DASSAULT SYSTEMES

Inceptra

MODEL-BASED SYSTEMS ENGINEERING: THE KEY TO ON-TIME PRODUCT LAUNCHES

EBOOK

Trouble is brewing and the pressure is mounting. Your company's major new product—the one that was supposed to leapfrog the competition and dazzle the market—is four months late.

You’re living in the prototype shop, eager to accelerate your team’s progress and desperate for a breakthrough. But each new physical prototype reveals dozens of new, unanticipated problems where mechanical, electrical and software systems intersect.

Each fix the team makes seems to create three new issues. Most of the innovations you’d hope to pioneer have been dropped in a push to get **something** that works. Instead of leading the market, your game-changer is in danger of becoming a me-too.

Sound familiar? If so, you're in the majority. At most product-driven companies today, the cycle of design-prototype-analyze-repair-prototype again (and again, and again) is situation-normal. No wonder, then, that Gartner's 2019 product manager survey found that 45% of all product launches were delayed by at least one month*.

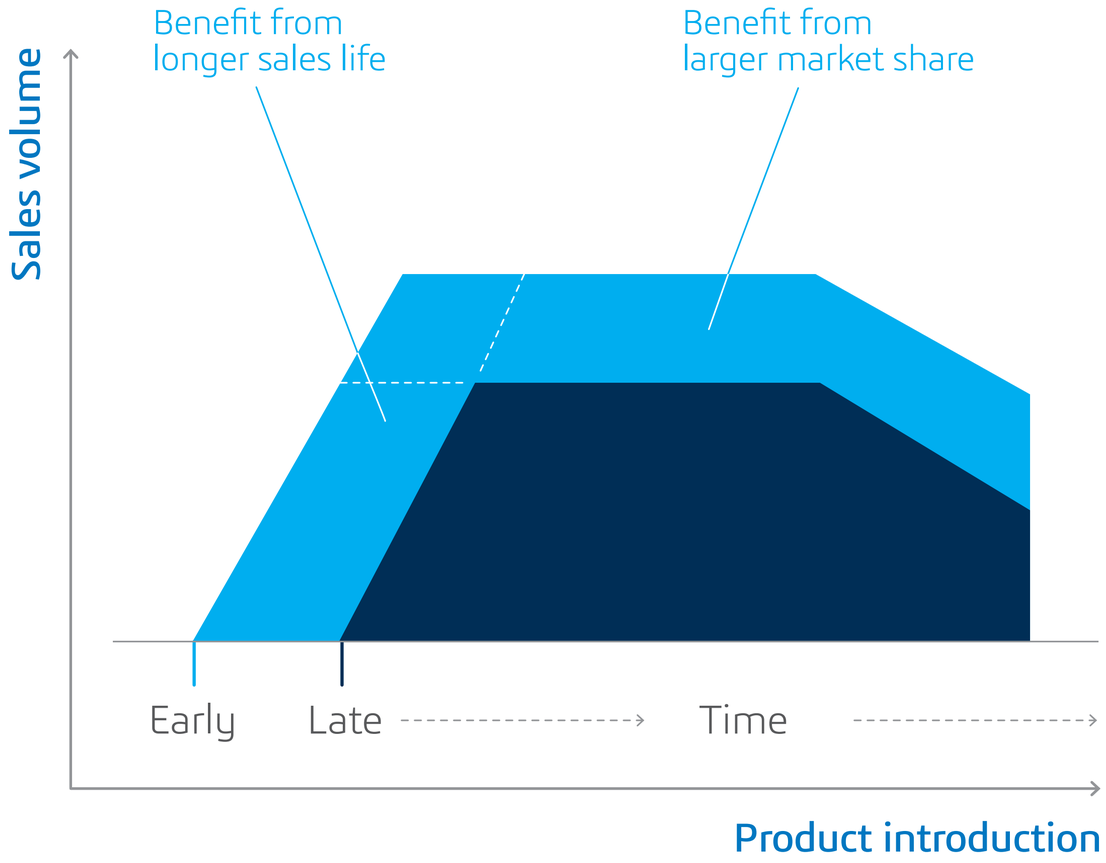
45%

OF ALL PRODUCT LAUNCHES WERE DELAYED BY AT LEAST ONE MONTH

* Gartner

OakStone Partners estimates that any product delay can cost a company 15% to 35% of a product's net present value*. For electronic products, a late introduction can cost 50% of anticipated revenues. And what company can long survive such losses?

HOW LATE LAUNCHES AFFECT LIFETIME PRODUCT VALUE

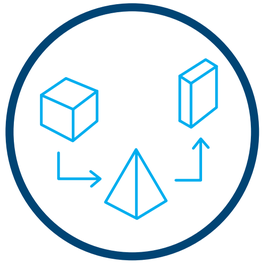


* Supply & Demand Chain Executive

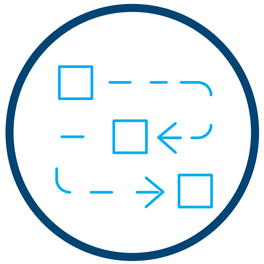
WHY NEW PRODUCT INTRODUCTIONS ARE SO DIFFICULT

In their study "The Effect of Product Innovation Delays on Operating Performance*," Vinod Singhal, departmental editor for Production and Operations Management at the Georgia Institute of Technology, and Kevin Hendricks, operations management professor at Wilfrid Laurier University, identified **four** major contributors to new product launch delays:

