Lean Product Development

Leveraging PLM for Dramatic Returns

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Executive Summary

As markets have become increasingly global and competitive, original equipment manufacturers (OEMs) have responded with strategies designed to lower costs and increase productivity. One of the most popular of these has been "lean" – a concept for recognizing and eliminating waste in manufacturing.

Because virtually everyone today practices lean manufacturing, its power as a competitive advantage is waning. However, the potential to apply lean principles to product development has barely been scratched, despite the availability of powerful Product Lifecycle Management (PLM) solutions that can eliminate the repetition, redundancy, error and other forms of waste common to the field.

Leaders in Lean

A few pioneering companies are already putting lean to work in their product development processes. The results are impressive, including product development cycle times routinely being slashed by 60-70 percent and errors being caught at the concept stage, when they are least expensive to correct, rather than at the manufacturing stage.

PLM addresses all seven of the most common sources of waste. In manufacturing terms, these are expressed as overproducing, waiting, conveyance, inventory, processing, motion and correction. These forms of waste are common and costly in product development, as well, although they can be boiled down to four much simpler categories, which include waste common in creating, storing, locating and re-using data. These potential forms of product development waste are on the rise due to the challenge of managing a constantly changing and evolving project with processes that span from purchasing and finance to marketing, engineering, manufacturing and maintenance. In addition, the complexities only grow greater as OEM dependence on partners and suppliers expands around the globe.

PLM addresses these challenges by enabling business, engineering and manufacturing functions to have visibility into each other's decisions and by capturing corporate knowledge and making it widely available. This ensures, for example, that engineers know the relative costs of similar purchased parts as they make their design decisions, and that manufacturing constraints are taken into consideration in product design. Capturing corporate design standards as templates and rules, meanwhile, allows them to be automatically applied to each design, ensuring consistency and quality.

Making Lean Work with Outsourcing and Offshoring

Communication and collaboration are among the biggest challenges to implementing lean product development, and they are increasingly difficult in the era of outsourcing and offshoring. In fact, difficulties in communicating and collaborating can eat away significant portions of the financial benefits available from outsourcing and offshoring, so

streamlining these processes for maximum effectiveness is critical. PLM creates such powerful efficiencies in communication and collaboration that it not only helps outsourced/offshored companies operate in a lean manner – they also can narrow or eliminate the wage gap between a supplier in a developed economy who uses them, and one in a developing economy that does not.

Offshoring, however, is often misused and rarely creates a sustainable advantage. Efficiency gains lead to permanent cost reductions and increased revenue, but offshoring can only temporarily reduce costs. While efficiency gains reduce product development cycle times, improve time to market and increase quality, offshoring can often have the opposite effect because it requires such a concerted effort to achieve desired results.

Following the same processes, enduring the same product development costs and merely reducing unit costs is not lean. Removing the waste, improving the processes, and eliminating the costs are lean.

Achieving Lean with PLM

PLM addresses all three elements of lean:

- Designing and developing products that meet or exceed customer needs;
- Designing products that can be effectively and efficiently produced and serviced; and
- Designing products without excessive development investment.

Companies ranging from Boeing to the Royal Canadian Mint and from QubicaAMF (bowling equipment) to A-dec (dental equipment and cabinetry) are achieving lean product development benefits with V5 PLM from Dassault Systemes. By eliminating routine work, streamlining processes, keeping far-flung teams in constant communication and collaboration, and dozens of other benefits, PLM is helping OEMs and their suppliers realize the dream of a product development process as lean as their best lean manufacturing processes.

Lean Product Development: Leveraging PLM for Dramatic Returns

As markets have become increasingly global and competitive, original equipment manufacturers (OEMs) have responded with strategies designed to lower costs and increase productivity.

For many years, one of the most popular cost-cutting initiatives has been "lean," a concept first applied by Toyota to its manufacturing processes. Lean involves recognizing and eliminating waste – defined as anything that does not add value for the end customer – to cut costs and improve product quality. Lean can be as simple as rearranging a manufacturing floor to minimize the distance parts must travel, or as sophisticated as building a culture in which every employee actively seeks to contribute to quality.

