

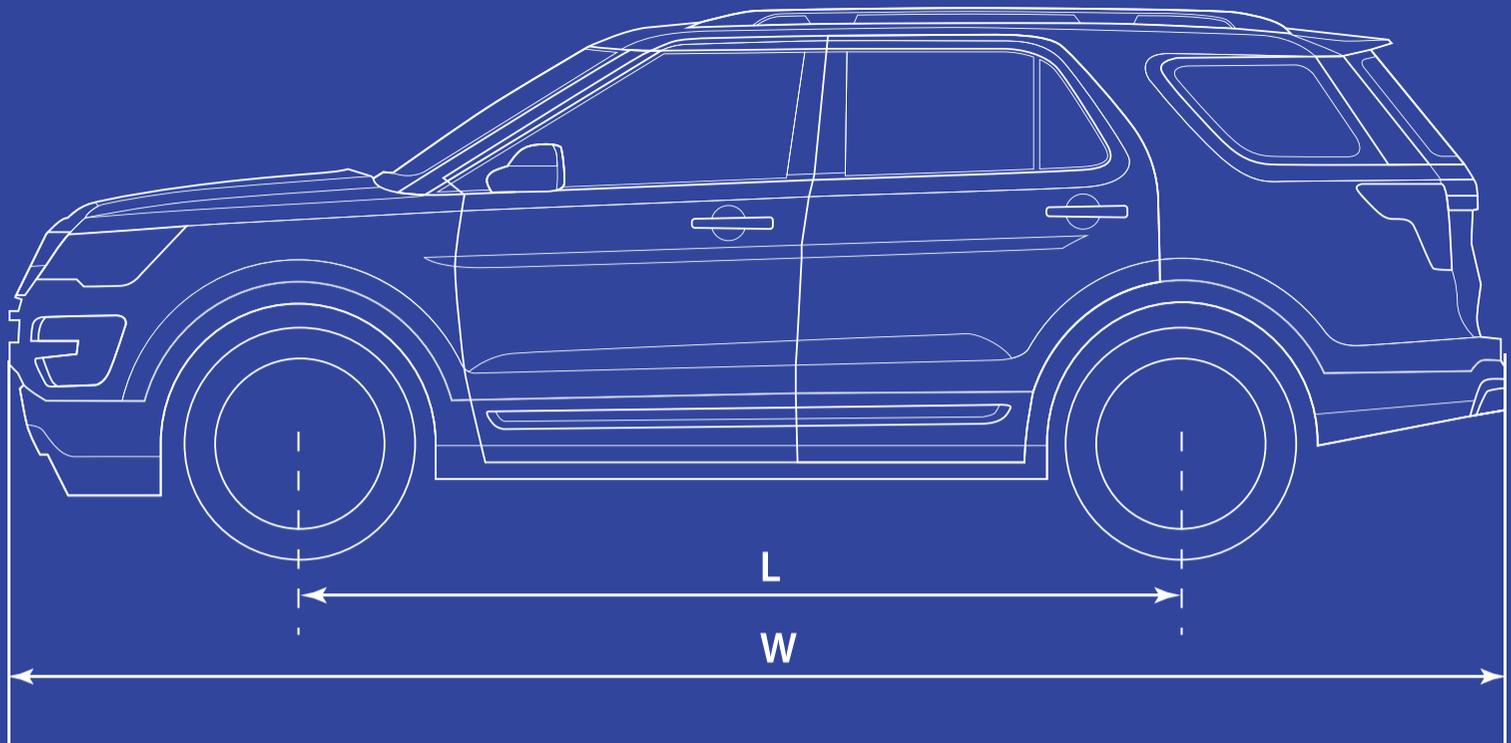
# How the Composable Enterprise Will Accelerate Digital Transformation in the Automotive Industry

Low-code opens the pathway to data-driven manufacturing excellence



**mendix**

A Siemens Business



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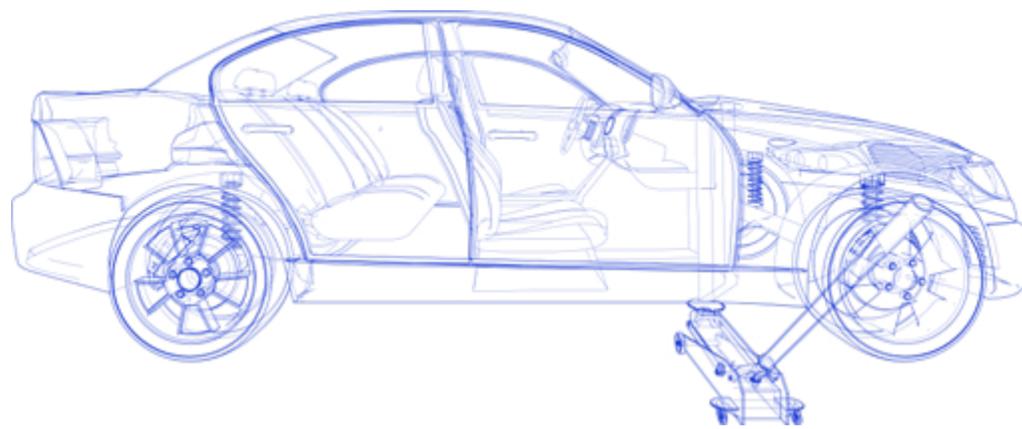
## Executive summary

**Across the automotive manufacturing value chain,** initiatives for new efficiencies, new connections, and new ways of engagement are at a peak. All well and good—but how do you bring such initiatives to fruition and gain the targeted benefits? Moreover, how do you do so while contending with today's extraordinary market forces—disruptive digital technology trends, supply chain issues, bold new customer expectations, burgeoning regulatory demands?

Your manufacturing initiatives can help you keep pace with innovation or even revitalize the way you do business, but success hinges on holistic manufacturing digitalization undergirded by visibility up and down the supply chain. With 70% of digital

transformation initiatives reportedly not reaching their goals,<sup>1</sup> something has to change. How can your company move beyond the planning phase to execute real, accelerated digital transformation? How can you leverage your wealth of industry know-how, as well as your existing digital assets, to gain the greatest value for your business?

A low-code, multi-experience development platform opens a new pathway to success. We believe that realization of the composable enterprise with adaptive solutions is key to achieving entirely new levels of agility and flexibility, and ultimately, the data-driven manufacturing excellence that will come to characterize thriving automotive manufacturers.



## **In an evolving automotive landscape, true digital transformation is essential**



**To keep pace with innovation and revitalize the way they do business**, automotive manufacturing executives are acutely aware that the path forward is digital. In many respects, digital transformation has become an existential imperative; yet digitalization is never an end unto itself. Rather, digital systems are a means for you to address issues and ideas that pertain to your particular manufacturing operations and goals.

This is true for the longstanding supplier of internal combustion engine components, who is not changing materials and processes but who needs new manufacturing efficiencies to remain competitive. It is equally true for the startup electric vehicle original equipment manufacturer (OEM) doing clean-sheet engineering and introducing nontraditional materials and processes to automotive manufacturing.

