

INCREASING THE WORK PRODUCTIVITY BY CREATING WORK PROGRAMMES FOR CNC WOODWORKING CENTRE USING MACROS

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ABSTRACT

This article presents the results of a research carried out by the authors of three different approaches of creating work programmes for universal woodworking machine center with computer control (CNC woodworking centre) on work productivity – input of operations by the CNC software, import from CAD software and using created macros.

The analysis of the results proves that the programming and the use of macros greatly increases work effectiveness when creating work programmes for CNC woodworking centres which leads to increased productivity and competitive advantage.

Key words: CNC woodworking centre, work programme, CAD/CAM, macros

INTRODUCTION

In the woodworking and furniture industries CNC woodworking centres are no longer considered luxury, but a necessity for the companies in the highly competitive environment of the globalised market and the global economic crisis. This makes their wide distribution in the Bulgarian furniture enterprises. But they are only high-tech equipment. Their high degree of automation gives the possibility for obtaining a highly competitive advantage when using the programming, mathematical and optimization capabilities of their software management. However, this requires the application of interdisciplinary knowledge working with them - on the one hand specialized knowledge in the field of woodworking and furniture production is required, and on the other hand knowledge in the field of CAD/CAM systems and ideally and VBScript programming (the language used for CNC) is also required. Scripting language in information technology is called a programming language in which the source code of the programs run directly. To accomplish this, use a special program called

an interpreter. The alternative method of running programs is through compiling. The source code of a program that is written in a scripting programming language called script. The scripting language is a programming language, allowing control over software applications. „Scripts“ differ from the actual code of the application, which is usually written in another language and are often created or changed by the end user. Script languages are almost always embedded in the applications they control [1]. The lack of specific knowledge in the field of programming may be compensated by involving a professional in this area in a team for creating programmes for the purposes of the particular production.

This article presents the results of a study, carried out by the authors using three different approaches in developing work programmes for universal woodworking centre machines with computer control (CNC) on the effectiveness of work-input of operations through the software of CNC, import from CAD software and using the created macros.

METHODOLOGY OF THE RESEARCH

The research was conducted using the method of controlled experiments with a control formulation [2]. The impact of the approach when creating work programmes for CNC woodworking centres for drilling technological holes for Minifix furniture fittings, bases and hinges, shelf supports and drawer guides on the time for their creation has been studied. The time for creation of a work programme through the software of the CNC woodworking centre having a developed design and technological documentation on paper has been accepted as a control formulation, because this is the most common approach for creating work programmes in practice in our country. The control formulation has been registered in a field experiment.

The embedded in the software of the CNC woodworking centre optimization module By Time has been applied to all work programmes.

Field experiments have been made accordingly to record the time required for the development of a work programme:

- Without a developed design and technological documentation;
- By importing a design drawing, developed in AutoCAD;
- Using the previously created macro.

The study was conducted in the Educational and Production Centre for the Furniture Manufacturing at the University of Forestry on a CNC „BIESSE ROVER A3“.

RESULTS AND DISCUSSION

The obtained experimental results cannot be regarded as absolute, because they

are highly influenced by the degree of knowledge of the particular operator of CNC in the respective areas – practical knowledge in the field of furniture production, knowledge of the constructive-technological activity, CAD systems and operator's experience to work with the software of the CNC woodworking centre. For this reason, the following results are in relative units representing the ratios between measured times. Even though the results are not commonly indicative they are typical for the extent of impact of the approach on the extent of the impact of the approach on the timing of the development of a work programme.

The analysis of the results obtained is made in accordance with the development of the work programme when using the following approaches: without the presence of developed design-technological documentation, importing developed in AutoCAD structural drawing and using the previously created macro, and reflects the authors' views on the studied issues.

- Without developed design-technological documentation

Although nowadays this approach is rarely observed, unfortunately it is still applied in practice. Remarks like “where is your problem? You can calculate it” can still be heard. This approach occurs in industries where the operator of CNC has a higher degree of knowledge in the areas listed above, and the supervisor is not a professional at the required level.

The result as a work programme for drilling drawer guide holes is shown on Fig. 1.

