for example, much of the profit enterprises make is not from the original design and sale, but from maintaining the product in service for its full lifetime. The real profit is in the overall lifetime service.

Strategic sourcing includes both supply chain management (SCM) and design change management. SCM, which is focused on ordering and procurement logistics, begins at the front end of the product lifecycle because, in many industries, the same partners that produce parts or components for a product are being delegated responsibility to participate in the design of those parts and components.

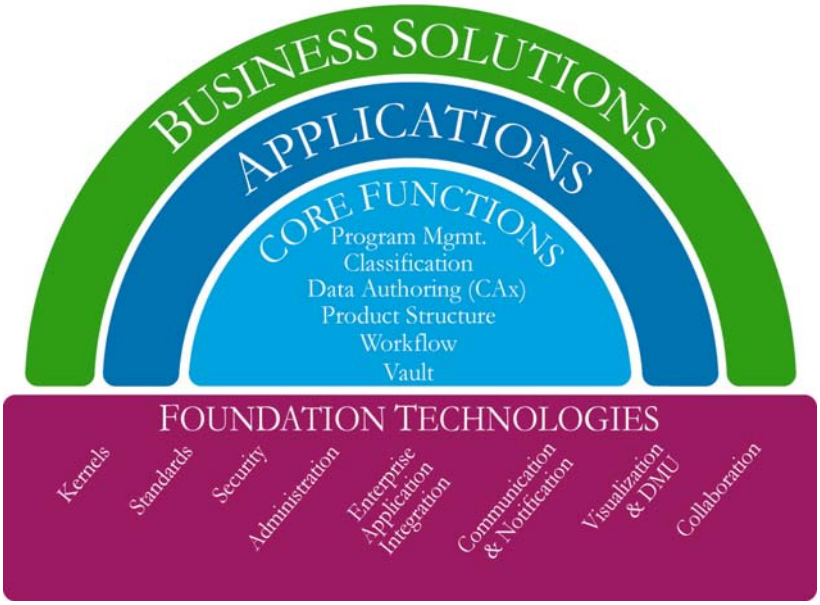


Figure 1—CIMdata's World-Class PLM Business Model

Design change management or management of the intellectual supply chain is becoming as, or more important than the logistics and logistics supply chain. Design chain partners must be able to quickly and effectively share and leverage each other's resources, knowledge, products, and where appropriate, intellectual capital. PLM encompasses and enables management of the intellectual assets created and shared among design chain partners. Integration of design processes fosters innovation for all organizations throughout the chain. A major evolution in PLM over the last few years, is a recognition that defining the manufacturing processes required to produce a product are just as critical as defining the mechanical, electronic, software, and documentation components.

Overall, PLM is an initiative that encompasses all of what is done in design and development, and the associated program management activities. It is expanding upstream into requirements management and sourcing, and downstream into maintenance and support. While PLM encompasses many areas, it is important to understand what PLM is not. PLM does not replace other major enterprises solutions, such as CRM, ERP, SCM, and Supplier Relationship Management (SRM). It also does not include systems supporting other major business functions, such as marketing and sales, distribution, human resource management, and finance. However, each of these major business areas must effectively and efficiently interact with multiple PLM components and the overall PLM solution. For example, CRM, which typically focuses on managing sales and order processes, is also being used to gather customers' product requirements. While portfolio management and product or customer requirements are part of PLM, the traditional CRM technologies are not. However, there is a significant level of information and process interaction between the two solutions.

The same is true for ERP—it is almost always integrated or interfaced with PLM. ERP has traditionally dealt with the product production lifecycle. Over the last five years or so, the focus has shifted from ERP to other enterprise solutions, such as SCM, CRM, and now, PLM. As part of the continuing evolution, new solution providers are beginning to deliver solutions that combine some ERP and some PLM capabilities into one offering. Other business functions, such as the logistics of supply chain management, logistics itself, marketing and sales, distribution, human resource management, and finance are not part of the basic PLM capabilities, but they all interact at multiple points along the product lifecycle or with components of a comprehensive PLM solution. As a result, companies like PDM technology are taking a more holistic approach that is intended to support the execution and tight integration of the business processes that operate within and between the three enterprise lifecycles by building their solutions on top of one common IT platform.

In many ways this approach is promising, because for many companies PLM is being looked at as the overall portal into the extended enterprise's product definition information and processes, providing collaboration and integration functions to synthesize information residing in CRM, SCM/SRM, ERP, and other business systems to enable new, complex business solutions. Unfortunately for many, this complexity has resulted in hesitation, and extensive and costly analysis of what PLM means to them, and where and how they should enable various PLM solutions.

2.1 PLM from Where?

For many companies that are preparing to launch a PLM initiative, the most difficult task is to determine what role their various enterprise systems, especially their ERP system, should play in PLM's enablement. The issue here is not whether to implement a PLM strategy, but how and through which enterprise solution (i.e., a PLM-focused application or an ERP application's view of PLM, or some hybrid solution that takes advantage of both).

PLM and ERP technologies and solutions have emerged from different parts of industry and different parts of the value chain, but are increasingly overlapping, leading to conflict as people in both camps defend their territories, based on their view of the world. This leaves many companies confused about the best direction to follow—should they utilize their ERP system to support PLM requirements or should they implement separate ERP and PLM technologies and integrate these systems to take advantage of the unique qualities of both? The answer is not yes or no, but is dependent on the true value-added or core competitive competence of the implementing business unit or enterprise.

The PLM-ERP issue has gained tremendous visibility since the late 1990's as organizations have begun to understand both the "information infrastructure" role that PLM provides, and the overlap and conflict with areas of functionality that are also supported within ERP systems. In coordinating product production activities (or lifecycle), the use of ERP systems is a necessity in running competitive manufacturing operations. On the engineering side, PLM solutions speed the flow of work and information throughout the product definition lifecycle.

In general, there are multiple approaches that can be used to address the PLM-ERP issue; all of which have been successfully utilized for various implementations around

the world. As alternatives are examined more closely, it becomes clear that there are several characteristics of an organization that provide insights into the "best" choice.

CIMdata's research and experience indicates that the most important characteristics are the value a company places on their ability to define their products, and how they are produced and supported in the market. This ability to manage the product definition lifecycle (i.e., from "cradle to grave") is directly related to their success. Companies that operate in this manner place priority on product definition (i.e., deigning the product as well as the design of the processes related to manufacturing and supporting it over its lifecycle). This aspect of organizational behavior has a major impact in determining the strategy for PLM and ERP. Wrapped up in all of this is the idea of knowledge management or intellectual asset management. One factor that makes this a difficult topic for companies within certain industries is that companies within specific industrial segments, e.g., Fabrication & Assembly (F&A), display both engineering- as well as manufacturing-centric business characteristics.

According to CIMdata's extensive research and industry experience, a manufacturing enterprise's business operating model falls on a continuum between two extremes: engineering-centric and manufacturing-centric. Simply stated, the engineering-centric operating model describes an enterprise that focuses its resources on product design, as opposed to production activities. These companies view their competence or competitive advantage to be product design and manufacturing engineering activities. These companies focus on managing the company's "soft" assets, including intellectual property, design knowledge, process knowledge, and the experience and skills of the company's employees responsible for product and process definition. Engineering-centric companies can be found in many industries, including F&A (see F&A sidebar), aerospace, automotive, and a few others.

The manufacturing-centric operating model describes an enterprise that focuses its resources on the production of their products. It is the trend in the industry to call this type of company "product production" focused because of the immense amount of resources dedicated to the production of their products. Companies that operate within this model focus on producing the company's "hard" assets. These assets are physical items such as material, parts, facilities, and the assembly and shipping of products. Manufacturing-centric companies tend to dominate the various process industry segments (e.g., petrochemical).

