

Enabling innovation through enterprise data management

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white paper



- ▶ Synchronize product data and processes across organizational boundaries to accelerate innovation and reduce costs.

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Enterprise data management spans organizational boundaries and disciplines

To maximize their investments in innovation, companies need to better synchronize information, knowledge and processes among all disciplines as well as across organizational and geographic boundaries. Given the diversity of information requirements and data management tools currently in use, it is challenging to transition from one stage of the product lifecycle to the next without losing sight of design intent or maintaining data integrity. To compound the problem, application data models grow more complex with each advance in business systems supporting engineering, manufacturing and service activities.

Only by managing product-related data at the enterprise level can companies address these issues, establish consistency across disciplines and maintain data integrity throughout the product lifecycle. Enterprise data management enables companies to reconcile disparate views within and outside the enterprise. By establishing a common data model and merging information from a variety of sources in a unified, secure data management environment, companies are better able to manage their process of innovation, collaborate across disciplines and leverage proven processes and data for continuous improvement.

In a survey of several large Fortune 500 companies, Forrester Research found that most enterprises claimed cost savings of 25 percent or more through a centralized data management solution. At one large company, a major standardization initiative achieved ROI of more than 150 percent in a five-year period. Another global giant reported \$20 billion in cost savings over a three-year period. [DBMS platform standardization can lower costs and improve efficiency, Forrester Report, May 27, 2005]

The ultimate goal is to promote rapid, effective collaboration across multiple departments and disciplines, as well as multiple organizations, including customers, strategic partners and suppliers. In order to do this, companies must create an infrastructure that can scale to support data management across an extended enterprise.

Product lifecycle management, or PLM, solutions can provide an ideal backbone for achieving enterprise-wide data management goals. When applied strategically, PLM technologies can create a digital environment that enables users to securely exchange data in a context that is meaningful to each discipline at every stage of the product lifecycle.

This paper discusses the fundamental areas that need to be addressed if manufacturers want to manage product and process information across disciplines in order to accelerate innovation:

Data management

Capture, organize, control and distribute product and process data across organizational boundaries to support collaboration among strategic partners, suppliers and customers.

Process management

Control and share processes in ways that institutionalize best practices and procedures. Capture metrics for decision support and process improvement.

Context management

Enable users to navigate and search for data in a meaningful and relevant context that supports the function they are performing. Quickly repurpose information for a variety of applications and audiences.

Today's companies must gain control over an explosion of data that has resulted from growing product complexity, the drive to increase product quality, mass customization for global markets and the variety of systems and applications housing duplicate data.

Companies across all industries manage multiple instances of product-related data, but most lack effective ways to consolidate this information or verify its accuracy. When data is pulled from disparate databases and knowledge stores, the inevitable result is multiple, conflicting product views, inefficient design and production processes and system-wide errors. The costs of continuing to conduct business in this way are fast becoming prohibitive.

"The profoundly challenging task for reconciling multiple views becomes more troubling every day, as the experts drive ever deeper into their individual silos in applying technical advances within their own disciplines," says Michel Vrinat, CPDA [Enterprise PDM: Reconciling multiple views, August 2006 CPDA]. "There is a completely different language from one discipline to another; they use different semantics, assemble product components under different breakdown structures and accumulate massive amounts of data that is impossible to reconcile in detail."

Without a central repository to manage information, there is little time for effective innovation. Indeed, engineers report that they currently spend 50 percent or more of their time looking for the information they need to do their jobs. Making business-critical data readily available can facilitate the creation and timely delivery of innovative new products.

In the past, data management solutions primarily dealt with the mechanical aspects of products. Now companies have to deal with highly complex products that have embedded electronics and software that could add up to hundreds of thousands of parts and dozens of systems within systems, as in the case of products like commercial aircraft. This complexity creates a significant data management issue.

Enterprise data management solutions that incorporate advanced PLM capabilities and support extended markup language (XML) and open standards initiatives such as JT Open allow the optimum exchange and repurposing of data outside traditional applications. These solutions also can incorporate a company's existing templates, formats or standards, improve data integrity and enforce best practices. By automating data updates and exchanges among multiple systems used across the product lifecycle, enterprise data management solutions provide users with timely access to the most current data and ensure a common understanding of the product across disciplines.

