The Connectivity Conundrum
By i4.0 Today Guest Writer

One might think there has been way too much talk of connectivity over the last year or two and that the subject is filling way too many column inches. But this is an important issue. In fact, right now it’s among the most important issues related to creating smart factory solutions. Connectivity is the foundation of the digital transformation of manufacturing. Without machine to machine, machine to system and machine to operator communications none of the benefits of Industry 4.0 or the smart factory will be realized.

To sort hype from fact, we ask four questions to six industry experts who are closely involved in the deployment of smart factory systems. Here’s what they had to say.

Discuss the importance of connectivity for Industry 4.0 or IIoT

James Mok - Strategy, IoT and Big Data at Dassault Systèmes:

At the heart of Industry 4.0’s core enabling technologies lies the mirror image of the physical world, or sometimes called the Digital Twin. These digital twins do not only represent the products but also the processes and operations from design, engineering, manufacturing to services. In Dassault Systèmes, we not only provide solutions for these digital twins, we consider it central to our strategy to deliver digital continuity within our 3D Experience platform, such that these digital twins work seamlessly with each other. To optimize design, engineering and manufacturing processes, we need to bridge the gaps between the silos of the value chain, as well as between the virtual and physical world. Connectivity is key in delivering digital continuity.

Sam Wong TS - Manufacturing Technology Product Management Manager at Keysight Technologies:

In the manufacturing world, there are many different vendors and each are specialized in their focus area. They have been less concerned about the bigger picture or other equipment, at least not until now. For the industry to optimize their processes, to have higher performance and tap into benefits of Industry 4.0, there must be synergy between these vendors in terms of data exchange. A common platform or standards is needed to make this happen.

Peter Bollinger – CEO of iTAC Software:

Connectivity is fundamental to implement features and functions of Industry 4.0, IoT or Smart Factory solutions. The goal is that the connectivity is simple
and standardized but in today’s production environment we see all kinds of different machine models with different interfaces and controllers depending on the age. As customers like to improve production quality and overall output of the whole plant we need to be able to connect every machine, and that means legacy system that may have been installed 5 to 15 years ago. At the end Software Solution Providers and machine manufacturer need to work more closer together to make the connection simpler with standardization as customers looking for reliable features to drive their goals and are not to much concerns about the technical solution to do so.

**What are the main issues or challenges associated with connectivity in our industry today?**

**James Mok:**
There are two main issues. Firstly, the standard around communication protocol. Secondly, the common semantics to interpret the messages. It would not be a challenge if all the machines of the world use the same communication protocol and speak the same semantics. There have been many attempts to establish such a standard. In the real world of automation, such a dominant standard is almost impossible. This is for several reasons: Firstly, every protocol has its own pros and cons, there is always a trade-off in choosing a protocol depending on the use case at hand. Secondly, there are always legacy devices and machines that cannot keep up with prevalent standards. Thirdly, there is constant development in the underlying network technology (Ethernet, wifi, 5G). Lastly, there is always a political struggle between powerful vendors and sometimes government bodies to establish standards. Therefore, despite all the efforts to simplify the landscape of connectivity standards, it is unlikely that one can fit all shapes and sizes.

**Gerry Padnos** - Director of Technology at Juki Automation Systems Inc:
I think of Industry 4.0 as the USB of the manufacturing world. Everyone wants to just plug all their devices together and for them to all “just work” without a lot of hassles or frustrations. Having this simple interfacing and interoperability is going to be very important to achieve continuing efficiency and productivity improvements and reducing costs. It’s pretty clear to us that customers want to have this functionality, but it just hasn’t been available so far. We’ve recently seen a lot more pressure on manufacturers to provide simpler and better connectivity and I think that will continue.

**Thomas Marktscheffel** - Director Product Management SW - Integration Platform at ASM Assembly Systems:
Smart equipment – like ASM’s SMT solutions – is and remains the basis of every efficient electronics factory. Connectivity and integration are the new challenges. Only the electronics manufacturers who provide reliable data in real time and irrespective of time, place and device, will be able to run a smart SMT factory with agility and competitiveness.

This requires strategic partnerships between electronics manufacturers and competent digital transformation experts – for target-oriented operation in teams, for workflows instead of production, and for open standards instead of proprietary islands. Manufacturers and equipment suppliers must “network” – not just technically, but with customers, partners and competitors.

