The Value of Unified Architectures for PLM

"Harmonizing the Environment"

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A CIMdata Topic Review

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"Harmonizing the Environment"

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The Value of Unified Architectures for PLM

"*Harmonizing the Environment*"

Today's manufacturing industries are under continuous pressure to deliver competitive products faster and are implementing PLM solutions to help address this issue. As PLM solutions expand to encompass the complete lifecycle, they are becoming increasing complex and harder to maintain. Unified PLM architectures are helping reduce this complexity while improving user and organizational productivity. This CIMdata white paper presents the challenges that companies are currently facing, defines a unified PLM architecture approach, describes the benefits that it can deliver, discusses factors companies should consider in evaluating whether to transition to a unified architecture, and discusses approaches to the transition. This paper is not a review of any specific architecture. Instead it is intended to provide an overview of such architectures, their potential value, and issues to consider in making a transition decision.

1. Introduction

Companies around the world are continuously seeking new and better ways of addressing their markets with innovative products that capture the imagination of their customers. They also focus intensively on better ways of running their business operations to ensure that they produce these innovative products cost-effectively with high quality. In order to achieve these goals, they have increasingly turned to Product Lifecycle Management (PLM) strategies and solutions as critical initiatives for their business success.

The early implementations of PLM solutions normally included applications provided by many different technology suppliers. These applications had to be interfaced or integrated with one another in order to support end-to-end product lifecycle processes. In cases where one supplier provided multiple applications, frequently those applications had been developed individually and also had to be integrated.

As the PLM environment expanded to encompass more of the product lifecycle, more and more applications were used and the number of integrations increased significantly. Additional resources—both human and financial—had to be committed to maintain and upgrade the overall environment.

In order to address these issues, companies want to simplify their PLM environment by using applications and solutions built on common technologies, with common data models and importantly, having a common user interaction paradigm. One approach to this problem has been the development of unified (or integral) PLM solutions suites provided by a single source.

While these newer, unified PLM solution suites are not intended to provide all of the applications encompassed in a company's PLM strategy, they are intended to provide the basic framework upon which the overall PLM solution can be based. In addition, the newer, unified solution suites strive to provide a relatively broad suite of applications that are components of the full PLM strategy and are fully-integrated upon the base platform.

Unified PLM architectures offer companies an opportunity to increase the benefits PLM can provide while reducing the overall cost of deploying and supporting the PLM technology solutions. This paper will discuss the challenges facing businesses and how migration to a unified PLM architecture can help address those challenges.

2. Market Situation

Today's global marketplace is challenging enterprises to become more innovative in order to compete more effectively and maintain their competitiveness. Figure 1 illustrates the continuing market pressures that companies face.

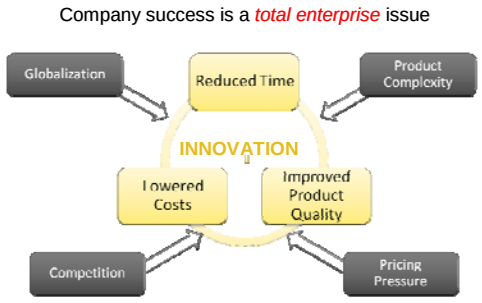

Figure 1—Today's Competitive Environment

Success in today's globalized, competitive market requires companies to focus on agility and innovation in order to better respond to changing market demands and competition. They must better collaborate among internal groups and with their partners and customers, and they must continually provide increased end user value to their customers through their products and services. In order to address these issues enterprises must:

- enable collaboration among virtual product teams spread around the world so that they can conduct product development and support 24 x 7.
- leverage their intellectual assets effectively across the entire product lifecycle.
- create a virtual, global value chain with no time, distance, or organizational boundaries.
- continually innovate and improve products, and the processes used to design, produce, and service them.

Drivers such as these and others are putting increasing pressure on organizations to invest in solutions that include technologies, methodologies, and best practices that can help them improve their ability to focus on product innovation, leverage business partners, and compete more effectively in the global marketplace. Further, companies need these solutions to be easier to implement, maintain and upgrade or enhance.

Addressing these issues requires that a company establish a single source of knowledge for all product-related information and processes. They need to be able to have connected processes so that information flows to workers when needed and as needed. Establishing a single source of knowledge that is accessible globally allows companies to design anywhere and build anywhere—enabling the flexibility to respond to competitive pressures and market changes. Finally, companies need to achieve a significant return on their PLM investments.

During the 1980s, companies used customized implementations of function-focused applications to address specific issues, e.g., CAD file management. In the 1990s, companies deployed domain-focused applications such as change management. Today, enterprises of all sizes are demanding solutions to business-level issues such as new product development and launch and strategic product planning.

