

## OPINION

on the dissertation work

for obtaining an educational and scientific degree "Doctor" in professional field 5.2  
"Electrotechnics, Electronics and Automation " scientific specialty "Automated  
information processing and management systems"

**Author of the dissertation**

**work:** master eng. Peter Pavlov Panev

**Thesis of the dissertation**

**work:** „Innovative technologies for increasing the  
efficiency in the production of tubular furniture“

**Prepared the opinion:**

member of the scientific jury

Assoc. Prof. Naiden Chivarov, Ph.D.

The dissertation is presented in a volume of 133 pages: 19 tables, 91 figures, diagrams and photos, references from 100 sources, a declaration of originality, 7 publications in connection with the dissertation, utility model of the Republic of Bulgaria reg.№ 3892U1 / 23.09.2020 and attached 11 photos of original - innovative modules, units and configurations of designed, manufactured and implemented in operation: IAAM1, IAAM2, IPAOL and structural layout of IAOL, commercialization of future projects, conclusion and contributions.

### **1. Relevance of the problem developed in the dissertation in scientific and scientific-applied terms.**

The dissertation presents the research of the author in the field of production of modern element base, building innovative tubular furniture, corresponding to the standard for geometric requirements for the product ISO/TC213. Operational safety requirements are noted. Various approaches are increasingly being applied to significantly increase efficiency, productivity and reliability in the design and implementation of innovative technologies and automation tools in the prevailing discrete production processes and operations, basic and auxiliary in various industries. The qualitative changes in the activity of the transition from small tasks and topics to complex tasks and topics, as well as the use of a variety of: metal, microcorrugated packaging, heat-shrinkable foil (pH-HB-rolls), PVC polyvinyl chloride tape, are analyzed (Solvent 5-30 °C, 2 Hotmel 15-25 °C), barcode sticker rolls, glue (Henkel hotmel) and purchase of ready-made elements. The main goal of the developed dissertation is to use the mechatronic approach and methodologies through digitalization for the development of competitive options, choice of

option, design and implementation of innovative automatic assembly and packaging machines and lines. The innovative technologies used and the optimized software increase both productivity and reliability in the production of pipe products, mechanical and etching, heel and cup preparations, use of welding during installation, painting and packaging of finished products curry legs or adils for fruit tables. Research in this area requires an interdisciplinary approach to improve the packaging of finished products, in line with the growing requirements for the appearance of products, quality and design of packaging, are one of the main factors serving the efficiency and reliability of AM and L. The problem is a high degree of relevance in the world scientific field, as evidenced by the increasing application of such AM and L in practice, as well as the ever-increasing number of articles and reports in forums. The specific tasks developed in the dissertation are relevant for research in our country and the world.

The above gives me a reason to note the relevance and originality of the developed topic.

## **2. Degree of knowledge of the state of the problem and creative interpretation of the literary material.**

An extended overview of the development of the factory for the production of tubular furniture and components has been made, what is the impact of joint work and adopted concept of IKEA to offer a range of furniture and accessories for home furnishing, combining functionality, quality, design, value and responsibility attitude towards the environment. Customer requirements for the products to be comfortable and light are considered. In terms of creation requirements, they need to be implemented through innovative technologies and automatic machines and lines, in convenient packaging. A review of contemporary publications has been made - (100 sources in the references are listed). Judging by what is stated in the dissertation, it should be noted that the author knows this matter very well and has provided in-depth work. The author has in-depth knowledge of the use of technological equipment, design and manufacture of punches, the use of laser technology and welding robots CIOOS. Table 11 discusses the nomenclature of beds, sofas, legs and components of 48 pcs. Packaging materials are analyzed - stretch film, heat-shrinkable film, types of corrugated wallpaper, duct tape, and adhesives. The overall formation of the work is very good, as well as the specialized concepts and terminology used.

## **3. Correspondence of the chosen research methodology and the set goals and tasks of the dissertation with the achieved contributions.**

The aim and tasks of the dissertation are set clearly and understandably. The dissertation proposes innovative approaches and methods for increasing the efficiency and productivity for the realization of automatic machines and lines for the production of legs for table countertops. Methods for automatic punching of the heel and cup are presented; the structure and methods of design processes are studied; an approach to machine design using 3D modeling and assembling software is considered; approach to shaping technical documentation with accurate drawing; approach to ensuring occupational safety; methodology for ensuring the technological process in packaging; methodology for achieving high productivity in packaging and methodology for a mechatronic increase of packaging productivity.

On this basis, a systematic approach has been implemented for the design and construction of reconfigurable automatic assembly machines 1 and 2, semi-automatic packaging line, as well

as structural layout of automatic packaging line. A machine for automatic gluing of cartons with finished products is designed and implemented by programming. The selected approaches and methods for research, design and calculations of productivity are the result of the implementation: IAAM1, IAAM2, IPAOL, structural layout of IAOL, which correspond to the goals and objectives of the dissertation.