In order to manage product-related data effectively enterprise wide, companies need to focus on the following areas.

Time-to-market reduced by 50 percent with enterprise data management

Consumer products giant, Bosch und Siemens Hausgeräte GmbH (BSH), is a global enterprise manufacturing and selling large and small household appliances, as well as an assortment of internet-compatible household appliances. BSH's culture of innovation is demonstrated by the more than 300 patents and trademarks the company applies for annually. Bosch's breakthrough products are enabled by an enterprise data management platform that supports collaborative design teams spanning many geographically dispersed departments. Using this digital environment, designers can jointly develop innovative and customized new products targeting the needs of local markets. As a result, time-to-market has been reduced by 50 percent.

Unified system of record

It is not unusual for companies to have multiple systems of record with no effective way to reconcile discrepancies. Manufacturers need to systematically identify and collect in a central repository all business-critical data, then make this information universally accessible (in highly secure ways) on a 24x7 basis. It is not necessary to capture all information – only the data that is relevant to the creation and timely delivery of products.

A central knowledge repository provides the best means for keeping data synchronized across all organizational boundaries. It also permits users to locate relevant information in seconds regardless of where it is created or stored. It ensures that users collaborate and communicate around a common data set that reflects the most current information. Ultimately, all personnel within the enterprise and across the value chain are empowered to complete tasks more quickly and effectively.

By interfacing with key systems used by all disciplines involved at all stages of the product lifecycle, an enterprise data management solution provides a practical, cost-effective way to identify, consolidate, centrally manage and secure the product and process data that currently is generated by and stored in a wide variety of systems in multiple formats, including e-mail, spreadsheets, scanned paper documents, enterprise-level business systems and 3D simulations. A central repository facilitates the process of keeping important data current at all times, so that all contributors can base their decisions on the latest updated information. Product and process data are carried forward along the lifecycle, so that maintenance and support have access to relevant historical data. At the same time, design has access to the full history of the product which it can apply to future product designs.

To capture such disparate information requires establishing data standards – including representational and format standards – so that data can be more readily shared and relationships can be more accurate and thorough. It also requires integration to the data source to ensure data accuracy and permit data sharing directly or through data exchanges to other enterprise systems such as ERP.

Enterprise data management systems running on a digital PLM backbone enable companies to establish a unified system of record and to provide decision makers across the value chain with one consistent answer every time. Data can be easily repurposed for users in multiple departments, such as design, production, marketing, procurement or support.

A central repository maintains a unified enterprise data model

ELTA Systems, a wholly owned subsidiary of Israeli Aircraft Industries (IAI), specializes in defense and intelligence systems. It has implemented a unified enterprise reference data model and is able to store all pertinent product information in a single data repository. Roughly 1000 engineers who specialize in systems design and engineering, as well as personnel in the mechanical, electronics, microwave and software development groups rely on the system. Each authoring application covering mechanical, electronics and software has its own tightly integrated data management that is reconciled with the enterprise data model.

Lockheed Martin creates a massive global data management environment

To deliver the state-of-the-art F-35 Joint Strike Fighter (JSF), Lightning II, aircraft, Lockheed Martin created a uniform, standards-based data management environment to support building multiple variants of an aircraft for multiple clients using a multi-site assembly operation. Currently, this robust, fully integrated global digital environment supports more than 6500 users across an extensive supplier network, totaling more than 130 sites worldwide. This includes orchestrating data spanning a coalition of 9 strategic partners and hundreds of suppliers in a value chain spread over 30 countries. Goals achieved include: 35 percent design and 67 percent build cycle reductions, 70 percent commonality between the aircraft variants and the lowest sustainment cost for a 30-year fleet life. “We start with a digital design, then we build and assemble the aircraft using that same digital data,” says Larry Mestad, Lockheed’s JSF airframe systems engineering lead. “After that, we deliver and repair the aircraft with the exact same digital information.”



