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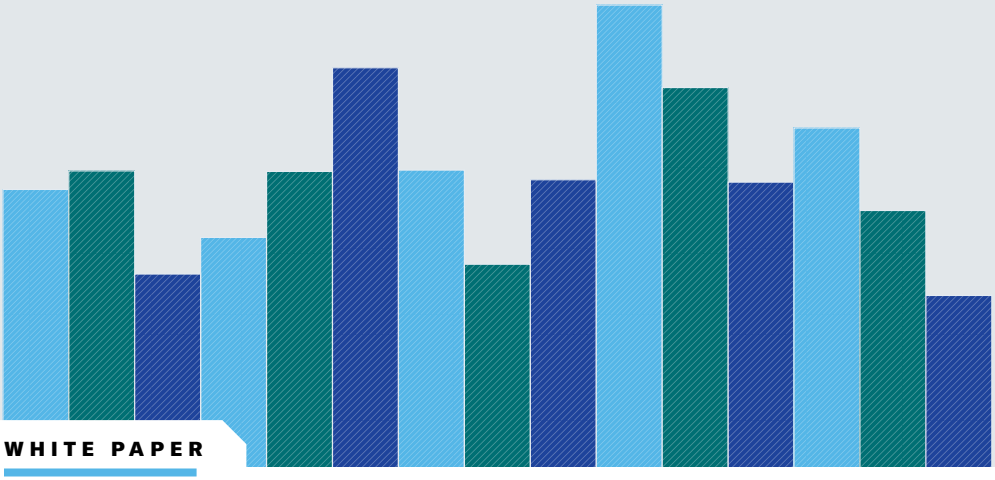

WHITE PAPER

Product Lifecycle Management: A Catalyst for Business Transformation

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In a world of finite resources, we are all looking for ways to harness the power of technology to do more with less—less labor, less money, and fewer resources. Fortunately, we have options. With new ways of working and cloud technology, we're seeing the pace of digital transformation accelerate across industries, including manufacturing.

At Autodesk, we believe that digital transformation begins with the convergence of design and manufacturing disciplines, putting data at the center to connect entire organizations. We were the first design and make company to bring integrated product development to the cloud, and we're committed to this journey with our customers. For manufacturers and supply chains, the cloud is no longer an option but rather a critical component of keeping teams connected and businesses operational.

In the past, product lifecycle management (PLM) systems were a luxury affordable only by larger businesses and associated with expensive implementations and hardware maintenance. Today, cloud PLM brings data and process management capabilities to any size organization, enabling collaboration across the value chain and unlocking the power of automation and insights.

According to this new research from Harvard Business Review Analytic Services, PLM is a catalyst for business transformation. Data connects the product life cycle end to end. Automation eliminates the delays of working manually and can exponentially accelerate product development across all processes and departments.

The cloud significantly expands the business value of PLM by making connected data and processes more accessible throughout the manufacturing ecosystem—saving time and effort for all involved. And with this comes the promise of greater efficiency, more effective work streams, and ultimately the promise of leveraging technology to do more with less where it matters most.

Derrek Cooper
Vice President
Autodesk

Product Lifecycle Management: A Catalyst for Business Transformation

These are challenging times for manufacturers; consumers are demanding high-quality and personalized products at record speed, supply chain disruptions and constantly evolving consumer demands call for unprecedented agility, and siloed and unstructured data is making it harder than ever for disparate teams to share knowledge and timely information.

Complicating matters is the fact that many organizations are relying on manual processes and outdated systems, such as local file drives and email, to manage all the information and processes associated with each stage of a product's life cycle, from the raw materials used to build a product to the changes made to a product's design. The results include increased risk of manufacturing delays, product defects, time wasted on non-value-added processes, and missed opportunities for market growth.

In response, many organizations are deploying technology to manage the life cycle of products to help them capture, process, and communicate product knowledge across their organizations. This technology, known as product lifecycle management (PLM), works by automating data and process management workflows and organizing design and engineering data in a single centralized system. With this central source of data, teams that include professionals ranging from engineers and product developers to third-party stakeholders can easily collaborate in real time for faster time to market, improved product quality, and greater agility.

