

OPINION

by: **Prof. Stancho Petkov Petkov, Ph.D.,**

IMETCHA- BAS (Institute of Metal sciences, Equipment and Technologies with Hydro- and Aerodynamics Centre – BAS), member of the scientific jury, appointed by Order No.53/01.03.2022. of the Director of IICT

on dissertation work

on thesis: “INNOVATIVE TECHNOLOGIES FOR INCREASING THE EFFICIENCY IN THE PRODUCTION OF TUBULAR FURNITURE ”

for obtaining educational and scientific degree “Doctor (Ph.D.)” scientific field: 5. “*Technical sciences*” in a doctoral program in scientific specialty 02.21.07. "Automated systems for information processing and management", professional field 5.2. „Electrotechnics, Electronics and Automation“

author of the Dissertation thesis:

master eng. Peter Pavlov Panev

Scientific Supervisor:

Prof. Dimitar Karastoyanov, Ph.D.

The dissertation of mas. eng. Peter Panev is a promising scientific and scientifically applicable field for the design of automatic computerized machines and the use of innovative technologies - controllers, power supplies and optimized software to increase the reliability and productivity of operations in the production of components and products of tubular construction.

I prepared my opinion based on Order No 53/01.03.2022 of the Director of IICT and based on the submitted documents, including:

- Application No / 18.01.2022, by mas. eng. Peter Panev, Ph.D. student in part-time form of study at the head of the RIUS section Assoc. Prof. Nikolay Stoimenov, Ph.D;

- Protocol No 13/22.12.2021 for expulsion from a remote meeting of the Scientific Council of IICT – BAS;
- Declaration of originality;
- Abstract;
- Order for pre-defense No 304/01.12.2021;
- Certificate for passed exams, according to the individual curriculum;
- Order No 53/01.03.2022 for approval of the composition of the scientific jury;
- Publications related to the topic of the dissertation;
- Dissertation thesis;
- Electronic medium with materials for the procedure;
- List of publications;
- Information on the fulfillment of the minimum requirements of the IICT for the educational and scientific degree "Doctor".

The procedure for the defense of the dissertation for the award of educational and scientific degree "Doctor" is followed and is in accordance with applicable regulations. The materials presented by the candidate are prepared following the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria, the Rules for Implementation of the Law on the Development of Academic Staff in the Republic of Bulgaria, and the Rules for Acquisition of Academic Degrees in IICT-BAS.

The dissertation is in a volume of **133** pages, which includes an introduction, **five** chapters for solving the formulated tasks, a list of the main contributions, a list of publications on the dissertation, and references. A total of **100** literature sources were cited. The work includes **101** figures and **19** tables. The numbers of the figures and tables in the abstract correspond to those in the dissertation.

Based on an order of the director of IICT-BAS, mas. eng. Peter Panev is enrolled in a part-time form of training in the scientific field 5. "Technical Sciences", "doctoral program in scientific specialty 02.21.07. "Automated systems for information processing and control", professional field 5.2 "Electrotechnics, Electronics and Automation" with a training period of four years.

With the development of this dissertation, the author has set himself the task of considering problems related to the production of tubular furniture and components, namely punching, welding and packaging.

Based on all this, **the main goal** of the dissertation is to study the progress and to initiate the introduction of new technologies to increase the efficiency and productivity of tubular furniture through modern research methods and innovative production tools.

In the dissertation, the modern methods for research and evaluation of the potential possibilities and effects are presented and analyzed.

Taking into account the performed analysis and the set goal, the following tasks have been formulated and fulfilled:

1. Detailed overview and analysis of the various methods and means for punching, welding, and packaging tubular furniture and components.

2. Existing methods and means for the production of tubular furniture have been studied.

3. Automatic machines have been designed to increase the productivity and quality of tubular furniture products.

4. On the basis of the projects, automatic machines have been constructed to increase the productivity of automatic table leg machines.

5. Approaches and methodologies for increasing the efficiency and productivity of automatic table leg machines are proposed.

6. Experiments and simulations of various methods for design and construction in an industrial environment have been conducted.

7. The obtained results are analyzed and tested.

The main task in the coming years is not only a significant increase in the introduction of automation tools in production but also qualitative changes in the transition from small tasks and topics to complex tasks and topics performing full mechatronic and automatic production of products and packaging.

