Digital library of chosen injection mold standard parts, dedicated for the *CAD/CAM/CAE UGS Unigraphics NX4* software system

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1. Introduction

Polymer material processing is one of the most profitable and development absorptive branch of the global economy. A huge amount of polymer products is manufactured every year around the world. They are massively applied in many different kinds of the industry.

On the basis of the market analysis, it is considered that the majority of polymer products (popularly called as plastic parts) are manufactured with the mold injection manner. Suitable product shaping tools – injection molds – are supposed to enable: long-lasting maintenance, high reliability and the chemical resistance. Applying necessary requirements that concern the appropriate precision during the design and manufacturing processes can enforce achievement of all theses aims. However, that is the reason why injection mold industry is a quite expensive and complex one. To decrease all possible expenses, connected with mold design & manufacturing and to accelerate the *ROI* (*Return Of Investment*) process, standard injection mold components are commonly used: plates, leader pins, locating rings, ejector pins, etc. Professional suppliers, e.g. HASCO, DME, Futaba, and Strack provide them.

Contemporary tooling industry is marked by modern *3D MCAD* (*Mechanical Computer-Aided Design)* systems application to increase engineers' abilities during the design process. The most modern *3D* systems (*"high-end" software*) consist of process specific environments, including professional add-ins dedicated for the injection mold design, where libraries of aforementioned standard parts can be found.

According to independent consulting companies reports, one of the most advanced *3D* systems is the *UGS Unigraphics NX4* that contains a professional mold design environment called *Mold Wizard* where libraries of the most worldwide popular standard parts are available. The example of the injection mold *MCAD* project, designed with the *NX4 Mold Wizard* tool is shown on the Fig. 1.

It is considered, that the most popular injection mold standard parts supplier in Poland is the *FCPK Bytów* company. Unfortunately for polish designers and their demands, the *3D* library of *FCPK* products hasn't been available in any domestic available *"high-end" MCAD* system so far.

So, there was an urgent need to extend *NX4 Mold Wizard* contents with the digital library main *FCPK* standard parts, to ease and accelerate design tasks of Polish mold designers. Authors have created such a tool. It is the „***KNSE – NX4 Mold Wizard - Library***". The paper presents the manner of the library forming, rules of its application and chosen advantages.

