

**8th INTERNATIONAL CONFERENCE ON INDUSTRIAL
ENGINEERING**

**INNOVATION CENTER OF THE FACULTY OF MECHANICAL
ENGINEERING**

&

**INDUSTRIAL ENGINEERING DEPARTMENT, FACULTY OF
MECHANICAL ENGINEERING, UNIVERSITY OF BELGRADE,
SERBIA**



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**Vesna Spasojević Brkić
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Mirjana Misita
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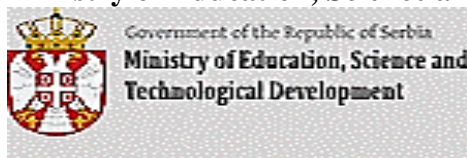
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PREFACE

Since the first event in Belgrade, Serbia more than 25 years ago, in 1996, International Conference on Industrial Engineering - SIE has been held regularly every 3 years. This time we are one year late due to pandemic conditions. It represents an opportunity for researchers in the Industrial Engineering community to review and evaluate their scientific achievements over the period since the previous SIE, share their most recent results and ideas, and discuss possibilities for new directions in research, joint experiments and observing campaigns.

The first aim of the 8th International Conference on Industrial Engineering – SIE 2022 is to celebrate 70 years from founding of our department by prof. dr Vukan Dešić! We are proud of professor Dešić who, as stated in one of the archive documents was “a man of excellent professional abilities and one of the best experts” and thank him for all his immeasurable contributions! The second aim of SIE 2022 is to contribute to a better comprehension of the role and importance of Industrial Engineering and to point out to the future trends in the field of Industrial Engineering. The conference is also expected to foster networking, collaboration and joint effort among the conference participants to advance the theory and practice as well as to identify major trends in Industrial Engineering today. According to these goals the conference addresses itself to all experts in all fields of Industrial Engineering to make their contribution to success and show capabilities achieved in the work that has been done are very welcomed. SIE 2022 traditionally provides an international forum for the dissemination and exchange of scientific information in industrial engineering fields through the large number of multidisciplinary topics and continues tradition established by prof. Dešić to gather and bring together experts in the field.

The book brought together almost 200 authors from 20 countries, namely from Canada, Croatia, Finland, Germany, Iran, Italy, Libya, Montenegro, Netherlands, North Macedonia, Poland, Portugal, Russia, Bosnia & Herzegovina, Singapore, Slovakia, Switzerland, Turkey and USA and Serbia. The 84 submitted full length manuscripts were peer-reviewed, and 81 of them were selected for publication by experts in their respective fields. The authors ranged from senior and renowned scientists to young researchers. Only unpublished papers were accepted and the first author is responsible for the originality of the paper. All papers are classified into five chapters, including plenary lectures and numerous results of national and EU projects are there presented (financed by MESTD, PSHE SR ARV, SF RS, EC, EF RD, TUKE, INAIL etc.).

We expect that papers and discussions will contribute to better comprehension the role and importance of Industrial Engineering in this and other countries, both in domain of scientific work and everyday practice.

Our efforts in organizing would not succeed without the considerable help of the members of Scientific Program and the financial help of Ministry of Education, Science and Technological Development was greatly supportive for the success of the entire project.

At the end, the editors hope, and would like, that this book to be useful, meeting the expectation of the authors and wider readership and to incentive further scientific development and creation of new papers in the field of Industrial Engineering.

Welcome to the 8th International Conference on Industrial Engineering – SIE 2022! We wish to all participants a pleasant stay in Belgrade and are looking forward to seeing you all together at the 9th Conference on Industrial Engineering – SIE 2025.

