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THE SOFTWARE APPLICATION FOR CAPP CREATED ON THE BASIS OF MULTI–VARIANT APPROACH

SOFTVÉROVÁ APLIKÁCIA PRE CAPP KREOVANÁ NA ZÁKLADE MULTI-VARIANTNÉHO PRÍSTUPU

Abstract

The article deals with the possibilities and advantages that offer the method of multi-variant process plan creation. This method is supported by database application working with mathematical tools. The preparing of processes, technological and manufacturing documentation by this way can be very advantageously for making good decisions in short periods and enable to be more flexible for manufacturing units by using of them.

Abstrakt

Článok sa zaoberá výhodami, ktoré ponúka metóda multi-variantného spôsobu vytvárania technologických postupov výroby. Táto metóda je v rámci databázovej aplikácie podporovaná matematickými nástrojmi. Príprava technologických procesov, technologickej a výrobnej dokumentácie uvedeným spôsobom môže byť veľmi výhodná pri voľbe správneho výberu nielen technologického postupu výroby, ale i použitých prostriedkov, pričom umožňuje väčšiu flexibilitu ich využitia.

1 INTRODUCTION

In the systems, which aid the activities by means of computer within the process plan, belong the CAPP systems. The procuration of integrated CAPP system can be for little and some middle plants expensive, sometimes inaccessible investment with the long recoupment period. On the other hand also for these plants it is fundamental to be the manufacturing information saved digestedly and to be used in various forms (for example for the generation of technological information or NC programs) with the possibility to successive complement, editing and modification of necessary data.

The other important precondition for the successful company application in business environment is its ability to archive of relevant data in the long term on the basis of management quality systems in the sense of ISO standard, exactly according to the requirements specified in concrete conditions. For the originating product-business subjects are the selection of the system, which aids the using and the processing of information obtained inside technological preparation of production, conditioned by financial possibilities and by the suitability for organization structure. For already existing plants, it is coessential the suitability of insertion such software product into already existing information structure without the needs of expansive interface – for example between CAD/CAM system and CAPP system, between CAPP system and the software for economical, wage and storage records.

One of the other demands for the choosing of suitable CAPP system or another software application is its flexibility and the possibility to adapt the user requirements. The solution of the prob-

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lem in regard to the data storage, data processing and data exploitation within computer aided process planning in little and medium size plants is the creating new software application on Faculty of Manufacturing Technologies of Technical University of Košice with the seat in Prešov, which aids apart from the activities listed above also the multi-variant creation of process plans with the optimization according to the selected criteria, the creation of technological documentation and NC programs on the basis of hybrid approach, comprendious production data holding and its processing with time and cost manufacturing savings.

2 POSSIBILITIES OF MULTI-VARIANT PROCESS PLANS CREATION

When applied some of technological approach, it is advantageous to subdivide complete process within a production company into problem-orientated system areas, which represent a limited area of activities. The formulated scheme of plant represents the first assignment stage for building concept of production information system. [1]

The specific tasks and activities of the production process are: design, process planning, manufacturing and assembly.

These tasks form the basis for the realization level of the corporate objective of design this information system. The direct system areas, which are subdivided into a field of Production System Design and Production System Control, are grouped around this realization level of production processes [3].

The indirect system areas cover the external influential factors of the corporate process:

- Corporate planning and organizational structure deals with the long-term and mid-term planning of corporate aim and the resultant structurizing of the corporation to reach the planned objective,
- Production system design has the task of attuning the methods and processes, which contribute to the rational realization of the technical and economic overall objective in design, process planning and manufacturing.
- Procurement deals with the optimum material arrangements in respect of times and costs,
- Marketing and Sales covers the comprehensive marketing and sales promotion systems,
- Quality assurance and accounting systems are auxiliary aids for the control function of the technical and economic corporate function of the technical and economic corporate objectives.
- Production system control is to optimize the throughput times of the orders.

The objective of product design is to raise or assure the technical value of product not only in the systemization of the design process, but also in the build-up of work aids for the rational elaboration of drawings and planning data. Thus, the term product design describes the comprehensive application of methods and work aids during the design process of a product to the release of the basic data for process planning. The objective of manufacturing design is to systemize the planning and preparation processes for the manufacture and assembly and to build up the planning data for the rational realization of the different partial assignments within the framework of the concept.

The aim of work study and wage structure is to optimize the working conditions at the work place and to increase output in accordance with scientific methods and processes.

The objects in machine engineering as are the parts, machines, equipments and other, it is possible to model on the various stages with various goals. These objects we can regard as the models (physical, simulation, computer, mathematical and other). Every of these objects it is possible to consider as system, which consists of other features, respectively as the feature that is part of some system.

The mathematical model represents the substantial object properties by the numbers or symbols, thus by the mathematical means. [2]

In the machine engineering we meet with numerical expression (for example at the part dimensioning, where conventional unit is millimetre), but we meet with non-numerical expression, too (for example at the coding of part in group technology).