Deploying a PLM strategy and environment has typically required implementing a set of applications (or applications modules) that encompass and support selected PLM functionality. These applications are then integrated to provide transfer and use of product-related information in as seamless and transparent a manner as possible. These integrations also support development of end-to-end processes across the appropriate applications.

The increasing diversity of applications, underlying data models, and technology as well as the potentially exponential increase in integrations has a negative impact on a company's ability to remain competitive. For a user, getting his or her work done often requires learning and working with multiple applications which often has different user interfaces and working paradigms.

While integration technologies have significantly improved over time, each point-to-point integration requires effort, and must be updated as the individual applications are upgraded or replaced over time.

3. Defining a Unified Architecture

A unified architecture (also known as an integral architecture) helps address many of the issues that have caused difficulties and increased costs in establishing a cohesive PLM environment. It provides a foundation for the overall environment but does not necessarily encompass all the applications or functionality that a company may require.

Prior to unified architectures, three primary methods have been used to address the wide range of applications integrations that are incorporated into PLM solution implementations—each with increasing capabilities that deliver higher benefits but generally at a higher cost.

- *Encapsulation* is a relatively simple solution and is easier to implement than either interface or integration. Persons using the data management system could search for, and locate the package of data but would have to transfer it to another application for use.
- *Interface* is more difficult to implement. Applications can exchange files and some meta-

data automatically (without user intervention). PLM functions are provided via menus within each application.

- *Integration* is the most difficult to implement. It enables a full, automatic exchange of all types of product data and meta-data between applications and function. However, integration implementers need to have a deep knowledge of each application's data structure and it requires user interface work in every integrated application.

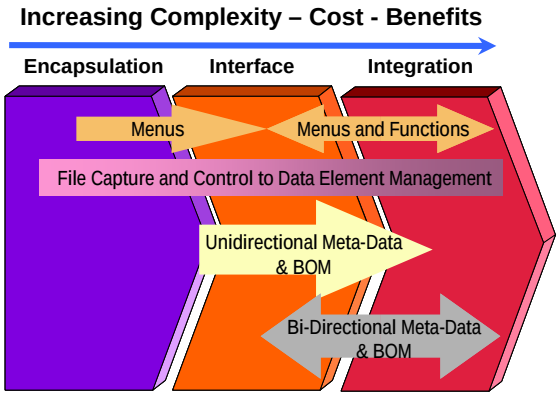

Figure 2—Previous Methods for Integration

While these various approaches are used to enable work to flow across PLM applications and modules, they require developing and supporting an ever-increasing number of interfaces and continuing translation of data. Further, users may have to use different user interfaces as they access different modules and data entry, and conversion errors are continuing sources of error.

A unified PLM architecture eliminates the problems associated with these integration methods for all applications that are delivered as components of the overall framework. A unified architecture is one in which all included functional applications and modules are designed and built on a common technology foundation and share a common data model and data base. Across the breadth of applications that are delivered as components of the unified architecture solutions, it presents the user a consistent context-driven interface tailored to role and task requirements regardless of the functional module in which they are working.

Within the suite of applications delivered as part of the unified architecture solutions, information created in one module or function is immediately visible and available in all other modules without additional data entry or transformation. A unified PLM architecture is intended to provide a consistent and cohesive environment for all users working with product-related information. Users normally have one user interface paradigm for interaction with the environment, regardless of the module or functions they are using. Common methods for information search and access are incorporated into all the modules within a unified architecture.

Unified architectures are built using industry-standard technologies and a service oriented architecture (SOA). While an SOA does not itself deliver a unified architecture, it provides a common suite of services that each module in the unified architecture uses to execute desired actions, e.g., search, display, etc. For more information on SOA and PLM, refer to "Service-Oriented Architecture for PLM" a CIMdata white paper available at www.cimdata.com.

While a unified PLM architecture provides the foundation, (and potentially many of the functional needs) of a PLM environment, no single product suite supports every application needed by an enterprise. Other applications will still need to be integrated using one of the three techniques described earlier. However, the unified architecture does provide the foundation upon which additional applications can be built. These additional integrations can utilize the common data model/database for information exchange, the common SOA services, and support the common user interface paradigm. Building on the unified architecture foundation with incorporated additional applications helps reduce the overall complexity of the environment when compared to previous implementation approaches.

