Creating a Digital Thread Using Low-Code to Enable Digital Twins

CIMdata Commentary

Key takeaways:

- *Industrial companies must be able to easily create and evolve flexible, dynamic, composable value chains and the digital threads that run through them.*
- *The digital thread and digital twin are key concepts in use today to improve business performance but have often required complex customization to create and sustain them.*
- *Low-code platforms are being applied to solve many business challenges including the creation and maintenance of digital threads and digital twins across product lifecycles throughout an industrial company's ecosystem.*
- *Siemens' Mendix low-code platform enables creation of personalized, business-unique solutions leveraging digital threads and digital twins by integrating Siemens Xcelerator applications and non-Siemens solutions within the broader enterprise application landscape.*

Introduction

"The Only Constant in Life Is Change."—Heraclitus. This is being experienced every day as changes imposed in personal and business lives continue to increase. On the business front, technology changes and improvements have been relentless over the past few decades. Every company continually struggles to effectively ingest and absorb new capabilities to make sustainable improvements in how their businesses operate. Startups, in particular, begin from a clean sheet, but they often reconfigure their strategy and operations to pivot and/or scale based on what they learn and need.[1]

The pace of business process change, and even business model changes, is always slower than the pace of technology change, but arguably has much more impact on the business. Moving from vertical integration to a supply chain strategy can be a major upheaval, but it's for the better. Products and services have dramatically improved because of broader supply chain participation. Price and innovation competition within supply chains enables better products to come to market faster, cheaper, and with higher quality. But for manufacturers not able to adapt to this mode of operation and pace, it can be a business death sentence.

Companies must adapt their products and processes to keep pace with market changes, all while updating their business and operational environments to maintain efficiency. Technology changes continue to create islands of information that need to be effectively leveraged and correlated for companies to survive and thrive. As technology advances, decision makers need to get access to new and existing data wherever it may be, in a form they can understand, to ensure timely, high-quality decisions.

The Internet of Things (IoT) and Industrial Internet of Things (IIoT) have become mainstream topics in recent years. This technology enables standardized communication flows, while data protocols make it faster, easier, and cheaper to connect to (and interconnect) physical assets, products, and systems. By enabling ubiquitous, often real time, data connections between individual devices or machines, the operator or manufacturer can use the resulting stream of

[1] Research for this commentary was partially supported by Siemens.

operational information to create new workflows and processes. In some cases, the connection can facilitate the creation of new business models such as product-as-a-service, that were formerly only deliverable using expensive, complex, proprietary technology.

The new workflows, processes, and business models enabled by ubiquitous device connections allow companies to create and/or evolve to next-generation business-specific solutions. Solutions enabled through end-to-end digital threads and comprehensive digital twins can be created at their own pace without requiring significant amounts of scarce or costly IT resources. To realize these new solutions, companies are using low-code platforms to create personalized applications and enterprise application extensions.

Low-Code Platforms

What is a low-code platform? It is a modern, faster, easier way to develop composable, personalized, maintainable applications that create value chains.[2] Low-code platforms can be used by non-IT domain experts and citizen developers as well as IT experts to create tailored applications and solutions. Low-code solutions incorporate a graphical environment to browse data and services exposed from enterprise applications and offer drag-and-drop functions or blocks of code to perform specific tasks. Pre-developed low-code applications from a developer marketplace can be easily downloaded and personalized, as required. Easy-to-use scripting tools can be applied to tie functions together into simple or more advanced applications. The low-code approach enables applications to be composed and adapted rather than developed from scratch, making it easier and faster to develop solutions tailored to business problems. Furthermore, low-code solutions are easier to maintain, providing businesses with greater flexibility to address business and operational changes while optimizing productive use of limited IT resources.

Check out the eBook titled “Low-Code Platforms Accelerate Business Value” published in November 2021. It can be accessed from the CIMdata website[3] and from Siemens.[4] It provides more details on the capabilities of low-code platforms and how they can be used.

Digital Twin

CIMdata defines a digital twin as a virtual representation of a physical product or process that includes both a visual and a behavioral representation of the product. Data often consists of models created from a wide variety of applications including requirements management, system architecture, 3D design, simulation, manufacturing, service, supply chain, and in-service operations applications. The physical product can be as simple as a consumer electronics device or as complex as an airplane, factory, or network of factories. To exist, twins require communication between the physical and digital representations of the object or process being modeled. Simulation technology can exercise the digital twin to predict the physical twin’s behavior. Once the digital and physical twins are created and communicating, many new value-adding capabilities can be implemented. In the case of a factory, line settings can be developed on the digital model and then downloaded to the physical machines, thereby shortening time to commissioning and production. Data captured from the physical twin can be replayed within the digital twin to predict problems and to develop solutions that are then tested

[2] “Creating a Flexible, Open, Lifecycle Value Chain.” 1 December 2020. At: https://www.cimdata.com/en/resources/complimentary-reports-research/white-papers

[3] https://www.cimdata.com/en/news/item/17276-cimdata-publishes-ebook-low-code-platforms-accelerate-business-value

[4] https://www.plm.automation.siemens.com/global/en/resource/mendix-low-code-platform-drag-and-drop-agile-development-methodologies/106472

on the digital twin, shortening time-to-value and reducing the risk of harming or delaying the operation of physical assets and products.

