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PARAMETRIC ASPECT IN CAPP SYSTEM BASED ON GROUP TECHNOLOGY

The paper deals with methodology of CAPP systems based on Group technology utilising. Disadvantages of current CAPP system based on Group technology consist in quantity of interventions during modifying of process plan. There is not expert support to help at modifying of process plan. The new approach consists in parametrization of process plan solves disadvantage of Group technology. The parametrization is implements between part features and process operations and parametrization between part features and machine equipment. Parametrizing in process planning gives higher intelligence to CAPP system.

1. INTRODUCTION

The computer aided process planning (CAPP) is a software equipment assisted at design of process plan documentation. Process plan is a recipe for manufacturing or assembling products. The CAPP is utilising the power of a computer to emulate the human capabilities.

Process planning consists of engineering activities of preparing detailed processing documentation. Theoretic and practical knowledge are a key for good designed process plan. Knowledge is associated with machines, tools, jigs, methods, methodologies, conditions and possibilities of all aspect of production.
During manual creation of the process plan a human analyses in mind the variants and to make decision for a “good“ process plan.
A computer aid must simulate these human, intellectual and mental activities. The CAPP is must emulate the capabilities of an experience planner. Therefore the CAPP systems must have a great level of “intelligence“.

In general there are two different approaches for the process planning assisted by computer power. The CAPP systems utilising Group technology principle or exact mathematical modelling as a second principle. The approaches are fundamental different.

2. SYSTEM VIEW ON THE CAPP

Development in computer based planning attempts to free the human from the planning process and to eliminate decisions required during design and planning. CAPP has a various level of human intervention according to used approaches.

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In the first principle - *variant approach* - human retrieves the plan for similar components using coding and classifications of parts. The planner edits the retrieved plan to create a variant to suit the specific requirements of the component being planned. This technique is based on the principle that geometrical and technological similar parts have similar process plans. The computer aid is used to assist in identifying similar plans, retrieving them and editing the plans according to the geometrical difference.

In variant CAPP system the process plan is assigned for the whole part according the global part information (Fig.1). Parametric information between the technological operations and the part feature does not exist.

