POLITECNICO DI MILANO

PhD in INGEGNERIA GESTIONALE / MANAGEMENT ENGINEERING - 37th cycle

Thematic Research Field: THE ROLE OF NEW DIGITAL TECHNOLOGIES FOR TEACHING AND LEARNING FACTORIES

Monthly net income of PhDscholarship (max 36 months)
€ 1400.0 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	Companies face increasingly complex challenges in managing the new digital manufacturing solutions within the Industry 4.0 context.In the last years, industrial production systems are being transformed due to a higher level of digitalisation, which leads to intelligent and connected solutions. This context requires training activity to prepare engineers to this new working environment. Laboratory activities play a key role for this type of training. In the recent years the concepts of Teaching and Learning factories have emerged and Industry 4.0 laboratories have been installed in many universities or existing laboratories have been upgraded or extended in accordance to Industry 4.0 concepts. At the School of Management of Politecnico di Milano, the Industry 4.0 Lab "Marco Garetti" was established in 2016. The Lab was one of the first example of this facility in Europe, paving the way for researches in technical activities but also in the educational field, and leading to a potential to create new teaching paradigms. The last COVID pandemic year introduced further challenges in the training and teaching activities, creating the need to realize such activities in remote way. In such a context the traditional laboratory activity must evolve considering new technologies opportunities. The research aims, thus, to define frameworks and tools to: • Integrate digital technologies for sharing data,

	algorithms and software running in cloud to allow all possible stakeholders to connect to laboratory facilities to enable teaching and learning factory paradigms also for remote use; • Integrate virtual and augmented reality tools into laboratory facilities for teaching and training purposes; • Identify skills that can be developed through the combination of new digital technologies and teaching factories approach; • Introduce serious game approaches, to formulate problems and run a problem solving approach that makes learner and/or trainee feeling to be immersed in a real industrial problem setting.
Methods and techniques that will be developed and used to carry out the research	The following methodologies will be applied in the research project: - Literature analysis in order to map the situation of research at international level; - Case studies, in order to analyse the best practices of laboratories, universities, research centres and companies that have already develop new good educational practices; - Action research projects to work on tools for data analysis in order to provide demo solutions, especially considering virtual and augmented reality. The research will be supported by the Industry 4.0 Lab of the School of Management of Politecnico di Milano and by Industry 4.0 Laboratory of CAR at UPM, for the technological support and competence that could be required from their Lab experience and context.
Educational objectives	The main educational objectives of the research project are the followings: - Developing the capacity to provide advanced educational approaches in the engineering field based on new digital technologies and virtual laboratory experience, taking into account automation and condition monitoring approaches; - Developing tailored tools through which effectively and

	efficiently carry out training and teaching activities, in relation to Industry 5.0 challenges; - Evaluating the impact in regard to the learning and training process, and to the achievable skills.
Job opportunities	The opportunities for a PhD graduate in this research area are: - Academic career in the fields of industrial, automation department and operations department; - Advisory for those Research Centres, Universities and Companies that want to invest on the next steps of Industry 4.0.
Composition of the research group	3 Full Professors 1 Associated Professors 5 Assistant Professors 2 PhD Students
Name of the research directors	Marco Macchi, Luca Fumagalli, Rodolfo Haber Guerra

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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	566.36 €
By number of months	12

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
The candidate will work at the Department of Management, Economics and Industrial Engineering and UPM (Universidad Politecnica de Madrid) and attend the PhD Courses and all the educational activities of the PhD Program in both the institutions. The student will obtain a Double PhD degree from Politecnico di Milano School of Management

and UPM.

Increase in the scholarship for stays abroad: Euro 566,36 per month, for up to 6 + 6 months
Funding for educational activities: 1st year: 1200 euros per student, 2nd year: 1200 euros perstudent, 3rd year: 1200 euros per student.Teaching assistantship:
There are various forms of financial aid for activities of support to theteaching practice. The PhD student is encouraged to take part in these activities, within the limitsallowed by the regulations.
Desk availability: shared use
Computer availability: individual use