Lean principles were born in the manufacturing arena, and that's largely where they have remained. The bad news is that virtually everyone practices lean manufacturing today, making it a prerequisite for remaining in business – not a competitive advantage. The good news, however, is that areas outside manufacturing are prime candidates for the application of lean principles. And few offer the potential returns of applying lean to product development and engineering.

"Product development is a virtual wilderness when it comes to lean," says David Van Horn, Director, Archstone Consulting. "Very few people have even attempted it because it's difficult to see how to translate the lean principles developed in manufacturing to the field of product development. But it can be done, and the potential return is substantial."

In terms of product design, "lean is all about designing and developing products that meet or exceed customer needs, that can be effectively and efficiently produced and serviced, and that do not involve excessive development investment," Van Horn says. "In manufacturing, lean 'works on' physical product and information flow, while in product development lean 'works on' engineering product and information flow – virtual products, if you will."

Leaders in Lean

A few pioneering companies – including Cessna (personal and corporate aircraft), American Specialty Cars (ASC, a specialist in innovative automotive concepts and options) and A-dec (dental equipment and cabinetry) – are already putting lean to work in their product development processes.

Cessna, for example, is using standardized product templates to eliminate routine engineering work, cutting the time required to design routine parts by 25 percent – time that can be used to get to market faster or increase design quality. A-dec has used lean principles to remove the limitations on its cabinetry production system, making its capacity virtually infinite and freeing its designers to concentrate on high-margin special orders. ASC has cut the time required to adapt an existing design for its innovative InfiniVu open air roof system to a new automotive model from 20 man days to just one.

"If you were ASC, what could you do with 19 saved days?" asks Mark Strobel, Director of Industry Solutions Portfolio Management for Dassault Systèmes, the world's leading producer of Product Lifecycle Management solutions that help companies drive lean product development processes. "You could use it to cut your workforce, but that's a one-time gain. Better choices would be to take on more work, to do more iterations of the design to improve quality, or put the saved time toward additional R&D that might generate the next great, innovative product. The beauty of lean product development is that the savings you create gives you that choice."

Studies have documented cases in which applying lean principles to product development have reduced product development cycle times by 60-70 percent.[1] Being on the leading edge of the lean product development curve gives companies like Cessna, A-dec and ASC tremendous competitive advantage in their respective markets because they are enjoying savings that can be used to cut costs or reinvested into product development – savings their competitors have not yet learned to tap.

Because lean product development looks different in each company, reflecting each one's unique processes, culture and intellectual capital, it is difficult to copy. This gives the leaders a head start with the potential to endure – the elusive advantage Gartner Group refers to as "competitive durability."

The Seven Sources of Waste

Studies suggest that 70-80 percent of the final unit cost of a product is driven by R&D-based design decisions[2], often without conscious awareness of the repercussions of those decisions. A focus on lean product development helps to bring those unconscious decisions into the open and manage them with processes designed to minimize waste.

So what does lean look like in terms of product development? One of the easiest ways to understand lean in this new context is to understand the seven sources of waste. Eliminate those, and the remaining process is inherently lean.

The seven sources of waste, originally identified in the manufacturing arena, include overproducing, waiting, conveyance, inventory, processing, motion and correction. Consider each one in a product development context:

- **Overproducing.** This includes producing goods the market doesn't want, loading a product up with unwanted features, over engineering (such as using a half-inch piece of metal where a quarter-inch piece will do the job), and suboptimal designs that generate excessive costs in manufacturing or purchasing. Overproducing is a symptom of insufficient design standards and lack of a clear understanding of customers wants.

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[1] *Accelerated Product Development*, Clifford Fiore, Productivity Press, New York, 2005.

[2] " Smart Spenders: The Global Innovation 100," by Barry Jaruzelski, Kevin Dehoff, and Rakesh Bordia. *Strategy + Business*, Booz Allen Hamilton, Issue 45, p. 52.