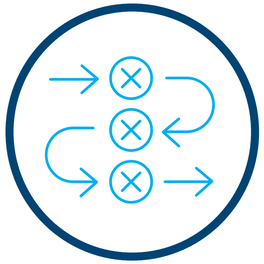
POOR MANAGEMENT OF DEVELOPMENT PROCESSES



FREQUENT DESIGN CHANGES

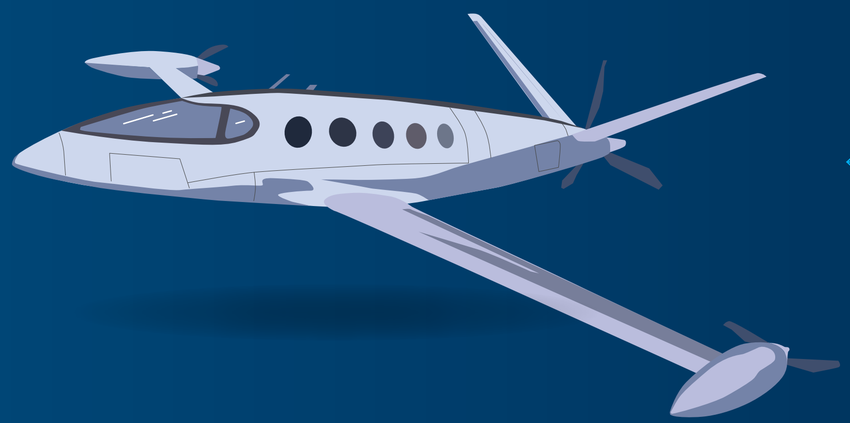


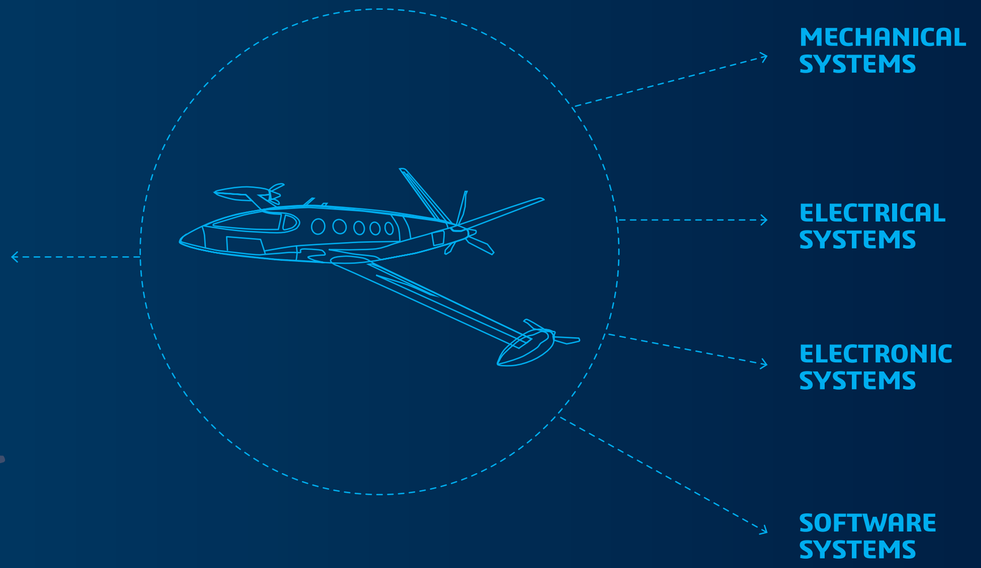
LACK OF COORDINATION AMONG DIFFERENT FUNCTIONAL AREAS



UNANTICIPATED RESOURCE SHORTAGES

* INFORMS





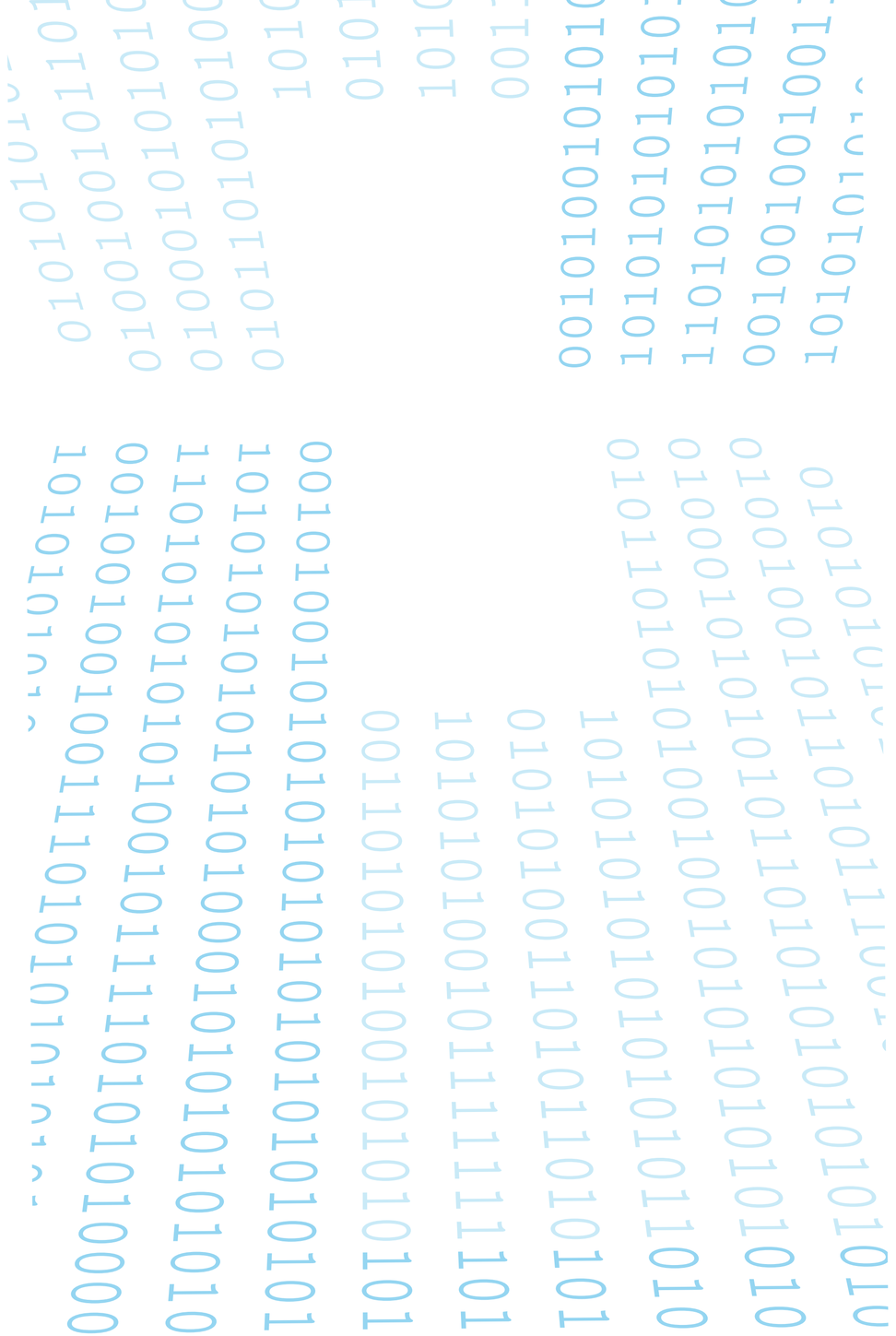
But why have these challenges become so common and intractable?

Part of the reason lies in the products themselves. Today, few products are purely mechanical, electrical or electronic. In today's hyperconnected world, virtually every product company has become a **mechatronics** company, combining mechanical, electrical, electronic and software systems into a single product. Many are even developing **cyberphysical** systems, which are continuously connected to a computing platform.

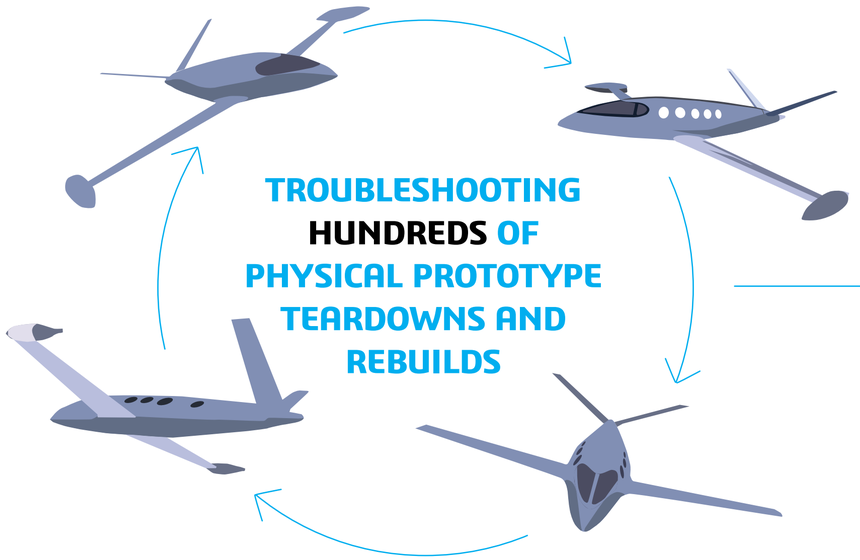
Designing so many fundamentally different systems to work together is a complex **systems engineering** challenge. To succeed, mechanical systems, electrical systems, electronic systems and software systems must all be designed to interoperate perfectly. In short, today's product companies need to design not just complex systems, but mega-complex **systems of systems**.