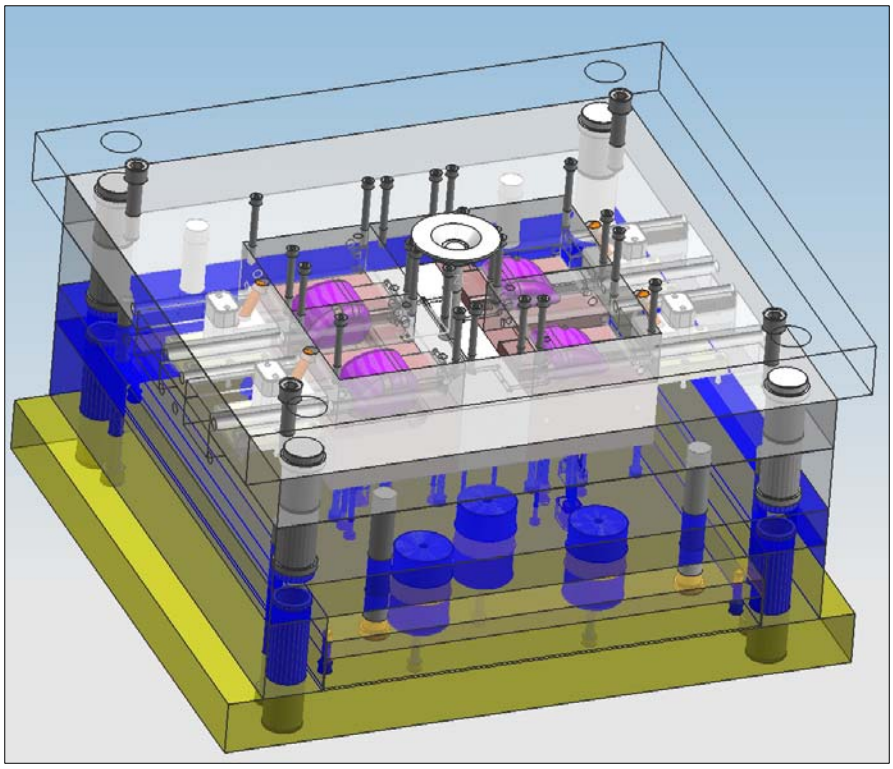

Fig. 1. The injection mold *3D MCAD* project, designed with *UGS Unigraphics NX4 Mold Wizard* tool

2. Short description of original *NX4 Mold Wizard* standard parts library contents

The process of *3D* standard parts selection is quite easy, first of all, because of intuitive system dialog boxes appearance (Fig. 2). The *Mold Wizard* library User is able to select metric (*ISO*) and/or inch (*ANSI*) dimensioned parts. When the components supplier is chosen, the next step is to select the kind of the standard part as well as its suitable dimensions. After that, the appropriate *MCAD* model is ready to be placed into the *3D* assembly.

