Introduction

Over the next five years, global manufacturing is expected to invest upwards of $6 billion dollars in product development solutions. Why? Because, after making massive investments in infrastructure and the physical supply chain with mixed results, leading manufacturing companies are re-discovering ‘what matters most’ for business success in the 21st century. Within this new global economy, product development processes have been elevated as a leading competitive weapon. This competitive advantage originates from the intersection of three critical capabilities – create, collaborate, and control – that form the foundation of a new category of software called Product Lifecycle Management (PLM).

In the following paper, learn about PLM and the critical issues related to developing and managing digital product content in a value chain environment. The paper introduces the Windchill® solution family, a core component of PTC’s comprehensive PLM suite of solutions and the key to improving the product development process. The Windchill solution family delivers capabilities in many areas, including product data management, project management and collaboration, dynamic design configuration, component management and parts catalog and manufacturing collaboration.

This paper is intended primarily for line of business managers and IT managers who want to understand PLM and learn the specifics of PTC’s Windchill offering.

Introduction to Product First: What Matters Most?

Today, more and more manufacturers are realizing that success begins with -- and is sustained by -- great products. Great products define markets, drive revenue growth, generate profitability, create powerful brands, and delight customers, employees, and shareholders alike.

“Product First” companies – those who now realize that success is rooted in great products – view their product development process as their greatest competitive advantage. Despite successful initiatives that improve operational effectiveness, companies that lack a strong focus on product leadership may continue to struggle with products that lack compelling differentiation, miss market requirements, are priced out of range of competitors, or otherwise fail to delight the customer. By refocusing on products and their product development process, manufacturers realize they have a new weapon to dramatically impact product differentiation, quality, predictability, time to market, manufacturability, serviceability, cost, and customer satisfaction.

To consistently produce great products, companies need a product development process that becomes, in itself, a competitive differentiator. While some see product development as synonymous with engineering, a truly effective product development process engages a variety of cross-functional participants from marketing, engineering, procurement, manufacturing, sales, and service departments. Ever-increasing levels of outsourcing have driven suppliers and manufacturing partners into direct roles in the product development process, at the same time a strong customer focus has necessitated the customer’s direct involvement as well. As a result,
attempts to optimize product development naturally evolve from a departmental focus within engineering, to an enterprise focus, and ultimately to a distributed value chain focus.

During the product development process, this cross-functional value chain works collaboratively to generate the intellectual property that represents a new product or product variant. This intellectual property, when captured digitally via software applications, begins to form a digital representation of the product. This “digital product” is typically a company’s most strategic asset; it defines at a minimum what products are, how they perform and differentiate, the cost envelope, the suppliers that will be involved, and the manufacturing processes that will be used. Because the release of the digital product is a prerequisite to production, the digital product must be complete, compelling, stable, and agreed to by all stakeholders before any serious manufacturing work can begin.

Developing digital products in a value chain environment – and under intense time and cost pressure – is certainly not easy. While many manufacturers have made great strides improving operational effectiveness across their enterprise and supply chain as it relates to manufacturing and logistics, most companies will admit that their product development processes are rife with problems. They are now beginning to realize that an even greater level of opportunity for improvement is available by better managing the digital product definition at every stage in a product’s life. The digital content that describes products during the development process typically gets fragmented across organizational boundaries, with each group having different forms of product definition stored in different systems, and many with incompatible formats. No easy-to-use capability exists to share information in a controlled manner and collaborate around projects with external customers/suppliers/partners.

Managing the change of product information across a product’s lifecycle and maintaining control of design and manufacturing processes is often considered an unattainable goal. Simply put, most manufacturing companies currently lack a suitable enterprise infrastructure to effectively aggregate and manage the diverse digital product information and to support efficient collaborative product development processes. Given the strategic imperative of product development, it is time to think about ways to improve.

The Rise of PLM

This recognition has given rise to a new category of software solutions known as product lifecycle management (PLM). Leading industry analyst firms including AMR Research, Gartner, Giga, and Yankee Group have identified PLM as the necessary enterprise infrastructure to successfully address these issues and improve the effectiveness of the product development process. PLM describes a comprehensive framework of technology and services that permits manufacturing companies and their partners and customers to collaboratively conceptualize, design, build, and manage products throughout their entire lifecycle. PLM has emerged as the primary means by which manufacturing companies can achieve step-change improvements in their product development processes. AMR Research reports that, within manufacturing environments, PLM was the leading category of information technology spending growth in 2002, bucking the overall downturn trend in investment.
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The Digital Product Value Chain

What’s the secret of manufacturing success? In a word, products. Superior products drive top-line revenue, bottom-line profitability, and shareholder value. In this competitive economy, CEOs are increasingly realizing that their company’s viability and future success lies in their ability to establish and maintain product leadership. Across all industries, companies are embarking on back-to-basics programs that refocus their energies on critical core competencies, with product development at the top of everybody’s list. In the automotive world, it is the development of new and innovative cars, while in hi-tech it is the design of new devices that converge voice and data connectivity. Everywhere, manufacturers are scrambling to bring new, innovative products to market faster, and at better cost and quality levels. As Yankee Group has observed, the sheer diversity of products hitting the market is astounding, greatly exceeding the diversity of products available 25 years ago.

