THE ASPECTS OF INFLUENCE OF TECHNOLOGICAL COMMUNICATION ON MANUFACTURING PROCESS PRODUCTIVITY INSIDE NEW MANUFACTURING INFORMATION SYSTEM

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Abstract. The article deals with influence of technological communication on manufacturing process productivity and with the possibilities of technological communication among companies in production chain regarding to the efficiency. This multivariant system originated at Technical University Košice with seat in Prešov, Faculty of Manufacturing Technologies, and it was called IAS - Individual Application System. There is pointing out advantages of some production data sharing and processing of them in the system. By means of this method it can be prepared the processes, technological and manufacturing documentation very advantageously for making good decisions in short periods. Established solution serves to the purpose of easier and faster assigning of the process parameters, shortening of the computer aided process planning documentation time in real production conditions, and it also supports the effective utilization of the production plant based on the model mathematical description of object variation of the computer aided process planning, fulfilling the combination of the required characteristics within the given production conditions. Output system data can be used for processing of the details for the warehouse, economic and wage records as for their control and optimization.

Keywords: efficiency, communication, information system, technological aspects

1. Introduction

Basic present-day problems of production companies from view of production information systems (IS) can be covered by their requirements: availability for usage in wide areas of production approach, modular concept for covering all necessary areas, simple implementation in entrepreneurial surroundings, 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 and reasonable price.

Generally, production companies can use for selection of production software all variations between two extremes: Complex systems or Independent solution for every application field of enterprise activities.

First one is for many small enterprises inaccessible by reason of system complexity, fixed structure, expensive price, large and complicated adaptation, time-consuming maintenance etc. Second of them generally dispose only by flat possibility of interconnection to other information systems. Basics problems deals by authors for development of manufacturing information system (MIS) are:

- Autonomous reasoning for wide variety of technological approaches,
- Flexible structure of data for optimizing procedures,
- Arrangement for obtain of advantages of both extreme - Complex systems vs. Independent solutions,
- Integration MIS in environs with specialized systems (CAD/CAM, salaries, financing, materials, accounting ...),
- Very good possibility of data sharing by external applications and co-operators.

The described research was focused to find out of newer computer aided process plan philosophy and data structure conjunction fore wide spectrum of technological approaches.

2. Basic Types of Technological process

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 [3].

From the point of view of the information system constitution, one of the basic demands is the security of the possibility of creating the information relation among the enterprise unit subjects on the European market in the way the exchange of the required information in a data way is secured. From the viewpoint of the demand variety of the individual companies, the conditions were assessed when proposing IS:

- The system has to be able to work with the possibility of the user view on the production process from several angles,
- Enterprise subject should be limited when launching new products to the production process as little as possible,
- It should be applicable for a wide range of business,
- It should be modular.

Thus, the system was built for the product definitions and their parts from the point of view of three profoundly different technological approaches:

1. Individual Approach,
2. Type Approach,
3. Group Approach.

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. The typification of technological processes can be realized by two methods that are varying in the usage and in the objects of classification. They are:

- The typification of technological processes as the series of technological operations, by means of which all parts of the specified group can be made.
- The typification of the items within technological processes. By means of such processes the specified operations, occurred on the dedicated group of parts, can be realized.

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.

Another kind of technological processes standardization 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 combined into the groups for which is used common solving and methods. The methodological tools for the sorting of parts are different classification and coding systems. [2]

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.

3. The Basis for Drafting the Computer Aided Process Planning

Computer Aided Process Planning (CAPP) represents activities leading to a creation of production documentation and the details of material equipment for the production process. The cost structure analyses for small and medium series production indicate a significant ratio of CAPP in the production costs composition. From the point of

view of these analyses it is very important to pay a considerable attention to the CAPP area which can, as a result, influence the output costs of a product and its quality in a great measure. When designing the new product the aim is to secure or increase its technical value not only by systematization of the production process but also by increasing the level of the supporting tools for the rational processing of the production documentation and data needed for planning.