Belgrade, September 2022

EDITORS



- CONTENTS -

PLENARY SESSION - CHAIRPERSONS: Vesna Spasojević Brkić, Vujadin Vešović, Teodora Rutar Shuman, Paolo Bragatto, Tijana Vesnić Pavlović
--

- | | | |
|----|--|----|
| 1. | <i>Vesna Spasojević Brkić, Mirjana Misita, Uglješa Bugarić, Zorica Veljković, Tijana Vesnić Pavlović</i> | 2 |
| | PROFESSOR VUKAN DEŠIĆ AS THE FOUNDER OF THE DEPARTMENT FOR SCIENTIFIC ORGANIZATION OF WORK: THE 70-YEAR JUBILEE | |
| 2. | <i>Vujadin Vešović</i> | 16 |
| | IN THE REMEMBRANCE OF PROFESSOR VUKAN DEŠIĆ, THE DOYEN OF ORGANIZATIONAL SCIENCES AND MANAGEMENT: THE DEVELOPMENT OF SCIENTIFIC ORGANIZATION OF WORK IN THE FNR YUGOSLAVIA AND THE SURROUNDINGS | |
| 3. | <i>Teodora Rutar Shuman, Yen-Lin Han, Kathleen E. Cook, Jennifer Turns, Gregory S. Mason</i> | 22 |
| | REVOLUTIONIZING ENGINEERING DEPARTMENT BY CHANGING ITS CULTURE | |
| 4. | <i>Paolo Bragatto</i> | 26 |
| | CYBER PHYSICAL SYSTEMS FOR OCCUPATIONAL SAFETY AT INDUSTRIAL SITES: OPPORTUNITIES AND DIFFICULTIES. | |
| 5. | <i>Eckard Helmers, Chia Chien Chang, Justin Dauwels</i> | 30 |
| | COMPREHENSIVE INSTITUTIONAL CARBON FOOTPRINTING – THE LONG AND DIFFICULT WAY TO ZERO | |

SESSION 1 - CHAIRPERSONS: Tatjana Šibalija, Katarina Dimić-Mišić, Sanja Stanisavljev

- | | | |
|----|---|----|
| 6. | <i>Aleksandra Taskovic, Tatjana Sibalija</i> | 35 |
| | RFID TECHNOLOGY AUDIT AND CONTROL IN HEALTHCARE SECTOR | |

7.	<i>Milica Vljaković, Dragan Đokić, Tatjana Šibalija</i>	40
	IMPROVING THE BUSINESS PROCESS BY IMPLEMENTING DOCUMENT MANAGEMENT SYSTEM AND CLOUD INFRASTRUCTURE	
8.	<i>Nora Trklja Boca, Žarko Z. Mišković, Katarina Dimić-Mišić, Bratislav M. Obradović, Radivoje M. Mitrović, Milorad M. Kuraica</i>	45
	BEHAVIOUR OF INDUSTRIAL STEEL UNDER HIGH THERMAL LOADS PRODUCED BY PLASMA FORMED WITHIN MAGNETOPLASMA COMPRESSOR	
9.	<i>Dragan Čočkalović, Dejan Đorđević, Cariša Bešić, Sanja Stanisavljev, Mihalj Bakator</i>	49
	SUSTAINABLE DEVELOPMENT AND ENTREPRENEURSHIP IN THE CONTEXT OF SOCIETY 5.0	
10.	<i>Jelena Vukajlović, Sanja Stanisavljev, Zlatko Košut, Mila Kavalić, Dijana Tadić</i>	53
	APPLICATION OF MODERN CONCEPTS IN PRODUCTION	
11.	<i>José Sobral</i>	58
	UNDERSTANDING ASSET MANAGEMENT MATURITY LEVEL IN INDUSTRIAL ORGANIZATIONS	
12.	<i>José Sobral</i>	62
	DEVELOPMENT OF A MODEL TO ASSESS TOTAL PRODUCTIVE MAINTENANCE IN AN INDUSTRIAL FACILITY	
13.	<i>Tanja Sekulić, Iris Borjanović, Dunja Popović</i>	66
	APPLIED MATHEMATICAL SOFTWARE TOOLS FOR ENGINEERS AT TECHNICAL COLLEGE OF APPLIED SCIENCES IN ZRENJANIN	
14.	<i>Dejan Randjic</i>	70
	ACHIEVING nZEB DESIGN USING GROUND SOURCED HEAT PUMP AND ON-SITE RENEWABLE ENERGY PRODUCTION	
15.	<i>Danijela Tadić, Snežana Nestić, Tijana Petrović</i>	74
	COMBINING MOORA AND DELPHI UNDER INTUITIVE ENVIRONMENT	
16.	<i>Uroš Ilić, Marko Đurović, Aleksandra Joksimović, Emil Veg</i>	78
	A DESIGN OF A TWO-ARMED ROBOT FOR COMPLEX OBJECTS ASSEMBLY	
17.	<i>Jelena R. Jovanović</i>	82
	UTILIZATION OF MACHINE CAPACITY AND STRUCTURE OF LOSSES PER CAUSE OF DOWNTIME	
18.	<i>Anna Vrabelova, Zuzana Kotianová, Shander Basilio, Peter Darvaši</i>	86
	PLAN OF THE 5S IMPLEMENTATION IN PROTOTYPE AND INNOVATIVE CENTRE IN FACULTY OF MECHANICAL ENGINEERING OF TUKE	
19.	<i>Radisa Jovanovic, Mitra Vesovic, Natalija Perisic</i>	90
	PI CONTROLLER OPTIMIZATION BY ARTIFICIAL GORILLA TROOPS FOR LIQUID LEVEL CONTROL	
20.	<i>Aleksandar Argilovski, Bojan Jovanoski, Robert Minovski, Afet Musliji</i>	94
	MAPPING THE CURRENT RESEARCH ON THE DIFFERENT VIEWPOINTS REGARDING RELATIONSHIP BETWEEN LEAN AND INDUSTRY 4.0	
21.	<i>Nermina Zaimović-Uzunović, Kenan Varda, Ernad Bešliagić</i>	98
	SAMPLING FREQUENCY INFLUENCE ON THE ACCURACY OF VELOCITY MEASUREMENT IN THE WIND TUNNEL	
22.	<i>Lazar Djordjevic</i>	102
	CONCEPTUAL SOLUTION OF OZONIZATION LINE IN DRINKING WATER PREPARATION PLANT	

