CIMdata

PLM Selection and A Company's Business Model

Selecting the Most Appropriate PLM Solution

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1. Introduction

One of the most significant challenges facing companies in the fabrication and assembly (F&A) industrial segment that are preparing to launch a Product Lifecycle Management (PLM) program is determining what role their Enterprise Resource Planning (ERP) system should play in enabling PLM. The issue 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 a combination of both).

PLM and ERP technologies have emerged from different parts of industry and different parts of the value chain. The PLM-ERP issue has gained tremendous visibility since the late 1990's as organizations 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, 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. The basic objectives of these initiatives are not in question. Rather, the issue is how to best utilize their capabilities and the money already invested to support the organization.

Fundamentally, there is not a single answer that satisfies all situations. There are multiple approaches to address the PLM-ERP issue, and many have been successful for various implementations around the world. Most focus on the true value-added or core competence of the enterprise in question. In this case, what are the core competencies of F&A companies, and how can PLM and ERP solutions best enable a successful PLM strategy?

2. F&A Industrial Segment

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:

- 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
- Textile Machinery

Companies in the F&A segment cover a wide range of industries and operating models. In general, all of these industries have a need for PLM in the product definition lifecycle and in managing the design supply chain. 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 Processes—Complex F&A products include many subassemblies with electronic, software, and mechanical components that require close tolerances and interactions. These products are purchased by industrial customers and are often designed and made-to-order. These products are usually major capital investments for customers, with prices ranging from hundreds of thousands to millions of dollars. F&A companies are under constant pressure to innovate as well as hold to high quality and performance standards at competitive costs.

PLM is essential to the design process for these products. PLM-enabling solutions extend the basic functionality of 2D and 3D design to provide document control, product structure, and change management. Visualization functionality is often critical to show purchasing, design supply chain partners, and customers how the resulting design will look and function. Because design reuse is

essential in leveraging the intellectual assets and increasing the pace of innovation at a typical F&A company, the ability of PLM to help people locate and quickly share types of design information (e.g., 3D models, design context, parameters, etc.) is critical.

Design Chain Management—Machine manufacturers have to share product information internally as well as with customers and suppliers. PLM enables this sharing and collaboration throughout design and manufacturing processes.

Manufacturing—Manufacturing these products involves very complex bills of materials plus 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.

Maintenance—Because many F&A companies produce major capital goods with long lifecycles, manufacturers are required to provide clear documentation of maintenance information, and in many cases, actually perform maintenance for their customers. From time to time, upgrade packages can be made available to customers to improve performance without replacing the entire machine. 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.

Given these requirements, where should F&A companies seek to enable their PLM strategies—ERP solutions, PLM solutions, or both? Answering this question requires looking deeper at an F&A company's underlying business operating model and core competencies: Are they engineering-centric or manufacturing-centric enterprises?

3. Engineering- and Manufacturing-Centric

According 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 adds the most value (i.e., its people and money) in product design and engineering. Engineering-centric companies view their competence or competitive advantage to be product design and manufacturing engineering activities. These companies are viewed as product innovators that design and engineer world-class products. People generally buy from these companies because of the innovative and unique products they sell. In general, engineering-centric companies operate in a very dynamic design environment where their ability to rapidly and iteratively modify their product and process designs provides a competitive advantage. 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.

The manufacturing-centric operating model describes an enterprise that adds the most value in the production of their products. Manufacturing-centric companies are more often seen by the market as competing on price, quality, and delivery time. Companies operating in 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. In general, manufacturing-centric companies seek to improve their ability to execute a high volume of rapidly-repeatable, non-dynamically-defined transactions (e.g., commodity orders and builds and financial payments). Fundamentally, a manufacturing-centric company's ability to streamline their execution of business transactions brings a competitive advantage.

Based on CIMdata's research, this manufacturing- or engineering-centric framework helps determine where a company should focus its resources and investment in technologies that support its product lifecycle. Where a company fits in this model determines where they should focus to gain improvements during the product lifecycle.

Since engineering-centric companies add the most value in the engineering process, they typically need the dedicated support that engineering-centric PLM solutions can best provide. For example, these solutions focus on flexibility in supporting the early phases of the product lifecycle, which is essential because up to 80% of a product's long-term costs (i.e., the cost to produce, deliver to market, support, and obsolete) are determined during the engineering phase. This is why it is so important to effectively manage the early product lifecycle stages. In these firms, the PLM solution needs to be integrated with the company's ERP solution, which is focused on processes and functions that support manufacturing production activities.