The genesis of any new product can be traced to a periodic alignment that occurs between the needs of customers and the assets of a manufacturing company. The most critical of all company assets are intellectual, as a company must first decide carefully how to apply its know-how, technologies, and capabilities to respond to the opportunity at hand in a manner that provides differentiation and competitive advantage. New product development efforts are initiated for just this purpose; a cross-functional team is formed to work together to determine the exact requirements of the marketplace, the design of a product that meets those requirements, the suppliers who will contribute to the design and manufacture of the product, how the product will be physically produced, how the product will be distributed to customers, and the service and support offerings that will complete the customer solution.

Product development is obviously not the sole responsibility of the product design and engineering group. To the contrary, successful product should be viewed as a collaborative effort involving marketing, engineering, purchasing, manufacturing, sales, and support. Yankee Group states that: “Collaborative product lifecycle management across business functions and among partner companies can reduce costs and drive revenue growth.” The manufacturers that win in this new game are those that most develop, manage, and leverage product-related intellectual property throughout their enterprise.

Product First initiatives ultimately require companies to analyze and improve their product development processes. During the product development process, cross-functional teams – frequently incorporating external suppliers, partners, and customers – work collaboratively to generate the intellectual property that represents a new product or product variant. This intellectual property, when captured digitally via software applications, begins to form a digital representation of the product. The complete “digital product” is a comprehensive collection of electronic information including mechanical and electrical CAD files; design, quality and manufacturing specifications; market and technical product requirements; software modules; and documentation and other media used to comprehensively define the product and test its behavior electronically.

Because the digital product is the deliverable that manufacturing ultimately needs to begin its work, the digital product must be complete and agreed to by all stakeholders before the manufacturing process can begin. In simplistic terms, the basic role of the manufacturing process is to convert the digital product into a physical product, so having a compelling digital product is a prerequisite to success with the physical product.

Upon examination, most manufacturers will see that their supply chains actually employ a “two-pass model” of operation. In the first pass, the supply chain members work together to create a digital representation of the product. In the second pass, the supply chain members work together a second time to create the physical representation of the product. While a tremendous amount of capital is expended in the physical product value chain, the bulk of strategic product decisions are typically made in the digital product value chain. It is within the digital product value chain that decisions are made which will determine what the product is, what it looks like, how it performs,
and how it will differentiate from competitors. While the product remains in its digital form, changes are comparatively easy and inexpensive to make, while changes made during production result in costly rework and significant delay. Full cross-functional agreement on the digital product representation is therefore essential prior to its release to manufacturing. In effect any organization involved has veto power because the product will likely be flawed from the start if it fails to meet customer or market requirements, incorporates the wrong suppliers, or cannot be manufactured effectively. Furthermore, the digital representation must be realistic and well tested via digital simulations, as any mistakes in the digital product that is released into manufacturing are assured to become further compounded and even more costly as the product moves into production.

![Figure 1: Digital vs. Physical Product Value Chain](image)

It is obvious that important decisions made during the digital product value chain processes will affect top-line revenue opportunity, but there is a more subtle yet dramatic cost impact to bottom-line as well. Though the bulk of expenditures are made during the production process, research indicates that decisions made in the digital product value chain serve to commit or "lock in" 70-85% of the total product costs as seen by the customer, making cost savings a critical product development issue.

Given the realization of the existence and strategic importance of this digital product value chain, Product First companies know that truly meaningful improvements to the product development process must be implemented comprehensively throughout the enterprise, and must also extend to embrace value chain participants.

**PLM: Create, Collaborate, and Control Capabilities**

The digital product value chain is a reality that is here to stay, and it certainly complicates concerns regarding how to most efficiently collaborate and share information in a timely, secure, and structured manner during the product development process. Enter PLM, which uses Internet technology to manage information and facilitate communication and collaboration across the entire product lifecycle from product concept and planning to final retirement of the product and every lifecycle contained therein. PLM systems provide a single system-of-record for the complete digital product so that different constituents have access to up-to-date information at
every stage in a product’s life. At a high level, the PLM lifecycle can be divided into six stages with multiple sub-processes as shown in Figure 2:

Product development is neither as sequential nor as enterprise-centric as Figure 2 might suggest. Since the decisions made by various departments are interdependent, it is critical that various constituents communicate effectively and work in parallel. Furthermore, participants in product development are in most cases not limited to internal organizations; Yankee Group notes “the monolithic manufacturing establishment, with the ability to conceive, design, engineer, manufacture, and distribute products, is a thing of the past.” Today, companies are becoming increasingly specialized, creating narrowly focused yet highly effective entities that work together in value chains to create the final product. In many industries, suppliers contribute more than 70% of the final product design, and in some cases the perceived “manufacturer” is essentially just a systems integrator. In effect, while companies continue to own the complete digital product, contributions are just as likely to originate from external suppliers, manufacturing partners, and even customers as various internal company departments. The ability of a company’s digital product value chain to effectively work together to produce great products is becoming the key measure of competitive advantage.

