

Orchestral manoeuvres on the factory floor

A factory without automation is like a symphony orchestra without a conductor, argues Gambica's deputy director, Steve Brambley*.

At first glance, you might not link the production of widgets in a factory with a philharmonic orchestra playing in the Royal Albert Hall, but bear with me while I draw comparisons between industrial processes and the musical arts.

On most factory floors we find a production line or machine cells, each containing specialist processes that make something. Often different cells produce different components, which are then all assembled together to make the final product.

In my orchestral analogy, I see the machines as individual musicians and instruments, arranged by section, with the violins together on one side, the cellos on the other and so on. Each musician produces an individual sound which, when assembled together results in the final product – the musical performance.

The final product in a factory has to

contain the correct number of components and sub-assemblies, put together in the right order. Similarly, the

symphony needs the correct number of string, brass, woodwind and percussion players to produce the correct number and type of sounds. However, having the right number of musicians and instruments is only the beginning – adding the components at the right time and in a co-ordinated way is vital for the piece to sound correct.

In an orchestra, the “bill-of-materials” and “manufacturing process instructions” are provided in the form of the sheet music that defines which instruments are needed, which sounds they should supply, and when. In theory, we now have enough to start playing the piece – or making our widgets.

However, the musicians in this scenario are playing independently, each one following the score, but not necessarily at exactly the same tempo, rhythm, pitch or volume. In a five-piece rock band, it is easier to keep timing when each member can hear and see the others, with the drummer and bassist setting the beat. In a 100-piece symphony orchestra, however, this is much more difficult to achieve and the end-result is likely to be somewhere on the scale of disjointed to cacophonous.

The impact of an uncoordinated approach like this on a factory is inefficiency. Lack of components in one area will hold up production in another, over-production in a cell will result in wasteful stock-building, labour can be under-utilised, energy is wasted, and the overall efficiency of the factory is reduced.

To remedy this problem, the orchestra has a conductor, which we can liken to an automation system. The conductor is the central focus, setting the tempo for everyone to follow in a synchronised way. Even if the musicians cannot all see or hear each other, they can all see and follow the conductor.

Not only do conductors set the tempo, but they monitor the resulting sound continuously and send feedback to specific sections and musicians in the form of gestures. The musicians receive these instructions visually and make adjustments to their dynamics, pitch or tempo accordingly. The end-result is harmonious and synchronised, continually fine-tuned through a feedback loop between the conductor and the musicians.

The automated factory doesn't have a human waving their arms around or pointing a stick, but the equivalent in the form of a control system that co-ordinates, synchronises, monitors and communicates. In a network of machines, processes, sensors, valves, actuators, instrumentation, motors, conveyors and so on, the control system takes inputs from various sources, analyses the data and sends instructions back out. The end-result is efficient and optimised, continually fine-tuned through a feedback loop between the central controller and the intelligent devices.

Who would have thought that the orchestral conductor was the first real-time, wireless, closed-loop controller using a standardised, open communication protocol? ■

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