"Companies want to conduct product life cycle management in the most profitable, cost-effective, strategic way they can," says Morris Cohen, professor of manufacturing and logistics at the Wharton School, University of Pennsylvania. "But it's a tricky thing." In fact, the PLM market grew from nearly $60.6 billion in 2021 to $66.6 billion in 2022, according to a 2023 report from CIMdata, a global strategic management consultancy in Ann Arbor, Michigan.[1]

HIGHLIGHTS

Many organizations are **relying on manual processes and outdated systems**, such as local file drives and email, to manage all the information and processes associated with each stage of a product's life cycle.

In today's highly competitive landscape, product lifecycle management (PLM) **must do more than simply manage the design and engineering data** contained within computer-aided design files.

Today's **cloud-based PLM technology** can document, track, and review everything needed to build a product; record and control the countless revisions made to a product throughout its entire life cycle; provide global supply chain partners with easy access to critical information; and ensure quality control with automated workflows and consistent metrics.

"Quality starts with how you design and how you define the requirements for a part or a product," says Brian Meeker, a principal with Deloitte Consulting.

But in today's highly competitive landscape, PLM must do more than simply manage the design and engineering data contained within computer-aided design files. Rather, using a flexible, cloud-based solution, manufacturers can digitize processes as well as build accountability and traceability across their product development process. Whereas yesteryear's PLM tools supported linear processes with limited visibility, today's cloud-based PLM technology can document, track, and review everything needed to build a product; record and control the countless revisions made to a product throughout its entire life cycle; provide global supply chain partners with easy access to critical information; and ensure quality control with automated workflows and consistent metrics. The result is broader visibility across all stages of the product development process for a faster time to market and greater flexibility.

From a competitive perspective, PLM's key capabilities—bill of materials (BOM) management, change management, supplier collaboration, and quality management—promise to help manufacturers manage business-critical processes while charting a product's journey, from initial ideation and development to after-service and disposal, for significant business advantages.

This report examines the challenges manufacturers face, including supply chain disruptions and complex product development processes; the increasing need to automate data and process management workflows using cloud-based PLM technology; the competitive advantages of working from a central source of information, such as improved product quality and faster time to market; and the best practices required to benefit from PLM technology.

A New Approach to Processes

Once a rudimentary manufacturing tool, PLM is now widely considered table stakes for enterprises that want to accelerate their business processes, increase efficiency, remove product development collaboration barriers, and fuel agility.

"It's hard to survive without PLM if you're a manufacturer," says Felix Nyffenegger, a professor of PLM at the Eastern Switzerland University of Applied Sciences in St. Gallen, Switzerland.

Fueling the need for PLM is the growing amount of high-quality data generated by enterprise systems and manufacturing processes. In the past, many organizations relied on email and Excel spreadsheets to exchange critical product information—a risky approach that often resulted in "a loss of knowledge," according to Nyffenegger. Consider, for example, an engineer mistakenly sending an attachment with outdated or missing product specifications to a design team.

PLM, on the other hand, minimizes the risk of errors and miscommunication by allowing engineers to store today's vast volumes of product-related data in one central, accessible location. Team members can access the same, most-up-to-date version of product data and gain a complete view of each step of the product development process—visibility that can fuel more-informed decision making.

But centralizing data only touches on the power of PLM. A cloud-based PLM system can transform critical business processes in ways that promise to improve product quality, manage product changes, and drive greater supplier collaboration across a product's entire life cycle, from ideation and design to testing and production.

One of the most impactful uses of PLM is quality management. Oftentimes companies "measure quality after the fact," says Brian Meeker, a principal with Deloitte Consulting and global leader of the product engineering and development practice at Deloitte in Cleveland, Ohio. But discovering defects in a product after it's already entered the market can be a time-consuming and costly exercise. Case in point: in 2021, for the second year in the past decade, more than one billion units of automobiles, consumer products, medical devices, food, and drugs were recalled, according to Sedgwick's State of the Nation Recall Index report.[2]

PLM can reduce the likelihood of defects and improve time to market, product quality, and reliability by supporting a more proactive, collaborative, and data-driven approach to quality management.

