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POSSIBILITIES OF COMPETITIVENESS INCREASING OF EUROPEAN COMPANIES VIA DATA UNIFICATION AT PROCESS PLANNING

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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.The results presented in the article are used in authors workplace conditions and they originate with the direct supporting of Ministry of Education VEGA registration number 1/0558/08.*

Key words: *template data unification, computer aided process planning – CAPP, production information system.*

1. INTRODUCTION

Many of East European (EE) plants were forced to transform their production schedule, quantity, types and kinds of products in 90th years of previous century, but they are working with old philosophy up to this day. This is one of the reasons why EE plants are still out of competition to west firms despite of cheaper manpower.

Modern methods of management and manufacturing control are based on computer aid. Production experiences pointed to that good implementation of computer aid can create benefits, but inappropriate implementation may be economically and technically

Basic present-day problems of production companies from view of information systems (IS) can be covered by their requirements:

- Availability for usage in wide areas of production approach.
- Simple implementation in entrepreneurial surroundings.
- Modular concept for covering all necessary areas.
- Reliable and secure data formats and structures.
- Possibility of flexible bilateral data sharing.
- Possibility of a trouble-free extension of IS.
- Securing the possibility of a relatively fast transfer to higher level of IS.
- Reasonable price.

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.

On the basis of these objectives, a structural concept was developed for the information system of production system design in the field of mechanical engineering. They constitute the basic form for further database structure building.

2. STRUCTURE OF ENTERPRISES IN THE EU

One of first steps was analyse of typical European enterpriser and selecting of key requests of these unites for manufacturing information system.

The statistical studies show that European micro companies constitute a substantial part of the European market as they comprise 92 per cent (17.82 million business units) of the overall number of companies and employ 39 per cent of the employees. Small and medium size companies together comprise 7.5 per cent of the overall number and employ 30.3 per cent of the employees. The rest (0.2 per cent production unites and 30.2 per cent employees) is covered by large companies.

Other results of this same study show that micro companies has the disposal of a free potential of 20 per cent of the productivity and 15 per cent profitability [1].

These are very important characteristics which describe a distinct ability of the dynamic growth production and the possibility of effective evaluation of micro company instruments basically ‘over a night‘.

On the basis of the analysis of potential system users securing the computer support of the computer aid process planning, it can be said that it is the micro companies that constitute the significant part of the enterprise subjects. The specifications of this type of enterprise units imply diametrically different demands on information systems from the normal setting of IS appropriate for

large and medium size companies. From the point of view of the information system constitution, the basic demand is the security of shared manufacturing information between commercial partners.

3. DESIGN OF COMPUTER AID OF PROCESS PLANNING

Fundamental operations for definition of information system for computer aided process planning (CAPP) were grounding at:

A. Formulated scheme of plant.
B. Structural concept of CAPP.
C. Process planning approaches.

For creation of system philosophy 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 shown in Fig. 1 [2] represents the first assignment stage for building concept of production information system. The specific tasks and activities of the production process are Design, Process Planning and Manufacturing & Assembly.

From view of structural concept is possible divide Production System Design consists to basic parts:

1. Product Design
   a. Design Procedures (E),
   b. Design Methods (E),
   c. Value Analysis (E).
2. Manufacturing Design
   a. Technological Structure Planning (I),
   b. Process Planning (I),
   c. NC Programming (E).
3. Work Study and Wage Structure
   a. Work Analysis (I),
   b. Work Measurement (I),
   c. Wage Scheme (I).

According this structure was selected fragments of information system in two main groups:

- Integrated modules (I) – created by authors of this contribution.
- External applications (E) – e.g. CAD/CAM software, postprocessors etc. required for.

