

Part 3: Defining PLM – Extended capabilities

MAXIMIZE YOUR PLM INVESTMENT WITH EXTENDED CAPABILITIES

Abstract

Over the past ten years, more and more discrete manufacturers have deployed Product Lifecycle Management (PLM) solutions to optimize product development and enhance bottom-line performance. Paradoxically, however, there is still widespread confusion and disagreement concerning the essential capabilities and functionality of PLM. Ultimately, PLM's potential as a game-changing technology will never be fully realized until a single, comprehensive definition of PLM is formulated and universally accepted. The fact is, manufacturers will be able to experience the complete range of PLM's benefits—and choose the best PLM solution—only when they fully and implicitly understand what PLM is, and what it can (and should) do for them.

In this third of a three-part series of papers, PTC provides a definition of the eight “extended capability” components of PLM and the added benefits that can be derived from your product development processes by implementing them.

Additional PLM components that provide extended capabilities

For those manufacturers seeking to experience the benefits of PLM’s value proposition in full, there are eight additional components that provide capabilities beyond the foundation set of “must-have” capabilities. Gaining ever-greater adoption by industry leaders, these extended capabilities represent the means by which manufacturers can successfully tap the full potential of PLM.

The table that follows identifies eight “extended capability” components as well as the seven “must-have” components covered in more detail in the earlier part two paper of this series.

PLM CAPABILITIES	Must-have capability	Extended capability
Document Management	●	
Embedded Visualization	●	
Workflow	●	
Distributed Collaboration	●	
Multi-CAD data management	●	
Complete BOM management (i.e., combined MCAD, ECAD software content in a single product structure)	●	
Change and Configuration Management	●	
Manufacturing Process Management (MPM)		●
Requirements Management		●
Program Portfolio Management (PPM)		●
Quality Lifecycle Management (QLM)		●
Product Analytics		●
Component and Supplier Management (CSM)		●
Service Information		●
Communities of Practice		●

Table 1. Each of the eight highlighted extended capabilities will be discussed in more detail in this paper.

A note on definition “validation”

The PLM market is currently in a state of transition—one in which the capabilities and characteristics considered essential in a PLM solution are being reevaluated, yielding some results that are already apparent. For example, two major PLM vendors—recognizing the importance of database consolidation and a single architecture platform—are evolving their offerings accordingly. Developments like these seemingly serve as third-party validation of PTC’s PLM definition.

Manufacturing Process Management (MPM)

Manufacturing Process Management (MPM)—the act of defining and managing the manufacturing processes used to make parts, assemble final products, and perform inspections—is performed by manufacturing engineers who are typically isolated from product engineering processes. This “disconnect” between the design and manufacturing disciplines significantly complicates the task of transforming the design engineer’s view of the product (i.e., the eBOM) into the manufacturing engineer’s view (i.e., the mBOM)—a task that, in essence, delineates how a digital idea represented by a CAD model becomes a physical product.

All too often, limited design engineer/manufacturing engineer interaction generates “completed” product designs that are deemed virtually unbuildable due to manufacturing considerations or prohibitive costs. Ultimately, such situations can result in costly redesigns, production ramp-up delays, increased scrap and rework rates, and defective products.

With MPM capabilities, a PLM solution enables manufacturing engineers to get involved earlier in product development, by providing them with access to design data and product engineering process plans—as they are evolving. This approach promotes heightened collaboration between the design and manufacturing disciplines, yielding product designs that are simpler and more cost-effective to manufacture. Furthermore, by using MPM capabilities, manufacturing engineers can associatively transform eBOMs to mBOMs—creating digital definitions of manufacturing process plans that include associative links to the mBOMs and the manufacturing resources required for each manufacturing operation.

“Cummins has made the concept of Design Anywhere, Build Anywhere a cornerstone of its business initiatives and commitment to customers. In switching to Windchill, we are looking to optimize accessibility throughout all functional areas of our PLM environment. In particular, the Windchill solution will allow us to best achieve our compliance and productivity goals and successfully extend our competitive advantage.”

– Chris MacAslan, Director, Global PLM, Cummins

In addition to digitizing and automating the manufacturing process and electronically integrating it with engineering and production, a true PLM solution with MPM capabilities ensures that process plan data is synchronized with ERP systems. NC tool paths and coordinate measuring machine (CMM) inspection programs are also generated associatively to the design model, while electronic work instructions are generated dynamically, ensuring that all shop floor deliverables are kept up-to-date.

