



# PhD in INGEGNERIA GESTIONALE / MANAGEMENT ENGINEERING - 38th cycle

**PNRR\_352 Research Field: DIGITAL TWINS FOR SMART AND SUSTAINABLE MANUFACTURING**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1450.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>In alignment with the Mission 1 of the "Piano Nazionale di Ripresa e Resilienza (PNRR)" objectives on "Digitization, innovation and competitiveness", the PhD position will focus on supporting the digital transition of manufacturing companies, with a specific research interest in one of the most promising Key Enabling Technologies of digitization: Digital Twins. Digital Twins represent a novel research and industrial challenge that is changing the way the products, systems and in general engineered assets are designed, produced, run and disposed of.</p> <p>Digital Twins leverage on digital technologies of the Industry 4.0 paradigm (such as Internet of Things, Big Data and AI, advanced simulation) to build a synchronized replica in the digital world of the physical system. This brings about new opportunities for monitoring, prediction, optimization, and performance improvement, eventually leading to a more sustainable performance and higher competitiveness.</p> <p>Despite the numerous scientific articles that demonstrate the use of Digital Twins for industrial engineering, industrial applications are still limited in number, problem size and technology readiness. The research will investigate the use of Digital Twins for industry, and in particular for manufacturing industry, to accompany the physical production system from its design/redesign to its use, in the light of the requirements due to the products and processes expected in the production programs over the years.</p>



	<p>The research will consider the scenario of a manufacturer in the high-tech sector supported by provision of IT capabilities in a value chain perspective, leading to a particular prestige to the research outcome.</p> <p>The expected outcome of the research project is the development of a Digital Twin architecture and a Digital Twin system for an effective and value-added data elaboration and simulation to support decision making in manufacturing. Architecture and system will be validated and demonstrated in industrially relevant environment, contributing to the most advanced research progresses on the Digital Twin for manufacturing and leading to the possibility to achieve a system prototype running in operational environment.</p> <p>Expected positive impacts on sustainable development and mitigation activity for the climate change through the use of the achieved research outcomes are envisioned. This will make manufacturing performance both oriented to the value creation for the business and environmental aspects.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The following methodologies will be applied in the research project:</p> <ol style="list-style-type: none"> <li>1) literature analysis in order to map the situation of research at national and international level;</li> <li>2) design and development of Digital Twin-based framework, models and IT architecture, for decision making in advanced operations of production systems; all these artifacts are built upon the integration of extant knowledge about methods and principles adopted for the data identification, data gathering, simulation, data analytics, and data visualization;</li> <li>3) conducting field studies in the form of action researches on the use of Digital Twin in manufacturing, especially in high-tech sector, in a value chain perspective;</li> <li>4) assessing and validating the developed framework, models and architecture through a series of experimental campaigns and experts' judgements.</li> </ol>
<p><b>Educational objectives</b></p>	<p>In the context of "Piano Nazionale di Ripresa e Resilienza (PNRR)", this scholarship promotes the competence</p>



	<p>required by the digital and green transitions. High-level competence and skills will be developed in order to deal with applications in production contexts of Key Enabling Technologies required by the Digital Twin implementation. On the whole, the research aims to contribute to a high-skill profile that is able to:</p> <ul style="list-style-type: none"> <li>• develop critical thinking capabilities regarding the opportunities and challenges opened by the digital transition to competitiveness and sustainability of companies;</li> <li>• analyse, integrate and contribute to the development of the body of research on Digital Twins for industrial engineering;</li> <li>• analyse and evaluate the Digital Twin practice and the required maturity to support sustainability strategies;</li> <li>• develop models and advanced capabilities to support decision making in operations through Digital Twins.</li> </ul>
<p><b>Job opportunities</b></p>	<p>The opportunities for a PhD graduate in this research area are manifold, in terms of professional development in:</p> <ul style="list-style-type: none"> <li>• research and development in the fields of industrial operations, with specific interest for challenges of the twin transitions (digital and green transition);</li> <li>• advisory and consultancy for those companies that want to invest on the next steps of Sustainable and Smart manufacturing: the PhD graduate will be the right person to lead twin transition projects in manufacturing companies, acting as digital champion, or may be hired by consultancy companies which accompany manufacturing companies in their twin transitions.</li> </ul>
<p><b>Composition of the research group</b></p>	<p>3 Full Professors 1 Associated Professors 7 Assistant Professors 10 PhD Students</p>
<p><b>Name of the research directors</b></p>	<p>Macchi M., Polenghi A., Negri E.</p>



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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	725.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	NTT DATA ITALIA
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	The PhD student will spend a period of at least 6 months abroad to interact with researchers and participate in joint activities potentially foreseen in the project, according to specific needs. Indeed, the project is highly interdisciplinary, and this favors the collaboration with foreign research centers where the candidate can acquire in-depth knowledge on the theme.
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p><i>Funding for educational activities: 4.900,00 Euros for three years.</i></p> <p><i>Teaching assistantship: There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</i></p> <p><i>Desk availability: shared use Computer availability: individual use</i></p>