So, where should an F&A company, e.g., machine builder, or another company that displays engineering- as well as manufacturing-centric characteristics, seek its PLM support? Well the answer is actually quite straight-forward—they should seek a solution where their PLM and ERP functionality are tightly integrated so that collaboration and interaction between the data and processes managed by each are optimized and streamlined for total product lifecycle support. Traditionally, this has come from a tightly integrated environment that included technologies from two different solution providers using two different technology platforms, or from one solution provider who developed and delivered a single solution that supports all the required functions. Unfortunately, this second option has traditionally been regarded as a poor alternative because of the natural tendencies of both PLM and ERP vendors to develop solutions that have been optimized for either PLM or for ERP, but not both. This is where PDM technology's approach is significantly different. They started by asking if it really had to be PLM from an ERP vendor or PLM from a pure PLM vendor. They asked, "Why can't there be a hybrid solution that tightly integrates the advantages commonly found in an engineering-centric PLM solution with a manufacturing-centric ERP solution's robust enterprise platform capabilities?" Their answer was the development and delivery of a hybrid solution—an engineering-centric PLM solution developed and delivered on top of an ERP platform. By doing so, PDM technology's solution has achieved an extremely high level of integration and collaboration between the product definition and product production processes.

3. Company Background

PDM technology is a Danish IT firm headquartered in Aalborg, Denmark. Since its founding in 1988, PDM technology has developed and helped its customers use advanced IT solutions to improve productivity. Historically, the company has developed automated engineering-based order processing and engineering document management systems. Over the years, PDM technology has expanded its offering to include a number of data management-focused technologies as well as strategic IT planning services.

From its inception, PDM technology has been a forward-thinking company with an international orientation. Much of this is due to the fact that its headquarters are located in Aalborg's NOVI Science Park. This business center is known for its fostering of interaction among a number of highly-technically-oriented companies. Its proximity to Aalborg University, where a number of PDM technology's staff have close relationships, has in many ways provided

Fabrication & Assembly Industrial Segment Defined

In CIMdata's vocabulary, the fabrication and assembly (F&A) industrial segment includes a varied set of companies that design and manufacture a diverse set of products. Major categories include: Machine Tools, Heavy machinery such as mining and construction equipment, Farm Machinery, Packaging Machinery, Paper Industries Machinery, Air Conditioning Refrigeration and Heating Machinery, Printing Trades Machinery, Food Products Machinery, and Textile Machinery. Although diverse in function, this group of products has many things in common regarding product design, manufacturing, maintenance, and management of the supply chain—all areas that require PLM enablement.

Design Process. These are complex products involving many subassemblies, electronic, software, and mechanical components, and close tolerances. These products are purchased by industrial customers and are often designed and engineered-to-order, working from a base design. These are major capital investments for companies with prices ranging from hundreds of thousands of dollars to millions. Suppliers of these products are under constant pressure to innovate as well as hold to high quality and performance standards at competitive costs. For these products, PLM is essential to the design process. In addition to the basic functionality of 2 and 3D design, document control, product structure, and change management offered by PLM enabling solutions, visualization functionality is often critical to show purchasing, design supply chain partners, and customers how the resulting design will look and function. PLM's ability to help people locate and share design information quickly is very important as well.

Manufacturing. The manufacture of these products involves complex bills of materials, and a combination of in-house and contracted manufacturing of parts and assemblies. PLM enables F&A companies to streamline these processes through the ability to share design and product structure information both as drawings, and as 3D geometry and visualizations so that production operations understand what is involved.

Maintenance. Because these are major capital goods and have long lifecycles, manufacturers are required to provide clear documentation of maintenance information and in many cases, actually perform the maintenance for their customers. From time to time, upgrade packages can be made available to customers to improve performance without replacing the entire product. When these upgrades are released, clear design and installation information is essential. The documentation of maintenance and product upgrades is not merely important; in many industries governed by health and safety organizations, it is mandatory. PLM provides the opportunity to document and control information regarding the ongoing maintenance of these machines.

Design Chain Management. As previously mentioned, machine manufacturers have to share product information with their customers and their suppliers as well as internally. PLM enables sharing and collaboration throughout the design and manufacturing processes.

The types of companies represented in this segment cover a wide range of industries and operating models. In general, all of these industries have the need for PLM in the product definition lifecycle and in managing the design supply chain. They all face the pressures of getting new, innovative products to market faster and at a lower price. All need to communicate between engineering and manufacturing as products are being designed. Most also involve outside suppliers for engineering services, materials, and parts manufacturing whether a specially designed package to feature the product on a retail shelf, or a machine for tire manufacture. As a result, they all need some form of PLM solution that is tightly integrated with their ERP.

the company with an atmosphere of innovation and technology leadership.

PDM technology is a self-funded and self-directed company. Over the years, the company has built up a significant amount of manufacturing engineering IT experience and know-how. This has resulted in the development of a number of manufacturing-focused IT systems, starting with the development and release of the View-a-BluePrint system in 1989. The focus of this system was to manage and deliver the appropriate blueprints to manufacturing personnel. Since that time, PDM technology has expanded on the concepts embedded in the View-a-BluePrint. In 1992, a more function rich BlueView solution was introduced to the market. This was then followed up with BluePrint DMS (Document Management System) in 1995 and BluePrint PDM (Product Data Management) in 1997. Each of these systems expanded on the original data management capabilities and included additional process enablement and data types managed. Finally, in 2003, PDM technology released the first version of Dynamics AX BlueStar PDM/PLM.

PDM technology began developing BlueStar in 1999 in partnership with the Danish software firm Damgaard Data A/S, which merged with the Navision Software in 2000 and then was acquired by Microsoft in 2001. PDM technology has continued its focused partnership with the Dynamics AX team from more than seven years. The partnership is now with Microsoft's Business Solutions group, which currently oversees all Microsoft Dynamics solutions, including Dynamics AX.

4. Program Assessment

In many ways, PDM technology is at a crossroads. It has been supporting primarily Danish F&A companies with an evolving engineering-centric data management solution—one that has been developed and is delivered on top of a specific ERP platform. As a result, their solution is only applicable to companies that have, or will implement Dynamics AX as their ERP system. This of course limits PDM technology's market opportunity, but it does allow them to be extremely focused and most likely highly successful when competing for PDM/PLM business in the Dynamics AX market.

Over the years, PDM technology has steadily evolved its overall BlueStar program (e.g., software and services in support of BlueStar). The company's management team has wisely focused the company on delivering a solution that supports a market that clearly needs PLM. They have also strategically acted when they decided to use a third-party development platform that already had a substantial installed base in their targeted industry segment. Over the next few years, their challenge will be to extend their support capabilities outside of Scandinavia, where most of its current customers are located, and leverage their industrial knowledge and capabilities to other engineering-centric industry segments.

Given that the F&A market is PDM technology's target, it should be noted that within that market PDM technology looks for companies that display the following characteristics:

- Using Dynamics AX for ERP support
- Discrete Manufacturing
- High use of parallel business processes (e.g., sales, engineering, purchase, manufacture, assembly, installation, etc.)
- 20-100 CAD users and 50-1000 AX users
- Multiple engineering and production sites across borders
- Short delivery requirement
- Project oriented
- Engineer-to-order
- High volume of engineering
- Driven to 80% reuse and 20% new part introduction
- 5000-10,000 parts per project

Based on these characteristics, the companies they have successfully sold to have primarily been systems and machine builders, subsystem suppliers, and parts and process technology sub-suppliers within the F&A market. Besides exhibiting these characteristics, they also are usually companies that deal with multiple objectives of globalization (i.e., manufacture, purchase, engineer, assemble, maintain anywhere). Again, this should be of no surprise, since these business pressures point to the need for tight collaboration of all major business processes and systems, no matter if they are controlled by ERP or by PLM, which again plays to BlueStar's strengths.

