For years computer-aided design has allowed product developers to create three-dimensional objects that exist only digitally. Expanding that capability, computer-aided manufacturing tools enable designers to simulate an entire factory and predict how it will function in the real world.

But once the real factory goes into operation, its digital simulation is put aside. Perhaps the next step in manufacturing is to give that factory simulation a continuing role by feeding it actual production line data, suggests Prof. Michael Grieves, a research professor at the Nathan Bisk College of Business at the Florida Institute of Technology. His recent white paper, Digital Twin: Manufacturing Excellence Through Virtual Factory Replication, describes this possible next phase in manufacturing.

What is the main benefit of a Digital Twin approach to manufacturing?

Today a company invests time and money developing a plant simulation to help lay out and configure a new factory. But once the plant itself is ready, the simulation tends to end up on a shelf, never to be used again. In the meantime, if you want to know how the factory is actually performing compared with the simulation, you have to go through the reams of data being generated by the facility and manually compare it against the simulated results.

Global manufacturers currently work either with the physical product or with a virtual product. Digital Twin is about connecting the two and working with each simultaneously. Factory data would feed into the simulation, which could immediately and specifically flag any anomalies. This would significantly speed the ability to make adjustments and optimize the plant.

The next step would be to link the factory’s machines directly to the Digital Twin’s feedback loop. This would enable, for example, the work stations within an operation to compensate for upstream variations and thereby help keep the downstream finished product within its acceptable tolerance range.

What would this look like to the user?

I envision a three-dimensional virtual model that appears on the user’s monitor. This model would incorporate actual dimensions from the physical product. Overlaying these measurements on the virtual product would instantly highlight differences. This ability to simultaneously view and compare the virtual and real products could be a very powerful tool for taking the manufacturing phase to the next level of efficiency and accuracy.

What would it take to enable Digital Twin?

The pieces at both ends of the process are out there now, but they haven’t been linked to create a Digital Twin system. Doing so should be relatively straightforward. It’s a matter of matching up information, not building an entire system.

The question at this point is whether industry sees value in the linkage. My white paper is intended as a thought piece that suggests a possible direction with which to achieve greater manufacturing efficiencies.

How would the digital and physical products be linked?

One approach would be a “unified repository” consisting of virtual development data and physical collection data. On the virtual side are such identifying characteristics as dimensions, tolerances, torque requirements and so on. The virtual model would include tags or placeholders for data representing the actual physical product.

The real-world data for those placeholders would be fed into the unified repository by way of a manufacturing process that incorporates the virtual model’s tags into the bill of process and manufacturing bill of materials. The result of this direct feedback would be a tool that doesn’t just simulate what should happen. It would be an application that shows graphically what is actually happening at each step in the manufacturing process.

How does this differ from what occurs today?

Today, humans have to perform this visualization internally. They take the reports with data from the factory floor and internally attempt to visualize what is occurring. We humans are simply not equipped to manipulate the massive amounts of data and visualizations this requires. In addition, there is no sharing an individual’s visualization.

The Digital Twin can serve that purpose. It can do the work of providing visualizations of trend lines and tolerance corridors. The Digital Twin also enables us to share such knowledge with others throughout the supply chain without losing time or compromising accuracy.

Click HERE to download a free copy of Prof. Grieves’ 7-page white paper on the Digital Twin concept.