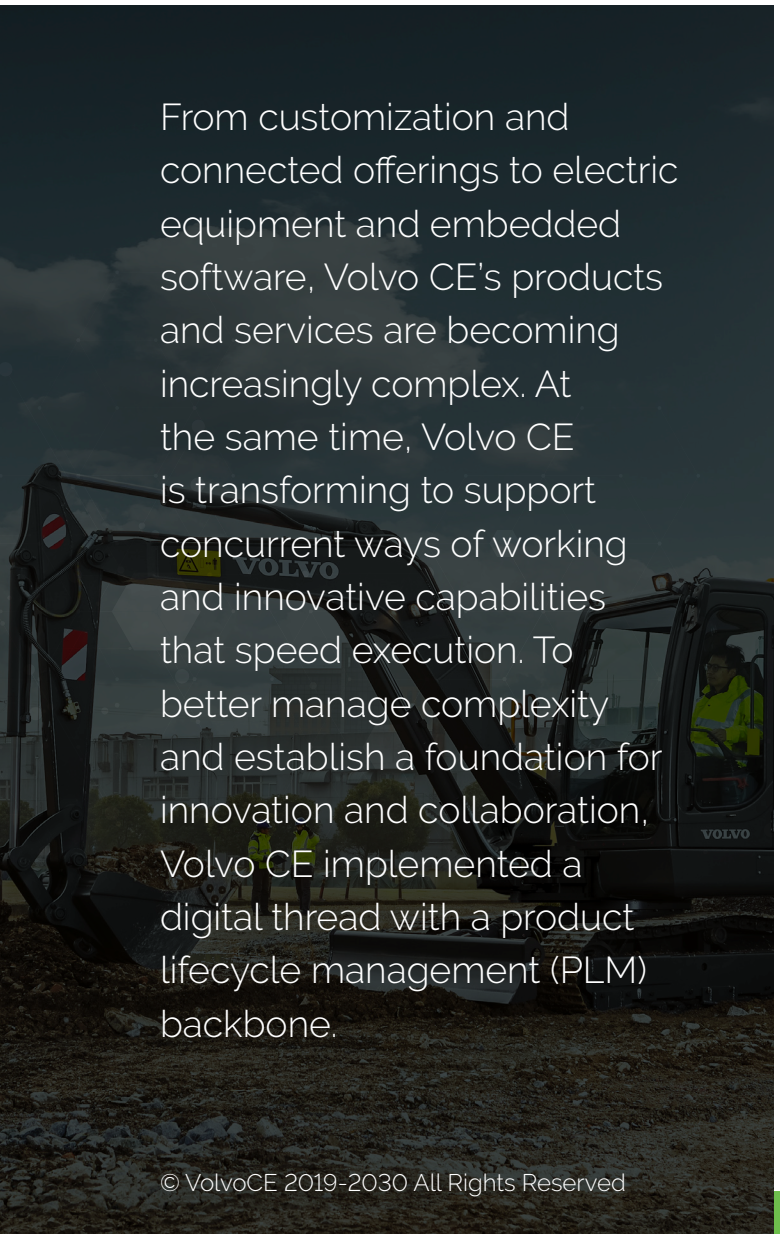
Volvo CE accelerates digital ways of working on its mission to build a better tomorrow

Managing complexity and enabling concurrent manufacturing with a digital thread



From customization and connected offerings to electric equipment and embedded software, Volvo CE's products and services are becoming increasingly complex. At the same time, Volvo CE is transforming to support concurrent ways of working and innovative capabilities that speed execution. To better manage complexity and establish a foundation for innovation and collaboration, Volvo CE implemented a digital thread with a product lifecycle management (PLM) backbone.

Committed to innovation, Volvo CE had a pressing need to improve their legacy systems

Headquartered in Gothenburg, Sweden, Volvo Construction Equipment (CE) is a leading international manufacturer of premium construction equipment. Leveraging more than 180 years of construction expertise and the knowledge of over 14,000 employees, it supplies products and services to more than 180 countries around the world. With innovation at the heart of its strategy and culture, Volvo CE provides the right machines and solutions for any construction job to ensure customer success.

Ever-changing market conditions, shorter product lifecycles, and increasing product complexity are requiring industrial organizations like Volvo CE to change. Companies are adapting by creating new business models, globalizing operations through decentralized production, and leveraging technologies like automation and connectivity to enable customized products and smart services. To realize key business capabilities and secure long-term growth, Volvo CE set out to define a vision for digital transformation.

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Volvo CE's legacy systems and processes were costly and complex

Like many companies with a long history, mergers and acquisitions have impacted Volvo CE's product and service portfolio. A complicated and costly IT landscape—based on no less than four different product data management (PDM) systems—emerged over the last four decades. As a consequence, a significant part of the investment capacity went to keeping the old systems running. Little or no investment could be put towards actually improving ways of working.

