



DIGITAL INDUSTRIES SOFTWARE

# Meeting ambitious production goals

Rapidly personalizing a manufacturing execution system to accelerate adoption, collaboration and efficiency

## Executive summary

In the race toward better, faster, cheaper manufacturing, a new paradigm has emerged. Rather than having the production team adapt to new technologies, manufacturing companies today are seeking powerful technologies that adapt to the needs of their team. A manufacturing execution system (MES) that offers rich functionality and a flexible user experience promises to bring an entirely new level of agility and productivity to your shop floor

## Introduction

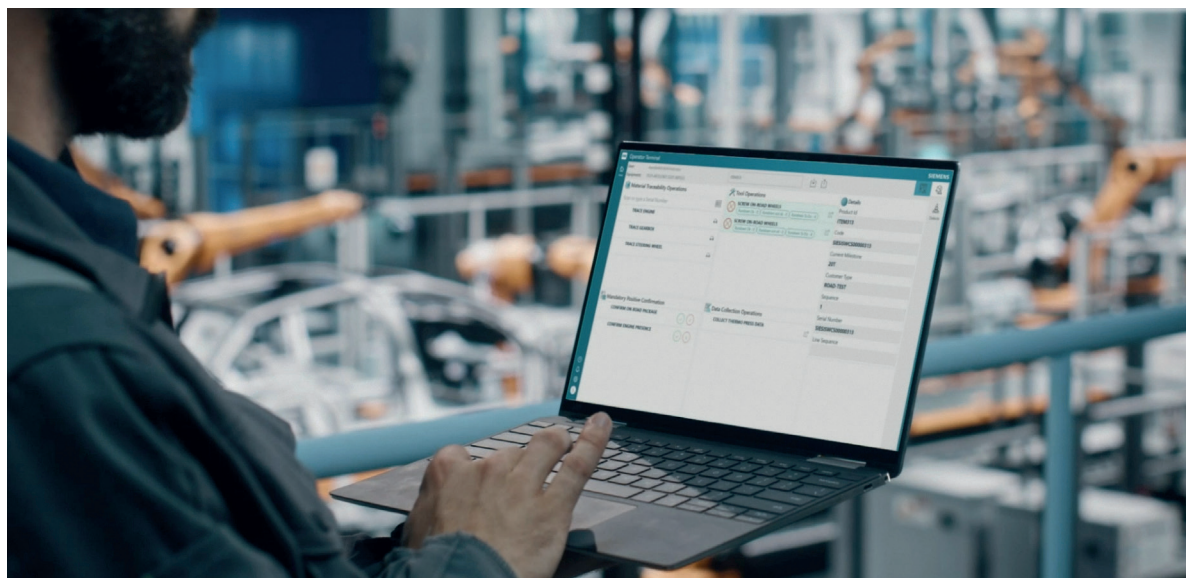
The enabling technology for this transformational system is a low-code, multi-experience development platform that augments the core MES. Low-code development lets team members personalize their user experiences (and, in many cases, make new connections to data they need) without waiting on highly skilled front-end developers to perform complex software development activities. With this intuitive approach, you will leverage the ingenuity and collective know-how of your entire workforce, empowering them to take ownership and drive innovation in each of their areas of responsibility. At the same time, your core, mission-critical enterprise manufacturing system will remain intact, lowering the cost and complexity of maintenance and upgrades.

### **Are you maximizing the value of your MES?**

If your manufacturing operations are going to help your company maintain or gain more of a competitive edge, your shop floor must quickly and efficiently accommodate each new product introduction (NPI), each new variant of an existing product and each new process or procedure. This goal is not new, but accomplishing it in the midst of today's unprecedented pace of change is a formidable challenge.

As an example, consider the plant of a mid-size automotive manufacturer, which may have up to 200 operator terminals. The advanced power and functionality of a state-of-the-art MES will provide this company with visibility into and control over product quality and production efficiencies across its manufacturing enterprise. At the same time, it will provide the operators with all guided tasks, visual instructions, behind-the-scenes track-and-trace activities, error-proofing and more. The functionality of such an MES has been tailored to the specific needs of an automotive manufacturer, giving the company capabilities that best fit their needs at the time of implementation.