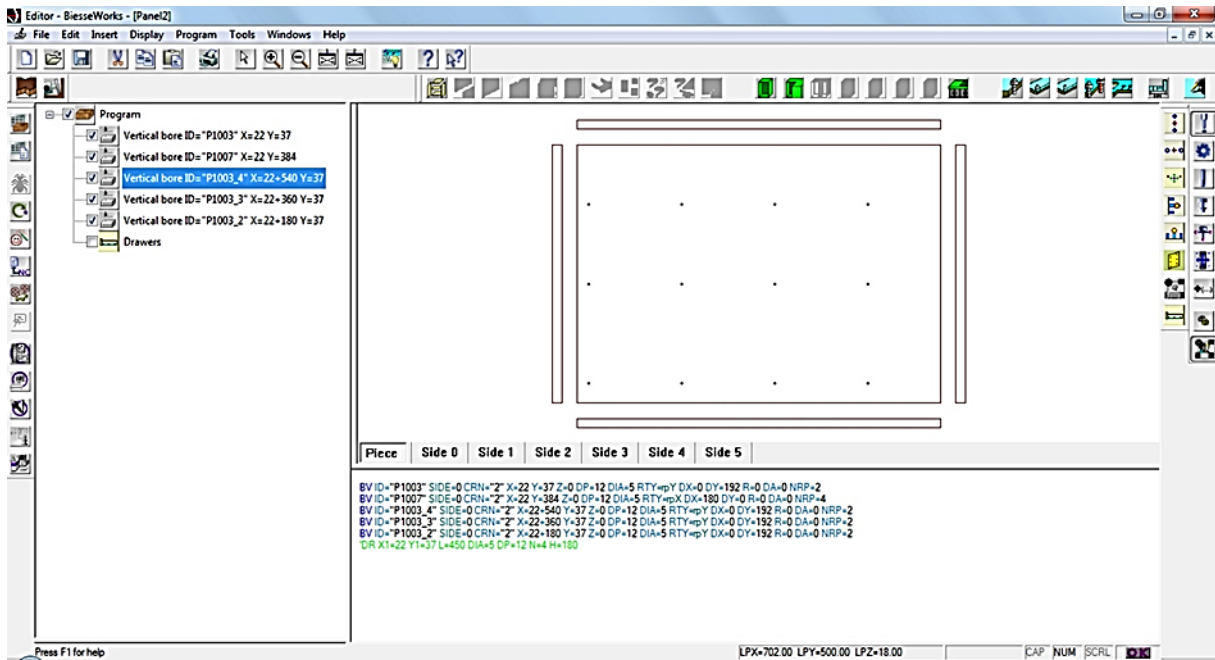


Figure 1: Work programme for the drilling guides of drawers – by input

In table 1 the reported times for various types of drilling are shown. The time recorded for the control formulation (development of the work programme through the software of CNC woodworking centre when there a design-technological documentation is developed on paper) is equivalent to 100,

with the purpose of further processing of the results obtained in percentages. This will ease making of a summarised economic analysis of the impact of the method of creation of the work programmes on the production, while expanding the scope of the study.

Table 1: Time for the development of a work programme

The control formulation	Shelf Brackets	Basics and hinges	Minifix	Guides for drawers
100	125	167	200	250

Advantages and disadvantages of the approach

The advantages and disadvantages of individual cases from the point of view of contemporary management paradigm for the triune of economic, social and environmental aspects will be observed without taking into consideration the ecological aspect.

- Economic aspect

This approach does not have advantages. It leads to a large percentage of errors, which in turn leads to a higher cost of materials, therefore raising the cost and deterioration in the quality of the final product.

- Social aspect

This is aspect does not have any advantages either. Most often it leads to frustration and frequent change of workers.

- Importing a developed in AutoCAD design drawing

This approach has a sustainable positive trend of its application in practice. There are several varieties: development of design drawing with or without the use of designed templates in AutoCAD; the presence or absence of a developed corporate rule; use of manual import (Manual Import) or setting of CNC and synchronizing the

drawing in AutoCAD for automatic import (Automatic Import).

Fig. 2 shows a developed design drawing of drilling for drawer guides, containing a template and a table with product catalog data for drilling of the standard type and

brand guides. The template is synchronized with the settings of the CNC for automatic import.

Fig. 3 shows the result as a work programme.