Done well, digital transformation reduces risks, accelerates speed to market, increases margins, and enhances your position as a market leader. But with the large majority of digital transformation initiatives failing to reach their objectives, the time is ripe for a fresh look at the execution of digital transformation.

As a Siemens business, Mendix draws on a deep repository of knowledge about the automotive industry. We have found that every company—no matter where it fits within the automotive supply chain, no matter if it is a longstanding “brownfield” operation or is building a “greenfield” factory—must continually find new ways to achieve ongoing success within the bounds of two realities.

The first reality is the ingenuity and speed relentlessly demanded of you by an

automotive landscape that is evolving at an accelerated clip. Ever-changing technological and market conditions create a growing web of interrelated challenges and opportunities. Electrification. Connected services. Autonomous vehicles. Flexible mobility. The pandemic. Supply chain complexities and uncertainties. Sustainability. Hyperautomation. To successfully navigate this web, it is essential to construct an agile, flexible manufacturing ecosystem—one that offers robust interconnectivity with enterprise and business systems, as well as visibility across your value chain.

The second reality is the investment you have already made in existing assets—facilities, machines, equipment, people, and digital systems. (Even if you are building a greenfield automotive factory, critical assets and know-how begin accumulating before your groundbreaking ceremony.) To succeed, you must get the most you can out of these assets. How can you leverage both your existing assets and the latest advancements to propel your company forward, while also grappling with the forces and fluctuations of today's marketplace?

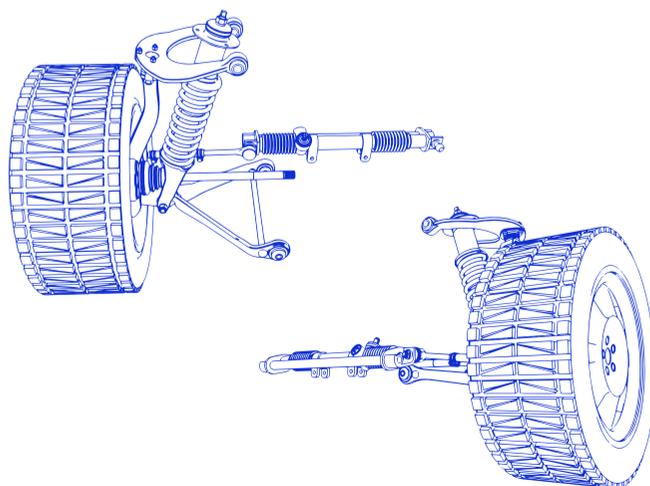
**Our answer: the composable and adaptable enterprise.**

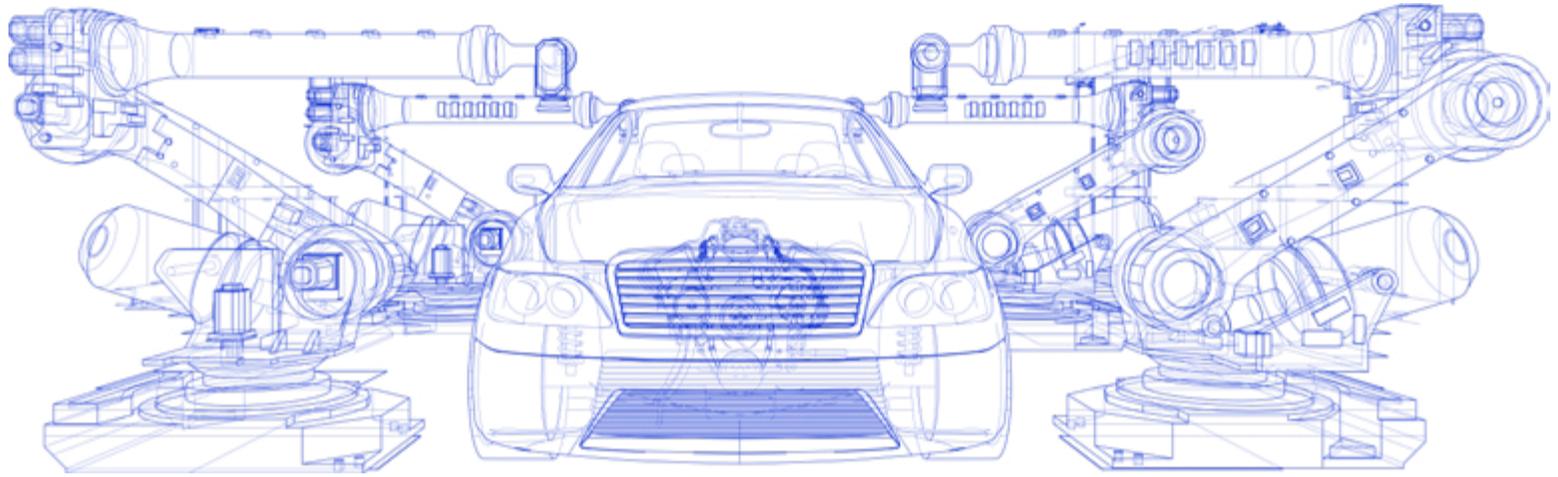
## **The composable, adaptable enterprise**

Gartner first coined the term “composable business” to describe an organization architected “for real-time adaptability and resilience in the face of uncertainty.”<sup>2</sup> The composable enterprise relies on a platform that supports collaborative problem-solving through experimentation and iteration. It democratizes application capabilities so that every member of your manufacturing team can assemble and reassemble applications at ease, retaining what works and shedding what doesn't. To create these capabilities, the composable enterprise turns monolithic digital systems into composable artifacts, enabling orchestration, modularity, and autonomy.

You need to know how to turn the conceptual idea of the composable enterprise into a practical, implementable strategy. Let's start with some clarity both on where the automotive industry is heading via digital transformation and on the obstacles that must be surmounted to realize this vision.

Then we will consider the resources and tools that enable companies to execute digital transformation. The role of a low-code, multi-experience development platform will be detailed. Finally, through use cases that target specific automotive business objectives, we will illustrate how digital transformation may be executed.





DIGITAL TRANSFORMATION GOAL:

## Data-driven manufacturing excellence

**Among the various manufacturing industries,** the automotive industry has been at the forefront of automation and digitalization, serving as an early adopter of computer numeric control machining, robotics, automatic inspection and in-line sensors, mature supervisory control and data acquisition, and more. This puts automotive companies well ahead of the curve in terms of data generation, a trend that shows no signs of slowing.

Yet currently, as little as 10% of this data is analyzed for manufacturing insights.<sup>3</sup> Most manufacturing data is used only for its initial purpose. A sensor, for example, might have an initial purpose of triggering a production step, such as laying down an adhesive bead on a door panel when a certain temperature is reached. But the untapped data generated by this sensor could also be used to gain insights into the heating process it is monitoring. Such insights could help the manufacturer identify a more efficient heating method or realize that the adhesive reaches desired viscosity at a lower temperature, enabling reduced heating time and energy expenditure.