PLM extends traditional digital product solutions such as computer-aided design (CAD) and product data management (PDM) across the digital product value chain and through the entire product lifecycle by providing extended enterprise collaboration capabilities. An effective, comprehensive PLM solution enables companies to create detailed, intuitive, and realistic digital
product information; to collaborate to incorporating early input from the various participants to identify and resolve critical issues; and to control and automate critical processes as release to production, change control, and configuration management. Without an integrated infrastructure to drive synergy between these three interdependent capabilities – create, collaborate, control – manufacturers cannot effectively optimize their product development processes. Thus, a PLM system enables a manufacturer to pursue a number of business strategies, such as customer-driven innovation, modular product architectures, digital prototyping and simulation, and process knowledge management and optimization.

**Figure 3: Optimizing the Product Development Process.**

Optimizing the digital product value chain, in short, demands synergy across three primary and interdependent capabilities:

- **Create** – To capture and develop ideas and intellectual capital into digital products that provide realistic, interactive, and intuitive representations of a product’s construction, look and feel, and behavior. Creation is critical in early stages of the product development process and remains important whenever changes are to be made. The “create dimension” is represented by amplitude in Figure 3.

- **Collaborate** – To communicate effectively with other stakeholders across the product development value chain to iteratively capture creative input and identify and resolve issues early when changes are easy to make. Ad hoc collaboration is critical early in the product development process, but ultimately gives way to more formalized processes in the endgame as the product nears the release to manufacturing milestone. The “collaborate dimension” is represented by frequency in Figure 3.

- **Control** – To ensure that the product development process drives toward a timely conclusion, it is necessary to ensure increasingly tighter alignment of stakeholders at various milestones along the way, with complete alignment achieved by the critical release to manufacturing milestone. In a perfect world, no additional changes would be made after the product is released to manufacturing. Unfortunately the real world doesn’t always work that way, so a formalized process for proposing changes, understanding their full impact, making a go/no-go decision, and notifying affected parties is essential. The “control dimension” is represented as a dampening effect in Figure 3.
Some manufacturers mistakenly assume their existing ERP (Enterprise Resource Planning), SCM (Supply Chain Management), or CRM (Customer Relationship Management) systems can manage this extended collaborative product development process. These systems, however, are intended to manage the physical product and processes that surround it — such as monitoring inventory levels — and not the digital product. Missing is an enterprise-level ability to comprehend the digital product, to handle rapid change, and control the dynamic product development process from product concept and design through manufacturing and after-market servicing. The ability to collaborate effectively across the value chain requires access to timely and accurate product information, even information created at the earliest stages of development. Resolving complex product development issues early not only has strategic advantages, it also reduces costs.

Figure 4: PLM Is The Enterprise System-of-Record For Product Information

It takes a PLM system to fully support the way products are conceived, evaluated, developed, managed and supported throughout the digital product value chain. PLM integrates the multiple islands of disconnected product information across the enterprise into a single digital system of record. With PLM, the ERP, CRM, and SCM systems finally have what they have needed all along — a reliable source for the latest, most accurate, complete product information in a widely accessible resource.

PTC's PLM Offering

Many vendors purport to offer PLM solutions, but none has a track record in product development software that rivals PTC. For more than 17 years, PTC has been a pioneer in providing technology to improve product development and is uniquely qualified to deliver a complete suite of leading PLM solutions.

At PTC, the critical requirements of manufacturing companies have been translated into a comprehensive suite of software solutions that allow companies to focus on product superiority and to manage their product development process for maximum advantage. With an integrated PLM solution footprint spanning its flagship Pro/ENGINEER® and Windchill® product families, PTC is the only vendor able to assist manufacturers who need to create innovative products, collaborate with participants throughout the value chain, and control their product development process.
Pro/ENGINEER is the industry's leading 3D computer-aided design (CAD) product development solution. It provides unparalleled digital design capabilities, enabling designers and engineers to more quickly deliver better digital products to the production process. The latest version, Pro/ENGINEER Wildfire, has been architected for the digital product value chain and provides an online, multi-user environment designed for the realities of today's product development process. Incorporating full Web services support, Pro/ENGINEER Wildfire integrates seamlessly with PTC's Windchill solutions and fundamentally redefines how participants collaborate and how design activities are managed throughout the product development process. The combination of Pro/ENGINEER and Windchill solutions enables you to simplify and accelerate the way you connect to other business systems and collaborate with co-workers and design partners. It gives you the power to create and seamlessly transfer ideas, feedback, and critical information among value chain participants while bringing order to the product development process.

Windchill is a production-proven set of modular solutions for rapid collaborative development of customer-driven products. In the process, it removes the traditional barriers existing within and between organizations and business systems.

### Windchill Critical Capabilities:

- Comprehensive digital product data model and secure product information repository
- Automation of product development processes with workflow and lifecycle driven processes
- Embedded CAD-neutral and Web-based 2D and 3D visualization of product information for all users
- Role-based Web access to product and process information with event-based alerts
- Project and program management and collaboration
- Analytics and reporting for process and activity monitoring and improvement
- Best practice change, configuration and release management processes
- Parametric searching of parts and designs for optimal reuse
- Manufacturing collaboration workspaces for manufacturing design and sourcing
- Enterprise integration across mechanical CAD, electrical CAD, ERP, CRM, Web services, etc.

Windchill’s scalable and flexible Internet architecture is built on open standards. It acts as the system-of-record for the management of the complete digital product from concept to retirement in a CAD-neutral environment. Windchill provides a unified data model that aggregates all forms of product information and easily integrates with other enterprise systems like ERP, SCM and CRM.

