7th INTERNATIONAL MULTIDISCIPLINARY CONFERENCE
Baia Mare, Romania, May 17-18, 2007
ISSN-1224-3264

DYNAMIC CLASSIFICATION IN GROUP TECHNOLOGY

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Abstract: *A framework for dynamic classification with computer aided process planning (CAPP) systems is presented. The dynamic classification is used to provide flexibility facility status information while the CAPP system is used to modify the retrieved process plans. The paper deals with aspect of classification systems in CAPP systems based on Group Technology (GT). The dynamic classification will be introduced as new method utilised especially for non-cutting technologies such as casting and forging.*
Key words: *CAPP, Group technology*

1. INTRODUCTION

The current production trends such as intelligence, automation and flexibility will determine the development tendency of CAPP /Computer Aided Process Planning/. CAPP systems often utilise Group Technology /GT/ as basic method for process planning. It is simple and very efficienct method how to create the process plan. Process planning play important roles in manufacturing systems. It role is to ensure the availability of manufacturing resources needed to accomplish production tasks result from a demand forecast.

GT has a great signification in engineering industry. There is the greatest utilisation of GT in planning activities, especially in process planning. GT emerges as one of the prime forces that will integrate the engineering and manufacturing processes.

The GT methods are especially utilise in process planning for machining processes. The classification system is very important part of the CAPP system based on GT. The classification system for machining has static character. It is not needful to change classified parts into individual groups. However there is a proposal to utilise GT methods also for non-cutting technologies such as casting and forming. The static classification system is not suitable for process planning of non-cutting operations. Therefore there is a concept design of dynamic classification system oriented especially for non-cutting technologies.

2. STATIC CLASSIFICATION METHODS

A company may make hundreds and thousands of different parts. Because the parts are made in a concrete manufacturing environment, many parts are similar in some way /Fig.1./. Therefore many process plans must be also similar. If similar parts are situated in one group afterward their process plans likely are similar. It is possible to create some groups of parts with similar characteristics. If similar parts have similar processes afterwards utilising this approach get very good economic benefit. The above describing principle of grouping is a basis for GT philosophy.

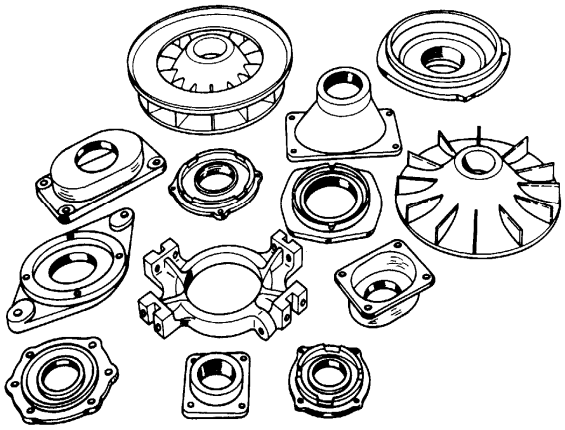

Fig. 1. Similar parts situated in one group

Process plans utilising is a main idea of utilising of grouped parts. The important task is to determine a similarity of characteristics among the parts. A wide variety of statistical, numerical and optimisation techniques solve the problem of grouping parts into families and machines into cells.

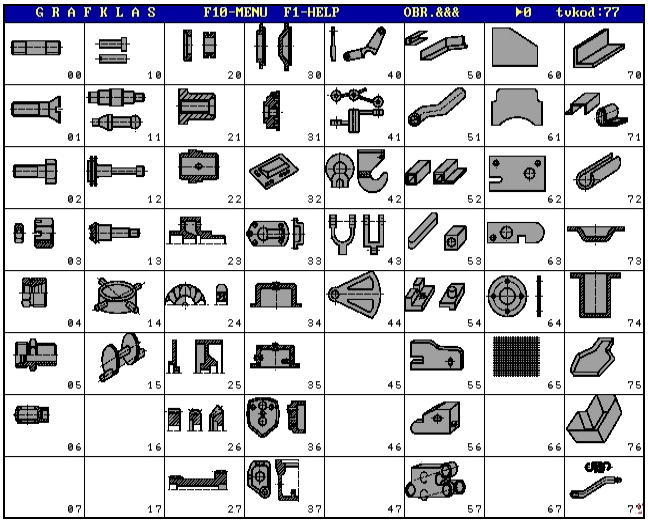

Fig. 2. Static classification system of Sysklass system

GT principle is one of principle used in CAPP methodology (Chang, 1990). The standard plans are created for a family of similar items. In the GT CAPP systems 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.

