



RESEARCH OF TIME REQUIREMENTS FOR PREPARATION OF CONTROL PROGRAMS

Michal HAVRILA

Technical University of Košice
Faculty of Manufacturing Technologies in Prešov, SLOVAKIA

ABSTRACT:

Time requirements for preparation of control programs for CNC machines can present suitable criteria for definition of usage area for systems of shop floor programming in production praxis of engineering plants, firms and companies. When preparing and collecting the time requirements for preparation of control programs it is important to compare and consecutively to analyse used programming methods by:

- ✚ conventional (manual) programming
- ✚ shop floor programming
- ✚ automated programming with CAD/CAM (modules dedicated to automated preparation of control programs)

KEYWORDS:

manufacturing, CNC control, control program

1. INTRODUCTION

For analysis and results obtained from analysis it is important to characterize the workpieces (parts) from the view of their constructional-technological elements while diving them into:

- ✚ simple workpieces
- ✚ medium complicated workpieces
- ✚ complex workpieces

Preparation of control programs by the way of shop floor programming was realized in following companies and plants of Prešov region:

- ✚ Regada, s.r.o., Prešov
- ✚ Tomark, s.r.o., Prešov
- ✚ Fragokov, v.d., Prešov
- ✚ Kovo-Finiš, s.r.o., Prešov
- ✚ Faculty of Manufacturing Technologies - Laboratory of Manufacturing Technologies

Mentioned phases of preparation and realization were executed using following CNC machining devices:

- ✚ CNC lathes „Leadwell“
- ✚ CNC machining centers „Pinnacle“

CNC lathes „Leadwell“ are produced by Taiwanese company Leadwell and are equipped with control system of Japanese company GE Fanuc with built-in systems of shop floor programming Manual Guide *i*. CNC machining centers „Pinnacle“ are produced by Taiwanese company Pinnacle and are also equipped with control systems of Japanese company GE Fanuc with built-in systems of shop floor programming Manual Guide *i*. In last 2-3 years in Slovakia there have been installed and operated over 150 of these CNC machining devices

2. RESEARCH OF TIME REQUIREMENTS FOR PREPARATION OF CONTROL PROGRAMS

Time requirements for preparation of control programs by conventional (manual) method were estimated by technologists – programmers in mentioned companies and time requirements for automated programming in CAM system were obtained after creation of control programs in Laboratory of Computer Aided Manufacturing Technologies at Department of Manufacturing

Technologies at FVT TU in Prešov using the software module of system Pro/Engineer. Realized phases of preparation of control programs and following manufacturing of selected parts present suitable sample of wider application of CNC machining devices in Slovakia.

2.1 Time requirements for preparation of control programs for manufacturing of parts by shop floor programming

On Figure 1 there are displayed simplified 3D models of group of simple rotary parts, of which manufacturing was programmed by the method of shop floor programming and Table 1 shows programming time requirements in selected companies from Prešov region.