#### **4. Scientific and scientific-applied contributions of the dissertation.**

The material presented in the dissertation, on which the contributions are built, has mainly a scientific-applied character. I accept the contributions formulated in this way in the dissertation. The reliability of the obtained results is proved by the 7 publications made in authoritative journals and conferences at home and abroad, accompanied by a registered utility model.

#### **5. Evaluation of the dissertation publications.**

The main results of the dissertation have found a place in 7 publications as follows:

3 independent:

1. Panev P., Development of Automatic Packing Line for Single Packs, 8th International Conference on Mechanical Technologies and Structural Materials (MTSM 2018), Split, Croatia, September 27-28, 2018, Croatian Society for Mechanical Technologies, Croatia, ISSN: 1847-7917, pp. 149-152 SCOPUS Visible
2. Panev P., State of innovative technologies in packaging processes and operations, International Conference Robotics, Automation and Mechatronics'18 RAM 2018, Bankya, Bulgaria, 2018., стр.61-66, ISSN 1314-4634.
3. Panev P., Increasing performance in punching and pressing of details for the production of tubular furniture, XXIX International Scientific and Technical Conference, ADP - 2020., 29.06-02.07 2020, Sozopol, Bulgaria., Publishing house of TU-Sofia ISSN – 2682-9584, Publisher Department “Automation of Discrete Production Engineering“ Mechanical Engineering Faculty, Technical University – Sofia, pp. 76-79

4 in co-authorship:

1. P. Panev, S. Dimitrov, Innovative Technology For Increasing The Efficiency In Tubular Furniture Production Machine, 8th International Conference, ICAT'19 Sarajevo, Bosnia and Herzegovina, August 26-30, E-ISBN: 978-605-68537-4-6, 2019 pp. 338-341
2. Panev P., Paneva M., Stoimenov N., Dimitrov S., Increasing the Reliability and Productivity of a Tubular Furniture Packaging Operation, International Scientific Conference “Industry 4.0”, 09-12 December 2020, Borovets, Bulgaria., Scientific Technical Union of Mechanical Engineering Industry – 4.0, ISSN: 2535-0153, pp. 133-135
3. Panev P., Paneva M. and Klochkov L., AUTOMATION OF WELDING OF A DETAIL FOR THE PRODUCTION OF TUBULAR FURNITURE, XXX International Scientific and Technical Conference, ADP - 2021., 29.06 ÷ 02.07.2021, Sozopol, Bulgaria., Publishing house of TU-Sofia ISSN – 2682-9584, Publisher Department “Automation of Discrete Production Engineering“ Mechanical Engineering Faculty, Technical University – Sofia, pp. 76-79

4. Paneva M., Panev P., Klochkov L. and Karastoyanov D., Analysis of defects obtained in the production of steel and steel products, VI International Scientific Conference Winter Session, 08-11 December 2021, Borovets, Bulgaria,, Scientific Technical Union of Mechanical Engineering Industry – 4.0, ISSN: 2535-0153, pp. 230-232.

Utility model:

Stoimenov N., Paneva M., Panev P., Holder for test bodies, Utility model of the Republic of Bulgaria, Reg. № 3892 U1/ 23.09.2020.

In my opinion, the main results of the dissertation have become available to the scientific community at home and abroad.

## 6. Opinions, recommendations and remarks.

The Ph.D. student shows very good research opportunities with the use and application of innovative approaches and methodologies, element base, and technological equipment in the design and implementation of reconfigurable automatic processing, assembly and packaging machines and lines for the production of innovative tubular furniture and accessories. These practices can be commercialized and implemented in other areas of the industry. The doctoral student can present himself as a designer and implementer, as well as a supervisor.

I had remarks and recommendations to the Ph. D. student communicated in person and taken into account. Some stylistic, spelling and punctuation errors have been made in the dissertation. In some tables was noted a wrong numbering.

As a recommendation for future work, it would be good to focus on more publications in international journals and publications with impact factors and/or SJR, as well as the protection of intellectual property.

The mistakes and inaccuracies do not belittle the dissertation.

## Conclusion

Regarding the educational part of the Doctor's degree, the doctoral student has received in-depth knowledge in the field of design and implementation of reconfigurable automatic machines and lines in the production of tubular furniture and accessories.

I believe that the dissertation meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria, the regulations for its implementation, as well as the specific requirements for obtaining scientific and educational degrees at IICT-BAS. I appreciate the relevance of the dissertation, its depth, practical application and results. I propose to the scientific jury to award the master eng. Peter Pavlov Panev educational and scientific degree "Doctor" in the professional field: 5.2 "Electrotechnics, Electronics and Automation" scientific specialty: "Automated information processing and control systems".

Sofia  
15.04.2022

Prepared the

НА ОСНОВАНИЕ

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