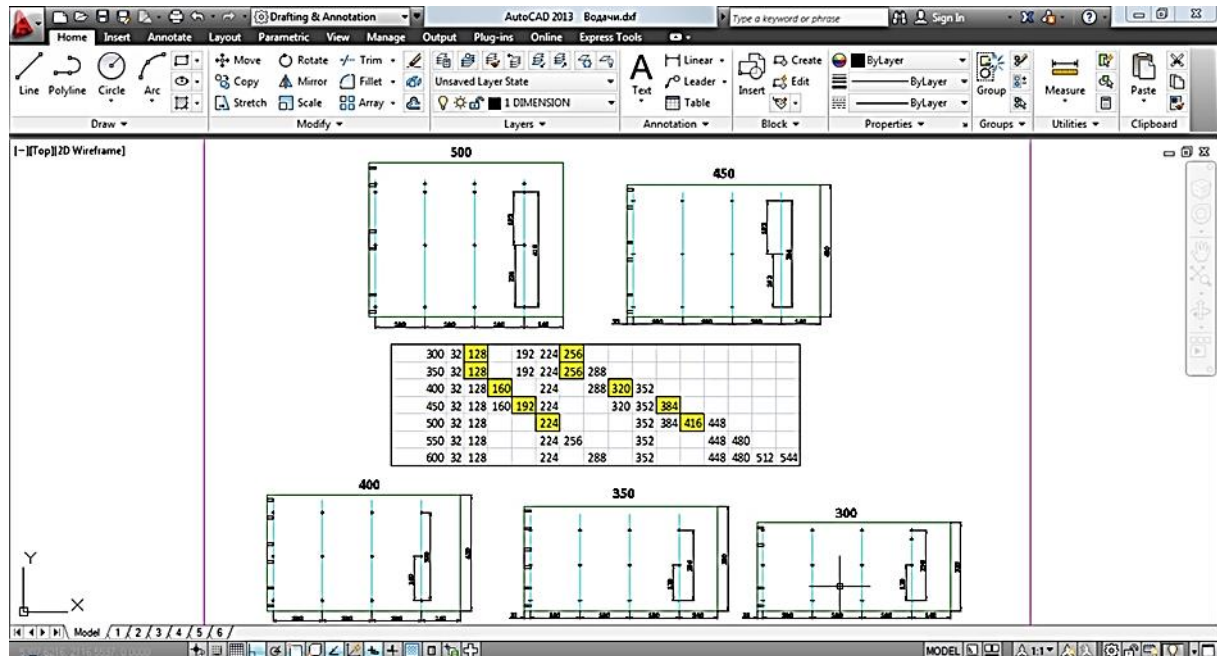


Figure 2: Design drawing of drilling guides of drawers

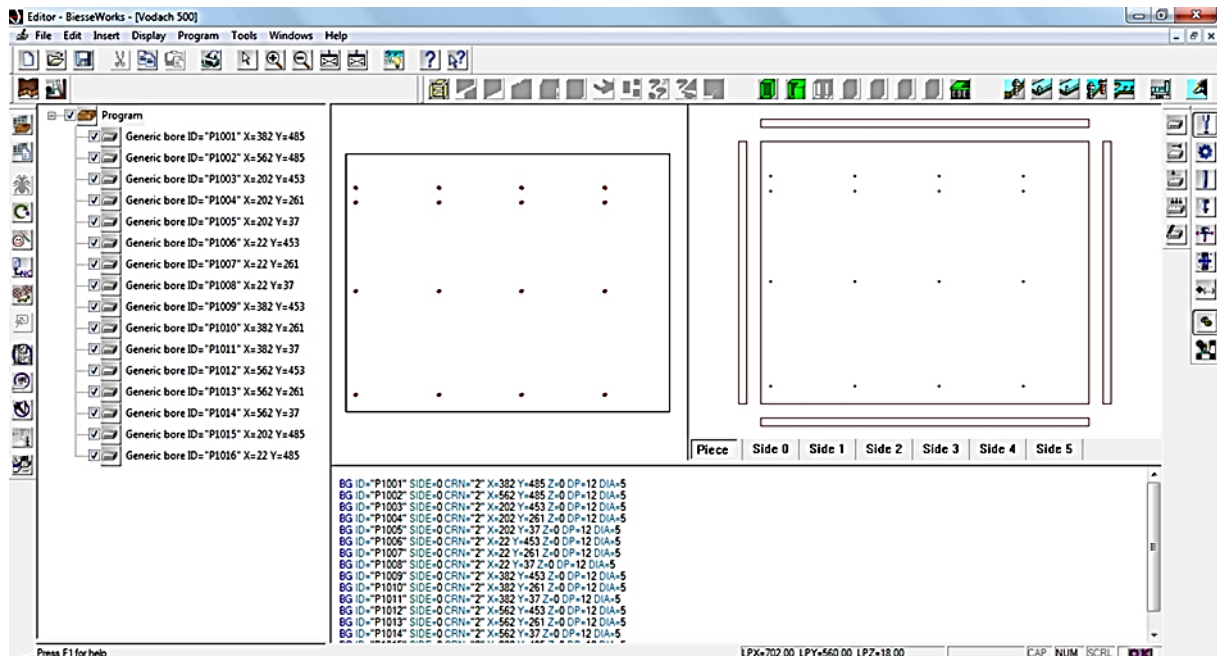


Figure 3: Work programme for the drilling guides of drawers - through import of a design drawing

Table 2 shows the reported times including the time required for import and

without taking into account the time for creation of design drawing.

Table 2: Time for development of the work programme

The control formulation	Shelf Brackets	Basics and hinges	Minifix	Guides for drawers
100	10	15	25	10

Advantages and disadvantages of this approach

- Economic aspect

This approach leads to minimization of errors and reduction of the cost, as well as to sustainability of quality of the final product. This in turn leads to the creation and maintenance of a good brand.

As difficulties in using this approach the need for employer’s demands for optimal number of employees in the constructive-technological team and the higher threshold of their remuneration can be noted.

- Social aspect

Advantages of this approach are the allocation of the responsibilities and necessary professional knowledge. Upon successful selection of employees this approach leads

to creation of effective working team of technologists, designers and CNC operator and satisfaction.

- Using the beforehand created macro

This approach is still rarely used in practice, but there is a potential for a rapid increase of its application. This is conditioned by the growing understanding of a certain number of owners of woodworking and furniture enterprises for the economic added value from its application.

Fig. 4 shows the developed macro for drilling guides of drawers.

Fig. 5 shows the window for entering the input parameters for drilling guides for drawers in the macro.

Fig. 6 shows the work programme.