Despite PDM technology's size, its employees have a reasonable amount of implementation experience. In its work with clients, PDM technology has implemented turnkey as well as customized solutions. Over the years, PDM technology's implementation experience has resulted in enhanced functionality in future releases and the definition and enhancement of its three-phase implementation methodology. The first phase of the methodology, which usually takes three to six months to complete, includes the implementation of basic PLM functionality (e.g., CAD integration, items, BOMs, drawings, and documents). The second phase, which also usually takes about a three to six months to complete, includes the implementation of Engineering Change Management functionality. The final phase, which usually takes six to twelve months to complete, includes the implementation of processes and associated functionality that integrate BlueStar tightly with AX driven processes (e.g., production release and purchase order, and other ERP related functionality). PDM technology utilizes a basic four-step approach during each phase—Scope, Build, Implement, and Use.

Currently, there are a number of non-technical support elements (e.g., training material, sales, and reseller network, etc.) that PDM technology has in place, which are limited or nonexistent. To expand and be successful outside of Scandinavia, PDM technology will no doubt need to develop partnerships with major Dynamics AX value-added-sellers (VARs) that either have PLM experience or that are willing to obtain it. In addition, PDM technology will undoubtedly continue to expand its relationship with Microsoft. There is no doubt that being a Microsoft partner will bring significant value to both companies, especially in the area of engineering-centric PLM process enablement in companies that have or plan to implement Dynamics AX.

5. Functional Assessment

Since BlueStar's inception, PDM technology has defined and refined it in the support of specific F&A requirements as outlined in the previous section. In business terms, these requirements can be summarized in three strategies:

- **Collaborative and concurrent**—the ability to compress time-to-operation (i.e., the time from initial inquiry to when the product is installed and running at full production at a customer's site).
- **Cost effective and efficient**—being highly productive and efficient (i.e., minimizing all non-value-added tasks), and cost competitive throughout the entire product lifecycle.
- **Holistic and systematic**—integration of all extended enterprise business processes and systems to operate as one common entity.

Fundamentally, BlueStar is an ERP-based PDM/PLM system for small- to medium-sized engineer-to-order machine builders and industrial equipment manufacturing companies in the F&A market. As a result, BlueStar provides capabilities that support the definition of complex custom-products that are defined by mechanical, electrical, electronic, pneumatic, hydraulic, software, documentation, and other similar systems and related information.

BlueStar is an engineering-centric PLM solution that resides within a specific ERP system's IT platform. At its core, BlueStar's architecture is AX's and is written in AX X++. As a result, BlueStar's scalability and overall performance is reliant on AX, but PDM technology has configured BlueStar so that it can also support distributed organizations with a number of engineering and manufacturing sites, some of which may not even have AX. For the most part, PDM technology has designed BlueStar as a PDM system especially suited for companies that design, manufacture, install, and service custom-products and use AX to manage their business transactions.

BlueStar, with its tight link to AX, also provides a significant amount of functionality that directly supports ISO 9000, the United States Food and Drug Administration (FDA), the Allied Quality Assurance Publication (AQAP), the Hazard Analysis and Critical Control Point (HACCP), the Occupational Safety and Health Administration (OSHA), and other similar regulatory requirements. Finally, BlueStar has proven to be well-suited for project-oriented design manufacture where collaboration across the extended enterprise and its various systems is critical.

The current BlueStar solution follows the heritage of PDM technology's previous solutions—View-a-BluePrint, BlueView, and BluePrint DMS and PDM. Today's BlueStar is PDM technology's fifth generation data management solution.

In summary, BlueStar is not meant to be a broad PLM solution that can be configured to satisfy any company's PLM requirements, but rather a focused PLM solution that enables engineer-to-order companies to streamline their product definition lifecycle and closely associate and collaborate with their product production and operational support lifecycles managed by their ERP system. BlueStar's main features include:

- **Document and data browser** for the viewing of 3D data, drawings, documents, and other product definition information.
- **Product structure browser** for the product structure information like BOM and Item information and links to documents and data. (A product view is shown in Figure 2.).
- **Revision control** of all managed product definition information (e.g., documents and files).
- **Parts classification and retrieval**, including search functions that facilitate searching

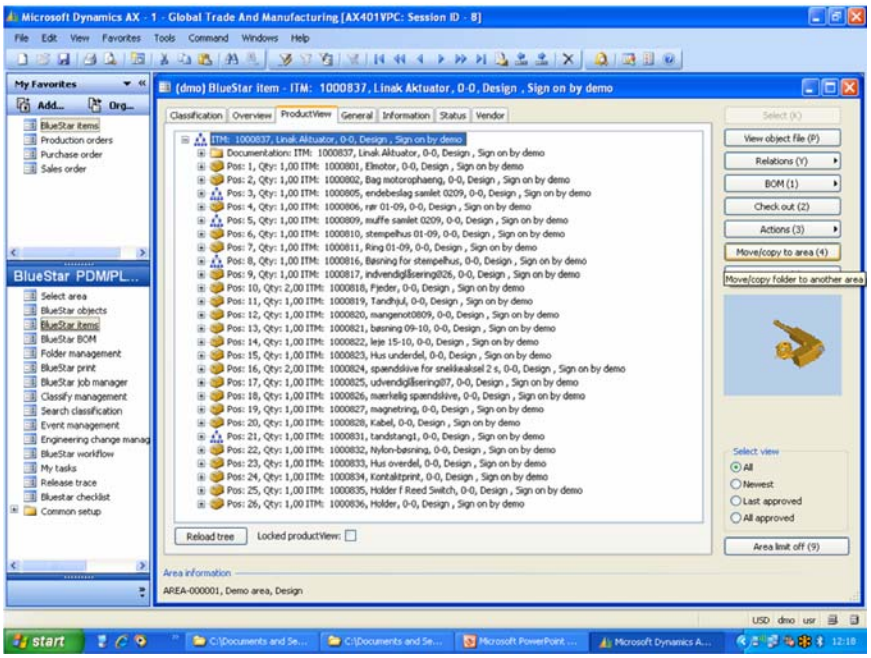


Figure 2—A BlueStar Product View Displayed

existing items and objects using specific engineering properties.

- **Traceability**, enabling capabilities that track all changes and allow previous versions of all documents and files to be recreated.
- **Distributed document and data vaults** that are presented to the user as one unified archive across sites, departments, and organizations.
- **Adaptability**, BlueStar provides a set of configuration options that can be set during implementation.
- **Platform independency** that allows BlueStar to run on any operating environment supported by AX and to be closely integrated with all common data applications (e.g., 2D/3D CAD and office automation applications).

Additional capabilities that are provided are described in the following sections.

5.1 BlueStar Basic Concepts

As with most PDM-focused solutions, BlueStar comes preconfigured with a set of predefined and versioned controlled data object types. In BlueStar's case, these object types include Projects, Folders, Documents, and Items. BlueStar manages security on each object and assigns rights (e.g., the ability create and edit) to individual users. BlueStar offers a significant amount of functionality that has been designed to create and use these objects in a secure and well-managed manner as described below.

- **Projects**—A Project defines a collection of objects. Projects define the basic structure for managing and accessing data within BlueStar. PDM technology reports that most companies define Projects so that data can logically be separated. For example, they will define one Project for every product line.
- **Folders**—A Folder is a collection of several

AR RF/Microwave Instrumentation

AR RF/Microwave Instrumentation (AR), one of PDM technology's first US-based customers, is a division of AR (www.ar-worldwide.com). AR designs and manufactures a broad range of Radio Frequency (RF) solutions. The company's products are used for a variety of critical applications including amplifiers, and RF test and measurement in a multitude of industries around the world. AR prides itself on delivering innovative technology, advanced design, quality build and workmanship, divergence capability, durability and longevity, and a robust support network to its customers on a consistent basis.