In regard to a large number of parameters that are variable in consequence of the varied manufacturing process conditions, it is most suitable to use the type of code at which are the starting positions reserved for the characteristic properties of the object. Other positions are attached to the attribute part of code according to the need to define the classification of the object. On the basis of this structure it is possible the manufacturing system consider to be set, which is unification of subsets marked as subsystems. (Fig. 1)

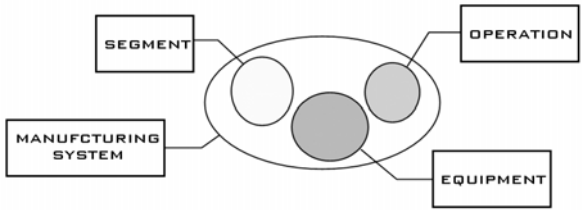

Fig. 1 Manufacturing system like set for mathematical model

The created system can be expressed by the relation:

$$MS = S \cup E \cup O,$$

where

MS .. manufacturing system,

S..... segment,

O .... operation,

E .... equipment.

The basis of subsystem "Segment" is the classification code for the segment description, which represents the start point of whole system. The suggested coding system keeps the space for the process plans creating not only for cutting technology but also for other technologies. The codes cover the following characteristics:

- the geometrical shape,
- the class of part,
- the manufacturing characteristics,
- the class of dimensions.

During the creation of software application it was suggested several manners of the segment classification, for example according to the types of surfaces that didn't comply from the view of the classification complexity. The example of generated code and the structure of this code are shown on the Fig. 2.

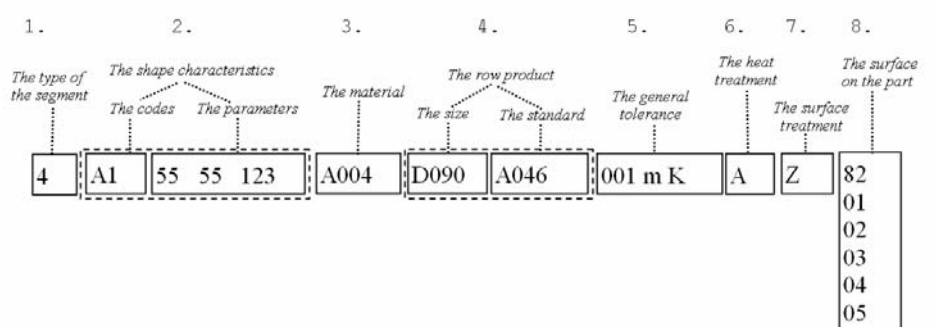

Fig.2 The structure of individual code parts in subsystem Segment

In this code, for example, the 4-th part of code describes the raw product size. This part of code is created by 4 positions. The first position is defined by alphabet letter, which determined the kind of raw product (for example into the group "A" fall the sheets, steel strips …). The second, third and fourth position give the standard sequence for specific kind of raw product in database module. It is possible for the plant to register till 1000 standards for one kind of raw product.

The coding of the Segment in this software application go out from the assumption that the data registered in this module will be next used at the creation of technological or drawing documentation and the parameters already once defined will be possible to record by another database module. Therefore the Segment code can to appear too difficult on the first sight, but at the work in user interface it is its creating very simply and it is aids by already partially charged by data bank.

3 INFORMATION SYSTEM FOR REAL PLANT BY MULTI-VARIANT PROCESS PLAN CREATION

According to analysis of requirements real plants concerned in project were at University prepared necessary data structures by means of relation database. By means of database system were created the following steps:

- Users rules for definitions of rights
- Queries for selecting required data
- Forms for data editing by operators
- Reports for exploring of relevant data
- Procedures for operation with data

For correct database working is required fill all relevant information to interface for storing properties and characteristics of production segment. Under term "segment" is for purpose of this information system mean all manufacturing objects from part, through subassembly and assembly groups to final product). This interface is asking for basic information about production segment and further indications (numbered following Fig.3) [5]:

1. Identifications of segment by basic information
2. Raw product identification
3. Information about prescribed tolerances
4. Heat treatment information
5. Surface treatment information
6. Surface roughness information
7. Documents (definitions and full electronic form) related to segment of production
8. Surfaces generating volume of production segment
9. Indications for individual technology
10. Indications for type technology
11. Indications for group technology
12. Indications for case cancelling of production segment

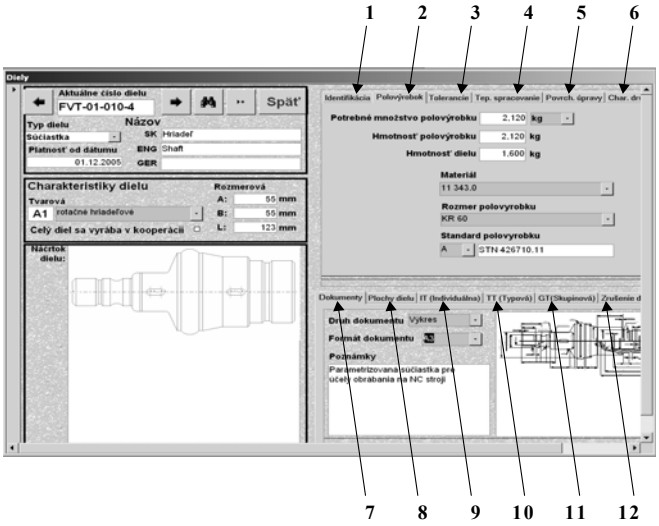

Fig. 3 Interface for definition of properties and characteristics of production segment (part, subassembly … final product)

These procedures must be worked out by operators with knowledge about advantages and disadvantages every strategy, which can be used for processing of production segment. In frame of this phase it is possible to prepare the classification of this segment for future handling as well as possible in manufacturer conditions. [4]

After imputing all relevant information - production segment data and classification – is information system ready for definition of manufacturing characteristics (Fig. 4).

