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DIGITAL TWIN DONE RIGHT

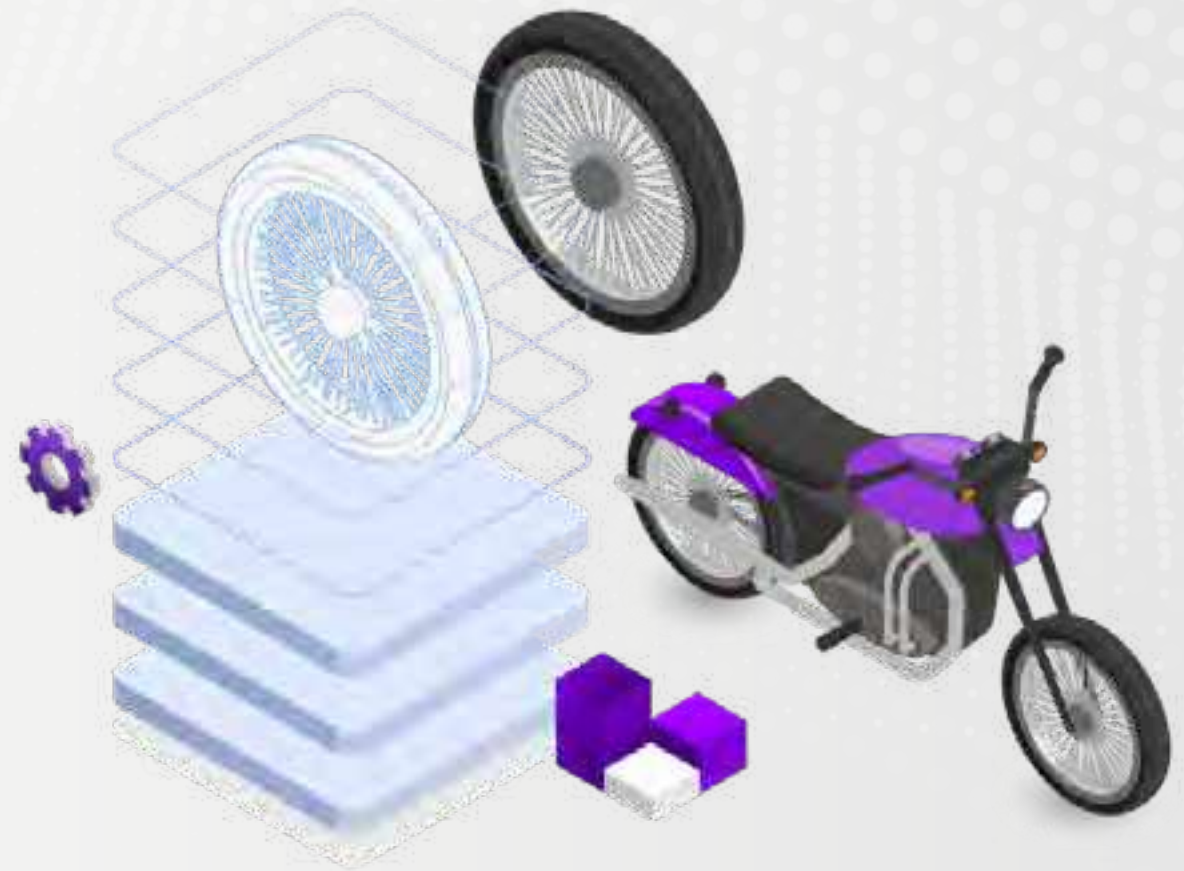
Twin-driven and AI-enabled is
the future of product development



Many organizations have at least begun to experiment with the use of digital twins: digital representations of physical things.

Using twins for testing during the validation phase of a design process, for example, is a popular starting point. But these implementations enhance or improve just one piece of a larger process; they barely scratch the surface of what the digital twin can accomplish.

In fact, done right, it will help to usher in the future of product development: a total process transformation that not only boosts efficiencies and speeds up development, but also delivers better design options and generates new revenue streams.