**Sam Wong:**
There are too many vendors, each with varying standards. Some of these are proprietary standards and have different hardware needs. At other times, customers have legacy systems. For some Test departments, they may also need to take directions from their corporate, to align with a global strategy. Corporate will take a longer time to meet the requirements of all their plants, each of which has different standards and requirements.

**Peter Bollinger:**
The main issue with standards is that there are too many and that legacy equipment will make it very challenging to adopt a single standard for any factory. In addition to that companies have customized business application that need to be connected as well. Our task is to build all the connections to upper and lower levels to execute business processes which vary between plants and factories, even when they belong to the same corporation. What’s more, we must deal with the existing environment. Companies will not replace their machine or business applications just so we can implement a new standard connection. Each new standard will be added on top of the other. Over a much longer time period it may be possible to get to a single standard, but this would mean that the standard needs to be accepted by all equipment supplier in an industrial vertical and survive from technical perspective for a very long time.

**Brain D'Amico:**
One of the biggest challenges with M2M communication is the ability to provide seamless connectivity between such
a wide variety of assembly equipment. The fact is that different vendors use different communication protocols, data formats, and standards.

**Gerry Padnos:**

The biggest challenge is getting everyone working toward the same goal. In the absence of a good standard, many companies have made their own. Some of these companies are now reluctant to switch because what they’ve made is working. There’s also a big challenge with the number of older machines in use around the world. In some cases, upgrading these to use new technology is difficult, expensive, or just impossible. In the PC industry, we saw relatively fast adoption of new technologies like USB and HDMI, but you’re talking about a product with a much lower price tag and typical life of 3-5 years. The machines used in the SMT industry are far more expensive and used for much longer, so replacing equipment for Industry 4.0 compatible ones will take many years.

**Thomas Marktscheffel:**

So far, the one-and-only industry standard that “does it all” is not available. Today, most data is still trapped in “silos” – in proprietary formats of various equipment makers, in machines, on the shop floor, and in standalone solutions. Furthermore, different parts of the industry have different histories of using certain different standards. I suppose midterm we will see a coexistence of a few standards playing different roles in their industries. Long-term there might be a convergence. However, for the time being, openness and flexibility is still key to successful communication and integration. Thus, ASM will continue to support industry standards in use by our customers, responding to customer demand and industry needs.

**Explain your strategy to address these issues and challenges**

**James Mok:**

At Dassault Systèmes, we have an open strategy when it comes to connectivity. We are not a hardware company so unlike many other automation companies that have a strong reliance on hardware revenue. This is driving them to adopt and promote their own standard. We make sure that our software systems are agnostics to all types of machines and devices. Also, we have adopted widespread standards of IIoT into our own solutions such as OPC-UA and MQTT, we also work with partners to enhance our connectivity such as Cogiscan in the domain of SMT integration, which is at the heart of any electronic manufacturing nowadays.

**Sam Wong:**

There is no single solution to meet this diversity. Our strategy is to rely on partners to provide these interfaces, partners specialize in these domain, such as Cogiscan.

**Peter Bollinger:**

We continue to maintain a connectivity tool box within our solutions to convert the information we get into our own internal standard protocol that feeds all our software modules for seamless and reliable communication. Of course, we will add new standards as they appear in the market. We are currently aware of several new standards in development, and they are not just those hitting the headlines, like Hermes or CFX, there are machine vendors adding new standards or updating existing ones too. Cogiscan is part of our tool box offering and we implement their solution to a standard iTAC API interface. With this approach we can enhance our interface tool box especially for legacy equipment.

**Brain D’Amico:**

Truly seamless integration of data across different manufacturing equipment requires another level of connectivity typically referred to as “Middleware”. Rather than “re-invent the wheel”, we at MIRTEC have chosen to strategically partner with companies like Cogiscan that specialize in machine-to-machine communication. These partnerships allow us to effortlessly connect to virtually any machine within the manufacturing line without tying up valuable engineering resources. This also overcomes the hurdle of working with some competitive systems.