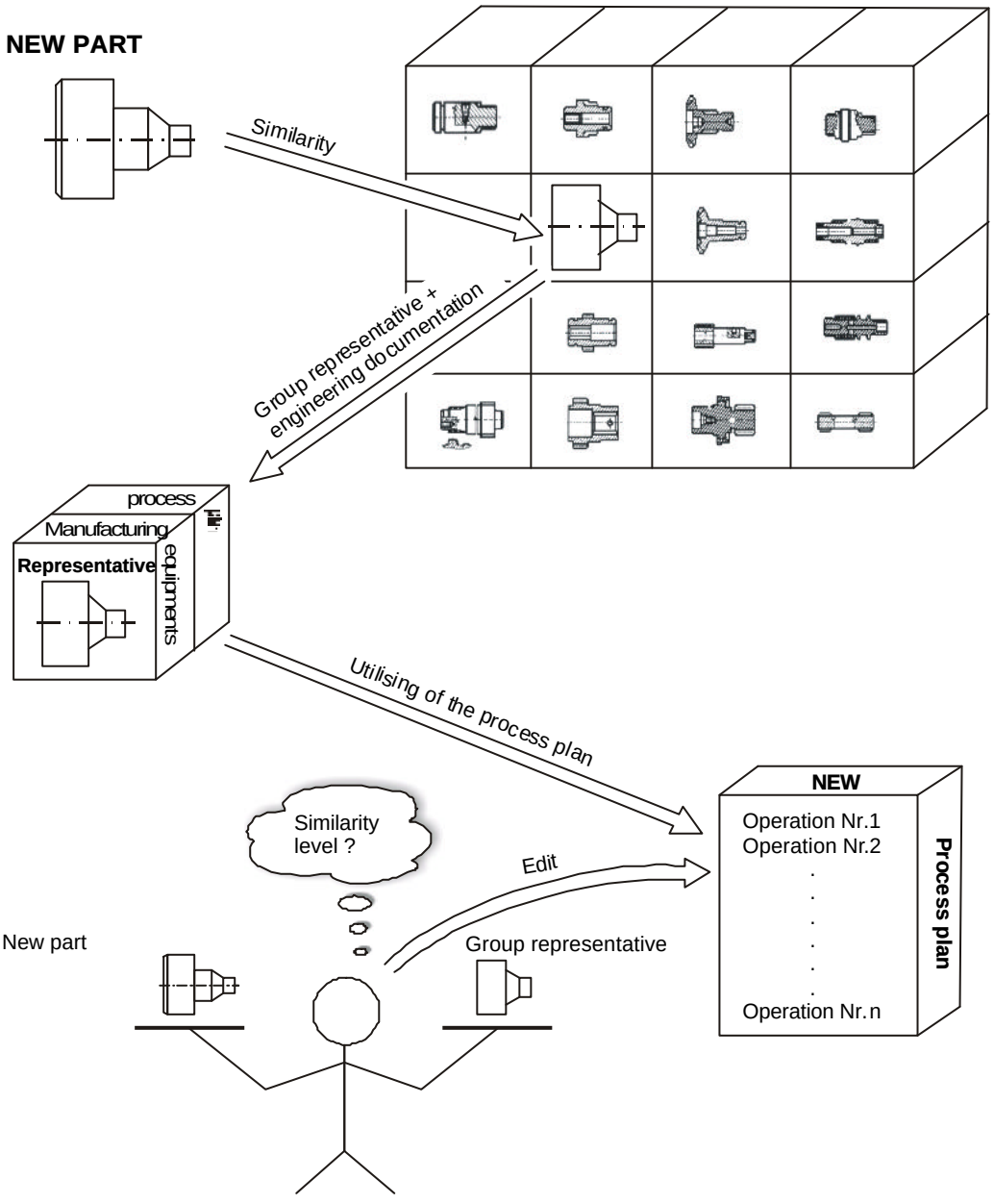

Fig.1 Principle of CAPP system based on Group technology

The second approach is used in *generative* process planning system. The process plan for a new part is automatically synthesized. The generative CAPP systems create the

process plan from information available in manufacturing databases according to a CAPP methodology. The CAPP system operates without or with small human intervention.
The part is described and modelled as a set of design and manufacturing features (hole, slot, cylinder surface, etc.). Each of part features can be manufacturable by several technological operations. For individual feature from manufacturing knowledge base, the technological operations (technological transformer) ensuring the required part properties are generated. From a set of convenient technological transformers an optimal aggregate of technological transformers is extracted. There is parametric information between the technological operation and the part feature.

The manufacturing knowledge is one of the basic information bases for automated process planning. The manufacturing knowledge in the variant CAPP systems is placed in standard plans for each family group. Knowledge is complexly expressed in manufacturing, fixturing and heat treatment instructions. The knowledge is represented in textual or coded form and is not systematicly divided into knowledge bases.

The knowledge in the generative CAPP systems is placed in the individual bases. They should consist of information on manufacturing methods, manufacturing equipment, fixturing, heat treatment, product feature structure, etc. The individual bases are mutually in relation. The knowledge is directly expressed and is represented in various representation schemes (production rules, frames, decision trees, decision tables, semantic nets).

The two basic approaches require the different describing of the part properties. The generative CAPP system needs the unambiguous description of the geometrical, topological and technological part properties. For variant CAPP approach it is convenient an ambiguous part information, for example some of well-know GT codes (Opitz, CODE, Miclass, Dclass code).

3. PARAMETRIC ASPECT – A NEW METHOD IN CAPP BASED ON GROUP TECHNOLOGY

Utilising Group technology principle in CAPP system is very popular and effective method to create the process plan. Planner executes the process plan in the two steps – firstly he must select representative part for a new part and secondly after retrieval a process plan for representative part he must modify this process plan. Modification of process plan is realised according the difference of properties of new part and representative part.

There is a great human intervention. The planner often looks on retrieved process plan and insert, delete or modifies the process operations. Insertion of process operation is supported only database of machine equipment. Ideal support consists in knowledge base and expert support for inserting and modifying of process operations.

According the above mentioned remarks and disadvantage of Group technology principle is made a proposal of new approach. The approach consists in parametrization of process plan. The parametrization is in two levels and it is between the following features:

- *Part feature and process operations,*
- *Part feature and machine equipment.*

3.1 Part feature and process operations

Parametrizing between part features and process operations creates the link between design features and manufacturing features located in process plan. Part representative will be described according the design features (feature modelling). We take a process operation as manufacturing feature. It is necessary to create link between the design features and manufacturing features.