Which brings us to the second challenge: the software used to design these systems of systems.

To do the best job, product companies naturally seek out best-in-class software created specifically for each engineering discipline. But here's the rub: each of these software packages was engineered for its own discipline; they were never intended to interoperate. They exist in functional silos, unable to reveal how mechanical and electronic systems will interact or how software code will affect electrical systems. As a result, the **intersections** between and among these systems are invisible. And, as every engineer knows, what you can't see or measure you can't manage.



When these invisible intersections number in the hundreds or thousands, the result is chaos. Work being done in one silo is invisible to the others, even though each discipline is affected by the others' decisions. With no end-to-end visibility, there's also no end-to-end signaling of mismatches and no natural, frictionless way to collaborate. This gives rise to ad-hoc workarounds—spreadsheets, emails, phone calls—that generate no historical record, create confusion and churn, and result in missed connections.



TYPICAL

50

CYCLES

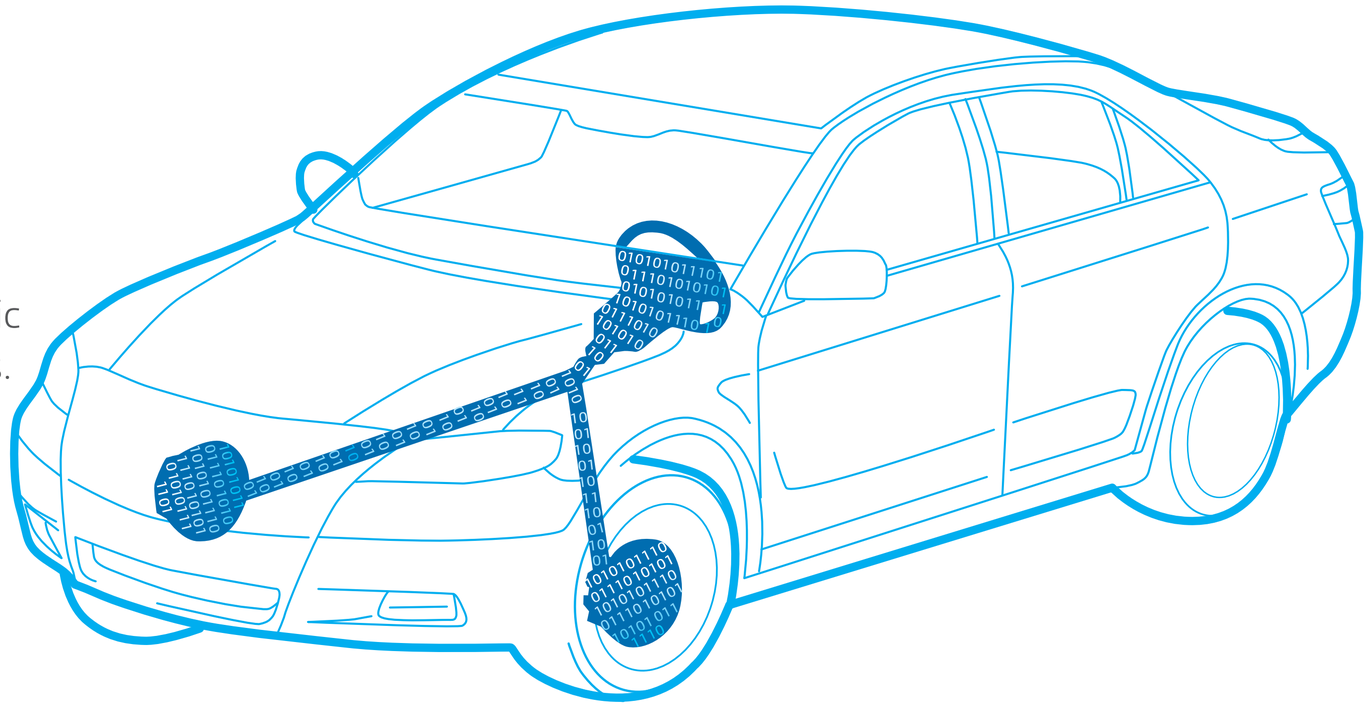
Worst of all, these missed connections won't be discovered until you get to the physical prototype stage—the most expensive stage to find problems and the most difficult point to craft resolutions. You assemble the first physical prototype and something doesn't work. Sometimes, the product won't even power up.

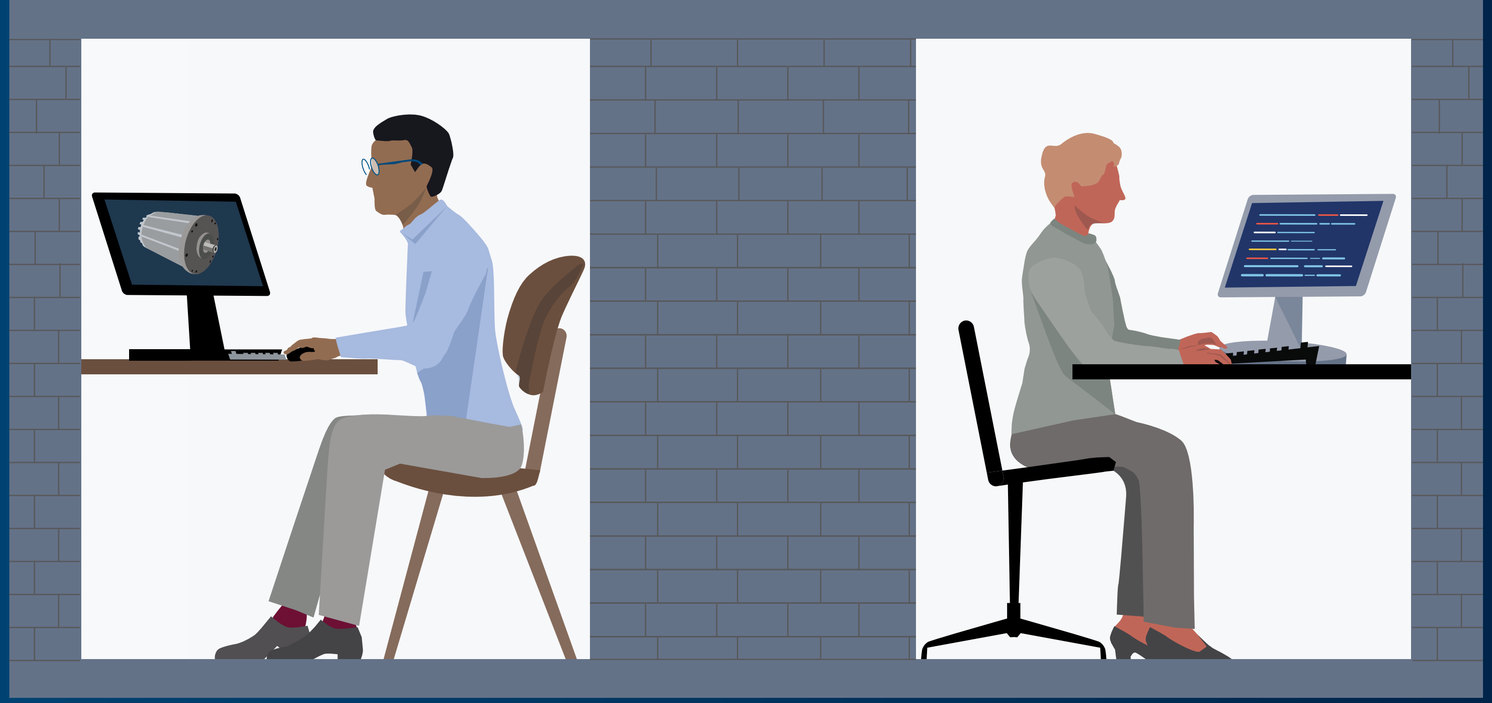
Troubleshooting and resolving these problems can require literally hundreds of physical prototype teardowns and rebuilds; 50 such cycles is typical. How long it will take to find and fix all these bugs is anyone's guess, beyond anyone's control. And that's the major reason so many products launch late.