A primary benefit, Windchill’s modular architecture gives manufacturers the flexibility to select the deployment option best suited to their unique product development process needs. Windchill solutions embody industry best practices, and companies can deploy one packaged solution or multiple solutions at the same time. In tune with today’s IT realities, each Windchill solution includes a popular Quick Start deployment option that is a predefined, fixed-price implementation package that lowers both risk and total cost of ownership while delivering fully production-capable solutions within just a few weeks.
Windchill®: Comprehensive Foundation for PLM

As part of a comprehensive PLM solution, Windchill addresses critical business processes throughout the product lifecycle.

The core Windchill offering includes:

- **Product Data Management** – helps manufacturers control information, ensure data accessibility, and manage the product development process throughout the life of a product.
- **Project Management and Collaboration** – enables employees, suppliers, and customers to work together on projects through Web-based workspaces, project plan development, milestone tracking, activity assignment and management, and discussion forums.
- **Dynamic Design Configuration** – helps discrete manufacturers address the increasing demand for design-to-order products through visually interactive, dynamic, collaborative capabilities including graphical product family modeling, product family catalog publication, product configuration, and automated generation of digital product deliverables.
- **Component Management and Parts Catalog** – enables designers to achieve maximum part reuse through Web-based access to standard, preferred part suppliers, and allows suppliers of standard parts to provide their customers with rich technical product data.
- **Manufacturing Collaboration** – facilitates release-to-manufacturing processes such as exchange of information and process status through organization-based workspaces.
cross-organization change management, sourcing process management, and supplier data management

- Customer-specific Business Process Applications—allows companies to create customer-specific, product lifecycle management solutions tailored to their unique business processes and legacy systems

To help manufacturers decrease risk and quickly deploy proven PLM solutions, PTC offers the Quick Start solution program, which delivers packaged implementations of Windchill PLM components in a matter of weeks.

PTC, along with its Enterprise Consulting Partners (ECP’s), offers additional value-added services to help companies create product development strategies, realign business processes, integrate legacy systems, and manage organizational change.

**Windchill® Quick Start Solutions**

Windchill Quick Start solutions are turnkey offerings that deliver rapid ROI by targeting specific business processes with pre-packaged software and services. The solutions deliver a combination of create-collaborate-control capabilities built on the common Windchill architecture and platform. Incorporating best practices gleaned from the deployment of Windchill at hundreds of customer sites, Windchill Quick Start solutions are easy to use due to their optimized user interfaces, pre-loaded standard workflows, and configurable processes. These solutions raise the bar in terms of out-of-the-box functionality by including CAD integration, rich visualization, and distributed information-sharing capabilities. Each solution provides the necessary functionality to support specific business processes, and these solutions can be combined synergistically to address the needs of multiple product lifecycle stages.

To further speed ROI, Windchill Quick Start solutions come at a fixed price and include fixed-scope technology services and training from experienced consultants. These implementations can be completed in a few short weeks instead of months or years as is typical of other enterprise systems.

Windchill Quick Start solutions include:

**Windchill PDMLink**
*Deployment Time: 5 weeks*

Windchill PDMLink aggregates, controls, and leverages digital product information throughout the product lifecycle, making it easy for everyone involved in the product development process to access current accurate product information in a variety of formats through a single Web-based source. Extensive browser-based visualization capabilities are woven throughout, ensuring that engineers and non-engineers alike can review and markup complex 2D and 3D product information on their desktop independent of their geographical location and without need for access to the original source applications.
Critical Capabilities

- A master product repository organizes digital product representations (including BOMs, documents, component attributes, drawings and models, schematics, software modules, specifications, data sheets and revision history) in a Web-based virtual vault; supports powerful search capabilities and hyperlink navigation of related information.
- Powerful product structure management capabilities enable the management of product configurations as they are created and manipulated, including automated capture from CAD models.
- Phase-gate management of processes and information helps guide the product development process.
- Release management capabilities facilitate review and sign-off on product data (including digital signature support) as well as transfer of product data to manufacturing.
- Lightweight, Web-based visualization capabilities enable viewing, markup and measuring of information generated by various 2D and 3D mechanical and electrical CAD and documentation authoring tools.
- Direct integration with Pro/ENGINEER and other 2D and 3D mechanical and electrical CAD authoring systems (CADDSS®, CATIA®, Unigraphics®, I-DEAS®, AutoCAD®, SolidWorks®, and Medusa®; Cadence® and Mentor®) enables capture and management of digital product data, as well as interoperability with various CAD team data management systems for data synchronization (Pro/INTRALINK®, Optegra®, and Co-Create®)
- Monitoring and reporting of processes enables process visibility and continuous process improvement.
- Browser-based user access to personalized product workspaces delivers targeted information and functionality relevant to a specific individual's roles, responsibilities, and tasks.

