Chapter 10

Design of Cloud-Based CAPP System to Aid Process Planning for Sheet Metal Products

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ABSTRACT

In the design of new products, it is usual for different planners to specify different processing routes for the same part, which do not always incorporate the optimal solution to the problem. Computerization of process planning has evolved as a solution to speed up planning for new products. The essence of the chapter is to explore machine capabilities, parameters, and constrains inherent in sheet metal forming processes and then illustrate CAPP software design for process sequencing for new products to support standardisation of production routes. The verification of the designed CAPP system has realised significant savings of 40% reduction in process planning effort, 5% in material, 15% in scrap and 10% in tooling. In order to design the cloud-based CAPP system, data was gathered on the machinery capabilities for the sheet metal operations in a case study company that manufactures sheet metal accessories for the construction industry. A computer-based system was developed to store the machinery tool capabilities and their functional parameters and to facilitate sharing of information across the system modules. Autodesk Inventor® was used as the source of input for the CAD models into the system. Visual Basic. NET programming language was used to design a module for feature recognition (FR) to capture characteristics from a CAD model drawing of the new sheet metal product. A module was then developed to sequence the process operations for the CAD model based on the part features. The process sequencing system helps designers and process planners to link the new model design with the production path, the tools, and equipment required in order to improve their design and planning in the early stages of the product life cycle.

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Introduction

Process planning is an important task in the manufacturing cycle; it determines how a product is to be manufactured. Traditionally process planning was carried out manually by experienced engineers who would interpret engineering drawings of products and determine the 'best' route and manufacturing methods based on available materials, processes, and the time scale and cost restraints. Computer-aided Process Planning (CAPP) is an important element of production planning. However, existing methodologies failed to meet the requirements for CAPP systems in the cloud, which is a distributed, collaborative, and web-based environment (Xu and Lu, 2015).

The sheet metal industry is ever growing due to the increasing demand for white goods and the ever rising demand in the built environment, but one of the limitations that it faces is the manual planning of production processes, thus causing time inefficiency in meeting the customer requirements. Manual planning is time consuming, labour intensive and may involve human errors. More time is spent attempting various iterations in order to establish the optimum method. This leads to many hours being lost as idle time in the production system. Experienced process planners have no difficulties in managing the complexity of process planning compared to the novice who is facing significantly bigger challenges. Grasping the scope and understand the type of decisions made in process planning is difficult (Lundgren et al., 2014). Large volumes of scrap accumulate at production lines as a result of the non-optimal process sequencing done manually. There is rework that looms in some instances due to some product batches that has to be either trimmed or cropped.

Traditionally companies have been buying complex standalone application software to be installed and hosted on company premises, which has proved to be an expensive investment. Many small-to-medium enterprises (SMEs) cannot afford the high initial investment. The approach also makes it difficult to manage ICT costs. Such a model is viewed as a one-fits-all approach, where companies would pay for certain number of users for their software licence for certain fixed periods. Many users would have to be trapped in the old software version, according to their licence renewal period. Cloud Computing (CC) is revolutionizing business approach across many enterprises, with its pay-as-you-go model and the SOA architecture. The service oriented model in which “Everything is treated as a Service” (XaaS) is helping manufacturers, among many other businesses, to align production efficiency with business strategy as well as promote collaboration through intelligent factory networks where resources of various kinds are shared. The huge success of cloud computing brings the opportunity to the manufacturing systems with high scalability, productivity and agility. It also provides practical solutions to the small and medium-sized enterprises with elastic investment solutions (Wang et al., 2017).
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