Every PLM system requires tailoring to specific business processes and the PLM environment needs to support business process tailoring with as little programming as possible. Companies need the ability to "configure" the PLM environment to support their business process with no (or very limited) programming via business modeling functionality. However, when customization is required, programming extensions need to be supported within and by the unified environment. In order to accomplish this, PLM architectures and platforms should support programming environments based on industry standards, e.g., the Eclipse framework. This better enables enhancements to the system and developing or integrating additional functionality and applications via a common mechanism.

Two other critical requirements for a unified PLM architecture are scalability and performance with rich business behavior and flexibility. Architectures that support a range of deployment options which can be configured to optimize the processing load within an enterprises IT landscape offer the flexibility to deliver higher performance with less impact on IT budgets.

Scalability also refers to how the system handles changes in loads and how it can be configured to maximize performance and reliability running on a given hardware and network infrastructure. In today's global environments, clients often need to connect across wide area network (WAN) connections with higher latency, lower bandwidth and higher probability of failure than is found in local area network (LAN) environments. A unified architecture can help reduce latency issues and be easier to tune to deliver the best possible performance, regardless of global location, network speeds, etc.

4. Benefits of a Unified Architecture

There are many benefits that can be achieved by transitioning to a unified PLM architecture. A significant benefit is simplification. Simplification addresses many areas and issues including a common user interface across multiple applications, reducing the number of integrations that must be supported, and eliminating errors due to multiple data entry or transformation across applications.

A cornerstone of a unified PLM architecture is a common data model upon which the functional modules provided within the architecture are built and shared. This eliminates individual integrations among modules and makes information created in one functional area immediately available in other areas. This significantly reduces or eliminates data entry or translation errors as well as the time required to make information available to other users and applications.

Unified architectures typically provide users a common interface to all applications and functionality within the environment. This reduces the complexity of their environment, and makes it easier for users to navigate across multiple functions and solution modules. This benefits both power and casual users, and empowers them to do more. Further, having a common user interaction paradigm reduces the potential for errors in entering information into the system as the user more clearly understands what to enter and how to enter it.

Simplifying the PLM environment can dramatically reduce the cost of deploying that environment, from installation to upgrades to operations. Having a common, shared data model and underlying architecture, including API's, etc. reduces or eliminates the custom programming required to develop and maintain integrations between functional modules. This reduces the number of resources needed to maintain the environment, the cost of those resources, and the time required to create and update integrations. This should enable a company to update or expand its PLM environment faster, with less cost, and with less risk. That in turn, translates into improved competitiveness and a faster return on the PLM investment.

A diversified manufacturing company in Europe indicated that one of the benefits to be achieved from using a unified PLM architecture is reducing the administrative complexity and associated cost of maintaining and evolving the environment. They also expect that using a unified PLM environment will help them standardize their product development processes across multiple divisions and organizations.

The common data model and architecture also reduces the complexity and effort to integrate PLM functionality with other business applications and solutions. This enables a company to expand the use of product information created and maintained within the PLM environment and also enable users within the PLM environment to access and use other business data that can help them perform their tasks and make better decisions. This flexibility should also improve the ability to integrate with a company's extended value chain—its design, manufacturing, and services partners.

Frequently, when transitioning to a unified architectural environment, a company can consolidate applications onto the unified platform. This can result in reducing the number of applications used within the PLM environment. Most companies have multiple applications that essentially provide the same or overlapping functionality but were acquired over time by different organizations or programs. Consolidating these applications typically reduces support costs as well as the complexity of the overall environment. As users work with a consolidated suite of applications, they become a more flexible work force since individuals can move more freely between programs.

As PLM becomes a more critical enterprise solution, more and more users of all types need to access the environment. Maintaining acceptable levels of performance for the expanding user community requires that the environment be easily scalable. It must support increasing volumes of data and access, frequency and size of data exchange among mechanical, manufacturing, analysts, electrical, electronics, software, and service/operations teams throughout the product's life cycle. There may potentially be thousands of global users working with and/or exchanging significant volumes of product information.

One of the major benefits of a unified architecture is that it provides a foundation for establishing common processes that can be used through an enterprise. While a unified

architecture itself does not mandate common processes (common processes can be established without using a unified architecture), the fact that all functions are supported by a common data model and database, and use common services and a common user interface, means that it is much easier to set up common/shared processes that flow across all the applications and functions supported within the unified PLM architecture environment. Additionally, the migration to a unified architecture provides a catalyst to making process changes.

A unified approach provides a cohesive architecture that should enable companies to harmonize their PLM environment and their product development processes. Fundamental capabilities are shared and available across all modules and external or extended capabilities can be built on this common base.