23. *Nikola Raičević, Danilo Petrašinović, Aleksandar Grbović, Miloš Petrašinović, Mihailo Petrović* 105
FRECAD IMPORTAIRFOIL MACRO - DRAWING AIRFOIL GEOMETRY IN AN OPEN-SOURCE CAD PROGRAM
24. *Dragan Milković, Vojkan Lučanin, Saša Radulović, Aleksandra Kostić* 109
OVERVIEW OF ACTIVITIES RELATED TO THE PROVISION OF LOGISTICAL SUPPORT DURING THE IMPLEMENTATION OF TYPE TESTS OF RAILWAY VEHICLES
25. *Thad Maloney, Josphat Phiri* 113
GRAPHENE/NANOCELLULOSE CO-EXFOLIATION FOR GREEN COMPOSITES

SESSION 2 - CHAIRPERSONS: Andrea Sütőová, Bojan Jovanoski, Peđa Milosavljević
--

26. *Andrea Sütőová, Katarína Teplická, Klaudia Budišová* 122
JOB ANALYSIS OF QUALITY INSPECTORS FOR IDENTIFICATION OF EFFICIENCY IMPROVEMENT POSSIBILITIES
27. *Afet Musliji, Bojan Jovanoski, Robert Minovski, Aleksandar Argilovski* 126
DIGITAL TWIN APPLICATIONS IN MANUFACTURING – LITERATURE REVIEW AND RESEARCH DIRECTIONS
28. *Srđan Mladenović, Dragan Pavlović, Peđa Milosavljević* 130
LEAN METHODOLOGY IN HEALTHCARE
29. *Bojan Jerinic, Nemanja Sremcev, Ilija Cosic* 134
EXAMINING THE RELATIONSHIP BETWEEN INDUSTRY 5.0 AND LEAN PHILOSOPHY
30. *Ivan Tomašević, Dragana Stojanović, Barbara Simeunović, Ivona Jovanović, Dragoslav Slović* 139
LEAN APPROACH TO IMPROVING THROUGHPUT IN UN-PACED ASSEMBLY LINE: ACTION RESEARCH REPORT
31. *Miro Hegedić, Nataša Tošanović, Roberto Skoliber, Jakov Bošnjak* 143
INCREASING THE PRODUCTIVITY OF PRODUCTION PROCESS IN FOOTWEAR INDUSTRY BY ADOPTING LEAN TOOLS
32. *Natalija Perisic, Radisa Jovanovic* 148
APPLICATION OF DEEP LEARNING IN QUALITY INSPECTION OF CASTING PRODUCTS
33. *Marija Savković, Nikola Komatina, Carlo Caiazzo, Marko Đapan* 152
IMPROVING THE QUALITY OF FINAL PRODUCT BY POKA-YOKE SYSTEM ON ASSEMBLY WORKSTATION: A CASE STUDY
34. *Sanela Arsić, Ana Rakić, Maja Glogovac, Anđelka Stojanović, Jelena Ruso, Isidora Milošević* 156
ENTROPY-TOPSIS METHOD FOR RANKING INDUSTRIES ACCORDING TO QUALITY 4.0 MATURITY LEVEL
35. *Branislav Tomic* 160
QUALITY IMPROVEMENTS IN QUALITY 4.0
36. *Ilija Tabasevic* 163
A TEMPERATURE MAPPING EXPERIMENT IN A PHARMACEUTICAL WAREHOUSE