Therefore the system was built on the basis of the following technological approaches:

A. Individual technology,
B. Type technology,
C. Group technology.

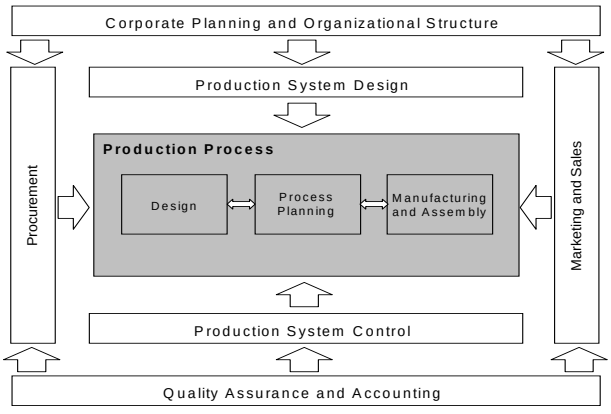

Fig. 1. Formulated scheme of plant.

The *individual approach* includes the creating of manufacturing documentation for each component individual without the possibilities to use the same repeated operations for certain set of manufacturing objects (from parts through subassemblies and assemblies to final products). It can be said that his approach is not connected with standardization of technological processes and with the activities linked with them.

The term *type technological process* represents the specific technological process for group of parts with the equivalent technological characteristics. This process is suitable for specific group of parts and defines the type and the sequence of main technological operations. The important term for Type technology is The Type Representative. It's real or abstract object of manufacturing, which technological process contains all basic and auxiliary operations existed in this group of parts. Typifying the technological processes can be realized by two methods that are varying in the usage and in the objects of classification. They are:

- typifying technological processes.
- typifying of the items within technological processes.

The following proceeding is typical for typifying the technological processes:

1. classification of parts,
2. projection of the type technological process (operation),
3. specification of individual technological process phases,
4. development of technological process for the type representative,
5. transmission of type technological instruction to specific part.

The proceeding of works on the typification is started by development of Design-technological classification list of parts. The main of such classification list is the analysis of part basis and technological processes, which are used now or which will be used in the future.

Last used approach is *group technology*. It is manufacturing philosophy and strategy that assists a company in understanding what it manufactures and how those products are then manufactured. In manufacturing engineering, Group technology focuses on similar machining operations, similar tooling, machine setup procedures and similar methods for transporting and storing materials. By identifying similarities in manufacturing (machines, tooling, process sequences, etc.), similar workpieces parts (geometric shape and size) can be grouped into distinct families and processed together in dedicated workcell. Some parts may look similar to each other, but because of differences in materials, tolerances or other production requirements, they have different manufacturing conditions and so don't create "manufacturing family of parts". In contrast to Type technological processes, the Group process is always specific and it serves as technical instruction to realize individual operations. The approaches to Group technology are today based on the fact that all technical and organizational evolutions inside specific manufacturing unit contain activities or data with some degree of similarity. So they can be combining into the groups for which are used common solving and

methods. The methodological tools for the sorting of parts are different classification and coding systems.

4. THEORY OF MULTI-VARIANT PROCESS PLANNING

Theory of multi-variant process planning deals with the production process (during its project phase, also during the production) as a homogenous whole, including technological and labour processes organised via various possible parallel phases in the way the final product could be processed in the optimized way for the set conditions whilst fulfilling all the demands required by a consumer.

The theory was developed by authors at Technical University of Košice, Slovakia.

On the basis of this theory it is possible to create combination possibilities of various techniques used in individual process planning based on the strategy aimed at achieving the specific goal of the production unit. The main objective of this theory is:

- Creation of the unified definition environment for all the factors immediately influencing the result of production process.
- Flexible interface which enables bidirectional exchange of the required information with all surrounding systems.

Via the unified definition environment the philosophical and conceptual unity is secured within the whole issue falling into the formation area of multi-variable process planning, a distinct classification product constituent and the laws of production sequence for operation projection which allow the use of several possibilities designed by information system based on this theory [3].

Very simplified scheme of information system working according to multi-variant process planning (MVPP) theory is shown in Fig. 2.