A major aerospace company stated that they are moving to a PLM environment built on a unified architecture to reduce the cost of the overall environment and to eliminate many of the current application-to-application integrations. They expect to increase data reuse with less data redundancy.

Establishing a common toolset built on a unified architecture improves a user's ability to work more effectively and productively. It reduces the training (and time) required for a user to learn a new tool or function and by providing a context-driven user experience, enables users to move between functions more easily. This enables managers to better utilize their human resources across programs and functional domains as business needs dictate. It also reduces the time required to incorporate new hires (or new employees added as part of a merger or acquisition) effectively into the overall environment.

A unified architecture increases the flexibility of deployment across the growing numbers of organizations and users that need to interact with product information. A unified architecture reduces the resources requirements and the number of skills needed by those resources to deploy and maintain the environment.

A unified PLM architecture provides a solid foundation upon which a cohesive, consistent, and more easily-sustainable PLM environment can be developed and used throughout an enterprise. As companies look for ways to improve their competitiveness, increase individual and organizational productivity, and at the same time reducing their IT investments, a unified architecture can be a key element for success.

5. Deciding to Transition

Companies considering moving to a PLM environment built on a unified architecture should evaluate several factors before committing to the transition. The first is "why" they should transition from their current environment to a new environment built on a unitized architecture. Transitioning to a new environment of any type requires time and resources and must provide a reasonable, if not substantial, benefit in return for the effort involved.

There are many issues that companies need to evaluate to determine in making a decision to transition to a unified architecture. These include:

- Is the current environment not meeting business needs? Is it limiting the ability to incorporate additional functionality or expand the use of the managed information?
- Do users have visibility of product requirements during product development?
- Do users have visibility into project schedules, resources, and costs throughout the product development process?
- Do manufacturing and procurement personnel have early visibility to begin their planning processes?
- Is there difficulty reusing components, parts, products, and processes across the extended enterprise?
- Are errors and time delays being introduced through redundant data entry and transfer between applications?
- Is there an ability to integrate and collaborate effectively across the global enterprise as well as with suppliers?
- Can the PLM environment be quickly adapted to meet changing market conditions and business requirements?
- Does it require too much effort to integrate, maintain, and upgrade multiple, diverse PLM applications?

Companies that have implemented PLM environments and solutions have made investments in technology, processes and workflows, and training. Further, they have multiple databases of product-related information that have been created using a variety of applications. Evolving or replacing the in-production PLM environment will require time, money, and resources. Such a transition must, over time, provide a solid return on the investment required and provide the company with a more flexible, efficient, and productive environment.

When making the decision about whether to transition to a unified PLM architecture, there are also a number of impediments to consider including:

- *Technological*—What new technologies will have to be introduced into the overall IT landscape? What will be required to deploy and sustain solutions built on those technologies? Are the new technologies compatible (both short- and long-term) with the other technologies to which the company has committed?
- *Financial*—What will be the initial and ongoing costs of the transition? This includes software acquisition or upgrade, training, deployment, data migration, and ongoing operations.
- *Cultural*—Will the transition impact the way in which users work? Will it change the applications they use, add or decrease their workload and tasks, or change the processes they follow?
- *Benefits*—What benefits will accrue and when will they be achieved?

Transitioning to a new environment and architecture will require effort and cost. Each company will face a different set of issues and constraints that will impact undertaking a transition. After a company has evaluated the issues most pertinent to their situation, they can make an informed decision about whether transitioning to a unified PLM architecture is appropriate for them. Once a company decides to transition to a unified PLM architecture, it can then determine how it will execute the transition.

6. Approaches and Issues to Consider

Transitioning to a unified architecture requires careful planning and must address many issues. Companies must define and manage the expectations of the individuals and organizations being impacted. Expectations about time, cost, and functional and operational (e.g., process) changes should be established and communicated clearly along with the benefits expected to be achieved. Setting expectations helps define and manage the scope and impact of the transition.

Several approaches can be followed in making a transition. Big bang, multi-phase, and selective replacement are types of approaches; however, multi-phase has generally proven to be the most effective and least disruptive for many organizations. A multi-phase approach enables a company to better define and manage the scope of a transition, the costs associated with the transition, and the impact on users and organizations.

An important requirement for a multi-phase approach is the ability to have efficient interoperability among the new, unified PLM environment and legacy systems. This enables the enterprise to continue to function, leverage existing IP, minimize disruption to the business, and bring new solutions in phases.

Develop a detailed transition plan that identifies any critical issues that must be addressed to ensure a successful transition. Appoint a program manager and an executive who will be responsible for the transition program and allocate the necessary budget.