Extend this example to data generated by all in-line sensors on a production line; to the manufacturing

execution system (MES) orchestrating that production; to the manufacturing operations management (MOM) system that coordinates MES functions with planning and scheduling and quality management; or to the enterprise resource planning (ERP) and product lifecycle management (PLM) systems that, together with MOM, comprise the key functional hubs within a company's manufacturing data infrastructure. You begin to capture some sense of the data available to leverage toward manufacturing excellence.

To turn this "big data" into useful intelligence and insights, you must first aggregate, contextualize, and analyze it in order to create a lake of "smart data." Then you must make the smart data easily accessible so that your data-driven enterprise makes the most of each employee's expertise through an unimpeded, collaborative communication network. Data-driven manufacturing excellence demands visibility across the enterprise, as well as an integral culture of quality and cost-effectiveness and a dynamic customer experience.

Data-driven manufacturing excellence uses your wealth of data to enable you to develop

agile, cross-domain applications; to innovate continuously, faster than ever; and to achieve new efficiencies both internally and across the supply chain. OEMs and suppliers alike can adjust to changing conditions with an unprecedented level of efficiency. This is true even when those conditions change abruptly, as they did at the onset of the pandemic.

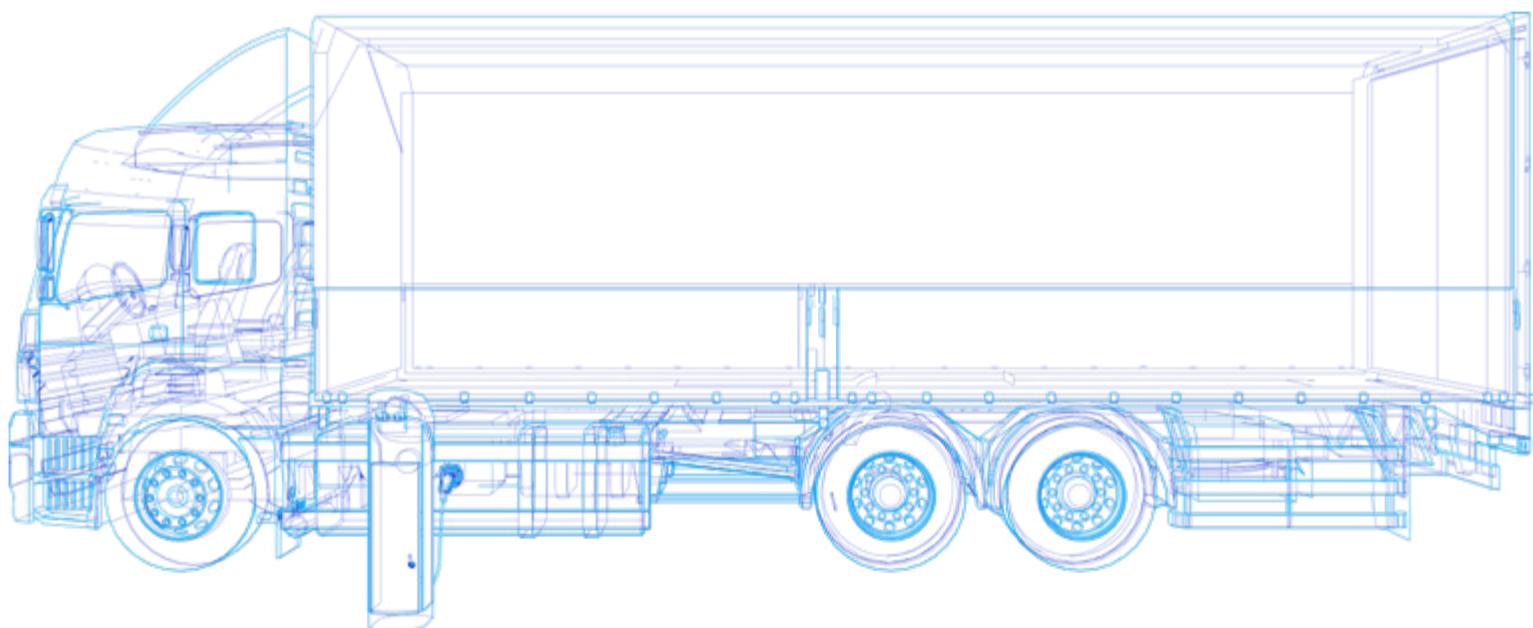
Imagine as an OEM, for example, what happens when a tried-and-true component supplier suddenly goes offline. Imagine your procurement team having immediate access not only to a list of alternative suppliers, but to details about each of those suppliers—their location and distance to your factories, your most recent supplier assessment of that company, replacement component specs and deviations from the original supplier's part, and more.

Imagine the team being able to utilize information on existing inventories of that component at each of your production locations, on shelf time and shelf life, and on planned consumption at each factory. Your procurement team would be empowered to make better decisions and more

profitable negotiations, faster than ever before.

Or imagine, as a supplier of roof systems, that you have just hired a materials scientist to investigate lighter-weight materials. Imagine that new hire having immediate access to all pertinent information—in a digestible format—from the existing system's design files, materials database, testing data, production quality data, part weight, and field testing data; Imagine also the new hire plugged into all information on the material under consideration: the list of suppliers for material test coupons and prototype component fabrication, the availability and cost of each, and the data and forms needed to generate purchase orders. Instead of spending the first few weeks under your employ learning how to extract this information from multiple digital systems, your new researcher can promptly begin the work you are paying for.

These scenarios, repeated time and again across your enterprise, represent where data-driven manufacturing could take your productivity and business vitality.



# Digital transformation frees the enterprise of rigid architectures and organizational structures

**To actualize data-driven manufacturing excellence,** you must have data visibility, availability, and access across your value chain. What is keeping you from realizing this true digital transformation?

A one-word answer to this question is *history*—both the broader history of industrial digitalization and your company's particular history of digitalization. Before digital systems became available as a mature, standardized technology, the automotive industry's fierce competition led companies to create homegrown solutions that accelerated specific manufacturing functions in specific ways for specific applications. As a company's product lines, production volumes, or production methods evolved, these homegrown solutions have had an extremely limited capacity to evolve in parallel. Every change in each system became a bigger and bigger effort, including potentially having to change every interface with every other system in use.

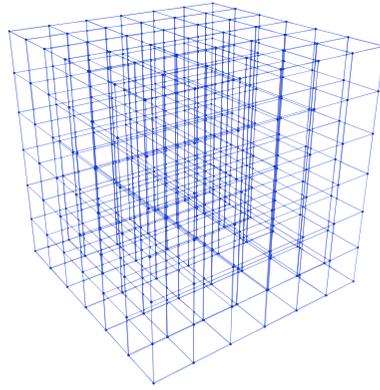
As they became available, point solutions from digital technology vendors helped accelerate and standardize operations within a particular domain. However, they were not easily scaled or extended to new functions, perpetuating digital "silos" within the organization. Today, integrated platforms transform these siloed functions into a linked ecosystem. The implementation of these platforms has resulted in a complexity of integration that limits the scalability of those integrations as the various platforms mature. It builds in a latency of data across systems designed for different functions and users.

