# PhD in Management, Production and Design

**Research Title:** Collaborative and versatile robotic systems for manufacturing processes

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<th>Funded by</th>
<th>Dipartimento di Ingegneria Gestionale e della Produzione</th>
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## Context of the research activity

In flexible and agile manufacturing and assembly environments there is a growing demand for versatile robotic systems to manage a wide variety of applications, including assembling, product handling, quality check. In the more complex activities, these robotic systems should be able to carry out collaborative operations with human in safety conditions and have cognitive skills.

In this regard, some research activities aim to support manufacturing processes with collaborative and versatile robotic systems equipped with artificial intelligence and sensors, capable of acquiring and processing many different kind of information in real time, which is an impossible task for any human operator. Machine learning algorithms, together with adaptive control systems, may allow robots to have a sort of "intelligence" supported by the huge amount of data collected through the IoT manufacturing network. They may let robots work in environments based on man-machine cooperation, and get experience throughout a “learn by doing” approach. As a result, a more holistic vision can be developed for the whole manufacturing process, along with a deeper knowledge of any potential cause of non-compliances, defects, and/or stoppages, as well as the possibility to give a quick response to the insurgence of any problem, thus improving the efficiency and capability of the process.

## Objectives

The objectives of the research activity concern the possibility of implementing artificial intelligence systems in manufacturing processes including collaborative robots. The algorithms assisted by the experience of human operators can process data from sensors in order to have a more detailed, reliable, on-time and/or off-line analysis of the manufacturing processes and of product quality.

So the research project will explore the use of machine learning algorithms to improve the efficiency, reliability, and product quality in robotic manufacturing cells.
The research activity includes:

- Bibliographic research on collaborative and versatile robotic systems for manufacturing processes.
- Identification and selection of suitable case studies among different manufacturing processes (machining, joining, assembling, or other operations) available at DIGEP Lab of excellence.
- Definition and implementation of the selected case studies with the equipment available at DIGEP Lab, along with the execution of experimental tests.
- Implementation of machine learning algorithms devoted to elaborating the information exchanged between robotic system, human operator, and machine.
- Validation of the machine learning algorithms and robotic systems for process control and product quality.
- Feasibility study of real industrial applications.

| Skills and competencies for the development of the activity | Master of Science degree in Engineering studies, with preferred qualification in Management, Mechanics, or Mechatronics. Desirable skills include basics in informatics, statistics, data analysis, manufacturing processes, CAD/CAM, and NC control systems. |