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MODEL OF REENGINEERING OF TECHNOLOGICAL PROCESSES - ITERATIVE AND VISUAL APPROACH

Abstract: *Shortening of the life-cycle for products and technologies as well as the growing competition at the market are characteristics of modern industrial development with which production companies are dealing with today. We are witnesses that nowadays market games start and finish with the "three". That "three" is quick, quality and cheap. The answer to the question "How to make this three?" beside other, can be found in reengineering of technological processes. Characteristics of the technological process as logical, iterative, variant and multidimensional process represented basis for making methodology and information model of reengineering of technological processes. This paper deals with architecture of methodology that is with model of reengineering of technological processes, main approaches at the model as well as its outputs.*
Key words: *Model, methodology, reengineering, technological processes, information technology*

1. INTRODUCTION

Technological environment is the constant technological changes which points are the new engineering and technological knowledge of producing more with the available amount of resources or production data achieved with fewer resources used. This is expressed by shortening development time, lower costs, more efficient use of funds, materials and optimize the flow of information and so on.

In order to achieve the above mentioned requirements, among the other things, required is the development of new technologies (and this is primarily an IT supported technology). Regarding it is necessary to shorten the time that lapses from idea to realization of a new product, considered the possibilities of so-called "savings in time" through technological processes and through the process of their design. The concept of the model includes the process of re-engineering (referring to the process of modeling technological processes), notation and tools for modeling. It is clear that all three components are complex. But today, there is more information tools that can help us in every aspect of the development process. In addition, the standards in the methods and computer tools are widely accepted, which makes it possible to put emphasis on the development and implementation.

In order to successfully implement the concept of reengineering and developed an appropriate model must be carried out analysis of the technological process, in terms of flexibility, level of automation, product quality, type of production, the flow of technological processes, relationship with the environment, structure, relationship (connection) elements of the technological process. Reengineering of technological processes are re-thinking on focusing of the process, thereby elemenating the processes and sub processes that are not necessary, and thereby finding more efficient ways of performing the remaining process. Reengineering is focused on improving the existing system (process) with a high return on investment than it would have been the case for investing in a completely new development.

Reengineering of technological processes, directly or indirectly, should make possible: the reduction of delivery time, price cutback products, improving product quality, easier maintenance and cheaper products, and environmental protection. Also, process reengineering technology should ensure the possibility of increasing production volume.

The model should enable reengineering of redesign of the existing technological processes with all the above mentioned aspects and to give a solution for the improvement of technological processes. The model allows the reengineering and development of new technological processes based on re-engineering of existing (piggybacking), Figure 1.

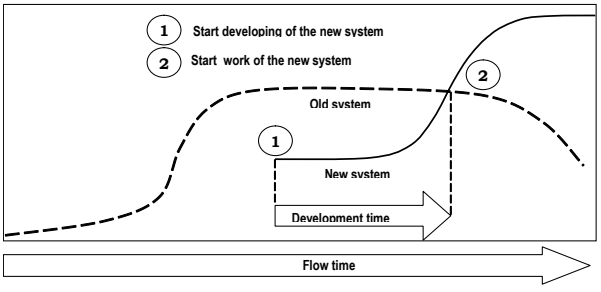

Fig. 1. Piggybacking systems [3]

Piggybacking is not a professional, sophisticated expression, nor is it the unique in the field of the system. And yet, it is a very exact picture of a system that uses the previous system to step into a more advanced status. The concept of piggybacking forced designers, developers and technologists to regularly and continuously reflect on the success of existing and developing new systems based on the existing one. As such, it requires the application of certain conceptual estimate, such as: (1) when the existing system deteriorirate, therefore, it is estimation of life of the

system, (2) how long it will take to develop a new system, and (3) when you should start with the development of the new system.