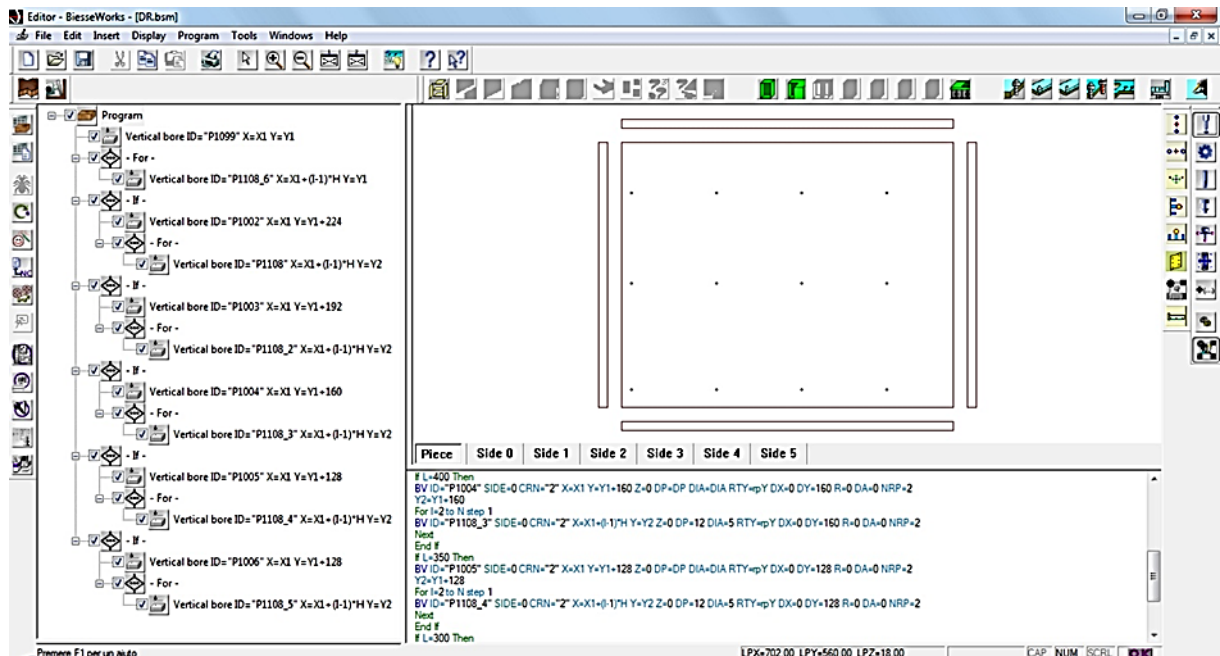


Figure 4: A macro for drilling guides of drawers

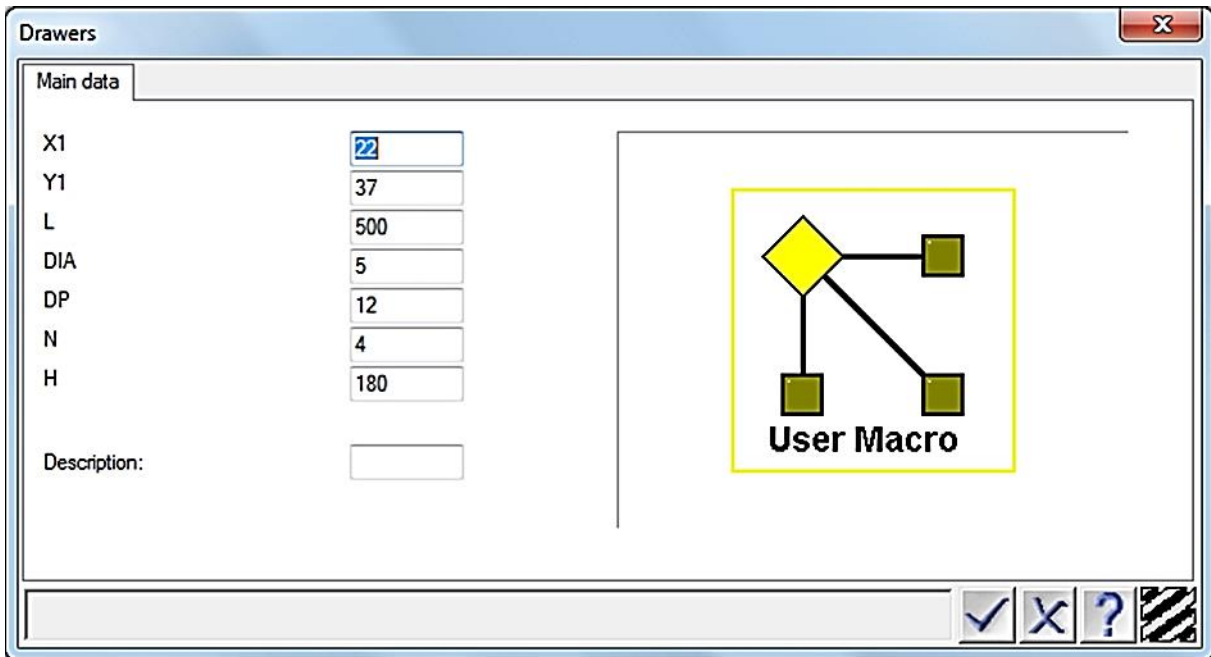


Figure 5: Entering the input parameters for drilling guides of drawers

X 1- off of the first guide from the bottom side of the page; Y1- off on the first hole; L – length of the Guide; DIA – the diameter of the hole; DP- depth of the hole;N – number of drawers; H- height of the forehead of the drawer, without deduction of spark plug gap between their foreheads.