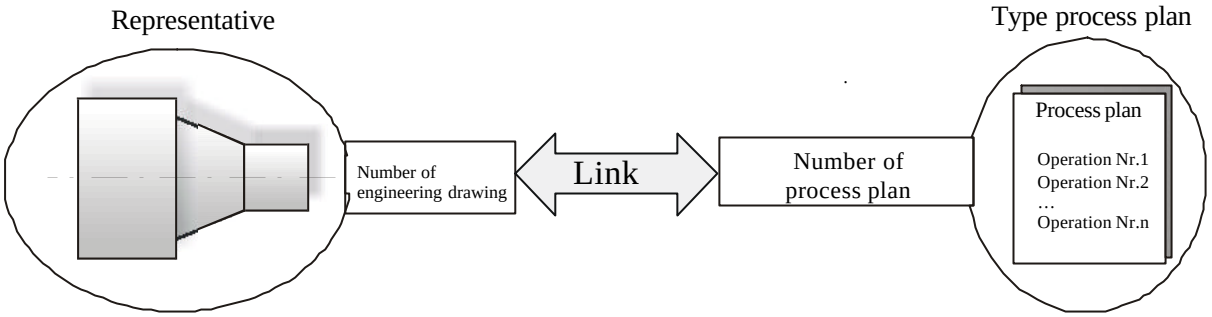

Fig.2 Link between engineering drawing and process plan

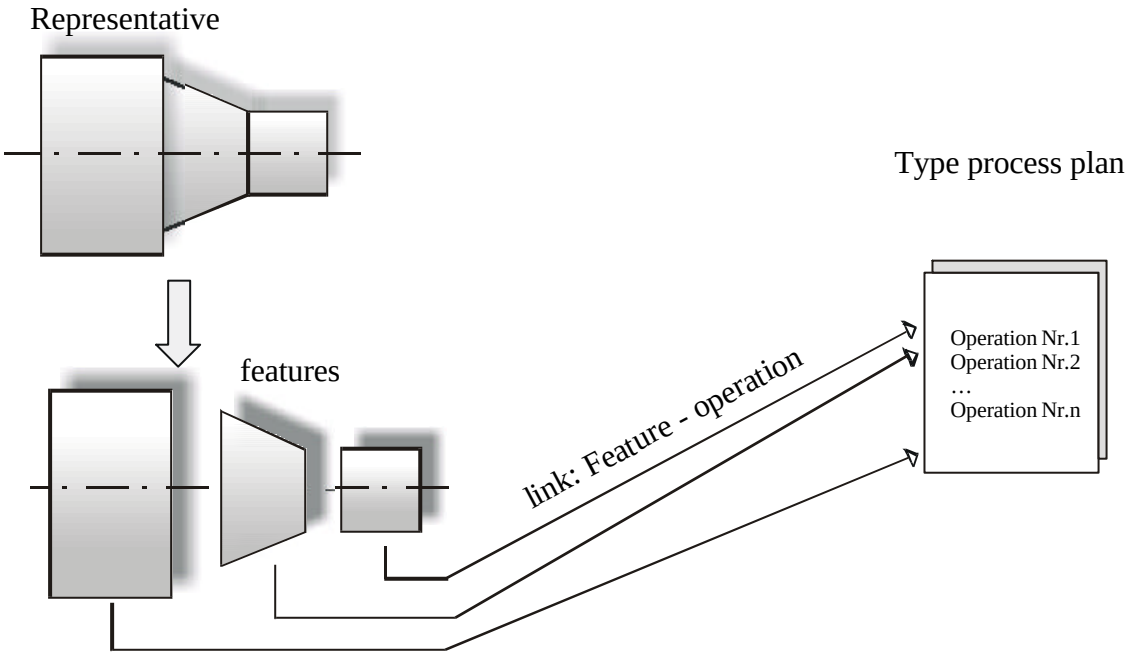

Fig.3 Parametrizing - link between design features and process operations

A new part is also described according to feature modelling. In case of process planning for new part, computer system comperes the design features between new and representative part. Following selection of manufacturing features from representative process plan corresponding to design features of new part.
Process planning will be more objective and CAPP system will have a higher level of intelligence.