CHAPTER 1 provides an overview, analysis and systematization of the factory for the production of tubular furniture and components; a careful and

exhaustive analysis of existing packaging and automatic machines and lines has been made. It is necessary to pay attention to the problems arising from the use of packaging materials. Marketing research of the various components of packaging has a good influence on the innovative technologies used, as well as the discrete processes and operations in packaging. **IN CHAPTER 2** are presented the existing methods and means for the production of elements for tubular furniture: stamping of details and their design, welding and packaging of the complete product. The degree of suitability for automation friendliness and installation suitability was studied. Actual and desired performance and tacts are calculated. Different structural and layout options for the packaging of finished products are presented. **IN CHAPTER 3** are developed methodologies and approaches for designing innovative machines that increase the productivity of tubular furniture - IAMM for welding a cup with a bolt, IAMM for laser welding of a pipe to a cup/bolt, AML 4 for packaging all leg Adils components for table and programming AM for automatic gluing of cardboard tape. Based on the compiled methods, the desired productivity of the AM is calculated; AM are designed according to the requirements for geometric accuracy, the normative requirements for the safety of equipment in case of mechanical hazards, and the software program for drawing Solid Works; all safety conditions for operation are met; equipment has been selected to design automated palletizing of table legs.

CHAPTER 4 presents the results achieved after the construction of automatic machines for welding a cup with a bolt, laser welding of tube to cup/bolt and packaging of all Adils leg components for a table. The desired and actual productivity of the AM and the tact of the production process are calculated.

CHAPTER 5 presents the future projects for the development of the factory.

SCIENTIFIC AND SCIENTIFIC-APPLIED CONTRIBUTIONS OF THE DISSERTATION

The contributions to the dissertation are mainly of scientific-applied character and are as follows:

1. The various methods and means for realization of processes of punching, welding and packing of tubular products are analyzed and systematized.
2. Existing problems, solutions and desired changes concerning the production of tubular furniture are discussed.
3. The influence of ICT on the methods of production of tubular furniture is studied.
4. Innovative approaches and methodologies are proposed for the design of machines for automatic punching of heel and cup of table leg and for increasing the efficiency and productivity of automatic table leg machines.
5. Innovative methods have been proposed to increase the productivity of packaging.
6. Designed, developed and implemented in the production is an innovative automatic assembly machine in two variants.
7. Innovative semi-automatic packaging line is designed, developed and implemented in the production.
8. A structural layout of an innovative automatic packaging line is proposed.
9. Experimental developments and simulations of various methodologies in industrial environment have been made.
10. Intellectual property is protected.
11. The developed automatic machines are in accordance with the European standards.

12. Methodological assistance was provided in mastering the principle of their work.

13. The quality, volume and efficiency of the produced products have been increased.

14. The results of the experiments are verified and analyzed in order to improve the quality of production and its productivity.

15. Future projects are proposed - Innovative leg.

CRITICAL REMARKS AND RECOMMENDATIONS

I have no critical remarks to question the reliability of the results presented in the dissertation and the contributions noted above.

I have some remarks that should be considered mainly as recommendations for the future scientific and publishing activity of the author. They relate mainly to omissions and inaccuracies in the dissertation.

Greater precision is needed concerning the means of expression, terms, and definitions related to the specifics of the field. For example, verbosity, long sentences, and sometimes not so clear wording are natural omissions inherent in young scientists.

The candidate has a sufficient number of scientific publications on the topic of the dissertation, reported at authoritative international forums and published in important editions.

Of all the 7 scientific papers related to the dissertation, shows that the contributions to the dissertation are mainly his merit. In general, I believe that the author of the dissertation is well aware of the state of the problems related to the object of study.

I recommend to the mas. eng. Peter Pavlov Panev to be more active in publishing the results in scientific journals with impact factor.

The above remarks in no way reduce the value of the presented materials, which definitely impress and outline an in-depth scientific and research activity.

CONCLUSION

In conclusion, I believe that the complex research work carried out in the conditions of "Factory for the production of tubular furniture and components" in Lovech for IKEA International Group of Sweden AB.

Dissertation work is an undoubted creative achievement, which as a topic, realization and theoretical and scientific-applied contributions and summaries have undeniable significance.

The claims for scientific contributions are substantiated and correspond to what has actually been achieved.

The dissertation is written in a competent technical and stylish language, well designed, and illustrated.

I consider that the dissertation presented for review on the thesis: "*Innovative technologies for increasing the efficiency in the production of tubular furniture*" fully meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and regulations for its application and allows to qualify as complete, containing solutions to complex scientific -technical task of important practical importance.

The analysis and evaluation of the dissertation and the significance of the scientific, scientific-applied and applied contributions to the theory and practice contained in it, give me a reason to suggest its author, **mas. eng. Petar Pavlov Panev** for awarding the educational and scientific degree "**Doctor**" in the scientific field 5. "Technical Sciences" in the doctoral program in the scientific specialty 02.21.07. "Automated information processing and control systems", professional field 5.2 " Electrotechnics, Electronics and Automation".

Sofia

20.03.2022

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