Thus, the challenge: How do you retain the valuable functionality of these core proven systems and, at the same time, advance toward data-driven manufacturing excellence? The obstacle to this digital transformation is the rigid architectures and organizational structures in which the core systems operate.

Returning to our two scenarios: before digital transformation, to change suppliers the OEM's procurement team must extract needed data from the ERP, PLM, inventory management system, production planning, supply chain management and logistics, and more. Likewise, the newly onboarded researcher must interface with the company's ERP, PLM, material characteristics test system, warehouse management system, and perhaps a couple of Excel-based systems.

To help the team or the scientist, you may wish to build an application that automates the data extraction process. Without a composable enterprise, this would require the dedication of considerable IT personnel and skill sets—and time you simply cannot afford. In fact, the job of leveraging information technology is less and less the responsibility of IT specialists, as widespread digitalization is managed by personnel within each department. Gartner reports that business technologists—employees who report outside of IT departments and create technology or analytics capabilities for work—now make up 41% of digital technologists.<sup>4</sup> Another 49% are technology end users,<sup>5</sup> leaving only 10% inside the IT department.

It is clear that the key to a true digital transformation—and the purpose of the composable enterprise—is twofold. First, provide a tool that automates the data extraction and workflow generation process. Second, empower non-IT personnel to participate in the creation of personalized applications, so that they can act on their ideas for business innovation. Let's take a look at how the composable enterprise enables this digital transformation.



## How the composable enterprise works

**To put the composable enterprise to work** in your business, three characteristics identified by Gartner are needed. The first is the cultivation of a culture of composable thinking—a broad recognition that assembly and reassembly of components is the fastest, most flexible path to desired outcomes. The second is the realization of a composable business architecture, which enables users to build, assemble, and reassemble different elements for the digital era. The third is the composable technologies themselves—digital assets packaged as discrete components that deliver independent, clear, and complete business value.

The key enabling technology of the composable enterprise is a low-code, multi-experience development platform, which automates data extraction and workflow generation by turning monolithic systems into composable artifacts.

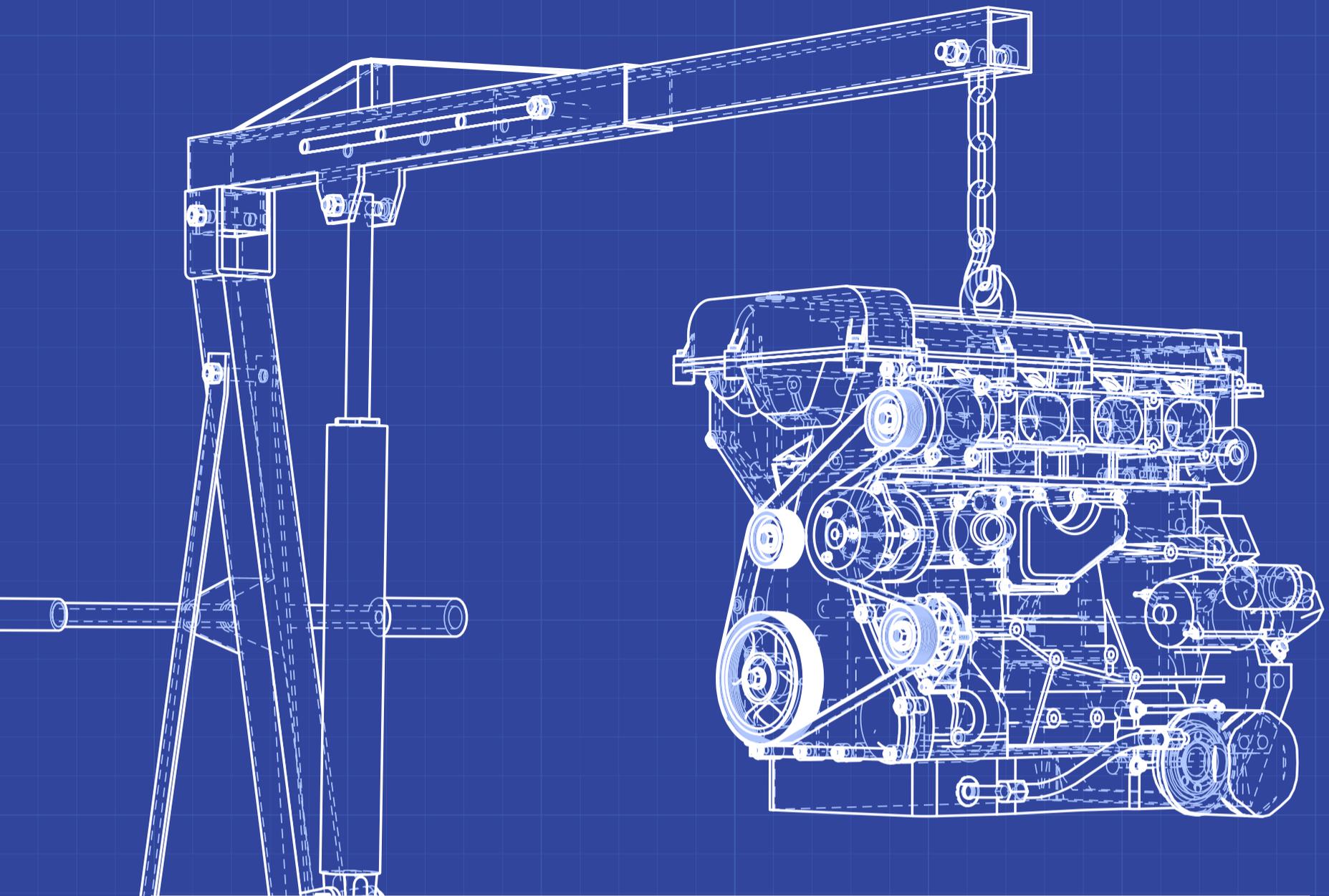
To illustrate, let's consider the process of moving a new roofing system from design to production. Using a powerful PLM, your design team has generated a 150% bill of materials (BOM) that includes alternatives for all the configuration options. The low-code platform accesses the PLM to extract the BOM as a composable artifact. Your manufacturing team can now use the low-code platform to pull the BOM as a building block into a personalized application—without having to conduct operations within the PLM. By pulling in data from other sources, such as the ERP or supply chain sources, the team can easily build an application that creates a visualization to compare complex BOMs and enables target-setting for critical attributes—optimizing weight, cost, or carbon footprint, for example.

Another digital system may contain a materials database that includes each material's carbon footprint. The low-code platform can be used to pull data on the carbon footprint of each material in the BOM. The composable enterprise allows the manufacturing team to assemble these building blocks while neither opening the software that generated the data nor writing code to extract the data.

