Industry 4.0

The first business processes that process analysts focused on were manufacturing processes. Fredrick Winslow Taylor wrote his book on *Scientific Management* in 1911, just after Henry Ford introduced his continuously moving production line. For the next several decades, as one manufacturing industry after another studied Ford’s approach and applied it, process analysts were there to analyze specific tasks and devise efficient procedures to be followed. In the 70s and 80s soon after robotics first proved successful, they were used to automate automobile production line tasks that process analysts had already defined. Now, instead of two employees lifting a door and attaching it to the chassis at just the right moment, a mechanical arm did the job and proceeded to weld the door in place at the same instant.

When one thinks of companies that are among the most productive and most process focused, one usually thinks first of Toyota, with its famous Toyota Manufacturing System (TMS), which combines many of the best process techniques and was the basis of the popular Lean approach to improving process efficiency.

In spite of considerable automation, however, many manufacturing jobs have still “left” Europe and the US for China where hourly labor is that much cheaper than it is in the US. A recent study showed that even when the jobs were returned to the US - as some have when faced with rising Chinese labor costs and a desire to locate manufacturing closer to end customers – the number of employees rehired is far less than the number that were formerly employed. In essence, in the past decade automation has improved and fewer employees are now needed. Moreover, there is every reason to expect that this trend will continue.

There are a number of technologies driving manufacturing productivity. Among them, the Internet of Things (IoT) is playing a major role. Increasingly, computer chips are being embedded in manufacturing machines, and in some cases in the product itself. These chips facilitate communication among the elements involved in the manufacturing operation.

Consider putting a chip in the chassis of a car as it starts down a production line. The chip knows what the car is supposed to be – a red convertible with a sports package – and it tells each of the machines it comes to along the production line – “I’m to be a red convertible with a sports package.” Each of the machines along the line responds by making appropriate adjustments to assure that the product is correctly processed.
You might ask why a company would go to all this trouble, and the answer is that companies are trying to be more flexible so they can deliver tailored products to customers much more quickly. Today, it’s common for companies to manufacture in batch, and create enough different batches to enable their dealers to respond to specific customer requests. In reality, of course, it’s hard to anticipate exactly what customers will ask for, and lots of delays and unused inventory result from manufacturing the wrong batches in the wrong numbers. Everyone agrees that it would be ideal if products could be created on demand as customers requested them. To do that, however, we need to be able to rearrange a production line’s operations as we send each new order down the line. In the past that required reprogramming each machine for the new run. Now, with the Internet of Things and smart chips, each robotic machine can readjust itself once it knows what’s required.

The Industry 4.0 Concept

One popular term for this new approach is Industry 4.0. It’s also sometimes called the Fourth Industrial Revolution or the Smart Factory and the cooperation of machines, guided by computers and the Internet of Things, is sometimes called Cyber Physical Systems.

The term “Industry 4.0” was coined for a project of the German government designed to promote computerization in manufacturing, and first used in 2011 at a Fair in Hanover. (The idea is that the Industrial Revolution is a continuing process that has changed manufacturing four times: 1) initially by mechanizing factories using steam power, then by means of 2) electricity and mass production, then by 3) computer automation, and today by 4) embedded chips and internet communications.)

Industry 4.0 is still widely used in Germany and has spread everywhere else since. In a recent study by McKinsey [1] on the adoption of Industry 4.0 principles, found that, today, Industry 4.0 is more popular in the US than in Germany. It also found that Japan is showing more interest all the time.

Industry 4.0 is not a precise standard, but a generic term embracing a number of different trends in manufacturing. The common element among these trends is a reliance on the Internet of Things – which in turn involves embedding chips in machines to facilitate the constant communication of instructions to the machines.

The essence of Industry 4.0 is decentralized decision making. This is made possible by embedding chips in production machines so that each machine is capable of a degree of autonomy. It relies on the Internet and wireless communications to facilitate communication between machines. Some would say that the machines, taken together, embody a virtual model of the world. This comes rather close to the way IBM talks about Watson and Cognitive Computing. Humans communicate goals and the machines work together to achieve the goals.

The example we provided above, where a chassis tells the machines on a production line what it wants to be, and the machines adjust to make that happen, can be extended to refer to an entire supply chain. Imagine that as newly designed parts enter the supply chain in China, adjustments are made throughout the shipping and subsequent manufacturing processes to take advantage of the new capabilities and requirements of the new parts. In the past this would have required people to
redesign every aspect of the supply chain, but, increasingly, elements of the supply chain will modify themselves in response to the new situations they face.

Of course a program as extensive as Industry 4.0 can not be achieved over night, and some companies that have tried to do too much too quickly, have been very disappointed in the results. Those who have been more successful have focused on taking one step at a time: Getting a set of machines to work together before moving on to a production line, or creating one smart factory rather than trying to introduce a smart supply chain. We have the technologies to realize the Industry 4.0 approach, but it takes a considerable effort to implement it and overcome the specific problems that such a complex effort enviably faces.

Broadly, however, individual machines are getting smarter and all the machines are being linked into a network. It’s only a matter of time before networks themselves become capable of tailoring products in ways we can only dream of at the moment.

**Beyond Industry 4.0**

Even the Smart Factory, whose elements are being rapidly put into place in leading manufacturers, worldwide, is hardly the end of increasing manufacturing productivity. I’ve written in the past about the trend toward 3D Printing, which is also termed Additive Manufacturing, which refers to an approach that creates products by latterly building them up from raw elements. Thus, like an ink jet printer head sprays ink molecules onto paper to create pictures or letters, a 3D printer can spray molecules of plastic into place to assemble a plastic part. Similarly, a very large 3D printer can deposit brick-like drops of concrete to assemble buildings. In the near future, it’s certain that companies will avoid creating and storing the vast inventories of spare parts that they currently stockpile around the world to assure customers that they can maintain their products. Instead, when a customer needs a replacement part, he or she will go to the appropriate service location and wait while the part is manufactured for his or her specific needs. 3D printing will probably not replace the traditional manufacturing line for the creation of new products, but it will completely change the way replacement parts are handled, and will supplement traditional manufacturing when customers want highly tailored, new products that will be too rare to benefit from volume manufacturing.

Anyway one thinks of it, manufacturing is going to change in the years ahead. It is going to change within factories, and the supply chains that link factories and define the overall flow of products to customers are going to change. Both are going to become more efficient and, accordingly, costs will fall. At the same time, however, new production technologies will allow companies to tailor their products more extensively, as factories are filled with machines, each with a bit of intelligence, that talk to each other as they work together to assemble new products.

Anyone involved in process work, especially if you work in industry, is going to want to study everything you can about the various Industry 4.0 innovations that are driving the latest round of productivity growth.
Notes

http://www.mckinsey.com/search?q=Industry%204.0%20after%20the%20initial%20hype

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