Figure 1, lead image

Creating a digital twin with the RF::Suite and PLCnext Technology

Saving time and cost while increasing safety and quality through the use of the digital twin

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Learn more about

- How the digital twin can be used to simulate and analyze an entire production system
- How the interaction between RF::Suite Software and PLCnext Engineer can open a wide range of possible uses for the digital twin
- The many benefits of virtual commissioning, including reduced costs, time savings, and better safety and quality

Introduction

In the wake of the digitalization of production processes, everyone is talking about the digital twin. In the context of the German "Industry 4.0 initiative," it is often equated with the Asset Administration Shell (AAS). However, a digital twin can be more than just an AAS. If the interaction of the individual components, including their behavior, is simulated, the user gets a digital image of a complete automation application (Figure 1, lead image).

The manufacturing sector is changing. Due to the demand for ever shorter commissioning times, greater flexibility, and higher quality, while simultaneously reducing energy consumption and emissions, more and more digital solutions are required for the entire lifecycle of products, production processes, and production resources/systems. Digital twins are used for this purpose.

The Asset Administration Shell is an implementation of the industrial digital twin. It contains all essential properties and capabilities, but also configurations and status information of automation components. The AAS can, therefore, be used as a digital image over its entire lifecycle.

Efficient implementation based on the RF::Suite

Figure 2

The RF::Suite from EKS InTec GmbH is a renowned software tool for realizing virtual commissioning in machine building and systems manufacturing. Due to its modular and scalable approach, the RF::Suite can be used flexibly with different applications and meets the daily requirements of a virtual replica of a physical manufacturing system. The software tool has become an integral part of the production system development process, especially in the automotive industry. With its automated processes and procedures, the RF::Suite allows users to carry out virtual commissioning efficiently (Figure 2).

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The digital twin of the manufacturing process offers additional benefits beyond virtual commissioning when used during system operation. For example, it can be used to train operating and maintenance personnel. Employees gain experience through integrated learning methods in the virtual training system even before they work on the real system for the first time. Although realism is essential, it can now be ensured independently of the production system's control hardware if the actual control logic is used. ■

PLCnext Technology: An open ecosystem for current and future automation tasks

Figure 3

PLCnext Technology from Phoenix Contact is an open ecosystem for current and future automation requirements. The technology can combine automation tasks and IIoT demands in a single device. In addition to the control hardware, the ecosystem includes the modular software platform PLCnext Engineer, the digital marketplace PLCnext Store, the informative PLCnext Community, and the option for systemic cloud integration (Figure 3).

The innovative firmware architecture is based on a Linux platform. The user can work in IEC 61131-3 code and numerous high-level languages – such as C, C++, and C# – and control algorithm models from Matlab Simulink to run in the real-time context of a deterministically operating PLC. A control program can consist of just one or any combination of the programming languages listed. Users can work in their preferred environment, which significantly accelerates coding.

In addition, users can add their own Linux-based components, such as data management or additional communication protocols, to the open PLCnext platform. These functional extensions can also be implemented in different programming languages – such as Python or Java – and with different technologies, from open source-based programs to the execution of container images (Figure 4). ■

Virtual SiL simulation of the complete system to be automated

There are various options for implementing the control system as part of virtual commissioning. In the past, a hardware-in-the-loop (HiL) concept was commonly used. HiL featured a real hardware control system. In this concept, the physical controller that runs the user program to be simulated and tested is connected to a virtual automation system. The aim is to correct unwanted behavior, identify potential for optimization, and ensure that the production system functions properly. For both systems to interact well with each other, they must be connected seamlessly without further programming effort. The RF::Suite can read all the necessary information from the PLCnext Engineer project to generate the appropriate simulation of the planned physical system.

In addition to the simulation of the connected automation system, a simulation of the user project that will be executed later on the control hardware is also helpful. The initial test scenarios and code improvements can be carried out while the program code is still being developed without any control hardware being available. With PLCnext Engineer Simulation, users can configure, execute, and test their projects on the engineering PC in a virtual

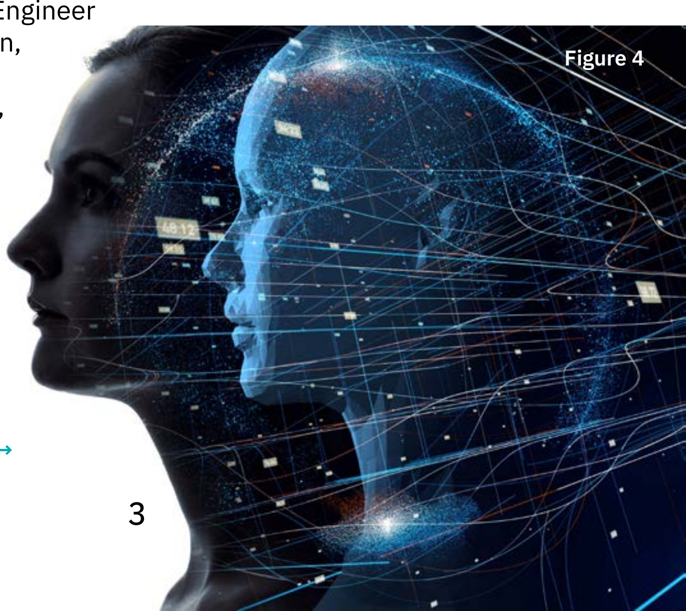

Figure 4

continued →

environment. The IEC 61131-3 code can be simulated with Matlab Simulink models and high-level language components created with other development environments. Additional functions include full web visualization, web-based management, and the setup and use of an OPC UA server connection.

To implement a simulation that is completely detached from the installed hardware components of the manufacturing system, a control simulation with a connection to the virtual automation system is required. The further development of PLCnext Engineer Simulation will make it possible to run the simulated user program via the configured I/O communication with the simulation of the physical system. Simulating the entire automation system virtually will produce a software-in-the-loop (SiL) realization. This creates a digital twin not only for individual components, but for the entire system to be automated (Figure 5). ■

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Many advantages of virtual commissioning

Virtual commissioning is a concept in which a virtual environment is used to test a production system before the actual manufacturing process starts. This approach offers numerous advantages, such as:

- **Reduced costs – Testing and optimizing a virtual model is more economical than a real model.**
- **Time savings – Virtual commissioning can be carried out faster than real commissioning.**
- **Increased safety – Processes and systems can be safely checked as part of virtual commissioning without putting workers at risk.**
- **Improved quality – Virtual commissioning can help to detect and rectify errors at an early stage, which increases the quality of the end product.**
- **Better training – Using the virtual model is an efficient way to train the production system's operating personnel.**

Figure 5

Conclusion

Virtual commissioning during the development process will save time and money, but it has many other benefits. For example, it can generate a digital image that can be used for many scenarios over the entire lifecycle – from error analysis through continuous optimization and enhancements to employee training. The improved interaction between PLCnext Engineer and the RF::Suite results in a wide range of possible uses for this digital twin in an automation application.

Learn more:

www.phoenixcontact.com/us-plcnext-technology

https://www.plcnext-community.net/

https://www.eks-intec.com/vibn_en.html

About Phoenix Contact

Since 1923, Phoenix Contact has created products to connect, distribute, and control power and data flows. Our products are found in many industrial markets, including energy, infrastructure, process, factory automation, and e-mobility. Together with our customers, we are empowering a smart and sustainable world for future generations.

For more information about Phoenix Contact or its products, visit **www.phoenixcontact.com**, call technical service at **800-322-3225**, or email **us-info@phoenixcontact.com**.