The RF/Microwave Instrumentation division manufacturers and distributes RF and microwave amplifiers, antennas, transient generators, and EMC test systems and accessories, including software. Most of the division's products support radiated and conducted immunity testing, including International Electrotechnical Commission (IEC), automotive, aviation and military susceptibility specifications, as well as medical test requirements. The division's amplifiers are used as test instruments covering multiple frequency bands and are suitable for a variety of communications technologies. Most of the RF/Microwave Instrumentation division's products are engineered-to-order and are comprised of a combination of standard and customized components and sub-systems.

Like many companies in the high-tech industry, AR RF/Microwave Instrumentation is under increasing pressure to design, engineering, manufacture, and deliver to the market highly customized products quickly and at a high quality. Over the years, AR has implemented a number of process improvements and supporting information technology (IT) solutions to enhance the company's competitiveness. Over the last several years, AR implemented the Microsoft's AX Enterprise Resource Planning (ERP) system. For the RF/Microwave Instrumentation division, AX supports all major business and manufacturing functions and their information technology needs. As a result, it was natural for the division to seek a PLM solution that integrated and directly supported AX's item master. For AR RF/Microwave Instrumentation, PDM technology's BlueStar product was the answer.

According to Paul Beckmann, AR RF/Microwave Instrumentation's CAD Supervisor, BlueStar has provided the division with the AX-embedded product data management support its 25+ designers and engineers needed. The designers and engineers, who use AutoCAD and Inventor for product design, use BlueStar as their engineering data management environment. All bills of materials, engineering item master information, etc. are defined and managed within BlueStar and pushed into AX's at the appropriate time. Since BlueStar runs directly on top of the AX platform, the designers and engineers always have the latest product information and they, and for that matter, never have to worry about AX's database being out of date. Overall, BlueStar has given AR RF/Microwave Instrumentation a seamlessly integrated product data management environment that enhances the organization's ability to swiftly engineer-to-order complex high-tech RF and microwave instrumentation for its demanding worldwide customer base.

BlueStar objects, which can include other Folders, Objects, Items, and Classification by adding, replacing, or deleting links associated with the Folder. Folders are typically used to logically group data together for access by an individual user or by groups of users.

- **Objects**—An Object represents documents or files managed by BlueStar. Users with the appropriate security rights can create, edit, and manage a company's documents using Object records. Most organizations use Objects to manage both native as well as neutral file formatted documents. BlueStar supports this by allowing multiple files to be associated with a given Object. All Objects are revision controlled, and date and time stamped for traceability.
- **Items**—An Item is a revision-controlled data object. There are three different kinds of Items managed in BlueStar: a Regular or Standard Item, a BOM, and a Service. A Standard Item is a single part and a BOM is a collection of Items. Items are closely linked to AX items, although in BlueStar the data on an item are only engineering-relevant. At the time of system implementation templates are pre-loaded with a significant amount of manufacturing-related data that can be associated with an Item at the point of release. This is a nice feature, which saves time for both engineering and manufacturing personnel.

As mentioned above, BlueStar provides capabilities that can be used to link (i.e., relate) objects to each other. These relationships can be one of four types—Follow Always link, Hard link, Soft link, and Reference link. The Follow Always link results in the linked objects being created, deleted, and having their status and revision changed when either object is operated upon. The Hard link requires that all children of an object be approved before the parent can be approved. The Soft link defines a relationship that has no dependency. The Reference link is used to manage CAD file relationships.

To better understand BlueStar's current capabilities that are used to create, manage, and utilize these objects, the remaining portion of this functional assessment has been divided into the following sections:

- Data & Document Management
- Microsoft Office Integration
- Configuration Management (BOM)
- CAD/ERP Connectivity
- Engineering Change Management
- Classification and Retrieval
- Workflow
- MySteps
- Subscription Management
- Job Management
- User Interface
- Security
- System Architecture
- Future Releases

What follows is a description of CIMdata's functional assessment of BlueStar's main capabilities in each of the categories listed above.

5.2 Data & Document Management

BlueStar provides a solid set of data and document management capabilities. BlueStar users can search and view documents, provided they have the appropriate security rights. They can also use BlueStar to view and manage all revisions associated with each object managed. The ability to check-in and check-out files (i.e., BlueStar Objects) is at BlueStar's core. Files checked out from the BlueStar vault are copied to a local vault. Only files with Sign-On indicated can be edited and checked back into the vault. This Sign-On marks the file so that the owner of the file can only check it into the vault. This ensures that all users can check-out files they have access to, but that only owners can revise them.

As mentioned above, users with the appropriate access rights can view managed documents. Viewing is either supported by the appropriate data creation tool (e.g., MS Word) or by the appropriate neutral file format viewing technology, such as Adobe Reader for PDF, BlueStar's embedded 3D viewer, or other 3D file viewers available on the market today. The build-in 3D viewer uses compressed STL neutral format applicable for most CAD systems. Unfortunately, the embedded viewer (i.e., BlueView) does not support native 3D CAD file viewing and measurement functionality. This viewer has been developed by PDM technology and offers basic view and DMU capabilities. This is somewhat limited as compared to a number of third party available viewers available on the market today. The BlueView (see Figure 3) is intended as a cross-CAD platform 3D viewer with tight integration into the product structure, where the information in the BlueView is obtained at runtime from BlueStar Item BOM and Document structure.

BlueStar supports both major and minor revisioning of all managed objects. For the most part, a user creates a revision if and when needed. Users, at time of approval, decide if the new object should have a new minor or major revision. This supports a company's need to adhere to backwards compatibility standards for their products. The backward

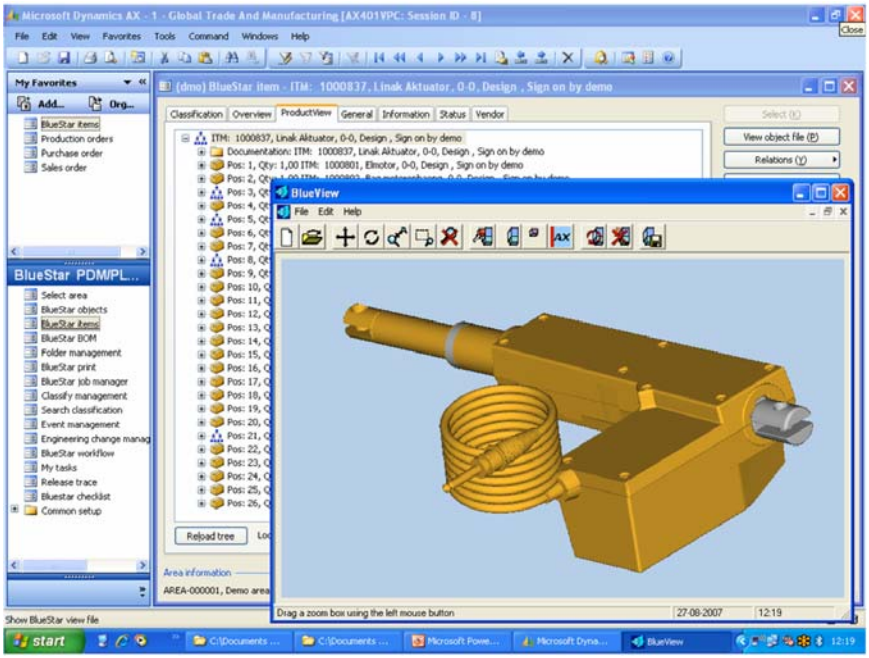


Figure 3—BlueView used in Conjunction with BlueStar

compatibility mode lets BlueStar handle the revision of the part so that the BOM, which the item is a part of, and the part are kept at the same revision, but managed by using the date-code of the exact "revision." This allows a user from the approval date at the top of a BOM to track which revisions was persistent in the structure at any time. This is also implemented in the checkout procedure so that a structure can be checkout on a specific date. In BlueStar terms, a major revision is a revision that changes a product and where full change management is required. Minor revisions, in BlueStar's terms, are revisions where the changes made are cosmetic in nature and that result in no impact on the product or production process followed. An example of a minor would be a spelling correction on a drawing.