"Quality starts with how you design and how you define the requirements for a part or a product," says Meeker. Yet suppliers are often excluded from these important processes. PLM rights this procedural wrong by providing suppliers with access to quality workflows, enabling them to work with engineers and designers to identify and source quality materials as well as analyze quality metrics to prevent issues from arising.

"Companies that collaborate with suppliers on all aspects of the product's design at the very beginning of the process

can significantly increase their chances of manufacturing it correctly,” says Meeker.

But even high-quality products “are subject to random failure,” warns Cohen of the Wharton School. For this reason, he recommends that organizations use PLM to analyze “data on how a product has performed in the field, which can provide engineers and designers with insights into how to improve a product.” Using after-sales service data to determine the root cause of an issue not only minimizes the risk of recalls and other costly remediations but also can improve design process efficiencies.

Tracking Change

Another way PLM is improving business processes is by better managing a company’s bill of materials—a comprehensive inventory of the raw materials, assemblies, subassemblies, parts, and components that make up a product.

“The structure of a company’s BOM is one of the most important factors for success,” says Nyffenegger, of Eastern Switzerland University of Applied Sciences. Yet managing BOMs is becoming increasingly complex as manufacturers diversify and personalize their products to cater to consumer demands and market fluctuations.

“Companies must deliver smart and connected products, be fast to market, and individualize their products based on what customers want, all of which can add complexity to a company’s bill of materials,” says Nyffenegger.

PLM addresses these complexities by managing BOM information across the organization in real time for easy accessibility and greater visibility. Engineers can create their BOM in the same application as the one used to manage design data. Using cloud-based PLM, the BOM can also be shared downstream with functions like procurement, manufacturing, and service, allowing teams with varying expertise to weigh in on a product’s design. If, for example, a supplier notes the scarcity of a particular component in today’s global supply chain, the design team can choose to replace this component with a more readily available alternative, thereby avoiding materials shortages and delays in the production phase.

Despite these advantages, managing changes throughout the entire product life cycle can be cumbersome. “It’s very easy to get lost” and lose track of a design’s various versions, warns John Stark, founder of John Stark Associates, a PLM consultancy in Geneva, Switzerland. “Change control is a big issue.”

Stark offers the real-life cautionary tale of a major automobile manufacturer whose faulty ignition switches were linked to dozens of deaths after an engineer failed to route a change request through the appropriate change processes.[3]

Today, the automotive and transportation industry accounts for the largest revenue share—20%—of the global PLM market, according to a 2021 report from Grand View Research, a market research company based in Maharashtra, India.[4]

"Unlike supply chains that move products slowly, one organization at a time, the ability of supply nets to facilitate information exchange simultaneously and instantaneously is huge," says Michael Grieves, executive director of the Digital Twin Institute.

It's easy to understand the automobile sector's adoption of PLM given the sector's commitment to product change and innovation. PLM allows teams to track product changes, including when, why, and by whom they were made, making it easier to implement changes and ensure that they are properly tested and validated. Revisions to designs, items, and records during the many stages of the product life cycle can be automated and documented for enterprise-wide visibility and traceability.

In fact, PLM-powered change management can serve "as a supply net for information so that everyone is in the loop" on engineering change requests, says Michael Grieves, executive director of the Digital Twin Institute in Cocoa Beach, Fla., and author of *Product Lifecycle Management: Driving the Next Generation of Lean Thinking*. "Unlike supply chains that move products slowly, one organization at a time, the ability of supply nets to facilitate information exchange simultaneously and instantaneously is huge."