In essence, a PLM solution needs to provide MPM capabilities for manufacturers to:

- Extend problem reports, change requests, and change notices to mBOM, process plans, resources and manufacturing documents
- Control evolution of engineering and manufacturing information via common revisions and configuration services
- Automate the release of engineering and manufacturing information to downstream production systems (e.g., ERP/MES)
- Dynamically generate accurate and comprehensive shop-floor work instructions, on demand
- Digitally define, manage and analyze plant-specific process plans, including sequences, operations and sub-operations, resource allocation, and time/cost breakdown
- Enforce the automatic reuse of proven and standardized manufacturing NC processes by embedding manufacturing process data into design feature libraries

Requirements Management

Products can only be successful if they satisfy previously identified customer needs. According to AMR Research, 46% of manufacturers listed “Product does not meet customer needs” as the reason product launches fail.⁶ Consequently, it’s important that manufacturers develop assessments of customer needs, from which they can derive the corresponding design and technical requirements necessary to fulfill those needs. As part of this process—referred to as Requirements Management—manufacturers must establish traceability between all levels of requirements and product design data, gauge the impact of changes on requirements and product design data, verify that all requirements are met, and ultimately ensure that customer needs are satisfied.

In short, a PLM solution ideally should include a Requirements Management component that enables organizations to align customer requirements with design and technical requirements by facilitating collaboration among all stakeholders—from marketing to design and manufacturing.

“46% of manufacturers listed ‘Product does not meet customers needs’ as the reason product launches fail.”

– AMR Research

The Requirements Management component in a PLM solution should help manufacturers:

- Enhance market success, by ensuring that product development teams correctly understand customer needs—and that their underlying designs serve to best meet those needs
- Improve decision-making, by using links between customer needs and product data to evaluate the impact of design changes—and by using requirements-to-data traceability to understand the costs of requirement changes
- Increase product quality, by measuring links between requirements and verification requirements to ensure proper validation of requirements—and by establishing traceability between design specifications and system-level requirements to demonstrate compliance with regulatory and contractual requirements

Program Portfolio Management (PPM)

Program Portfolio Management (PPM)—a component involving the coordination and execution of portfolio management, program management, and project management business processes—is designed to alleviate management concerns related to product development initiatives. Specifically, PPM can prevent poor decision-making, wasted resources, missed milestones, delayed product launches, and ultimately lost profit opportunities.

In managing product development initiatives, product development executives and managers are concerned with such critical issues as:

- Deciding which product ideas, programs and projects warrant investment of resources—and determining the optimal allocation of resources among those initiatives

- Ascertaining whether current product development programs are being executed efficiently, such that they are consistently meeting key milestones
- Ensuring that current product development initiatives remain aligned with stated business objectives and strategies
- Ensuring that product development processes are being executed consistently across programs and across the enterprise—and that project management tools are standardized
- Ensuring that engineering stakeholders participate fully in program processes through access to product definition data
- Ascertaining whether tools are in place for effective large program planning and execution that address the challenge of cross-project interdependencies by ensuring every team realizes the extent to which other teams are dependent on their deliverables

Conventional solutions have exclusively targeted the project management level—focusing on how project teams execute specific tasks against detailed schedules and failing to address the management of larger, more complex, and higher-order product/program development efforts. In contrast, by managing what is produced by a product development program and who needs to collaborate in order to produce it, a mature PPM component enables management to focus on the top priority: Delivering high-quality products to customers, so as to meet critical business, development, program, and customer milestones—while simultaneously ensuring that product development programs are executed consistently and remain aligned with current business objectives.

In essence, the Product Portfolio Management component of best-in-class PLM software should offer:

- Advanced deliverables-management capabilities, to coordinate information flow across project teams and disparate programs—thereby fostering a practical, flexible approach for monitoring and managing product development programs
- Stage-and-gate process configuration for new product development process automation, to ensure that programs across a product family or organization are executed consistently, resourced optimally, and have well-defined decision points to determine future resource allocation

- Automated metrics capture, roll-up and reporting, and balanced scorecard tools, to enable effective program/project monitoring and consistent program measurement across a portfolio, while simultaneously ensuring that programs remain aligned with specific program objectives and overall business objectives
- Visibility into product development program status, to assess team collaboration in producing deliverables and gain insights on the social nature of product development that can help reveal hard-to-detect problems early and thereby negate their impact on program operation
- “Loose coupling” to the underlying project execution environment, to facilitate top-down program planning with bottom-up project scheduling—thereby providing project teams with the flexibility to utilize the project—and task-management tools that best meet their needs
- Richer evaluation of program progress, by complementing traditional project management metrics (e.g., “earned value” and “percent complete”) with design metrics based on actual product data (e.g., “percentage of parts in the released state” or “trend in engineering change requests”)

Quality Lifecycle Management (QLM)

Three of the most critical factors that manufacturers must continuously assess and gauge throughout product development to ensure successful outcomes are product quality, reliability, and risk. To have a complete, accurate understanding of these three factors—which typically are subsumed under a “quality” umbrella—across a product’s entire lifecycle, manufacturers need to employ Quality Lifecycle Management (QLM) technology.