Business Benefits

- Increased productivity and fewer mistakes resulting from enterprise-wide access to, and control of, data.
• Reduced costs by increasing operating efficiency with best-practice configuration, release, and change management
• Greater design and part reuse
• Faster, easier adoption and widespread use through an intuitive user experience

Windchill ProjectLink
Deployment Time: 2 weeks

Windchill ProjectLink provides a comprehensive, real-time project management and collaboration infrastructure for all members of the extended product development team, both inside and outside the enterprise. It drives innovation through Web-based, self-administered virtual collaboration workspaces that include all the tools necessary to pull globally dispersed project team members together as if working in the same room, including members utilizing Pro/ENGINEER and other CAD systems.

Critical Capabilities
• Project and program management capabilities facilitate project scheduling, status reporting, task assignments, and deliverable and milestone tracking.
• Bi-directional integration with Microsoft® Project enables users to load project plans from Microsoft Project to initially configure project spaces and to automatically regenerate Microsoft Project plan updates based on current project status, including impact and dependency analysis, based upon Windchill-managed project collaboration activities.
• Step-by-step wizard interfaces make it easy to create projects, invite team members (from within or outside the firewall) with role-specific access, assign tasks to team members, and subscribe for automated change notification.
• Centralized project data sharing allows 24x7 real time access to all project-related information, including both CAD and office documents, with check-in/check-out capabilities and change history logs for auditing purposes.
• Browser-based uploading and downloading allows sharing of digital product information and other data among the extended product team, including customers.
• Lightweight Web-based visualization capabilities enable viewing, markup and measuring of information generated by various 2D and 3D mechanical and electrical CAD and documentation authoring tools.
• Integrated online communication tools such as discussion forums to capture allow teams to design decisions and host collaborative meetings (powered by WebEx).
• Integration with Pro/ENGINEER and interoperability with various CAD and team data management systems allows for data capture, sharing, and synchronization.

**Business Benefits**
• Accelerates time-to-market by eliminating geographic and organizational barriers to collaboration.
• Reduces potential errors by ensuring that dispersed project teams have access to the latest information and are automatically notified of changes
• Improves access and reporting of project management information, for better decision making and tracking
• Fosters increased innovation through real-time collaboration inside or outside your firewall

**Windchill DynamicDesignLink**
Deployment Time: 6 weeks

An effective design-to-order capability enables products to be varied according to customer requirements, yielding more satisfied customers and wider profit margins. The application engineering process required to modify standard designs in order to deliver design-to-order products, however, can be difficult, slow, and expensive. Windchill DynamicDesignLink fully automates the application engineering process, dramatically reducing the time it takes to configure digital products, including engineering changes, to meet customer specifications. Windchill DynamicDesignLink reduces manual design rework and helps companies to get high quality new products to market faster.
**Critical Capabilities**

- Interactively creates multiple designs of customized products, guided by technical and business rules that constrain variability.
- Automatically reuses existing parts and creates new parts automatically only where permitted and when necessary to meet customer requirements.
- Empowers customers, distributors, and sales representatives to directly configure and visualize application-engineered products via the Web.
- Allows users to store, update and compare product alternatives to best leverage past designs and intelligence.
- Generates necessary digital product information automatically, including CAD models and drawings, lightweight visualization files, product structure, and manufacturing and support documents, based on customer specifications.
- Incorporates lightweight, Web-based visualization capabilities that enable viewing, markup and measuring of information generated by various 2D and 3D mechanical and electrical CAD and documentation authoring tools.
- Ensures complete understanding and buy-in from the customer, based on the digital product representations, before costly manufacturing resources are committed.

**Business Benefits**

- Creates competitive advantage through advanced, design-to-order automation.
- Increases responsiveness to customers by automating application engineering processes that are otherwise tedious and slow.
- Increases profitability through reduction of manual design effort and improved design reuse.
- Ensures complete understanding and buy-in from the customer, based on the digital product representations, before costly manufacturing resources are committed.
- Increases customer loyalty through greater responsiveness and customization to exactly meet customer needs.

**Windchill PartsLink**

**Deployment Time:** 2 weeks

A primary business goal for many manufacturing organizations is design reuse and strategic sourcing in order to reduce product cost and time to market. Windchill PartsLink allows the organization and classification of internal component libraries and makes them available through a Web-based environment that is tightly integrated with other Windchill solutions and Pro/ENGINEER. Internal part libraries reduce part duplication and part number proliferation throughout a company and improve the efficiency of engineers. Designers can easily conduct parametric searches for parts, preview them in a 3D Web viewer, and then drag-and-drop them directly into a CAD assembly.

Windchill PartsLink also enables the creation of a digital parts catalog which enables part and component suppliers to differentiate themselves by offering content-rich information to their customers, including 3D CAD data, which may be downloaded in various formats. With superior technical content, manufacturers can positively influence internal part selection processes, and suppliers can position their parts at the point of design, ensuring that their parts get designed-in during the digital product value chain, and therefore ensuring subsequent purchase during the physical product value chain.
Critical Capabilities

- Provides a consolidated source of part information for part standardization.
- Supports inbound supply chain optimization to enable strategic component selection.
- Powerful search capability (parametric, hierarchical, natural language, part number, etc.) makes it easy to rapidly find and reuse part and part designs.
- Industry leading classification development and design tools allow you to organize and structure your product information.
- The ability to serve dynamic parametric 3D CAD models directly to internal users or customers in Pro/ENGINEER, STEP, IGES, DXF and other standard formats enables a true "digital parts catalog".
- Controlled access to product information in the catalog, based on the end users Web authentication, ensures security of product information.
- Statistics reporting tools track internal user and customer usage of the product catalog.
- Multi-catalog querying capability that complies with RosettaNet e-business standards makes it possibly to dynamically find and compare alternatives from various vendors.
- Powerful tools lessen the pain of cleansing, normalizing, classifying and publishing part information.
- Lightweight, Web-based 3D viewer plug-in enables visualization and measurement of component geometry.
- Tight integration with other Windchill solutions allows an enterprise to make design reuse a regular part of the product development processes.