- **Waiting.** Waiting includes time spent searching for information, waiting for someone to design or change something so you can take the next step, designing parts in sequence rather than concurrently, and designing tooling only after part design is complete. In each case, something that could be moving forward is stalled, waiting for something else to happen. The result is waste. “A lot of waiting happens because a company hasn’t created a culture and a process that facilitates sharing,” says David Wireman, Principal, Archstone Consulting. “You don’t want chaos, but you want openness. It has to be the social norm to release and share.”
- **Conveyance.** Conveyance is closely related to waiting. Handoffs are a common form of conveyance that can slow the process due to delays on the part of either party in the handoff, lack of clear instructions, or lack of complete information. Releasing a design to manufacturing without clearly conveying the intent behind the design is an example of a conveyance likely to generate waste, because recipients won’t have the context necessary to act on the information. A related but opposite problem with conveyance involves excessive information distribution – making everyone wade through information that only a few need to know.
- **Inventory.** Inventory can take several different forms in a product development context. Inventory can refer to designs; for example, a company that cannot organize its existing designs for reuse is generating waste. The unused designs are waste, and the time spent re-designing parts that exist but cannot be found is waste. Inventory waste can also refer to inefficiency in design systems, primarily because the systems aren’t sized to accommodate demand, leading to batching and lengthy queues of information waiting to be processed.
- **Processing.** Processing refers to redundant, stop-and-go tasks, reinvention and lack of standardization. For example, if a design calls for 3,000 brackets that vary only by size, it is wasteful to design each bracket individually, rather than designing the bracket once and adapting it to the requirements of each occurrence. Such a process not only wastes design time; it also wastes manufacturing time.
- **Motion.** Motion involves activity undertaken specifically to compensate for broken communication processes, and includes lengthy searches for information, travel designed to overcome information disconnect, redundant meetings, and redundant status reports. Re-keying bills of material created in one system into a second system or tracking key information with paper spreadsheets are other examples of motion-based waste.
- **Correction.** Correction is perhaps the single largest source of waste in product development. Change orders, physical prototypes created to verify design integrity, program audits and rework are all examples of costly correction waste. “First pass success is one of my primary measures of lean product development,” says David Fitzpatrick, Principal, Archstone Consulting. One key measure of correction waste is the ratio of parts in a finished product to the number of released drawings. “If you’ve released 2,500 drawings to get 1,000 parts that work together and meet customer needs, that’s a lot of waste,” Fitzpatrick says. “If you released 1,250, you’re doing much better. You’ll probably never develop a new product without a change order, but you want to get as close as possible.”

At their essence these seven sources of waste, originally defined for a manufacturing context, can be boiled down to just four in a product development context: waste in creating, storing, locating and re-using product data. These four forms of potential product development waste are on the rise due to the challenge of managing a constantly changing and evolving project with processes that span from purchasing and finance to marketing, engineering, manufacturing and maintenance. In addition, the complexities only grow greater as OEM dependence on partners and suppliers expands around the globe.

The Challenge of Managing Constant Change

One of the major challenges with applying lean principles to product development is that, unlike physical products in manufacturing, products in development are in constant flux.

Every time an engineer sits down to work on a part or an assembly, it changes. Because parts must fit together and work together, each change to one part may necessitate changes to dozens of other parts – parts that probably are being designed by different engineers – and to associated tooling.

“Interfaces are a key aspect of lean development,” Fitzpatrick says. “You have to define your interfaces early and in detail, and then all the relevant parties design up to the point where those interfaces start. But they don’t change the interfaces once they’re defined unless there’s a major problem. Everyone has to understand the interfaces well and early.”

Because design systems often are not integrated with business systems such as ERP and manufacturing systems such as MRP, these three highly interrelated functions often have no shared visibility. Engineers have no way of knowing that Design A can be manufactured with existing equipment while Design B will require the purchase of new machinery, or that Part C can be purchased for 25 percent less than Part D. Working in an information vacuum, they may make the wrong choice. By the time Manufacturing or Purchasing has visibility into that decision, it is too late to change it, and the chance for savings is lost forever.