Many of classification systems especially based on graphical classification (Fig. 2.) are utilised in GT CAPP systems in SK, CZ and PL. All systems are based on static classification method and they are utilized especially for planning of cutting operations.

3. CAPP SYSTEMS AND DYNAMIC CLASSIFICATION

CAPP has evolved to simplify and improve process planning and achieve more effective use of manufacturing recourses. GT utilise a classification method as key principle. There is a effort to realize automatic classification which will be more flexible and efficiency.

Existing classification systems are mainly based on deterministic algorithms operating in a predictable and stable environment. However future manufacturing systems will be increasingly more dynamic. They have to be able to rapidly respond to changing conditions by concurrently balancing and optimizing multiple manufacturing constraints.

The classification system is very important part of the CAPP system based on GT. Majority of CAPP systems based on GT is intended for manufacturing process planning. It is sufficient for the manufacturing process to create classification system which will be only fill up. There is no need for changing the number of groups, change localisation of individual engineering parts in individual groups. Therefore it is possible to consider these classification systems as static system.

However there is a big demand to utilise the group technology also for other technologies and not only for machining process planning. As the characteristic of non-cutting technologies (such as forging and casting) are different as cutting technologies, there is need to take other view on utilisation of GT in this area (Varga, 2000).

As the static classification system is not suitable for process planning of non-cutting operations, therefore there is a concept design of dynamic classification system oriented especially for non-cutting technologies (Sugar, 2000).

The dynamic classification is based on *flexible classification system* (Kuric, 2006). The engineering parts are *dynamic grouped* to the individual groups according to classification aims. For example the engineering parts will be dynamic grouped to the family groups according the total costs or operational total times, number of produced parts, series,

etc.. There is a mathematical method - *cluster analysis* - which seems to be a very good candidate for support of dynamic classification system creation (Marcincin, 2006). *Clustering techniques* have been applied to a wide variety of research problems. The term cluster analysis actually encompasses a number of different classification algorithms.

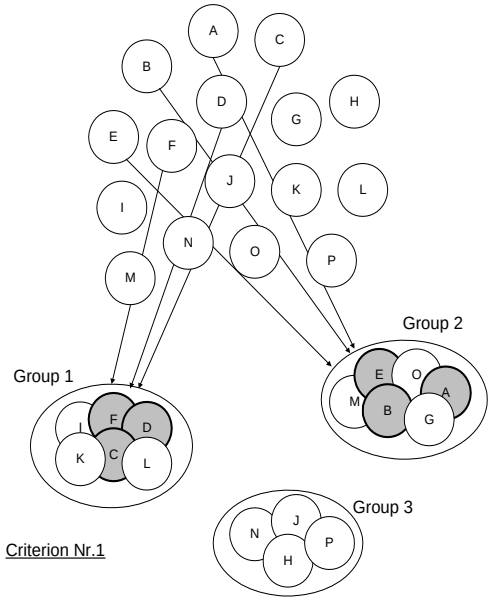

Fig. 3.Dynamic classification according 1st criterion

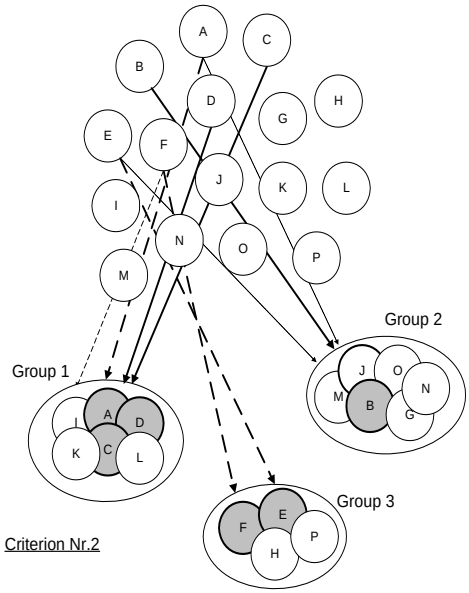

Fig. 4.Dynamic classification according different criterion

The principle of dynamic classification is evident on Fig.3. and Fig.4. The parts are flexible and dynamic grouped according selected criterions. It is still appropriate to utilise the visual classification as it is very simple and effective method however with flexible possibility the grouping the parts according actual demands. There is a development of dynamic classification systems and GT CAPP SW on the University of Zilina (Fig. 5.).

Disadvantages of current CAPP systems based on GT consist in their static classification systems which are not suitable for flexible change of GT representatives. There is no support to serve it in this systems. New approach consists in applied methods which making possible dynamically to group the engineering parts in the individual groups according selected criterions (e.g. cost, precision, equipments, level of automation, etc.).

