RESEARCH IN LOGISTICS & PRODUCTION

DATABASE OF MULTI-VARIANT MACHINING PROCESS PLAN

Łukasz Gola*

* Institute of Production Engineering and Automation, Cracow University of Technology, Kraków, 31-864, Polska, E-mail: lugola@gmail.com

Abstract This paper presents database of multi-variant machining process plan. This database is a part of CAPP (Computer Aided Process Planning) – prototype system, which was built on the basis of algorithm generating multi-variant process plan. Database was implemented to Microsoft Access 2010.

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1. INTRODUCTION

Computer aided process planning systems are built with adaptation three basic methodical approaches: variant method, semi-generative method, generative method. Generative method has the most possibilities among remaining methods, particularly if it depends us on considerable to raise the automation of machining process plans. Generative method is more difficult in comparison with variant method, because generative method require to create more formal models which describes different working and objects on process planning. In Institute of Production Engineering research have brought to make algorithm generation machining process plan so far (Samek 1996), (Duda, 2000). The main feature of this algorithm is based on possibility choice by technologist partial solutions from admissible set on given stage.

But progress enabling realization of concurrent product development is defined requirements for computer aided process planning systems:

- The ability to projection machining process plans for wide set of typical parts of machines, the elements of component products,
- The ability to projection machining process plans with regard the fit manufacturing capabilities,
- The ability to generation of variants machining process plans with different degree of circumstantiality.

Above mentioned features were reached building generative skeletal system CAPP, which it be characterizes:

- The possibility of record, modification and manufacturing knowledge,
- The possibility of record technological profiles of manufacturing system oriented on profile realized in enterprise of productive processes, the possibility generation admissible solutions which are realized on manufacturing stations.

2. ALGORITHM OF GENERATION MULTI-VARIANT PROCESS PLAN

The effect of previous work carried out in Institute of Production Engineering was to develop algorithm of generation multi-variant process plan (Gola, 2012). Based on the basic structure of the process plan PT (1), defined places where we can create variants of process plan (Duda, 2008), (Gola 2012). The process plan PT has a hierarchical structure. Generally process plan consist from operations, fixturings, positions and cuts but must be preserve principle: one operations is set of more fixturings, positons and cuts, one fixturing is set of more positions and cuts and one positon is set of more cuts.

PT = [OP-operation [US-set-up [PZ-position [ZB-cut]]]] (1)

Places (where we can create variants of process plan) were the basis for the development algorithm of generation multi-variant process plan (Fig 1).

