The Results of Software Complex OPTAN Use for Modeling and Optimization of Standard Engineering Processes of Printed Circuit Boards Manufacturing

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Abstract – **The results of software OPTAN testing on the examples of modeling and optimization of technological processes of printed circuit boards manufacturing using various techniques are presented. The software efficiency is confirmed, and ways of the technological processes research improvement are suggested.**

Keywords – **software complex OPTAN, technological processes modeling, modeling and optimization of technological processes of printed circuit boards manufacturing.**

INTRODUCTION

At the Lviv Polytechnic National University under the scientific guidance of professor Nedostup L. A. a group of authors developed scientific basis and methodology of modeling and optimizing of radio-electronic equipment (REE) at the stage of its manufacturing [1-4]. Nowadays, a universal software complex OPTAN was developed on this basis. The complex allows to solve following practical tasks:

- to build a structural, formal, and mathematical models of technological processes (TP) of REE manufacturing, which implement the proposed methodology of modeling, and are suitable for the study of a wide class of real TP;
- to maintain basic (standard) TP options research to assess their effectiveness;
- to optimize the TP with criteria of the total minimum manufacturing and operating costs, which generally shows the possibilities of their improvement using providing optimal (rational) options of process control organizing.

TESTING SOFTWARE COMPLEX

The software testing was conducted on examples of printed circuit boards manufacturing using various technologies, including combined positive method of circuit boards manufacturing with metallized holes at foiled material (subtractive method), the boards manufacturing at non-foiled materials with adhesive layer (semi-additive method), and multilayer circuit board manufacturing with through-holes metallization method. The choice of these TP research was made due to the following considerations. First, mentioned processes are a group of standard manufacturing processes, which are widely used. A sufficient amount of relevant information concerning defects at various stages of TP, the cost of defects removal, the impact on service and maintenance, etc. was accumulated. Secondly, the study indicated processes were already partially carried out using different software that allows to compare results and draw conclusions about the effectiveness of the developed software in general.

For the above TP structural, formal, and mathematical models were built, information database were generated, basic variants of TP were studied, and the results of optimization of control depth with the minimum total manufacturing costs criteria were obtained.

The example at Figure 1 shows the input window for information about the TP of printed boards manufacturing with combined positive method and its technical and economic characteristics (model name, the processing steps list, the probability parameters matrix, cost parameters, etc.).

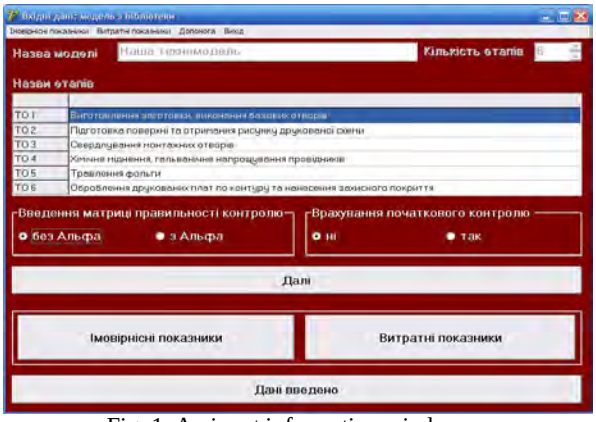
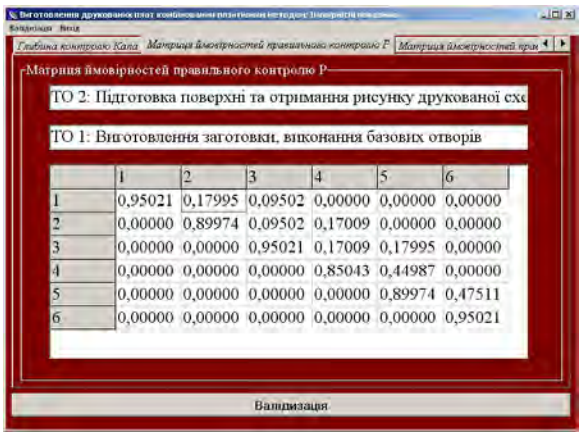


Fig. 1. An input information window

The example of information in the matrix form input is shown at Fig. 2.



