FUNDAMENTALS OF CAPP SYSTEM DESIGN

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Abstract:

Manufacturing process is related to the process of concept and the process planning. These should be closely effectively connected and should be aimed to remove human routine and manual work.

Manufacturing process planning is the process of creating a complete reference for the implemetation of the manufacturing process. Unfortunately, this process is very often realised manually – what is routine as well as long-term and subjective activity. It is realised by human and his/her work with many materials, and in fact, it is him/her who determines the factors entering the process and so it is him/her who makes the price.

Big boom of computer implementation into education has made process planning more effective and disburded many people. However, the level, where the whole process could be realised by human, was still not achieved. This is the reason of incoherence in process planning. The process of design and the process of manufacturing could be connected with CAPP system. This system was based on the theory of group technology (GT); however, it has improved and applied artificial intelligence as well. Its implementation into production can improve the following effects, positively influencing economical factors of manufacturing: [2]

- Increasing of capacity utilization of existing machinery
- Reduction of tools, fixtures and equipment
- Reduction of rejects
- Reduction of manufacturing costs
- Reduction of labour content
- Better usage of material

Main benefits of computer aided design and planning process are:

- Higher productivity of technologists
- Rationalization of design documentation
- Better clarity of technological documentation
- Standardisation of technological documentation
- Objectification of technological process
- Technological documentation can be optimized
- Reduction of time needed for the ongoing desing of technical documentation
- Reduction of boot time of production
- The possibility of integration with other application programs and systems
- Higher flexibility to change the product assortment
- Higher flexibility to change the customer´s requirements

Beginning of CAPP based on group technology (GT) was beneficial in smaller productions and in shorter life cycles of the product. The main aim was to make use of similar

components and their manufacturing processes. These systems are used yet; however, nowadays only two basic types are known– CAPP and its modification – variant and generative.

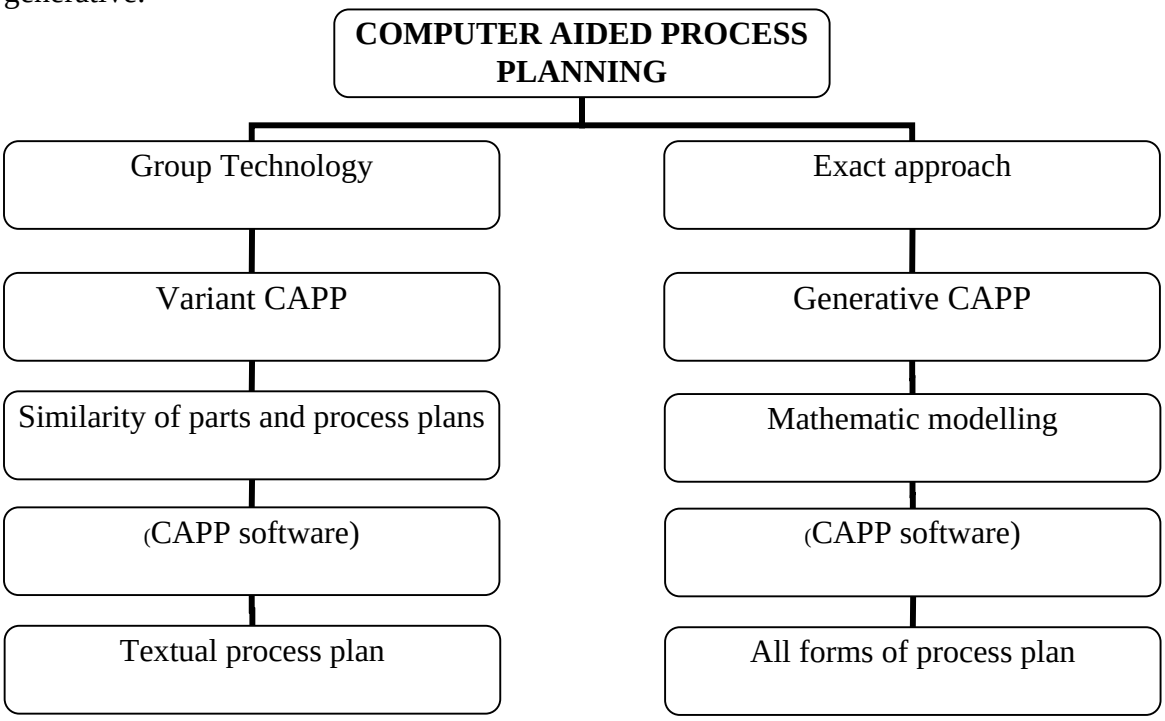


Fig. 1 *Two basic approaches for CAPP*[3]