The plan should define the transition phases and the timeframe for each phase. Identify all dependencies between the phases. All costs of the transition should be defined (and budgeted) and those costs should be allocated by phase of the transition. Transition phases should also be synchronized with other IT projects to reduce impacts and cost and to leverage other activities within the enterprise.

The impact on users and organizations by phase should be identified, described, and communicated to all affected persons. When describing the impacts, the expected benefits associated with the transition should be communicated. Show users how they will be able to work more effectively after the transition in order to get their support. The transition plan will need to address the following factors:

- *Prerequisites*—This would include any software changes or updates, functional capabilities that must be carried forward, training that should be performed prior to transition, and any IT infrastructure changes or updates that may be required.
- *Process Change*—What processes will be changed and how will that impact the users? Will the transition simplify or complicate how they will work in the future versus how they work today?
- *Data Cleansing and Migration*—Will data have to be modified or cleansed as part of the transition? Diversity of data and the migration of that data to a new structure can be a major cost and time impact and must be carefully evaluated and planned.
- *Application Consolidation*—Can functions and applications be consolidated? If so, which applications will be replaced or eliminated and at what point during the overall transition?
- *Implementation Scope*—How many applications and functions will be supported within the unified architecture suite? How many additional applications will need to be integrated?

- *Overlap Between Legacy PLM Solutions*—What exists and what will be removed or replaced?
- *Resources*—Who will be required to participate in the transition and when (make their availability a priority).
- *Training*—Who, how, and when?
- *Replacing Old Customized Solutions with OTB Tailored Solutions*—What customizations are no longer needed? What functionality will replace each? How will this impact users and processes?
- *Timing*—When, how long, and what will be done in each phase?
- *Scope of Implementation*—What functions or applications, programs, etc.
- *Adding New Capabilities*—What capabilities are being added and when will they become available?

In defining the phases, transition the core functions such as data management, review and release, change management, etc. first. Then transition additional functionality based on business priorities. For example, one company may have a higher need for requirements management and compliance while another may need product portfolio planning and strategic sourcing. Prioritizing the transition phases will enable a company to achieve maximum benefits earlier in the process.

Using a multi-phased approach also enables roll out of the new environment division by division rather than having to implement across all divisions simultaneously. Conversely, roll out can take place program by program. This approach lessens the impact and disruption on the company and the user community. It also enables companies to better plan long-term support for programs with lengthy lifecycles, e.g., airframes, ships, elevators, etc.

Each company will have unique transition issues and should evaluate transition options accordingly. Effective planning and careful program management and scope control are the keys to transition success.

7. Summary and Concluding Comments

Enterprises today must maximize the use of all their resources—both financial and human—to create environments that enable them to deliver competitive products and services in a timely manner. As PLM environments have expanded to cover more and more of the complete product lifecycle, the complexity and cost of supporting those environments have continued to rise. Simplifying the PLM environment while providing more information and capabilities to the individual worker, is an important factor in the overall success of PLM programs.

Reducing the complexity of the product development environment and the cost of maintaining and upgrading that environment allows companies to put more of their resources into developing and delivering those products. Creating environments in which users have a consistent, role-based way of working increases the productivity of workers and organizations.

Unified PLM architectures can provide a major step forward in creating and sustaining more flexible, productive PLM environments. They address many of the issues of integrating the diverse set of applications and functions required across the full product lifecycle by delivering many of the required functions and processes via a common set of services, providing a common data model and database and a consistent user interface across the included modules, and reducing or eliminating redundant data entry and transformation within the supported modules.

While unified PLM architectures can provide significant benefits, they do not encompass every application and function needed by an enterprise to address the complete product lifecycle. Additional integration of selected applications will still be required. However, a unified architecture provides a foundation upon which these additional applications can be built, integrated, and delivered and this can reduce the cost of maintaining the overall PLM environment.

Unified architectures offer companies an opportunity to establish a more flexible, comprehensive PLM environment while reducing the overall cost of maintenance, support, and enhancement. Significant potential benefits include providing users with a more consistent working environment tailored to individual roles, reducing or eliminating redundancies and errors in data entry and transfer between applications and functions, lowering the cost of IT support, and providing a more flexible environment that can be rapidly adjusted to changing business needs.

CIMdata believes that companies should evaluate the use of solutions based on unified architectures as part of their PLM strategies.

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. 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. To learn more about CIMdata's services, visit our website at www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 (734) 668-9922. In Europe: Siriusdreef 17-27, 2132 WT Hoofddorp, The Netherlands. Tel: +31 (0)23 568-9385.

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