For the analysis of technological systems (processes) is used a systematic approach. As in nature and society there is a general correlation of objects and phenomena, it is necessary during the observation of any system to perform its elimination of the outside. The technological process of making the product is part of the production process in which the change is in shape, size, aesthetic appearance, the internal properties of materials, and controls, which set the conditions for giving the best technical and economic effects [9]. Before the technological process are set three kinds of requirements must be satisfied. Technical requirements, as a starting point, are arising from the construction documents and functions of individual pieces. These are primarily the shape, tolerance of dimensions, machined surface quality, composition and etc. Another type of request are economic requirements. It is necessary to achieve the technical requirements and achieve the lowest cost. For optimal design of technological processes and the optimal variant, it is often necessary to compare more economic options, as is generally possible to produce several alternatives of the same product. This way of looking at the technological process and making it, is a variable.

A new, almost daily, knowledge related to engineering and technology has helped to set up a technological process is a subject of changes. This requires engineers to constantly monitor and extend their knowledge of new technological knowledge of the design, so they could be applied on technological processes . One of the engineers task is to constantly improve the technological process. It can be argued that technological process has never been so well designed that it cannot be designed better. This constant review and improvement of technological processes, both in the design phase and development phase of implementation as well as making it iterative.

2. PROPOSED METHODOLOGY REENGINEERING OF TECHNOLOGICAL PROCESSES

Theoretical analysis of the technological process and reengineering, discussed through the "magnifying glass" of principles, approaches and methods of modeling processes and systems are induced reengineering methodology for technological processes, Figure 2.

The structure of shown methodology is in two parts, CAD and CAPP's. The base of on the CAD parts models and CAD is following: 3D model of part/products, 2D geometric model of parametric, parameter technological model, meta model. CAD models are defined in CAD software (Pro/Engineer, CATIA, AutoCAD, Mechanical Desktop, Solid Works, etc..). 3D model, as a result of a process design and modeling, and the target model as a result of the technological transformation of the model, the model inputs and technological reengineering process. Target content model carries the same information that is necessary to define the technological operations and procedures as well as the technological model.

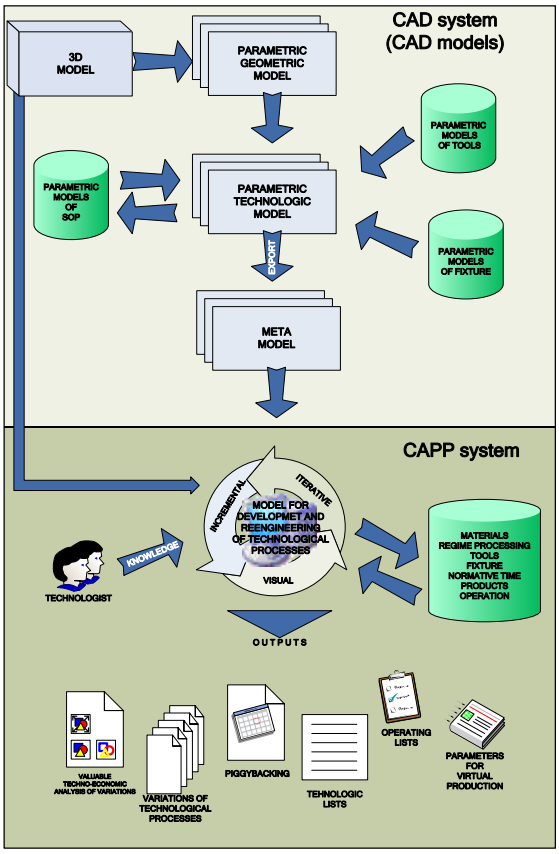

Fig. 2. Architecture Methodology (re)engineering of technological processes [2]

The difference is "only" in the way the information was presented, meta model is in the field of disperse and technology model in the field of vectors. The advantage of vector in the domain changes (modify mode), and the advantage of the raster domain is taking dramatically less storage space (file compression). The advantage of the target model is utilized for visual modeling and composition of technological processes.

