

THESIS ABSTRACT

Increasingly complex and customized products require in-depth life cycle knowledge, which is almost always impossible. This thesis project aims to propose a design support methodology for making informed decisions in all those contexts that can be defined as One-of-a-Kind. In one-of-a-kind production (OKP), the probability of defective products is very high; moreover, designers must test their ideas quickly and inexpensively. In this context, knowledge generation, storage, and reuse play a fundamental role. Scientific research proposed a paradigm that involves the integration of Product Lifecycle Management (PLM) system tools with the Manufacturing Execution Systems (MES), employing a central Knowledge Base System (KBS), allowing communication between designers and the production line in both senses. This way, it is possible to manage design using data from production to minimize defects. For all these reasons, designers need to precognition the optimum process parameters and get insight from the production. Furthermore, a tool to make designers aware of quality's impact on cost and environmental impact is crucial.

The thesis is based on analyzing three different One-of-a-Kind Design problems from various industries and domains. The first challenge involves the deployment of an innovative wireless recharging system for industrial applications. The purpose of the first case study is to create a tool to support the sales teams in forecasting the best positioning of the system, given some customer constraints. The second case study is an application of Additive Manufacturing to find the best parameters to support the designers in considering the quality of the part and its cost and environmental impact. The proposed approach can be used both in small and big contexts, even if we think that the best-achieved results can be obtained in democratic manufacturing paradigms like Crowdsourcing Manufacturing, Semi Artisanship Manufacturing, Cloud Manufacturing, Urban Manufacturing, and Social Manufacturing characterized by open or easy-to-share design approach, high personalization, unicity and specificity of products low production volume.

Finally, the third case study is based on a study of the feasibility of an innovative robot-to-parts warehouse picking system with two distinct issues: (A) find the best shape of racks and the minimum number of vehicles needed to manage the warehouse, and (B) study most appropriate.

This case study analysis makes it possible to define a general framework. The framework is composed of four different steps (A) Design Space Definition, (B) Knowledge Generation, (C) Optimization, and (D) Final Decision.