4. Key Engineering-Centric PLM Requirements

Engineering-centric companies in the F&A and other industrial segments must look for PLM solutions that satisfy their fundamental PLM-related business

requirements. Meeting these needs requires a robust set of integrated solutions that support the entire product lifecycle and its requirements for product and process definition creation, management, dissemination, and use. These requirements include:

- An integrated and dynamic process and product definition information environment
- Well-defined configuration management processes and practices
- Knowledge reuse throughout the product lifecycle
- Design supply chain integration
- A holistic and comprehensive approach to supporting design through after-sales support
- A cost effective and flexible environment that supports the changing business needs
- A distributed data and process environment

The following sections describe each of these requirements.

4.1 An Integrated & Dynamic Process and Product Definition Information Environment

A truly integrated process and product definition information environment must allow for the capture of an engineering-centric company's intellectual assets as a natural element of the process and not as an after thought. The environment must allow the right people from throughout company's extended enterprise to access the right information at the right time. Finally, the environment must recognize and support the various user groups and their specific requirements for viewing the product definition information in the proper context without overwhelming them with too much information.

To accomplish this, a PLM solution must offer tight integrations with one or more 3D CAD modeling environments. These integrations must support iterative, collaborative design practices across an enterprise and its design partners. It must also support leveraging 3D geometry and embedded intelligence with other development tools. For example, CAM, digital manufacturing, and enterprise simulation all have a significant impact on the enterprise's ability to compress a product development cycle, improve quality, and decrease product lifecycle costs. Ultimately, PLM solution integration must offer more than just document management; a significant amount of metadata management (e.g., 3D parametrics) must also be enabled by the integration offered.

4.2 Well-defined Configuration Management Processes and Practices

To be more efficient and effective, an engineering-centric company should focus its attention on lifecycle process and data optimization that guarantees that clear, concise, and valid data and processes are always used and executed properly. Most engineering-centric companies have found that the best systematic and consistent way to enable such an environment is to incorporate configuration management processes and practices into the way the company works.

For engineering-centric F&A companies, configuration management (CM) must be an integrated part of PLM and it must support a number of activities:

- Establishing and maintaining the definition and status of products and their components, all associated information and the relationships between them.
- Managing all changes to any product, component or defining documentation in an auditable, repeatable, verifiable, controlled manner.
- Keeping track of what you design, develop, deliver, sell, and support.

To enable such an environment, a PLM solution must provide robust product structuring functionality and associated change management practices and processes. In turn, this functionality must be tightly linked with the PLM solution's 3D CAD integrations, visualization and digital mockup technologies, and enterprise simulation capabilities. The product structuring functionality must also seamlessly support the definition and dynamic management of product options and variants. This capability is often seen as the major difference between engineering-centric PLM solutions and those that are more focused on manufacturing-centric PLM support. Finally, these capabilities must enable a comprehensive and iterative configuration management driven product development process—enabling innovation and never restricting it.

4.3 Knowledge Reuse throughout the Product Lifecycle

As the central repository of an enterprise's product definition information, today's engineering-centric PLM solutions are in fact knowledge repositories. For engineering-centric organizations, they hold not only files and metadata, but also a rich set of interrelationships among metadata and a host of electronic content. To properly support this, an engineering-centric organization needs a PLM solution that not only provides robust document management but also integrated part and assembly management capabilities. These capabilities play a critical role throughout a product's lifecycle and are required if a company wishes to reuse not only parts but also designs and

their embedded intelligence. This type of reuse requires a solid understanding of various design methodologies and processes, and the associated definition data that must be captured, managed, and shared by the PLM solution with the various design tools utilized throughout the product development lifecycle.

4.4 A Holistic and Comprehensive Approach to Supporting Design through After-Sales

In the most basic form, product development is item-focused (e.g., parts, assemblies, manuals, training, and other physical items to be delivered to a customer), while after-sales product support is operationally-focused (i.e., focused on operational performance of the delivered items). This is not to say that the core support capabilities are not the same. In fact, they must be. The foundation must be the same because at the core is the delivered product's configuration, i.e., all the product definition information that defines what the product is, including what has changed over time. In fact, change/audit histories provide very important feedback from the after-sales phase of the lifecycle back into the engineering phase of future solutions and technologies. This closed loop process environment must understand and support the entire product lifecycle. Maintenance should not be an island unto itself, but rather an integral part of the entire product lifecycle.

