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ŁUKASZ GOLA*

DATABASE OF TECHNOLOGICAL CAPABILITY MANUFACTURING SYSTEM ORIENTED FOR MACHINES KINEMATICS

BAZA DANYCH MOŻLIWOŚCI TECHNOLOGICZNYCH SYSTEMU WYTWARZANIA ZORIENTOWANA NA KINEMATYKĘ OBRABIAREK

A b s t r a c t

This paper presents database of technological capability manufacturing system oriented for machines kinematics. 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.

Keywords: *CAPP*, *process plan*, *manufacturing system*

S t r e s z c z e n i e

W artykule przedstawiono bazę danych do zapisu możliwości technologicznych systemu wytwarzania z uwzględnieniem kinematyki obrabiarek. Baza ta jest częścią prototypu systemu CAPP (Computer Aided Process Planning) zbudowanego w oparciu o algorytm generowania wielowariantowych procesów technologicznych obróbki skrawaniem. Baza danych została zaimplementowana w MS Access 2010.

Słowa kluczowe: *CAPP*, *proces technologiczny*, *system wytwarzania*

* PhD. Eng. Łukasz Gola, Institute of Production Engineering, Faculty of Mechanical Engineering, Cracow University of Technology.

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 [4, 5]. 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 plans

The effect of previous work carried out in Institute of Production Engineering was to develop algorithm of generation multi-variant process plans [2]. Based on the basic structure of the process plan (1), defined places where we can create variants of process plan [1, 2].

$$\mathbf{PT = [OP\text{-}operation\ [US\text{-}set\text{-}up\ [PZ\text{-}position\ [ZB\text{-}cut]]]]} \quad (1)$$

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

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* (Fig. 1).