This degree of visibility is especially critical in highly regulated industries. Just ask Louis Rivest, a professor at École de technologie supérieure in Montreal, Quebec. Rivest says that in the aerospace sector, product information is categorized according to its maturity level, such as "work in progress" or "released." Proper product definition management requires, he says, that "once information is released, you cannot modify it in a nonstructured way. You have to actually obey the engineering change process and change management process." By tracking change orders and change requests in real time, engineering and design teams can make modifications before they're locked in and subject to strict review processes.

More importantly, tracking the complete history of change requests and change orders can capture not only the modifications made to a product but also the thinking behind these changes—the hand-wringing and brainstorming that spur every innovation. PLM can provide a playback of how every decision was made, from the steps taken to select a product's raw materials to the criteria used to determine how best to distribute a product to consumers.

"Companies should document all of the paths that have been tried and did not work because, in the end, they want to have a product definition that can be questioned, and to know why they made a certain decision a year ago," says Rivest. "The intent is to capture the product definition in a very sound manner but also to capture why you made all these thousands of decisions."

Partnering with Allies

As the pace of decision making accelerates, there is a growing reliance on partners to provide valuable information and competitive insights. This need for greater collaboration is particularly evident when it comes to supply chain partners and their ability to help manufacturers navigate a challenging terrain defined by trade wars, raw material shortages, climate change, and economic uncertainties.

"It really behooves organizations to better collaborate with suppliers, because they can help them innovate faster, drive down costs, and reduce the amount of churn, or rework, in the design cycle," says Meeker.

Using a PLM's supplier collaboration capabilities, a supplier with access to product drawings, BOM details, and 3D visualization models can offer input in the early stages of the design cycle, such as how to replace costly components with more-affordable alternatives.

In addition to supporting product development, supplier collaboration can align the interests and goals of internal stakeholders with those of external suppliers. For example, inviting suppliers to collaborate during the request-for-quote process can lead to more accurate quotes and help set realistic expectations regarding product outcomes. And storing accurate and up-to-date information on suppliers in a single system can provide a quick snapshot of a supplier's overall performance and strategic importance to an organization—a critical advantage when a manufacturer must switch suppliers in response to an emerging crisis.

Although not necessarily a business workflow like quality management, BOM management, or supplier collaboration, business decision making is at the crux of every phase of the product life cycle. Decisions must be made at each stage, from selecting raw materials to determining after-sales support, and even small decisions can have a significant impact on the success of a product. Time is also of the essence; the faster the right decisions are made, the faster a product can reach the market, increasing efficiency and reducing costs. Decisions must also be made collectively in today's global economy.

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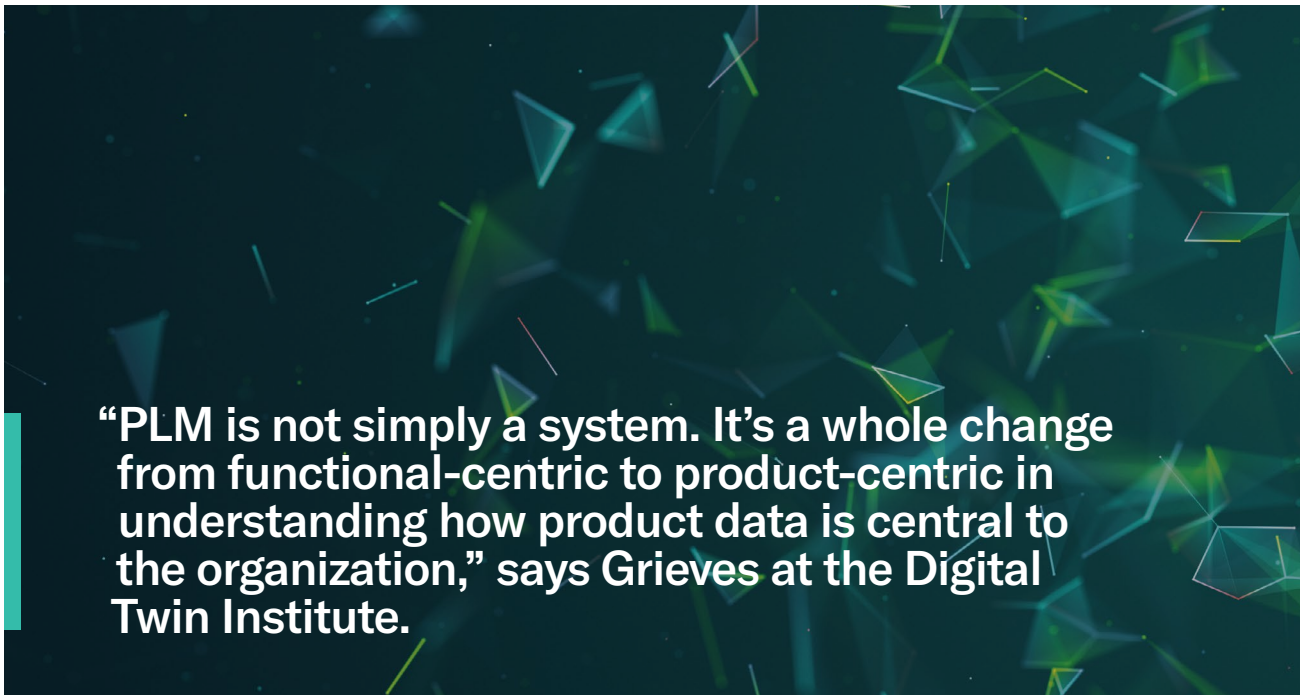