Designing of technological processes in variant CAPP systems is based on the usage of group technology principle – the similarity of components and similarity of technological processes. Most of the operator´s work of CAPP system during the technological process is editing taken similar procedure. Methodology is not as exact as in later mentioned generative CAPP system. It is not necessary to understand the sequence of individual steps in design of technological process, because technological process is already available. Knowledge is not explicitly expressed in separate databases, but they are comprehensively represented in technological process of representative. The components to be planned are limited to similar components previously planned. Experienced process planners are still required to modify the standard plan for the specific component. Details of the plan cannot be generated. Variant planning cannot be used in an entirely automated manufacturing system, without additional process planning. Some other advantages of variant process planning are following: [1]

- Once a standard plan has been written a variety of components can be planned
- Comparatively simple programming and installation (compared with generative systems) is required to implement a planning system.
- The system is understandable, and the planner has control of the final plan
- It is easy to learn and easy to use

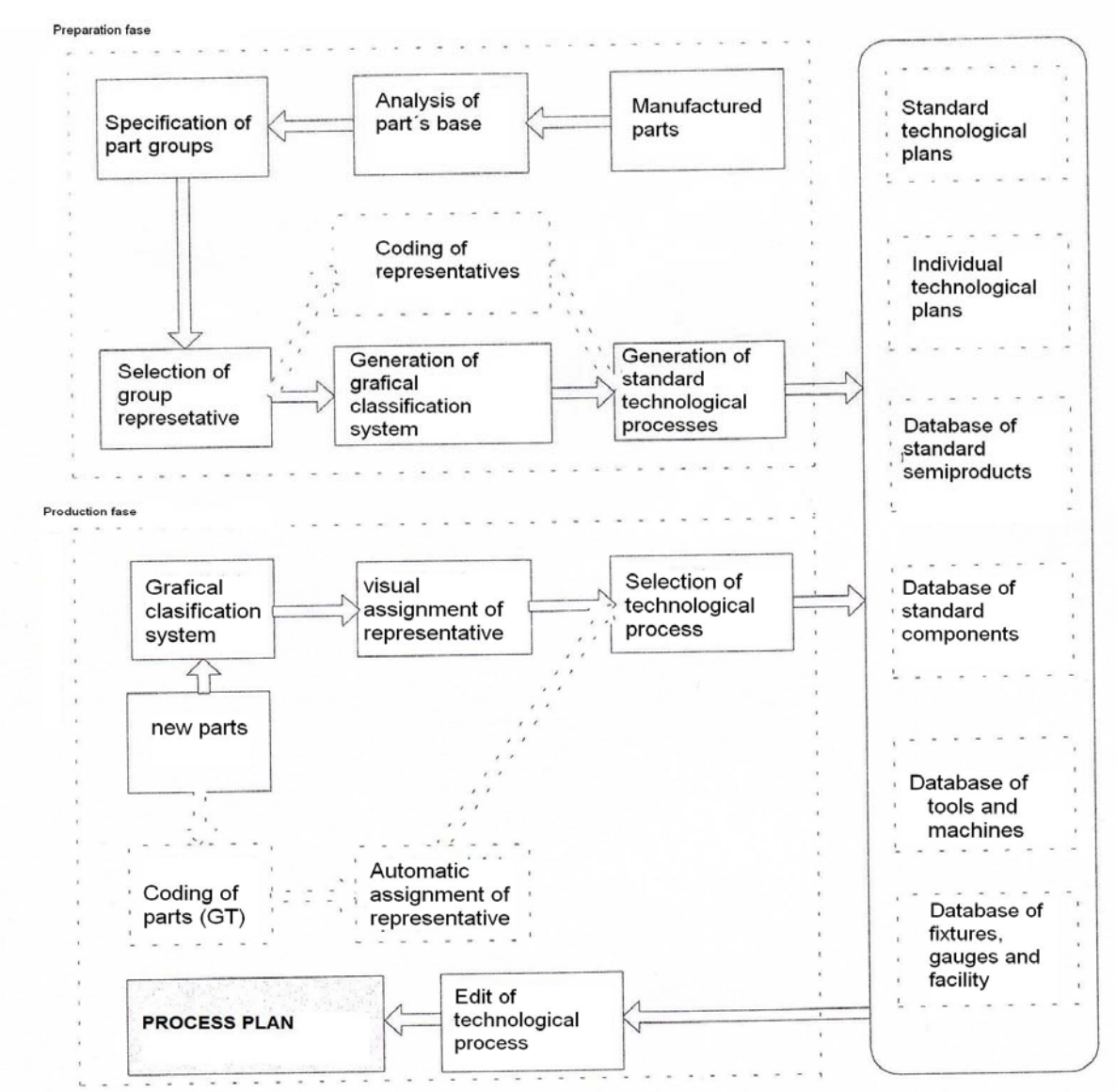


Fig. 2 *Scheme of variant system CAPP* [2]

Generative approach seeks to synthetize individual parts using appropiate algorithms defining the different technological requirements that should be considered in the manufacturing process. In this system all process parameters as well as sequence of operation are automatically determined and previous plans are not taken into account. It comprises three main components: part description, manufacturing databases and decision making ologic and algorithms. The generative proces planning approach has the following advantages:[1]

- It rapidly generates consistent process plan
- New components can be planned as easily as existing components
- It has potential for integration with automated manufacturing facilities to provide detailed information control