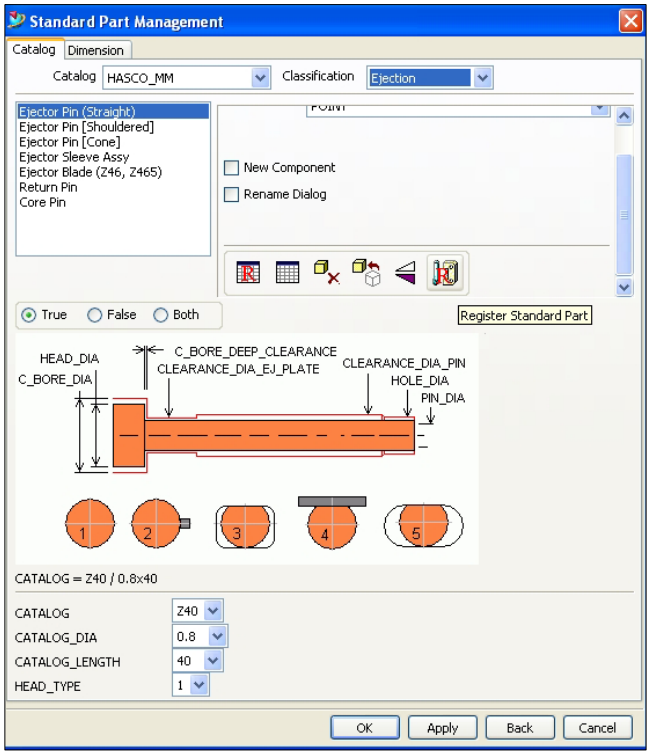

Fig. 2. One of *NX4 Mold Wizard* standard parts library dialog boxes

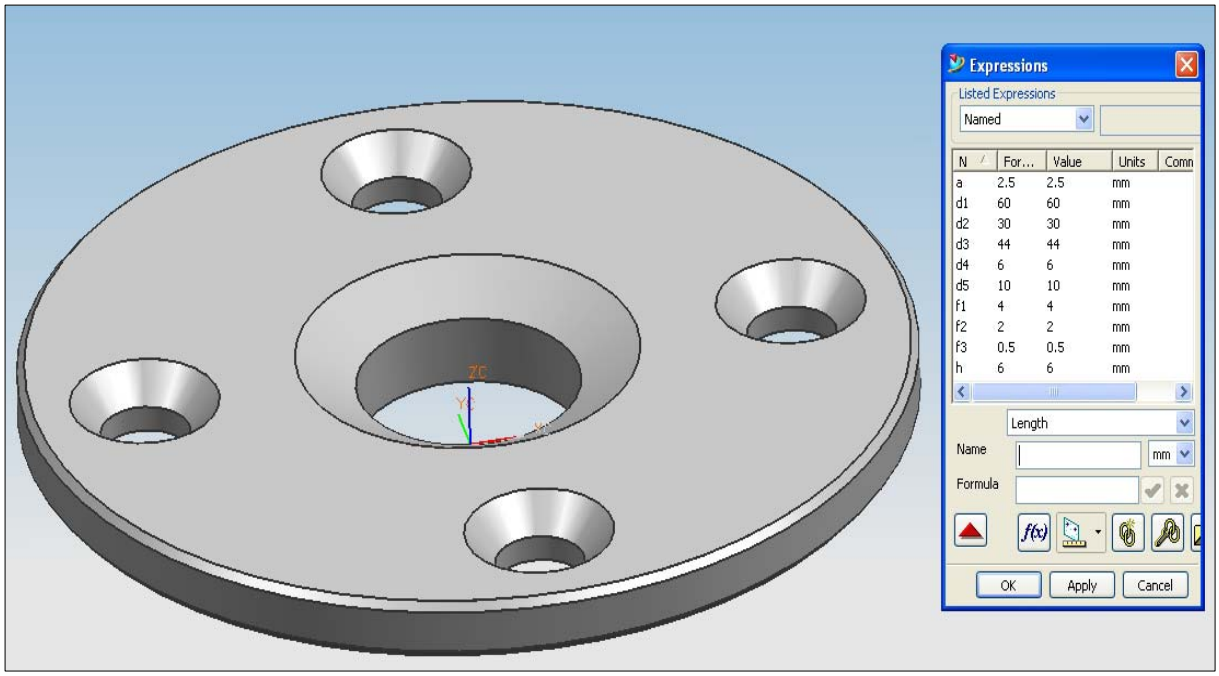

Fig. 3. Parametric 3*D MCAD* model of the locating ring and the "*Expressions*" variable table dialog box

Microsoft Excel - FCPK_14b_sl_assy.xls

F15 = EJ_SLEEVE::SUPPLIER=FCPK

##FCPK BYTOW Sleeve Assy_KNSE

PARENT <UM_PROD>
POSITION POINT

EXPRESSIONS
SLEEVE_LEVEL=-<UM_MOLDBASE>::EJB_off
BCP_bot=-<UM_MOLDBASE>::BCP_bot
PLATE_CLAMP_THICK=<UM_MOLDBASE>::BCP_h
PLATE_RETAINER_THICK=<UM_MOLDBASE>::EJA_h

ATTRIBUTES
EJ_SLEEVE::SECTION-COMPONENT=YES
EJ_PIN::SECTION-COMPONENT=NO
MW_SIDE=B
EJ_SLEEVE::MW_COMPONENT_NAME=EJECTOR
EJ_PIN::MW_COMPONENT_NAME=CORE_PIN
EJ_PIN::CATALOG=<PIN_CATALOG> / <SLEEVE_ID>x<PIN_CATALOG_LENGTH>
EJ_PIN::DESCRIPTION=EJECTOR PIN
EJ_PIN::MATERIAL=<PIN_MATERIAL>
EJ_PIN::SUPPLIER=FCPK
EJ_SLEEVE::CATALOG=<SLEEVE_CATALOG> / <SLEEVE_ID>x<CATALOG_LENGTH>
EJ_SLEEVE::DESCRIPTION=EJECTOR SLEEVE
EJ_SLEEVE::MATERIAL=<SLEEVE_MATERIAL>
EJ_SLEEVE::SUPPLIER=FCPK