THE RISE OF MULTIDISCIPLINARY SYSTEMS

To illustrate the ways in which missed cross-discipline errors occur and multiply, let's consider automotive steering systems. Until five years ago, these systems were primarily mechanical. You turned the steering wheel and pieces of steel connected to the car's wheels turned the car. Today, however, the steel connections are gone; when you turn the wheel, the motion transmits an electronic signal to one of the car's onboard computers.

The computer receives the signal and transmits instructions to four motors, one attached to each wheel. When the motors receive the signals, they activate and turn the wheels. The entire process takes a split second.





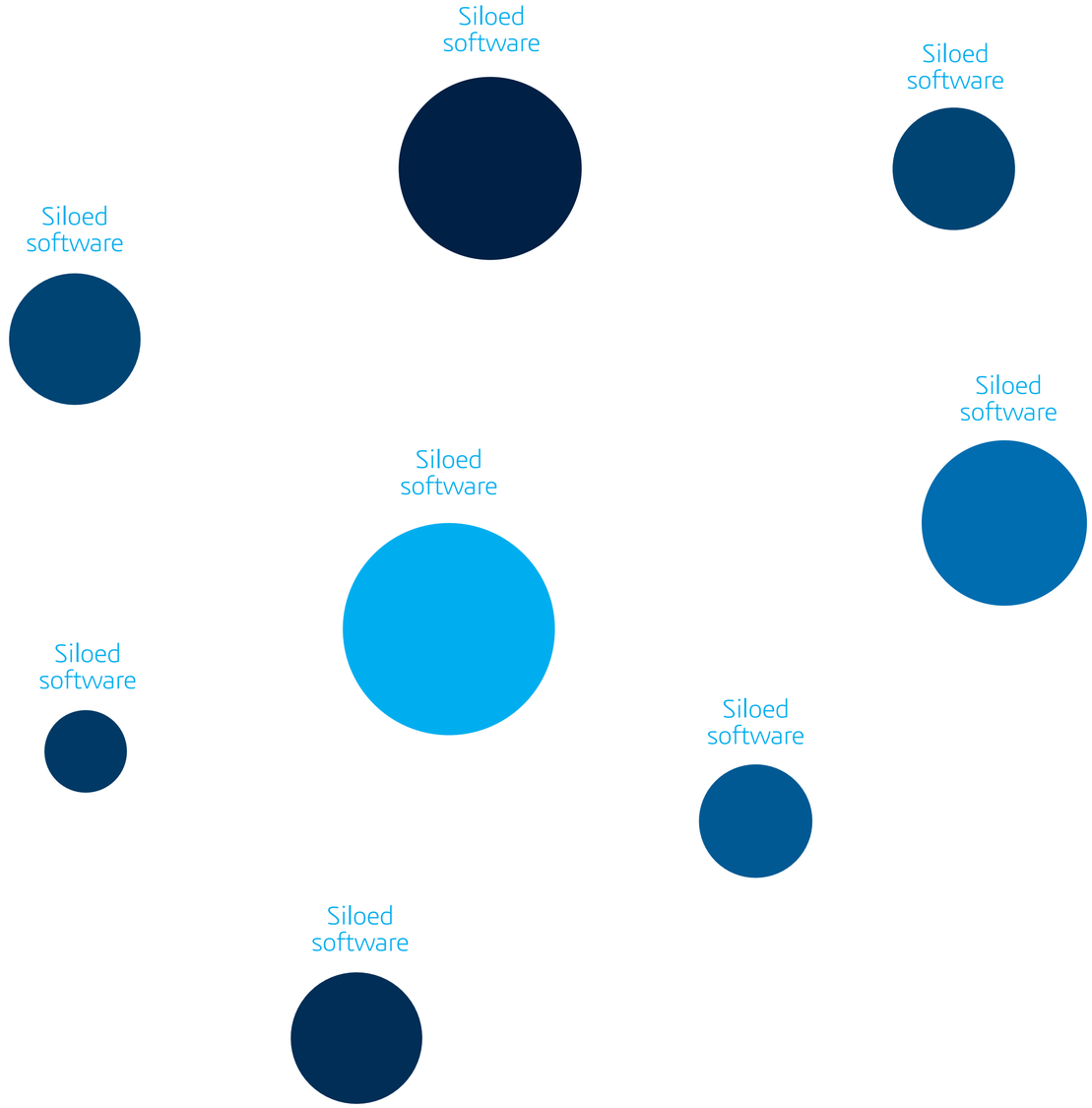
Now, consider the interface between the electromechanical engineer who designs and specifies the motors and the software engineer who writes the control code. What if, after the motors are specified and the software is written, Purchasing discovers that the specified motor is no longer available? The electromechanical engineer will almost certainly be notified to choose a different motor.

But will anyone remember to tell the software engineer to rewrite the code? If not, what happens when the first physical prototype is tested?

Multiply this situation by hundreds or thousands of intersections among systems engineered in siloed applications, and the high cost of these silos becomes clear.

The biggest cost, however, may be the one that can’t be measured: loss of innovation. In multidisciplinary cyberphysical systems, innovation occurs at the intersections between disciplines. When engineers in different disciplines can’t interact and brainstorm, opportunities for spontaneous innovation evaporate because ideas can’t cross-pollinate.