This same information vacuum exists when there is no way to capture corporate knowledge. For example, many companies have standards that control the ratio between the size of a hole cut into a piece of metal and the distance to the edge of a part. These ratios vary depending on the type and thickness of material involved. Looking up that information each and every time a designer has to design a hole in a piece of metal is time consuming and repetitive. Now multiply that time by the large number of such parts in an automobile or an airplane, and you begin to see how standardizing such decisions can add up. Capturing such ratios in templates or as rules that can be automatically applied by a design system takes time on the front end, but creates a savings each and every time the rule is used.

All this uncertainty, coupled with increasingly complex products, shorter time frames and geographically dispersed supply chains contribute to other sources of waste. For example, although it is possible to design and assemble parts in 3D and then set them in motion to test operation and reveal clashes, many companies build multiple prototypes of their products to ensure that systems fit and work together the way they should. If your product is an MP3 player, physical prototyping may not represent a significant cost. If you're building airplanes, however, every prototype adds millions of dollars to your development costs. Physical prototyping is the most expensive way to verify design validity, and is the antithesis of lean.

Making Lean Work in Conjunction with Outsourcing and Offshoring

Communication and collaboration are among the biggest challenges to overcome in implementing lean product development. These challenges are especially critical today, as OEMs outsource much of the design and manufacturing for parts or entire subsystems to strategic partners, spreading the risk of large projects across multiple companies. These partners, in turn, have joined the OEMs in sending business "offshore" – delegating to low-cost suppliers in emerging markets – in an effort to meet the severe price pressures that characterize the modern marketplace.

Outsourcing and offshoring have many benefits. For example, outsourcing allows OEMs to place detailed product design and manufacturing in the hands of companies that specialize in particular types of systems. This helps to improve product quality by placing specialized work in the hands of specialized experts, while greatly expanding the number of minds working on an engineering challenge. Offshoring, meanwhile, allows suppliers to tap pools of skilled labor at far lower costs than may be available in their home countries, and to keep work progressing 24x7.

But lean emphasizes minimizing handoffs, streamlining communication and facilitating collaboration. In contrast to these basic tenets of lean, outsourcing and offshoring disperse work geographically, causing the number of handoffs to skyrocket. But geography is not the only challenge: culture, language, time zone and even a partner's choice of IT platform can all affect the success of outsourcing and offshoring.

For example, a recent report in CIO magazine found that workgroups consisting of OEM employees and contractors were most efficient when co-located away from the main OEM site. This group's efficiency was therefore designated as 100. For aggressively dispersed workgroups, where some workers were at different sites onshore and the rest were located offshore, productivity dropped to 62, with a range from 41 to 91.[3]

A recent study by neoIT.com found that while labor rates offshore can be 70-90 percent lower than domestic rates, most companies save 25-50 percent at best due to a wide range of unanticipated costs. Communication costs are a prime culprit, averaging 30-60 percent higher when dealing with offshore suppliers and eliminating much of the gain from lower labor rates.[4]

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[3] "What's the Real Cost of Your Offshore Operations" by John Parkinson, CIO magazine, Feb. 8, 2006.

[4] "Total Cost of Offshore (TCO): Understanding the True Offshore Financial Rewards and Costs," www.neoIT.com, May 2004, Volume 2 Issue 4.

Higher communication costs are not the only costs that cut into the benefits from offshoring, however. Without proper planning and investment, other challenges include lack of necessary infrastructure at the offshore vendor, lengthy and costly initial setup issues, inadequate process planning, insufficient QA testing, and cultural issues, such as a reluctance to ask questions or challenge instructions.[5] Of even greater concern, any benefits realized through offshoring represent a one-time gain that can quickly be copied by the competition – not a sustainable competitive advantage. Furthermore, simply following established processes at a lower cost is not lean. The waste remains – it just costs less. Lean, however, eliminates the waste and, thus, the cost.