That's the good news. But as managers at the company look out across the plant floor, they see 200 workstations and operator terminals providing 200 user experiences (UXs) – some of which are standard out-of-the-box (OOTB) implementations of the MES product and some of which are tailored to certain processes and tasks that happen at particular stations. The tailored ones typically have required a moderate to high degree of implementation effort involving information technology (IT) and software specialists. Now imagine changing products or procedures or introducing new machines or



equipment. Suddenly a large portion of the 200 operator terminals require a UX update for the enhanced operations. Such updates achieve improved productivity by providing intuitive human interactions with the new process or machine.

For an MES solution to be as beneficial as possible to this automotive manufacturer, the challenge is to keep each UX personalized so the set of tasks at each workstation can be performed effectively and efficiently, even as the task set evolves. Indeed, for any manufacturing company that makes complex discrete products or produces goods with process manufacturing – consumer packaged goods (CPG), food and beverage (F&B) and chemicals – the MES solution must be able to reflect the specificity of the supported production system. Complex discrete and process manufacturers must meet exacting requirements for flexibility to adapt to evolving demands that necessitate changes to processes and visibility into updated information, as well as visibility, traceability and accountability into the changes themselves. Achieving this flexibility means personalizing the MES solution to particular and evolving details of each company's production processes and machine systems.

Because processes, machines and products are changing so fast, there is an ongoing need for personalization and extending dependent processes. This cannot be sustainably achieved by customizing the core MES. Each personalized application is designed to meet a unique, unrepeated set of requirements to produce a particular user experience at a particular operator terminal – possibly for a limited amount of time until the next manufacturing change occurs.

### **Two painful options**

Until recently, the mid-size automotive company and others like it have been limited to two problematic options as they sought to maximize the contribution of their MES to operational excellence on their shop floors. The first was to enlist the expert services of front-end software developers, possibly

on staff but more likely from the software vendor or a certified third-party integrator. Siemens Digital Industries Software has heard growing frustration from many of our customers regarding this option. First because it fails to give the manufacturing company visibility into the total cost of ownership of their MES. When each adaptation requires outside software coding, it is exceedingly difficult for a company to produce a realistic estimate of annual expenses associated with such personalization, much less build a business case to determine if the expense is justified by productivity or quality gains. Of course, conventional coding by expert software developers is costly in terms of financial expense, but it is also becoming more costly in terms of development time. Putting off implementation poses a considerable impediment when companies seek to leverage the tribal knowledge of employees who interact with production systems and processes every day.

To use an illustration from a process industry, imagine that a frontline team member at a filling, labeling and packaging operation recognizes that a UX change at a labeling terminal would eliminate toggling between multiple screens, which would make the process more efficient and lower the labeling error rate. To change the UX using conventional front-end coding, this idea must travel a labyrinth to reach implementation – and may fail to do so. The person with the idea may have to build a business case – a task not typically in that person's skill set – such as 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 research and development (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 tribal ingenuity rarely leads to improvements in productivity.