How does the manufacturing team create its personalized application? The low-code platform provides assembly tools for this task:

- \* **Templates** are prepackaged frameworks that provide a starting point for the application. In a few simple visual steps, the template can be customized to address a specific need.
- \* **App services** provide domain-specific building blocks packaged in cloud services.
- \* **Integrations** enable users to reach specific data and pull it into a workflow or experience.

On the low-code development platform, the manufacturing team may start with a template and connectors to the ERP, PLM, and carbon footprint database, using simple drag-and-drop to pull the BOMs and other material and part data into their application. To access the roof system's 3D CAD view, they could use a 3D Viewer app service. As the building blocks are pulled into the personalized app, the team specifies elements to include in a front-end dashboard. They now have a user interface that supports their interaction with all relevant information—and the connection of this personalized app means they are always interacting with live, up-to-date data.



## The composable enterprise in the automotive ecosystem

If the goal of digital transformation and the composable enterprise is data-driven manufacturing excellence, what objectives contribute to this goal, and how does an automotive manufacturer fulfill these objectives?

**The composable enterprise allows users to achieve three key objectives of digitalization:**

- 1. Enabling agility with personalized, cross-domain applications**  
Manufacturers can assemble applications quickly across supply, engineering, manufacturing, service, and business domains, creating the agility and flexibility required in today's market.
- 2. Innovating continuously, faster than ever**  
Process experts can become co-creators and co-innovators with IT.
- 3. Increasing productivity and throughput**  
The composable enterprise enables and accelerates alignment across the enterprise and the value chain

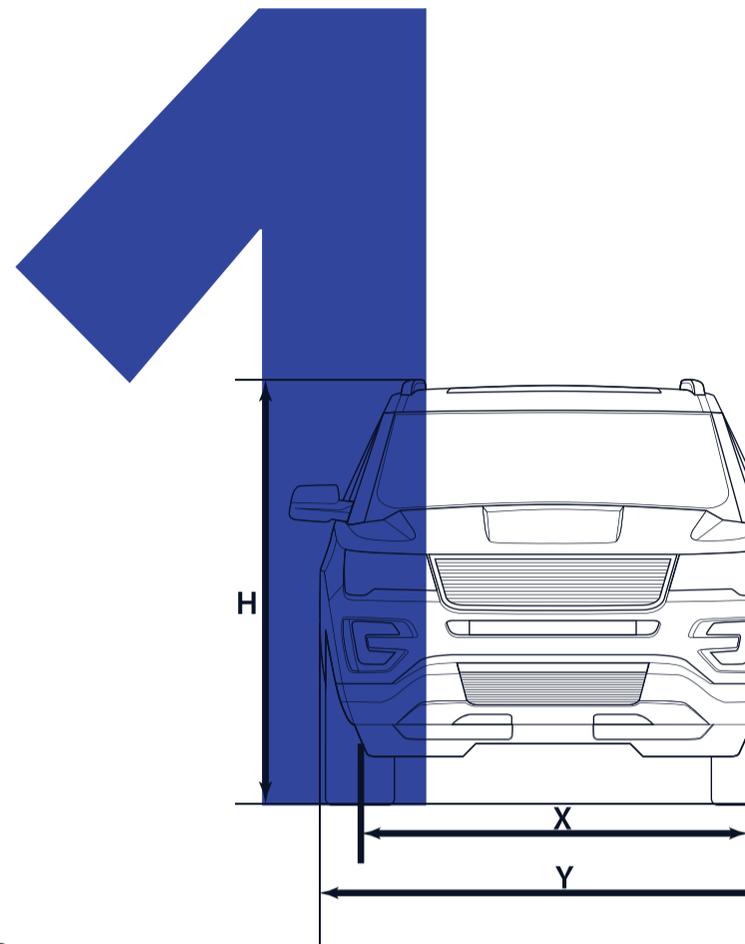
## USE CASE 1

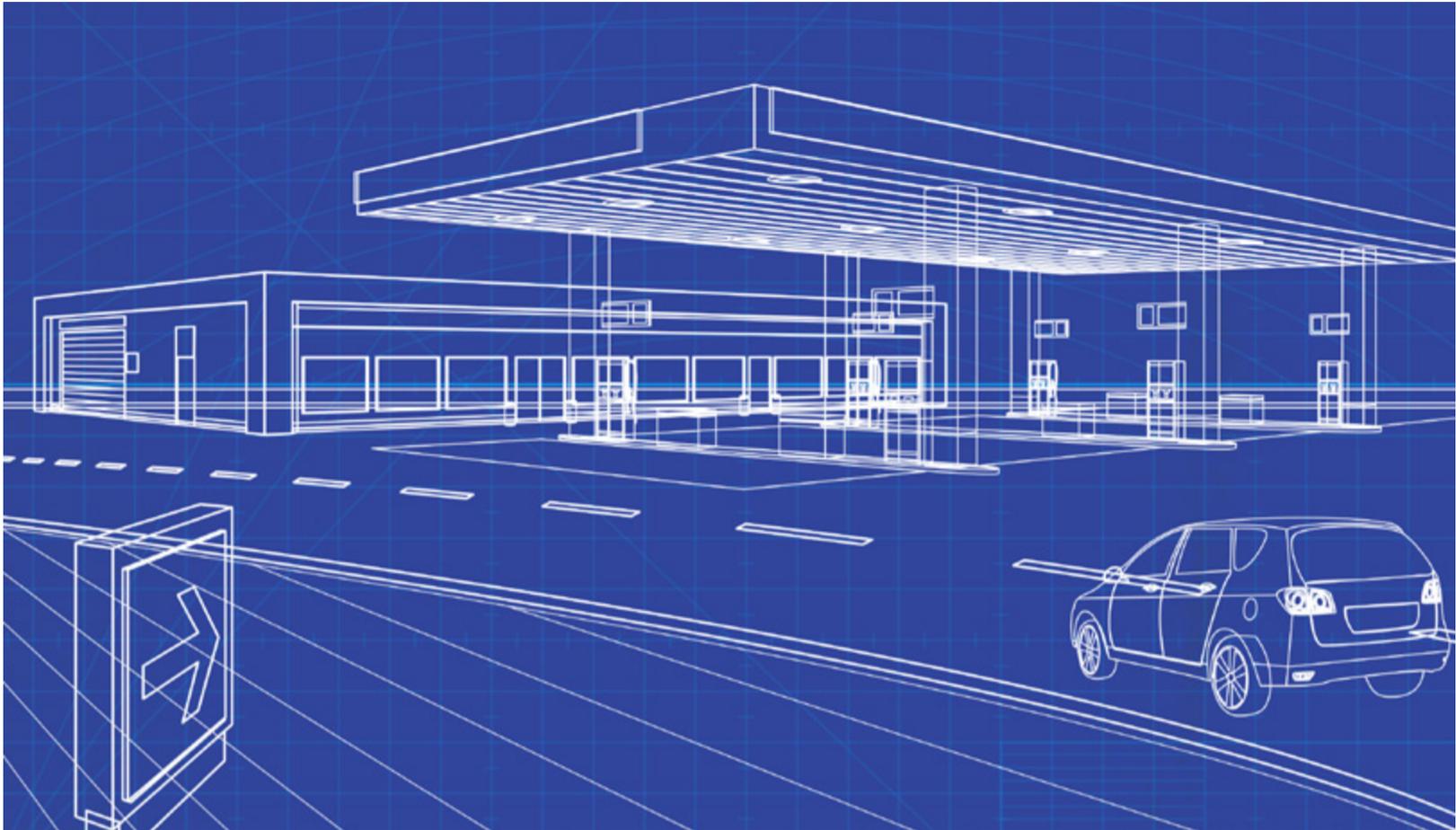
# An agile and flexible customer experience