The technological model is defined on the basis of geometric models, by adding parametric models tools and if necessary and parametric models of support equipment. The mentioned models are 2D models. At the level of technology CAD model can correspond with the base model by type parametric procedures. In this case, the model of type covers and declares the model and defines the technological model stored in the database as a standardized (standard or group).

All mentioned models in the CAD system have shown the methodology prefix parameter. And in any case should take advantage afforded by parametric modeling, that is, the dimensions defined by the parameters and their values for some of the variations of the model, are stored in appropriate databases. Target model as input into the model for the re-engineering and technological processes, must be defined with specific values from the database. Target allocation model also gives an overview or topology elements of the technological process/system.

Entry for the model reengineering and

technological processes that can be used for development / engineering and technological processes, is the technology and database-related materials, modes of processing, cutting tools, measuring tools, ancillary supplies, regulations, time, products, operations, etc. Reengineering model for technological processes belongs to CAPP shown methodology. The model enables technology, based on the knowledge and experience gained, visual, iterative and incremental approach to implement process reengineering and technological processes.

3. ITERATIVE, INCREMENTAL AND VISUAL APPROACH IN THE REENGINEERING MODEL OF TECHNOLOGICAL PROCESS

Basically, reengineering, in its essence, is the development. The development, which in the iterative and incremental life cycle (Fig. 3) runs in a series of successive iterations that evolve into the final system, a variant / scenario / alternative or solution. Each iteration is composed of changes in one or more components that are declared as "entering" of the technological process.

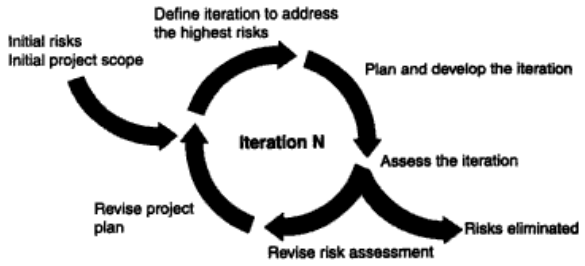

Fig. 3. Iterative and incremental development [5]

Variations in parameter values that are found in some limits (eg, treatment regimes), the changes in relations between elements of technological processes (eg changes in operations or concentration Ordering / differentiation operations), the use of specially designed accessories, or group and aggregated, implementation of special and standard cutting tools provide a designer-technologist opportunity for many assumptions and dilemmas. Assumptions and dilemmas, carry the risk in the sense that this variant is not the one that is the most optimal.

All the dilemmas and challenges encountered by designer-technologist in the election of certain options are being resolved so that we must rely on a metric, on which the valuation is the same. The most commonly adopted metric or the system of evaluation is a particular monetary unit.

Iteration planning process should enable the controlled and reasonable number of iterations. By the end of each iteration risks should be re-assessed, and the impact of changing parameters. After that iteration, it will occur variant of the technological process, and their number depends on the evaluation and the knowledge and experience of the designer-engineers.

Output parameters of the model (ordered time, productivity and cost of processing), designer-technologist should be provided by valuable analysis of the alternatives on the basis of their decision on the final version, version in which the largest number of requests are satisfied.

This type of life cycle is the process of reducing risk. In the early stages of life cycle is assessed the technical risks and gives them priority, and after finishing it during each iteration. Risks are considered in each iteration, so that successful completion of iteration minimizes the risks discussed. Variations are also planning to process initially the greatest risks. This method exposes a system and reduces the risks in the system early in the life cycle. The result of this approach in the life cycle of decreased risk with minimal investment.

Development of life cycle has an opportunity to give creativity and innovativeness of architects-engineers. At the same time the development process must be measured and controlled in order to ensure successful completion of design. Well-managed iterative and incremental life cycle provides the necessary control and no violation of creativity.

Visual modeling is the process of taking information from the models and their graphical display using a series of standard graphic elements. Standards are necessary in order to benefit from significant drew Modeling: communication. Communication between all users of the model and all those involved in designing, modeling and design, is the main purpose of visual modeling.