37. <i>Ivan Simonovic, Pavle Ljubojevic, Tamara Vasiljevic</i>	167
STANDARDIZATION IN THE FIELD OF MACHINE ELEMENTS AND DESIGN	
38. <i>Dejan Kovacevic, Sanja Stanisavljev, Zlatko Košut, Dragan Čočkaló, Dejan Đorđević</i>	171
MODERNIZATION OF PRODUCTION USING LEAN, JIT CONCEPT	
39. <i>Í. Kol, A. Glisic</i>	176
A CASE STUDY ON RISK MANAGEMENT IN AN OPEN-PIT CALCITE MINE	
40. <i>Ernest Barcelo, Katarina Dimic-Misic, Monir Imani, Patrick Gane, Hummel Michael</i>	182
REGULATORY PARADIGM OF MODERN ENERGY SECTOR IN RENEWABLE ENERGY GRIDS	
41. <i>Ernest Barcelo, Monir Imani, Michael Hummel, Patrick Gane</i>	191
BLOCKCHAIN IN MODERN ENERGY SECTOR	
42. <i>Ana Bantić, Marija Milanović, Goran Đurić</i>	195
ANALYTIC HIERARCHY PROCESS ANALYSIS OF QSG USABILITY EVALUATION	
43. <i>Goran Đurić, Ana Bantić, Petar Đurić</i>	199
AUTOMATIC GENERATION OF DATA FLOW DIAGRAM	

SESSION 3 - CHAIRPERSONS: Ivan Mihajlović, Mirjana Misita, Zoran Anišić, Maria Francesca Milazzo

44. <i>Ivan Mihajlović, Nenad Nikolić, Peter Schulte</i>	204
FACTORS AFFECTING SMEs FAILURE - PART ONE: GENERAL ASPECTS	
45. <i>Ivan Mihajlović, Nenad Nikolić, Peter Schulte</i>	208
FACTORS AFFECTING SMEs FAILURE - PART TWO: POSSIBILITIES AND BARRIERS OF DIGITALIZATION	
46. <i>Anđelka Stojanović, Nenad Milijić, Isidora Milošević, Ivan Mihajlović</i>	213
SMEs' DIGITALIZATION IMPACT ON ECONOMIC DEVELOPMENT	
47. <i>Mirjana Misita, Aleksandar Brkić, Vesna Spasojević Brkić, Neda Papić, Martina Perišić, Ivan Rakonjac</i>	217
DUMP TRUCK EFFICIENCY AND RISK MAPS: CASE STUDY	
48. <i>Mirjana Misita, Vesna Spasojević Brkić, Milanko Damjanović, Goran Đurić, Neda Papić, Martina Perišić</i>	222
EVALUATION OF THE HAMRISK EXPERT SYSTEM BY HIERARCHICAL STRUCTURING OF CRITERIA	
49. <i>Nenad Medic, Zoran Anisic</i>	228
COMPARISON OF MCDM METHODS: THE FOCUS ON ALGORITHMS	
50. <i>Damir Ilić, Isidora Milošević, Tatjana Ilić-Kosanović</i>	232
SMART CITIES IN THE FIGHT AGAINST THE COVID-19 PANDEMIC - LESSONS FOR THE CITY OF BELGRADE	
51. <i>Branislav Petrovic, Milan Gojak</i>	236
ENERGY EFFICIENCY IMPROVEMENT POTENCIAL AND ENERGY SAVING STRATEGIES IN GLOBAL INDUSTRIAL SECTOR	
52. <i>Luka Djordjevic, Eleonora Desnica, Borivoj Novakovic, Mica Djurdjev, Mihalj Bakator</i>	241
TECHNICAL PERFORMANCE PREDICTION OF THE 1MW SOLAR POWER PLANT IN THE CITY OF ZRENJANIN	