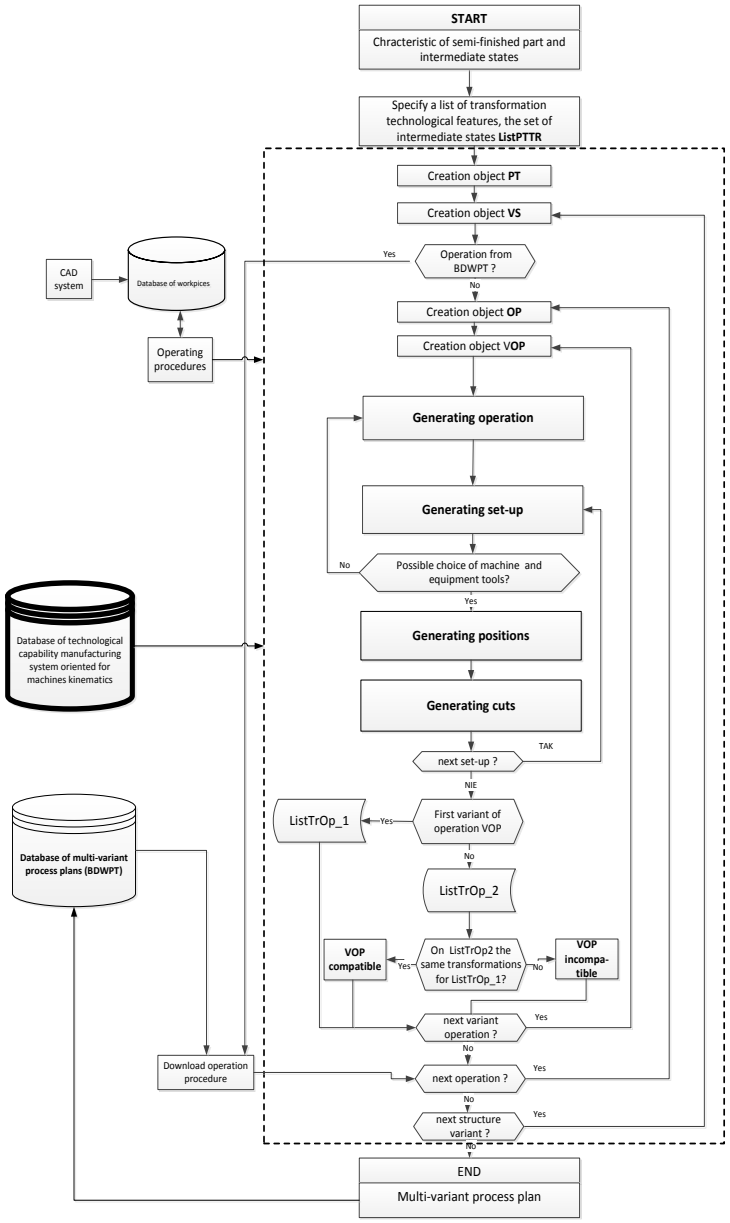

Fig. 1 Algorithm of generation multi-variant process plan

The algorithm is carried out at different levels, including: generating operations, generating set-ups, generating positions, generating cuts. The algorithm can generate acceptable variants (possibilities of movement of individual machine components). Calculation procedures on this algorithm are based on a simple kinematics task and reverse kinematics task. Necessary data to generate acceptable variants are stored on *Database of technological capability manufacturing system oriented for machines kinematics.*

3. DATABASE OF MULTI-VARIANT MACHINING PROCESS PLAN

Generated machining process plan is saved to database of multi-variant machining process plan (BDWPT). Need to write multi-variat structures of machining process plan and possibility to use such a database by PPC (Production Palning Control), resulted in the design and construction of such a database from the base. The high level of integration in such complex systems, which are for example CAPP systems, achieved by using a common data model PPR (Product, Process, Resourses).