A secure environment

Companies must make secure access to business-critical information a top priority. They must implement a secure framework for capturing and managing data across the value chain, enabling users to see only what they need to see to get their jobs done, and no more. An enterprise data management solution provides the capability to establish and maintain access rights, which is especially important when managing large, globally distributed teams.

Security is of course very important for products like the Joint Strike Fighter, which is built by strategic partners and suppliers spread over 30 countries. Having a single source of information makes it possible to apply consistent airtight security and data standards with the assurance that these standards will be enforced globally. That same security is required to protect the intellectual property (IP) of organizations and their partners. PLM provides the mechanisms to address data security and to tailor solutions to the needs of each company and each program.

Companies need to provide secure access to uniform knowledge in order to support effective collaboration across multiple product disciplines. An enterprise data management approach also allows companies to eliminate redundant systems managing the same or similar information, thereby significantly reducing infrastructure maintenance costs.

“Until manufacturers can assess the impact of processes on product specifications and outcomes, it simply isn’t possible to make rational decisions about proposed product designs (and changes to those designs), whether to build or buy, whether to outsource or in source,” according to AMR Research. [MES for discrete industries, Part 2. August 7, 2006] Indeed, process management is essential to continuous innovation. This includes the ability to establish and capture metrics at each stage of the lifecycle to promote business decisions related to product portfolio management.

Companies need to focus on key processes and better ways to support them, such as product stage-gates, enterprise-wide change management and data review and exchanges. New levels of communication and control throughout all product and organizational disciplines are fundamental to success. Stage-gate processes ensure product development follows a logical course where all information required for decision making and down stream activities is available before proceeding to the next stage.

Establish standards within and beyond the enterprise

As knowledge has exploded, many companies have found themselves unable to govern systems and networks. Fragmented systems have institutionalized fragmented processes. To get global innovation initiatives back on track, process management has to function regardless of departmental or technical barriers. For this reason, companies must have the will to impose internal standardization and institutionalization of best practices and lean processes.

Companies need to establish common best practices and procedures internally and then extend them across the entire value chain. They must make sure that the right data is delivered to the right people at the right time and in the right formats through formal processes. By establishing standards, companies ensure that the same processes are followed by everyone during the normal course of work and that processes are inclusive of all required steps and tasks. When common processes are automated throughout the extended enterprise, lean standards and compliance with corporate or regulatory procedures become a matter of course.

Additionally, companies need to establish standard processes to ensure that the hand off of data takes place when data is mature enough to provide decision makers with complete, accurate and timely information to support key functions – such as purchasing or responding to maintenance requests. As a result, companies can minimize unnecessary delays, reduce errors, increase efficiencies at all stages of the product lifecycle and compress time-to-market. Wherever possible processes should be mapped to, and be part of, the wider product development process.

A managed PLM environment based on an enterprise data management framework enables companies to synchronize workflows and manage the efforts of internal and external contributors – from systems engineering to drafting, contract engineering and outsourced manufacturing – as a unified team. Suppliers and key customers who are part of the team participate when needed and can access required data to optimize workflows and streamline their own processes in response to the evolving product.

Goodrich Aerostructures eliminates redundant systems and improves productivity

Goodrich is a major supplier and partner to leading aerospace and defense companies. After applying the Toyota lean methodology to its manufacturing plants and processes, Goodrich applied the same principles to the “business” side of the business. Implementing an enterprise data management initiative via PLM and ERP, Goodrich was able to eliminate 40 legacy systems with product data replicated in them, mistake proof its data capture, provide realtime access to a single source of product data for its 4200 employees worldwide and integrate numerous business systems to reduce time cycles, improve productivity within the company and improve customer service.

Continuous improvement

Continuous improvement in products and processes is only possible when companies establish, monitor and report on meaningful metrics. While individual disciplines might have their own, it is important that metrics be established to gauge the organization's effectiveness at delivering the whole product and meeting clear goals at critical stages of the product lifecycle.

By implementing PLM solutions as part of an enterprise data management initiative, companies can achieve their process management goals based on captured metrics that facilitate continuous improvement and innovation. Process management tools built on a PLM foundation can be designed to ensure that the information on performance against goals is disseminated to anyone who is dependent on the timeline.