“One of the big challenges in manufacturing is coordination,” says Cohen. “There are many different stakeholders and players with different objectives, data, and opinions. You have to arrive at a consensus to make decisions.” A PLM system can tackle “this challenging task,” he adds, by giving multiple stakeholders access “to the same information so that there’s only one version of the truth” used to make decisions.

The advantages of this collaborative approach to PLM are twofold. First, when multiple stakeholders have access to a single set of data, they are more likely to reach a consensus on time-sensitive matters. Second, collective decision making invites outsiders to contribute ideas drawn from their own unique experiences in ways that can spark innovation and broaden the scope of product development.

And in much the same way PLM can solicit input from external stakeholders, so too can it draw interest from skilled workers. By eliminating “mindless paperwork” and automating processes such as BOM management, PLM is becoming increasingly “attractive for retaining talent,” says Grieves of the Digital Twin Institute.

A Challenging Perspective

The promise of PLM is to minimize the complexities of product design, development, and decision making in today’s fast-paced marketplace. Manufacturers are taking note, embracing PLM systems at a rapid clip.

“PLM makes processes more collaborative across the entire organization so that manufacturing, supply chain, marketing, and even finance can interact with engineers in a way that is most effective, improving the overall efficiency of how companies develop new products,” says Meeker.

But embracing best practices that recognize the transformational power of PLM, along with its challenges, is imperative for success. For starters, an on-premises PLM system demands a hefty investment in both IT infrastructure and talent, placing it out of financial reach for smaller enterprises. As a result, Grieves says, “an affordable cloud-based solution is a requirement for smaller manufacturers to access the capabilities they need.”

A shift in mindset is also key when it comes to deriving long-term value from PLM. “Unfortunately, many organizations think of PLM as a technology and not a business transformation,” says Meeker. In its most basic terms, PLM technology streamlines the management and tracking of product-related data and processes from inception to service maintenance. But if executed properly, it can also revolutionize the way teams collaborate and harness the power of data to unlock new opportunities for innovation and operational efficiency.

“PLM is not simply a system,” says Grieves. “It’s a whole change from functional-centric to product-centric in understanding how product data is central to the organization.”

Yet convincing stakeholders to rethink the way they design, develop, and manufacture products can be challenging. PLM

emphasizes discipline throughout the design process, which may cause some employees to bristle. In other instances, engineers and designers may be reluctant to share product data and collaborate with external stakeholders, such as suppliers.

"You are asking big teams to change the way they work and to get used to a new system," says Rivest. "They may not see the benefit in the short term; the concept needs to be sold to them."