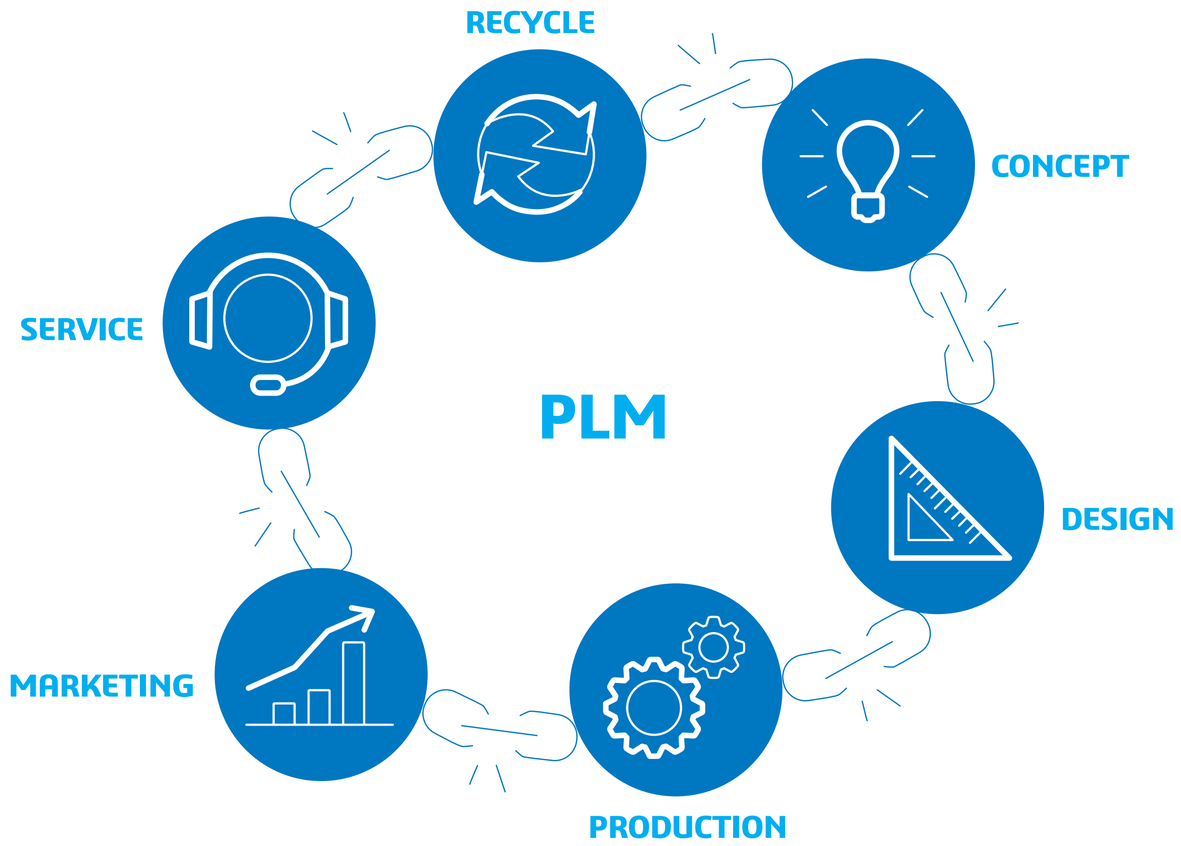
In short, **siloed software engineered for the analog age is insufficient for the multi-discipline products of today’s digital era**.



WHY INTEGRATION IS INSUFFICIENT

Companies across the entire industrial spectrum encounter this difficulty. The traditional product lifecycle management (PLM) software "solution" is to "integrate" disparate applications with custom interfaces that attempt to make information created in one system accessible to another.

Because each software package employs its own unique data model and user interface, however, and because they store data as files rather than as consistently formatted, reusable digital data, this "integrated" view loses much of its richness and context. In effect, the information must be "dumbed down" to be shared.



COMPETING NEEDS OF DIFFERENT DISCIPLINES

DELIVER THE BREAKTHROUGH EXPERIENCES

This loss of fidelity, as the stripped-down data is known among engineers, obscures what each discipline needs, leading to bad decisions. It also obscures the original customer requirements and engineering intents. This makes it difficult—if not impossible—to manage the delicate balancing act among the competing needs of different disciplines and deliver the breakthrough experiences that today's consumers and customers expect.

Overcoming these hurdles requires hundreds of meetings and manual, ad hoc workarounds to keep each discipline informed of interface changes that affect their designs. And we all know how reliably manual, ad hoc workarounds (don't) work in large, distributed organizations.

Here’s a sampling of how designers, engineers and product managers in a wide variety of industries describe their experience with siloed functional software packages and the problems those applications create when designing complex mechatronic and cyberphysical products:

In the development process, you have different stakeholders who contribute to projects, working with their own tools and exchanging designs through interfaces,” says Christian Simonis, Project Coordinator for Proof of Concept, Model-Based Systems Engineering, at Bosch Car Multimedia*, which creates cyberphysical systems for autonomous automobiles. “The concern with this is that a lot of information is lost. It’s not an effective way of working.”

* BOSCH CAR MULTIMEDIA

Trying to move data between siloed systems "creates errors and wastes time," observes Steve Schmitt, Business Unit Manager of Mechanical Design for Safran Electronics and Defense*.

Charles Manin, formerly CIO, Safran Transmission Systems**; now CIO, Safran Seats, laments the need "to bridge independent software together or to convert data back and forth, which not only complicates development but proves complex and costly to maintain over time."

Bosch's Simonis summarizes: "I emphasize this cross-domain aspect because being able to evaluate how a software parameter, for instance, affects a mechanical component, would make our overall development process more effective… to combine individual disciplines and evaluate them holistically. This front-loading is a must if we want to evaluate product performance at an early stage, rather than after physical integration and testing."

As these working engineers make clear, the inability of siloed software packages to shine light on the intersections among different engineering functions is a major factor in new-product launch delays—and the negative financial repercussions that result.