53. <i>Nikola Komatina, Aleksandar Aleksić, Nikola Banduka</i>	246
DETERMINATION OF FAILURES PRIORITY BASED ON FMEA, FUZZY SETS, AND FUZZY LOGIC RULES	
54. <i>Zoran Nestic, Nikola Komatina, Nebojsa Denic</i>	250
APPLICATION OF GENETIC ALGORITHM AND LINEAR PROGRAMMING FOR DETERMINATION OF OPTIMAL PRODUCTION VOLUME	
55. <i>Aleksandar Videnovic, Aleksandar Djurdjevic, Jadranka Labus, Dejana Popovic</i>	254
APPARATUS FOR DETERMINING THE EXPLOSION CHARACTERISTICS OF DUST CLOUDS, TEST METHODS AND PROCEDURES	
56. <i>Sanja Puzovic, Jasmina Vesic Vasovic, Vladan Paunovic</i>	258
AN APPROACH TO NEW PRODUCT CONCEPT SELECTION DECISION-MAKING	
57. <i>Milovan Paunić, Vladimir Černicin</i>	263
APPLICATION OF FINITE ELEMENT METHOD FOR ANALYSIS THE PARAMETERS OF FRACTURE MECHANICS	
58. <i>Maria Francesca Milazzo, Paolo Bragatto</i>	267
UPDATING THE PROBABILITY OF RELEASE DUE EQUIPMENT DETERIORATION USING INCIDENT AND NEAR-MISS DATA	
59. <i>Zorica A. Veljković, Slobodan Lj. Radojević</i>	270
CONSTRUCTION OF THE FIVE LEVEL TAGUCHI'S ORTHOGONAL ARRAYS	
60. <i>Bogdan Ristić, Ivan Božić</i>	274
A SHORT OVERVIEW ON INDUSTRY 4.0 IN MAINTENANCE OF HYDROPOWER PLANTS	

SESSION 4 - CHAIRPERSONS: Uglješa Bugarić, Aleksandar Žunjić, Ernest Barcelo

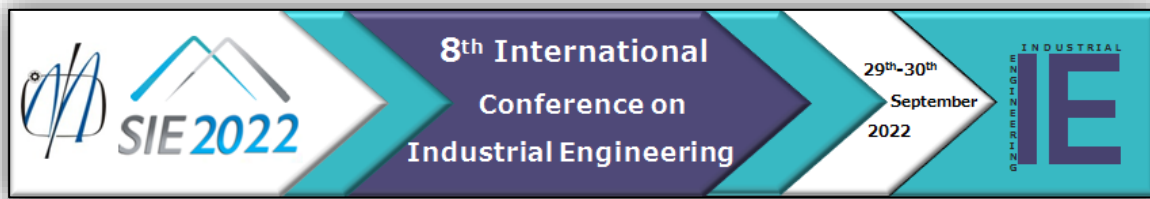
61. <i>Al-Sifao Abdalla Al-Sifao, Uglješa Bugarić, Abdughder Mohahmed Alsharif, Hetham Omer Mohamed</i>	279
PUBLIC-PRIVATE PARTNERSHIP (PPP) PROJECTS IN LIBYA - AN OVERVIEW	
62. <i>Milica Gerasimovic, Ugljesa Bugaric</i>	284
CURRICULUM TO TEACH ARTIFICIAL INTELLIGENCE FOR VET SCHOOL – DESIGNING AND CHALLENGES	
63. <i>Aleksandar Zunjic, Uros Manojlovic, Svetlana Cicevic, Aleksandar Trifunovic</i>	287
EVALUATION OF THE USABILITY OF SYMBOLS INDICATING THE STATE OF AUTOMOBILE LIGHTING	
64. <i>Aleksandar Trifunović, Svetlana Čičević, Dalibor Pešić, Maja Petrović, Aleksandar Zunjic, Dragan Lazarević</i>	291
THE IMPORTANCE OF TRAFFIC PLAYGROUND DESIGN FOR EDUCATING CHILDREN ABOUT TRAFFIC SAFETY	
65. <i>Katarina Dimic-Misic, Aleksandar Brkic, Monir Imani, Ernest Barcelo, Patrick Gane</i>	295
FILTER EFFICIENCY AND AGING IN HEAVY-DUTY VEHICLE CABINS	
66. <i>Živan Živković, Marija Panić, Aleksandra Fedajev</i>	299
HEALTH SECURITY ASSESSMENT OF THE WESTERN BALKAN COUNTRIES	