With the digital twin deployed to its full potential in combination with AI, companies enable an entirely new, intelligent and resilient product design capability. The physical manifestation of a product can be pushed closer to the supply chain and closer to the customer. Design and manufacturing cycles shrink from years to weeks, while creativity is unleashed with unprecedented force. Consider, for example, that Volkswagen used Autodesk's AI-driven generative design capabilities to develop a lighter and greener concept version of its iconic VW bus—and completed the process in a matter of months, compared to a previous cycle of one and a half years.¹

Artificial Intelligence (AI) dramatically enhances the capabilities of these digital doubles. Our vision of digital twin done right combines AI and automation with data and models within the twin to reimagine and reshape the entire product development process.

Here, a digital twin isn't an end, but a means—together with AI, it enables a new kind of product development: customer-led, highly flexible, and innovation-friendly. A true competitive edge.



With this next evolution of product development, multiple goals are within reach: customer-led design, Agile product development that can respond quickly to changing preferences, regulations, or supply chain challenges, and ecosystem enabling innovation.

What's more, this vision also enables products that are never finished, but rather evolve continuously through updates even after they are in customers' hands. A full-fledged digital twin + AI solution supports connections in both directions: released products can capture information about real-world usage and customer needs, which can be immediately put to use in designing new functionality.

In the past, this kind of continuous innovation was limited to companies that designed high-end "living" products from day zero, like Tesla: its cars continuously evolve via over-the-air firmware updates that roll out new features and work alongside the physical product to change its capabilities.² Tesla's fleet also provides a continuous stream of data to help its engineers improve self-driving technologies and develop future product innovations. Now, with low-power compute that can make even the most basic products "smart," coupled with connectivity in increasingly far-flung environments, the only limiting factor is the traditional development process. With the power of the digital twin + AI applied to reimagine development, it's possible for even the simplest "static" products to become "living" ones, delivering an evolving experience for customers.

Ultimately, AI + twin-driven development enables customer-led, evolutionary product design that can optimize the entire product lifecycle. Customers will be able to identify the value-added features and functionalities for which they are willing to pay; organizations can add automated requirement generation for updates or future products based on both direct feedback and real-world product use. And in the near future, physical product components will be manufactured and assembled via an expanded ecosystem of local service centers, or even 3D-printed and directly applied by the end user. This will create even more flexibility and customization opportunities for products after they're in customers' hands.

This customer-led vision is groundbreaking, but highly complex. It requires tools that focus on collaboration at scale across different groups—manufacturer-to-designer, designer-to-end-user, end-user-to-manufacturer, and more. Product design and engineering teams will be challenged to make components interchangeable and adaptable enough to complement “living” products that combine ever-changing physical and digital intellectual property.

The digital twin done right is the product development game-changer that makes it all possible. Here's why.



A CUSTOMER-LED MODEL

Traditional product life cycles are driven by human engineers and primarily influenced by technology advancements. AI, however, is upending this relationship. Data about how customers use products is applied directly in the design process, in a complete inversion of the traditional R&D-to-manufacturing-to-marketing model.

With this approach, “lot size one” manufacturing becomes possible, enabling highly personalized, contextualized and even individual-use products. Consider, for example, how Accenture leveraged AI and the sensor technologies of the Internet of Things (IoT) to help Ducati Corse, the racing arm of Ducati Motor Holding, optimize their MotoGP racing bike configuration to suit every possible race.³





This same promise is possible for consumer products. Instead of sporadic and delayed customer feedback being relayed for future development efforts, the customer's voice is pervasive from the start—and it continues through manufacturing and into support as continuous monitoring directs the product to update itself.

Companies can create richer, more individualized experiences that have previously been limited to the most expensive luxury goods. For example, we are currently looking to reproduce the high-end car buying experience for all consumers, allowing everyone to customize a car's configuration down to component level. Using telemetry data from the customer's current car or from a test drive, we create a digital twin for the car's wheels. The twin then feeds AI models that generate wheel designs to meet all of the necessary criteria: designers' operational and aesthetic requirements, safety regulations, customers' actual driving habits, and the desire for custom functionality and self-expression. Each design also factors in the cost and complexity of manufacturing.

The customer's voice is pervasive from the start.

Critically, all of these factors are considered while also preserving brand identity.

Our tool captures the elements that go into a brand's aesthetic identity, creating a kind of style "grammar." Infinite variations can be explored, and every wheel design can be customized for the end user—yet all will still clearly belong to the same product line.