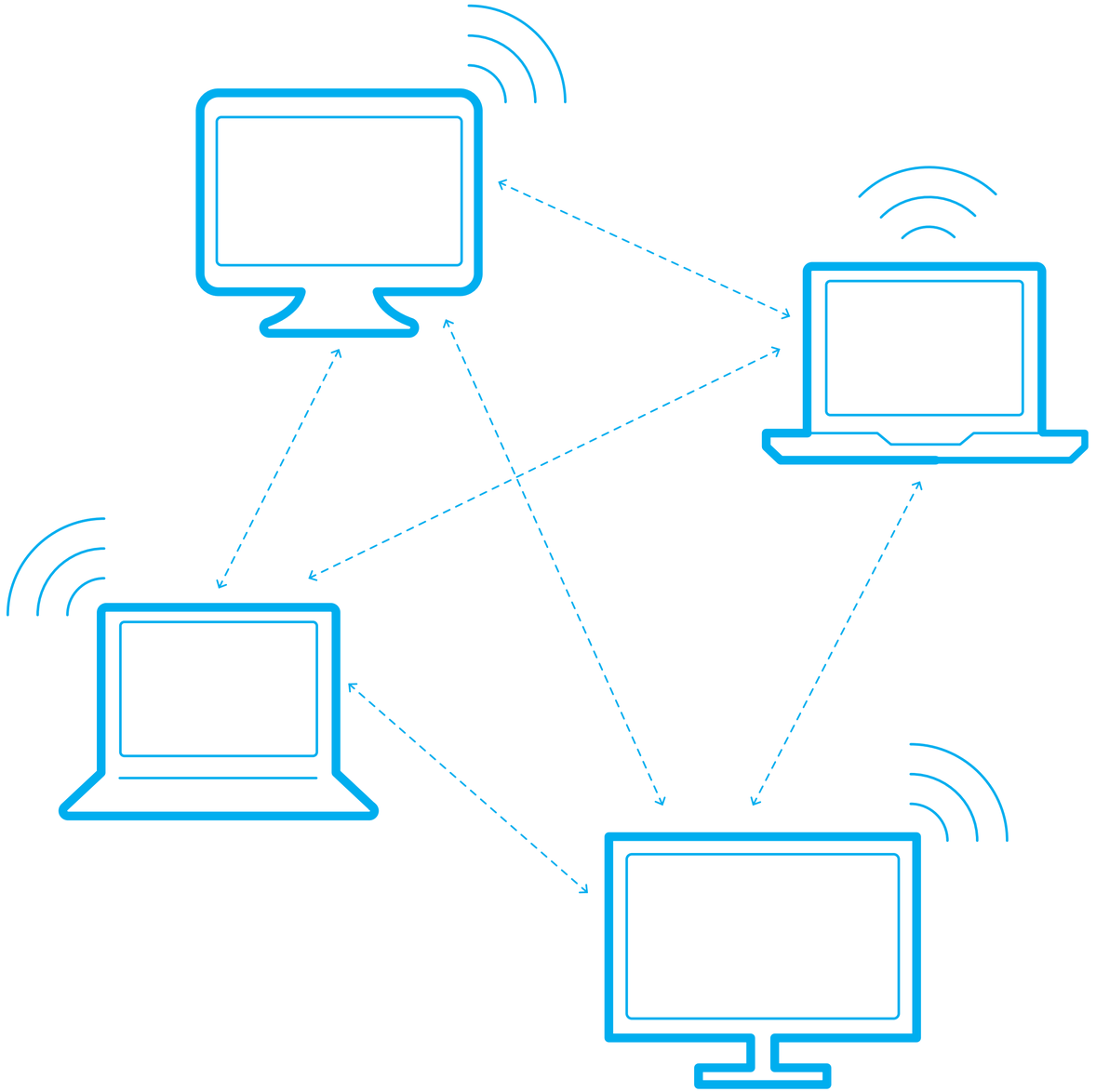
* SAFRAN ELECTRONICS AND DEFENSE

* SAFRAN TRANSMISSION SYSTEMS

THE UNIQUE 3DEXPERIENCE PLATFORM

Because closing the gaps and revealing the intersections between software packages intended for different disciplines is so important to designing today's complex, multi-disciplinary products, every software company wants to say it has an answer. Most even claim to have a platform that bridges the gaps among these applications, delivering a single "digital thread" that links every discipline and process, from initial concept to manufacturing.

But ad-hoc integrations, as previously noted, share information stripped of rich and vital context. This makes it impossible to create a unified representation of a multi-disciplinary product, except with considerable rework of the data.



Dassault Systèmes is the only company that has invested more than a decade of research and development and billions of euros to fundamentally reengineer its software suite to create a fully digital platform, engineered specifically to reveal, manage and facilitate the intersections among disparate disciplines from initial concept to detailed design, manufacturing and service.

With the **3D**EXPERIENCE platform, Dassault Systèmes takes a fundamentally different approach to preventing the challenges that delay new product launches—a single platform with apps for every engineering discipline, eliminating the silos.

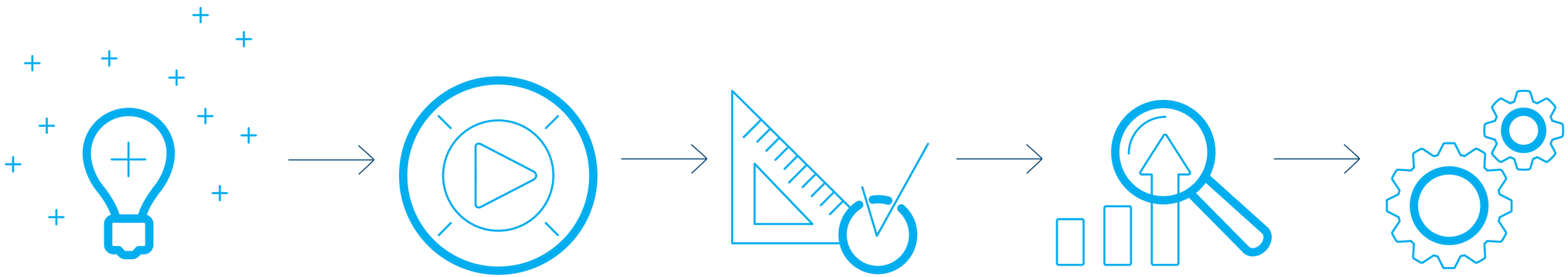
Every engineer works natively on the **3D**EXPERIENCE platform and stores all data digitally; the platform tracks interdependencies that integrations can't. On the platform, each contributor sees and interacts with their counterparts in other disciplines, freely exchanging ideas and resolving issues.

In short, the **3D**EXPERIENCE platform fundamentally changes the way you work, putting everything at the fingertips of everyone. Instead of struggling with non-value-added work related to exchanging information and managing dependencies, the platform empowers everyone to focus on value creation. The end result: you deliver the experiences your customers demand—stellar, game-changing experiences that build long-term customer loyalty.

“

The 3DEXPERIENCE platform not only helps us to master complexity, but also supports collaboration... And it's not just the engineering departments, but all downstream departments. Building more intelligent machines is a collective effort of multiple disciplines that must work together, and the sooner the better.

THOMAS BÖCK
Executive Board and CEO
CLAAS Group



In the first conceptual stage, the platform displays all systems as descriptive models, making the interfaces and intersections between disciplines visible from a project's outset. Even at this early stage, the models incorporate physical, control, computation and logical behavior, demonstrating compliance with all requirements.

As a project advances from preliminary to detailed design, the model's fidelity increases. By the time you reach the 40% mark, **3D**EXPERIENCE platform users are working with 3D models of the entire product. They can "operate" the product in this 3D virtual environment to verify fit, form and function and to evaluate performance, manufacturability, serviceability and the operating experience.