Using several PDM systems also meant that throughout the product development cycle, different teams and organizations relied on multiple manual interfaces and ways of working with data. This generated information silos. For example, Volvo CE created and managed its manufacturing bills of materials (MBOMs) using Excel spreadsheets. As a result, subsequent design changes required bills of process (BOPs), standard operating procedures (SOPs), and other types of documentation to be manually propagated across multiple documents.

Additionally, duplicate data across systems caused inefficiencies and unclarities. Product and software parts documentation were often managed in separate PDM systems using different methods. This meant a degree of duplicate documentation was required to ensure changes were implemented across all systems.

Altogether, disconnected systems and interrupted workflows had an unwanted impact on traceability,

costs, quality, and built-in lead time. With a large amount of product releases annually, this had consequences for all cross-functional areas. Furthermore, manual and paper-based processes slowed down the change notice (CN) workflow, affecting the whole change management process.

Because it was too difficult to manage hardware and software complexity across legacy systems, Volvo CE decided to revolutionize its approach to product development by leveraging the latest product lifecycle management (PLM) technologies. This would enable more efficient closed-loop product lifecycle management and unleash opportunities across the company.

Volvo CE developed its strategy for execution leveraging Windchill's Value-Ready Deployment

In order to successfully drive change throughout the organization, the company's Strategy, Architecture and Systems team first created an end-to-end value flow and established a strong approach to program management. They planned to use PTC Windchill's out-of-the-box capabilities along with PTC's Value-Ready Deployment methodology to connect the vision with employees on the ground floor.

First, Volvo CE defined its innovative vision for the technology

Windchill is a comprehensive PLM solution for data governance and traceability, providing an authoritative source of truth across engineering, operations, suppliers, and customers. Leveraging Windchill's open architecture and easy integrations with other enterprise systems, the team recognized the opportunity to establish a digital thread and consistent product architecture. Rather than working in siloed systems and manually handing over product data, this would enable all teams to collaboratively manage product hardware and software complexity in one place.

For Volvo CE, embracing a digital thread was a significant shift in the product development documentation. This enabled engineering for choice and established parts-centric documentation, with smoother handovers, reduced duplicate data across systems, and increased collaboration across the organization—laying the foundation for being a software-driven company. The ultimate goal was to replace all four legacy PLM systems with a single source of truth, where all users contribute to adding value.

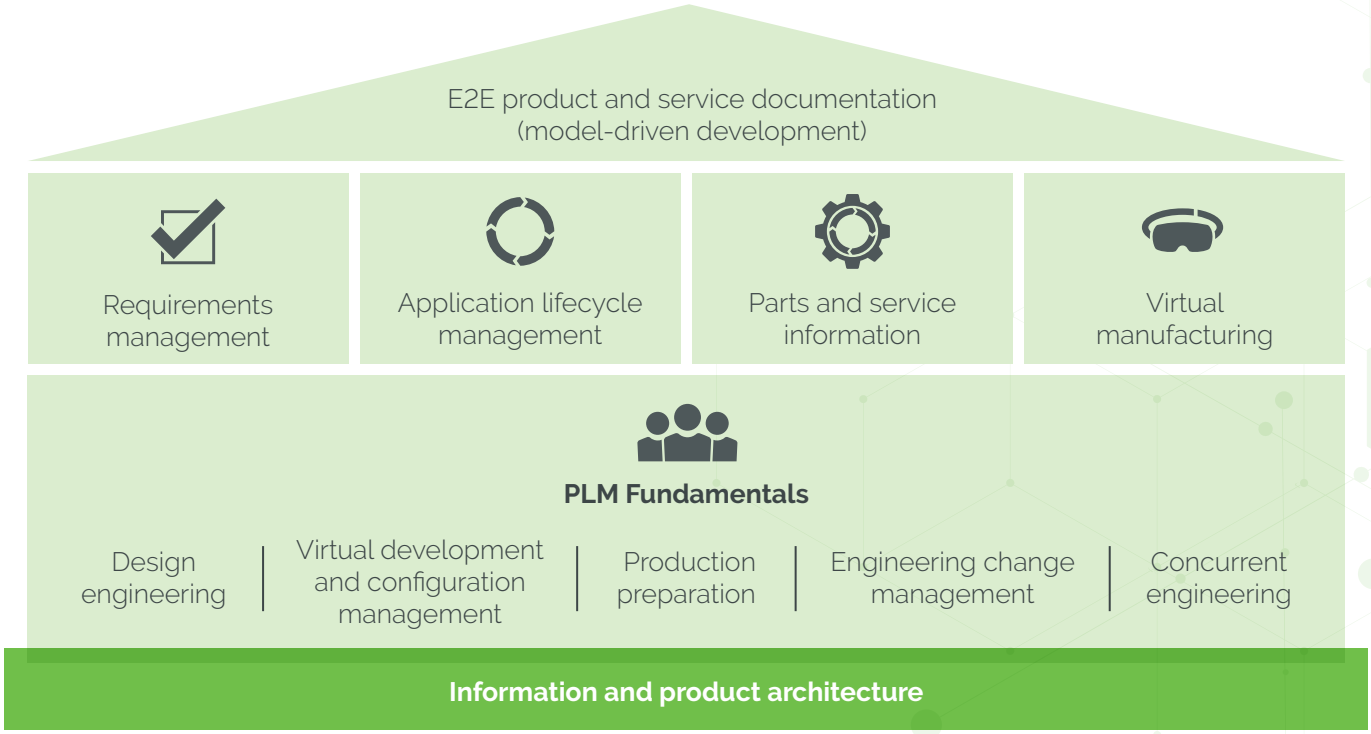
Volvo CE laid the groundwork for success with an end-to-end PLM "house"