A car manufacturer could use our approach to create a system that generates unique 3D-printable wheel designs. They'll meet the specific performance and appearance requirements of an individual driver, while retaining key aspects of the brand's design DNA—and meeting safety requirements.

Complex and individualized products make automated systems essential, and it's not just because they lower costs and boost efficiencies. AI assistants can validate processes, reduce the likelihood of missed constraints and, critically, identify more opportunities for innovation.

We've already seen adaptations of the same approach in purely digital spaces; take Adobe Sensei, an AI tool that automates and accelerates the creation of a marketing campaign by filtering thousands of images and transitioning them to Photoshop for final editing.⁴ The user selects the images they want, and Sensei automatically generates layouts for review, pairing sizing, photos and text with the intelligence of the system—all within seconds.

Sensei also learns from community-shared new layouts and designs, pairing that knowledge with design and communication best practices to assist users throughout the design process.

With the digital twin and AI working together, we can support similar tools for physical products, making customer-led design a reality.



mySpeaker: the future of products

Accenture leveraged this new approach to build the next generation of mobile, smart speaker. Every stage of product development, from initial design, to engineering, to manufacturing, is AI-assisted. Extended reality supports collaboration across stages and from disparate spaces. And the end user becomes a co-creator of the product's evolution. Consumers share both direct and indirect feedback for future features and product evolutions just by using the product, and designers get a clear view of potential supply chain impacts on manufacturing early in the design process, allowing for quick pivots to alternate parts and designs that keep development on track. A disjointed and linear process with a lengthy time to market becomes collaborative, continuous, and creative—not just end-to-end, but evolutionary.





AGILE DEVELOPMENT

Flexible manufacturing, modular design, and intelligent (automated) engineering make it possible to quickly and affordably update and refine designs. And we are working to make the process even smarter, using digital twins to enable better decision-making.

To truly transform product development, everyone in the process—from designers to engineers to those working in manufacturing—needs access to a continuously updated single source of truth but tailored for their own responsibilities. The digital twin done right supports this kind of visibility (like cost and lead time of parts, materials, and manufacturing skillsets), while also supporting “what if” scenarios that show how a decision will affect other aspects of development—and supporting the scale needed to serve each customer.

| Collaboration isn't limited to human teams

What's more, collaboration isn't limited to human teams: AI assistants work alongside human designers to streamline the data captured by the twin and create a seamless, iterative process. An AI-powered design assistant for automotive interiors can walk a designer step-by-step through a design spec, for instance, just as automated tax preparation software guides users through the filing process, generating increasingly specific questions based on their past answers.

Many product design principles and procedures can be embedded into a digital format from which an infinite number of possible products can be generated. Such software-like representations enable the use of these designs in AI-driven automated tools. By supporting combinations of designs, products, and applications, digital twins can help designers explore a variety of different brand identity options and allow more creative exploration in less time.

Take style transfer, an AI technique that can analyze a brand's existing products and extract key aspects of the brand's style—in 2D and 3D, across colors, patterns, materials, and finishes—to create an abstract model of a brand's unique signature. That model can then be incorporated into the design process alongside other requirements in real-time.

Designers can be confident that all of the relevant factors have been considered from the start.

AI-powered digital twins also offer a solution to one of the biggest challenges in agile development: ever-shifting government regulations and its impact on product design. In a traditional product development approach, a change in product safety regulations could derail an entire design. But with digital twin done right, regulation models are continuously updated using natural-language processing techniques that extract rules from regulatory documents proactively and early in the design process. As a result, unnecessary reworking is avoided, and compliance issues are identified, even if the regulatory landscape shifts in the midst of the product life cycle.

This same approach can be adapted to identify potential impacts from a variety of internal or external requirements—ensuring that the development process remains adaptive to meet company, consumer, and regulatory needs.



AN ECOSYSTEM OF INNOVATION

Some leading companies already sell products “as a service”—a key outcome of digital twin done right. Consider how Signify, formerly Philips Lighting, offers lighting based on the uptime and energy needs of its customers, essentially providing “lighting-as-a-service”⁵—where industrial customers pay a subscription to have their sites lit, their lighting and energy used optimized, and all lighting materials maintained. Such innovations require an extended ecosystem of manufacturing, retail, cloud-based services, and distributed networks of devices. Signify, for instance, needs to maintain the materials, lightbulbs and sensors required to deliver its lighting experience, as well as the capability to swap out older pieces for new in order to maintain consistency—all while reusing, refurbishing and recycling as much as possible, to help meet both its own and its customers’ sustainability goals.