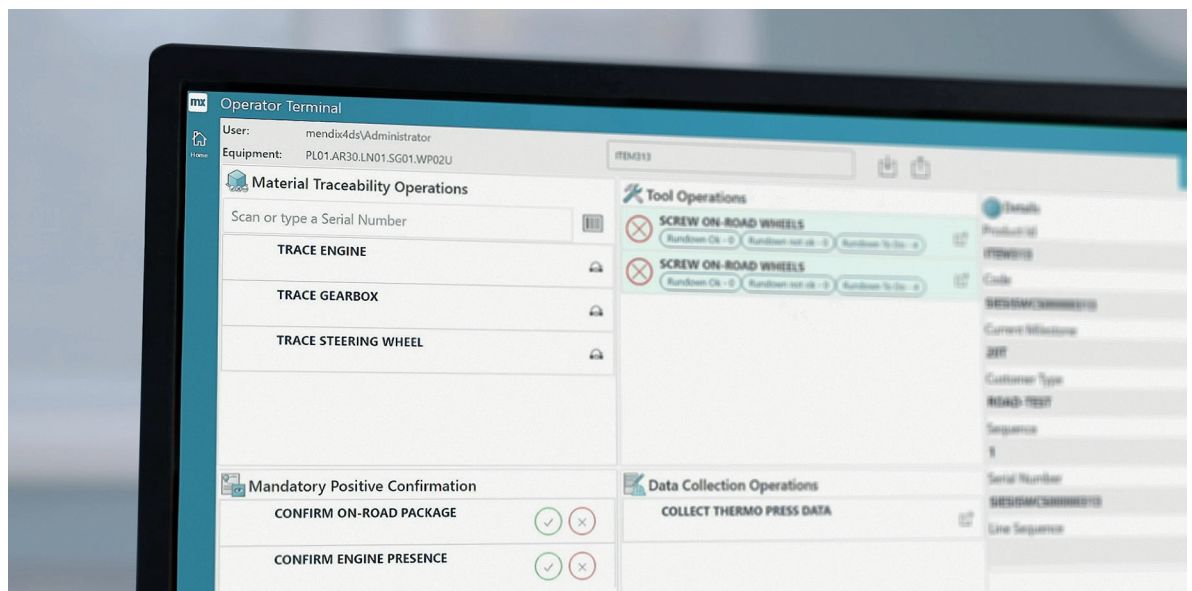
Even if a more streamlined implementation process is developed, it may have little effect on development time because of yet another factor – a global shortage of software developers combined with considerable growth in demand for personalization. An approved UX change will often sit in the queue of a developer's job list too long to benefit the company. In the meantime, more product or process modifications may ultimately render the change order obsolete.

The second problematic option, which may be deliberately chosen or may be the de facto circumstance because of software development delays, is to have the production team adapt to the standard UX. This option requires companies to allocate a substantial budget to change management. Returning to the mid-size automotive company, upfront costs of this option are incurred both in initially training 200 operators per shift on the new UX and in inefficiency losses as these workers become accustomed to the change. Further, each product or process change the manufacturer makes may entail more toggling between screens or other adaptations required of your team – and more training and inefficiencies.

### A third option emerges

With the advent of low-code, multi-experience development platforms, a third option has been pioneered – one that alleviates the pain accompanying the other approaches while also enabling manufacturers to maximize the quality and productivity benefits of a modern, powerful and flexible MES. A functionally rich MES, tailored to your industry and also embedded with low-code capabilities, empowers your entire team with an adaptive solution that achieves entirely new levels of agility and flexibility.

This adaptable MES combines Opcenter™ Execution Discrete software and Opcenter Execution Process software with the Mendix™ low-code platform. All three products are part of the Siemens Xcelerator portfolio, the comprehensive and integrated portfolio of software, hardware and services. Siemens collaborated with numerous MES customers from a variety of process and complex discrete industries to develop this solution. These customers conveyed their growing need to accelerate customization of user experiences and workflows while maintaining the core mission-critical MES.



An Opcenter Execution Discrete or Opcenter Execution Process system embedded with low-code Mendix technology uniquely places ownership of UX personalization in your hands, empowering you to follow new business leads and requirements in a simple and timely way. It enables your team members to personalize the solution to their specific requirements, while also deriving maximum value from the core MES. This capability has the added potential to expand to the rest of your organization's process value chain for increased connectivity with disparate systems and enriched, connected digital experiences.

This white paper describes and then applies the novel capabilities of our adaptable MES to illustrate issues on manufacturing floors and also to extended connections across dependent processes and systems. Our goal is to prompt innovative thinking about your specific operations. Your manufacturing initiatives, powered by and implemented on our low code-embedded adaptable MES platform, promise to spark new business vitality both today and into the future.

## Low-code MES personalization empowers your production team

A modern MES, with its powerful functionality tailored to your industry, already drives your business a long way toward operational excellence. The next wave of MES benefits arises from the system's wealth of capabilities and flexibility that can be tapped through personalization, making your user experiences custom-fitted to your distinct operations and personnel. Achieving these gains quickly and cost-effectively requires the right digital tools.