This requirement emphasizes the need to tailor processes for the operating requirements of each lifecycle phase. As described in a previous requirement, the overall PLM environment must be governed by a comprehensive CM approach. This requirement extends that approach and uses it to manage the processes specifically adapted to the needs of the various lifecycle phases.

4.5 Design Supply Chain Integration

For many F&A companies, their move into the development, installation, and service of their products has required them to investigate, purchase, install, and service associated parts and components from a significant number of third-party suppliers. An engineering-centric company's ability to incorporate these parts and components created by its design supply chain partners is critical. To accomplish this, an F&A company's PLM solution must provide comprehensive visualization and digital mockup functionality. At a minimum, these capabilities must allow the company to view and interrogate 2D and 3D product definition information provided by its suppliers. Additionally, these capabilities should allow the company to incorporate their suppliers' designs into their own through the use of digital mockup functionality.

4.6 A Cost-Effective and Flexible Environment Supporting Changing Business Needs

Businesses in the rapidly-evolving F&A industrial segment must be able to change quickly: markets change, customer requirements change, regulatory requirements change, product demands changes, etc. To keep up with these changes, an engineering-centric company needs to implement a flexible PLM solution that can be cost effectively (i.e., easily and quickly) implemented and enhanced on an ongoing basis.

Flexible tools that allow for the rapid tailoring of workflows, data models, user interfaces, etc., enable an engineering-centric organization, not restrict it. Users and groups can innovate while still fitting within the corporate framework and, more importantly, have their product definition information managed for the benefit of all. Besides supporting external market changes, these flexible tools can more readily support the acquisition and incorporation of other organizations into a company's product definition information management environment.

It is important to note that the distinction between tailoring and customization. Tailoring is system modification supported by the software solution within the bounds of its existing operating model. In most cases, these modifications will continue to operate even as the underlying software is updated. In contrast, customization is the changing of the internal code of the system. These changes usually require re-coding to support new versions of the software, often at great cost. This type of system modification should be avoided. Companies that customize their enterprise software lose the ability to readily upgrade their solutions to take advantage of new capabilities. This results in yet another legacy system with limited ability to change.

4.7 A Distributed Data and Process Environment

A federated PLM architecture provides an engineering-centric company with centralized indexing and control of product definition information, while allowing for the actual data to be locally managed. Implementing such a distributed data and process environment is a proven way to support distributed organizations of all sizes. The federated architectures offered by many PLM solutions enable all sites to locate and retrieve data from each other while providing a common index to insure uniqueness of data. Fundamentally, a federated architecture will allow a company to operate in a distributed fashion, while at the same time providing all users with access to corporate knowledge in the proper context.

It is important to note that the benefits of applying the proper technology to fit the company's operating model will ultimately drive competitive advantage. For engineering-centric companies, the implementation of PLM technologies from engineering-centric PLM solution providers allow them to provide their product and process engineering and design communities with flexible knowledge-capture mechanisms and information infrastructures . The bottom line is that an engineering-centric company must look for a PLM solution that supports its engineering-centric PLM requirements.

5. Supporting Engineering-Centric Requirements

PLM solutions from engineering-centric PLM solution providers typically provide a solid support infrastructure for companies who display engineering-centric characteristics. These are the kinds of companies for which engineering-centric PLM solutions were designed. Their designed-in flexibility generally allows them to be tailored to support the ever-changing product definition management requirements and leverage the use of engineering methodologies, such as collaborative engineering. Their relatively high level of flexibility also allows them to manage the iterative product definition processes and capturing design knowledge and intent without constraining employee creativity.

Most engineering-centric PLM solutions originated with the central philosophy of integrating best-in-class design and engineering applications. For the most part, these solutions support design in-context, complex assembly management, and embedded visualization and simulation tools better than manufacturing-centric PLM solutions. This more tightly integrated design, visualization, and simulation environment can yield significant savings in prototyping time and reductions in overall product development cycle time, especially for companies in engineering-centric industries, such as F&A, automotive, and aerospace.

