

*IEs can be strategically positioned to
bridge the gaps
in PLM implementation*

Product lifecycle management and you

BY JASON ROSEN

DESPITE ITS FUNDAMENTAL ROLE IN THE MANUFACTURING enterprise, the field of product lifecycle management (PLM) has not been given sufficient attention by the IE profession. The essence of PLM is not new and neither is the core functionality offered by supporting information systems, yet many design and manufacturing companies do not utilize these tools and methodologies in the best possible way.

Industrial engineers possess valuable skills that can help organizations make significant progress toward achieving the considerable benefits of PLM.

Definition and evolution of PLM

Product lifecycle management is a term that has evolved over time. With the avid support of software vendors and busi-

ness consultants, it has been repackaged from product data management (PDM), document control (DC), engineering documentation control (EDC) and numerous other less-persistent acronyms. This multitude of terms and abbreviations along with the mix-up between the discipline itself and the supporting information systems has led to much confusion regarding the substance of PLM. Furthermore, the confusion has subsequently impeded the standardization of the field, which could have led to more widespread implementation in the workplace.

The current consensus surrounding the meaning of PLM as a discipline is defined by John Stark in *Product Lifecycle Management: 21st Century Paradigm for Product Realization* as “the business activity of managing a company’s products all the way across their lifecycles in the most effective way.”

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While this definition is very wide and open to interpretation, note the similarity to Frank Watts' more focused definition of configuration management in his *Engineering Documentation Control Handbook* as "... a process approach to planning, identifying, controlling and tracking a product's configuration from its inception throughout its life with minimum cost."

It could be said that for practical implementation purposes, the modern day buzzword "PLM" is essentially a beefed up version of CM with engineering document control at its core.

In this respect, PLM is not a new concept. However, in today's highly competitive and complex product development, manufacturing and business environments, its importance and useful application are more crucial than ever before.

Marked by the enthusiastic propagation by Eli Whitney, the foundations of CM were laid in the beginning of the 19th century with the widespread adoption of the concept of interchangeable parts. The groundbreaking meaning of this concept was that a complex product could be assembled from independently manufactured parts according to an accurately documented process. The use of parts that were manufactured independently of the final assembly according to precise specifications contrasted greatly with the previous practice of artisan industry, where one highly skilled individual would personally and directly control the entire process of small-scale design and production.

Enabling breakthrough efficiencies in the manufacturing process, interchangeable parts became one of the foundations of the "American system of manufacturing" and subsequently contributed greatly to the Industrial Revolution.

The utilization of interchangeable parts prescribed the use of precise technical documentation that was to be created and shared by multiple participants in the design and manufacturing process. The reliance on this documentation necessitated effective control. Thus, the discipline of EDC or CM was born, later to evolve into current day PLM.

CM comprises two main processes: documentation release and documentation change control. Karl T. Ulrich and Steven

D. Eppinger in *Product Design and Development* provide a very useful overview of the product development process. Adding the Ongoing Production and Phase Out stages, the full product lifecycle can be described as being made up of the main stages in Figure 1.

Practical PLM can be described as consisting essentially of CM with the addition of a higher-level management of the products' progress along its lifecycle. For example, we manage the release status of the hundreds of individual components and their associated documentation while managing a higher-level "new product introduction" (NPI) process for the entire product at the relevant stage in the lifecycle (See Figure 2).

This simplified view is convenient for understanding the concept of PLM; however, it disguises a higher level of complexity resulting from the fact that the "documentation" we are releasing and controlling is varied, with each type requiring slightly different mechanisms of control. Types of documentation include not just drawings and specifications but also bill of material (BOM) data, approved manufacturer lists (AML), compliance data and a wide variety of electronic file formats.

The importance of control

The goal of control is to make sure the right version of the documentation is used by the relevant party at the right time. Lack of control can take many forms: Documentation is not available to those who need it; it is difficult to determine whether

NEW PRODUCT INTRODUCTION

1. Documentation release
 2. Change control
 3. High-level management of progress along the product lifecycle
- } Configuration management