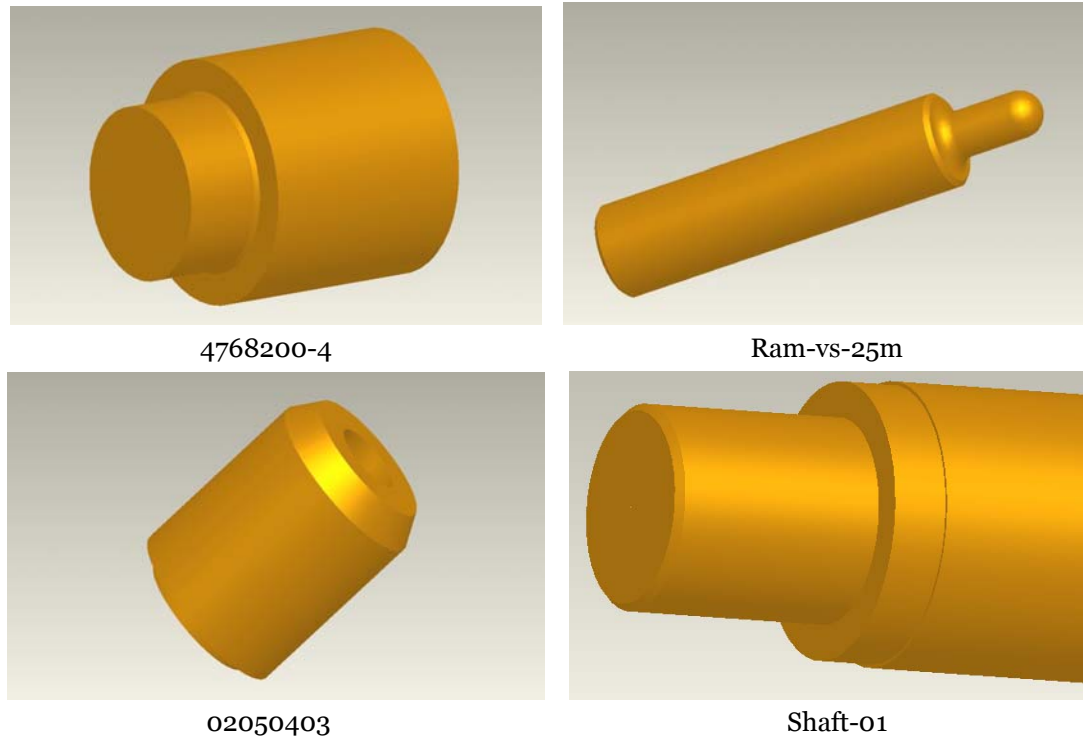
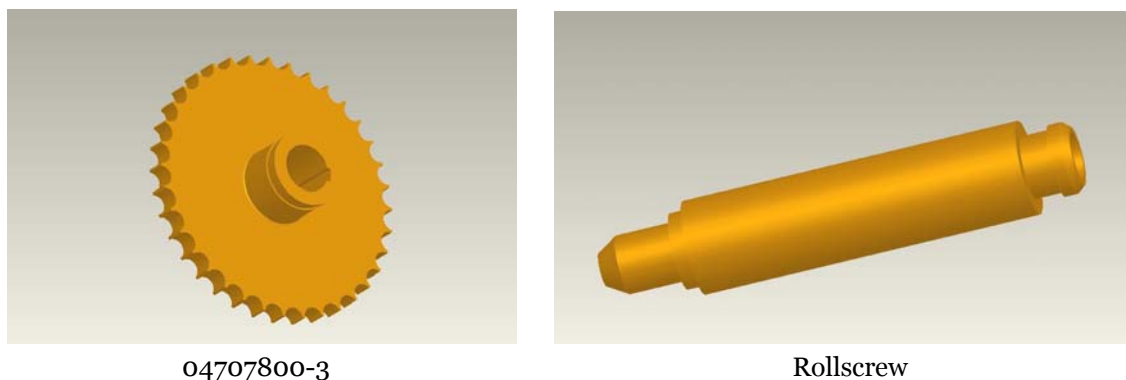


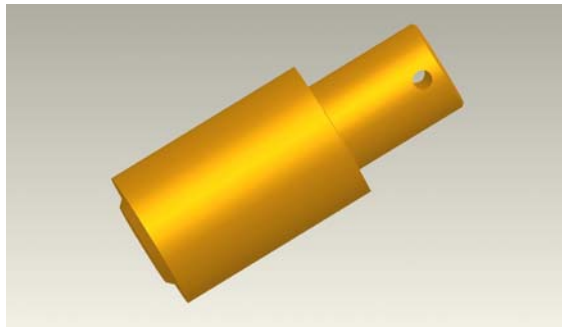
Figure 1. Set of simple parts produced by turning

Table 1. Time requirements for preparation of control programs for turning of simple parts by the method of shop floor programming