In general, ERP technologies were developed to provide a controlled environment from which a company could run its product production operations. Today, the PLM capabilities of ERP systems often provide considerable support for capabilities needed by engineering-centric companies. These capabilities include such mechanisms as engineering bill-of-material management and BOM change management, but they generally don't provide a flexible enough environment to manage the iterative product definition lifecycle where the digital 3D geometry and its associated parameters are refined and leveraged throughout the product's lifecycle, and iteratively shared with various product and process development technologies (e.g., CAD, CAE, digital manufacturing, etc.).

Fundamentally, ERP systems typically force their product production use model on the design/engineering community. This is generally viewed as a constraint-based environment that makes the innovative process of iterative design difficult to execute. ERP systems are generally more suited for the management of the transaction-based manufacturing environment, for management of the product production lifecycle where it is important to optimize material usage, production scheduling, material purchasing consolidation, and other manufacturing tasks and activities.

When looked at closely, today's commercially-available ERP systems provide support for varying degrees of PLM capability; some are quite extensive while others provide little. However, most do not provide full and flexible PLM functionality in a manner acceptable to many engineering-centric companies. When the PLM capabilities of an ERP system are used to support engineering, it is important to understand the relative weaknesses of ERP-supplied PLM capabilities to better prepare for the implementation, and to achieve user acceptance and eventual success.

When compared with major market-leading engineering-centric PLM solutions, the PLM capabilities provided by most ERP systems suffer from a consistent set of weaknesses that impact successful implementations. These include:

- ***Application Integration (especially CAD and digital manufacturing applications)*** — A limited number of robust integrations are available to application systems, especially integrations to high-end CAD/CAM systems and digital manufacturing applications (e.g., process planning and simulation tools). The concept of applications integration is not prevalent within the ERP industry, and very few ERP systems even have an Application Programming Interface (API) toolkit; some provide limited ones. Since a major focus of many PLM implementations is to enable integration with multiple application tools, this lack of an in-depth integration capability is a severe limitation. At best, this makes future system integrations difficult to architect and implement. In some cases, integration is impossible.
- ***Graphical User Interface*** — User interface quality is essential to PLM solutions that are viewed as a facilitator of product information exchange between many people throughout an extended enterprise. Flexible, easy-to-use interfaces are a market and user requirement for PLM solutions (as the users are not typically dedicated to only using a PLM solution to perform their entire computer

related duties), and are not generally provided by ERP systems. ERP user interfaces (even though several "look" quite graphical) are generally quite restrictive, require significant training, and are cumbersome to use.

- ***System Flexibility for Tailoring and Customization***—Most engineering-centric PLM solutions are easily tailored and customized to better fit with the requirements of the implementing organization, and support the iterative changes that allow the organization to meet ever-changing market requirements. ERP systems are typically based upon the philosophy of little tailoring, heavy and complex customization of code and processes, or a change of company operation to match the operational philosophy embedded in the system. Many companies that have attempted to customize an ERP system have found the effort to be extremely time-consuming and expensive.
- ***Document Management***—Most ERP systems are not well suited to support integrated document management, a basic PLM capability that is beyond file management. It includes the ability to manage design content in multiple electronic forms and the linkage of this content with parts, assemblies, routings, and other product definition information. This capability is generally poorly supported by manufacturing-centric PLM solutions which usually view documentation as the output from engineering that is used by production operations. This limited view often provides only a fraction of the benefits.
- ***Workflow/Process Management***—As with document management, the concept of flexible and configurable workflow support is generally not well supported by ERP systems. The philosophy that is embraced with many ERP systems is to predefine any processes to be supported by the system and force users to adapt to it. This is counter to the philosophy of PLM solutions which support process definitions based on each company's own operations, and are designed to support change over time.
- ***Configuration Management***—Configuration management requires a combination of product structure management capabilities, including options and variant modeling support, which are fully integrated with engineering change processes and document management of supporting documents. Due to the major constraints of document management and workflow/process management (as previously described), engineering configuration management is poorly supported in most ERP systems, in spite of an ERP focus on bill of material management capabilities.
- ***Distributed System Support***—ERP systems are typically based upon a philosophy of centralized operation and decision support. This theme runs completely counter to the trend in the PLM industry—to support highly-distributed, but integrated, system operation and decision support.

Not all ERP systems are the same, and some are much better than others in providing PLM support. A few of the major ERP suppliers offer much more substantial support for PLM than they previously provided. Even with limitations, however, these technologies have enough PLM functionality to prompt users to question the need for additional systems. Many companies that have already invested heavily in existing ERP systems are asking themselves if they truly need an additional system to support PLM. The growing areas of overlap are thus forcing PLM solution providers to redefine their role in an increasingly competitive and evolving market, and for users to consider more than just the features and functions of a given solution before selection.