Despite all these drawbacks, according to a study by Booz Allen and INSEAD, the European graduate school of business, more than 75 percent of the new R&D centers that businesses plan to open in the next three years are planned for China or India.[6]

"The way you get a product to the floor is all about designing parts and code and electrical circuits and someone getting all of those pieces to come together, be manufactured, fit together, work and last," Fitzpatrick says. "You have to have a plan for how to get all those different drafting tables, regardless of where in the world they sit, to come together, work together, share knowledge and fit together in the virtual 3D world in a way that lets you know they will also fit together in the physical world."

A few years ago, the challenges would have been insurmountable. But today, powerful and proven Product Lifecycle Management (PLM) processes and technologies are available to help OEMs and their suppliers to take full of advantage of "lean" in a process development context. Best of all, these same technologies help to make both outsourcing and offshoring more beneficial.

These PLM solutions are so powerful, in fact, that the efficiencies they create can not only help an outsourced/offshored company operate in a lean manner – they can also help narrow or eliminate the wage gap between a supplier in a developed economy who uses them, and one in a developing economy that does not.

"The fact is, if you encounter issues at any phase in your development cycle after you have sourced to a low-cost country, your cost to incorporate changes in product definition will dramatically increase," says Howie Distel, a solution architect for Dassault Systèmes. "Your risk from both a time and quality perspective have increased as well. PLM would help to keep your sourcing partner up to speed on your product changes – but only if they have made the investment in PLM as well."

Achieving Lean with PLM: Delighting Customers

To understand how PLM can help to facilitate lean processes in a product development context, let's take a moment to revisit Archstone's definition of lean:

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[5] "The Hidden Costs of Outsourcing" by Stephanie Overby, CIO magazine, Sept. 1, 2003.

[6] "Smart Spenders," op cit, p. 55.

> “**Lean is all about designing and developing products that meet or exceed customer needs**, that can be effectively and efficiently produced and serviced, and that do not involve excessive development investment.”

While PLM cannot determine what the market wants or needs – that is the job of sales and marketing – PLM can help a company arrive at a design that meets identified needs faster and less expensively.

“The PLM system can store all of the information about what the market wants and needs so that it can be accessed by those who are qualified to separate good ideas from bad ideas,” Distel says. “In defining a product that has category killer potential, it is important to eliminate bad concepts quickly. The ability to create rapid design candidates and interrogate those designs through simulation and validation of virtual product data is at the heart of PLM.”

Best of all, it isn’t necessary to actually build the product to see if it delivers. Products can be mocked up in virtual 3D in much less time at significantly less cost to determine if they meet project goals. Designers can explore several different approaches to a challenge simultaneously and at minimal cost, continuing to refine multiple designs until a clear winner emerges.

With a solution such as ENOVIA VPLM to store and manage data in process, no idea is ever discarded. If it becomes clear at some point that a design has moved along the wrong path, it is possible to go back to early designs that were discarded and reevaluate them. PLM also can be leveraged to present top executives with a view into available options, helping to ensure that designers stay on track with a project’s original intent. “ENOVIA 3D Live is an excellent example of a solution that provides executives a dashboard view into projects and allows the executives themselves to access the product information,” Distel says. Data can be filtered by cost, timing and function, providing different perspectives on the same project.

3D digital mockups also can be used to test product concepts with potential users without a physical prototype. “PLM is a mechanism to bring 3D to everyone, including partners, customers and even consumers,” Distel says. “With the optimal PLM system and process defined, you could bring a product to market before you had a physical model. I don’t believe virtual product launches are very far into the future.”

Boeing, for one, is very close to that goal today. Its new 787 Dreamliner was rolled out virtually in 2006, when the company introduced the plane to press and customers in virtual 3D form. The multimedia event featured engineering-based simulations, video of production startup and the unveiling of the 787 final assembly production flow – all created digitally using V5 PLM from Dassault Systèmes.