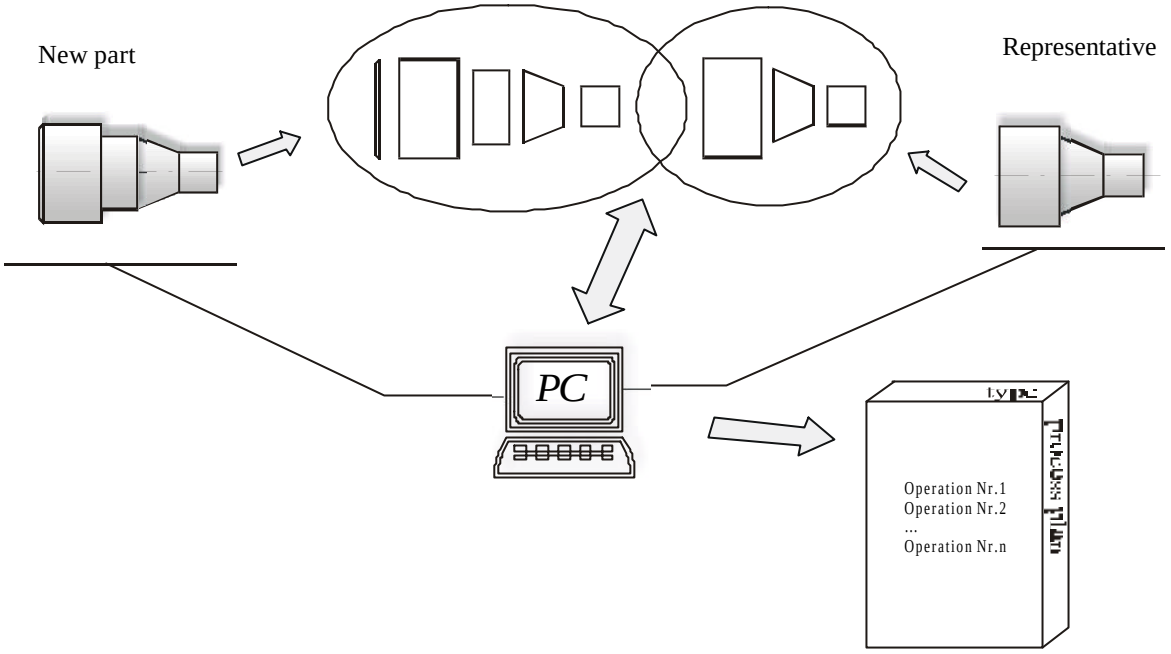

Fig.4 Comparing of design features of new and representative part

3.2 Part feature and machine equipment

Parametrizing between part features and machine equipment is other very important task in intelligent CAPP system. The parametrizing helps at insertion and modifying the process operations. Each of real design features is machine-made by concrete machine tool, cutting tool and at concrete work clamping. Creating knowledge base based on production rules consists real design features and concrete machine, cutting tools and work clamping of real workshop. If planner will insert a new operation, he select for concrete design feature corresponding machine equipment. It is another contribution to increase intelligence of CAPP system.

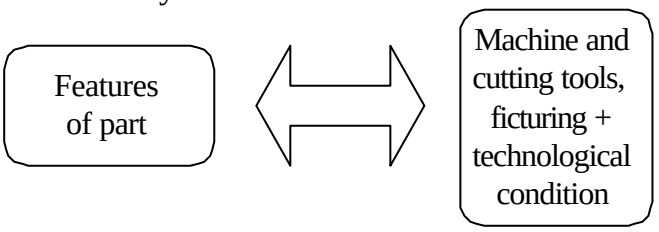

Fig.5 Parametrizing – link between part features and machine equipment

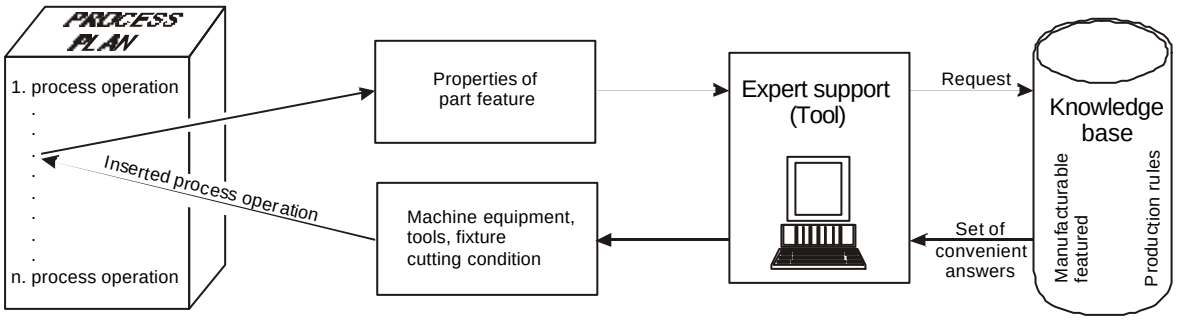

Fig.6 Principle of insertion of process operations

4. CONCLUSION

Disadvantages of current CAPP system based on Group technology consist in quantity of interventions during modifying of process plan. Planner inserts and modifies process operation according his theoretical knowledge and experiences. There is not expert support to help at modifying of process plan.
The new approach consists in parametrization of process plan solves above mentioned disadvantage of Group technology. The parametrization is implements between part features and process operations and parametrization between part features and machine equipment.
Parametrizing in process planning gives higher intelligence to CAPP system. Process planning is more objective.

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