Without calling on IT specialists to code each personalized UX or requiring the end user to adapt to the OOTB user experience, low-code personalization for Opcenter Execution Discrete or Opcenter Execution Process enables your team members who have less software development skills and know-how to personalize the solution in-house to their individual requirements. Key to this new approach is a shift from OOTB user experiences to OOTB UX templates. The UX templates provide solutions to end-to-end use cases and can be used as they are out-of-the-box. Many such templates are offered as OOTB features of the core MES system, and they can also evolve into a company-built library of best practices and institutional learnings.

For a personalized UX, each template presents a prepackaged baseline application that serves as a starting point. The template can be customized to address a user's needs with a few simple visual steps using low-code assembly tools:

- Snippets and widgets are tools that simplify and speed up screen creation starting from a set of reusable building blocks. These are graphical components and modular pieces of the UX created in Opcenter Execution
- App services provide domain-specific sets of capabilities. For example, a 3D viewer app enables the user to view computer-aided design (CAD) drawings much like one would within the CAD program – rotating, zooming in, etc.
- Connectors enable users to extend a workflow or experience beyond a normal MES scope

With low-code personalization for Opcenter Execution, low-code capabilities are embedded within the MES development tool set, enriching the development experience. As a user employs these tools, Mendix performs the data extraction and workflow generation processes for the UX behind

the scenes, thus eliminating the need for high-level coding. Meantime, the MES continues to host and power data model definitions and business logics implementation.

Depending on the availability and skill sets of team members, a manufacturer may assign certain personalization tasks to the IT department, which is now able to make changes much more quickly and without the assistance of the software vendor. This is good news given today's changing IT landscape. Gartner reports that business technologists – employees who report outside of IT departments and create technology or analytics capabilities for work – now make up 41 percent of digital technologists. Another 49 percent are technology end users, leaving only 10 percent inside the IT department.

Business technologists within a manufacturing team are tech savvy, but they typically are not high-end software developers. A low-code platform makes it possible to give these employees the responsibility to build UXs for their production areas. In some cases, the person using the operator terminal possesses the requisite skills to personalize the UX with a low-code platform.

Screens are personalized by pulling the desired information or snippets into the UX template with simple drag-and-drop actions. App services are then employed to bring in specific functionality. The resulting UX supports each individual's run-time interaction with all relevant information, which remains up to date because the UX interacts directly with the MES backend thanks to standard OData protocol and REST APIs.

## MES personalization delivers new quality and productivity gains

Adaptable MES enables manufacturers to accelerate the development of user- and process-specific applications. These personalized user experiences enable operators to access MES capabilities more readily and leverage them to generate new efficiencies across your manufacturing floor. Moreover, because personalization occurs in the low-code layer of the platform, you will leave the core MES system intact, which lowers the cost and complexity of maintenance and upgrades.

With personalized UXs built in-house with great efficiency, the total cost of ownership of your MES will not only be reduced but it will also be visible and controllable. You will decrease IT demand and expenses. Application development will occur much faster – as fast as drag-and-drop operations compare to writing code. Your business technologists and floor operators will be able to put their creative, cost-saving ideas to work quickly. Product and process changes will take less time and money

to implement. Additionally, because you control the personalization layer of the MES, you also control the timing and pace of personalization. You decide how and when you will innovate to meet specific needs on the manufacturing floor.

As the use cases below clearly illustrate, an adaptable MES with an embedded low-code platform addresses three specific demands of present and future operational excellence:

**Adapting to change:** The unprecedented pace of change in manufacturing operations is fueled by supply chain disruptions, new enabling technologies, more sustainable materials, new product introductions, mergers and acquisitions and more – and none of these factors shows any signs of slowing. As your production operations change at an accelerated pace, an adaptable MES is able to keep up.

**Accelerating workflows:** An adaptable MES not only provides a wealth of information to manufacturing personnel, but it also enables each team member to choose the elements of that information most critical to their job performance. By constructing their personalized screens to make this data easily and quickly comprehensible, your manufacturing team can make better, faster decisions that increase the efficiency of your production operations.