As Boeing’s partners began to assemble physical parts, the power of digital simulation became even clearer. First-time assemblies that had been expected to take days to complete, until workers’ learning curves ramped up, were accomplished in hours. And

Boeing now calculates that the jet's overall operating cost to airlines will be 20 percent better than the 8-10 percent improvement Boeing originally projected.[7] On the strength of its 787 virtual models, Boeing took 435 firm orders worth $68 billion in just eight months, which the company says qualifies the Dreamliner as "the most successful commercial airplane launch in history."[8]

Achieving Lean with PLM: Efficient Manufacturing and Servicing

Now let's consider the second piece of the Archstone definition of lean product development:

> "Lean is all about designing and developing products that meet or exceed customer needs, **that can be effectively and efficiently produced and serviced**, and that do not involve excessive development investment."

This is one of the most difficult pieces of lean product development to achieve, and one of the places where an investment in PLM can pay the greatest dividends. This is the piece of lean product development where engineering meets both manufacturing and service, and requires that products be designed to be manufactured and serviced efficiently.

Designing products with manufacturability and serviceability in mind requires a tight interface with Manufacturing and Service from the earliest product development stages. It is not effective to fully develop a product and then throw it over the wall to Manufacturing or Service for comment. Too much has been invested and too much time has passed to make changes cost effective at this stage.

PLM facilitates effective and efficient production and service by allowing Manufacturing and Service to see designs as they develop and bring their specialized expertise to bear, advising designers on manufacturing options or testing servicing scenarios in virtual 3D. Workflow processes in the system can be established to alert Manufacturing and Service at key junctures in the development of a design, and to flag challenges for resolution.

For example, a Tier One automotive supplier that manufactures dashboard systems may test early designs in 3D to ensure that the finished dashboard can be moved into position through either the windshield opening or the door, verifying that assembly is possible. An aircraft manufacturer may design cabinetry with snap-out back panels, facilitating service by providing easy access to wiring harnesses, plumbing or electronics installed behind the storage units. 3D digital mockups enable users to view designs from all angles and even put assemblies in motion to understand the interactions among parts. Simulation capabilities even empower users to study the angles, sight-lines and ergonomics of performing certain maintenance procedures.

"The ability to create rapid design candidates, interrogate those designs through simulation and validation of virtual product data and then merge functionality into the

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[7] " 'Good, steady progress' on 787 as Boeing works to lighten up," Seattle Times, November 7, 2006.
[8] "Boeing 787 Dreamliner Rolls Out of Factory – Virtually," Boeing news release, December 6, 2006.

final choice should be facilitated by the PLM system," Distel says. "The flexibility of the system to accommodate merging and changing data throughout the process to accommodate the various needs of manufacturing and service with minimal investment is a key capability the PLM system should possess."

The same 3D files used to design a product also can be output as NC instructions to run the machines that produce the parts. Beyond manufacturing, they can be used to demonstrate how to assemble the product, how to repair it, and how to use it. For complex products such as airplanes or ships that undergo numerous configuration changes over their life cycle, as-built 3D designs can be modified to reflect as-maintained realities as the product evolves, so maintenance and operation documentation always remains up to date.

Achieving Lean with PLM: Minimizing Development Investment
Now let's consider the third piece of the Archstone definition of lean product development:

> "Lean is all about designing and developing products that meet or exceed customer needs, that can be effectively and efficiently produced and serviced, **and that do not involve excessive development investment**."

Although PLM can help with all three phases of lean product development, this is perhaps the phase where a properly planned and implemented PLM solution shines the brightest. PLM achieves this by facilitating broad visibility into product data, keeping everyone informed about the progress of a project whether they are in engineering or marketing and whether they sit down the hall or on the opposite side of the world.

Because PLM designs are created in electronic 3D, it is fast and cost-effective to try many different approaches to a design challenge before settling on one. Powerful in-process data management capabilities manage the relationships between parts as they develop, automatically alerting part owners if someone else's change will influence their design. This enables multiple designs to proceed in tandem, rather than sequentially, slicing development times by 50 percent or more. Even tooling to make the parts can be designed as the part designs are still evolving, because change is accommodated so quickly and efficiently.

