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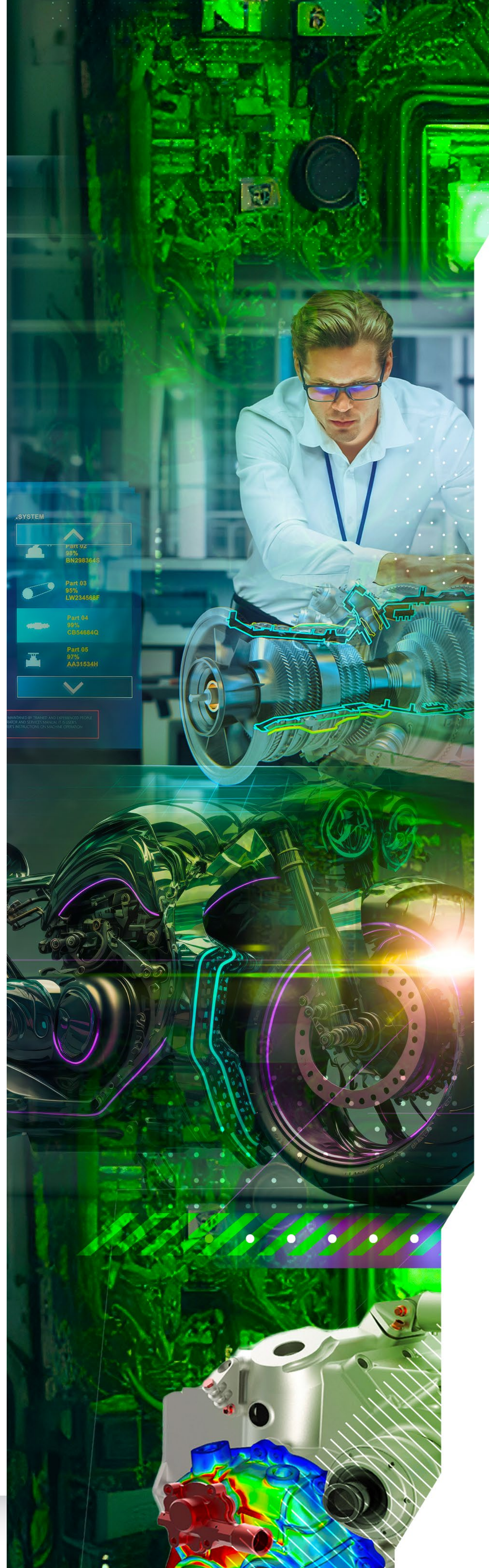
MODEL-BASED **PRODUCT DEVELOPMENT** TAKES CENTER STAGE



By Brian Thompson
PTC Division Vice President and
General Manager, Creo Business

WHITE PAPER

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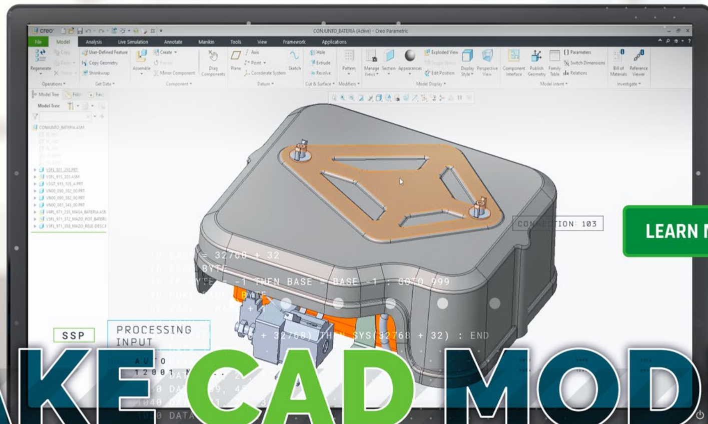
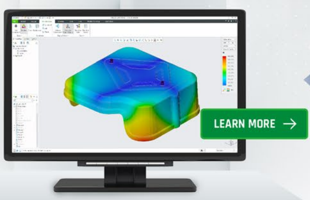
JOURNEY TO MODEL BASED PRODUCT DEVELOPMENT

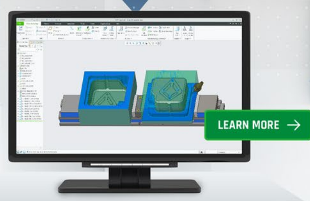


MAKE CAD MODELS WORK FOR YOU.



DESIGN VALIDATION

Validate your designs with integrated simulation before making costly prototypes and tools.