**Leveraging tribal knowledge:** Adaptable MES enables you to harness the tribal knowledge found among those employees who work closest to your production processes and machinery. The originator of an idea and his or her manager can tap a company-created set of templates and best-practice UXs as a starting point, then assemble the application directly in the UX. Experimentation, iteration, implementation and refinement all are spearheaded not by IT specialists, but by domain experts who are motivated to complete each project quickly to make their own jobs easier.

#### **Multiplying the benefits of personalization across your shop floor**

By moving UX development closer to your MES end users, you will unlock new opportunities to benefit from the creative innovation of your frontline manufacturing team. Here are some ways in which adaptable MES owners can leverage their own unique knowledge about real needs on their production floors.

#### **Use case 1: Different responsibilities over different operations within one plant**

Data that is vitally important to the activities at one workstation on your manufacturing floor may be only tangentially relevant to another. Additionally, whenever process or product changes occur, the MES user experience of some – but not all – floor personnel may require a new adaptation.

A low-code UX builder lets users populate and update their dashboards and screens with only the information most pertinent to them. Consider, for example, a chocolate maker that decides to enlist a new supplier of roasted cocoa beans. The company wants to add a new quality check for the first several weeks of production with the new supplier's beans. This check must be visible early in the overall production process to the winnowing machine operator and perhaps further downstream to milling or pressing operations. By the time a chocolate batch reaches later stages like conching operations, however, data from the quality check is needed only as part of the product's traceability records; it does not need to be visible on the operator terminals at this point in the production process.

The low-code platform enables rapid UX building, empowering the chocolate maker to design or modify a UX for the winnowing operator terminal, adding a snippet about the special inspection procedure. After the trial period with the new supplier, this user experience could revert to its normal mode.

#### **Use case 2: Change management when replacing a legacy system**

Your manufacturing floor, materials, processes and finished products are in a state of nearly constant change, and with each change you must manage any transitions your team must make. The more smoothly such transitions take place, the more quickly you achieve the productivity and performance gains for which the change is being made.

Perhaps the most challenging of such changes is replacing a legacy system. As you upgrade from a homegrown or less capable MES to the full, rich functionality of today's offerings, your staff might lose the familiarity they had with the former system – but they don't have to. A low-code UX builder enables your IT department and business technologists to mimic proven and familiar user experiences to perform their respective tasks. This transitional UX means that you will not have to undertake a massive training program or incur loss of operator efficiency. From the user perspective, introduction of the new system is seamless.

### Use case 3: Workforce upscaling and upskilling

How do you manage the implementation of a new digitalization project when that project demands a more skilled workforce than you currently have? Many of our customers have found that manufacturing operators are still skeptical about new technologies – often because the advantages of the technology are not apparent upfront. By mimicking the proven UX of the legacy technology being replaced, as noted above, you accelerate technology adoption by giving your employees a familiar user experience that they already work with efficiently.

