



PhD in INGEGNERIA GESTIONALE / MANAGEMENT ENGINEERING - 37th cycle

Thematic Research Field: INDUSTRIAL ARTIFICIAL INTELLIGENCE SOLUTIONS FOR FUSION OF ADVANCED SCHEDULING AND PREDICTIVE MAINTENANCE

Monthly net income of PhDscholarship (max 36 months)
€ 1750.0
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	<p>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.</p> <p>Manufacturing companies need to get a high return of investment. They can achieve such goal leveraging on the improvement of productivity, but also with improvement of quality performance as well as the capability to adapt to market changes in a rapid and flexible way. Indeed, in this context, scientific literature shows that Artificial Intelligence solutions can play an important role.</p> <p>The current literature proposes a number of solutions, but still there are gaps. On one hand, focus of some researches is still driven by the technology to get and analyse data, more than on the way the information extracted by data and use of artificial intelligence solutions is then used for responsive decision making. On the other hand, when the decision making process is well addressed, generally simplified solutions are used.</p> <p>Overall, there is a relevant need for Industrial Artificial Intelligence, with applications characterized by a sustainable performance for decision support.</p> <p>As application fields, the research will especially focus on the topics of predictive maintenance and advanced scheduling, considering how decisions can be made with real time data and production can be promptly adapted to</p>



	<p>the status of the production system. Artificial intelligence will be applied together with model based analysis. To this end simulation softwares will be also considered. The research activity will consider the context of manufacturing and process industry, especially addressing context in which process constraints create scheduling challenges.</p> <p>The research aims, thus, to define frameworks and tools to:</p> <ul style="list-style-type: none"> • Analyse and integrate the huge amount of information and data generated by new machines and production systems in order to obtain industrial artificial intelligence solutions, with the final purpose to merge predictive maintenance analysis and production information for advanced scheduling; • Identify the leverages to use in order to get the operations management aligned with the use of such solutions as enabling tool for a new generation of decision making processes; • Outline gaps in industry, highlighting the need for different tools, methods and skills.
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The following methodologies will be applied in the research project:</p> <ul style="list-style-type: none"> - Preliminary literature analysis in order to map the situation of research at international level; - Case studies, in order to analyse the best practices of companies that have already developed practices about artificial intelligence; - Action research projects to work on tools for data analysis in order to provide demo solutions; the research will be supported by the Industry 4.0 Lab of the School of Management of Politecnico di Milano; - Demo development with the use of commercial and open source softwares; in particular the use of Open Modelica (for simulation) and Python (for data analysis) are considered; moreover the demos must consider also communications between machines and Human Machines Interfaces through the development of webservice solutions; the use of OPC-UA architecture and



	<p>MQTT brokers is considered.</p> <p>Overall, the final aim is to deploy Industrial Artificial Intelligence solutions for practical implementation in Industry 4.0-based manufacturing systems.</p>
Educational objectives	<p>The main educational objectives of the research project are the following:</p> <ul style="list-style-type: none"> - Developing the capacity to elaborate quantitative models through which supporting the definition of responsive decision making approaches. - Developing tailored tools through which effectively and efficiently carry out operations management. - Developing an understanding of current industrial context and the related gaps, while envisioning subsequent requirements to pave the way towards a sustainable performance of Industrial Artificial Intelligence solutions.
Job opportunities	<p>The opportunities for a PhD graduate in this research area are:</p> <ul style="list-style-type: none"> - Academic career in the fields of industrial, automation department, operations department; - Advisory for those Companies that want to invest on the next steps of Industry 4.0; - Employment as data scientist.
Composition of the research group	<p>3 Full Professors 1 Associated Professors 5 Assistant Professors 2 PhD Students</p>
Name of the research directors	<p>Luca Fumagalli, Marco Taisch, Marco Macchi</p>

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	566.36 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>The candidate should have the capability to handle the topics related with the Smart Manufacturing Lab course and the teaching activity related with the Industry 4.0 Lab at the School of Management.</p> <p>Funding for educational activities: 1st year: 1200 euros per student, 2nd year: 1200 euros per student, 3rd year: 1200 euros per student.</p> <p>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.</p> <p>Desk availability: shared use</p> <p>Computer availability: individual use</p>