It should be noted that the structuring of data and documents is possible through the use of Projects and Folders. BlueStar's capabilities in this core PLM functional area are reasonable and they do not appear to be limited in any manner, considering that they have been built on top of an ERP platform.

5.3 Microsoft Office Integration

BlueStar offers a capable integration with Microsoft Word and Excel. This integration makes a number of BlueStar's data and document management functionality available to MS-office users. BlueStar provides an easy to use wizard that guides the user through the steps required to create a document.

At time of creation, users have the option of creating a new document based on an object template that already exists in BlueStar or using the current object as the template. After finishing the steps in the wizard, the user has the choice to open the associated editor (i.e., MS Word or Excel) with the newly created document. Once the user is ready to save the document for the first time, BlueStar allows the user to check the document into the vault. During the check-in process, the user can have BlueStar generate a PDF of the document and/or update the BlueStar with the document. Once these have been stored, the user will view the PDF of the document if they request to view the document. If they request to edit the document, and they have the appropriate security rights, then the native file will be checked out.

5.4 Configuration Management (BOM)

BlueStar's configuration management capabilities are focused on creating and managing items and their structures from an engineering viewpoint. In the simplest form, the BlueStar BOM capabilities act as AX's Engineering BOM. Overall, BlueStar provides a reasonable set of functionality design to support the creation and maintenance of BOMs, the viewing of BOMs, comparing of BOMs, and releasing of BOMs to manufacturing.

BlueStar uses a table format to define a BOM. Each BOM line has a Position, Item Number, Revision, Unit (e.g., pieces and weight), Release Quantity, Item Name, and Item Status. BlueStar also allows BOMs to be viewed via a tree structure, but manipulation of the structure is not permitted in this view. BlueStar includes some advanced BOM related functions such as the ability to define long lead-time items to let purchasing and manufacturing begin activities long before the approval of the final BOM structures. This usually results in a reduction of the total lead-time of the product being developed and delivered to the market. This capability is referred to as "Open BOM" management.

BOM creation is fairly simple. All a user has to do is create a new Item of type BOM and then add one or more new BOM lines by entering or selecting Items already defined and managed by BlueStar. PDM technology reports that

most companies actually implement BlueStar with a CAD integration and that these integrations automatically control the creation of the BOM.

The BOM compare function provided, which is commonly found in many of today's PDM systems, is straightforward to use and allows for only the differences to be displayed. Unfortunately, only one BOM can be compared against a baseline BOM at a time. Besides this comparison report, BlueStar has three other standard BOM reports for outputting the BOM is various layouts. These reports can be printed or copied into MS Excel.

BlueStar also provides a Copy BOM function. This function can be used to copy the BOM and selected Items associated with the BOM to a new BOM structure—a function that is often used by engineer-to-order companies.

Finally, it should be mentioned that BlueStar's BOM releasing procedures, which are configured during implementation, and their supporting functionality allow for a BOM structure and its Items to be copied (i.e., released) to the AX inventory tables with the quantities set to zero. This allows an organization to release long lead-time items in such a manner that net requirements can be defined and released for other items later as they become known. This type of out-of-the-box capability is not typically available in other engineering-centric PLM solutions. No doubt this has been included because of PDM technology's understanding of ERP requirements as well as BlueStar's close proximity to AX.

As mentioned previously, BlueStar supports "Open BOM" management practices. This practice supports successively releasing items to manufacturing. BlueStar accomplishes this by having two consumption fields in the BOM structure—Release Quantity and Final Quantity. The released quantity is the actual release quantity and final quantity is the engineered quantity. When releasing long lead-time items, a BlueStar procedure runs through the BOM structure and where an item or BOM is marked as a "Long Lead-time" item the release quantity is updated with the final quantity. When approving other parts in the structure the release quantity is updated according to the final quantity. As a result, when releasing the structure to AX the BOM will have a structure where not approved or non-long lead-time items are represented with a zero quantity and only approved items and long lead-time items have a material consumption defined.

Overall, BlueStar's configuration management capabilities should satisfy most companies who are looking to implement an engineering PDM system. Unfortunately, some will be disappointed in the lack of capabilities that fully define and manage product options and variances, and multiple product structure views. Currently, BlueStar only offers limited capabilities in these areas. However, it should be mentioned that PDM technology plans on adding these types of capabilities in up coming releases.

5.5 CAD/ERP Connectivity

The BlueStar CAD/ERP interface works with a range of CAD systems, including Inventor, AutoCAD, SolidWorks, Solid Edge, CATIA V5, and ME 10. PDM technology reports that a basic integration to Pro/ENGINEER is currently being developed. Additionally, PDM technology reports that two of the most common CAD system interfaces implemented have been Inventor and SolidWorks. The integration to SolidWorks is illustrated in Figure 4. Like most PDM systems on the market today, BlueStar's CAD interface provides the CAD user with a pull-down menu from within the CAD system. For the integration with Autodesk's Inventor system, this menu

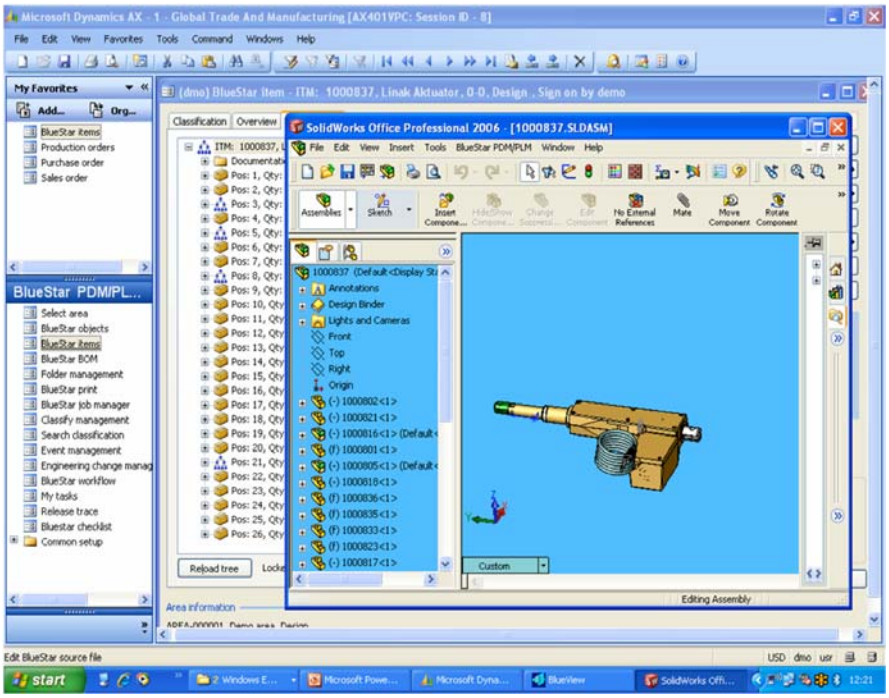


Figure 4—BlueStar's Integration to SolidWorks

provides the CAD user access to a number of key BlueStar functions, including a set of capabilities that take advantage of BlueStar's tight integration with AX. Examples include:

- The ability from within Inventor (through the use of a BlueStar wizard) to create and insert new parts and assemblies that are automatically known by AX
- The ability to create non-modeled BOM items
- The ability to identify specific Items as being part of a skeleton and not on the physical BOM
- The ability to identify an assembly as a phantom (i.e., an assembly that should not be handled as an Item/BOM)

Other more traditional capabilities are also provided (e.g., check-in and check-out models, create drawings, load and export title block information, and create new revision, to name a few.