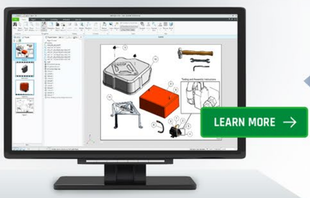


MOLD ANALYSIS

Develop production tools and evaluate mold flow performance.

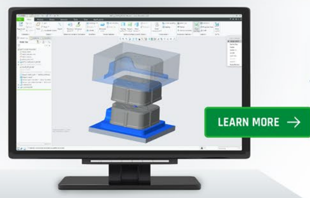
CRITICAL DESIGN

Deliver clear and concise design reviews, using Augmented Reality Design Share.



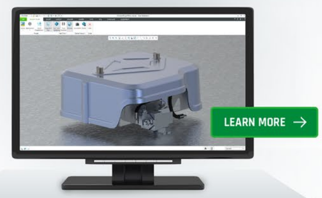
TECHNICAL DOCUMENTATION

Create high-quality technical illustrations and service documentation.



MANUFACTURING PROCESS DEVELOPMENT

Turn your designs into reality, using NC machining, traditional casting and molding, as well as innovative additive manufacturing.



INDUSTRIAL DESIGN

Optimize your products' aesthetic quality with industrial design tools.

YOUR CAD MODELS CAN SAVE YOU TIME!

You are an engineering pro, and you have invested precious time to develop great designs. Now it's time to put your CAD models to work, creating more value for you, your team and your company.

Creo capabilities are fully associative, meaning that changes to the CAD model are automatically propagated to downstream deliverables; there is no need to re-create work derived from original CAD models. You can watch this **FREE WEBINAR** to learn how Creo can help you deliver your best designs in less time.

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With the C-suite increasingly onboard with model-based definition (MBD) and the value it delivers to downstream manufacturing and service processes, attention needs to turn to engineering and product development, which is still hampered by disconnected processes and siloed tools.

Faced with mounting global competition, increasing product complexity, and a mandate to accelerate delivery cycles, organizations are taking every opportunity to optimize design and manufacturing processes. MBD has gained traction as a key step in that direction, replacing the traditional 2D drawings used in upstream processes with annotated 3D models that contain all the pertinent information required to manufacture and inspect a product, including elements like dimensions, tolerances, surface finishes, and notes. The model-based enterprise (MBE) builds on that vision to extend MBD even further into manufacturing, supply chain, marketing, and other disciplines, aiming for across-the-board organizational benefits such as process efficiencies, lower overall costs, and faster time-to-market.

Yet there remains a missed opportunity to achieving that full MBE vision. Engineering, despite championing 3D models for MBD processes, has yet to embrace a comparable model-centric design mentality in its own house, across the full spectrum of product development processes. Outside of core CAD modeling and design work, it's been open season for engineers to tap best-of-breed tools for adjunct functionality in key areas like simulation, generative design, surfacing, tool path creation, and documentation. What's needed is a Model-Based Product Development approach, which promotes a unified platform and a common CAD model across the core set of tools and functionalities required throughout the engineering lifecycle.

Key Terminology

Model-Based Definition (MBD) is "an annotated model and its associated data elements that define the product in a manner that can be used effectively without a drawing graphic sheet". (ASME Y14.47-2019 3.1)

Model-Based Product Development (MBPD) is the process of using the native CAD model throughout the entire product development cycle. Beginning with concept development, including industrial design, ranging all the way through detailed design, simulation, tooling development, manufacturing process development and service instructions, the native CAD model drives the digital thread through the entire product development lifecycle.

Model-Based Enterprise (MBE) is "an organization that uses model-based definitions for the purpose of commission, operation, service and decommission of a product." (ASME Y14.47-2019 3.11)