After defining their vision, the Strategy, Architecture and Systems team set up their strategy and project management approach—revolving around an end-to-end PLM "house"—to deliver the digital thread using out-of-the-box solutions from PTC. The end-to-end PLM house describes the fundamental areas of change that would comprise end-to-end product and service documentation. These include requirements management, application lifecycle management, parts and service information, and virtual manufacturing.

A unique organizational structure facilitated agility and "pull"

Change management is extremely difficult across an organization. It's achieved by developing the desire and will to shift through a long-term vision. Then, teams and employees need to build the right knowledge and skills so they can adapt to the next generation of product development methodologies.

Rather than lead with a directive from leadership downwards, Volvo CE wanted to establish an agile and supportive approach to change management powered from the bottom up. In order to do this successfully, Volvo CE introduced the concept of "pull," which describes when employees across



the organization want to implement the change. In this case, that meant a new PLM solution and more modern ways of working.

To generate pull and ensure buy-in, the local needs of teams would have to define the global picture. Local leaders would work as change agents, driving change from the bottom up. Leaders were assigned to each product platform: wheel loaders, articulated haulers, excavators, and the road platform. There was also a global view consisting of global product architecture, global IT systems, global laws and regulations, and organization change management. These groups would lead the R&D organizations to deliver new ways of working more efficiently, helping manage the complexity from both an IT and business perspective.

The team knew that facilitating change would require frequent hands-on work and meetings with all the teams involved. Only by collaborating with the relevant organizations and helping them unlock value for their individual projects would they create the pull they needed to implement PLM.

Recurring workshops ensured support for an enterprise-wide vision

The Strategy, Architecture and Systems team set out to align on an organization-wide vision that would bring the digital thread to life. To do this, they would need input from every corner of Volvo CE. In 2016, the team organized a three-day, enterprise-wide Acceleration Workshop. This wasn't just a one-off event—weekly Pulse meetings continued throughout the digital transformation journey. These meetings, as well as other activities, helped the Strategy, Architecture and Systems team build commitment and credibility with leadership and other groups.

The initial workshop was attended by almost 60 people across sales, marketing, IT, manufacturing, aftermarket, and other teams. Attendees quickly rallied around the transformative potential of a single, unified PLM system. Rather than presenting the idea as a directive from leadership downwards, the Strategy, Architecture, and Systems team involved people from across the company to help establish a tangible, organization-wide vision with clear business outcomes.

By developing strategy and value flow in collaboration with cross-functional teams, they generated support from the ground up. All decisions were made together in the meetings. One principle they used to ensure buy-in was that every release and initiative would result in value for the relevant parts of the organization. There would never be an investment that didn't realize benefits quickly for those involved.

Turning the triangle upside down and involving everyone to establish the vision makes the vision theirs. This approach was very different from corporate governance where decisions are handed down to people not involved with the decision; the upside-down approach makes change management much easier.

At the conclusion of the Acceleration Workshop, the team found ways to eliminate 170 pain points. They would create more value in each site by empowering people, processes, methodologies, and tools to remove manual handovers and drive faster time to market, higher quality, and lower costs. By using a single source of product data along the entire product lifecycle, all work done would add value and collective knowledge, improving efficiency at every stage. Volvo CE also anticipated improving customer satisfaction and increasing quality through fewer mistakes caused by manual handovers and data duplication. And finally, the digital transformation initiative would set the foundation for becoming a service-oriented provider.

While implementation seemed like a difficult task, the team demonstrated that with the right communication and training strategies, they could produce the knowledge and skills needed to realize business value quickly. Leadership came on board, recognizing the benefits of a comprehensive digital thread and authoritative source of truth.

