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INDUSTRY 4.0 IN CERAMICS: PECULIARITY, POTENTIALITY AND APPLICATION CASES

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The term **Industry 4.0** is very used, and occasionally misused, at present, but can be declined in several ways. The current scene is characterized of a strong technological speeding up and various emerging technologies, but the application of a new technology should not be an end in itself. How can this new paradigm be applied in ceramics and what are the targets?

The digitalization in the industrial reality can offer several potentialities: greater production efficiency, beginning of new products or services, greater customization of the offer. In general, all along the value chain, there are new opportunities for increasing product value, creating new business models (smart factory, servitisation, data-driven) and improving the welfare of all involved parties.

Among the qualifying technologies, typical of Industry 4.0, some of them can find immediate application in ceramics: from the software for control and automation of production processes to the ones for simulation and virtualization of process and product (digital twin). From the use of new materials and technologies to instruments for computer vision. From Industrial IoT, big data and analytics to cybersecurity criteria.

The application projects of these new technologies can be challenging, involve all company levels and be of great complexity. There are several risk factors, which can determine the failure of the whole project: how can the risks be limited and what are success key factors? A first example is represented by the human factor: training for acquiring new skills, changeover of the existing resources, birth of new roles in the company, promotion of a new culture and attention to personnel motivation. A second example is represented by re-engineering of production processes. The application of Industry 4.0 paradigm does not mean to automate everything right away: a suitable environment for receiving a new technology must be created, with the aim of preventing from automating the wastes.

While developing these projects, profitable partnerships among the different parties of the value chain arise, since anyone can give his own skills in *win-win* logic.

Some application cases are listed hereinafter. Their different technologies find real application in the ceramic field. Even the evolution steps, the advantages, the challenges, the potentialities and the involved skills will be pointed out for each mentioned case.

- Installation of HERE system for the control of **logistic-productive process**, able to automate all production phase, from the arrival of the raw material to the arrangement of shipment units, with particular attention to cybersecurity and data privacy topics.
- Realization of **digital twin** for the different phases of the ceramic process, useful during virtual commissioning and evaluations for dimensioning or engineering modifications, together with the Customer.
- Application of **computer vision** techniques for co-ordinating different decorations of the tile or slab and use of dedicated software for regulating the settings of the different decoration machines.
- Use of **analytics** for controlling the ceramic process: for example, for keeping constant residue at mill outlet or adjusting the compacting pressure of the tile in function of raw material properties in order to ensure bulk density values within a certain range.

Keywords: Industry 4.0; Smart Factory; New business models; Digital twin.

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