In this brave new world, Research & Development teams and designers function more like platform developers, managing communities of suppliers, ecosystem partners and end users who are now also responsible for aspects of product design. In fact, multiple partners collaborate to combine mechanical, electrical, and software components to envision and test the functionality of the integrated product. And they need tools that operate across different deployments—from cross-enterprise data exchange, requirements management, and distributed problem solving. Those tools must also manage exponential quantities of data.





Accenture is using digital twins in combination with AI to enable tools capable of handling feedback on this scale. Such tools support ecosystem management by identifying the most critical issues during product development, and providing proactive input and assistance to the ecosystem's members. This allows for powerful collaboration on development efforts far beyond what we think of as traditional "products."

For example, we are using AI to automatically propose changes to a bill of materials for 5G network site planning based on local market demands. This relies on the digital twin to capture context-specific knowledge (geography-specific information, for example) about the appropriate configurations of the components in the bill of materials and how they should be configured in combination with others.

When introducing a new capability like 5G, we capture how to model the necessary materials for a site deployment—everything from a radio

Digital twins facilitate dialogue between designers, clients, marketing, product managers and manufacturers”.

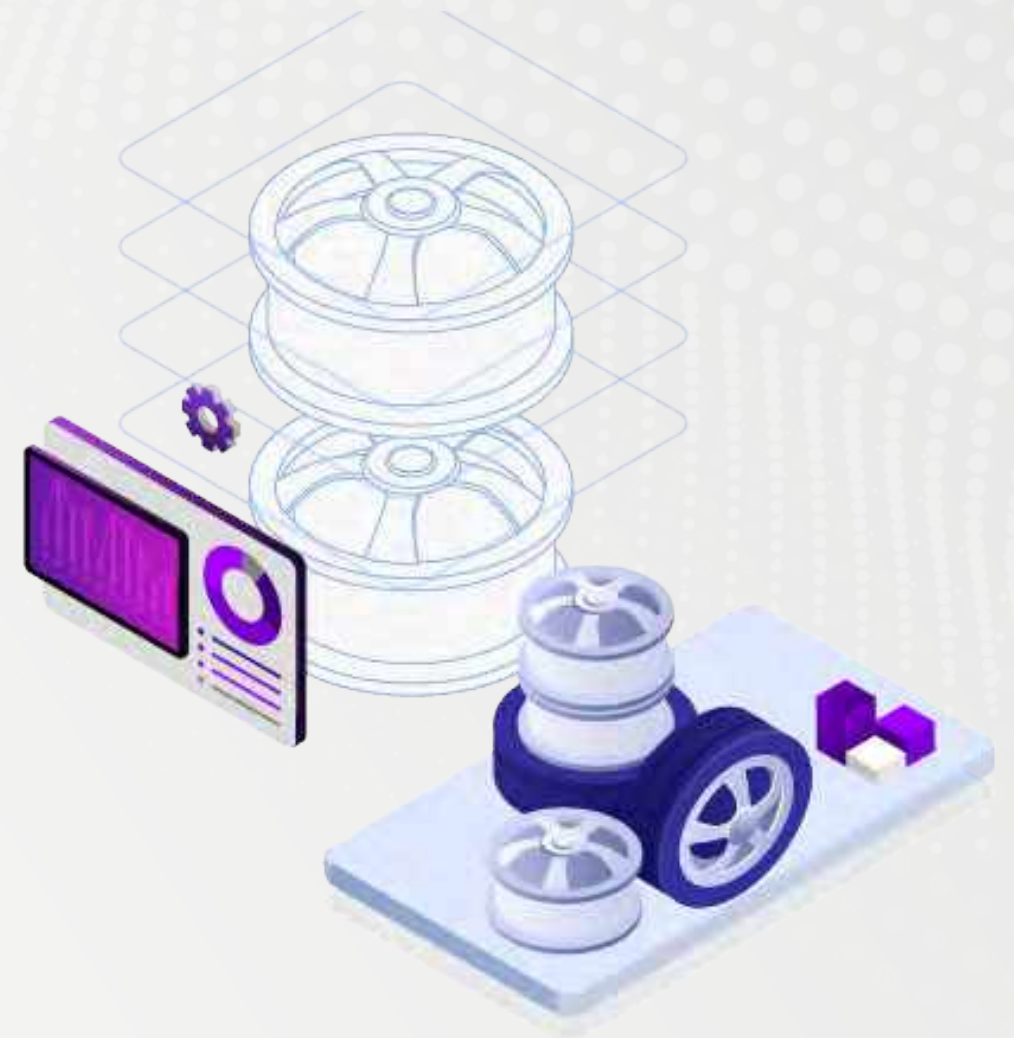
to the screws and brackets needed to hold things in place. The model includes their cost, the impact on transmissions, suppliers and service, and generally enough detail needed for the end user to configure.