Historically, many manufacturers have addressed quality-related issues too late in the product development process, using disparate “point solutions” or department-specific tools that do not enable cross-functional collaboration, product-quality stakeholder communication, and high-level information visibility—all of which are essential to successful quality management efforts.

Such deficiencies—and the resulting inadequacies in quality management—can have dire consequences. For example, a company’s reputation can be severely damaged, which often results in decreased revenue and profitability. Other possible ramifications of not addressing product-quality issues soon enough include catastrophic product failures, cancelled programs, extensive product recalls and repairs, high numbers of warranty claims, and legal liabilities.

QLM helps manufacturers avoid these pitfalls by providing a formalized, systematic solution that manages all factors related to product quality—using methods that are fully integrated into the product development lifecycle and highly visible to all personnel with a stake in product quality. As an enterprise-wide, cross-functional process, QLM is used to ensure that product performance, reliability and safety are aligned with the requirements established for them over a product’s life. In essence, QLM ensures such requirements are met by systematically tracking product characteristics across the development, testing, manufacture, field-use, and service phases.

Ultimately, output from each lifecycle stage—including analysis results, product failures, corrective actions, and best practices—is compiled within a single database platform and made accessible to other relevant lifecycle stages. This ensures continuous improvement of products throughout development and during next-generation product design. By thus enabling feedback from one stage to automatically “feed” other related stages, QLM provides manufacturers with a unified, holistic view of overall product quality.

A PLM solution with QLM capabilities helps manufacturers manage product quality in numerous significant ways:

- Quality is managed early in the product development lifecycle and consistently throughout the entire process, using cross-functional, collaborative methods, so that quality-related information obtained in one lifecycle stage is available to relevant processes in other lifecycle stages
- Quality-related information is highly visible throughout an organization, thereby ensuring that all decisions that may affect product quality are supported by accurate data available in a timely, efficient manner
- Fosters cross-functional collaboration across departments and teams responsible for product quality, safety and reliability
- A single software platform allows a complete range of quality-, reliability- and safety-related analyses to be performed and output as comprehensive, high-level product-quality information
- Provides a “single source of truth” that gives all stakeholders insight into the current state of product quality at any time in the lifecycle
- Provides functional links between product requirements, product characteristics, and quality activities at every lifecycle stage

- Connects top managers—as well as all teams with a stake in product quality—with the critical information they need to make decisions that impact product quality, reliability and risk
- Helps personnel across the product development lifecycle understand how their activities impact product quality

Furthermore, QLM capabilities within a PLM solution should encompass and connect quality-related development activities across all lifecycle stages, including such activities as:

- Quality planning—defined as the ability to identify all functional needs of a product ahead of time and incorporate such information into each stage of the product development lifecycle
- Gathering insight into quality, reliability, and risk—whereby early reliability and risk analyses identify how well a product performs its anticipated function and how safe it is—well before a prototype is developed
- Cost planning—which involves formulating a clear assessment, early on, of a product’s expected reliability and its post-production maintenance or service needs, as well as creating a well-documented trail of every effort taken to mitigate product risks
- The leveraging of lessons learned—whereby newly acquired knowledge is communicated and reused, and the root causes of issues are investigated and corrected across the product development lifecycle

Product Analytics

Product performance can be measured across a multitude of dimensions—including everything from cost and reliability (e.g., mean-time-between-failure and mean-time-to-repair) to technical performance (e.g., power consumption and sensitivity) and degree of environmental compliance (e.g., percent of recyclable parts). Since overall business performance is greatly determined by the aggregation of all these dimensions, it’s important that manufacturers understand how they interrelate throughout the product lifecycle—that is, how decisions in one area influence and affect product performance in other areas. This practice of measuring and managing product performance along multiple dimensions—and, significantly, analyzing the inherent trade-offs between them, such as cost versus quality, or environmental compliance versus functional performance—is called Product Analytics.

Product Analytics enables organizations to make better, more-informed product development decisions earlier—data-driven decisions that can enhance risk management, increase product quality and safety, drive continuous process improvement, decrease costs associated with reliability deficiencies, and ultimately generate greater profitability.

