ABSTRACT

Currently, traditional production planning and control (PPC) systems focus on producing what the market demands with the expected quality, schedule and volumes at a minimum cost, while adjusting for disruption. The exploration and implementation of new technological advances, such as CPS, cloud manufacturing (CMfg), additive manufacturing (AM), big data, artificial intelligence and the Internet of Things (IoT), could change organisational aspects like PPC responsibilities. In this context, no studies on a system for decision making, architectures and conceptual frameworks for the new intelligent systems of PPC and industry 4.0 (I4.0) have been identified.

In this context of new technological and organisational changes that small- and medium-sized enterprises (SMEs) have to face, the problem of designing PPC tools that enable the integration and collaboration of production operations arises. Thus, based on the new digital production technologies and organisational tools that will support the connected smart factories of the future, lack of an integrated PPC and I4.0 system was identified.

The present doctoral thesis is a compendium of articles addressing a comprehensive literature review on PPC in an I4.0 environment. It also proposes a conceptual framework and the design of models and algorithms for decision making and to support PPC functions in a digital I4.0 context based on the new digital production technologies and organisational tools that will support the collaborative and connected smart factories of the future. The proposed mathematical models and algorithms focus on solving the problem of designing a sustainable and resilient supply chain where strategic and tactical decisions are made in an integrated way. The models, algorithms and resolution method have been programmed in Python. The models have been validated by means of software that generates synthetic data instances and allows the models' computational complexity to be evaluated. The development of this type of models and algorithms is a significant contribution to the academic field.