MODELS AND SIMULATION SUPPORT DIGITAL TWINS AND INDUSTRIAL IOT

By Rick Nelson, Interim Chief Editor

The concepts of digital transformation and the Industrial IoT are driving major changes in industry. Yet engineers' understanding of concepts such as digital twins is still evolving, according to Philipp Wallner, industry manager for industrial automation and machinery at MathWorks. In an interview with *EE-Evaluation Engineering*, he discussed the Industrial IoT and cited as examples case studies involving BuildingIQ, a company that helps building owners and operators reduce their energy use, and Transpower, which transports New Zealand's bulk electricity from where it is generated to cities, towns, and some major industrial users.

EE: **What is the state of the Industrial IoT today?**

Philipp Wallner: The Industrial IoT comes up in more and more of our conversations with customers. However, what we also still see is that only a few companies have already adopted or implemented Industrial IoT and have digital-twin solutions in operation. When it comes to fully implemented projects, I would say we're still in the beginning.

EE: **At a high level, what constitutes an Industrial IoT implementation?**

PW: One thing that we see in a typical Industrial IoT topology is a structure similar to the one that you see in **Figure 1.** It includes smart assets connected to other assets, edge systems, and to the IT and OT enterprise systems.

Figure 1. Common Industrial IoT topology: MATLAB programs or Simulink models can be deployed on the edge, asset, or cloud.
Courtesy of MathWorks

EE: **Could you elaborate on digital twins?**

PW: Typically, digital twins are implemented on the edge system or on the OT system or on both. One trend that we observe in conversations with our customers is that edge systems really play a more significant role—mainly for two reasons. One reason is security. The edge system is close to the assets. Data doesn't have to leave the facilities. The second reason is response time—you get far faster reaction times with edge systems. Also, bandwidth limitations are lower if you don't have to transfer big amounts of raw sensor data outside of the facilities.

EE: **You suggest a reluctance to let data leave a facility because of security concerns. But isn't the cloud a big part of the Industrial IoT even though data has to leave a facility to get to the cloud?**

PW: Yes, another trend in general is that even though it requires sending data outside of the facilities, cloud solutions have become more of a commodity. So, once data is preprocessed, we see more and more customers using cloud solutions, whereas two or three years ago sending out data through a cloud system would have been a no-go for most of our customers.

EE: **What are other challenges in successful Industrial IoT implementations?**

PW: Another challenge that we see is that no one organization can provide all the methods and tools that are required to make effective use of Industrial IoT systems, and therefore, it is really important to have an ecosystem in place that covers different aspects, like handling or implementing real-time algorithms, making time-sensitive decisions, handling big amounts of data, and so on. We believe that this is one aspect that MathWorks handles quite well. We do have a strong focus to ensure that we don't have a closed system. We think that a good IoT solution has to come from different vendors. Therefore, one of the challenges is really getting the different vendors and solutions working together. And that will become even more important in the next few years when bigger and more open Industrial IoT implementations find a way into operation.

EE: **What about regulatory issues?**

PW: I haven't noticed major regulations for the Industrial IoT yet. It might still be too early—this whole area is still developing. However, we do see requirements relating to the sending of sensitive data out of your closed environment. This issue could require a stronger focus on the security aspect. We see that come up more often in our conversations with customers. For instance, when it comes to industrial protocols like OPC UA, support for security methods is definitely a key topic.

EE: **Apart from security, what are other issues related to data?**

PW: It's obvious that the Industrial IoT only really provides its full value if you have enough data and the right data in place. Here, we also see that many companies don't have a clear picture yet on which data they need for the respective uses or applications they have.

Let's talk about applications with some examples where these applications could be used—for instance, predictive maintenance, operations optimization, or performance management. Here, one requirement of course is again to find out, "Do I have the right data in place, do I need some additional sensors elsewhere in my facilities or on my equipment, is the resolution of my data in the right shape?" These are all additional requirements that we see becoming more and more important with Industrial IoT solutions.

EE: **What is the role of simulation software in the Industrial IoT?**

PW: We see a couple of areas where MATLAB and Simulink can be used in Industrial IoT systems. One very good example is predictive maintenance. Here, it's really about data being collected at the outset. Typically, an edge system collects all the data from assets in the same neighborhood and then runs algorithms that pre-process this data—for instance, eliminating outliers or filtering the data and then sending this preprocessed data to an OT system in the cloud or on-premises where machine-learning or deep-learning algorithms predict remaining useful lifetime. That's a common-use case that we see, and these algorithms are typically implemented in tools like MATLAB and then tested in simulation.

We also see that methods based on machine learning or deep learning require a lot of data—especially failure data. Very often, this failure data is not available, because obviously your asset doesn't fail that often. Here, simulation models can play another significant role. You can use the simulation models to generate failure data for training your algorithms.

EE: **What about the operations optimization example?**

PW: In the BuildingIQ case study posted on our website,[1] simulation models are actually used for optimizing the overall behavior of the system. What they do is they have these intelligent edge-like systems that take into account factors like what's the date or the time, when do people typically come to work, what's the weather outside now, what's the weather forecast, what's the price of energy, et cetera.

Based on the simulation model that runs in the Industrial IoT, they continuously update the center point in the system and optimize the behavior.

In another case study, Transpower uses big Simulink models that they run on their OT systems.[2] They collect data from the assets and they feed this measured data optimizing the grid load to make sure that the grid can still operate. Every 30 minutes they feed data from the grid and then run hundreds of different scenarios in the respective Simulink models that are deployed on the OT system. The results will either show that everything is okay and that the grid will be stable for another 30 minutes, or human operators will get feedback that something won't work, and then the human operators will intervene. That's how it works today, but obviously one future step for systems like these will be to take the human out of this loop, in general, and then have the system adopt the different parameters of the grid automatically.

EE: **How can people get started with the Industrial IoT? What would the first basic step that they can take?**

PW: That's a really good question, because for all the potential that Industrial IoT and digital-twin technologies offer, people very easily get lost. So, they could get scared off. Or it could be that people don't get scared off, but they jump into different projects and don't really think them through upfront and then don't get a solution that pays off.

What we offer at MathWorks is a consulting crew that has good experience from a number of customer projects. We ramp up customers with getting their first Industrial IoT, digital-twin application up and running. Of course, we also discuss with them whether they have a good use case or not. And, of course, we help make sure that customers have data available. If you don't have any data or any essential equipment in your facilities, then it's difficult to get any benefit from the Industrial IoT and digital twins. It sounds very clear if you say it like that, but interestingly, most of the cases where the people struggle with getting started in adopting this technology, the biggest issue is that they don't have enough data or they have the wrong data available. Again, this is also something where our consulting team can give them some guidance and some ideas to help improve that.

Maybe the key takeaway for what role MathWorks plays here is that we do have building blocks for developing a customer's IoT application. We don't believe that anyone could come up with a closed Industrial IoT solution or digital-twin solution. What is important is that we have these building blocks and we do work with other solutions and vendors to complement our building blocks to get a good Industrial IoT application for our customers in place. We're more than happy to get into conversations with people and support them as well. EE

REFERENCES

1. "BuildingIQ Develops Proactive Algorithms for HVAC Energy Optimization in Large-Scale Buildings," User Stories, MathWorks.
2. "Transpower Ensures Reliability of New Zealand National Grid with Reserve Management Tool," User Stories, MathWorks.