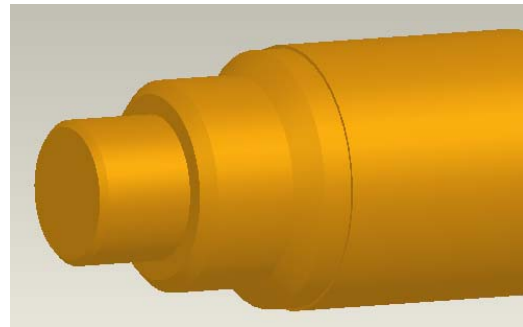
Workpiece type	Time requirements for preparation of control programs by the method of shop floor programming (min)				
	Drawing/Company	Regada	Fragokov	Kovofiniš	FVT
Simple (turning)	04768200-4	9			
	Ram-vs25m		12		
	02050403			15	
	Shaft-01				10

Part numbered as „02050403“ serves as representative for set of simple parts for turning. Figure 2 shows simplified 3D models of group of medium complicated workpieces, of which manufacturing was programmed using the shop floor programming and Table 2 contain time requirements for programming in selected companies.





St-52-3-SH



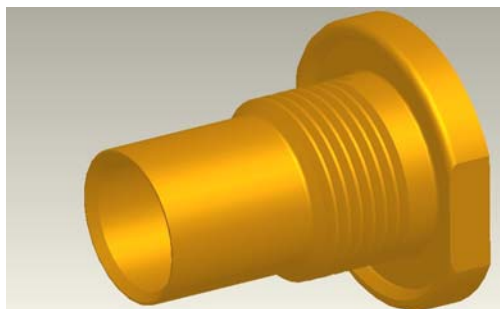
Shaft-02

Figure 2. Set of medium complicated parts for turning

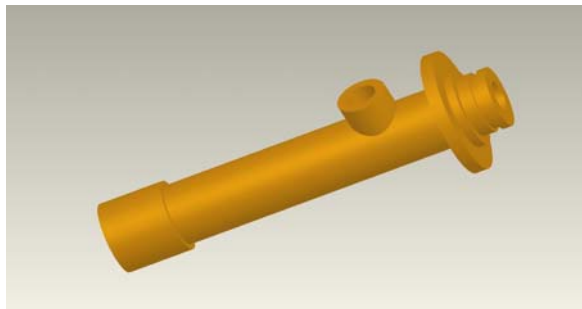
Table 2. Time requirements for preparation of control programs for turning of medium complicated parts using the shop floor programming

Workpiece type	Time requirements for preparation of control programs by the method of shop floor programming (min)				
	Drawing/Company	Regada	Fragokov	Kovofiniš	FVT
Medium complicated (turning)	04707800-3	25			
	Rollscrew		22		
	St-52-3-SH			11	
	Shaft-02				23

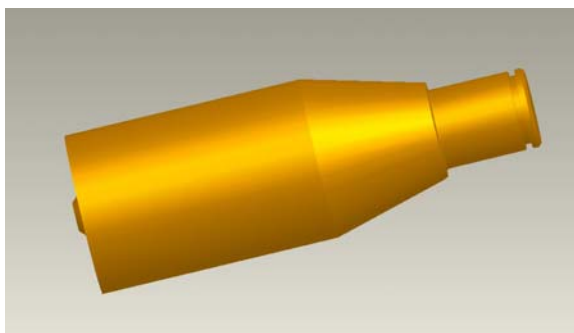
As representative for the set of medium complicated parts for turning there was selected part numbered as „St-52-3-SH“. On Figure 3 there are displayed simplified 3D models of group of complex rotary parts. Their manufacturing was programmed using the shop floor programming and Table 3 shows programming time requirements in selected companies.