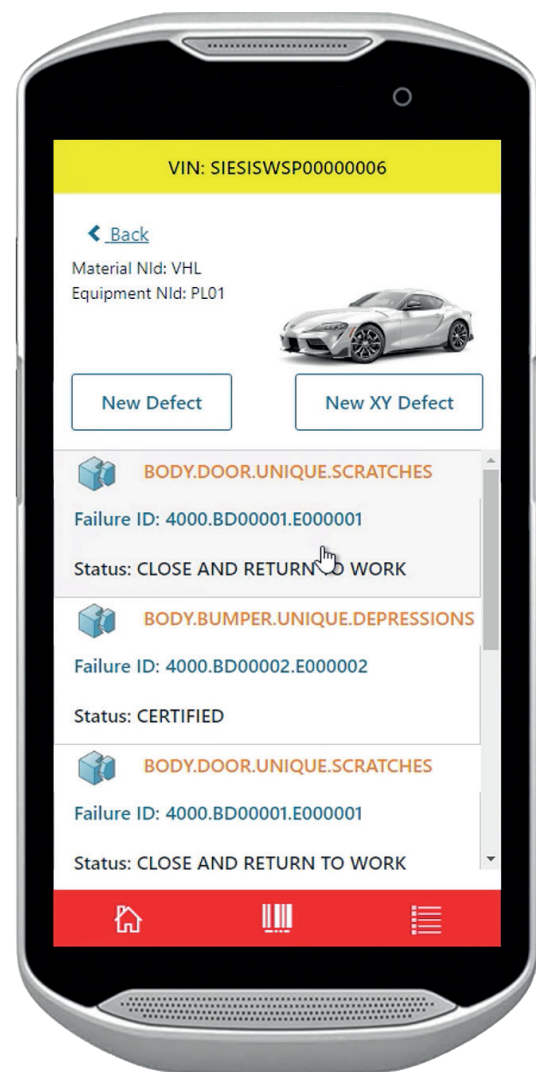
This is a good transitional strategy, yet it initially may mask some of the new functionality that will increase your operators' accuracy and efficiency. With the rapid application development afforded by low-code technology, a manufacturer may implement incremental UX changes to gradually introduce users to the greater functionality of the new system.

This capability complements an overall digitalization strategy of implementing new technologies with a step-by-step approach. As a manufacturer transitions to each new digital system, processes can be changed incrementally and at a sustainable cost by leveraging the adaptability provided by a low-code platform supporting the new core enterprise system.

### Use case 4: Mobile UXs for production operations

An easy integration of smart devices in production could increase efficiency significantly and provide more flexibility to your employees. A low-code UX builder enables your production supervisor, for example, to create screens for smart mobile devices – handheld tablets, phone-size devices or smart watches. The production supervisor needs real-time information on lines, machines, stoppages, supply quality, personnel, shift key performance indicator (KPI) issues and more. If the supervisor is sitting in a control center, he or she can see the production overview and receive notification of any unplanned need, but the machines themselves might be far away. However, if the supervisor is on the floor, the big picture the control center UX provides is not visible.

To support the creation of a mobile UX interface, low-code personalization for Opcenter Execution Discrete and Opcenter Execution Process provides access to mobile templates, which can be personalized for connected and offline applications. Connected applications enable the production supervisor to receive notifications for unscheduled needs. Offline applications provide the supervisor with information needed to perform operations away from the control center. While in the field, the supervisor can enter data about the operation or import data from affected machines. Offline devices can upload this data when the supervisor returns to the control center.





## | Conclusion

Importantly, the kinds of UX personalization suggested in these use cases support an intuitive approach to digitalization: adapting the UX to make the user's work easier rather than having users accommodate the UX in its existing form. By listening to employees and co-developing solutions with them, we have found manufacturing companies experience much more positive uptake and feedback as production changes are made.

Outpacing the competition has never been as challenging as it is today. A modern MES like Opcenter Execution Discrete and Opcenter Execution Process offers manufacturers a state-of-the-art platform on which to increase manufacturing efficiency and flexibility, and at the same time achieve consistently high quality. By using the Mendix low-code platform to support UX building, a powerful MES becomes even more powerful, enabling your team to personalize their user experience efficiently and without the burden, expense and delay incurred when IT specialists must get involved.

Another important aspect of low-code UX building within your MES is that it represents a great entry point for low-code technology. Manufacturers today are looking across their enterprises for ways that low-code solutions may accelerate digitalization. A low-code UX initiative at your company may serve as a springboard to more widespread use of low-code technology, beginning with the efficiency and quality boosts you will realize by applying low code to MES-dependent processes. All in all, low-code technology represents a watershed opportunity to advance your agility, accelerate your innovation and maximize your productivity so you can realize greater business vitality.

The rich and mature MES functionalities of Opcenter Execution Process and Opcenter Execution Discrete combined with the embedded low-code capabilities of Mendix create an excellent environment to support your entire team's individual information and functionality needs in a way that is rarely seen in today's market.

## Siemens Digital Industries Software

Americas: 1 800 498 5351

EMEA: 00 800 70002222

Asia-Pacific: 001 800 03061910

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