Model-Based Product Development Takes Shape

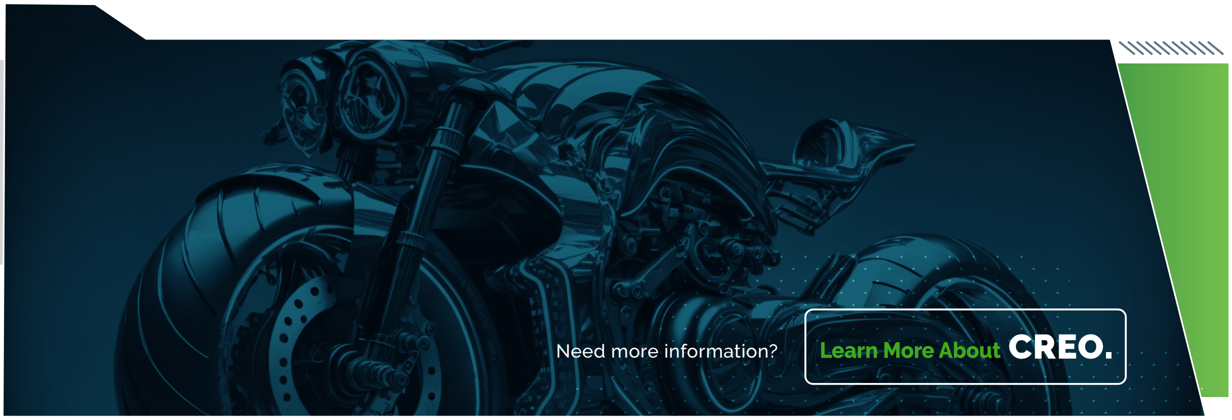
When you consider the big picture, Model-Based Product Development is crucial to advancing the vision and goals of the digital thread and MBE, now at the forefront of forward-looking business strategy. The approach takes shape through a series of interconnected design, optimization, and build processes coalescing around a common, native CAD model instead of derivative artifacts that aren't tied to the core design. With all contributors working from a unified 3D model, organizations have the best chance of driving efficiencies throughout the design process and eventually, across a product's full lifecycle.

Just look at how MBD's focus on a unified 3D model has made it easier to share relevant information and collaborate across design, production, and service functions. MBD has had a measurable impact on product delivery workflows, streamlining what was once an onerous process of managing 2D drawings and shortening the time spent in design reviews. PTC's customer research shows a robust MBD approach enables companies to produce documentation up to 40% faster, reduce first article inspection time by 60%, and benefit from a 90% drop in product errors and non-conformances.

Engineers require a robust tool bench to build today's competitive products. However, a best-of-breed portfolio doesn't typically share a native file format, which creates all sorts of complications and integration problems when aiming for a universal, annotated 3D model. It also makes it next to impossible to drive comparable efficiencies along the lines of MBD.

Without a common backbone to work from, product organizations find themselves subsumed by disconnected processes and manual workarounds—the tell-tale signs of a landscape dominated by siloed tools and disparate file formats. Engineers wind up channeling too much time and energy to context switching between applications, which takes away from higher-value experimentation and design innovation. Without a model that transcends the full design tool stack, they are bogged down by translation and integration tasks, caught in a continuous cycle of unproductive rework that can lead to serious and costly design errors.

The promise of 3D CAD, and specifically parametric modeling, is that design intent is easily captured using features and constraints, which makes it easier to define how the model should behave when something is changed. Moreover, best-in-class parametric modeling is deeply associative so that when changes occur in one part of a model, the relevant updates are automatically orchestrated to related geometry and downstream artifacts, keeping every point in the design chain in sync, eliminating mundane rework, and minimizing the possibility of design errors.



The vision starts to fall apart, however, when point solutions are introduced for enhanced capabilities beyond core CAD modeling. For example, simulation is gaining traction early on in the development cycle to ideate, optimize, and narrow the design space as opposed to being a latter-stage tool used by a select few for validation. Similarly, design teams are now enthusiastically embracing an array of powerful capabilities for generative design, rendering, augmented reality (AR), and tool path creation to uplevel their innovations and streamline processes, all furthering the quest to get better products to market faster.

The problem is most of those auxiliary functions are happening outside of the main CAD environment, thus are not directly associative with the native 3D model. In most cases, if an engineer wants to run a FEA analysis on a part to test strength or to lightweight a particular component using generative design capabilities, they must toggle between point solution tools. This work pattern introduces a cycle of importing, exporting, and translating dumb geometry, which is not only inefficient, but it also breaks the tool chain and decreases the inherent benefits of associative parametric design.

By context switching between applications, engineering organizations effectively create a series of disconnected processes that lack associativity. Instead of letting the native CAD model do the work, the onus falls to the designer or engineer to propagate changes throughout the design chain. It's tedious work, and a colossal waste of engineering time and resources.

Consider this reality in the context of creating an NC tool path. A manufacturing engineer sets up a study in a point solution to create the tool path, but realizes there's a problem. Because this function isn't done with a native CAD file, the process requires someone to go back to the original CAD model, make the pertinent changes, and restart the process, importing and exporting geometries and recreating the tool path design from scratch. The same workflow, performed inside the CAD tool on a native CAD file, initiates a change and everything automatically updates, allowing the new tool path design to run without any additional setup or import steps. This same process applies to simulation or rendering or writing assembly instructions. The takeaway is that engineering processes CAN and SHOULD reap the same benefits of a model-based approach that other areas of the organization now enjoy with MBD.