Metrics that are collected on processes and product data (duration of process steps, part quality, etc.) can be analyzed, reported or displayed in dashboards, thereby assisting in decision support and continuous process improvement. Once efficient processes have been defined, they should be captured in ways that allow them to be leveraged across facilities worldwide. This ensures that proper processes are followed, supporting organizational policy and regulatory compliance.

Enterprise change management

A key process for any organization is change management. Enterprise change management processes ensure the planning, communication, review, approval, execution and incorporation of change in all affected product and business areas to reduce errors that lead to costly manufacturing rework, purchasing errors or recalls. Wherever changes originate in the enterprise, process management capabilities should ensure that they are pushed out to key stakeholders and are immediately reflected across all systems and disciplines.

Extended review and exchange

A digital environment enables companies to leverage a 'follow the sun' strategy. Extended review and exchange processes support review processes on a 7x24 365-day basis, including the routine exchange of comprehensive 3D images and full disclosure of engineering data and test results. This workflow capability also automates the exchange of data throughout the extended enterprise on a global basis and among business systems at the correct time with the correct data.

Knowledge capture and re-use

As a company's experts begin to retire, it becomes more critical than ever to capture the subject matter expertise and best practices it has developed over the years in ways that enable less-experienced engineers to quickly achieve proficiency.

Enterprise data management solutions implemented with PLM provide the capability for creating "knowledge-driven archetypes" that not only capture this critical knowledge; they also support its continual enhancement as products and processes are improved. These archetypes go beyond traditional "templates" to embody all product-related information and processes, including critical dependencies with other functions that affect the product lifecycle. All levels of product information can be captured during normal work activities.

In order to make informed decisions that support the whole product design, contributors at every stage of the product lifecycle and in every discipline need to have information that is delivered in the context of both the parts and functions each is working on as well as those with which they interface. This enables companies to ensure that all of the components and parts that make up the product, regardless of where they are defined or manufactured, will come together correctly in the final stage of product development. It enables procurement, for example, to understand the context for a part that will be purchased from a supplier.

By implementing an enterprise data management framework, companies create a digital environment in which data are reconciled and made available to authorized personnel across organizations and disciplines in an appropriate context. Through this environment, companies empower individual contributors to quickly find the information they need and to then decisively act upon it within the context of the whole product effort.

The more contributors see and understand within the context of the whole product, the more innovative the product lifecycle process becomes. This “connected” view of product is in essence the ability from any focal point in the product data to examine surrounding, related data in a 360-degree view.

For example, a systems engineer should have access to information on how all functional product elements, parts and subsystems will come together and comply with product requirements. By the same token, a manufacturing engineer should be able to access all data relevant to the production of parts or components manufactured at that site. To reduce further errors, speed processes and boost efficiency, both the systems engineer and the plant engineer should be able to see the broader context of the product from each other’s point of view. In addition, all participants should be notified when data within their context has been changed, so that they can all work on the most current view of the data.

Containing complexity

A top priority is to enable geographically dispersed teams to function in highly focused ways. To do this, multi-disciplinary teams need to be able to view a master product model with comprehensive insight into the complete “DNA” of every part, subsystem and system in a new product. The goal is to provide all critical information up front so that all key decisions are made well before production begins.

To get 360-degree views of the entire product at any stage in its design, production and support requires a robust data management infrastructure that spans organizations and disciplines. When this environment is in place, it supports simultaneous global and micro-views of any product, enabling contributors to see the same product but in ways that directly relate to their product responsibilities and those of their co-workers.

Context management also empowers users with easy-to-use search and navigation tools that leverage relationships among data to ensure a more complete understanding of the product. These tools can identify the relationships among data elements, ensuring a complete understanding of product from the point of view of any contributor.

Configuration management of product data through the design, build and support phases of the lifecycle is critical to a complete understanding of the product as it is perceived yesterday, today and tomorrow. Configuration management provides the historical framework to know what parts and data are applicable to what design, what production run or what physical product maintenance. Companies with complex, long-lived products that require extended maintenance or upgrade programs must see products throughout extended lifecycles and multiple revisions that could last many years – as long as 40 to 50 years in the aerospace and defense industries. This contextual organization of data depends on strong configuration management.