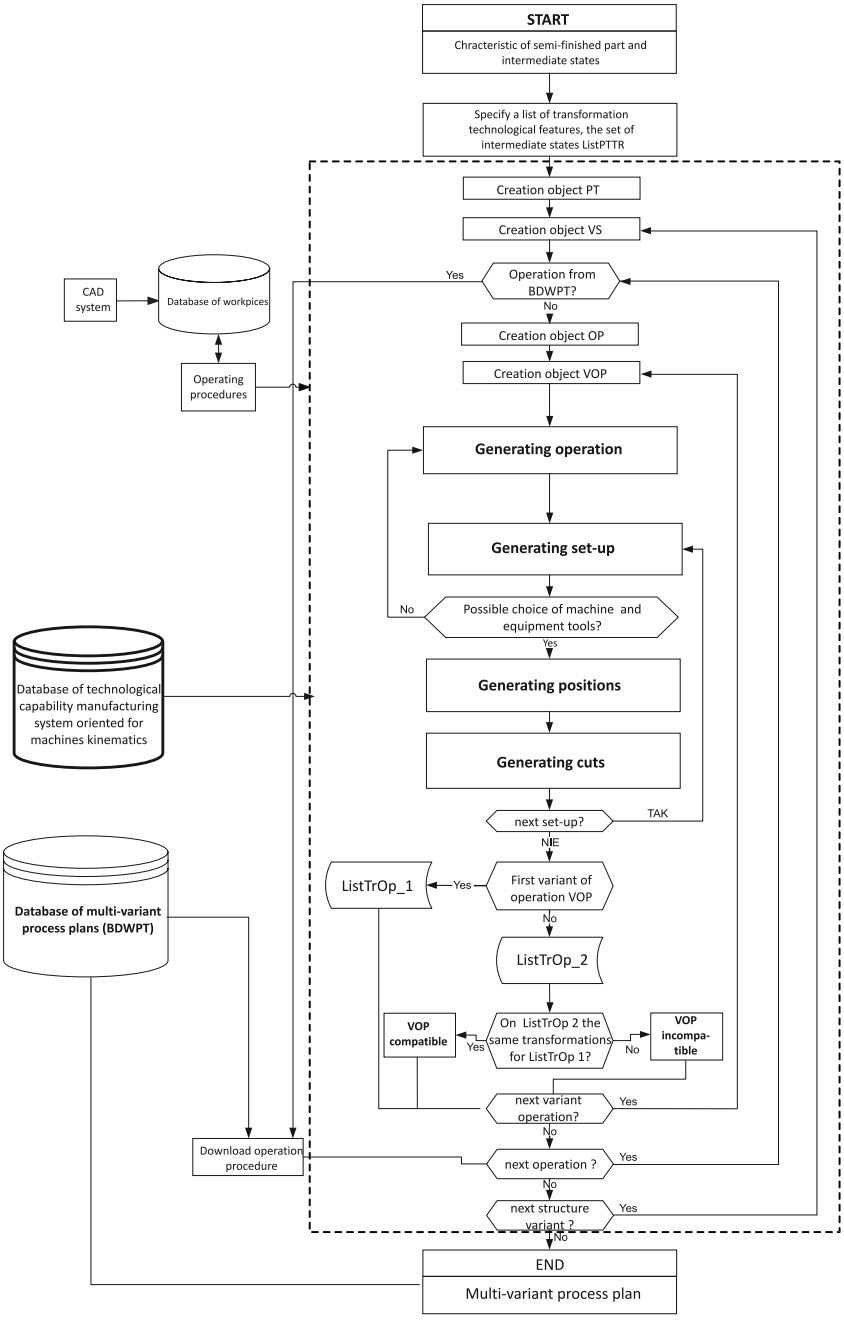

Fig. 1. Algorithm of generation multi-variant process plans

Rys. 1. Algorytm generowania wielowariantowych procesów technologicznych obróbki

3. Database of technological capability manufacturing system oriented for machines kinematics

For the purpose of generating acceptable variants of process plan, designed and built database which was named *Database of technological capability manufacturing system oriented for machines kinematics* (BDMTSWZK). The database is divided into four areas (Fig. 2):

– System resources (for example: vice, handle, jaw-chuck, cutter, drill,...),
– Technological capabilities,
– Variants of fixing W and T (workpiece and tool),
– Kinematic structures.

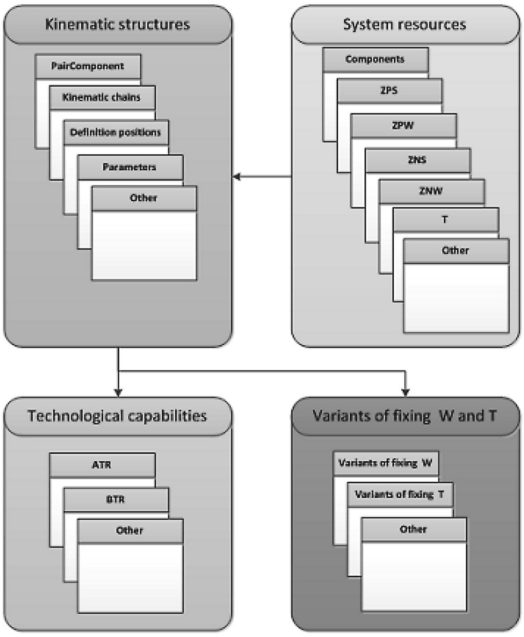

Fig. 2. BDMTSWZK – conceptual model
Rys. 2. BDMTSWZK – model koncepcyjny

This database is a modification of an earlier version developed in Institute of Production Engineering. A completely new element of the database is field *Kinematic structures*, which was designed based "method of creating a database that describes the structure of the kinematic" [3].According to this method, the definition of machine kinematics is carried out in few steps:

STEP 1

Defining a machine component objects. Component objects are saved on the *"component list"* (sample components: vice, dead centre, tailstock, spindle, ...)

STEP 2

Defining the pair of components object. For this purpose, earlier must be defined *"component list"*. Selecting object from *"component list"* we can create *"list pair components"* of machine (sample pair: cross slide – vice)

STEP 3

Defining possible to obtainment *kinematic chains*. For this purpose, earlier must be defined *"list pair components"*. Selecting from *"list pair components*" consecutive pairs, *kinematic chains* are built (sample *kinematic chain*: machine trunk – carriage – cross slide – vice – workpiece)

The (Fig. 3) shows one part of the database BDMTSWZK (*Kinematic structure*) – this is a logical data model.