67. <i>Aleksandar Brkić</i>	303
CRANE OPERATORS' TRAINING IMPORTANCE AND RISK MANAGEMENT	
68. <i>Abdughder Mohahmed Alsharif, Al-Sifao Abdalla Al-Sifao, Hetham Omer Mohamed</i>	307
RISK MANAGEMENT FRAMEWORK FOR OCCUPATIONAL HEALTH AND SAFETY IMPROVEMENT IN THE CONTEXT OF INDUSTRIAL TECHNOLOGY INNOVATION	
69. <i>Nemanja Janev, Martina Perišić, Milan Krantić</i>	311
CONTINGENCY OF EMPLOYEES' TRAINING	
70. <i>Marek Dźwiarek</i>	315
SAFETY OF SERVICE WORK AND CYBER SECURITY OF MACHINERY CONTROL SYSTEM IN INDUSTRY 4.0	
71. <i>Višnja Mihajlović, Mila Kavalić, Ali Reza Afshari, Verica Gluvakov</i>	319
THE CONCEPT OF CIRCULAR ECONOMY IN MODERN BUSINESS	
72. <i>Iosif Aronov, Olga Maksimova</i>	323
GENERAL FACTORS INFLUENCING CONSENSUS IN A SOCIAL GROUP	
73. <i>Novak Simin, Petar Vrgović</i>	327
NEW DEMANDS IN THE ENGINEERING EDUCATION	
74. <i>Marko Orošnjak, Mitar Jocanović, Ivan Beker, Velibor Karanović, Nebojša Brkljač</i>	330
ASSESSMENT OF DIGITAL COMPETENCES OF INDUSTRIAL ENGINEERING STUDENTS: POST-COVID19 RESULTS	
75. <i>Juraj Glatz, Hana Pačaiová, Zuzana Kotianová, Anna Vrabel'ová</i>	334
PROPOSAL OF HAZARDOUS ENERGY MANAGEMENT METHODOLOGY	
76. <i>Milovan Paunić, Vladimir Černicin</i>	338
VIRTUAL MODEL GENERATION OF REPRESENTATIVE VOLUME ELEMENT FOR UNIDIRECTIONAL COMPOSITE	
77. <i>Marija Milanović, Neda Papić, Ana Bantić</i>	342
INVESTIGATING RISKS AT WORKPLACES IN THE MACHINE INDUSTRY	
78. <i>Marko Djurovic, Uros Ilic, Aleksandra Joksimovic, Emil Veg</i>	346
THE PRINCIPLE OF DESIGNING THE FILLING OF A OPEN RAPID SAND FILTER BY THE METHOD OF PRESCRIBING THE MINIMUM MASS OF AN INDIVIDUAL LAYER OF FILLING	
79. <i>Monireh Imani, Gane Patrick</i>	349
PRINTABILITY OF ARONIA INKS ON CALCIUM CARBONATE CONTAINING SUBSTRATE	
80. <i>Ivana Nedeljkovic, Mathieu Skrzypczak, Andjelka Glisic</i>	355
EXTRACTING VALUE OUT OF QUALITY DATA USING MICROSOFT POWER BI IN AN INDUSTRIAL COMPANY: CASE STUDIES	
81. <i>Giuseppa Ancione, Rebecca Saitta, Paolo Bragatto, Giacomo Fiumara, Maria Francesca Milazzo</i>	361
PREDICTING AND VISUALISING THE DEGRADATION OF THE BOTTOM OF ATMOSPHERIC STORAGE TANK BY A VIRTUAL SENSOR	