**A satisfying customer experience in the automotive marketplace** is a moving target, perhaps more so than in most industries due to disruptive innovations in automotive technology. Connected services are blurring the line between product and service as vehicles engage customers with the driving experience through smart “things,” smart infrastructure, and the cloud. Mobility as a Service models are introducing consumers to shared ownership concepts in transportation. These major trends compound an already fluid customer experience created by mass customization and other global market trends. Automotive OEMs and suppliers both must think about their models, as well as the secured services built within each vehicle, in new ways today—and newer ways tomorrow.

The “customer experience” (CX) is also a critical matter for internal customers within your organization. In larger companies or across the supply chain, cross-departmental collaboration often hinges on the right level of engaged experiences. Approaching these needs with a CX strategy helps drive engagement among an organization’s otherwise-siloed groups. Investing in CX has become a necessity but also an opportunity for automotive manufacturers to gain a tremendous competitive edge—but only if you are able to execute CX modalities and upgrades at the speed demanded by today’s digital consumer. The prerequisites for developing a winning CX program include:

- \* Making the most of existing digital assets, both customer-facing (digital portals) and in-house support structures (like customer relationship management software).
- \* Regularly adding more digital touchpoints, each of which must be developed and maintained for multiple modalities (such as desktop, mobile, chat, or phone).
- \* Having methods in place to gain an understanding of today’s customers, including rapid feedback-gathering methods.



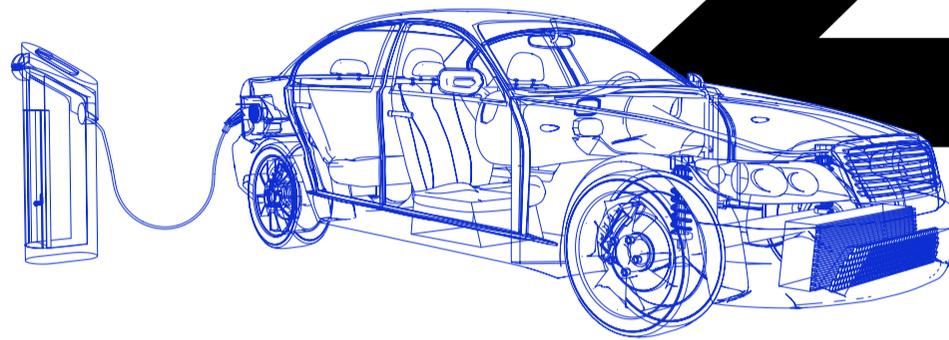


Becoming an automotive CX vanguard with a customer-first mindset—without breaking the bank in IT investments—is something the composable enterprise makes readily attainable. A low-code platform creates the interactive ecosystem needed to connect all groups involved in CX: IT, customer service, and the customers themselves, as well as each department that supports and makes the customer experience happen. The CX process expert can collaborate with IT to create interactive digital tools that intersect with every process and system related to the customer journey.

The composable enterprise also supports workflow development by IT and domain experts alike, enabling them not only to work separately and together to put the right processes in place to build CX software but also to establish feedback-gathering and iterative processes that ensure continuous improvement and meet evolving customer expectations.

Low-code tools allow users to create building blocks for a business capability, such as app services, that can be plugged into applications for different digital touchpoints and modalities. A low-code platform with an entire marketplace of prebuilt integrations accelerates CX innovation and implementation.

As automotive companies seek to implement a modern customer-first business model, they must remember that the customer experience is always going to evolve. Meeting customers' changeable needs leads to more loyalty and retention. A low-code platform enables you to build experiences that attract, retain, and delight not only your customers but your workforce.



USE CASE 2

## Innovating for sustainability

**At the corporate level**, automotive companies must find ways to contend with sustainability on three fronts: **regulatory changes**, **supply chain impacts**, and, eventually, **the circular economy**. On the **regulatory** front, manufacturers face a jungle of data and systems—or multiple jungles, depending on your presence in different geographic regions—from which you must derive a clear understanding of your regulatory status and pathways to meet compliance demands. As you face new limits on your company's carbon footprint, for example, your production and process systems data must be composed in the right way so that you can uncover the driving factors most strongly impacting your current footprint.

This assessment demands a holistic understanding of sustainability, including the resources and materials your processes consume, the tools you are using in your facilities, and the car or component you are producing. The composable enterprise enables the corporate sustainability team to generate a planning app and pull in needed data for this evaluation.

Through the composable enterprise, your engineer is empowered to learn where the carbon footprint comes from, broken down for each part's material, energy consumption, and logistics. This enables the engineer to identify the most critical part in the BOM and put it into review by the procurement team. With their personalized application, procurement quickly checks part inventory, current and alternate suppliers, and other critical information. They efficiently prepare the review and then enter negotiations supported by comprehensive data and insights.

Sustainability also entails the management of **supply chain** complexities and uncertainties. You need data on where materials are coming from: the typical mix of

energy used to manufacture in that locale, the distance materials must travel to your facility, whether other suppliers of the same material are located closer. Information and digital workflows that support such efforts come from multiple sources. For example, supply chain management orchestrates most production-related activities that occur outside the primary manufacturing floor: movement and storage of raw materials; inventory of supplied parts, components, and sub-assemblies; and movement of finished goods to the customer. But other systems focus on the manufacturing floor itself, such as the advanced planning and scheduling system that optimizes efficient production and order fulfillment. Sustainable supply chain management entails assembling and reassembling data and workflows from these and numerous other internal and external systems.

A whole new dimension is added when you consider alternative materials that have a lower carbon footprint. There are so many moving parts in the supply chain and so many different digital systems that, as the saying goes, you don't know what you don't know. Further, once you uncover new information or develop new insight, it is important to be able to act on it quickly. You cannot accommodate the long and costly cycle of traditional application development. The composable enterprise lets you leverage new knowledge rapidly.

If you are a supplier, your engineering team might use the composable enterprise to import data that the OEM has generated on new material or processes relevant to the component or system that you make. The composable enterprise then supports collaboration between you and the OEM, as well as with lower-tiered suppliers.