Using the MVPP theory was created information system combining many flexible modules. The system was tested in real manufacturing condition.

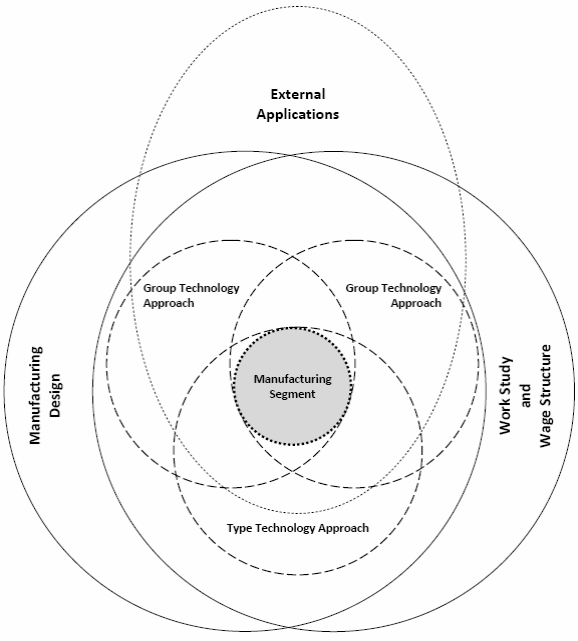

Fig. 2. Scheme of CAPP information system relations.

5. THE REAL MVPP APPLICATION

Flexible interface of the system must enable an effective work in the production environment in the way all the individual relevant systems creating heterogeneous information system (CAD/CAM application, wage records, accounting, material management, ...) have the inter-connection secured via the suitable interfaces in order to prevent the errors caused by data redundancy, human factor, but also to reduce the response time to a minimum. Really tested Multi-variant Process Planning system was originated by interconnections for wide variety of CAD/CAM systems (models, CL data & NC programs etc.) and various methods of technological approaches for multi-variant process plan design correspondent to requests of European plants.

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.

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 structuring 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.

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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.

All functions of this system were tested at work different kind of products – from simple assemblies to complex product consists of some thousand parts.

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 every manufacturing objects (starting from part, through subassembly and assembly groups to final product).

This interface is asking for basic information about production segment and further indications:

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, standards etc. in full electronic form) related to segment of production.
8. Information about segment shape (Surfaces or volumes generating 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.

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

It is possible for operator to create more process plans suitable for actual production segment. 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 cases Maximal efficient or Minimal cost or Change of goods flow (in occurrence of use to full capacity machine tools).

It is possible to define more phases inside every process plan. 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,
2. NC program – direct writing by operator or established for group in frame of GT or downloaded from NC program creator …
3. Sequence of operation pictograms,
4. Simulation sequence (video, animation, …),

Every prepared process plans can be used for production optimization to find the best way for actual condition of plant.

6. CONCLUSIONS

On the basis of the aforementioned theory characteristics the information system was created and applied into real production conditions. The largest product operate in this system consist of approximately 6 000 components.

The main contributions of assigning IS elaborated in the real manufacturing conditions, can be summarized as reduction of the variability of warehouse stock (at the first application by nearly 30 per cent), immediate information about the product elaboration, fast acquisition of the details via interfaces for the wage records and accounting, elastic analytical tools enabling the adoption of better decisions, and acquisition of the statistical values of parameters applicable to plan production in the future.

The software tool is created in the way to be easily implemented to an already existing information company structure via flexibly adjustable interfaces. It is also user-friendly, developed with the characteristics of GUI, typical for OS MS Windows, so that the basic grasp of its functioning does not require expensive trainings [4]. Obviously, if the maintenance of this system is to be productive, it must be familiarized with the given philosophy and possibilities of tactic and strategy planning, through which the production can be optimized.

Presented manufacturing information system is unique in possibility cooperation by CAD/CAM system (practically with any from known) and connectivity to other systems (accounting, stock, wages etc.). This concept brings advantages manly for micro companies.

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