Figure 2. The three main processes of PLM

PRODUCT LIFECYCLE STAGES

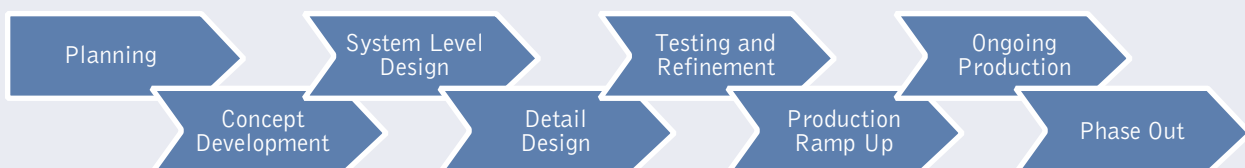


Figure 1. The eight stages of the product development process

ENTERPRISE SYSTEM MAP

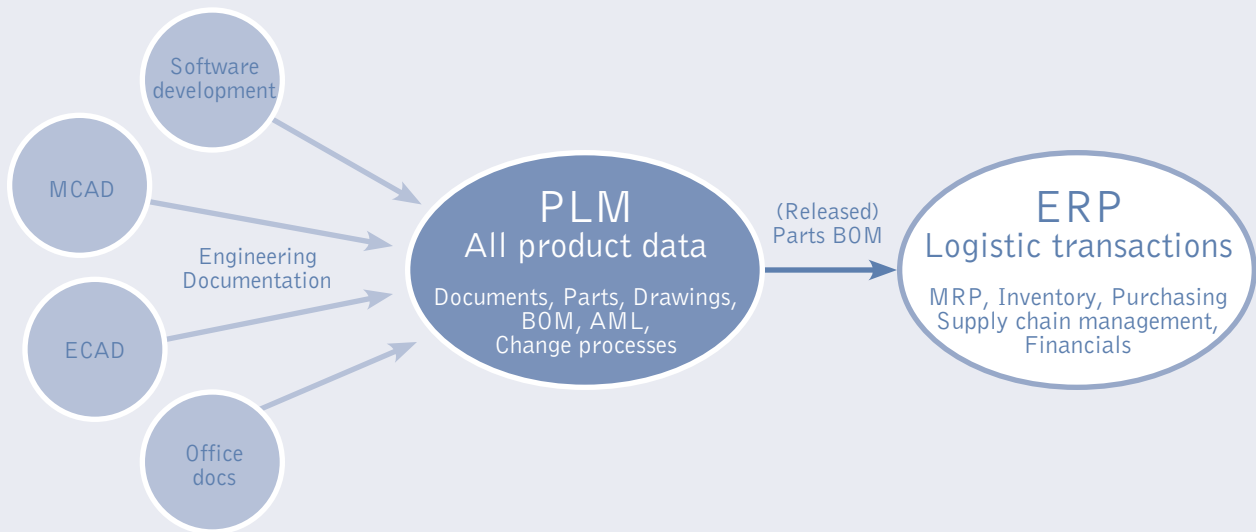


Figure 3. PLM systems are used as one of the three cornerstones of enterprise systems.

the available documentation is updated; or the documentation is not secure. Whatever the reason, these phenomena can have disastrous results through wasted time, costly scrap and rework and loss of intellectual property.

Control is established through two fundamental mechanisms:

1. A central and secure data archive
2. Well-structured and enforced processes and procedures for the creation, release and change of all forms of product data

With the development of business computing, most of these mechanisms can be addressed effectively by careful implementation of information systems.

Supporting information systems

Like many other data management requirements, PLM lends itself naturally to the utilization of information systems.

In the early days of business computing, corporations with the means and know-how engaged in developing homegrown applications to support various aspects of PLM: one program to manage drawings, another for part number generation and a third application for engineering change order processing. As dedicated commercial systems began to emerge, these disparate solutions often were consolidated into one central system.

Commercial PLM software systems (originally called PDM) tend to originate from two main sources:

1. CAD (computer-aided design): Systems that were originally intended to manage the engineering work-in-process design files and approval processes (typically in organizations with a large mechanical engineering department) expand into the cross-functional domain by including engineering change order process capabilities and interfaces with enterprise resource planning.
2. BOM: Systems that focus on product-level configuration management and cross-functional change control processes that begin to offer improved connectivity to the CAD world.

Either way, PLM systems are used as one of the three cornerstones of enterprise systems in manufacturing organizations, along with enterprise resource planning and customer relationship management (See Figure 3).

Regardless of the roots of a particular system, most PLM systems include the following basic functionality:

1. Secure vault for all product-related documentation
2. Item and document classification, including part number generation
3. Approved manufacturers and manufacturer item management
4. BOM management
5. Change control processes — engineering change requests and orders

Additional areas of functionality include compliance management, project management, costing and interface with

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CAD, and enterprise resource planning.

The Internet has brought important, although sometimes overrated, improvements. Most significant is a built-in capability to support collaboration with the extended supply chain — suppliers, manufacturing contractors and design partners — all of whom require ready access to current engineering documentation and can contribute greatly when directly involved in change control processes.