Figure 1 show the production system design logically divided into parts. [1]

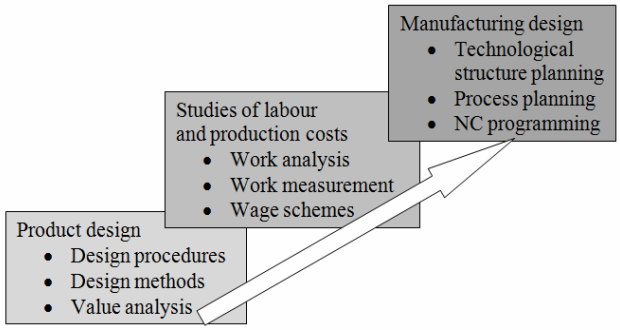

Figure 1. Structural concept of information system

4. Multi – Variant Process Planning

The 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. 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.

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 and various methods of technological approaches for multi-variant process plan design correspondent to requests of European plants.

According to analysis of requirements real plants concerned in project were at Technical University of Kosice prepared necessary data structures by means of relation database. The real database consists of approximately 100 tables and relations among them. The prepared information system was called Individual Application System (IAS). Relation database makes it possible to creating models of real objects and processes by Relational Algebra (RA).

Relational Algebra can be viewed as a data manipulation language for relational model. It consists of several basic operations which is enable user to specify retrieval requests. RA is called a procedural language in which user need to specify how to retrieve the expected data.

Database of IS was built by application of RA by means of creating all necessary joins for generation of database models of real manufacturing conditions. The joins are comparatively complicated because the database connecting totally different technological approaches (Individual, Type and Group). System complexity is increased by wide variety of working possibilities of system user. [5]

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:

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

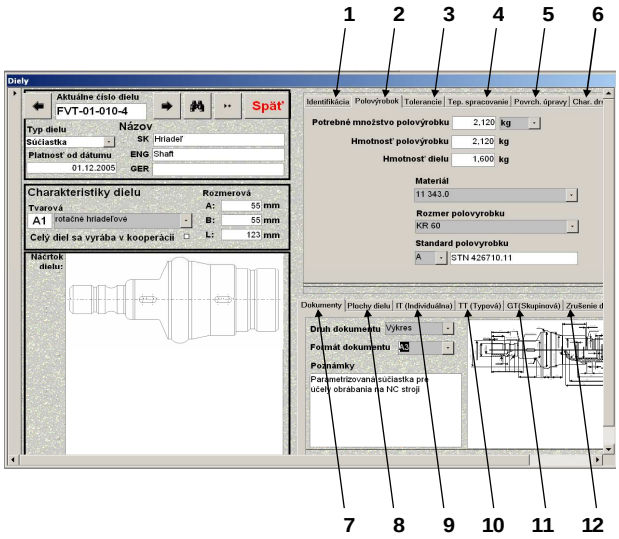

Figure 2. Interface for definition of properties and characteristics of production segment (part, subassembly … final product) [4]

5. Conclusion

On the basis of the aforementioned theory characteristics the information system was created and applied into real production conditions in the computer aided process planning consisting of approximately 6,000 components. The given product was a result of the cooperation between a German company, providing investments and cooperation of the activities, and Slovak companies providing a technical process planning and the production of a final product. [4]

From the very beginning of the project the established IS served for a suitable analyzing of individual real database objects (components, substructures, structures, finished product), i.e. new analytical tools were created when required. Established solution serves the purpose of easier and faster assigning of the process parameters, shortening of the computer aided process planning documentation time in real production conditions, and it also supports the effective utilization of the production plant based on the mathematical model description of object variation of the computer aided process planning, fulfilling the combination of the required characteristics within the given production conditions. Output system data can be used for processing of the details for the warehouse, economic and wage records as for their control and optimization. [4]

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. Of course, 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:

- Modular conception
- Flexible interconnections to databases of partners
- Possibility of cooperation with wide variety of external software
- Convenient price level

Following the success of IS application were generated next task for development. The ground tasks for near future in focus of authors are:

- Research for finding general properties of format for process plan data,
- Investigation of production environs in other European countries for innovation of information system structure,
- Research focused on suitable format of manufactured segments geometrical features related to technological operations.

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