Figure 1 illustrates the preferred implementation of ERP and PLM enabling technologies within an engineering-centric environment. This preferred implementation model has been developed based on our extensive research and experience. The exact place or moment in time during a product's lifecycle where data is either moved or communicated from a PLM solution to ERP should be determined based upon the company's business model, change process style, system capabilities, information technology environment, and available information technology skills.

In general, PLM technologies, as delivered by engineering-centric PLM solution providers, typically communicate a static copy of the product and process definition to the ERP system when it is finalized. The master product and process definition is typically owned and managed in PLM, thereby making the definition information within the ERP system a slave to PLM. Any changes to the PLM-managed definition

Figure 1—Communicating BOM Information in an Engineering-Centric PLM Implementation

would require a formal engineering change process. This fully supports the idea of a single version of truth by managing one product and process configuration for both product definition and product production lifecycle requirements. Do not interpret Figure 1 to mean that ERP capabilities are not utilized earlier in a product's lifecycle, since this figure is only meant to indicate the major point in a product's lifecycle where product definition information is transitioned over between the PLM and ERP solutions. For example, engineering-centric companies may communicate early versions of the engineering BOM to their ERP solutions to manage part and subsystem procurement.

The benefits of applying the proper technology to fit the company's operating model will ultimately drive competitive advantage. For engineering-centric companies, the implementation of PLM technologies from engineering-centric PLM solution providers generally allows them to provide their engineering and design communities with flexible information infrastructures as well as knowledge capture mechanisms. The information infrastructures provided by engineering-centric PLM solution providers are designed to manage the changes that occur throughout the product development without having to expend significant amounts of money and time rewriting computer programs.

6. Choosing the Most Appropriate Solution

Many companies have found out the hard way that the successful implementation of a PLM solution doesn't just depend on the selection of the appropriate technology; it also heavily depends on the selection of an appropriate solution provider. Since the implementation of PLM can have a significant impact on an organization and the ability to support its complete product definition information management requirements, a company must take the evaluation and selection process very seriously. The implementation of a PLM solution requires ownership by all of the stakeholders in an organization's internal business units and external business partners. Each group must provide focused involvement throughout the entire selection process, including building a tight relationship with the solution provider on all levels. The relationship the organization builds with the PLM solution provider will last for a number of years. As a result, building a strong partnership with the PLM solution provider can help maximize the benefits an organization receives from the PLM solution and other related technologies.

When selecting the most appropriate PLM solution, it is important to understand the characteristics of a strong relationship along with the technical requirements. The order of importance of these depends on the selecting organization, how it operates, its management style, and its requirements for services and solutions. A checklist of the most important selection factors should include:

- ***Partnership Potential***—Partnership is the ability of the solution provider to work with, and understand its customers from the time of system selection and definition well into the future. Partnership is dependent on more than the solution provider's software products; it must include their vision for the future, style of operation, aura of trust, and ability to bring proper and knowledgeable resources to bear as required.
- ***Personality***—The personality of the solution provider has to match the philosophy of the customer. Personality or cultural fit will dictate how easily the solution provider can synergistically work with customers and to support their needs without causing undo difficulties and friction.
- ***Domain Expertise***—The solution provider's domain expertise plays a major role in the success of a PLM implementation project. Many companies have found out the hard way that there is no substitute for good, solid, and extensive industry experience within the solution provider and their implementation resources. Time and time again, engineering-centric companies have struggled to explain their issues and requirements to solution providers that don't understand product development and other engineering-centric PLM requirements. Not only does the lack of domain expertise jeopardize the success of the implementation, but it also is embodied in the solution's functionality, or lack thereof. Ultimately, it is difficult for a solution provider with manufacturing-centric domain expertise to use its knowledgebase to define and deliver best-in-class engineering-centric functionality.
- ***Financial Soundness***—The solution provider's financial stability is another important factor in undertaking a long-term relationship because this stability provides assurance that the solution provider's products and services will continue to be updated and supported. Financial success can be measured by the solution provider's size, performance, and longevity in the market.
- ***Innovation Ability***—A solution provider's ability to innovate is often driven by financial success and an interest in maintaining a strong customer relationship. Innovation is the key to ensuring that their customers will continue to have access to up-to-date solutions that support their business requirements well into the future. The solution

provider should demonstrate flexibility, adaptability, and a vision that encompasses their current offerings and provides a direction for innovation, including the continued incorporation of best practices into their solutions.