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SMEs' DIGITALIZATION IMPACT ON ECONOMIC DEVELOPMENT

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Abstract. *The accelerated development of information and communication technologies has caused notable changes in all spheres of life and business. In order to contribute to their own economic goals and the economy in general, companies are forced to embrace technological innovations. This study aims to test a hypothesis that the digitalization of business operations in small and medium-sized enterprises (SMEs) positively influences economic development. Since the degree of digitization is a complex phenomenon, it is approached through several quantitative indicators. The data from the Eurostat database were used for the research. The analysis results obtained using the structural equations modeling confirm the positive relationship between the level of digitization of SMEs and gross domestic product (GDP).*

Key words: *Digitalization, Small and medium-sized enterprises, Economic development.*

1. INTRODUCTION

A key component of competitiveness and sustainability in the severe conditions of modern business is the digitalization of business in all its aspects. The concept of digitalization of business operations and the emergence of new information and communication technologies (ICT) that uniquely integrate business systems is known as Industry 4.0. With their ability to collect, store, analyze and share large amounts of data, digital technologies play a crucial role in transforming business and providing new opportunities for companies to establish their business on a much broader scale and with significantly improved productivity and results. Accepting digitalization accelerates resource utilization and improves the ability to operate sustainably in a new business environment. However, changes in production and how values are created in

modern business can pose serious challenges for enterprises. Acceptance of the new global business reality in the case of small and medium-sized enterprises (SMEs) is still in the early stages as many companies hesitate and run the risk of falling behind in the global race [2, 6]. Digital technologies, on the one hand, reduce business barriers, increase resources and market availability, and SMEs can have significant benefits if embracing these changes. On the other hand, despite the great potential of digitalization, there is an impression that there are several limitations related to the application in SMEs. Small and medium-sized enterprises that employ less than 250 employees have a significant share in local economies and the world economy. The European Union was assessed to have 22.6 million SMEs in 2021, with an average contribution to the economy of around 56% (<https://www.statista.com>). Baring these facts in mind, it is important to overview the challenges and drivers for adopting digitalization in SMEs and examine how much impact the digital level has on economic indicators.

2. LITERATURE REVIEW

The limitation of SMEs' to exploiting IT technologies at the level that derives significant benefits is the readiness reflected in the lack of technological, human and financial resources. Those features stand out as key in many studies when analyzing the degree of digitalization in SMEs compared with large companies [11]. Integrating data in whole value chain creation requires using networks and various information technology systems. In fact, there are many relations between the size of the company and the degree of acceptance of Industry 4.0. The share of automation in SMEs is significantly lower, as well as

the production volume. SMEs usually operate on specific smaller market segments and opt for specialization as a business strategy. On the other hand, tools developed for digitizing business-production processes are most often designed for large companies with the ability to receive and process vast amounts of data from different processes and various sources. Therefore, it is not easy for SMEs to reach a certain technological level in order to be able to use solutions offered by Industry 4.0.

Implementing existing solutions can be problematic for SMEs. Small and medium-sized enterprises usually do not have particular IT or research and development departments, and in addition to the lack of resources, there are shortcomings in know-how, both when choosing the appropriate technology and during its use. Thus, the introduction of Industry 4.0 requires dramatic changes in SMEs' structure, strategy, and mindset, which causes SME owners and managers to be suspicious towards the full integration of digitalization in business [8, 10].

In addition to changes in the structure and appearance of the workplace for the successful implementation of new business models, adequate employees and adequate exchange of knowledge and information are necessary. A skilled employee is still the backbone of a successful and sustainable business in Industry 4.0 because it is indispensable for managing the increasing complexity of tasks, interaction and initiative, coordination and problem solving, and decision-making [5].