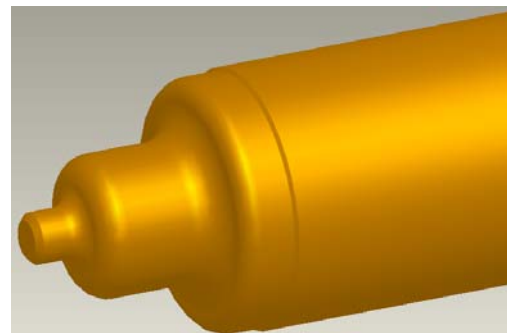
4549400-4



HV-19-UR



S355JO-TG



Shaft-03

Figure 3. Set of complex parts for turning

Table 3. Time requirements for preparation of control programs for turning of complex parts using the shop floor programming

Workpiece type	Time requirements for preparation of control programs by the method of shop floor programming (min)				
	Drawing/Company	Regada	Fragokov	Kovofiniš	FVT
Complex (turning)	4549400-4	54			
	HV-19-UR		41		
	S355JO-TG			21	
	Shaft-03				30

Representative for set of complex parts for turning is part numbered as „S355JO-TG“. In similar way there were detected and handled time requirements for preparation of control programs for manufacturing of parts by the method of manual programming and with using CAM system for CNC machining (software module of system Pro/Engineer). For information there is 3D model of complex box part (Figure 4) as the example for creation of control program for CNC machining using CAM programming module „Complete Machining Option“ in system Pro/Engineer.

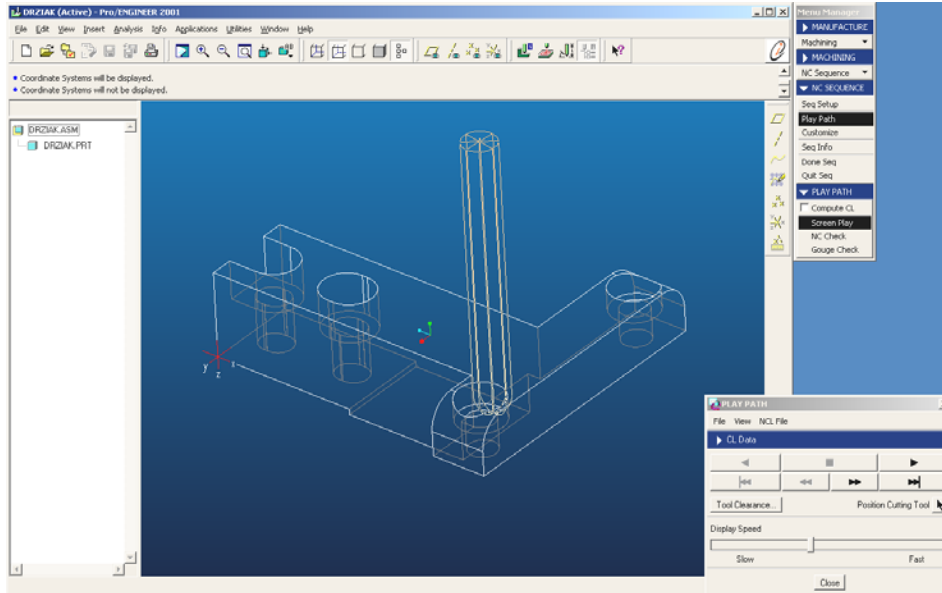


Figure 3. 3D model of part „Holder-03“

With respect to very similar data about time requirements for preparation of control programs for particular groups of parts (simple, medium complicated and complex), the data of representatives of particular sets were used for evaluation (Table 4 and 5).

Table 4. Time requirements for preparation of control program (min) for groups of rotary parts

Rotary parts (set representative)	Time requirements for preparation of control program (min)		
	Manual programming	Shop floor programming	CAM programming
Simple parts (02050403)	34	15	25
Medium complicated parts (St-52-3-SH)	26	11	30
Complex parts (S355JO-TG)	54	21	30

Table 5. Time requirements for preparation of control program (min) for groups of box parts

Box parts (set representative)	Time requirements for preparation of control program (min)		
	Manual programming	Shop floor programming	CAM programming
Simple parts (235-7969)	26	10	15
Medium complicated parts (2873764)	36	15	45
Complex parts (Holder-03)	110	40	55

2.2 Analysis and evaluation of time requirements for preparation of control programs

Time requirements for preparation of control programs for representatives of part groups (simple, medium complicated and complicated rotary and box parts) using the shop floor programming, manual programming and CAM programming are presented on graphs (Figure 4 and 5).

