Introduction

The recent history of manufacturing IT can be viewed as two overlapping technology waves. The first wave came in the 1990s with the rise of ERP (enterprise resource planning), as companies worked to increase the efficiency of their operations and better manage the supply chain. Today, product life-cycle management (PLM) is leading a new wave—this one focused as much on accelerating innovation and supporting global collaboration as it is on driving process efficiencies to improve business performance.

When ERP and PLM solutions are delivering maximum value, they help companies develop the best products possible and deliver them to their customers efficiently. But how do you ensure that ERP and PLM are delivering maximum value? And which of these two enterprise solutions is better suited to address which challenges?

With the rising adoption and expanding reach of PLM in recent years, it has become increasingly important for manufacturers to understand the relative strengths of PLM and ERP in addressing critical business needs, and what added benefits PLM brings to the enterprise. At PTC, we believe that each solution has a critical role to play, and this paper presents our thoughts and insights as to how those roles align with each other—and why they will become more integrated and more interdependent in very short order.
A historical perspective

In the early 1990s, manufacturers began to see the value of having a single, enterprise-wide software suite that integrated all the major functional areas of the business, including manufacturing, logistics, distribution, inventory, shipping, human resources and accounting. Vendors offering these suites—now known as ERP—promised better alignment of operations, improved planning and productivity, greater efficiency, and better visibility and control. Large manufacturers were quick to adopt ERP solutions, such as SAP and later Oracle. According to The McKinsey Quarterly, companies invested $300 billion in ERP solutions in the 1990s.

While companies were deploying ERP solutions to squeeze inefficiencies out of the manufacturing supply chain, PTC and other CAD/CAM-related vendors envisioned an equally far-reaching opportunity. As industries of all kinds embraced CAD tools, manufacturers were generating vast amounts of complex, ever-changing design data—data they wanted to make available to their suppliers and global collaborators.

Initially, PDM (product data management) worked well to keep track of the product design information. PLM then emerged in response to the need for better management of engineering processes and improved workflows in global, distributed supply chains via web-based applications. The realization that engineering data could be repurposed throughout the enterprise and beyond, to help optimize product designs, shorten time-to-market, and streamline downstream processes, transformed how products were developed.

These were formidable challenges. However, by the dawn of the new millennium, this ambitious vision—now known as Product Lifecycle Management (PLM)—began to be fulfilled. Today, companies around the world are using PLM to leverage the data generated in the product design and engineering process to accelerate innovation and improve productivity and efficiency—not only within the engineering department, but also across all ancillary and downstream functions involved in product development, from product analytics to service documentation.

The growing scope of PLM

Because they originated from different disciplines with different goals, and evolved at different speeds, ERP and PLM have, until recently, existed as largely separate entities. However, these formerly discrete realms are drawing closer together. Today, ERP systems consistently rely on product information supplied by PLM, so much so that several ERP vendors have begun to incorporate PLM capabilities into their offerings. Their objective is to help customers understand the impact of product design decisions on other areas, such as sales forecasting and labor resource planning. Meanwhile, PLM vendors see their value to the enterprise growing beyond the engineering department, as PLM’s strengths in collaboration and accelerated innovation have emerged as a strategic advantage—and major cost-saver—for many manufacturers.

IDC analyst Joe Barkai put it this way in a December 2009 article in Managing Automation: “We will see more and more PLM companies encroaching into what has traditionally been ERP territory.” The author of the article, Stephanie Neil, elaborated on that theme, writing, “Today, there is a much broader working definition of PLM as it begins to touch sustainability efforts and the supply chain, two areas that have become key components of the product lifecycle.”

As the definition of PLM has broadened along with its impact, many manufacturers are unclear about how to develop and implement a strategy that enables their companies to derive maximum benefit from both ERP and PLM. PTC believes that both have critical roles to play, and that the proper coordination and calibration of these roles can add value beyond what either can deliver alone.
Challenges facing manufacturers today

To understand the proper roles and respective strengths of ERP and PLM, it’s helpful to begin by looking at the critical challenges companies are trying to solve by using these solutions. These challenges include the need to:

• Increase productivity
• Improve asset utilization
• Develop higher quality products at lower cost
• Increase the number and variety of products, without driving up costs and negatively affecting delivery schedules
• Deliver products that meet customers’ demands
• Coordinate the work of global, diverse, cross-functional development teams
• Enable and accelerate innovation
• Comply with corporate standards and procedures
• Implement company initiatives across the enterprise
• Ensure regulatory compliance
• Support sustainability initiatives

Both ERP and PLM can—and should—play key roles in addressing these challenges, but it’s important to understand their respective strengths. That understanding begins with a look at ERP’s and PLM’s different origins.