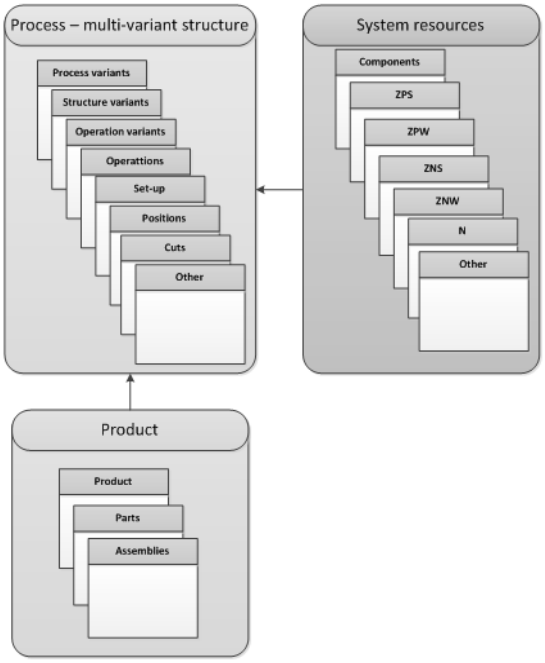

Fig. 2 BDWPT – conceptual model

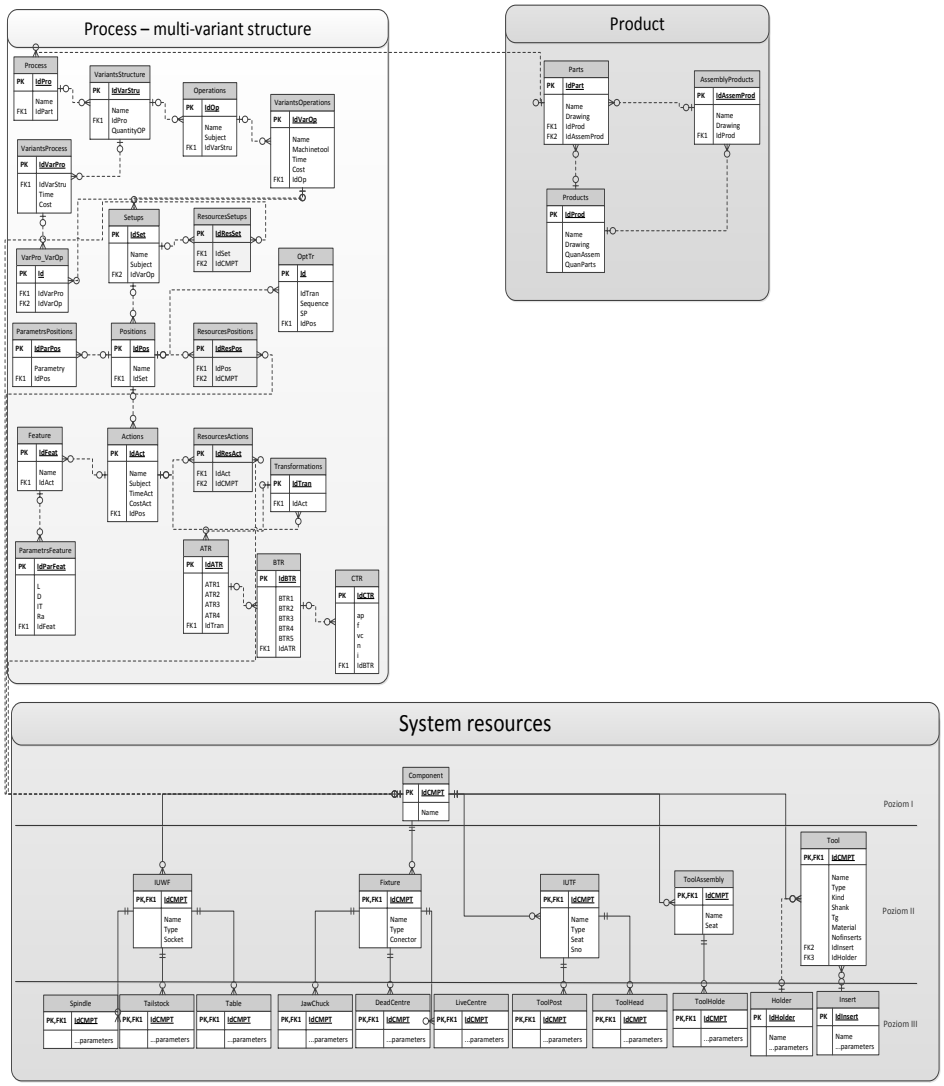

Fig. 3 BDWPTO - logical model

This model enables data exchange between modules used in the design process. Therefore, the database is divided into three parts (areas):

- Process – multi-variant structure,
- System resources,
- Product.

To stored informations about the machining process plan, it is necessary to replicate the structure process. This information is stored in the part *Proces-multi-variant strucure*. There are stored informations about the machining process,

the structure of the process variant, variant operations, operations, set-ups, positions, cuts, transformations, technological features,.... On the part *System resources* stored informations about resources system (machines, tools, ...). On the part *Product* stored informations about products for which the manufacturing process is designed. The following diagram shows the logical data model of BDWPT (Fig 3).

3.1. Implementation

The database has been implemented to MS Access 2010 (Fig.) In order to validate the designed and built database, stored in it multi-variant machining process plan of machine shaft (18 variants).

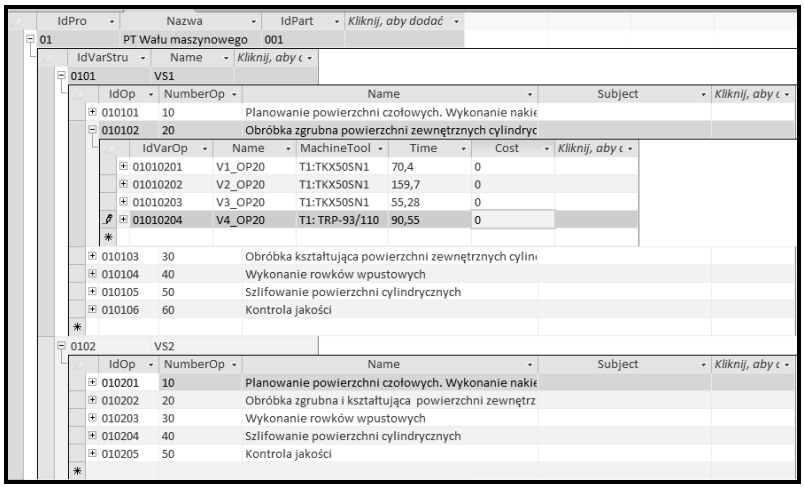

Fig. 4 BDWPT - example of the multi-variant machining process plan

This was followed by a test database search. Formulated for this purpose severa SQL queries. Below is a sample query and the result has been attained:

Question 1

Show the process variants VPT that time TP is less than 200 [min]

```
SELECT VariantsProcess.[IdVarPro], VariantsProcess.[Time]
FROM VariantsProcess
WHERE (((VariantsProcess.[Time])<"200"));
```

Answer:
12 from 18 variants of the process match the selected criteria

3. CONCLUSION

Presented in the article database allows to record information about the multi-variant machining process plan. Clearly designed form of database, cause easy and intuitive data entry. This database is an essential element of CAPP which generates multi-variant process plan. Generated variants of process plan next can be used in the construction of production schedules.

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BIOGRAPHICAL NOTES

Łukasz Gola is currently a researcher and teacher on Institute of Production Engineering and Automation at the Cracow University of Technology. Her research interests include machining process plans, assembly process plans, CAPP systems, production scheduling and process optimization, methods of working time measuring and standardization of work time.