It is possible for operator to create more process plans (No. 6) suitable for actual production segment (No.5 in Fig.4). For example for every hypothetic event, which is able to occur in the future, the operator creates one process plan with equivalent strategy, or in case of new unpredictable state it can be worked out new strategy. Basic varieties of prepared process plant are worked out for example for these cases:

1. Maximal efficient
2. Minimal cost
3. Change of goods flow (in occurrence of use to full capacity machine tools)

It is possible to define more phases inside every process plan (No.7). Every phase is relative independent line of operations. For example the first phase may be the casting, the second - machining and the last one - surface treatment.

In the frame of phase the operator may work out manufacturing sequence by this way:

1. The handle writing of technological operation cycles (No. 1 in Fig.4),
2. NC program (No. 2) – direct writing by operator or established for group in frame of GT or downloaded from NC program creator …
3. Sequence of operation pictograms (No.3)
4. Simulation sequence (video, animation, …) (No.4)

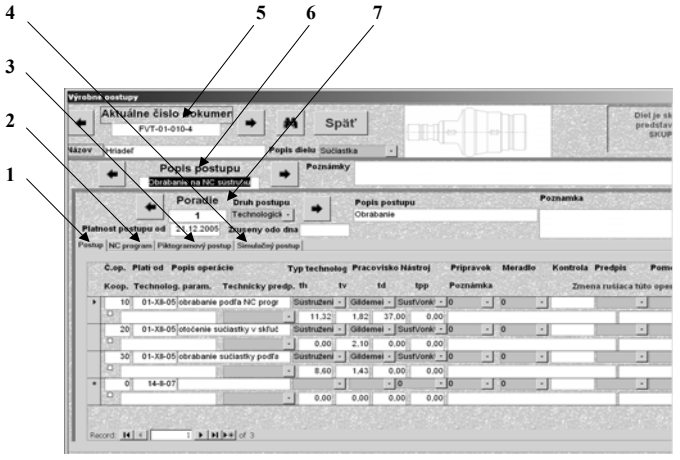

Fig. 4 Interface for definition of manufacturing characteristics

Every prepared process plans can be used for production optimization to find the best way for actual condition of plant. This way of looking for best manufacturing flow is in project named MULTI-VARIANT PROCESS PLAN CREATION.

4 CONCLUSION

Economic pressures urge manufacturers to make more customised products of high quality, in smaller series, with shorter lead-time and without increased costs. Time is becoming rapidly the most strategic topic of companies. Costs are also important, but more important are competitive price and the most significant are marketability of manufactured products. [7]

Resource cost and job cost have essential influence on direct product cost. The outline strategic business goals can be achieved by increased flexibility and well-organised information flows.

The process planning activity nowadays mostly influences on flexibility during the production phase. Currently, process planning generates operation sequences which do not comprise manufacturing alternatives. It is important to overcome unpredictable disturbances in the information chain of manufacturing, such as variations in customer demand, stochastic malfunctioning of manufacturing equipment or evolutionary developments.

Engineering activities realised before manufacturing are very important in term of influencing of total production cost. The engineering drawing and the process planning such as the main engineering activities are critical production cost factors. Designed features of the part determine the used machine operations and the machine equipment during the manufacturing. The selected machine equipment represents essential factor for evaluation of the production costs. That is why during the process planning is possible to a big extent to influence on the production cost.

The process plan also very affects another important factor as is time to market. Accordingly consistent computer assistance and aid can reduce time to market and also production cost. These factors impact on competitive advantage as a very important tool of market success.

The process planning activities are significant means for flexibility, time to market and competitive advantage of enterprise. The process planning systems are therefore important tools for increasing of efficiency and profit. [6]

Information system project for process planning is running at Technical University of Košice, Faculty of Manufacturing technologies with seat in Prešov, developed in collaboration with plants in Prešov, tries to find new tools and advanced methods for solving of the process planning task in the modem enterprise.

Built information system was tested in real manufacturing conditions and on the fly reworked to better results of out coming manufacturing and control information. By means of this information system it is possible to execute these activities:

- Multi-variant process planning,
- Production planning,
- Necessary direct material for manufacturing,
- Optimization of incoming material variety,
- Evidence of orders and in-process of those orders,
- Evidence of workers piecework.

The information system is built like open system. This characteristic makes it possible connect additional modules for extension his functionality.

Modules for analyses of incidental time and batch time are created at Technical University in Košice in present time.

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