Equipping your company to contribute to the **circular economy**—ensuring that end-of-life materials and components are worked into similar products—requires packaging and communicating data on a much broader plane. The goal is to track a vehicle and all its components in a way that enables you to provide pertinent data to anyone. For example, when a car is disassembled after a crash, circularity requires knowledge of which parts can be reused. If, for example, a battery from an electric car becomes available for potential reuse, determining the likely life and behavior of this battery could be made possible by composing data on its previous use: what conditions and temperatures it had been exposed to, whether it overheated or experienced low temperatures for an extended time, and so on.

All this data is “out there,” having been generated by a variety of digital tools. (If the data is not digitally stored but recorded manually and stored on paper, yet another opportunity arises to digitalize such processes with low code.) The composable enterprise makes it feasible to connect to data, no matter its source, and include it in application development that produces a useful display of the data in a composite way.

On each of these fronts, a low-code development platform quickly connects the broad array of data sources and provides the insights needed to innovate continuously. The result is accelerated completion of initiatives and achievement of sustainability objectives and goals.

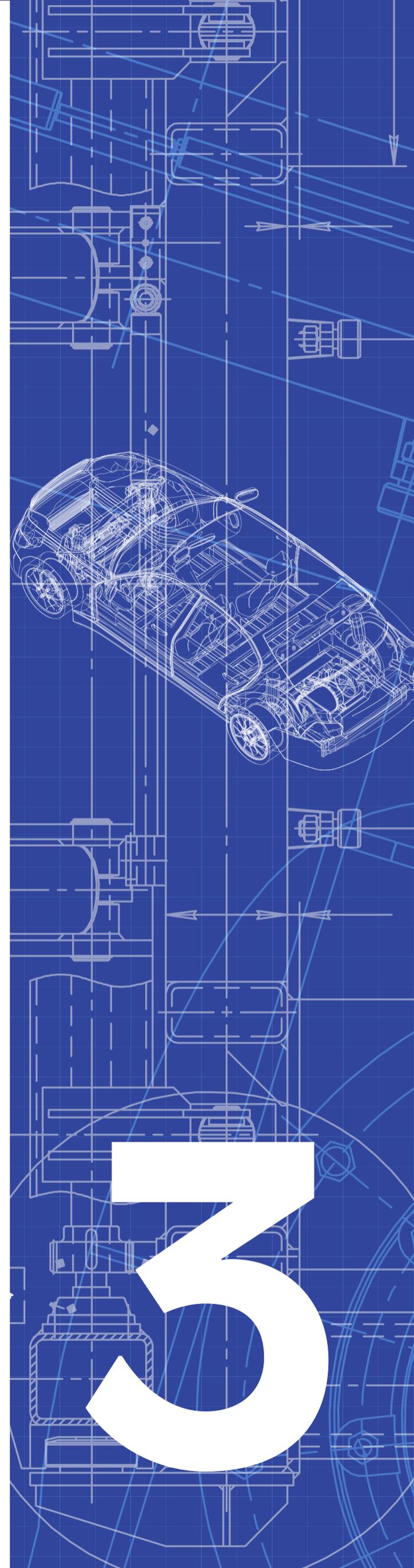
# Maximizing brownfield productivity and throughput

**To compete with the many new players in the automotive space** (globally, for example, more than 400 OEMs are developing electric vehicles and more than 200 OEMs are developing autonomous vehicles), existing companies face a double challenge. At the same time that they are implementing more flexible, reconfigurable production lines to manufacture a more diversified product line—often in older factories with limited footprints, located where expansion is not an option—they must leverage each resource to maximize its contribution to productivity and throughput. This means optimized business operations, production planning and scheduling, manufacturing execution, and quality management. It also means continuous improvement. The composable enterprise enables a manufacturer to make the most of digital resources as well as inventory, workforce development and retention, equipment, and production lines.

Consider the specific case of leveraging existing assets in a recent acquisition. A company might raise its productivity by standardizing manufacturing execution software, for example, across all its facilities. However, in a climate of market consolidation and numerous mergers and acquisitions—especially among Tier 1 suppliers—it makes no sense for a company to invest time and resources in standardizing MES software. It could be “unstandardized” tomorrow through an acquisition.

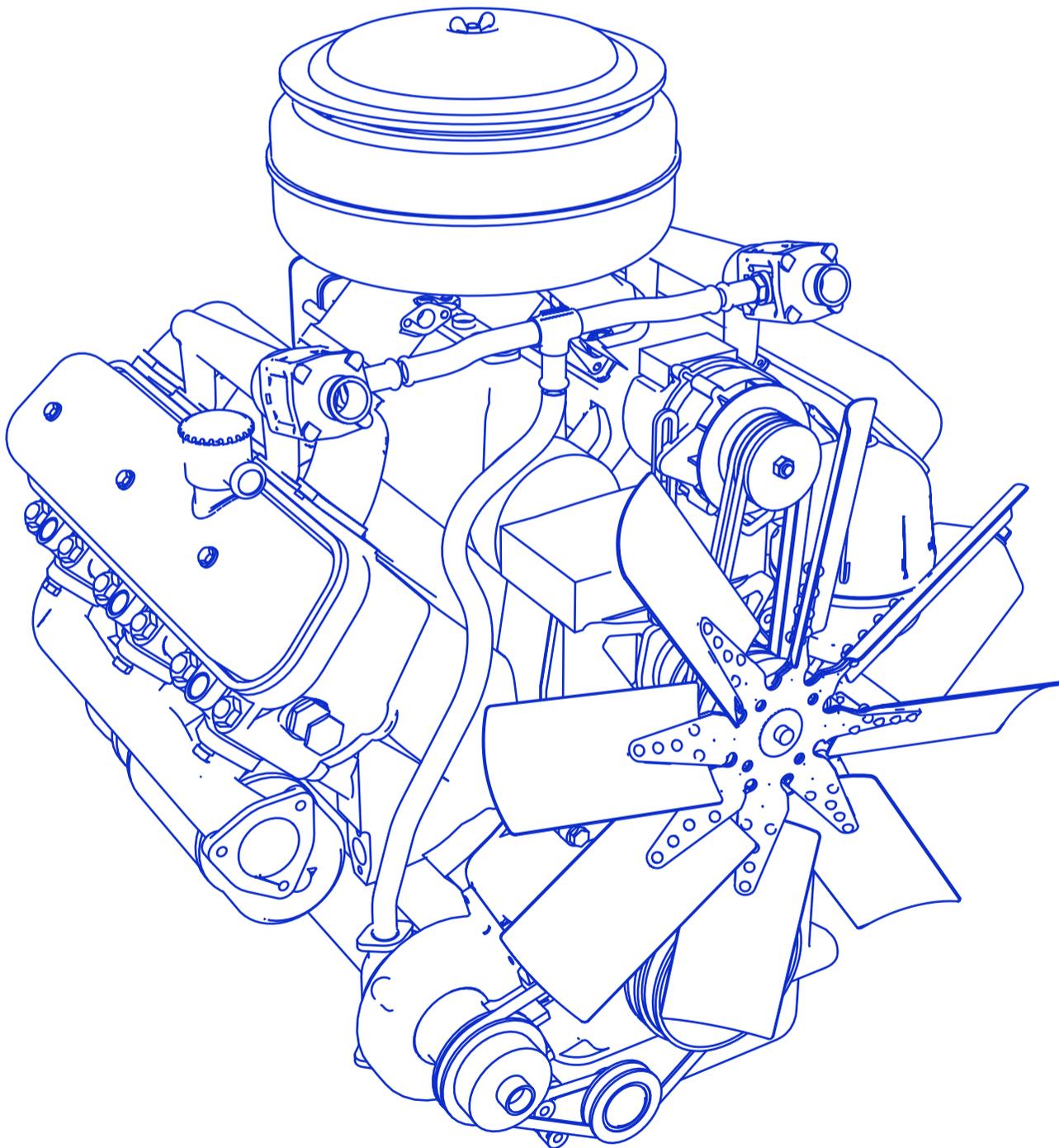
Instead, a company can develop modern user interfaces on the low-code platform and integrate MES layers through low-code connector suites. Existing customization is situated in the MES layer. The company is now in a better position to upgrade or migrate existing systems’ standard capabilities without incurring new costs for re-customization.