The Internet also has eased some of the technical issues involved with PLM system deployment, although I'm sure many would agree that Web-based applications still suffer from inferior graphical user interface functionality when compared with "thick client" applications.

Furthermore, the Internet age has contributed the more recent Software-as-a-Service (SaaS) software architecture that enables businesses without highly developed IT infrastructure and resources to access state-of-the-art PLM system functionality.

The gaps and what IEs can do about them

Despite the relative maturity of both the PLM discipline and the supporting information systems, significant gaps continue to exist with respect to the widespread implementation of both in the workplace.

Large corporations, particularly those required to follow configuration management procedures in accordance with Department of Defense regulations, have been executing CM and using supporting information systems for decades. These same organizations have become accustomed to the considerable investment that proper PLM entails in terms of expertise and general attention, in addition to the application of appropriate resources.

The same cannot be said of a vast number of smaller design and manufacturing organizations where the PLM culture has not laid roots. The reasons are as follows:

- Lenient industry requirements do not force companies to

ADDING PLM TO THE IE CURRICULUM

Shamoon College of Engineering (SCE) in Israel has introduced its industrial engineering students to PLM as an integral part of their undergraduate education. A course on engineering design management teaches PLM and gives students hands-on experience with a commercial PLM system.

Professor Zohar Laslo, the dean of industrial engineering at SCE, comments, "PLM is the conduct codex

of modern industry. Practitioners who are not aware of the principles of this body of knowledge are certain to encounter difficulties when faced with the need to operate in an industrial environment. We aim to provide our students with powerful tools to bring to the workplace, and PLM is certainly one of them."

Engineering design management is currently a required part of the curriculum for industrial systems majors at SCE but is offered as an elective course to all IE majors.

The course covers various topics relating to managing the product lifecycle, such as planning new product projects, developing product concepts, design for manufacturing and configuration management. One of the highlights of the course was made possible through the cooperation of PLM software provider Arena Solutions.

Throughout the course, student



The students use Arena software to manage product data, such as this bill of materials.

teams conduct a new product project, beginning from the concept stage and ending with the processes involved with ongoing production of the finished product.

The teams use Arena to manage all product data: the development project, associated documentation and drawings, parts, BOMs and AML data. Configuration management is demonstrated through the utilization of online request and change processes.



Students at the Shamoon College of Engineering in Israel learning about PLM

commit to high-level CM and thus enable managements to allocate scarce resources elsewhere.

- Expertise in the PLM discipline is not easily identified with a particular profession, leading to the field being orphaned from having a natural champion in the organization.
- PLM system costs and complexities constitute major obstacles in the way of adopting these technologies.

The negative effects of not implementing PLM do not spare these organizations: They suffer from less efficient and less effective product lifecycle processes, higher costs, wasted resources and longer time to market.

The IE skill set is the perfect match for the challenges commonly encountered on the path to PLM implementation. What makes IEs so well-suited to contribute in this area? They have three main skills that constitute substantial components of the typical IE education:

1. Systems thinking. Strict CM procedures aim at guiding the involved parties to consider all possible important implications of the various processes. If such consideration came naturally, there would be no need for predefined procedures. In industries that do not require adherence to such demanding guidelines, healthy systems thinking can compensate for the lack of explicit direction. IEs are accustomed to taking a systems approach to organizational processes and are thus excellent candidates for applying it to PLM.

2. People-orientation. PLM encompasses a wide variety of cross-functional activities. It is common for tensions to exist between departments regarding the product data and processes. Such tensions sometimes can become fierce and are a logical outcome of a reality in which individuals from different departments have different perspectives and priorities relating to the same product. IEs are trained in the skills to understand, adapt and communicate effectively with people who work in a variety of capacities, from the stock room to the board room. Such “people skills” can be applied as effective tools in facilitating open communication between departments.

3. Information systems. Modern PLM can be supported effectively by enterprise information systems. Much has been written about the complex and challenging task of implementing and maintaining such systems, mostly in the context of enterprise resource planning. IEs with an information systems background have the advantage of a deeper understanding of the PLM discipline and organizational context in addition to the ability to carry out information systems projects of this scale.

Conclusion

Although the PLM discipline and supporting information systems have been around for quite a while, gaps still exist on the road to widespread implementation in the workplace. With the proper direction, IEs can be positioned to apply their unique skills to bridging the gaps toward effective and efficient PLM. One way to achieve such positioning is to include PLM in the regular IE curriculum at universities and colleges so that IEs entering the workplace are well-equipped to deal with increasingly complicated product lifecycle environments. ✨

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