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Integration of different computer-aided systems in product designing and process planning on digital manufacturing

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Abstract

In the article discusses the integration of CAD/CAPP/PDM/CAM and ERP systems while designing and process planning of machine-building production on digital manufacturing. Main attention is paid to the problem of data integration between systems developed by different software companies. Digital manufacturing makes a special demand to data structure and exchange on any stage of product life cycle. Paper shows the practical application of this problem on one of the Russian enterprises.

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1. Introduction

Rapid development of science and technology sets the following main requirement to high-performance and high-efficiency production: it has to be ready and able to stop manufacturing its previous, well-established product at any time and without losses, and within a short period of time switch to manufacturing a batch of any size of new product type.

This and many other problems can be solved by introducing digital technologies followed by creation of a single digital platform, where all components of an information system are integrated with each other, with further perspective of implementing "digital manufacturing" [1].

In most cases, the term "digital manufacturing" means an information (electronic) model of hi-tech production embracing main trends in advanced manufacturing technologies, as well as new materials and information and communication resources [2,3]. This model includes information about all processes taking place in manufacturing, as well as all volume of information about product, which can be classified by stages of its life cycle.

Development of an information model is necessary to create single information environment of an enterprise. With the expansion of production volume and product mix and increase production rates, the need for management information increases dramatically. Increasing requirements for information. Created at the enterprises of the system are already inadequate. In the new conditions it raises the question of the organization of complex information systems including all documentation, codes and media, covering a range of indicators required for management enterprise. A new quality of integrated information systems and their components (informational space) is that they must work in close integration with production management systems [4].

In most cases, engineering enterprises employ traditional technologies, such as computer-aided design (CAD), computer-aided manufacturing (CAM) and computer-aided engineering (CAE). However, enterprises are not yet ready to introduce such latest digital technologies as real-time big data analysis, electronic data exchange, cloud manufacturing. Also, most employed technologies come from different vendors, and can only be partially integrated with each other, or even are not compatible at all.

Digital tools aid process-planning services in overcoming lack of information, creating conditions for effective planning, implementing multi-function tools in technological area, as well as manufacturing operation management [5].

We treat digital technologies as being able to aid engineering enterprises in reaching excellence in process-planning. However, this requires structured approach, including initiative priority determination, data digitizing and creation of digital workflow model.

2. Concept of digital manufacturing

The basic concept that became the standard for foreign developers and manufacturers of high-tech products, is a cross-cutting modeling as properties (in the early stages of design), and processes for the preparation of production and product release. This ensures achievement of the required production (cost, time, exit products to market) and operational parameters.

The complex solution of this problem may be reached by introduction of digital technologies which allow modeling of alternative scenarios at all stages of product life cycle: designing, process planning, manufacturing, operation and aftermarket servicing [6].

The generic diagram of digital manufacturing according to the modern concept of PLM (Product Lifecycle Management) is shown at Fig. 1. It is necessary to notice that this concept is not fully implemented at engineering enterprises.

The main causes of difficulties in implementation of this concept are reviewed below.

Each stage of life cycle should ensure a digital link with neighboring ones according to provided workflows. The continuity of electronic interaction sets invariance continuity requirements for model of transferred data, including data transferred between different facilities: design offices, manufacturing plants, operators, etc.

In particular, the engineering documentation in model provided by design office has to be understandable by personnel of manufacturing plant, as well as cooperating enterprises (stage 1 to 2 at Fig. 1). The problem complexity increases if the manufacturing plant receives documentation from several design offices which use different data models. In this case, the enterprise has to develop its own internal data model (invariance compared to external sources) and ensure unequivocal conversion of source data from different source models into its own internal one.

Application of digital manufacturing principles to technological developmental work on electronic design documentation (stage 2 at Fig. 1) in ideal conditions can provide a range of advantages compared to traditional process:

- reduction of number of cycles in preparation of electronic technical document set: electronic technological models, design and technical specifications, process planning sheets, technological routes, structured assembly sets (assembly units), etc.;

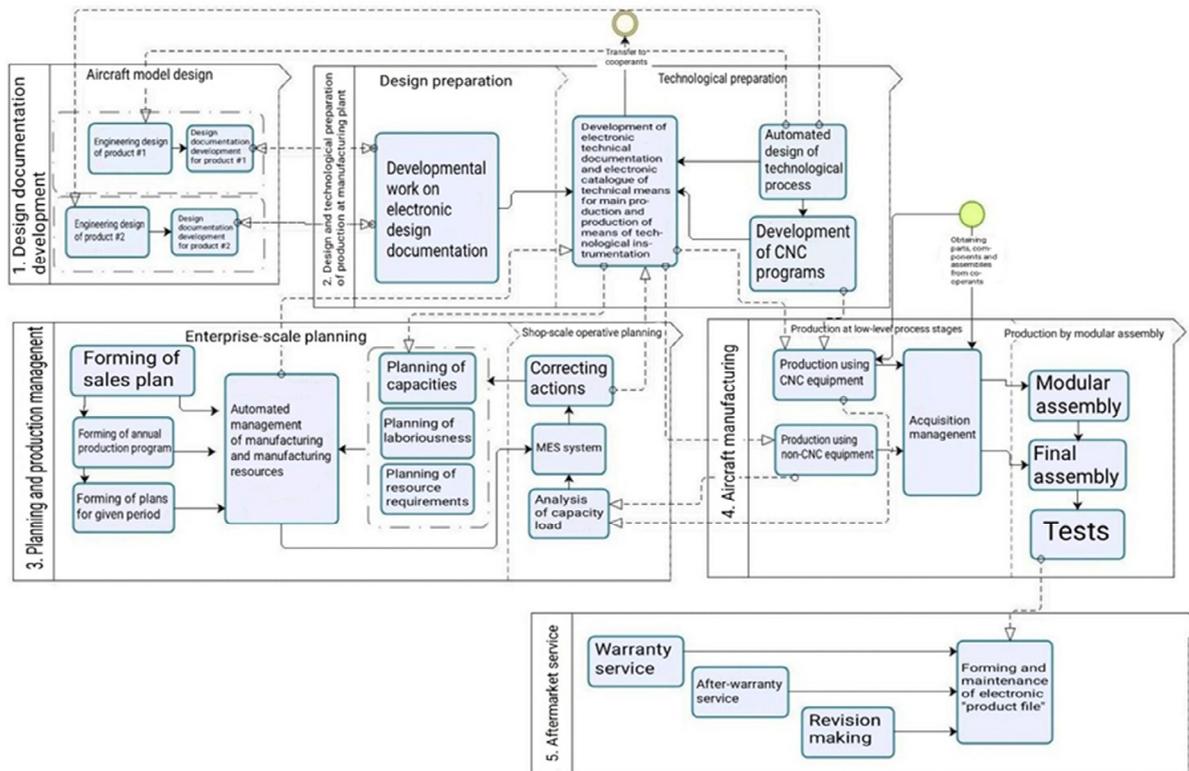


Fig. 1. Generic diagram of digital manufacturing.

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