Business Benefits

- Enables design and part reuse to accelerate time to market and lower costs.
- Reduces global procurement costs via decreased overhead, consolidated orders for volume discounts, and profit from preferred supplier relationships.
- Enables part suppliers to capture the critical design win up front and provide an unprecedented level of customer service by bringing rich technical content to the design engineer's desktop.

Windchill SupplyLink

Deployment Time: 5 weeks
Windchill SupplyLink provides online connectivity to contract manufacturers, suppliers and other disconnected manufacturing operations in support of “design anywhere, manufacture anywhere” initiatives. In addition to managing access to digital product definition data, it also facilitates key cross-organizational business processes such as sourcing and change control that involve the exchange and interaction with technical product information commonly managed in a PDM system. Windchill SupplyLink facilitates the formation of new supply agreements for engineered items, and ensures that distributed and external organizations have online access to the correct product definition (e.g., CAD, BOM, AML, AVL) relevant to their role in the supply chain. Windchill SupplyLink offers superior integration with Pro/ENGINEER and interoperability with various CAD and team data management systems for data synchronization.

**Critical Capabilities**

- Provides online product data access and exchange to external or disconnected manufacturing partners – including documents, models, drawings, BOM (Bill of Material), AML (Approved Manufacturers List), AVL (Approved Vendors List) information.
- Supports and leverages common data exchange standards such as PDX (Product Definition eXchange).
- Allows OEMs to selectively disclose product information to manufacturing partners without giving them full access to the product data management area.
- Lightweight, Web-based visualization capabilities enable viewing, markup and measuring of information generated by various 2D and 3D mechanical and electrical CAD and documentation authoring tools.
- Organization-specific product and document vaults enable distributed manufacturing partners to contribute the technical information and work products they author.
- Out-of-the-box sourcing process facilitates product data intensive sourcing events.
- Online archive manages supplier information, sourcing event data, and contracts and agreements.
- Online, cross-organizational communication and exchange of product change data including problem reports, change requests, and change notices which can carry BOM and drawing markups, attachments, and new revision information ensures that all parties are aware of changes and are using correct information.
• The ability to manage multiple, independent manufacturing partner relationships by capturing “as-planned” product information and by having multiple manufacturing BOM’s associated back to a shared engineering BOM.

**Business Benefits**

- Speeds time-to-market by coordinating information flows and accelerating design-to-manufacturing reconciliation of the product, materials and supply chain definition
- Reduces operating costs by enabling benefits capture for manufacturing sourcing decisions
- Results in higher quality products due to better collaboration between design and manufacturing operations

**A Broad PLM Footprint**

Together, the Windchill Quick Start solutions represent a broad PLM footprint that addresses the critical issues that occur throughout the product development process.

![Windchill Solution Coverage of PLM](image)

To provide maximum implementation flexibility, Windchill solutions can be deployed independently or in combination to address the needs for cross-functional collaboration and process management that occur throughout the entire product development lifecycle.

**Company-Specific Business Process Solutions**

Windchill also includes several modules that may be utilized in various combinations to deliver company-specific solutions to address unique needs within complex manufacturing organizations. Windchill’s open architecture makes it practical to modify and extend a Windchill-based PLM solution to accommodate special business requirements both upon initial implementation and over time as business needs evolve. Unlike other product information management applications based on proprietary architectures and toolsets that discourage customized configurations, the Windchill modular architecture and toolsets explicitly enable manufacturers to extend the data models, functionality, and user interfaces as they see fit.
Windchill Foundation offers a number of critical capabilities that are incorporated into standard Windchill solutions but also available as the baseline for customer-specific solutions:

- **Document Management and Vaulting**—allows users to construct and manage complex publications that may consist of multiple files, at multiple revision levels, and in varying formats, including outsourced files that are linked to the publication by URL reference and are managed externally. Core capabilities include data vault, check-in and check-out, version control, and history management.

- **Integrated Search Engine**—incorporates standard Web search engine technology as a means to perform fast and simple cross-system queries given that multiple, dissimilar data repositories are likely to exist in any extended enterprise solution. The search engine allows users to quickly find product information of almost any type (e.g., part numbers, ECOs, documents, etc.) independent of its structure or location in the enterprise.

- **Lifecycle Management**—defines the product lifecycle as a sequential set of phases that identifies the current state of an object and the gate conditions needed for that object to move on to the next phase. This allows lifecycle-managed objects to be moved through their lifecycle automatically by associating workflow processes with lifecycle phases and conditions. The automation provided by workflow support of lifecycle transitions can deliver large productivity gains. For any type of managed object, users can easily model the major states through which an object passes as well as the gate criteria that must be met in order to move to the next phase.