BITMAP ../../interchangeable/ej_pin/bitmap/FCPK_14b.bmp

PARAMETERS

PIN_TYPE	PIN_MATERIAL	SLEEVE_MATERIAL	PIN_CATALOG_DIA	SLEEVE_ID	PIN_CATALOG_LENGTH	SLEEVE_CAT_L	PIN_NOM	PIN_EJ_PLATE_HOLE_DIA	C
STRAIGHT	HOT_WORK	HOT_WORK	1/16 (0.0625)	1/16	6	3,4,5,6	1/16	<UM_VAR>::EJ_CLEARANCE_DIA_0625	5
			3/32 (0.0937)	3/32	6,10	3,4,5,6,7	3/32	<UM_VAR>::EJ_CLEARANCE_DIA_0938	7
			1/8 (0.1250)	1/8	6,10,14		1/8	<UM_VAR>::EJ_CLEARANCE_DIA_1250	9
			5/32 (0.1562)	5/32	6,10,14,18,25	4,5,6,7,8	5/32	<UM_VAR>::EJ_CLEARANCE_DIA_1563	1
			3/16 (0.1875)	3/16		4,5,6,7,8,9,10	3/16	<UM_VAR>::EJ_CLEARANCE_DIA_1875	1
			7/32 (0.2187)	7/32		4,5,6,7	7/32	<UM_VAR>::EJ_CLEARANCE_DIA_2188	1
			1/4 (.2500)	1/4	6,10,14,18,25,35	4,5,6,7,8,9,10	1/4	<UM_VAR>::EJ_CLEARANCE_DIA_2500	1
			5/16 (0.3125)	5/16	6,10,14,18		5/16	<UM_VAR>::EJ_CLEARANCE_DIA_3125	2
			3/8 (0.3750)	3/8			3/8	<UM_VAR>::EJ_CLEARANCE_DIA_3750	1
			7/16 (0.4375)	7/16	10,14,18,25		7/16	<UM_VAR>::EJ_CLEARANCE_DIA_4375	1
			1/2 (0.5000)	1/2	6,10,14,18,25		1/2	<UM_VAR>::EJ_CLEARANCE_DIA_5000	1
		TOOL_STEEL	1/16 (0.0625)	1/16	6	3,4,5,6	1/16	<UM_VAR>::EJ_CLEARANCE_DIA_0625	5
			3/32 (0.0937)	3/32	6,10	3,4,5,6,7	3/32	<UM_VAR>::EJ_CLEARANCE_DIA_0938	7
			1/8 (0.1250)	1/8	6,10,14		1/8	<UM_VAR>::EJ_CLEARANCE_DIA_1250	9
			5/32 (0.1562)	5/32	6,10,14,18,25	4,5,6,7,8	5/32	<UM_VAR>::EJ_CLEARANCE_DIA_1563	1
			3/16 (0.1875)	3/16		4,5,6,7,8,9,10	3/16	<UM_VAR>::EJ_CLEARANCE_DIA_1875	1
			7/32 (0.2187)	7/32		4,5,6,7	7/32	<UM_VAR>::EJ_CLEARANCE_DIA_2188	1
			1/4 (.2500)	1/4	6,10,14,18,25,35	4,5,6,7,8,9,10	1/4 E	<UM_VAR>::EJ_CLEARANCE_DIA_2500	1
			5/16 (0.3125)	5/16	6,10,14,18		5/16	<UM_VAR>::EJ_CLEARANCE_DIA_3125	2
			3/8 (0.3750)	3/8			3/8	<UM_VAR>::EJ_CLEARANCE_DIA_3750	1
			7/16 (0.4375)	7/16	10,14,18,25		7/16	<UM_VAR>::EJ_CLEARANCE_DIA_4375	1
			1/2 (0.5000)	1/2	6,10,14,18,25		1/2	<UM_VAR>::EJ_CLEARANCE_DIA_5000	1
END									
ziooom									

FCPK_KNSE_NX4_MOLD WIZARD

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Fig. 4. The database input file, where available values of appropriate standard part dimenions are recorded

3. The manner of „*KNSE – NX4 Mold Wizard - Library*” shaping

One of the evaluation criterions in the case of the *3D MCAD* system modernity is the possible level of its User - personalization. To build additional sets of standard parts into the *NX4 Mold Wizard* tool, series of suitably parametric base models have been established.