"Allowing data to accumulate in silos is dangerous, because then no one can have confidence that they are working off the latest information," Distel says. "This is one of the situations that leads to a proliferation of late-cycle changes, when change is most expensive. When all departments can access, create, modify and manage information concurrently from a single source, the savings in time and resources is enormous."

Because design information is broadly available through web-browser style viewers and dashboards, the difficulties of static information – such as paper drawings or electronic spreadsheets – are eliminated. Everyone shares the same information, and that information can be shared with remote partners at onshore or offshore sites in virtually the same way it is shared with colleagues across the room or down the hall.

“Let us suppose that we have received some top-level system requirements from our customer,” Distel says. “Our internal preliminary planning indicates that the system will be made up of three sub-systems that must work together. These three sub-systems will be provided by different suppliers with the appropriate competencies.

“We have a fixed envelope to design our system within. Rather than try to articulate this through 2D drawings and documents, we might use a 3D collaboration session to convey our spatial requirements. We can distribute this envelop to our suppliers so they can initiate their development processes for each sub-system. In an ideal world, we would authorize our suppliers to work off our data inside our PLM system.”

Because everyone in this scenario draws their information from a single centralized database, no one needs to worry about working off outdated data or missing out on an important change.

“Using the wrong data and not recognizing that you’ve done so until at or near launch is costly,” Distel says. “Each step that you delay a change increases your costs by a factor of 10. If you break your lifecycle into five phases and make a change at the first phase, your cost of change might be $1. If you make that change at Phase 3, your cost will be $100. If you make that same change at Phase 5, your cost will be $10,000. So using a PLM system to search for data with the knowledge and security that what you find will be the right data is extremely valuable.”

Powerful search capabilities make it easy to find existing designs that fit defined characteristics and can be adapted to work in new projects. This eliminates rework and reinvention. “In most companies, on average, product development resources spend 40 percent of their time searching for data,” Distel says. “With PLM you never have to worry about who has it, which drive it resides on or whether you have the latest update. It’s all in one central place, and everyone has access to it, provided they have the proper authority. When you adapt an existing product to meet new requirements, you minimize your investment of time and money.”

Relational design capabilities employ templates that enable a part to be designed once and automatically adjusted to fit new parameters, eliminating routine re-design of basic, common parts and the design variability that comes with it. Using templates to standardize how such routine designs are created also helps to create consistency that pays dividends in manufacturing, which can spend more time making the part and less time deciphering how it was designed.

When knowledge-based engineering methods are used to capture corporate know-how and standards, part quality and consistency improves dramatically, and the time required to ensure that parts meet corporate standards shrinks exponentially. “Over time, PLM properly used becomes the repository for everything a company knows and what they have learned from past projects," Distel says. "Because you save so much time on the back end, PLM makes it possible to spend more time in the early stages of development, investigating design alternatives that lead to new innovations."

American Specialty Cars (ASC) knows the power of such savings first-hand. ASC cut the time required to adapt an existing design for its innovative InfiniVu open air roof system to a new automotive model from 20 man days to just one. "Instead of designing the product from scratch we capture our knowledge and build on it, which allows us to meet our customers' need for speed, contributes to continuous quality improvement and keeps the cost below what you would expect for an option like this," ASC Vice Chairman Chris P. Theodore says.

Lean Product Development in Practice: Customer Experiences
Dassault Systèmes customers around the globe are leveraging the power of V5 PLM to implement lean product development processes. A few examples include:

- **QubicaAMF:** This well known manufacturer of bowling equipment has used ENOVIA SmarTeam to move from sequential to concurrent design of parts and eliminate time once spent trying to locate parts or designing new parts to replace ones it couldn't find. BOMs are compiled directly from 3D assemblies, rather than being manually retyped into a spreadsheet.

