

What is the link between Instrumentation and Control and the concept of Industry 4.0?

Establishing the link between Instrumentation and Control and Industry 4.0 requires an appropriate knowledge of these two concepts. These two domains are complex, and linking them requires a minimum and preliminary exercise of analysing, to define them in a simplified way. We will then be able to develop the two concepts in more details, in order to better integrate them.

Instrumentation and Control is a profession that has existed for a very long time, beginning even before the era of industrialization. Instrumentation and Control is the science of automation of systems in industry, because it is in this environment, with this environment, that it has evolved. Automation systems are used to perform a task independently to those systems, in an automatic way. Initially, mechanical systems were implanted, using physico-chemical and mechanical measurement and control principles.

In the early days, the systems were relatively complex in order to perform simple automation tasks and processes. Many automation systems consisted of these mechanical elements. Subsequently, pneumatic systems appeared and made it possible to achieve even more sophisticated automation processes. The advent of electronics then came to give a tremendous momentum to the myriad possibilities of automated controls. Electronics have been a key vector for an even more multiple and sophisticated automated systems, with the advent of computer science and microprocessors, the major element that leads us today to the concept of the Industry 4.0. Computer science has become a real revolution, propelling us into the concept of the Industry 4.0.

Instrumentation and Control uses the control loop as one of its basic elements. It consists of three main sections:

- The measurement of a value, like the temperature of our houses.
- A control system that receives this measurement and, according to its design, generates a control signal at its output, such as the rotary controls for adjusting the temperature of our houses.
- A final device that serves to adjust the measured value to the desired value, like a radiator to heat our homes.

We could cite and develop this example of a control loop, known by all of us, the systems of temperature control of our buildings, houses or offices. The same principles are used both to heat our buildings or to cool them; only the final devices are different for each case.

The link between the two concepts, the science of Instrumentation and Control and the concept of the Industry 4.0, is now emerging. The Instrumentation and Control brings the element of the temperature control of the building, with the reading of the ambient temperature, the possibility for a person to define the desired value, and an automated control system which acts on the system of heating, or air conditioning, to ensure that the ambient temperature is precisely adjusted to that desired. The development of all the subsystems used is necessary in order to make the direct and precise connection with both concepts. Simply explained, we will add the dimension of the electronic circuits used, the integration of the computers technologies, as well as the communication networks, the latter being a

major vehicle for establishing the link with the Industry 4.0. This communication link is mainly composed either by the Internet or by cellular networks.

For 'citizens applications', the communication network thus available is the key element for establishing a clear link between the two concepts; we are coming out of the industrial domain, and we are now in applications for individuals. Citizens now have the opportunity to visualize the temperature of their building, on their cell phone, and at a very low cost for such an application. Even better, they can also launch a command that will change the current temperature for a more comfortable value when they return. They can also automate the process, by ordering the change at a defined time, or even accessing a chart of the building temperature for the last day. What industries have been doing for several decades, at a much larger cost and quantity of devices, is now being transposed into the everyday lives of individuals.

The concept of Industry 4.0 is not only ' industrial ', because it affects all societies, all countries, all cities, and all its citizens. But the concepts come from decades of industry development, with the specialty area of Instrumentation and Control. And future developments will be even more important for the various sectors of activity. The union between Instrumentation and Control technologies, originally industrial, and the use of cellular networks and the Internet by millions of peoples, creates a new technological combination, called Industry 4.0. A real revolution, and not only industrial.

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