Throughout the entire process, PTC and Volvo CE collaborated in these strategic meetings on all levels, from engineers to leadership, forming a true open collaboration, allowing the teams involved to take a very proactive approach to any challenges.

Volvo CE delivered on the PLM fundamentals to realize value quickly

To ensure a successful rollout, the Strategy and Solution Portfolio team defined the solution and capabilities deployment so that it could be completed in phases. The team identified capabilities that could be implemented independently and unlock value at each step, based on factors like user communities targeted,

competencies enabled, cost evaluation, and data availability and maturity. Then, they prioritized deployment based on project impact, user availability, funding capacity, and more.

Coming out of the Acceleration Workshop, the team aligned on a high-level approach for implementation with key stakeholders. This was valuable throughout the process, for example when reprioritizing deployment was needed due to strategic constraints.

To execute the vision, Volvo CE first focused on implementing the PLM fundamentals—or scopes of work that would be applied to different aspects of their product and service documentation—identified in their E2E PLM house. These included part-centric change and configuration management, product data management (including 3D multi-CAD environment integration), application lifecycle management, product variability management, multi-BOM management (including engineering, manufacturing, and service bills of material), concurrent engineering, and more.

Together, these fundamentals helped Volvo CE manage new product architectures envisioned in the Volvo CE product strategy. A common language fosters communication and collaboration. They're able to capture and retain product knowledge faster and more efficiently. And they now have the opportunity to use up-to-date 3D data developed by design engineers throughout the whole product lifecycle.

While these fundamental capabilities were implemented across 700 use cases, there are five high-level areas of the product development lifecycle where Volvo CE realized tangible benefits:

Design engineering

Volvo CE implemented one common system for product data management, allowing them to unify their engineering tools—including software—and establish governance and traceability for real-time visibility of upstream and downstream data. They increased efficiency and reduced costs by removing manual work and handovers and improving re-usability. Also, cross-functional interaction between engineers in early phases helps reduce costly later-stage design changes.

Moving forward, Volvo CE will leverage one common system for PDM, with CAD and assembly structures managed in the same system. This will eliminate double entries and provide a simple way to find and share parts across the ecosystem.

Virtual development and configuration management

By establishing one global process with one common data infrastructure, Volvo CE teams can now create a component once and reuse it in many different places. This dramatically increases efficiency and enables visible configurations. They've also improved quality with better traceability of status on the virtual verification of models and analysis through clear and correct configuration rules.

Production preparation

Windchill enables Volvo CE to establish a connection from engineering bills of material (EBOMs) to operational bills of process with fact-based feedback and visualization. By reducing manual work throughout these processes, they've also reduced the cost of human errors and accelerated the time to industrialization. Increased interactions between designers and manufacturing engineers during development

helps identify issues in early phases and ensure manufacturability and agility.

Engineering change management

Leveraging Windchill, Volvo CE creates and collects all change management requests and problem reports in one system. By establishing a connection between parts in EBOMs, MBOMs, and SBOMs with visualizations, engineers see the direct impact on downstream processes and execute analysis on a single source of information, greatly reducing change cycle times. With a single configurator, it is easier to connect options to a product and track their combinations. When adding or removing an option, engineers see the direct link with products and projects.

One single source of information and simplified connections between CAD and BOM data increases efficiency, enabling designers to quickly validate the impact of development changes on products.

Concurrent engineering

Consistent data in one database and a single authoritative source of truth means that cross-functional teams can collaborate on one shared system. Increased cross-functional collaboration leads to improved product and process quality, as well as the ability to reuse existing solutions and assets. This helps teams reduce costs and lead times.

Volvo CE accomplished their PLM goals and set the stage for future innovation in steps

Windchill helps Volvo CE harmonize processes across factories and improve handovers, product structures and information, and more. They started

their journey in 2018 with the migration of their road platforms, training hundreds of users in two sites. In 2019, they made huge strides by training an additional 2,000 users and implementing the program across 11 more factories, transferring 7 million files, and impacting another five product lines.

By the end of 2021, Volvo CE will have trained over 3,000 users and successfully implemented Windchill in 15 sites. They have fully upgraded the first three legacy systems to Windchill and made progress toward the fourth, allowing them to start taking advantage of improvements like digital assembly, smart diagrams, and more. Also in 2021, they plan to migrate their final product platform and leverage Windchill to develop a manufacturing execution (ME) lite solution that enhances data quality.

The new approach to PLM has covered all of Volvo CE's fundamental product lifecycle needs. Furthermore, it has laid the foundation for broader value across the entire Volvo CE organization, giving employees more capabilities to better contribute to the company mission of building a better future.

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