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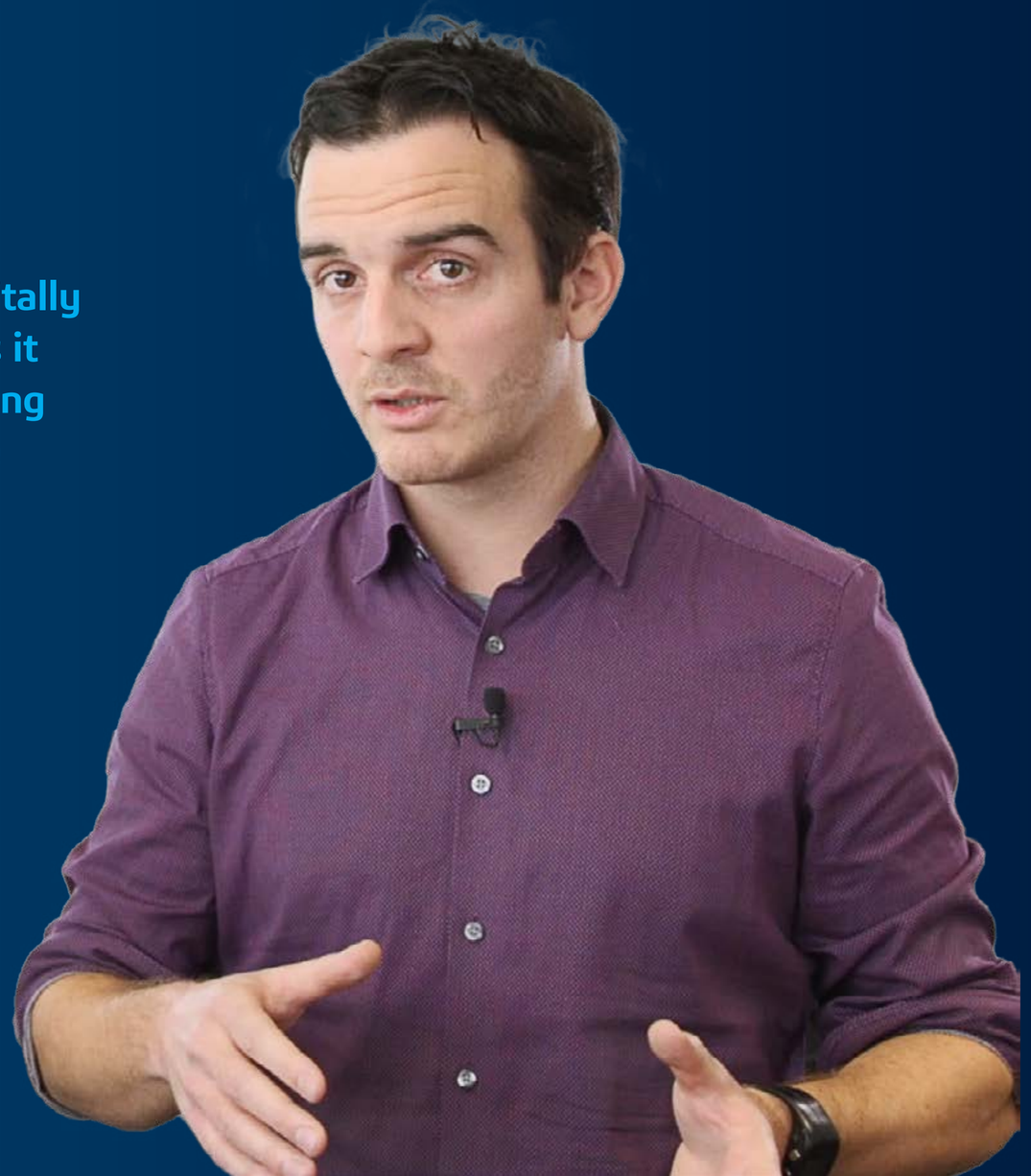
With the 3DEXPERIENCE platform, “I can digitally see after my modeling if everything works as it should, early on, and show in 3D how adjusting certain parameters will influence the way the entire product functions.



MICHA SCHÖNWIESNER
Systems Behavior Engineer
BOSCH Car Multimedia

In fact, the **3D**EXPERIENCE platform is the ONLY way to virtually prototype an entire product, regardless of how many disciplines it employs or how complex it is; to quickly identify and resolve issues across disciplines in the virtual stage; to try out new ideas for innovations—ideas sparked by collaboration and interactions among your specialist teams; and to optimize any and all systems.

The **3D**EXPERIENCE platform even allows you to test the experience you have created on customers and prospects in the **virtual stage**, while there is still time to incorporate their feedback. After the sale, IoT-connected products can even feed usage data back into your models, delivering insights to power the next round of development or adding value for existing customers through cyberphysical updates.

Best of all, once the model's performance has been optimized and proven in the virtual world, physical prototypes have a high probability of working as intended.

3D model of the combined heads-up display in the **3D**EXPERIENCE platform

Image © Bosch Car Multimedia

As a result, the 40% of project time typically spent on troubleshooting physical prototypes virtually disappears. Along with that troubleshooting time, the uncertainty about when a product will be ready for launch disappears too.