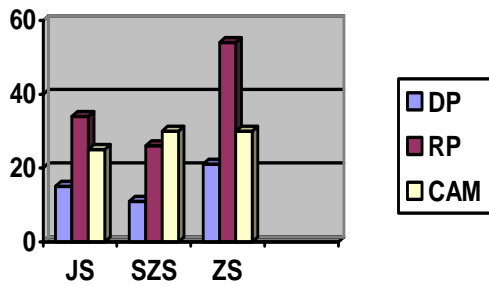


Figure 4. Time requirements for preparation of control programs for rotary parts in min. (DP - shop floor prog., RP - manual prog., CAM - prog., JS - simple parts, SZS - medium complicated parts, ZS - complex parts)

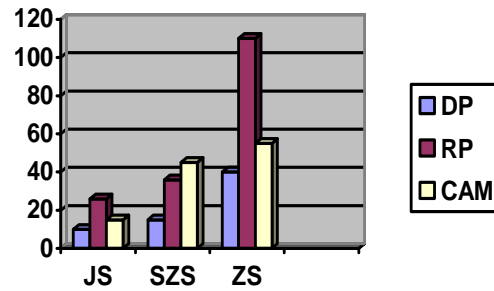


Figure 5. Time requirements for preparation of control programs for box parts in min. (DP - shop floor prog., RP - manual prog., CAM - prog., JS - simple parts, SZS - medium complicated parts, ZS - complex parts)

3. CONCLUSION

Research of time requirements for programming of CNC machining devices in selected companies and firms of Prešov region on the chosen sample of rotary and box parts (simple, medium complicated and complex parts) by the method of shop floor programming, manual programming and CAM programming indicated following facts in production praxis:

- ✚ it is advantageous to use the systems of shop floor programming for production of simple and medium complicated parts,
- ✚ using of systems for shop floor programming is effective for production of parts in part or semi-batch production,
- ✚ using of systems for shop floor programming is effective in small firms, in workshops of maintenance and prototype workshops of larger companies and firms (what is confirmed by preview of companies in Slovakia, that are in last two years using the systems for shop floor programming on new CNC machining devices),
- ✚ shop floor programming provide the operating staff of CNC machines significant increase of their own technical-technological scientific level and qualification pretentiousness,
- ✚ efficiency of using the systems of shop floor programming gets in comparison to CAM programming higher due to the fact that direct work (usage) of operating staff of CNC machining devices with technical and technological documentation (workshop drawing - sketch of workpiece and part, cutting parameters of manufacturing and other data) eliminate difficult, high-qualified work of technologist - programmer in CAM programming (creation and design of postprocessor, design - 3D construction of workpiece and part - model, database of used tools, selected set of cutting parameters and others). Besides this for user of CAM programming there are arising higher financial and personal costs for purchasing the hardware (PC) and CAD/CAM product.

REFERENCES

- [1] HAVRILA, M.: Možnosti dielenského programovania CNC obrábania. AT&P Journal, HMH s.r.o. Bratislava, č. 5, 2005, str. 38 - 39
- [2] POLYWKA, J., STANLEY, G.: Programming of CNC Machines. Industrial Press, Inc., New York, 1992, ISBN 0-8311-3129-2
- [3] SMID, P.: CNC Programming Techniques: An Insiders Guide to Effective Methods and Applications. Industrial Press, Inc., New York, 2006, ISBN: 0-8311-3185-3
- [4] STANĚK, V.: Dílenské programování, Průmyslové spektrum, Praha, č. 6, 2006, str. 46-47.
- [5] URBANOVÁ, R., HAVRILA, M.: Súčasný systémy dielenského programovania. Manufacturing Engineering/Výrobné inžinierstvo, 2007, č. 2, str. 31-35
- [6] URBANOVÁ, R., HAVRILA, M.: Workshop oriented programming CNC machining, p. 213-217, volume 2. The 4th International Congress on Precision Machining. 2007, Kielce, Poland, ISBN 978-83-88906-91-6