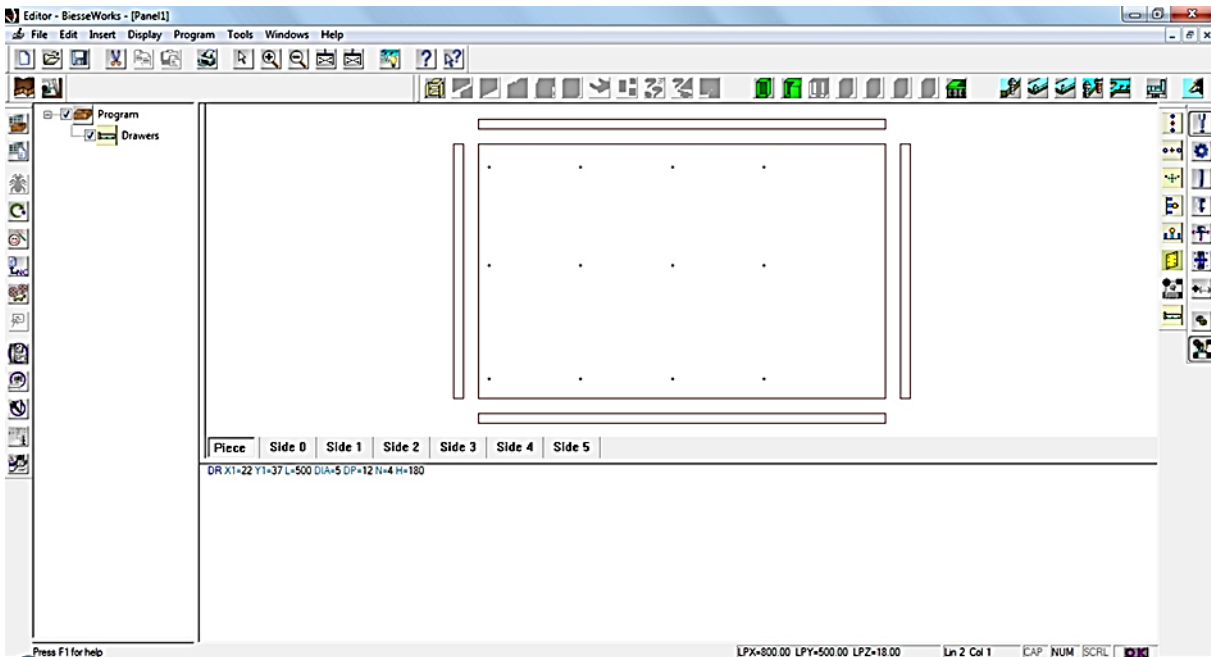


Figure 6: Work programme for the drilling guides of drawers-through macro

The reported times for the development of a work programme through this approach for all studied types of drilling is **under 1 min.**

Time is taken into account when using the standard toolbar buttons for user created macros in the software of CNC (item 1 on

the Figure 6), as the buttons on the relevant macros are assigned created icons suggesting their action.

The time for creation of the macro are not taken into account, because this is a one-time process, unlike the development of a

design drawing for different subtypes of a given device.

Ability to create macros with a specific focus for a given production and its product range, as well as combining multiple macros in a work programme expands the applicability of this approach.

Advantages and disadvantages of the approach

- Economic aspect

This approach leads to greater economic added value by increasing the effectiveness of work to create work programmes for CNC woodworking centres. Automation of the development of work programmes by carefully entering the input data practically reduces the possibility of making errors to zero.

As difficulty in using this approach it can be noted the need to recruit a specialist in the field of programming for the creation of macros. This difficulty can be minimized by training students from specialty Wood Technology at the University of Forestry at a basic level of working with VBScript. The applied in CNC woodworking centres designs from instructions of VBScript are relatively few in number.

- Social aspect

The advantages of this approach are connected with the following: minimising the time for creation of a design-

technological documentation, making the work of the CNC operator easier, raising productivity, which in theory should lead to increasing the remuneration.

CONCLUSION

Based on the study and analysis of the obtained results the following conclusions can be made:

- The approach used to create the work programmes has a strong impact on the efficiency, productivity and satisfaction of employees;
- The achievement of high levels of automation of production and quality of manufactured production gives the possibility to obtain highly competitive advantage;
- The use of the complete functionality of the software management of CNC woodworking centre will lead to a more rapid return of the investment;
- The dissemination of the approach for using of macros in the development of work programmes is a prerequisite for the creation and dissemination of good practices for working with CNC woodworking centres in the woodworking and furniture industry.

REFERENCES

1. http://en.wikipedia.org/wiki/Scripting_language
2. <http://en.wikipedia.org/wiki/Experiment>