In the case of every standard component kind, the solid part model has been designed (Fig. 3). Then, the system integral *Standard Component Creator* tool has been applied, so the *NX4* automatically created and saved database *.xls* files. They have been filled up with data concerned with every possible combination of appropriate model dimensions values (Fig. 4). Every variables combination case is assigned to the different dimensional type of the suitable standard part. Furthermore, database *.xls* files contain values of custom attributes, e.g. part material (*PN* nomenclature), supplier (*FCPK*), section-cut availability in draft drawings etc.

For the sake of the appropriate parametric model linking with the database file, it is possible to create a *3D* model of any given standard part, included in the *FCPK* supplier up-to-date market offer.

Every single one of aforementioned base models contains two types of geometry. The first one, called *“TRUE”* corresponds with the standard part solid body dimensions (its basic shape). The second one, *“FALSE”*, defines the material *Boolean* subtract parameters to take place in selected parts that exist in the assembly before the model placement. It means rules of material removal in chosen parts to achieve necessary technology clearances.

To ease the workflow, suitable *.jpg* pictures appear when necessary. They are fully dimensioned perpendicular views of a model, so it enables fast designer recognition of a given standard part type and shape (Fig. 5).

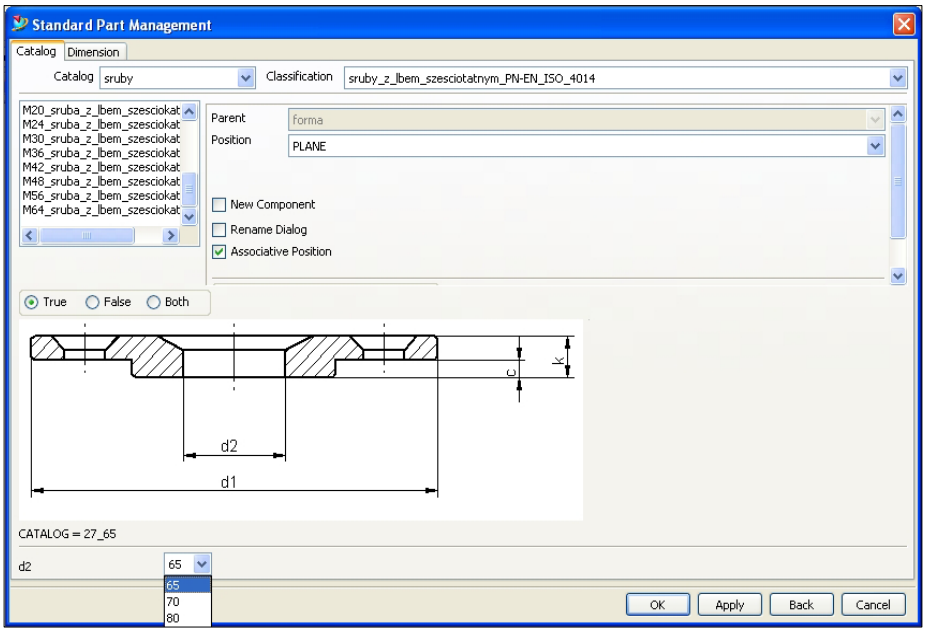

Fig. 5. The FCPK-made standard part selection dialog box of „*KNSE – NX4 Mold Wizard - Library*”

After the User selection of the appropriate standard part type and its dimensions, the proper set of variables is supposed to be transferred to the base model. Then the brand new part file will be created and placed into the active assembly file.

4. The application of „*KNSE – NX4 Mold Wizard - Library*”

During the maintenance of the aforementioned digital library, the *NX4 Mold Wizard* User is able to place the suitable kind and type of the injection mold standard parts into the *3D* assembly. These components (Fig. 6) may be: plates, leader pins, sprue bushings, etc.

