PTC revolutionized digital 3-D design, and was first to market with internet-based product life cycle management. The company has developed a leading Internet of Things (IoT) and augmented reality platform that delivers field-proven solutions to combine the physical and digital worlds. Chief technology officer Andrew Timm is an evangelist for the IoT, the digital twin and the overall digital–physical product convergence currently underway. Part of his role is leading the implementation of PTC’s technical vision for IoT throughout the organization, and inspiring other companies to leverage the value of the technology for business success. Rob Harwood, industry director at ANSYS, talked with Timm about the evolution of these technologies, the potential value they can create and how organizations can adopt them.

Rob Harwood (RH): Can you give me your perspective on the multiple terms and phrases being used to describe the connections now being made between devices?

Andrew Timm (AT): It really is a flurry of buzz words, but the fact is that people have been connecting devices for decades. The Internet of Things is just the new catchall phrase for that. Depending on where you are in the world, you hear different terms. For example, in some regions, other names are more common, such as Industry 4.0 in Germany. The concepts are broadly similar but there are nuances. My own definition is this: As ubiquitous network connectivity and cheaper, smaller sensors are available, you can use that additional wave of data to do new and exciting things across a broad range of industry sectors. Examples of this are driving operational efficiency in a factory, predicting what machinery will fail and figuring out how to track shoppers in retail, so you can enhance their shopping experience.

RH: This connectivity of the physical and digital product is giving rise to the concept of a digital twin. Can you explain what the digital twin means to PTC?
AT: That definition is evolving in the industry, but at a high level, it is creating a digital representation of a physical object. For example, if a pump has sensors on it that provide you with vibration data, flow rates and other information, that is only part of the definition. The digital twin also pulls information about the CAD design behind that pump and other enterprise systems that contain data related to the pump, like your product life cycle management system. That will tell you when was the last time something broke, and whether there is an open change request, or if a part is obsolete. There may also be service data that includes the last time a part was serviced, or what part should be used for replacement or the next scheduled maintenance date. Basically, it is about creating a digital model of a real-world asset that combines the real-world performance data with the entire suite of digital information the organization has about that specific asset. A digital twin pulls all that information together into a single digital record that represents the physical operation.

RH: Can you describe an example of how the IoT and the digital twin are making a real difference?

AT: Service is a massive area where the Internet of Things and the digital twin are providing immediate benefit. For instance, in an oil refinery with thousands of pumps, when a critical pump goes down, that oil refinery stops. This could cost the company millions in just one day. By creating a digital twin to represent each of those assets in the digital world and monitor their performance, you can predict the equipment failure. In the past, this might have shown up as an alert, and the only option would be to shut things down and fix it. Using the digital twin, you might know about the failure five days in advance so you can react in a smarter manner. Maybe you can fix it during a scheduled maintenance in three days and avoid any unscheduled downtime.

Another example is in a factory where an alert goes off. A senior technician in a remote control center might be able to use digital information to feed a simulation of the equipment problem to determine the best possible remediation scenario. He/she could then provide that information to a junior technician on-site to enact the repair.

RH: Bringing all this sensor and digital data together into a whole that a user can interact with requires a software IoT environment or platform. Can you explain how PTC is addressing this?

AT: PTC has created a platform called ThingWorx®. It is a complete IoT platform and contains a number of layers for industrial connectivity. If you have a programmable logic controller (PLC) in your factory it is likely that ThingWorx can plug in and share information almost immediately using our edge microservice and SDK-based customized connection interfaces.
Application enablement is the heart of the platform that allows us to quickly build business logic through user interfaces. A machine-learning capability is tightly integrated into the platform so that data coming from a device can quickly be put to use to drive insight from the tons of data being collected. This deluge of data requires new ways of presenting it for people to understand. We provide augmented reality as an incredible way to display that information, and to overlay it in context over the physical asset for the technician or the operator. Because of PTC’s legacy in computer-aided design (CAD), we are also able to animate service procedures using CAD models.

**RH:** Developing a digital twin and realizing the benefits requires an ecosystem of technology partners. Simulation is a key component of the digital twin. What does ANSYS bring to the table?

**AT:** The partner ecosystem is critical. An IoT solution is far more than just an IoT platform. You need hardware, sensors and gateways, and integration to other enterprise systems. The ANSYS simulation platform is a really vital component and provides good synergy. ThingWorx connects to the devices and collects information to provide data for the simulation model. What ANSYS brings to the table is exciting: the ability to simulate failure. Simulation is applied in both the upfront engineering — the digital twin might include information about the stress level before something broke, or how thin a wall can be — and during operation in the field. If something breaks you can test potential solutions in a simulated model and feed that information back to resolve the problem. All of that information is stored in this digital representation of the physical equipment. The results of the simulation are then transferred back to ThingWorx to take appropriate action.

But it is also much more than predicting failure. Today we provide solutions like opening a valve, turning something off, creating a trouble ticket or summoning a service technician. However, the key to the future is machine learning, so we can detect anomalies very quickly even without historical data. In the past you would need historical data to create a predictive model. Unfortunately, there is a large amount of equipment in the field that doesn’t have data records of past behavior. This is where simulation combined with machine learning comes in. For situations like this, ANSYS software can provide simulated data that can be used in place of historical data. The machine-learning algorithm takes the simulation result and real data from the field and, within seconds, figures out normal conditions and notifies you of abnormalities that could be costly. Prediction is the key. This is the future.

**RH:** Many people are still trying to understand how IoT will disrupt their business and may not yet have come across the concept of the digital twin. As an industry veteran, what advice would you give to organizations that are looking to start the journey?

**AT:** There is a lot of hesitancy to get started because it is not clear how long it will take you to recoup your return on your investment — if you are successful at all. But you don’t have a choice. You have to get started because your competition is moving forward with a digital twin. The ThingWorx platform is fast and intuitive so you can develop solutions quickly. The key is to start with something small and have a vision of where you want to go. Learn from what worked and what didn’t and adjust your trajectory. Getting started now is the key. Don’t spend months trying to figure out every step of the way. There are tools and partners, and smart systems integrators and management consultants that can help you.

At PTC, we are trying to remove the low-level integration process for components of an IoT system. We will perform the integration, including not only our platform but gateways, sensors, hardware and simulation platforms, so that you can focus on extracting business value. Bottom line, it is a business imperative, so get started!