- **Workflow Management**—allows users to proactively guide and monitor their unique business processes within a flexible process management framework with the goal of delivering superior products, while reducing time to market and development costs. Sample workflow templates help manufacturers rapidly tailor and deploy common business processes. The Windchill graphical process editor defines workflow processes quickly and easily. The workflow process manager visually monitors and manages running workflow processes and investigates processes that have been completed or were manually terminated. Detailed information about workflow processes and activities indicates an activity's current state, when it began and ended, its duration, participants, and variable values.

Important capabilities embedded in standard Windchill solutions are also available in a modular form to extend the capabilities of a customer-specific solution to further manage and communicate information about product structures and related changes. These include:

- **Windchill PDM**—enables multiple, related BOM representations to be created and maintained to ensure the product is consistently represented throughout its evolution. In addition, it defines and manages configuration and change management activities across multiple disciplines and systems, which streamlines product enhancements and updates.

- **Windchill ProductView**—allows users throughout the enterprise to view all types of digital product information— from documents such as Microsoft® Word files, to 2D drawings, to 3D models— in a familiar Web-based framework. Users can view models and navigate through product structures and associated information in a single, integrated Web-based environment without knowing which applications created the files or how and where the files are stored. Users can view and markup various types of 3D and 2D standard and native formats to create supporting materials for engineering change orders (ECOs) and for online reviews.

- **Windchill Workgroup Managers**— captures and manages critical digital product data as it is being created with standard available interfaces in any of eight major MCAD packages (including Pro/ENGINEER®, AutoCAD®, CATIA®, and SolidWorks®), three team data managers (Pro/INTRALINK, Optegra, CoCreate), and two ECAD packages (Mentor,
Cadence). Windchill is, by design, CAD neutral and Workgroup Managers provide integration to the authoring tools by embedding Windchill menus and capabilities directly within the native CAD application user interface. The integrated menus place capabilities such as check-in/out, upload/download, and revise at the fingertips of the engineers, and allow for the user to directly operate on the authoring data from within the native CAD application. By the virtue of the integration, mission-critical engineering information from various applications will no longer be confined to the engineering community, but will be elevated to an enterprise asset providing visibility throughout the entire enterprise.

- **Windchill Information Modeler**—provides professional, object-oriented, rapid application development (RAD) tools for customizing Windchill and for creating and deploying customer-specific PLM applications. It offers a model-driven application development environment and embeds best-in-class tools for object-oriented analysis, design, and application development. This approach reduces the administrative overhead and maintenance typically associated with application development.

Manufacturers can begin with one or more Windchill Quick Start solutions or start with Windchill Foundation and then complement it by choosing from additional Windchill modules. And since Windchill Foundation-based applications are built on the same Windchill technology as the Quick Start solutions, companies can combine their business-specific functionality with any out-of-the-box Windchill Quick Start solutions. Manufacturers are no longer forced to choose between standard applications and business-specific requirements – both can be realized within Windchill.

**Windchill: Pure Internet Architecture**

Architecture matters when trying to optimize product development in the digital product value chain. Windchill was the first PLM solution developed specifically for Internet deployment; Windchill is pure Internet technology from the ground up. Windchill is based on the Java™ 2 Platform, Enterprise Edition (J2EE) standard for developing multi-tier enterprise applications, and naturally offers full capabilities in its native Web environment. A history of large customer implementations proves Windchill’s ability to scale and perform to the most exacting requirements. Windchill remains the industry’s only PLM solution architected under a common banner, with competitive alternatives invariably representing a patchwork of acquired technologies based on multiple architectures and lacking meaningful integration.

With Windchill’s pure Internet foundation used consistently across all solutions and modules, integration between solutions is seamless and cost of ownership low. With a zero-footprint Web browser client, manufacturers can provide any user having Web access with the ability to log into the full functionality of Windchill solutions, such as collaborative project spaces for the sharing and visualization of valuable product knowledge, and participation in complex multi-enterprise change requests.

With full support for Web services standards like SOAP, XML and WSDL, Windchill also quickly integrates with a range of enterprise and desktop applications (such as ERP, SCM, CRM, CAD, and legacy) and external partner systems, regardless of location or native format. In addition to full Web Services support provided through the Windchill Info*Engine technology, PTC provides robust support for traditional enterprise application integration through its strategic technology partnership with EAI vendor TIBCO.

The Windchill architecture utilizes a multi-tier approach to ensure the scalability required to accommodate the largest of implementations. The Windchill runtime architecture is divided into multiple tiers: client, application and data, and integration.
At the client tier, users access Windchill solutions with any commercially available Web browser, such as Microsoft Internet Explorer or Netscape Navigator, to view HTML pages over the Internet via a connection to a standard Web server.

The application and data tier consists of the Windchill Java Application Server, which handles business logic and processing along with the necessary security services (user identification and authentication), database communication, and system administration tools. The data portion includes the scalable Windchill data schema, which provides a comprehensive enterprise representation of the product structure and its associated digital product content. This tier also includes Windchill ProductView, which provides visualization services and conferencing and the Windchill Workgroup Managers for the supported engineering authoring application integrations.

The integration tier consists of messaging services that integrate with EAI middleware for connectivity to enterprise systems and the Windchill Info*Engine adapters for connectivity to other systems, including native support for Web services via XML, SOAP, and WSDL; JMI, JNDI, JavaMail, 3270/5250 mainframes and other native APIs.