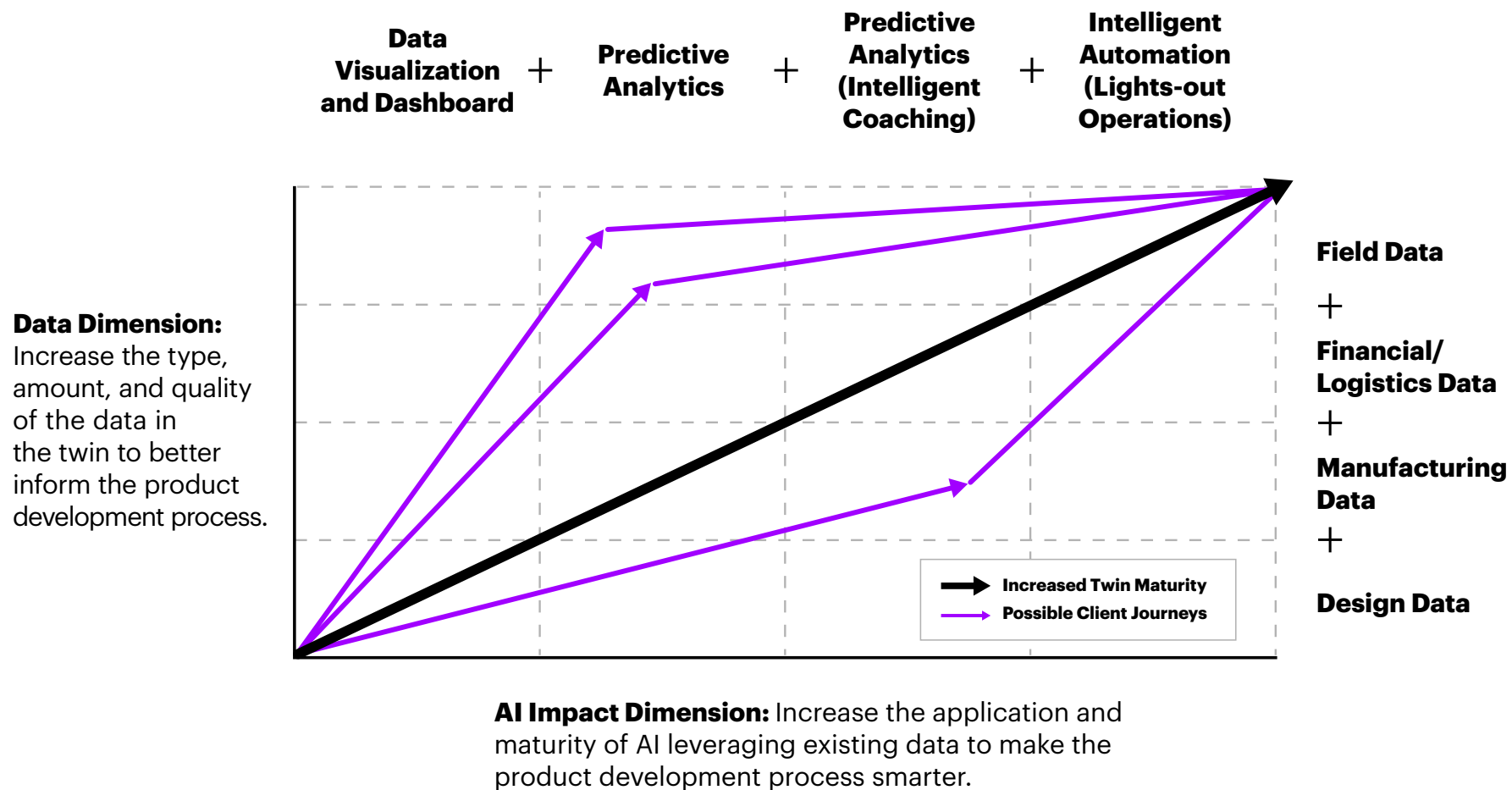
The AI solution can then adapt based on future changes: for example, if an OEM recommends an upgrade to a component, the AI-powered solution can determine whether it should be used in that configuration, or flagged as being incompatible with the other parts in the bill of materials. The digital twins, meanwhile, facilitate dialogue between designers, clients, marketing, product managers and manufacturers, enabling these players to communicate what is possible, new or desirable.