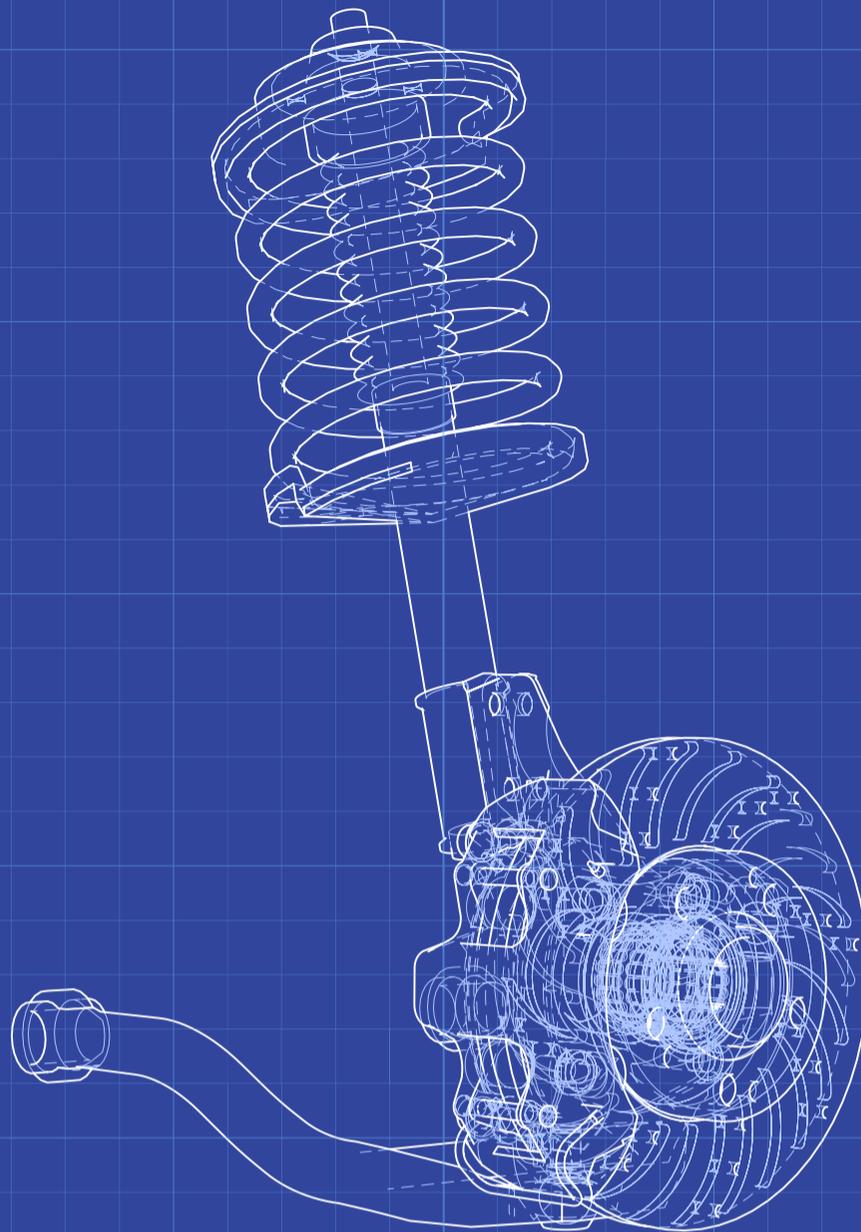
Another example: Within the walls of your existing brownfield factory, a low-code platform enables you to harness the tribal knowledge found among those employees who interact with production systems and processes every day. The person or team responsible for kitting at a particular plant naturally develops ideas on ways to make this process more efficient or to lower the kitting error rate. Without the composable enterprise, such ideas could travel a labyrinth to reach implementation—and often become irretrievably lost on the way. The person with the idea must build a business case (a task not typically in that person’s developed skill set), write requirements, and pass these along to the manager. The manager transfers the requirements to IT, which looks (or enlists



someone to look) for a system integrator. The integrator works with a project manager, perhaps also with R&D or even an offshore development center. By now, six months have passed, and the requirements have been translated multiple times. It is no wonder that actual improvements in productivity are rarely realized from such a convoluted process.

Realization through the composable enterprise, on the other hand, occurs much more frequently and much more quickly. The originator of the idea and his or her manager assemble the application on the low-code platform, collaborating along the way with IT, R&D, and others on the manufacturing floor. Experimentation, iteration, implementation, and refinement all are spearheaded by the domain experts, who keep the project on course to fulfill the requirements in a timely fashion. Additionally, clear visibility and transparency ensure IT's governance over what gets to production and what is scaled across facilities for reuse.





## Conclusion

**Each automotive department or domain within each facility or factory of each automotive manufacturer faces unique challenges** that require different entry points to digitalization. Ideally, your company's digital transformation enables each individual and team to leverage their tribal knowledge, existing assets, and innovative technologies and approaches to maximize their contribution to your business success. Instead of giving them something they need to learn to work with before they can even get started, the composable enterprise allows them to directly enter their processes and journey toward new business solutions.

The end result? In today's climate of disruptive technologies, increasingly more complex supply chains, growing regulatory demands, and escalating customer expectations, the composable enterprise empowers every member of your team to contribute their personal ingenuity toward the new efficiencies and greater productivity that your business requires. Digital transformation is itself transformed from a plan to an executed reality. Agility, flexibility, and accelerated responsiveness will define your company and your prosperity through any automotive metamorphosis.



## End Notes

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5. 2020 Gartner Digital Friction Survey; 2021 Gartner Reimagining Technology Work Survey