Standard parts *MCAD* models, available in the ***„KNSE – NX4 Mold Wizard - Library"*** tool are equipped with additional data sets that concern semi-automatic creation of associative features in parts that already exist in the active *3D* assembly file. They can be executed for the sake of *"TRUE"* and *"FALSE"* geometry parameters settings. Suitable placement of the ejector pin model into the assembly of the mold base can cause previously defined *Boolean* subtract features (Fig. 7). They are executed in the case of chosen mold plates in places justified with the ejector pin appearance. Furthermore, the shape of *3D* standard parts can adjust itself to the shape of selected models that can be found in the assembly file. The correct piece of the plastic part geometry can replace the top face of the ejector pin.

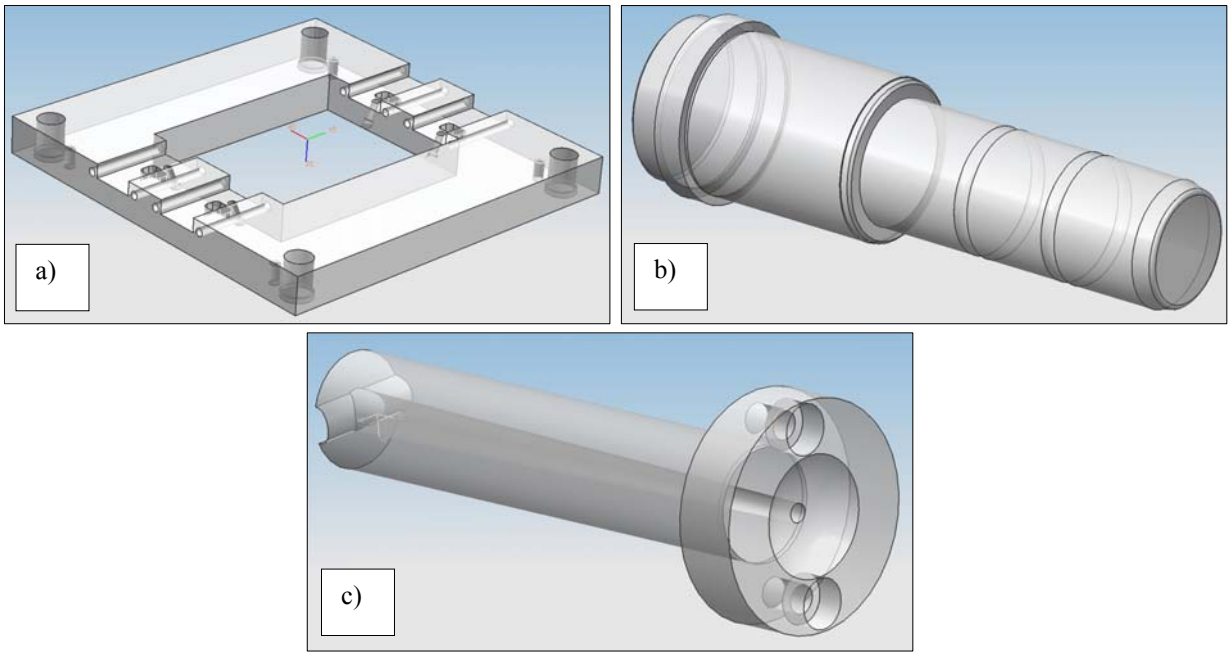

Fig. 6. Chosen kinds of parts available to place into the assembly: a) plate, b) leader pin, c) sprue bushing