- **American Specialty Cars:** ASC, a designer of innovative automotive styles and systems, uses Knowledgeware "to capture our knowledge and build on it, which allows us to meet our customers' need for speed, contributes to continuous quality improvement and keeps our costs below what you would expect," according to Vice Chairman Chris P. Theodore. Innovation and quality ramp up faster because users build on their knowledge with each design iteration, delivering more benefit to each successive customer. Accumulated learning and design-in-context also eliminate arbitrary mistakes, because everyone on a project can see not only what has been done, but also why. "Having one set of data that is shared in real time makes information clear and transparent and eliminates a lot of waste," Theodore says. "Our ultimate vision for PLM is that if a change is made, everybody knows about it in a nanosecond, along with all of the implications for cost, tooling and assembly."

- **A-dec:** A designer and manufacturer of dental equipment and cabinetry, A-dec is using CATIA V5 with parametric design capabilities driven by Knowledgeware to store its standard cabinetry assemblies as design templates. CATIA V5 generates the numeric control (NC) instructions to manufacture the components, outputting them to A-dec's milling and routing machinery directly from the 3D model. This eliminates data re-keying and its inherent potential for error. When combined with ENOVIA SmarTeam, "CATIA V5 lets us see the product virtually in 3D, eliminating the multiple rounds of prototypes we needed to find the errors," Staff Manufacturing Engineer Chris Etzel says. "Now we're virtually paperless." 3D XML allows Manufacturing engineers to resolve questions by viewing CATIA designs in 3D

- **Royal Canadian Mint:** The Mint uses CATIA V5 3D parametric modeling, combined with ENOVIA SmarTeam data management, to generate, modify and validate concepts for coins and packaging in a fraction of the time previously required for 2D drawings. When designers adjust parameters such as dimensions, the model and drawing update themselves automatically. “With V5 PLM we just change one number and everything – the coin, tooling, drawings and reports – all update automatically,” says Xianyao Li, Director of RCM Corporate Engineering. SmarTeam provides product data visibility to 18 separate departments, and SmarTeam Workflow ensures optimal collaborative procedures are followed, incorporating automated reminder notices to ensure nothing is overlooked. The average time needed to produce a foreign currency quote dropped by 50 percent, enabling the Mint to better manage bids for rapidly fluctuating precious metals.

- **Laepple AG:** This German automotive tooling manufacturer uses DMU and photorealistic rendering capabilities in CATIA V5 to study part surfaces in widely divergent light levels and angles. “By looking at the lines of light, we can see on screen whether the surface of a vehicle part is mathematically correct or whether we need to take corrective action,” says Jürgen Faller, head of the CAD/CAM production department. “In doing so upfront, we avoid costly retooling further down the line.” NC programming for production of cast tools is created directly from 3D designs in CATIA V5, and the complete tool design is made accessible to project stakeholders through ENOVIA V5 DMU. This enables all users to easily understand the design and conduct early assessment of product manufacturability, resource and process planning. “By reducing or eliminating the need for hardcopy drawings on the shop floor, V5 DMU minimizes common misunderstandings between manufacturing and engineering,” Faller says.

- **AREVA NP:** This nuclear services company designs tools and parts used in maintenance of nuclear power plants. “With ENOVIA SmarTeam, we saw the opportunity to improve our search capabilities, making it easier and faster to locate the data we needed and ensuring that data is preserved,” says Gary Poling, Design Engineer for AREVA NP Component Repair Technologies. Building a new tool on an existing design saves time, increases the opportunities for design improvements and reduces prototype rework, because many design challenges have already been solved in the initial design process.

PLM: Lean and Getting Leaner

These are just a few examples of how OEMs and suppliers worldwide are leveraging V5 PLM from Dassault Systèmes to apply lean practices to product development.

By eliminating routine work, streamlining processes, enabling early exploration of design alternatives, supporting concurrent design, eliminating data inconsistencies and keeping geographically dispersed teams in constant communication and collaboration, PLM is helping OEMs and their suppliers realize the dream of a product development process as lean as their best lean manufacturing processes.

As impressive as these early results are, however, they represent just the beginning of PLM's potential to eliminate waste, improve efficiency and deliver better products faster and more cost effectively than ever before. Each success generates new ideas about how to leverage the technology for even greater benefit, and the potential is as limitless as the creativity and commitment of its users.

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