BlueStar's CAD integrations mainly focus on providing basic check-in and check-out functionality. For example, when checking in an AutoCAD drawing, the AutoCAD user can utilize the BlueStar pull-down menu to check-in the model as well as the paper layouts that are usually printed to a multi-paged PDF file. This check-in process automatically saves the source file in the BlueStar vault and updates the title block with the appropriate data from BlueStar. Other functions supported by this basic integration include the ability to reload the title block with data from BlueStar.

5.6 Engineering Change Management

As with other commercially available PDM systems on the market today, BlueStar comes pre-configured module that supports Engineering Change Management (ECM). This ECM module acts as a container for all information regarding a Engineering Change Order (ECO) and is used as the basis upon which changes are implemented against specific BlueStar-managed data objects. BlueStar's ECO object is displayed to the user as an ECO form. This form helps the user gather information that is useful for the execution of a specific change order. ECO information is divided into the following seven categories (i.e., form tabs):

- **Overview**—this tab contains the ECO's base attributes (i.e., basically the ECO header information).
- **General**—this describes the ECO and is used to set basic ECO attributes and security rights.
- **Status**—the attributes on this tab describe the status of the ECO and the proposed corrective action.
- **Documentation**—this tab lists the documentation that is attached to the specific ECO being viewed.
- **Items**—this tab has two parts. One part is used to identify the Item(s) associated with the ECO and other is used to identify the Item(s) the affected Item(s) are changed to.
- **Items affected**—this tab is used to analyze which top Item(s) are affected.
- **Object affected**— this tab has two parts. One part is used to identify the Object(s) associated with the ECO and other is used to identify the Object(s) the affected Object(s) are changed to.
- **Workflow**—this tab provides a graphical overview of the workflow managing the specific ECO being viewed. Most companies wishing to use the ECO object implement the BlueStar Workflow module to control the flow of their change orders.

Users of the ECO object can, given the appropriate security rights, create, modify, and delete them. They can also change their status to be "Compliant," "Request," "Proposal," "Change Order," "Change Notice," "Implemented," "Closed," or "Cancelled." Finally, the ECM functionality provided allows BlueStar to directly communicate changes to AX managed purchases, sales, and production orders, and production operations. This is one of the benefits of having BlueStar embedded in the AX platform. BlueStar's capabilities in this critical functional area are in line with similar commercial PDM systems available on the market today, with the exception of its capability to directly communicate changes to AX. This capability is beyond what most other commercial PDM systems offer today.

5.7 Classification & Retrieval

BlueStar supports the definition and use of classification structures. Capabilities provided allow for any BlueStar object to be classified and searched upon. A BlueStar user can use the classification structure to find BlueStar managed items. Using the Classification and Retrieval capabilities provided, users create new items and documents by inheritance and thereby implementing not only reuse of items and documents but also those relationships already built using the BlueStar link system (as described previously). These capabilities appear to adequately support parts reuse and other knowledge sharing initiatives.

5.8 Workflow

BlueStar offers a fairly robust workflow module. A new workflow can be created either by creating one from scratch, by loading a template, or by copying an existing one. A wizard is provided to guide the user through workflow creation. Fundamentally, a workflow is comprised of one or more steps. Each step is a description of a single subtask in a workflow or in a different workflow. The creation of these steps and the links between them are accomplished using a graphical workflow editor.

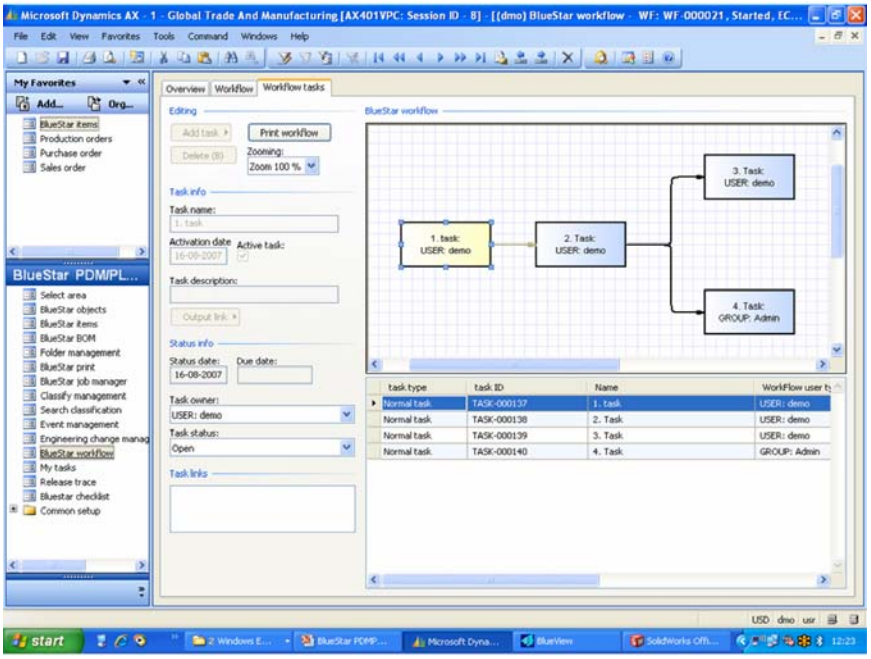


Figure 5—BlueStar's Workflow Editor

The graphical workflow editor (see Figure 5) provided displays all steps and links related to the active workflow. These flows can be a combination of parallel and serial steps. Each step is represented by an appropriate symbol in flow. A step can be "Open," "Accepted," "Completed," "Rejected," or "Returned." The status of the step is represented by a specific color. Links between steps can have different colors. Each color represents the type of link being represented—"Next Step," "Reject Step," "Completed," "Pending Step," and "Choice Step." A "Choice Step" link allows the user to create links to new steps that are optional. The colors of the various steps can be customized in BlueStar's Symbol Setup Configurator application. This is a very nice feature that is not offered by many other PDM systems today.

Defined workflows can be set up or changed only when their status is "Setup" or "Stopped." If one of these two conditions is met, the name of the workflow can be changed, steps can be added, the description changed, responsibilities changed, and it can be set to "Active" and linked to other steps in a workflow and then restarted. Each workflow has a set of defined attributes that describe the flow, for example, ID, Name, Priority, Due Date, and Status. An interface is provided where a user can query the workflow module to display workflows in various states (e.g., "Started") or of specific types (e.g., template).

In addition to the ability to define and execute formal workflows as described above, BlueStar also allows user to define simple ad-hoc workflows. These ad-hoc workflows are managed by BlueStar with full history tracking.

5.9 MySteps

Like many other PDM systems available on the market today, BlueStar offers users an interface where they can view the tasks they have been assigned. This functionality, called MySteps, provides an easy-to-use interface that displays all active steps in which the user is currently participating. Basically, MySteps is a tool for system users to access an overview of their tasks currently open or accepted by them. Users of MySteps have access to a graphical Workflow tab that displays data (e.g., the step's status) for step that is active in the overview list. In addition, the workflow, of which the current active step is a part, is shown in the graphical workflow part of the user interface. The step chosen in the overview is marked on the graphical workflow interface to show the user the current step.