THE BUILDING BLOCKS OF SCALE

We are scaling digital twin technologies to break new ground; inferring users' desires for new products and features and translating this information into actionable insights for manufacturers, designers—and the end consumer.

Companies will begin their journeys toward this vision from different starting points, and the transformation toward the future of product development will be an evolution, not a flip of the switch. We see AI + digital twin capabilities as a two-dimensional journey, with increasing value maturing toward a vision of completely automated design. How far companies will get on their journey—and how quickly—depend on two dimensions: data and AI impact.





The data dimension reflects increasing the amount and quality of data available to support the AI + twin solution. There are immediate opportunities based on the data organizations already have; moving forward, companies climb this dimension by analyzing what additional data they need, then deploying the appropriate data collection mechanisms. That may mean installing physical sensors, instrumenting online processes, or creating “virtual sensors” that mine internal or public data sources.

The AI impact dimension reflects increasing the sophistication and autonomy of systems which leverage the available data—to augment, or even replace human-labor steps in the process.

As companies progress among the stages of AI maturity, they will move from intelligent analytics all the way up to the full capabilities of an AI + twin solution: full process automation.

Intelligent analytics provide a quick way to get started, by augmenting the steps in the product development process with dashboards and control towers. Moving forward, the twin can support **stakeholder synchronization**, allowing different stakeholders across different processes to see the same data as one another. The views of the data may be stakeholder-specific, but they enable collaboration from the same base of truth.

The next level of maturity supports **stakeholder coaching**: intelligent assistants coach human stakeholders to complete activities. Finally, at the height of both data and application maturity, an organization can reach **full process automation**: the twin automates individual tasks or a process so that it requires little to no human intervention. At the most basic, process automation automates rote tasks based on pattern matching and rules that could be trained to almost anyone and different people would have the same outcome. At the most mature, cognitive automation applies to tasks that require higher level reasoning. These problems do not have single answers but rather multiple options that could be debated. AI-systems need to make choices and apply judgements by reasoning over captured expert knowledge.