40%

PROJECT TIME TYPICALLY SPENT ON TROUBLESHOOTING PHYSICAL PROTOTYPES VIRTUALLY DISAPPEARS

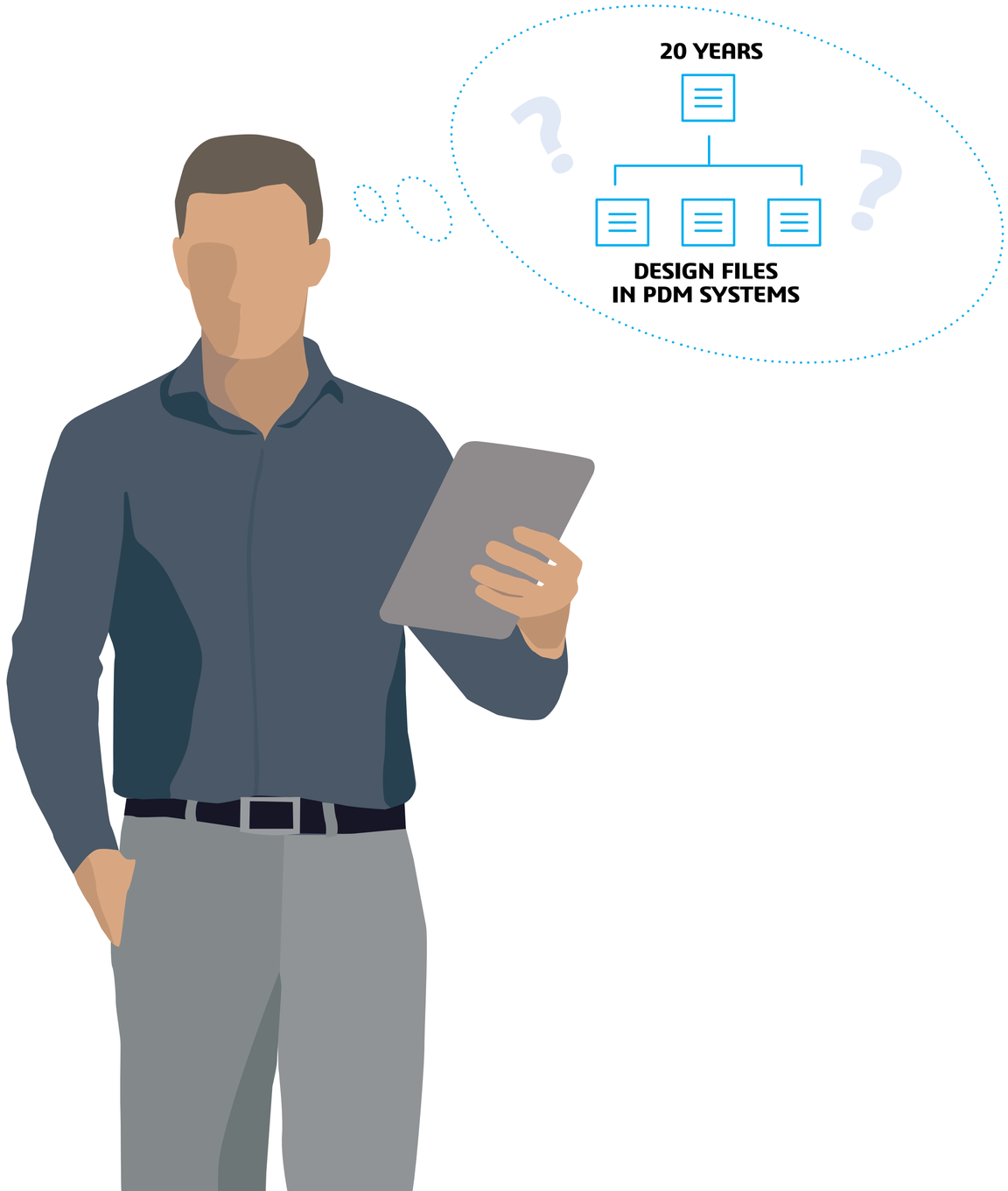
“

All relevant information is stored in one common, digital model. This knowledge base allows subsystems to be validated at very early stages, meaning costly changes late in the development cycle can be avoided, which significantly reduces the number of physical prototypes.

MARC ÖLSCHLÄGER
Systems Validation Engineer
BOSCH Car Multimedia

WHAT ABOUT MY EXISTING SOFTWARE AND IP?

By this point you may be thinking, “Sounds great, but we have adopted modeling and simulation software over the last 20 years and maintain all our design files in our PDM systems; we must be able to carry this forward.”



Not to worry. The **3DEXPERIENCE** platform is specifically engineered to work **with** the best-in-class modeling and simulation software you already have, whether they were created by Dassault Systèmes, one of our software partners, or by other software companies.

With the **3DEXPERIENCE** platform, your mechanical, electrical, electronics and software teams can choose to work with leading-edge Dassault Systèmes applications or other domain-specific software tools, **but connected to the platform and managed as consistently formatted digital data available to all**.

In this way, over time, everything you need from your historical files and folders migrates to the platform naturally, as you work with it.

Alternatively, if your company is a startup, or if you would like to test the **3DEXPERIENCE** platform on a single project, you can implement all or part of its capabilities on the cloud, with no investment in hardware, paying only for what you use.

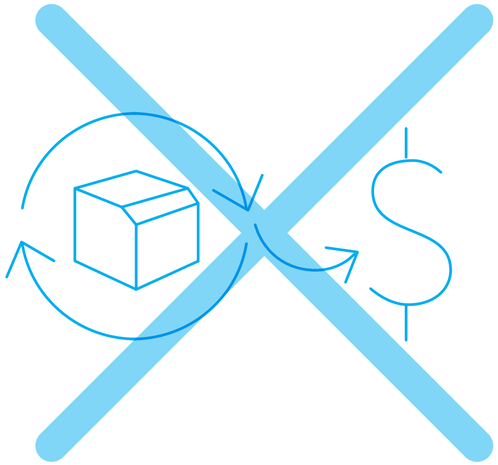
ACROSS THE ENTERPRISE— AND BEYOND

The **3D**EXPERIENCE platform connects the dots with your suppliers, too. With a few clicks, you can involve all of your suppliers in product development processes online, multiplying the brain-power at work on your project. As development advances, the platform also helps you track where your suppliers stand on their assigned parts and systems. Imagine the power of seeing in advance that a supplier has fallen behind—in time to resolve the issue.

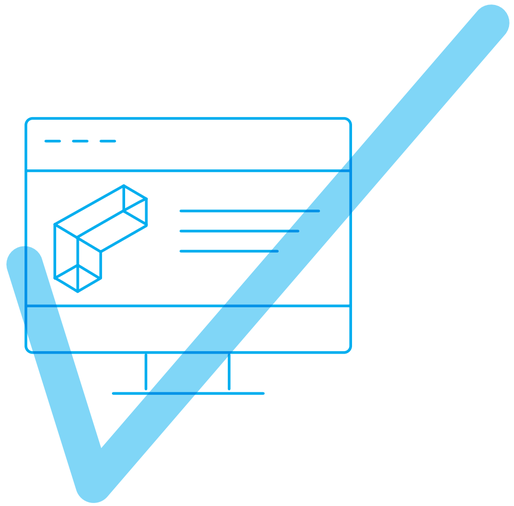
The **3D**EXPERIENCE platform scales to as few or as many participants as you need; there's no limit to how many people you can involve or where they are located, inside or outside your organization.

SUMMARY

As we've demonstrated, the **3D**EXPERIENCE platform's model-based, data-driven capabilities empower you to:



REMOVE THE UNKNOWNS AND HIGH COSTS OF ENDLESS PHYSICAL PROTOTYPES FROM YOUR NEW PRODUCT DEVELOPMENT PROCESSES



PROVE YOUR PRODUCTS' PERFORMANCE DIGITALLY, BEFORE YOU PRODUCE ANYTHING PHYSICALLY

INTRODUCE MORE INNOVATIVE, RIGHT-FIRST-TIME PRODUCTS TO THE MARKET ON BUDGET IN 40% LESS TIME

To learn more, schedule a consultation with your Inceptra Account Manager. They can help plan and implement a proof-of-concept project, on premise or on the cloud.

Or, if you don't already have an Inceptra contact, visit **inceptra.com/general-enquiry** and submit an online enquiry to schedule your MBSE consultation today – get ready for a whole new way of working: on time, on budget, with more game-changing innovations to keep your organization on track for market dominance.

DASSAULT SYSTEMES

The **3D**EXPERIENCE® Company

Inceptra

Inceptra supports engineering and manufacturing organizations with best-in-class solutions to digitally design, simulate, produce, and manage their products and processes, enabling enhanced innovation and productivity.

As the largest Platinum partner in North America, Inceptra is dedicated to Dassault Systèmes' product development software portfolio, complementary solutions, and related services, including training, implementation, integration, support, consulting, and automation services. For more information, please visit Inceptra.com.

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Our 3DEXPERIENCE® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE® Company, provides business and people with virtual universes to imagine sustainable innovations. Its world-leading solutions transform the way products are designed, produced, and supported. Dassault Systèmes' collaborative solutions foster social innovation, expanding possibilities for the virtual world to improve the real world. The group brings value to over 250,000 customers of all sizes in all industries in more than 140 countries. For more information, visit **www.3ds.com**.