Model-Based Product Development At Work

You don't have to look far to find companies across a variety of industries already profiting from their embrace of Model-Based Product Development. Here are just a few real-world examples:

HPE COXA, which provides engineering solutions and oversees technology projects in the automotive, motorsport, and defense spaces, was grappling from inefficiencies related to a multi-step, multi-software design process. The firm was all-in on taking advantage of emerging technologies like generative design, additive manufacturing, and real-time simulation to better product development. Yet to do so required juggling four or five disconnected software tools with different files for each step, which meant the team had to start a process all over again any time they wanted to adjust or test designs. This disjointed approach quickly led to miscues between design and analyst teams, ushered in a host of quality issues, and stalled production times.

HPE COXA consolidated these cutting-edge technologies in a single software, now performing all design steps in a linear, fluid process. Live simulation and geometry changes can be made quickly without losing any previous work. The shift helped streamline workflows, simplify communications, and expedite timelines for finished parts. HPE COXA was able to reduce total design and production time by 30% and cut the window from concept to delivery in half. Also notable: The company significantly improved its ability to respond to customer requirement changes as well as sped up design iteration cycles leading to better design outcomes.

Global power leader Cummins is another prime example. To deliver on its sustainability goals, Cummins set out to rethink its design process, leveraging generative design capabilities and live simulation to test and optimize digital prototypes and to lightweight its engine product line, reducing the amount of materials and other natural resources used. By centralizing these capabilities in a core CAD platform, Cummins was able to get design functionality right the first time without the usual back and forth between designers and analysts. By freeing analysts from doing routine simulation work that could be done by designers, this also empowers the experts to spend more time on complex analyses.

With Model-Based Product Development, the Cummins team didn't have to disrupt workflows or break the design chain to handle unnecessary translation and integration steps. They also make a strong business case for the emerging paradigm: In the product designs where it applied generative design techniques, Cummins was able to reduce the amount of materials used between 10% and 15%. That effort contributes to their sustainability mission of cutting greenhouse gas emissions in half by 2030.

Volvo Group is unifying its CAD platforms and adopting Model-Based Product Development for one core reason: To establish a digital thread of connected data that will increase the reuse of digital product data and drive productivity across all levels of the organization. As part of this effort, the truck manufacturer is standardizing around a single CAD and PLM platform, helping to eliminate the inefficiencies of translating data between different product groups and design tools. The vision is to enable a seamless data and tool chain built around a 3D model that connects each stage of the product's lifecycle, from design through manufacturing to maintenance and repair.

Making the Shift Happen

If engineering departments were convinced of the utility of 3D models long ago, why has it taken so long to expand use beyond core CAD functionality? The simple reason is that auxiliary capabilities have been underserved by most CAD tools, steering engineering users to point solutions to secure more robust functionality. That dynamic has dramatically improved over the last few years as leading CAD vendors like PTC acquired or built advanced functionalities like real-time simulation and generative design and integrated them into the native CAD environment.

Organizations looking to make the leap to Model-Based Product Development should look for an open system built around the native CAD file format that offers the breadth and depth of capabilities to support the entirety of the design process whether that's simulation or some element of conceptual design. It's also important for the system to work in concert with a PLM platform—again, supporting the same native CAD file format—to streamline and simplify key processes like release and change management.

As with any shift in process, there's likely to be pushback from engineers, who are notoriously resistant to change and remain loyal to their preferred tools. Enlisting executive sponsors, many of whom are already champions of MBD and MBE, can help motivate the engineering ranks to get on board and embrace new tools and work patterns.

As companies advance digital strategies, Model-Based Product Development will be crucial to achieving MBE's full value. It's well past time for engineers to unleash the power of a model-based approach throughout the development process and reap the rewards of a transformative design chain.

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Creo is the 3D CAD solution that helps you accelerate product innovation so you can build better products faster. Easy-to-learn Creo seamlessly takes you from the earliest phases of product design to manufacturing and beyond. You can combine powerful, proven functionality with new technologies such as generative design, augmented reality, real-time simulation, additive manufacturing and the IoT, to iterate faster, reduce costs and improve product quality. The world of product development moves quickly, and only Creo delivers the transformative tools you need to build competitive advantage and gain market share.

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