	1	2	3	4	5	6
1	0,95021	0,17995	0,09502	0,00000	0,00000	0,00000
2	0,00000	0,89974	0,09502	0,17009	0,00000	0,00000
3	0,00000	0,00000	0,95021	0,17009	0,17995	0,00000
4	0,00000	0,00000	0,00000	0,85043	0,44987	0,00000
5	0,00000	0,00000	0,00000	0,00000	0,89974	0,47511
6	0,00000	0,00000	0,00000	0,00000	0,00000	0,95021

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Fig. 2. The way of correct controls probability matrix input

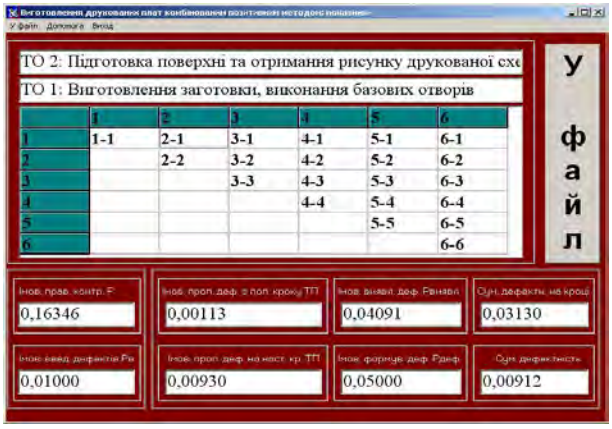
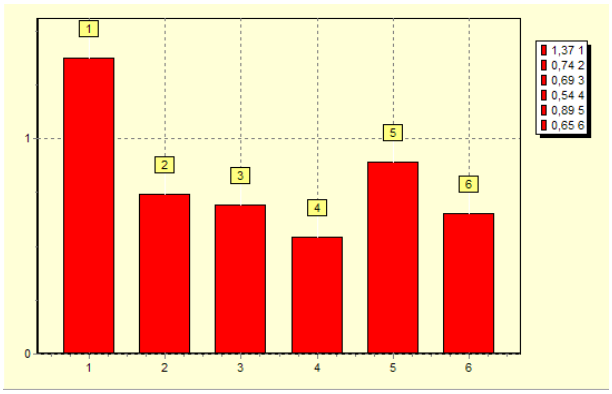
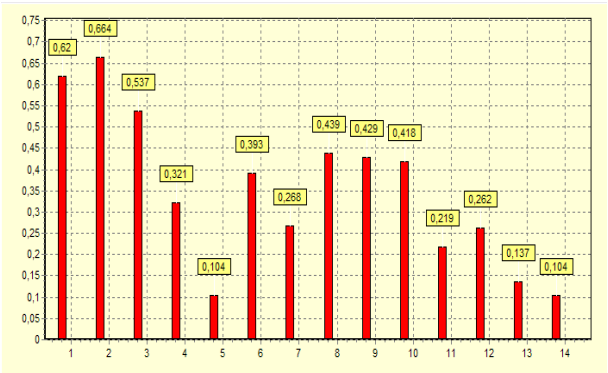


Fig. 3. The information output about standard (basic) version of TP



a



b

Fig. 4. The results of depth control optimization: a - for TP of printed boards with combined positive method manufacturing and b - for TP of boards manufacturing with subtractive method

The results of a standard (basic) TP version are formed as given at Fig. 3. It shows the 6-step model of studied TP of printed circuit boards manufacturing. Additionally it is possible to obtain necessary information for each technological operation (given at the window bottom).

At Fig. 4 the results of optimization of depth control for two standard TP - technological processes of printed circuit boards manufacturing with the combined positive method, and boards with metallized holes on foiled material manufacturing are shown. As seen, the first one is presented in the form of 6-steps process, and the second – in the form of 14-steps process. As one of the possible optimization methods the stepwise optimization method, which provides alternate search of optimal values of the depth control for each step of TP, is used.

CONCLUSIONS

1. Comparative analysis of the obtained results confirmed the efficiency of the developed software, and also showed possible improvement options of analyzed TP using optimizing control procedures.

2. Due to results shown at fig. 4a the possibility of some control requirements redistribution is fixated - more stringent requirements should be transferred to the initial steps of TP. For TP at Fig.4.b optimal values of depth control less then standard are set. This may indicate the possibility of control operations requirements relaxation, for example, the transition to the sampling methods, some control operations association, and so on.

LITERATURE

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