5.10 Subscription Management

BlueStar users can subscribe to BlueStar data, defining an unlimited number of subscriptions. Each subscription defines a notification rule against any type of BlueStar object. The BlueStar Subscriptions Manager allows a user to select one or more BlueStar-managed objects and set the criteria that will be used by the system to determine when the user should be notified. A trigger can be set to notify the user any time the object's status changes or when the object

reaches a specific status (e.g., "Released"). This is a very nice feature.

5.11 Job Management

BlueStar's job management system allows users to set up a series of tasks (i.e., a collection of sequential tasks or workflow definition) requiring processing so that the system can execute them automatically. A task is a single BlueStar operation (e.g., "copy a BlueStar Item"). The job management system can be used to execute the following types of jobs:

- **Approval Job**—allows for a complete structure, including sub-parts, to be approved.
- **Copy Item Structure Job**—can be used to copy and replace objects in an item structure.
- **Revision Job**—this type of job ensures that a structure's child that receives a new revision is linked to its parent Item and the parent item is revised if needed.
- **Sign on/off Item Structure Job**—this type of job allows a user to Sign On/Off on one or more objects in an item structure.
- **Print Job**— this type of job prints all drawings for an item and will include all sub-drawings as well if specified.

BlueStar provides an easy-to-use form to define jobs for execution. This job-generating tool allows for a parent or child impact tree to be viewed, depending on the kind of Job being defined. Using the impact tree the user can define a Job by using a few mouse clicks. The affected BlueStar objects can be checked out in the impact tree. When the Jobs have been generated, they can be managed in the Job Manager. In addition, the Job Manager allows the user to start or stop a Job, as well as display error messages. Jobs, like other BlueStar objects, have a set of predefined valid statuses. In the case of Jobs, the valid statuses include: "Waiting," "Started," "Stopped," "Done," "Error," "Skipped," and "Waiting on CAD system."

CIMdata is impressed with this capability. This functionality, which is not usually found in today's commercially-available PDM systems, is extremely useful and demonstrates PDM technology's understanding of the needs of a PDM system that is embedded within an ERP environment.

5.12 User Interface

BlueStar's client adheres to the AX's user interface (UI) look and feel, and leverages many AX built-in functions (e.g., search capabilities, reporting, etc.). PDM technology has spent a significant amount of time defining user interaction with the system and it shows. PDM technology is constantly looking to streamline user interaction by enabling one-button click operations (e.g., one button to release) and wizards to perform specific sequences of tasks. BlueStar makes good use of wizards that help guide users through the execution of a number of common tasks including:

- **Change Status**—guides the user through changing status on Folders, Objects, and Items.
- **Approve**—guides the user through changing status to "Approve" on Folders, Objects, and Items.
- **Error**—guides the user through changing status to "Error" on Folders, Objects, and Items.
- **Create**—guides the user through creating Folders, Objects, and Items.
- **Copy**—guides the user through copying Objects and Items.
- **Replace Item**—guides the user through replacing an Item in selected BOMs.
- **Release Item**—guides the user through releasing Items to AX.

The basic premise behind these wizards is to make sure that the user fills in all required fields.

In addition to the thick client offered, PDM technology also provides a read-only web-based client. PDM technology reports that they are currently porting this client to .NET.

BlueStar's user interface currently supports three languages—Danish, English, and German. The UI uses labels to describe all fields. These ~2,000 labels have been translated into the three supported languages. Currently the online help and system documentation are only provided in English. This clearly limits BlueStar's appeal to companies based in non-English speaking countries.

5.13 Security

BlueStar leverages AX's security model and adds specific security rules at the BlueStar object level. The security level gives the user permission to view BlueStar controlled objects with a security level at or below the level they have been assigned. The supported security levels are: Public, Sales, Manager, Develop, Confidential, and Admin.

Given these levels, a user with the Public object security level can only see BlueStar managed objects with security Public, while a user with the Admin object security level can see all the objects (i.e., all objects with security level of Admin or lower). On top of this security, BlueStar manages

a set of Rights. These Rights define how the user can interact with BlueStar managed objects. A user can for example only be given access to viewing objects, while other users can edit or even delete objects. This approach to security is reasonable and consistent with the capabilities found in similar commercially available PDM systems on the market today.

5.14 System Architecture

At its core, BlueStar, which is written in AX X++, is a data management system that has been designed to support the creation of data objects and relationships. All BlueStar objects (e.g., Items and Folders) are COM/XML defined. BlueStar shares its .NET compliant database (i.e., MS SQL Server) and data model with AX. PDM technology is currently in the process of migrating the BlueStar code-base to a full .NET 3 Service Oriented Architecture (SOA). PDM technology reports that this migration should be completed by mid 2008.

BlueStar can be implemented in a manner that supports a multi-level data vault structure (see Figure 6). This structure can in theory support an unlimited number of local and distributed vaults. In the usual configuration, three or four levels of vaults are configured. The first level is closest to the user and can be considered to be a local cache, known as MyLoadPoint. The next level is considered in BlueStar's terms as a Local vault. Beyond that, BlueStar supports a Central vault and distributed Cluster vaults.

As mentioned above, BlueStar's architecture is AX's. As a result, BlueStar's scalability and overall performance is reliant on AX, but PDM technology has configured BlueStar so that it can also support distributed organizations with a number of engineering and manufacturing sites, some of which may not even have AX. In the simplest configuration, BlueStar CAD users can access BlueStar over a WAN by utilizing a Citrix client and server setup. In this configuration, the user's CAD system would be connected to a Local vault via BlueStar's CAD/ERP connector. PDM technology reports that this type of system configuration works well for many of its customers since this UI client supports almost all of BlueStar's functionality except for some minor CAD integration capabilities. For other customers, BlueStar is configured with a Cluster service. This service sends and receives Objects, Items, BOMs, ECOs, Workflow tasks, and other BlueStar-managed information to and from other Cluster services or external applications (e.g., another ERP system via an XML adapter). In these Clusters, only information specified is moved between specific instances of BlueStar.

BlueStar also supports the configuration of Cluster Replication servers. In this distributed information management model, one BlueStar instance is remotely connected to one or more replicated vaults. BlueStar's Cluster replicated vault configuration copies files required on the actual physical site so that the user has LAN access time for all files. The Central vault stores all files that are managed by the Local vaults. The Local vault store only data released to the actual Local vault. It should be noted that these vaults are logical and physically separate from AX's vaults. As a result, BlueStar's releasing processes copy data from a BlueStar vault to the appropriate location(s) in AX's vaulting structure.

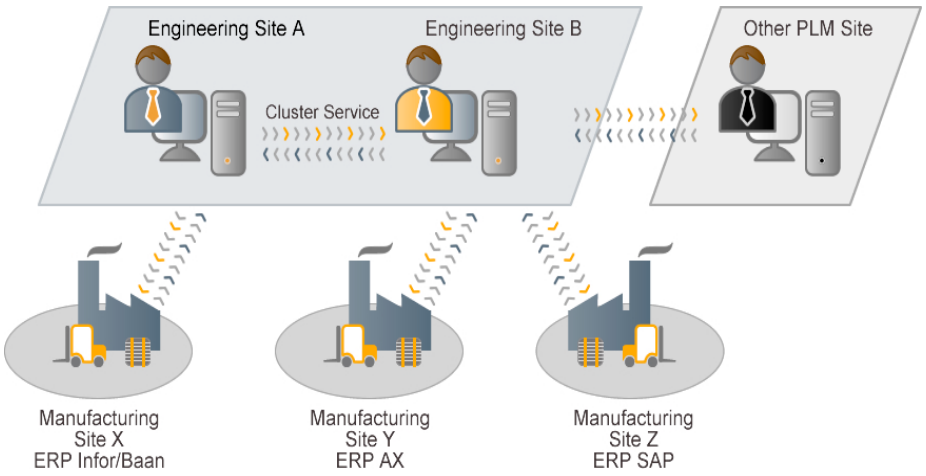


Figure 6—A Typical BlueStar Configuration

In the area of BlueStar configuration and customization, PDM technology delivers BlueStar's full source code within AX's integrated development environment (IDE). This allows companies to modify and/or extend BlueStar's capabilities if they wish. In addition, companies can use the AX tool kit to develop BlueStar reports.