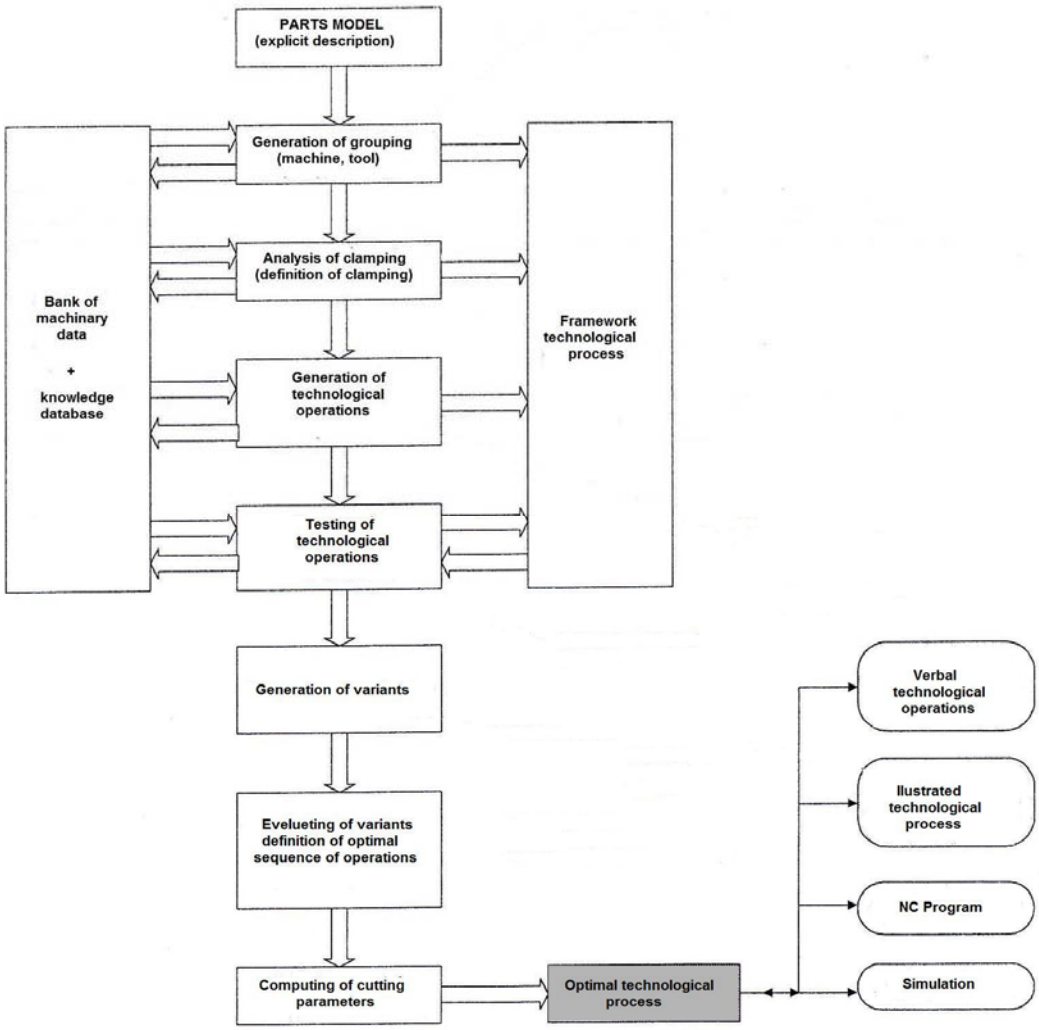


Fig. 3 *Scheme of generative system CAPP*[2]

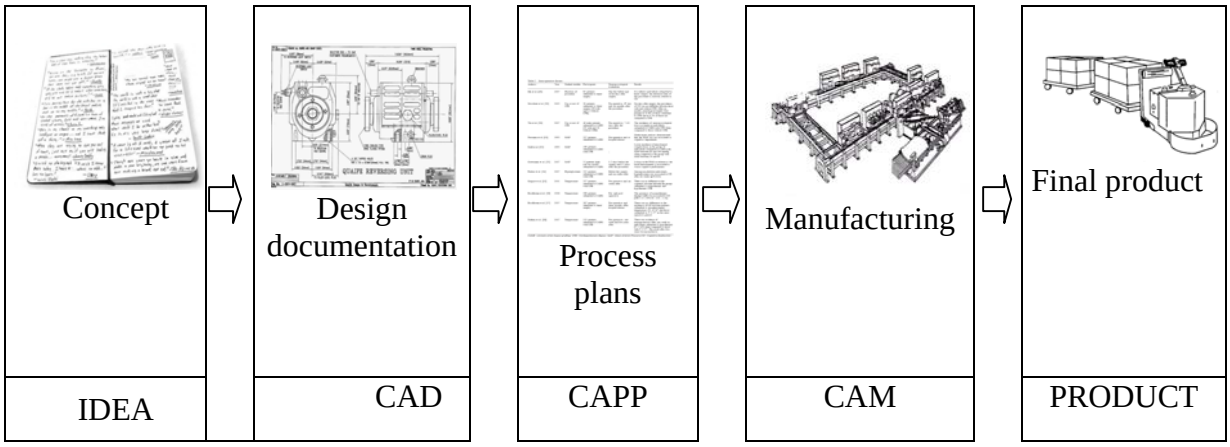
One of the biggest disadvantages is the cost for generation such a system and therefore can not be a comprehensive introduction into production. Generative CAPP are applied only to certain operations of one or more similar components, where the use of similar components can be profitable and efficient.

Tab. 1 Compare variant and generative CAPP [2]

Activity\ task	**Variant CAPP**	**Generative CAPP**
Basic approach	Group technology	Mathematical modelling
Existing documentation usage	Yes	No, partial
Production	repeated	Piece production, serial production
Supported manufacturing technology	Metal cutting	Cutting
Component description	Unclear	Clear
Component type	All types	Usually rotating
Component model	GT code	CAD data
CAD integration	insufficient	Existing – but problematic

CAD to CAPP transformation	Usually non-existing	Problematic
CAM integration	Usually non-existing	Existing
Output	Process plan	Separate knowledge databases
Cutting condition optimisation	Existing	Existing
Sequence of technical operation optimisation	Usually non-existing	Existing
Process plan type	Verbal, picture	Verbal, picture, NC program
Simulation	Non-existing	Existing
Toleration analysis	Non-existing	Needed
Program language	Database, FoxPro	VB, C++, Delphi, Java
Program implementation difficulty	Simple	Very difficult

The ideal situation would be, if the direct input for CAPP are CAD data and direct output would be data for CAM. Currently, frequently discussed are CAD/CAM systems, where CAPP module is integrating element.



Reviewer: doc. Ing. Peter Monka, PhD.

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