Three important components for successful implementation of visual modeling are notation, process and tool.

Notation can be learnt, but if you do not know how to use (process), success is likely to be absent. One can have a great process, but if you do not know how to express it (notation), also will not succeed. And finally, if you cannot document the results of their work (tool), you probably will not succeed.

In the model of technological process re-engineering notation is defined meta-model technology. This model represents the topology elements technological processes, tools and case processing at the level of operations / procedures and the building is in the graphic notation of visual modeling of technological processes. Process or function "drag and drop" it is possible to change the place of the object, and thus change the order of operations / procedures in the technological process. The same function can compose a new technological process based on the current, "piggybacking." The function and mechanism of "drag and drop" is a complete system to move through made moves, keeping certain phases of the possibility of changing the future using the past to the present. Results of visual modeling is documented through the technological and operational lists.

4. OUTPUTS MODEL OF TECHNOLOGICAL PROCESSES REENGINEERING

Published models of re-engineering and technological processes are variations of the technological process, piggybacking, technological exchange (treatment plan), operating the list, the

parameters for the valuable techno-economic analysis of the variations, the parameters for virtual manufacturing.

Variations of technological processes (TP) arise as a result of a large number of possible combinations of input parameters, and their relations (order), which differently affect the output characteristics of the technological process. For a TP, in theory can be defined a number of variants.

The concept of "piggybacking" is shown with the basic idea of the development of new technological process based on the current (Fig. 4). It can be applied in the case of products which have a technological resemblance. To the already established structures - target models, the function "drag and drop" used to compose a new technological process. It can be applied in case of rough estimates of development time or cost of treatment, when there is no time to make detailed models of the new technology of similar products. Created a new technological process can be subjected to change and reengineering, which in most cases it is.

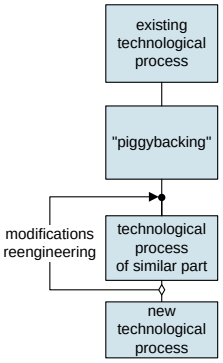

Fig. 4. "Piggybacking" technological processes [3]

Technological exchange and operating lists, as an integral technological documents, are the output reports the technological model of technological reengineering process. They are defined based on the structure and content of coating. Technological exchange is a treatment plan and sequence, and one of the basic operating document preparation technologies of production, operating list is the basic document technological workplace.

Parameters for the valuable techno-economic analysis of alternatives were chosen so that it can be calculated based on the input parameters (parameters of the regime of processing the order and concentration of operations, standards of time, parameters related to cutting tools, equipment and machine tools) that directly affect the technological process. Fee, time and productivity are drafting the output parameters that need to complete a picture of the technological process variations. Based on this assessment, personal experience and evaluation, the designer-technologist decides on a final version that will be implemented.

Parameters for virtual production are possible outputs from the model re-engineering and technological processes. The final defined version of the technological process before implementing in production can be simulated in software (DELMIA), which supports the concept of virtual manufacturing. For the simulation of production among others are required and parameters which define the technological process and are in the base model of technological re-engineering process. Thus, the concept of virtual manufacturing is another level that makes it possible to detect an error, try variations, improve processes, verify the optimality of the adopted parameter values before technological implementation process.

5. CONCLUSION

We present the methodology and software solution, to support the design and engineering and technological re-engineering processes, and they have four main objectives: (1) reduction of manual work during the preparation of technological process, which is a burden for the manufacturing engineers and experienced designers of technological processes, (2) improving / optimization of existing technological processes through the use of available information on machinery, tools, accessories, workability, and so on., (3) systematization of the best observed technological processes for families of components within the enterprise, providing the knowledge and experience of experienced designers, (4) systematization of production time and costs as a preasumption for techno-economic analysis.

Advantages of the system, which allows the design of new and reengineering of existing technological processes, are: reduction of time planning, design and lower costs of production, enabled the creation of technological processes of the same validity and quality; rationally production of technological processes, increased productivity etc.

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