Overall, BlueStar's architecture is what one would expect to find in today's modern engineering-centric PLM solutions. CIMdata is happy to see that AX's IDE is reasonably flexible and capable to support configuration and customer application development to a significant

GEA Niro A/S

GEA Niro A/S (Niro) is an international company specializing in the development, design, and engineering of liquid and powder processing equipment for the manufacture of products in powder, granular, or agglomerate form. Today, the Danish GEA Niro A/S is the headquarters for the Process Engineering Division of the GEA Group AG, based in Bochum, Germany. This 1 billion Euro division provides a complete range of services and process systems to the beverage, brewery, chemical, dairy, food and pharmaceutical industries, and is a world leader in liquid and solids processing technologies. The division maintains primary offices in Denmark, USA, China, and Germany. In addition, the division includes Niro Pharma Systems (NPS), a group of companies specializing in the design and supply of equipment for the pharmaceutical industry. The GEA Process Engineering Division is represented in more than 50 countries and has approximately 4200 employees, 450 of which work for GEA Niro A/S in Soeborg, Denmark.

According to Niro, many of the world's leading manufacturers have chosen Niro technology for their production of dairy and food products, chemicals and pharmaceuticals. Some of these products are manufactured in a single plant, others in a fully engineered process line designed and installed by Niro in collaboration with leading suppliers of auxiliary equipment. Niro prides itself on its substantial product and process know-how, commitment to customers, qualified staff, and a flexible global organization. The company has achieved a high market share in many industries, the most significant being for spray dryers supplied for instant coffee, food and dairy products, and pharmaceuticals.

For the most part, Niro designs, engineers, and delivers highly complex engineered-to-order systems where process integration is critical. This usually includes the integration of existing or customer-specified equipment into the overall system as well as the delivery of turnkey installations. This product and associated project complexity, and the need to consistently and quickly deliver to each customer's unique requirements, drove Niro to investigate and implement a product data management environment that would integrate directly with AX's project module and AutoCAD, Niro's current CAD system. Niro desired to implement a solution that would allow them to manage both the large-scale engineered-to-order projects, many of which are 18 to 24 months in length, as well as all the product data associated with them in one holistic environment. In addition, such solution would allow Niro's project managers to always know the state of the project's deliverables. To accomplish this, Niro focused on a partnership with PDM technology and the implementation of their BlueStar solution.

According to Christian Bentzen, GEA Process Engineering Division's Chief Information Officer (CIO), BlueStar provides the division's users with an environment that closely links product and project documentation with AX's item master. AX in turn, drives the projects and the business to make sure that each customer's requirements are met. Having BlueStar built on top of AX's platform, according to Mr. Bentzen, reduces the amount of training required and integration expenses associated with any solution that would have utilized a different platform. In addition, Mr. Bentzen notes that BlueStar will support their planned move to Autodesk's 3D Mechanical CAD solution, Inventor. At the present time, Niro has verified BlueStar's capabilities with an initial implementation of 25 users. By the end of 2008, Mr. Bentzen expects Niro to have more than 2000 BlueStar users. Niro also plans on leveraging BlueStar and its integration with AX throughout their products' extended lifecycle. By doing so, Niro hopes to continue to differentiate itself in area of support and supply of spare parts. Overall, Niro is extremely happy with capabilities provided by BlueStar and the strong partnership they have built with PDM technology over the last two years.

extent (i.e., to the extent to which BlueStar has been developed).

5.15 Future Releases

With today's current release of BlueStar, PDM technology has provided a very capable PDM system on top of the AX architecture. Functionality is reasonable and in line with other PDM systems available on the market today. According to PDM technology's plans, work is progressing on future releases of BlueStar. In the future, PDM technology plans on releasing additional distributed vaulting capabilities, an integration with AX's Project module, assembly modeler support for BlueView, manufacturing BOM creation and management, creation and management of engineering rules and associated data, and the ability to define and manage routings and operations for multiple sites. Additionally, PDM technology is planning on enhancing functionality in a number of areas, including workflow where they are planning on enabling checklists and role based matrices, the ability to roll up cost and weight data from AX within BlueStar's BOM structure,

and configuration management where they intend to implement a parametric, logic-based configurator that can drive CAD modeling based upon the BlueStar BOM and product model definitions.

One of the most interesting items on BlueStar's roadmap is the planned integration to a feature-based Computer-Aided Process Planning (CAPP) tool that they have developed and are currently enhancing. When this integration is completed, BlueStar will support the complete manufacturing process definition of the engineering product and projects that manages its creation. PDM technology reports that the CAPP tool will support synthetic time estimations as well as semi-automatic NC-programming based on features. CIMdata looks forward to reviewing this capability in future.

6. User Assessment

PDM technology's engineering-centric process knowledge is clearly visible when one considers the long list of reference customers (e.g., GEA Niro A/S, AR RF/Microwave Instrumentation, Odense Shipyard, and DISA Industries) primarily in Denmark, and also located in Germany, The Netherlands, the United States, and a few other countries. Many of PDM technology's customers are similar when it comes to their PLM business requirements. In addition to having AX, nearly all of PDM technology's customers are engineering-centric companies in the F&A industrial segment. Their fundamental requirements for a comprehensive PLM approach included a robust set of integrated solutions to support the entire product lifecycle and its requirements for product and process definition creation, management, dissemination, and use. They also understood that the solution implemented had to support collaboration between work teams across departments and enterprises so that all extended enterprise participants were able to collaborate on an as-needed basis, supported by both formal and ad-hoc workflow-enabled business processes. In addition, they all needed a solution that would be flexible and scaleable to support managing requirements and the enterprise's resources so that their right-to-market objectives would be achieved.

Over the years, the following seven main PLM business requirements have consistently emerged during CIMdata's work with these types of engineering-centric companies. In general, these requirements describe what an engineering-centric PLM enabling solution like BlueStar should support, namely:

- An integrated process and product definition information environment
- Well-defined configuration management processes and practices across the entire organization and throughout the entire product lifecycle
- An integrated project and process management environment that is deliverable driven
- Supplier integration for complete lifecycle product support
- Product development as well as lifecycle product maintenance in a consistent manner
- A cost effective and flexible environment that supports the changing business needs through easy to use rapid application development tools
- A distributed data and process environment

It is no surprise that PDM technology's customers align with these requirements almost completely in every case; AR RF/Microwave Instrumentation and GEA Niro A/S are two excellent examples (see sidebars).

7. Conclusion

CIMdata is impressed with the fairly unique approach that PDM technology has taken in the development of BlueStar. PDM technology has clearly delivered a hybrid PLM solution that tightly integrates the advantages commonly found in an engineering-centric PLM solution with a manufacturing-centric ERP solution's robust enterprise platform capabilities. With BlueStar, PDM technology has achieved an extremely high level of integration and collaboration between the product definition and product production processes. For companies who have implemented or are thinking about implementing Microsoft Dynamics AX, BlueStar should be considered for its PLM capabilities.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM) solutions. CIMdata offers world-class knowledge, expertise, and best-practice methods on PLM solutions. These solutions incorporate both business processes and a wide-ranging set of PLM enabling technologies.

CIMdata works with both industrial organizations and suppliers of technologies and services seeking competitive advantage in the global economy by providing world-class knowledge, expertise, and best-practice methods on PLM solutions.

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

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