# Automation of Engineering Activities in Pre-Production Stages

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# INTRODUCTION

Between 2008 and 2015, many businesses were experiencing a difficult period of recession in production. This has given businesses an opportunity to look for new possibilities in development, as the pressure to reduce costs continues up to now, causing market shifts in terms of its share redistribution. Customers are looking for new products at more affordable prices, certainly of high quality, with good service attached. Projects involving new product launches are being designed and prepared. Company managers are getting ready for production recovery. Preparation of projects introducing new production takes into account all aspects related to development and technical preparation of production, production of prototypes, familiarization with production, processing marketing sales support, as well as preparation of service support. The development and design stage, that conceives of the shape, design and overall structure of the product, design documentation including, significantly impacts the total costs, and therefore the price of the product. In the 1980s, a massive introduction of CA systems (computer-aided systems) proved to be an effective step in reducing costs, shortening the TPP (technical preparation of production) and increasing the efficiency of TPP stages. The engineering calculations, analyses, modeling and design documentation became streamlined and accelerated. Presently, there is pressure to design projects and use elements and project management methodologies which would enable planning and management of all processes and stages related to launching new products on the market and significantly reduce the duration of TPP stages. Customer requirements of reducing development stages, minimizing costs, and increasing product quality put pressure on shortening the product innovation cycle. Meeting the requirements to shorten the overall product cycle, from design to delivery to the customer at the lowest produc-

tion costs, is the most important prerequisite for success of a company. In addition, it is necessary to take into account the competitive environment and the customer demanding high quality at low price. For the product to be competitive, it must meet the qualitative and functional requirements, low price, pleasant design, high reliability criteria. This all affects the product marketability.

Concurrent Engineering – CE introduces a philosophy of new perception of the process of component creation. It establishes new relationships between employees, departments and computer systems. The CE concept can be applied in a company with various degrees of development of CA systems and technologies. There are a number of definitions of the concurrent engineering concept. One of them defines it as: "An organizational strategy that promotes close cooperation between different areas of component development and production in a company, as well as between the company, the component suppliers, the means of production and the customers. The aim of this organizational strategy is a parallel development of a product that is functional, reliable and safe at the same time, and of such design of manufacturing process and manufacturing system that will enable the overall time of innovation implementation to be as short as possible, while achieving a higher level of quality at a lower cost." The primary goal of concurrent engineering is thus to maximize the reduction of product development time by applying parallel task execution. It is often the case that only in the production process it is found that the design of a component cannot be manufactured or, if it can, then at a relatively high cost. The component design often includes elements that are expensive to produce, need special tools, or involve special technologies. This is mainly reflected in increased production costs. Such finding is followed by a revision process, during which the designing department is instructed to change the component structure. Thus, the production time is

extended. Again, the component passes consecutively through the design – technology – production chain. As a consequence of this negative phenomenon, the concept of concurrent, parallel, or simultaneous engineering has emerged. It is a new perception of the component production, where later additional interventions due to improper design are eliminated in the early stages of design and construction. This is mainly due to the fact that the consequences of an incorrect design are manifested in later operations, such as production, assembly, inspection and dismantling, although the functional part is properly dimensioned and designed.

A typical tool for applying the Concurrent Engineering philosophy is the use of the Product Lifecycle Management (PLM) systems. PLM systems represent the tools for automating engineering activities in the product life cycle. PLM solutions are based on the idea of a close cooperation between individual areas involved in the final product, from its design to the end of its technical life. Collecting a large amount of data and information on the product under observation is typical for this kind of activity. PLM integrates the areas of computer aid, database and information systems, and computer networks.

From the CA tool application point of view, the generation of Shop Floor Documentation has recently gained traction in the field of computer aided production. It is a progressive form of automated generation of simplified technology documentation and is primarily designated to be used in NC machining. This option has emerged from the requirement to speed up the production of technology documentation when deploying complex CAD/CAM/CAE systems. It can be said that by nowadays, all important players in CAD/CAM systems have incorporated this functionality into their products. However, it should be noted that this documentation is often simplified, has the form of reports generated automatically on the basis of prede-

fined parameters when creating specific machining cycles. Availability of information on these modules is relatively limited, and they are only briefly mentioned in information brochures.

Automation of activities in technological preparation of production is of undeniable importance. The underlying problem lies in the specific software implementation of activities that need to be automated. Verbally described problems and actions must be oftentimes mathematically formulated. Of another importance in computer-aided systems is the integration of CAPP (Computer Aided Process Planning) with other information systems in the company. The resulting effect of CA technologies and systems will only show up in the combination of functional one-tier systems in one cooperative system with common sharing of data and information databases. The importance of integrating CA systems is limited by the way information is transferred. An integrated data transfer database is created primarily by the CAPP system. It includes complete production information about products, completed orders and work-in-progress, machinery, as well as materials for calculation of the remuneration for the work performed, etc. This information is also needed, in particular, for production planning and management systems (PPS).