The DNA of ERP

ERP was developed in response to the “islands of automation” problem: companies had deployed a variety of stand-alone departmental software products that were not integrated. This lack of integration caused major inefficiencies in business operations, particularly in the area of supply chain management, which depends on a smooth and reliable flow of materials data from one functional area to the next. Without this integration, organizations could not plan and schedule resources properly, leading to the over- and under-inventory of parts and finished products, procurement difficulties, manufacturing scheduling issues, order fulfillment and distribution problems, and so on throughout the supply chain.

ERP filled a serious need in the marketplace by providing companies with an enterprise-wide solution that spanned and linked all the key operational functions and departments. This linkage has enabled manufacturers to integrate their manufacturing and supply chain processes to reduce delays and increase efficiency. This is ERP’s primary source of value.

ERP solutions, which grew out of accounting software products, are primarily focused on physical assets and the flow of materials, and this “DNA” is reflected in the attributes and requirements of ERP solutions. ERP solutions perform particularly well when managing recurring transactions. And, since ERP solutions are geared toward planning and accounting for production, they only require whatever information is necessary for production.

For example, if a lawn-tractor manufacturer purchases fully assembled engines for its tractors from an engine supplier, its ERP solution does not need to know all the details about the individual components that comprise the engine. For the ERP solution’s purposes, the engine is a single part. The ERP solution can perform its planning and accounting functions perfectly well without further detail.
These attributes and requirements make ERP especially effective at executing and optimizing manufacturing and distribution processes involving well-defined physical assets. However, as its common characteristics suggest, ERP is less effective than PLM at managing design changes and is unsuited to enterprise activities that involve less tangible, but more strategically vital, assets, such as the intellectual capital typically found in product data and the product’s bill-of-materials (BOM).

**Common attributes of ERP include:**

- Execution-focused
- Repeated transactions
- Inventory/order lifecycles
- Controlled, well-defined business processes
- Simple BOM hierarchy
- BOM to procured part/assembly level
- Released versions
- Central theme of control
- Order/supply/demand-focused
- Rigid data model
- Structured data
- Hierarchical data relationships
- Data mining
- Text-based with some static 2D and 3D images

**The DNA of PLM**

PLM arose in response to the growing needs of product design organizations, as they struggled to manage, synchronize and share increasingly complex, interdependent CAD files among global teams involving both internal and external members. They needed a power tool to keep the team collaborating effectively, and required capabilities beyond those of PDM to serve as a “data vault” for product designs. PLM enabled product engineers to work and rework products to optimize designs – and with the rise of the Internet, to collaborate on that goal globally, in real time.

As product-development solution vendors—most of whom came from a CAD software background—created solutions to enable better collaboration on a global scale involving distributed supply chains, new needs were revealed. Vendors realized that all the data generated in the process of developing products had to be captured, continuously updated, and made accessible to all team members in usable formats. Because of the iterative nature of design, and the complexity of products incorporating many mechanical, electrical and software components, the product data vaults of these organizations had to be powerful and flexible enough to link multiple layers of data, as well as robust and dynamic enough to support frequent change.

In addition, as the nature of product development became truly global in response to low-cost outsourcing and emerging market opportunities, vendors had to accommodate demands for more product configurations, and be able to manage the multiple CAD systems used in increasingly complex product structures.
In the process of providing these capabilities to global engineering teams, solution vendors also became aware that the digital product data being captured throughout the design cycle was of tremendous value to upstream processes and to future design work. Furthermore, the PLM paradigm they were developing could act as both a platform and an engine to guide the entire product development process.

These solutions could also provide management with visibility into product development processes, for better-informed decision-making earlier in the lifecycle. The ability to make changes early, while the products are in a digital state in the PLM system, results in tremendous savings, when compared to the cost of making changes once the product is released to manufacturing and in production.

Over time, PLM evolved into a flexible, dynamic environment adept at managing both product knowledge and data from a variety of sources, while making it accessible across the enterprise.

By capturing and synthesizing the complex and diverse volume of data generated throughout the design and engineering process, PLM provides a means for better understanding—and better aiding—innovation and collaboration, and their related functions.

