



PhD in INGEGNERIA GESTIONALE / MANAGEMENT ENGINEERING - 39th cycle

PNRR 117 Research Field: CONCURRENT ENGINEERING OF PRODUCTS, PRODUCTION CYCLES AND SYSTEMS THROUGH INDUSTRIAL METAVERSE

Monthly net income of PhDscholarship (max 36 months)

€ 1450.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The improved competitiveness of the industrial market requires Italian companies to take action to lead the market share by leveraging several factors such as reduced time to market for innovative products as well as cost-effectiveness. This can be achieved through advanced practices enabled by digitalization, which is aligned with expectations by the Mission 1 of the "Piano Nazionale di Ripresa e Resilienza (PNRR)".

Upcoming of concepts such as the Industrial Metaverse opens new opportunities, paving the way to unprecedented benefits in terms of collaborative approaches in the design of industrial products and the production systems. In this scope, the research will contribute to the advancement of a well-known design approach, called Concurrent Engineering (CE), in a digitally enhanced context and a human-centric approach. The goal is to:

- 1)enlarge the scope of CE from an integrated product development, to the integrated design of products, production cycles and production systems;
- 2)explore innovative uses of the cyberspace, in the paradigm of Industrial Metaverse, towards an advanced collaboration of multiple stakeholders;
- 3)explore the behaviour and the cognitive effort of the production operator, taken into account already from the CE activity.

The research will adopt a selection of digital technologies (Internet of Things, Digital Twin, Artificial Intelligence, ?)



	<p>with a specific focus on modelling and experimentation in industrial environments to improve the CE of products, related production cycles and systems, inclusive of the production operator. It will enable seamless dependence between them, guaranteeing an effective two-way adaptation to any required modification; and the digital models will concurrently live in the cyberspace for new ways of interactions between stakeholders. From a managerial perspective, such a design approach will optimize ideation, gross and fine design, and prototyping towards an error-free development of products in different industrial sectors, reducing time to market.</p> <p>Besides, through the improvement of the CE activities, data analytics and simulation modelling approaches, the human will be placed back to its pivotal role inside the factory, helping them to do their job better and safer.</p> <p>Finally, in the long term, such a design approach will bring Italian companies improve their competitive advantage built on technical design, customers' expectations matching, and operators' requirements.</p>
Methods and techniques that will be developed and used to carry out the research	<p>The research will require to apply different methodologies to grasp the entire academic and industrial knowledge related to the topic of interest:</p> <ol style="list-style-type: none"> 1) literature analysis, to map the situation of research at national and international level; 2) expert interviews, to extract the requirements of the stakeholders involved in the concurrent design of products, production processes and systems; 3) design and development of Concurrent Engineering solutions, including framework, simulation and modelling, and any required decision support tool, that should cover both the managerial/organizational aspects as well as technical implications; 4) demonstration and evaluation of the developed framework and related tools through experimental campaigns and experts' judgements.
Educational objectives	<p>The doctoral program offers advanced training in a key topic explored by the scientific community and the industry. The educational objectives of this research encompass fostering research skills, interdisciplinary</p>



	<p>collaboration, development of domain-specific knowledge, empirical and experimental investigation, and effective communication. Therefore, engaging in this research provides valuable opportunities that will contribute to the professional and personal growth of the PhD candidate while advancing the field of smart manufacturing. In the context of "Piano Nazionale di Ripresa e Resilienza (PNRR)", this scholarship promotes the competence required by the currently on-going transitions, having a major focus on the digital transition. High-level competence and skills will be developed in order to promote innovation and market competitiveness of Italian companies by dealing with digital technologies applied to design of products, production processes and systems towards Concurrent Engineering.</p> <p>On the whole, the research aims to contribute to a high-skill profile that is able to:</p> <ul style="list-style-type: none"> •analyse, integrate and contribute to the development of the body of research on Concurrent Engineering for products and related production cycles and systems; •analyse and evaluate the benefits and challenges of bringing such a design approach to reality in a multi-stakeholders environment; •develop framework and tools, both managerial/organisational and technical, to support Concurrent Engineering of innovative products, production cycles and systems, validated in manufacturing companies.
Job opportunities	<p>High quality research and innovation jobs can be obtained thanks to the professional skills developed during the PhD research. Careers in research organizations, industrial companies, consultancy firms, are possible. Specifically, opportunities for a PhD graduate in this research area are manifold, in terms of professional development in:</p> <ul style="list-style-type: none"> •research and development in the fields of industrial operations, with specific interest for challenges of the digital transition;



	<ul style="list-style-type: none"> •industrial engineering for manufacturing innovation and improvement: the PhD graduate will be the right person to lead transition projects in manufacturing companies, assuming a leading role in the transition towards manufacturing practices that are enabling fast and effective innovation of industrial products and configuration/reconfiguration of required production systems; •advisory and consultancy for those companies that aim to develop the smart manufacturing practice, building upon the IT-driven transformation of manufacturing systems: the PhD graduate will be the right person to lead digital transition projects in manufacturing companies, or may be hired by consultancy companies which accompany manufacturing companies in their transitions.
Composition of the research group	4 Full Professors 1 Associated Professors 11 Assistant Professors 12 PhD Students
Name of the research directors	M. Macchi, M. Taisch, A. Pozzetti, S. Terzi

Contacts
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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	0

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Consorzio Intellimech
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	



By number of months abroad	6
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Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Funding for educational activities: 5.900,00 Euros for three years. 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. Desk availability: shared use Computer availability: individual use