- ***Services Offered***—Services are a key element of beneficial solution offerings. The solution provider's ability to provide consulting and implementation services designed to enhance the implementation and adoption of their solutions is key topic. By providing appropriate supporting methods (i.e., services that deliver appropriate solutions and domain expertise in a meaningful manner), and the ability to support the ongoing use of their solutions in the long-term, the solution provider creates ongoing value to the implementing organization.
- ***Solutions and Technologies Offered***—The solutions and technologies offered by the solution provider and their fit in a company's business model are obviously important parts of any PLM selection process. As a result, it is imperative that the product offering being considered satisfies an organization's most immediate requirements, and that it can scale as the company's requirements change and expand.
- ***Geographic Distribution***—Geographic distribution determines the solution provider's ability to support an organization's operations. If the solution provider does not have a presence and sales and support capabilities in all of the places in which an organization operates, it will be more difficult and possibly more expensive for an organization to gain maximum benefit from the PLM solution.

Evaluating PLM solutions involves investigating the solution provider as well as their technologies and their fit with a company's business operating model (i.e., engineering- or manufacturing-centric). This complicates the selection process, but is essential to achieving improved performance and rapid payback. There are some fairly easy steps an organization can take during its PLM selection process to assure that the solution provider can provide the level of service and support needed.

First, as in any strategic software acquisition, an organization should have a broad vision that is based on real business requirements that are linked to their business strategy and operating model. The selection process should then be linked to the vision that is clearly communicated to prospective solution providers. A solution provider's reaction to the vision usually provides a good insight into their ability to support the true business requirements.

An organization should interview and exchange ideas with the solution provider's management team as well as their sales and support personnel. One area to probe is how well the solution provider understands the industry segment in question (e.g., do they have the appropriate domain expertise), the peculiarities of how specific business processes operate in that industry segment (e.g., in an engineering-centric or manufacturing-centric manner), the companies they have worked with in the industry segment, and robustness of the template and applications embedded in their system that are applicable.

In addition, an organization considering a particular PLM solution should be sure to compare return on investment calculations of the various systems they are considering as applied to their specific business requirements. It is important to remember to model all the costs and benefits for each candidate's solution. Companies that look to leverage their investment in their existing systems often believe that since they already have the necessary PLM licenses implementation must to cheaper than purchasing another solution. Unfortunately, this is often not the case when a full benefit analysis is performed. Finally, they should also pilot not only the software system—its functionality and scalability, but also the support, services, and training of the solution provider.

7. Conclusion

In summary, engineering-centric PLM solutions need to be designed to manage the iterative process of product and process definition. Many refer to this as the management of the product definition lifecycle or the intellectual assets of an enterprise. In this lifecycle, people who work within the enterprise take their knowledge and transform it into a reproducible form. This environment is quite dynamic, and as a result, PLM solutions from engineering-centric solution providers have typically been designed to handle rapid change, both changes that impact the enterprise as well as changes that must be incorporated into the way the PLM solution itself operates.

PLM support is also delivered through some ERP systems, but it should be remembered that ERP systems development has been focused on the establishment of scalable systems designed to manage the product production lifecycle and the physical assets of an enterprise. A key characteristic of ERP systems has been to take the virtual definition of the product, the intellectual assets of the product lifecycle, and transform them into physical assets—some product or service that is purchased by the enterprise's customers. In support of this process, ERP systems have typically evolved into very orderly systems that can do much to streamline and optimize the operations of an enterprise, but typically lack the scope of flexibility that is preferable to successfully

manage the ever changing environment of product design and development; the world of knowledge capture and management.

In typical F&A manufacturing companies, there is a major role for both engineering-centric PLM solutions and ERP solutions. The key is to define the dividing line between ERP (focused on product production) and PLM (focused on product design). Unfortunately, this line is not the same from company to company, and many times, not even from division to division within a company. One of the best ways to understand where this line should be is for the company to understand if its business-operating model tends to be more engineering-centric (product definition focused) or more manufacturing-centric (product production focused). CIMdata's experience and research has shown that once this is understood, defining the dividing line is much easier. This dividing line is where PLM and ERP are balanced in such a manner that optimizes the benefit to the enterprise.

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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