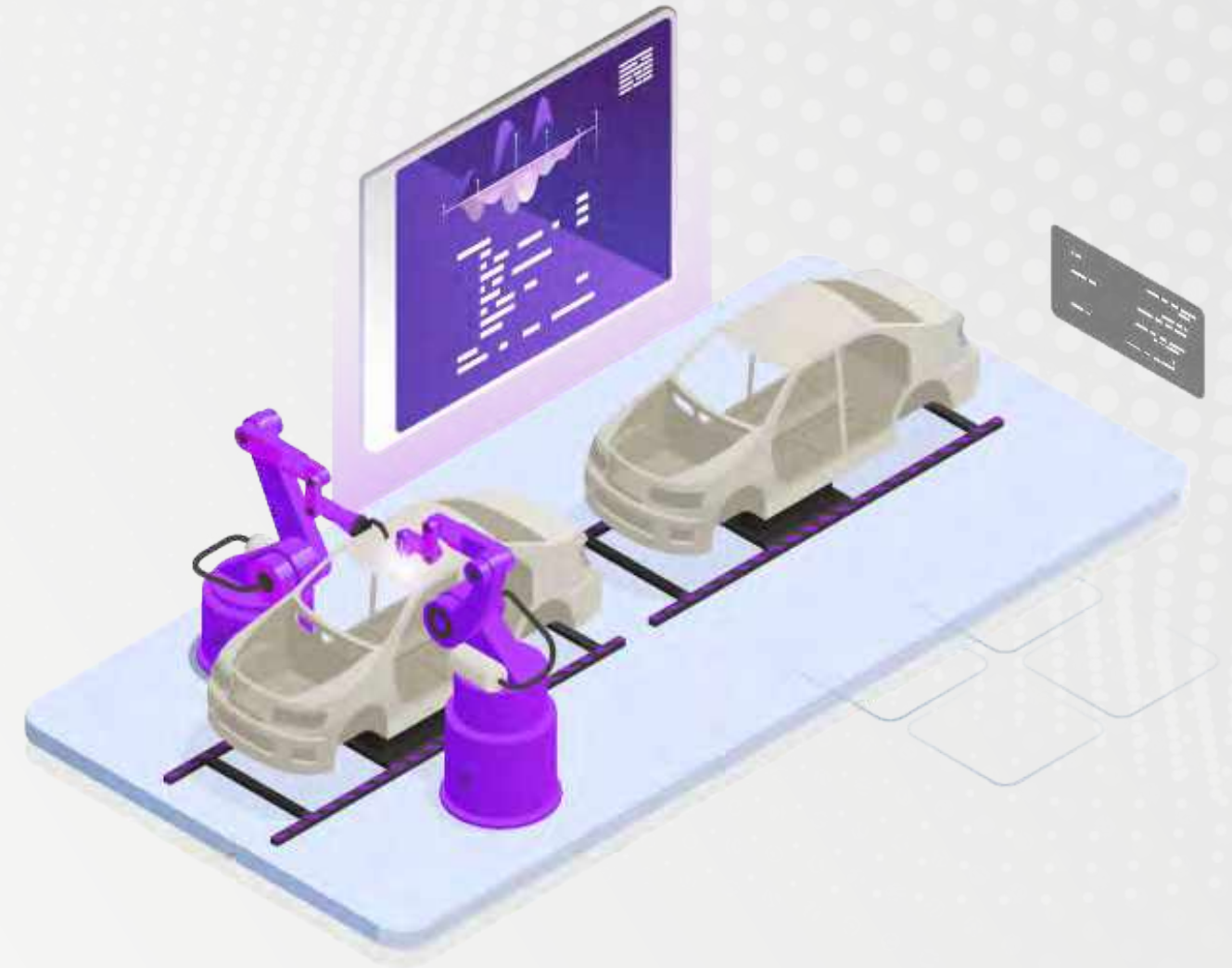
Within organizations, different levels of data paired with increasingly sophisticated intelligence can unlock different capabilities. Over time, organizations can invest in capturing more data or in building more intelligence for the data they have. Both investments can unlock value and will be required to ultimately create more intelligent, automated and user-driven product development.

No matter where a company currently sits on the maturity scale, the digital twin done right offers opportunity—both to unlock immediate value, and to build a roadmap toward complete transformation.

DESIGNING THE FUTURE OF COMPANIES

Digital twins can make the real world machine-readable—and machine controllable. That's why combining twins with AI is such a powerful concept: we can automate routine tasks, enable continuous and enhanced collaboration, and focus the time of human experts on new value streams and moving to market with new, ground-breaking products at speed. Design, prototyping, testing, and validation can all be done in a virtual space, permitting more experimentation, and every change can be rapidly evaluated for its impacts before the product is manufactured.

The digital twin done right enables companies to reimagine product development, but the true transformation is even larger. Ultimately, building these capabilities will determine the difference between companies locked in the past, unable to keep pace in today's marketplace—and the living, evolving companies of the future.



CONTACTS



Marc Carrel-Billiard

Senior Managing Director, Technology Innovation
marc.carrel-billiard@accenture.com



Teresa Tung

Managing Director, Accenture Labs, San Francisco
teresa.tung@accenture.com



Matthew Thomas

Managing Director, Industry X
matthew.thomas@accenture.com



Sarat Maitin

Managing Director, Strategy & Consulting Industrial
sarat.maitin@accenture.com

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