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Common attributes of PLM include:

- Innovation-focused
- Creation, design, iteration and revision
- Dynamic change management
- Visibility across the entire product lifecycle
- Disciplined, but flexible design processes
- Complete BOM management (combined MCAD, ECAD, and software content in a single product structure) spanning as-designed BOM, as-planned BOM, as-serviced-BOM, as-built BOM
- Full product structure to component or raw material level
- Product and process iterations, revisions, and decision history
- Central themes of speed and managed creativity
- Focus on design/requirements/configuration/project/program
- Flexible data structure
- Documents, structured and unstructured information, metadata
- Complex design relationships; dynamically related, networked data relationships
- Knowledge search and retrieval; geometric search
- Visual, 3D models, simulation, animation
What PLM brings to ERP customers

Even for manufacturing companies that have deployed ERP successfully, many areas of product development are beyond the reach of ERP. That’s because ERP solutions are not equipped to handle the complexity and dynamic nature of engineering data. ERP solutions must wait until product designs are finalized before information can be shared with downstream functions or suppliers. PLM solutions, on the other hand, allow managers and designers to design, test, update and refine every detail of the ultimate physical product while it still resides in its digital state. This difference allows staff, not only in engineering, but also in related functions such as manufacturing, quality, purchasing, and service, to work concurrently and address issues in their Web browser before production even begins, resulting in both time and expense savings and a higher quality product.

Even more significantly, PLM facilitates and streamlines the process by which products are developed. In turn, it creates the framework for ongoing continuous improvement. PLM also brings more stakeholders into the process, helping to ensure that key product criteria and customer requirements are met.

These activities are beyond the capabilities of ERP. By enabling companies to harness the power of innovation, PLM can have a larger and more lasting impact on business performance than ERP, which can only address expenses. Innovation drives greater added value, which, in turn, drives both revenue and profitable growth.

How PLM works with and improves ERP

While the primary focus of PLM has been the product development process, many organizations have seen PLM make a positive impact on their ERP-supported operations, as well. This is because PLM defines BOMs in a comprehensive way that ERP solutions cannot. This, in turn, has a positive effect on the efficiency of ERP and supply chain activities. As Gartner Group, Inc. put it recently:

“In addition to PLM’s inherent value, PLM decisions have strong influence on the business model and benefits that can be realized by ERP, SCM and CRM applications in downstream business processes; in that sense, PLM is the most fundamental business application in manufacturing. Since PLM fundamentally defines bills of materials, it influences the efficiency of ERP and supply chain activities.”

It’s important to note that companies can capture all of these benefits today—without the need to integrate their ERP and PLM solutions. However, the potential benefits of ERP and PLM, in combination, can be expected to grow as ERP and PLM are integrated to enable bi-directional information-sharing, and as PLM takes on more product-related processes over time.

Another important distinction between PLM and ERP is that PLM capabilities are leveraged throughout the product lifecycle, beginning at the critical early design stages and extending into manufacturing process management and other ancillary functions. An ideal ERP/PLM integration leverages the strengths of the PLM system to manage and update all engineering content and processes and all of a product’s BOM states: as-designed BOM, as-planned BOM, as-serviced BOM, as-built BOM—as they extend into other functional areas. ERP systems, on the other hand, focus on the operational aspects of the physical product. (See areas of focus in the chart below.)

Distribution of ERP/PLM Processes and Responsibilities

Why is it beneficial to integrate PLM and ERP systems? Because this integration links together the critical upstream and downstream processes and data between classically disparate user groups who work in different enterprise systems.
An ideal integration environment provides a bi-directional framework and reliable closed-loop transaction management, and allows for the release of all pertinent business objects from one system to the other.

**PLM/ERP integration going forward**

Today, many manufacturers are integrating PLM and ERP to improve efficiency and quality. While these organizations may be initially motivated by a desire to eliminate the inefficiency of re-entering data, along with the human error that can accompany it, the benefits go well beyond that. Organizations can also ensure that BOM data, captured by the PLM system, is made available to all functions that need it. And, because the PLM system can provide routing and manufacturing process plans as well, critical upstream and downstream processes are linked and made more efficient and productive.

For the vast majority of manufacturers, the question should not be ERP or PLM, but how to most effectively implement and integrate these two solutions. Choosing the right ERP and PLM systems for the business is crucial, and manufacturers should not have to compromise on the benefits of either to fully realize the value in both. The value begins when product development and execution processes are no longer implemented as islands, and the functions of PLM and ERP are deployed in a seamless, end-to-end solution.

Through the well-executed integration of ERP and PLM, companies can develop a smooth flow of major innovations such as new and more highly differentiated products, as well as ongoing business innovations like continuous cost and quality improvement.

Integrated ERP/PLM systems help deliver value across the entire range of innovation, while providing the continuous controls a modern manufacturing enterprise requires. This integration can provide a significant competitive advantage, as it drives nimble manufacturing, enabling manufacturers to quickly and confidently make the most of every significant and niche market opportunity.

For organizations that are still on the fence regarding the value of adding PLM to their ERP strategy, it’s time to re-examine PLM’s impact in modern manufacturing.

Visit PTC.com/go/plm for more information.

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