Strong leadership can help in this regard by emphasizing the what's-in-it-for-you aspects of PLM. In terms of organizational structure, Benoit Eynard, a professor of mechanical engineering at the Université de Technologie de Compiègne, recommends that each department in an organization "have two or three people who are dedicated to supporting PLM—individuals who can train, support, and guide employees through the change management process."

Certainly, IT also plays an important role in procuring, deploying, and maintaining a PLM solution. Legacy systems, data silos, and poor user provisioning can prevent product data from reaching the right people at the right time. Today's IT teams must integrate a PLM system with customer relationship management (CRM), enterprise resource planning (ERP), and other business-critical systems to ensure that all stakeholders have access to consistent product design, procurement, and supplier information. Provisioning can also ensure that engineers, for example, see only the information most relevant to their work, while external stakeholders are prevented from accessing more proprietary and confidential data.

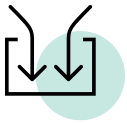
"For PLM to achieve a consistent set of product information along a product's entire life cycle, IT must integrate data with ERP, CRM, service platforms, and other systems," says Nyffenegger. "That's what makes PLM such an important concept."

But according to Meeker, while organizations "need IT involvement, IT should not be the leader of a PLM transformation." Rather, he says, an executive leader who has cross-functional business ownership can ensure that a PLM implementation is part of an overall digital transformation strategy.

Conclusion

A trifecta of factors promises to push PLM along the maturity curve. The exponential growth of data, the widespread availability of cloud-computing resources, and the increasing popularity of artificial intelligence (AI) and machine learning (ML) are opening up new possibilities for product design and development.

"There's excitement around artificial intelligence and machine learning and how these technologies can allow organizations to maximize the value of data," says Cohen.



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And for good reason—a PLM system with AI and ML capabilities can synthesize large amounts of data and apply predictive analytics to create future scenarios, ranging from a scarcity of raw materials to a dip in consumer demand. Based on these data-driven predictions, organizations can pivot on product design, adjust supplier selection, or revise any other aspects of a product's life cycle to take advantage of emerging opportunities and stay ahead of the competition.

Model-based approaches to product design and development are also generating interest among manufacturers. Teams can create a complete digital definition of a product within a 3D model, significantly reducing the time needed for documentation and other drawing-centric workflows. But while a model-based system can provide a better understanding of a product, there are drawbacks to consider.

"Convincing engineers to change their behaviors, adopt new software, and use it in the way it's meant to be used is not easy," says Meeker. "Plus, it's expensive to migrate all of that legacy data into new capabilities."

Today, PLM technology serves as a powerful and strategic response to mounting challenges. Heightened consumer expectations, global competition, and a deluge of data mean manufacturers can no longer rely on a file-based, document-centric approach to managing the product life cycle. After all, failure to properly document, track, and share product information, from part descriptions to design changes, can increase the likelihood of manufacturing delays, lost revenue, and potentially dangerous product defects. However, by transforming labor-intensive business processes such as BOM management and supplier collaboration using PLM, manufacturers can steady themselves against a rising tide of change.

Endnotes

1 CIMdata Inc., "CIMdata Publishes Executive PLM Market Report," July 6, 2022. https://www.cimdata.com/en/news/item/19059-cimdata-publishes-executive-plm-market-report.

2 Sedgwick, "2022 State of the Nation: Recall Index," 2022. https://marketing.sedgwick.com/acton/media/4952/2022-sotn-recall-index-report.

3 Atiyeh, Clifford. *Car and Driver*. "GM Ignition-Switch Engineer Speaks After Months of Silence: 'I Did My Job,'" November 17, 2014. https://www.caranddriver.com/news/a15359217/gm-ignition-switch-engineer-speaks-after-months-of-silence-i-did-my-job/.

4 Grand View Research, "Product Lifecycle Management Market Size, Share & Trends Analysis Report by Software (Portfolio Management, Design & Engineering Management), by Deployment, by End Use, by Region, and Segment Forecasts, 2022-2030," 2021. https://www.grandviewresearch.com/industry-analysis/product-lifecycle-management-market.

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