A primary use case is to leverage data from the physical device to support predictive maintenance and design improvements.

Creating a digital twin is not an out-of-the- box process, it requires a robust digital thread connecting appropriate data sources across the lifecycle. A digital twin is built using configuration-controlled data from many different sources such as mechanical CAD, electrical and electronic CAD, software development repositories, and simulation models that represent the physical instance. To complete the digital thread, sensor-based operational and environmental data from the physical instance must be captured and connected to the digital instance via links to data delivered via the network or Internet. The digital thread construct can also connect extended data that a digital twin may not need to use in normal operation such as requirements, documentation, and testing data.

Creating the digital thread and digital twin requires many data sources to be connected and the data exposed in a way that is easily consumable. Engineers and technicians want to spend their time solving product and business problems, not hunting for and verifying that they have the correct data. CIMdata believes a low-code approach makes it simpler, faster, and easier for subject matter experts and professional developers to create the tools and solutions needed to solve business problems.

Using Mendix to Create Composable Environments

The Mendix low-code platform from Siemens is more than just a development tool, it is a complete, modern application development and integration platform. It was designed to simplify software development, making it accessible to subject matter experts as well helping professional developers create or compose complex applications. Composable applications are created when developers reuse existing, proven blocks of code, capabilities, and existing applications and combine them to create new solutions to business problems. These applications often integrate data that support business processes from multiple sources or repositories via a digital thread or applications such as a digital twin. As an example, Siemens offers a 3D Viewer[5] app service via the app store, the code is available so companies can adapt it to their requirements. Composing is much faster than coding, enabling companies to quickly create tailored solutions to their problems so they can maintain their competitiveness in today's fast-paced world. The "Mendix, Optimize my plant"[6] app is a great example of a useful solution for plant optimization. It uses BOMs, calendars, and many other resources to validate optimization scenarios. Since the base code is available it can be easily adapted to meet company-specific needs.

The Data Hub, accessible via the graphical development environment, enables the composition of applications. The Data Hub has a large catalog of connectors to a wide variety of enterprise applications such as SAP and Oracle ERP solutions and is built into the Siemens Xcelerator portfolio as an integral part of the Xcelerator cloud architecture. For example, MindSphere, Siemens' industrial IoT as a service solution is also Mendix-enabled. Using out-of-the-box Data Hub connections make the composition of digital threads and digital twin applications much simpler and straightforward, especially when compared with the customization required before composable low-code solutions became available.

[5] https://marketplace.mendix.com/link/component/118345
[6] https://marketplace.mendix.com/link/component/119126

Beyond composing applications, Mendix has deep development capabilities so professional developers can create custom connectors and distribute them via the Mendix marketplace. Our recent eBooks[2,3] describes Mendix capabilities and how they can be used to compose applications. It also includes case studies from Siemens partner Avertra describing how they solved a wide variety of business problems using Mendix.

Conclusion

Business pressures and lack of acceptable ROI on previous IT investments are forcing companies to change the way they create, manage, and most importantly, leverage their IT landscapes. The digital thread and digital twin are concepts that companies are implementing within their environments and across their extended supply chains by connecting existing applications, repositories, and processes.

Low-code solutions that support development and deployment have emerged as an effective way to integrate and improve the ROI of IT investments, and to create and maintain digital threads and digital twins. The Mendix low-code platform with its catalog of out-of-the-box applications, code library, Data Hub, and connections to many business applications, such as SAP and the Siemens Xcelerator portfolio including MindSphere, enables it to provide needed digital thread/digital twin support. In fact, it is currently being used to create business-specific applications to support many industrial companies' digital thread and digital twin initiatives, and in the most advanced companies, business partners are working together to support collaborative co-invention and creation of new business models.

CIMdata believes the Mendix platform from Siemens is a great way to build composable applications, environments, digital threads, and digital twins. If you use the Siemens portfolio, and even if you don't, you should evaluate Mendix to improve business performance and better leverage IT landscape capabilities. Download our eBook[2,3] on Mendix to get a more detailed understanding of how Mendix can help your business.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design, deliver, and support innovative products and services by identifying and implementing appropriate digital initiatives. For nearly forty years, CIMdata has provided industrial organizations and providers of technologies and services with world-class knowledge, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) solutions and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.