“Having products that we can confirm are compliant allows us to stay in markets that we could not, otherwise.”

— Raymond Lizotte, Jr., Director of Product Stewardship Office, APC by Schneider Electric

As such, a PLM solution should ideally include a Product Analytics component that can be consistently and systemically implemented across the enterprise and provide the capabilities to:

- Leverage design data managed in product BOM systems—whether an “as-designed” BOM mastered in a PDM system, or an “as-built” BOM mastered in an ERP system—and key data sources located elsewhere in the enterprise or throughout the supply chain
- Leverage data from disparate databases and functional silos in differing formats, track data quality, perform data analyses, and provide centralized dashboard views of product performance along multiple dimensions based on that data
- Deliver data in the appropriate format to internal stakeholders (e.g., design engineers, manufacturing engineers, purchasing managers, marketing managers, and sales representatives), as well as external stakeholders (e.g., customers, auditors and regulatory agencies)

As part of an analysis- and decision-support system, product analytics helps manufacturers meet product performance targets across the entire product lifecycle—from inception through development, manufacturing and retirement—by providing greater, earlier visibility and predictability of performance-related data along multiple dimensions. In short, Product Analytics enables manufacturers to identify and mitigate risks before they occur.

Component and Supplier Management (CSM)

Products being marketed today are often so complex that it can take hundreds of people and parts to successfully design, develop and manufacture them. Since, typically, more than 70% of a product's cost is determined during the initial design stage, it's important that manufacturers identify the "right" parts and suppliers as early as possible in the product development process—and that design engineers, who play a fundamental role in predicting a product's end-cost, have a clear understanding of the key cost drivers. CSM is specifically designed to address these challenges.

Making sound decisions about parts and suppliers enables organizations to reduce costs, enhance product quality, improve environmental regulation compliance, accelerate time-to-market, and strengthen the bottom line. Unfortunately, factors frequently exist that cause manufacturers to make less-than-optimal decisions. Some of these factors include:

- A "disconnect" between design and procurement processes, whereby component and supplier information is scattered across disparate systems. Without access to detailed enterprise and supply chain data, design engineers are unaware of production constraints that could hinder a supplier's ability to expeditiously and cost-efficiently manufacture a product in accordance with a given design—or they are unable to find and reuse preferred existing parts, resulting in wasted expenditures on duplicate parts.
- Inability of product development teams to access regulatory-compliance information, whereby non-environmentally-compliant parts are inappropriately "designed-in."
- Lack of standards for internal cross-discipline collaboration and external supplier collaboration, whereby unqualified vendors are selected, and early, valuable supplier input is severely limited, respectively.

PLM software with a CSM component prevents these occurrences—all of which relate to poor part or supplier choices and ultimately result in late-stage design changes or manufacturing delays that derail product launch dates or generate cost overruns.

In essence, making CSM integral to the product development process facilitates the development of:

- Collaborative, cross-functional teams—involving stakeholders from design, manufacturing, procurement and compliance—that identify supplier capabilities and risks, assess supplier qualifications, select suppliers, determine supplier roles, identify applicable compliance regulations, and set product development milestones.
- Formal process controls for creating and sharing new design data. Such controls include systematically enabling and mandating the reuse of existing qualified components, as well as standardizing and automating the new part request process.
- An enterprise component record—a comprehensive and dynamic information repository for all component characteristics relevant to product development. Data stored in the component record—which relates to areas such as environmental compliance, supplier qualifications, technical specifications, and quality assurance/control—is accessible to all authorized users, such as design engineers, so that they can get immediate feedback on design "acceptability" and make any necessary changes early in the product development process, as well as select parts based on supplier capabilities, reusability preferences, functionality, environmental-compliance compatibility, time-to-market milestones, and targeted costs.

Service Information

The longtime support and service required to maximize the performance of a product throughout its lifecycle—including information related to everything from assembly, training and operation to maintenance, repair, and safety—have traditionally been considered "costs of doing business." However, today's manufacturers realize that such service-related information can provide ongoing, predictable revenue streams—often with higher profit margins than new product sales—via support/maintenance contracts, spare parts and product accessories sales, and equipment upgrades and renewals.

Equally significant, providing high-quality, accurate Service Information is critical for generating customer loyalty and satisfaction. Any product performance problems or product downtime in the field can seriously affect a customer's business operations or even outright profitability—particularly in situations that involve industrial equipment, whereby a customer's revenue-generating opportunities are directly dependent on the reliability of the equipment used.

While Service Information can be a key driver of a manufacturer's success—with some businesses earning a significant percentage of their gross profits from the aftermarket—Service Information itself is all too often unreliable, complex, outdated, language-inappropriate, or difficult to find.

