INTERUNIVERSITY PH.D. PROGRAM BETWEEN

POLITECNICO DI BARI AND UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

IN INDUSTRY 4.0

Virtual and Augmented Reality in manufacturing lines for performance and maintenance optimization in Industry 4.0

PhD candidate

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Tutors

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Research program

Industry 4.0 leads to the digitalization era. Everything is digital; business models, environments, production systems, machines, operators, products, and services. It's all interconnected inside the digital scene with the corresponding virtual representation. German manufacturing strategy played a key role in this shifting. I4.0 aim is to work with a higher level of automatization achieving a higher level of operational productivity and efficiency, connecting the physical to the virtual world. The I4.0 implementation should be interdisciplinary in a closely between different key areas. Several authors described nine pillars (also called the building blocks) of the I4.0 framework: *The Industrial Internet of Things, Cloud Computing, Big Data, Simulation, Augmented Reality, Additive Manufacturing, Horizontal and Vertical Systems Integration, Autonomous Robots and Cyber-security*. A fundamental key point to achieve the integration of I4.0 framework is the human contribution that will be improved with the development of professional skills of the stakeholders.

In today's highly competitive markets, digitalization in manufacturing is seen as an opportunity to achieve higher levels of productivity. The use of digitalization technologies enabled virtual product and process planning. The resulting large amounts of data are processed, analyzed and evaluated by simulation and optimization tools in order to be able to make them available for planning in real-time.

One of these simulation-based planning and optimization concepts with great potential in many industrial fields is the **Digital Twin**. It is the virtual and computerized counterpart of a physical system. The Digital Twin (DT) is one of the main concepts associated to the Industry 4.0 wave. This term is more and more used in industry and research initiatives. A Digital Twin can be used to simulate it for various purposes, exploiting a real-time synchronization of the sensed data originating from the field-level and is able to decide between a set of actions with the focus to orchestrate und execute the whole production system in an optimal way. These results in higher efficiency, accuracy, and gains economic benefits in the production.

The proposed research aims at designing a uses case with the Digital Twin approach. The first step will be to simulate the production and logistics processes, using simulation software it will be possible to optimize the material flow, the operators flow, the logistics for the whole layout or each station. This tool allows to simulate discrete events and create digital models of logistic systems (e.g. Production), optimize the

operation of production plants, production lines, as well as individual logistics processes.

Digital models make it possible to perform experiments and test “what if” scenarios without disturbing the work of production systems or, in the case of the planning process, long before their assembly. Thanks to advanced analytic tools, such as bottleneck analysis, statistics and charts, it's possible to evaluate different production scenarios. The aim will be to get results to ensure information necessary for quickly making good decisions at early stages of production planning.

Digital technologies increase the possibilities of communication, exchange and cooperation: between people, people and machines, and even between the machines or industrial objects themselves. The second step aims to implement the *Augmented Reality* and *Virtual Reality* in the simulation model.

Relying on reality by embedding virtual 3D elements, AR and VR technologies allow integrating precisely the virtual (what we have to do) with reality (what exists and what we see). In other words, it enables the users to visualize and interact with 3D objects, in the real environment, more easily than they can through a simulation or a computer screen. One of the research objects will be how to develop and evaluation of a VR-based tool to support engineering design review.

The research project will be developed with Masmec S.p.A. collaboration and throughout the whole PhD, a regular report about the progress will be performed and will be prepared scientific publications and material useful for the final dissertation.