**Gerry Padnos:**

We always try to support different protocols and standards, but we have seen past attempts to make a standard fizzle out (CAMX). It’s hard to know what will happen with new standards like CFX and Hermes. Because of this, it’s difficult to justify big investments in software that may not ever be fully adopted. I’m sure most equipment manufacturers have the data available for CFX, but making the connection isn’t necessarily driving sales just yet. Rather than getting distracted from our main mission of building the highest quality machines, Juki has partnered with Cogiscan for many years. Since Cogiscan is a neutral third party and already has access to the required data for many machine manufacturers, it is just one more step for them to convert the data into CFX format. It’s easier and faster for everyone, which hopefully will help customers reap the benefits faster.

**Thomas Marktscheffel:**

ASM is already offering a coordinated portfolio of products and services for all integration levels – from circuit board information to standards and an MES for process data integration in the digital age to an IIoT platform for apps. We have answers for partners of choice for all questions regarding data and process integration. We also believe in openness. Connectivity and integration are more than technical concepts. No supplier can do everything, but he must be willing and able to communicate and cooperate with...
other people and companies in a respectful and trusting manner. We focus on our customers, their objectives and their capabilities in everything we do. ASM chose Cogiscan as a partner to support industry standard protocols on top of OIB, because in this cooperation both partners can focus on their core competencies. With Cogiscan for instance, ASM works closely with a partner which has been known for a long time for their expertise in communication standards.

What is your perspective relative to new industry standards such as Hermes, CFX and others you are aware of?

James Mok:
The availability of these new standards is making it much easier to connect. Hermes provides information of the board in an efficient manner making horizontal integration across the line seamless. CFX along with OML simplify vertical integration to enterprise systems and MES. However, the application of such standards depends on the type of individual equipment. For the same reasons mentioned above, we do not see any single standard solution that can meet the needs of smart manufacturing. That is why we work with a partner like Cogiscan. With such a solution, we do not have to worry about so many protocols and standards or the burden of bridging gaps between legacy equipment and new machines. The connectivity platform solution that they provide can speak to all the protocol and standard in the SMT world. And if ever a standard raised to power, we can rest assured that they would support that too.

Sam Wong:
This is really a good step forward and Keysight participates in the CFX and Hermes initiatives. In my view, this is only the beginning and the vast majorities of our test and inspection customers are coming to speed, especially on their requirements. Not many customers had deployed such connectivity and they usually come back to Keysight for advice. We have also worked with proprietary SMT standards, based on specific customers' requests.

Peter Bollinger:
It will take years for a standard like CFX to be adopted widely. As I have said, we need to be able to connect regardless of standards or protocols and while these new standards might seem to tick a lot of boxes, they are just that new. There are numerous industry standards that are established over decades, and with high levels of adoption in specific markets. Standards are also aging based on technology demands which means at the end that they need to survive at least the life time of machine in production so we get one standard we could use for all machine in production. My hope is that at least the equipment suppliers could agree on the standards that are used for a couple of years so there is no need to have for each of them connected to a different Interface. If this would be the case, it will at least reduce implementation efforts for all.

Brain D'Amico:
While there is certainly a trend toward standardization, we must consider the fact that there are a host of communication protocols that are used throughout our industry. Proposed standards such as CFX and Hermes are gaining momentum and will undoubtedly help with M2M communication initiatives. In my estimation, however, there will still be the need for middleware in order to bridge the communication gap between standards.

The machines used in the SMT industry are far more expensive and used for much longer so replacing equipment for Industry 4.0 compatible ones will take many years.

Gerry Padnos:
I think the concept of having easy interoperability is a great idea and I hope the new standards succeed and really become “standards”. Writing and approving a standard is one thing, but getting everyone to use it is another. There seems to be more excitement for the latest standards than we have seen in the past. This should be a good thing because if more users and manufacturers get on board, the adoption will be better and faster. The investments some companies have made in other technology could be a roadblock, but if enough companies get on board, it will just be a matter of time for everyone to switch over.

Thomas Marktscheffel:
Getting new standards like CFX and HERMES into the market does need some effort and broad support in the market. Midterm, I believe we will continue to see a coexistence of a few standards playing an important role in their industries. Long-term there might be a convergence. However, openness, sharing among partners and highest level of flexibility is still and will always be key to successful communication and integration. Thus, ASM will continue to work closely with partners on all integration levels and support the industry standards, which are in demand by electronics manufacturers and industry needs.