A PLM solution with built-in Service Information capabilities ensures that Service Information is optimized throughout the product lifecycle, particularly because it is sourced directly from original product development data related to design and structure. As such, Service Information is user-friendly, readily accessible by all stakeholders (e.g., support analysts, service technicians, call-center representatives, dealers, equipment operators, and customers), and always up-to-date with current product configurations and service procedures. The quality and accuracy of product support and Service Information plays a direct role in the success of your product support and customer service organizations.

As an important component of the PLM solution, Service Information capabilities should enable manufacturers to:

- Deliver accurate, concise and relevant service, operator, and spare-part information—reducing service- and call-center costs
- Associate original, up-to-date product data, to provide consistent Service Information for all downstream product processes—reducing no-fee service callbacks
- Manage a single source for interactive Service Information—for faster service times

Communities of Practice

Manufacturers are constantly seeking to identify and tap new knowledge resources—whether internal or external—so they can extract information that will advance the success of their product development efforts. Specifically, they are seeking to reveal valuable, “hidden” knowledge and expertise by stimulating the free, easy flow of information and the fluid expression of ideas.

By leveraging the Communities of Practice initiative, organizations can assemble a diverse array of knowledge resources to help accomplish this objective. Such resources could include:

- Colleagues with similar roles, but situated in different business units (e.g., finite element analysts)
- Colleagues with expertise in a particular area (e.g., plastics)

- Users of specialized software (e.g., Creo™ Elements/Pro™)
- Colleagues with an interest in a specific product line (e.g., smartphone technology)

Manufacturers can employ numerous means to access and prioritize these resources, such as:

- Wiki websites, which can facilitate collaborative content creation
- Activity feeds, metrics and reports, to enable community monitoring
- Discussions and announcements, which can accelerate problem resolution
- Tagging and rating for relevancy identification and inferencing

A PLM solution that includes a Communities of Practice component can enable manufacturers to:

- Rapidly discover valuable content and subject matter experts (SMEs)
- Raise questions and troubleshoot previously unidentified issues
- Rank information and formulate strategic and tactical recommendations
- Provide context to knowledge (e.g., search-results boosting, filters for activity/newsfeeds)
- Motivate user participation through inclusion in a respected “community”

In short, by establishing a recognized community of cohesive, comprehensive knowledge resources, this component facilitates idea-generation/exchange and information-sharing that can drive greater profitability for discrete manufacturers.

Conclusion

To date, PLM has delivered significant inroads in the discrete manufacturing industry. Numerous manufacturers have already experienced some of the ways PLM can enhance product development processes—and scores of others are seeking a better appreciation of the technology to discover how they, too, can benefit.

However, if manufacturers are to tap the full potential of PLM, they first need to explicitly understand its value proposition. After all, manufacturers can't know what to expect—and what to demand—from PLM unless they know what's possible.

This paper is the final paper of a three-part series where we explore PLM. In this paper we sought to provide insight and along with a clear explanation of the “extended capability” components that provide the opportunity for additional value within best-in-class PLM software. Armed with this knowledge, manufacturers will be better prepared to make purchase decisions that maximize their returns on PLM investments, increase their process efficiencies, and ultimately enhance their bottom-line results.

For more on the definitions and benefits of the capabilities that make up a complete PLM solution, we invite you to read:

[Part 1: Defining PLM—Executive overview](#) and
[Part 2: Defining PLM—Critical “must have” capabilities](#)

Visit [PTC.com/solutions/product-lifecycle-management](https://www.ptc.com/solutions/product-lifecycle-management) to learn more about the promise of PLM.

© 2010, Parametric Technology Corporation (PTC). All rights reserved. Information described herein is furnished for informational use only and is subject to change without notice. The only warranties for PTC products and services are set forth in the express warranty statements accompanying such products and services and nothing herein should be construed as constituting an additional warranty. References to customer successes are based upon a single user experience and such customer's testimonial. Analyst or other forward-looking statements about PTC products and services or the markets in which PTC participates are those of the analysts themselves and PTC makes no representations as to the basis or accuracy thereof. PTC, the PTC Logo, Creo, Elements/Direct, Elements/Pro, Elements/View, Unlock Potential, Think. Create. Believe. and all PTC product names and logos are trademarks or registered trademarks of PTC and/or its subsidiaries in the United States and in other countries. All other product or company names are property of their respective owners. The timing of any product release, including any features or functionality, is subject to change at PTC's discretion.

5896C-Defining PLM: Part 3-WP-EN-1110