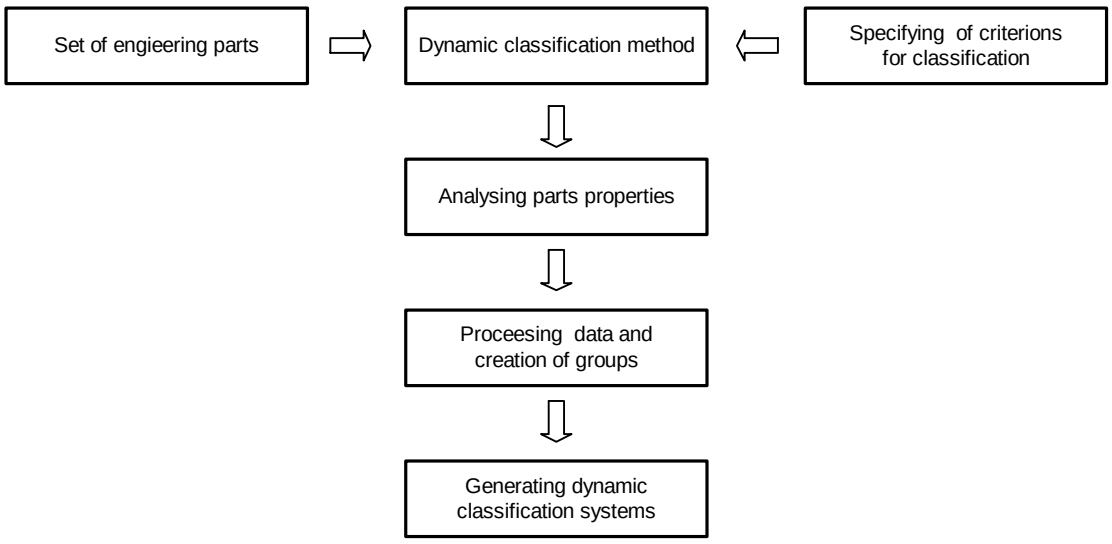

Fig. 5. Schema of dynamic classification system creation

4. CONCLUSION

Classification system that more precisely reflects flexible demands is needed. Dynamic classification has been used to categorize product properties according actual demands. During past years the classification systems in CAPP systems utilize static classification. The static classification system doesn't reflect the important changes in the factory. In past approaches to classification, the objective has been to find a general purpose classification

system that will meet all major user needs. It should provide the maximum benefit to the variety of needs for data.
The dynamic classification system includes a flexible classification system that generates a detailed and comprehensive knowledge catalog based on actual criterions used in the input.

A method for dynamic classification has the following respects:

- determining the significant properties of engineering parts to be classified,
- determining a criterion for classification /geometry, costs, quality, etc./,
- specifying a level of similarity of properties,
- analysis all engineering parts /properties/ according criterions,
- generating groups,
- generating dynamic classification system.

The building of dynamic classification system utilized in GT CAPP is time demanding and very labour task. The task requires the theoretical elaborating, working out the serious methodology of process planning and used advanced programming technique. It seems that dynamic classification method is very effective and flexible method of part grouping for casting and forging process planning.

Acknowledgement: The article was made under support of Grant Agency VEGA – project Nr.1/0046/03 and the project of MS - Applied Research Nr. 4/0002/05.

5. REFERENCES

Chang, T.C. (1990). *Expert process planning for manufacturing*. Addison-Wesley Publ., Massachusetts, USA

Varga G.; Dudas, I. (2000). Intelligent Manufacturing System for Productions of Sophisticated Surfaces, *Proceedings of the Int.Computational MicroCAD 2000*, pp.99-104, Miskolc, 23-24.2.2000

Marcinčin, J.N. (2006). Application of Group Technology theory for creating of NC programs. *Proceedings of 11th Int.DAAAM Workshop "CA Systems and Technologies"*, pp. 119-123, ISBN 3-901509-56-9, Cracow, 2.-4.10.2006, Cracow

Kuric, I. (2006). Static and dynamic classification systems. *Proceedings of 11th Int.DAAAM Workshop "CA Systems and Technologies"*, pp. 113-118, ISBN 3-901509-56-9, Cracow, 2.-4.10.2006, Cracow

Kuric, I.; Matuszek, J. & Debnár, R. (1999) *Computer Aided Process Planning in Machinery Industry*, Politechnika Lodzka, ISBN 83-87087-00-9, Bielsko Biala

Šugár, P. (2000) *Similarity of objects and processes of machine production*, Publishing center of TU Zvolen, Zvolen