

Predictive and resilient approaches to industrial planning applied to the automotive sector

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Abstract. Automotive production planning has become increasingly complicated and its structures and processes difficult to manage as a result of planning volatility, disruptions to logistical flow and urgent customer demand for increasing availability of customization. Digital solutions that have developed from Industry 4.0 technologies such as artificial intelligence have and continue to create opportunities to automate decision making, resource management, demand forecasting. However industrial systems and complex continuity of operations have taken critical damage from recent crises (primarily COVID-19) and these events have highlighted the fragility of planning within the context of the disruption cycles of Industry 4.0 planning. In this context, resilience has emerged as a critical capability, defined as the ability of systems to absorb shocks, adapt to change, and maintain operational continuity. In this study, the complexity of the notion resilience will be compared with two models of industrial planning: one rooted in the Industry 4.0 sector predictive performance models; the second is built in the future notion of Industry 5.0, which builds on elements of resilience, flexibility and human-machine alliances. The analysis reflects a lit review demonstrating recent findings, and illustrated with examples in the European automotive sector, the analysis uses a multidimensional evaluation grid of the two models of planning, covering criteria such as agility, robustness, transparency and human integration. Quantitative results show that Industry 4.0 outperforms in accuracy (57.1%) while Industry 5.0 leads in flexibility (57.1%), robustness (58.3%), agility (56.2%), transparency (63.6%), and human-machine integration (72.7%).

The findings demonstrate both paradigms, while showing some differences, are complementary, and postulate the idea of a hybrid planning system. The importance of digital twins, explainable AI and other collaborative interface technologies as a means of adapting and maintaining continuity when planning in conditions of uncertainty will be examined.

Keywords: Planning, Industry 4.0, Industry 5.0, Artificial intelligence

