

PhD in Management, Production and Design

Research Title: Machine scheduling solutions for innovative production systems.

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Context of the research activity	Nowadays we have seen the raise of new frameworks in production systems, mostly thanks to the enabling technologies of industry 4.0. It is in fact not always true that consolidated production schemes suitable for equal jobs, could be the right answer to market requests of customization, flexibility and time to market needs for products. Customization and flexibility are key aspect in today's production systems, thus also giving rise to new issues in the field of production planning and control of such systems. The classical approach in scheduling relies on one typical instance, under which the problem data are assumed to be completely known in advance (during the generation of the schedule) and to be constant. The schedule performance is then optimized and evaluated only with respect to the nominal instance. Today's technologies related to industry 4.0 pose new challenges with respect to machine scheduling in different contexts. These technologies exhibit key characteristics of high customization and flexibility also considering when concurrently scheduling orders from different customers may be crucial to match requests and to some extent competitiveness.
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Objectives	Aim of the research is to create a framework for scheduling problems in the context of Industry 4.0 and innovative production systems (for example highly customization and additive manufacturing). One objective of the research is to be able to derive processing times of jobs starting from the characterization of the part to be produced for example, by means of a CAD design in order to be able to generate a schedule. This involves the use of machine learning approaches or other statistical based methods to study the possibility of inferring processing time of an object given its characteristics (technology, material, etc.) These derived processing times may or may not be deterministic, in this case the framework should also consider robust scheduling which involves the use of interval based processing times. As a second fundamental objective it is expected to identify and select different innovative production system to study in detail. In particular, this part of the research will be devoted to design and implement solution algorithms able at managing different aspects of such innovative systems, constraining the solution methods based on different technologies and/or specific characteristics. This second objective will be achieved applying combinatorial optimization methods and in particular mathematical programming and heuristic algorithms or a combination of both (matheuristics).
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Skills and competencies for the development of the activity	Candidates should have a solid background in management engineering and Management Engineering Master Degree is required. Coding skills in a common programming language (C++, Java or Python) are key competences to develop the proposed research. Knowledge in the field of combinatorial optimization and in particular about production scheduling are also required. Any previous research experience at international level are also considered as valuable elements to better develop the proposed activity.
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