**Using Windchill in the Product Development Process**

Manufacturers use Windchill to facilitate collaboration and manage information throughout various stages of the product development process. The following examples show how organizations typically use Windchill to facilitate collaboration and management of common business processes:

- **Engineering Change Requests (ECR)** – The processing of an engineering change request initiated by a procurement manager using product data management capabilities is streamlined by inviting the appropriate supplier and design engineers into an ad-hoc collaboration effort to investigate the impact of the change before the request is agreed to and implemented.
• **New Product Introduction (NPI)** – During the product design process, design engineers can create an ad hoc project collaboration workspace where members of a cross-functional team can take the design through multiple iterations and track their progress against a pre-determined project schedule. If the initial concept is based on an earlier managed version, this product information can be passed into the project for collaboration among the team and then passed back to product data management for long-term lifecycle management.

• **Product Sourcing (RFx)** – Sourcing processes can be dramatically improved by facilitating bi-directional information exchange between organizations. The buying organization (OEM) can compile a specific package of digital product definition, invite manufacturing suppliers, collect responses, and create agreement documents. Invited bidders are granted online access to a secure workspace with visualization, and markup capabilities within a sourcing process context.

The following examples show how organizations typically use Windchill to share and control digital information across the entire digital product value chain:

• **Release to Production** – Managers can direct the promotion of the digital product from the as-designed configuration created in product data management to the as-planned configuration defined in collaborative manufacturing in preparation for release to manufacturing, and do so with a complete audit trail and design feedback. The feed of digital product information to ERP systems can be accomplished automatically after the information passes through the online review and release process.

• **Design & Component Reuse** – As part of a product design process, design engineers can search on key criteria to determine if existing parts or designs can be reused from the internal enterprise component library or from external online supplier catalogs. Identified components can be added to the configuration being managed by the product data management system.

### Valuable Business Benefits

Unlike traditional enterprise applications that require heavy, top-down data modeling and lengthy implementation cycles, Windchill, with its flexible Internet-based approach to PLM, delivers a number of benefits that improve product quality, speed product development, and boost efficiency.

As documented by Giga in a study entitled “Total Economic Impact of Collaborative Product Development”, the benefits of using an enterprise PLM solution can be:

• **Reduce product development lifecycle time by 40%**
  Accelerates information sharing between design engineers with robust collaboration spaces aggregating required information, project timelines and activity assignments.

• **Reduce number of process errors by 50%**
  Ensures that participants are using the most up-to-date and accurate product data.

• **Reduce product development travel expenses by 65%**
  Powers collaboration spaces that aggregate all required information and include discussion forums and meeting spaces to conduct design reviews and other virtual meetings.

• **Reduce engineering change order processing time by 85%**
  Delivers automated, standards-based engineering change processes (spanning request,
analysis, and notification) containing supporting data, assignments and activity tracking for monitoring.

- **Reduce time to market by 40%**
  Bridges the communication and exchange of product data between design and manufacturing to meet time-to-market requirements.

To deliver these benefits, Windchill provides enhanced enterprise capabilities in a number of areas:

- Integrated strategic system of record for product and process information
  - Makes information accessible to disparate business systems
  - Enhances the value of existing IT investments

- Increased customer, supplier, and partner collaboration
  - Facilitates customer-driven design and innovation
  - Enables engineer- and build-to-order practices
  - Leverages supplier and partner innovation
  - Natural, intuitive user interface (simple and secure browser-based Web page)

- Improved product and corporate agility
  - Creates new customer interaction and service opportunities
  - Enables the rapid addition or removal of suppliers and partners
  - Facilitates design anywhere, build anywhere practices

- Lower total cost-of-ownership / easy implementation
  - Offers prescriptive and low risk, clear ROI deployment options
  - Enables rollout of additional functionality with modular architecture

**PTC: The Product Development Industry Leader**

There is no single best way to develop products, and product leadership can be fleeting. Where great products once provided advantage for years, today the advantage may last only months as customers demand yet more up-to-date technology and the latest product capabilities. With the speed of business itself much quicker, companies must strive for sustained competitive advantage by refining their product development processes to consistently yield superior products faster.

Putting product first has emerged as an imperative for the success of customer-focused manufacturers. A Product First focus places product development at the center of the organization – driving customer satisfaction, operational efficiency, and the business goals of the company. Product First, as envisioned by PTC, establishes the unifying framework for other business process systems that manage supply chains, customer relationships, and resource planning to contribute to corporate growth and success and drives the passion and zeal for excellence of everyone in the organization. Windchill enables companies to begin putting product first by facilitating the product development processes that occur throughout the digital product value chain. It provides the process and the enabling infrastructure for Product First.

PTC has been a pioneer in providing technology to improve product development, continually creating solutions that help manufacturers not only create great products faster but also turn those products and the information that defines them into assets that deliver value time and again. As the world’s largest software provider devoted entirely to product lifecycle management solutions and with over 33,000 manufacturing customers worldwide, only PTC is qualified to offer a complete suite of leading PLM solutions.
For More Information

For more information about Product First or PTC's PLM solution set, please visit PTC on the Web at http://www.ptc.com.