An enterprise bill of material (BOM)

An enterprise data management framework makes it possible to establish an enterprise BOM that consolidates the information stored in discipline-specific BOMs as well as other data stores in a form that can be readily used by key business functions and shared with a company's business systems.

An enterprise BOM provides all users with a consistent, updated version of the product – including data related to all product variants. It is designed to assure that design and manufacturing teams (in fact all teams that contribute to or must utilize BOM information) work concurrently with a unified view of the product. Since everyone, no matter what the task, works from the same source definition of the product, errors are minimized, quality is improved and time-to-market can be compressed.

An enterprise BOM allows the different disciplines to communicate their contributions to the product BOM. Individuals perform work within the context of the enterprise BOM. Engineers collaborating with design partners productively work on their portion of the design in the context of the surrounding design. Purchasing agents, for example, are able to see a part in the context of the product, thereby ensuring the proper parts are ordered. An integrated BOM can also be used to align both virtual and physical builds with production intent. Errors are detected and eliminated during the virtual build process, reducing the number of physical prototypes required.

Mercury Marine establishes an enterprise BOM

Mercury Marine, a US-based marine-propulsion company, has engaged in an ambitious plan for its enterprise PLM with the objective of maintaining a consistent and complete reference model for product definition. The system must serve CAD and multiple analysis tools, quality inspection applications and a home-grown ERP solution. Requirements management, reconciliation of multiple BOMs by creating a single enterprise BOM and the application of DFSS (Design for Six Sigma) at the conceptual phase are all major functions targeted in the initiative.

In an era when knowledge in multiple formats and places of creation, storage and usage is exploding, companies must find ways to capture, control and securely share product and process data. They need to create a foundation for innovation that spans internal organizations and disciplines within the enterprise and across the value chain.

Currently, process and product data is buried in multiple disparate systems adhering to inconsistent standards and formats. Significant resources are expended trying to synchronize all of these versions, often with limited success. What is needed instead is one version of the truth providing a common, accurate and timely answer every time to all participants. To support effective collaboration and sustained innovation, this answer must make sense to individuals or groups across organizations and disciplines.

To achieve this goal, companies must implement enterprise data management initiatives based upon a centralized data repository that feeds all tools used to support products from requirements to retirement. This repository not only helps eliminate errors but also resolves inconsistencies. Equally important, it provides the framework for contextualizing data for individual contributors throughout the product lifecycle.

Pulling data from multiple systems, organizations and disciplines spread across the value chain is a daunting but achievable task, especially for companies able to build a unified digital data management environment on a PLM backbone designed to support continuous innovation. Open architected PLM solutions enable organizations to establish a secure data management environment that enables all contributors across the value chain to achieve greater levels of efficiency, resulting in revenue growth and cost containment.

Tight integration supporting capture and access to fine-grained data is essential. It provides direct and targeted support for fully informed decision making in a dynamic collaborative environment that stresses making the most critical decisions at the very beginning of the process. It also supports an environment where changes are quickly evaluated based on multi-disciplinary analysis with precise and detailed technical information and are accurately communicated across the enterprise.

Companies can successfully implement enterprise data management initiatives by focusing on the three strategic areas addressed in this paper:

- Data management
- Process management
- Context management

By establishing a single system of record, enterprise data management based on PLM makes it possible to compare, balance and optimize disparate product requirements, directly linking product data and processes across the lifecycle. Ultimately, it transforms companies to new levels of data management supporting an arsenal of strategic decision-making tools.

“Companies that continually seek better ways of managing their corporate information put themselves in a better position to handle the complexity of today’s globally competitive business environments,” says Rich Cohen of Deloitte Consulting. “Their access to timely, accurate and consistent information gives them a leg up on competitors that don’t have access to such quality information.”

About Siemens PLM Software

Siemens PLM Software, a division of Siemens Automation and Drives (A&D), is a leading global provider of product lifecycle management (PLM) software and services with 4.3 million licensed seats and 47,000 customers worldwide.

Headquartered in Plano, Texas, Siemens PLM Software's open enterprise solutions enable a world where organizations and their partners collaborate through Global Innovation Networks to deliver world-class products and services.

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