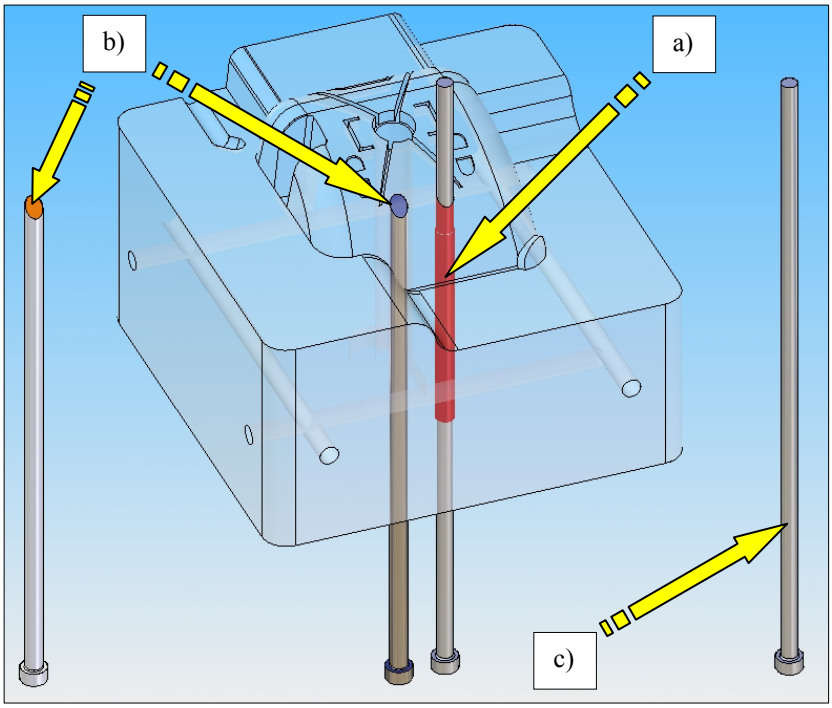

Fig. 7. Associative *Boolean* subtract features executed during the placement of the ejector pin, created with the library tool: a) hole feature in the mold insert model, that enables the movement of the ejector pin, b) ejector pin top face replacement with the correct piece of the plastic part, c) the model of the ejector pin, awaiting for the "parent-geometry" selection

5. Conclusions

The manner of shaping the flexible standard parts library, dedicated for injection mold *3D* design, is shown.

The main suggestion for designers is to finally quit the old-fashion way of receiving the standard parts models. In that case, designers used to download proper *MCAD* model straight for Web sites of standard components suppliers. Those files are universal ones and saved in popular indirect formats, e.g. *Parasolid*, *IGS*, sat. Such a philosophy main disadvantage is the fact that these files need to be translated to the owned *3D* file extension every single time. Furthermore, they are only pure solid models without the feature chronology and the possibility to make them parametric. Even worse, if *n* versions of the same part are wanted, *n* files need to be downloaded. If so, available workstation disk space can decrease rapidly.

In the case of the ***„KNSE – NX4 Mold Wizard - Library"***, the philosophy is totally opposite. The main core of the tool is a small set of parametric parts (single one for each component kind) and the appropriate input file that manages the library contents.

All files created during the library maintenance are additionally copied to the common network folder. Then, all collaborators can enjoy the benefit, even if the library is not installed on their workstations.

The effect of launching the ***„KNSE – NX4 Mold Wizard - Library"*** as the add-inn of the *UGS Unigraphics NX4* system can finally terminate problems connected with using the most popular standard parts *MCAD* models by Polish mold designers.

6. Literature:

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[5] UGS – Mold Wizard Design Process, User Guide, *UGS Unigraphics NX4 system manual*

[6] www.ugs.pl , www.ugs.com

SUMMARY:

The paper presents the manner of shaping the digital library of chosen standard parts, necessary during the contemporary injection mold *3D* design. The flexible „***KNSE – NX4 Mold Wizard - Library***" tool is dedicated for *CAD/CAM/CAE UGS Unigraphics NX4* system, particularly in the case of its injection mold design process specific environment, called *Mold Wizard*. The library is based on the up-to-date market offer of chosen standard parts supplier that is claimed to be the most popular within the Polish tooling industry. Library contains solid models of following injection mold components: plates, leader pins, leader bushings, locating rings, injection bushings and ejector pins. The „***KNSE – NX Mold Wizard - Library***" *MCAD* tool can be easily updated if the components supplier's market offer changes. The library recourses can extend *NX4 Mold Wizard* original standard parts one. The aforementioned tool application can increase the productivity of injection mold designer and enable the flexibility of their design tasks.