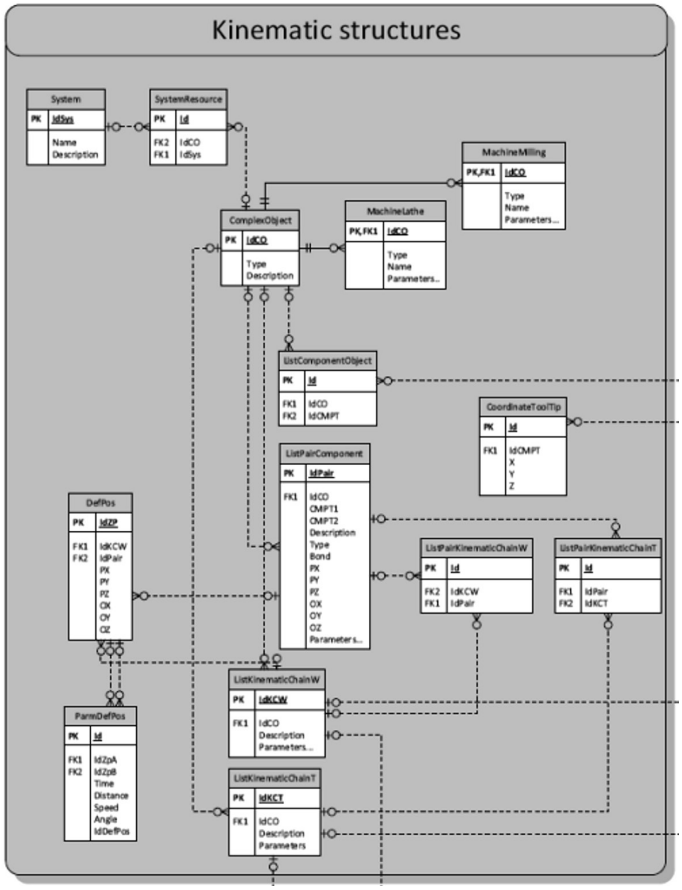

Fig. 3. Database BDMTSWZK – the logical data model (part *Kinematic structure*)

Rys. 3. Baza danych BDMTSWZK – model logiczny (część *Struktury kinematyczne*)

The figure (Fig. 4) shows a sample table *ListPairComponent.* The table identifies the kinematic pairs that may occur between objects machine components. This is the physical data model.

ListPairComponent					
Attribute name	**Domain**	**Limit**	**Kind of attribute**	**Description**	**Example**
IdPair	Char(50)	Not null	Primary key	ID kinematic pair	IdPair="P:1"
IdCO	Char(50)	Not null	Foregin Key	ID a complex object	IdCMPT="TKX:1"
IdCMPT1	Char(50)	Not null		ID 1 object component (OB1) pair	IdCMPT="ZPS:1"
IdCMPT2	Char(50)	Not null		ID 2 object component (OB2) pair	IdCMPT="ZPW:1"
Type	Char(50)			Type of pair	Typ = "przesuwna"
Bond	Char(10)			Bond type	Bond = „P,K"
PX	Decimal			Coordinates location object OB1 and OB2 along axis X	PX = „100"
PY	Decimal			Coordinates location object OB1 and OB2 along axis Y	PY = „100"
PZ	Decimal			Coordinates location object OB1 and OB2 along axis Z	PZ = „100"

Fig. 4. Sample table (*ListPairComponents*) – phisical data model

Rys. 4. Przykładowa tabela (*ListaParKomponentów*) – fizyczny model danych

4. Implementation

Database was implemented to Microsoft Access 2010. The database is filled with data of two machines: lathe machine *TKX50SN* and milling machine *Arrow500*. Data are entered using with form. Selecting another tab, the user enters data about machines, then he can builds the kinematic structure of machine.

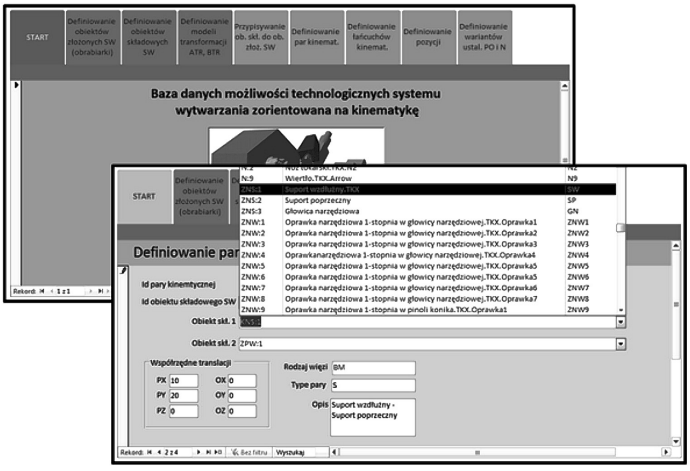

Fig. 5. Database – implementation to Microsoft Access 2010

Rys. 5. Baza danych – implementacja do Microsoft Access 2010

5. Conclusions

Presented in the article database allows to record information about the machines and kinematic structures between its components. 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.

References

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