Another significant restraint related to the implementation of Industry 4.0 concerns data access. Namely, in addition to installing new technologies, additional investments are needed to ensure the security of all network users in the value chain. In fact, the most important obstacle to the full utilization of cloud services in SMEs is the security of the company's sensitive data and the fear that third parties could access it [10].

However, Li et al. (2019) highlight the benefits of digitalization for SMEs [5]. The authors consider the process of overcoming the challenges faced by SMEs to be a source of competitive advantage. As Industry 4.0 supports flexibility and transforms mass production in the direction of the business closer to meeting individual customer requirements and new levels of integration between people, technology and resources are being formed [6]. Many researchers were evaluating the relationship between digitalization and economic growth, and concluded that the influence is positive [3, 4]. Brodny and Tutak (2022) emphasize the importance of the link between

the implementation of digital technologies in SMEs and economic parameters [1]. In addition to economic parameters, digitalization affects productivity, competitiveness and sustainable development [9].

Analyzing the literature, the link between digital level and economic development remains ambiguous [7, 13]. The research hypothesis in the study states: It is possible to establish a positive connection between the level of digitalization of SMEs and economic development.

3. METHODOLOGY

The implementation of digital technologies in business is a result of the development of the internet and the almost unlimited connectivity opportunities that the network offers. Intensifying ICT use improves business performance and conditions the company's economic growth [12]. This research focuses on the implementation of digital technologies in SMEs and the impact of digitalization on economic development. The study is based on qualitative data on the level of digitization of SMEs and its comparison with economic changes. Digitization is considered a complex phenomenon, and seven indicators from the Eurostat database related to SMEs (10-249 employees and self-employed persons) are used for assessment, Table 1 (<https://ec.europa.eu/>).

Table 1. Indicators of SMEs level of digitization

Indicator	Description
E-commerce sales	Enterprises with e-commerce sales
Website	Enterprises with a website
Website functionalities	Enterprises where the website provided online ordering or reservation or booking
Pay to advertise	Pay to advertise on the internet
Social media	Use any social media
ERP software	Enterprises who have ERP software package to share information between different functional areas
ICT specialists	Enterprises that employ ICT specialists

For accessing economic development, Gross Domestic Product (GDP) per capita (current US\$) from the World Development Indicators database was used (<https://datatopics.worldbank.org/world-development-indicators/>). Changes in indicator

values from 35 European countries in the period 2014-2020 were observed.

In order to confirm that the selected indicators adequately describe the researched phenomenon and to assess the effect of the level of digitization of SEMs on GDP, the methodology of structural equation modeling using SmartPLS software was applied.

4. RESULTS

The conducted confirmatory factor analysis indicates a strong internal consistency of the selected indicators for SMEs' digital level, given that the value of the Cronbach's alpha coefficient is .854 (acceptable above .7). Composite reliability is achieved since all factor loadings are greater than .5 (acceptable above .5, preferable above .7), as well as the convergent validity measured with Average Variance extracted (AVE) with a value of .545 (acceptable above .5). Namely, the indicators "ERP software" and "ICT specialists" are retained in the model, although they do not have preferable values of factor loadings over .7 because the AVE value is acceptable as well as the composite reliability value of .891 (acceptable above .7).

The analysis of the results of testing the hypothesis on the impact of the digital level of SMEs on economic development indicates a strong and statistically significant relationship between the observed variables ($t\text{-value}=14,261$, $p\text{-value}=.000$), which is shown on Figure 1 and Table 2. The digital level of SMEs can explain 36.7% of GDP variability.

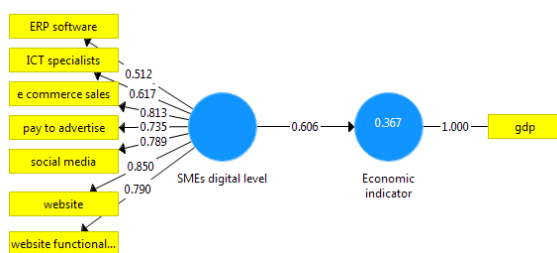


Figure 1. Results of research model testing

Table 2. Results of hypothesis testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ((O/STDEV))	P Values
SMEs digital level -> Economic indicator	.606	.613	.043	14.261	.000

5. CONCLUSION

Sustainable economic development has become the predominant paradigm of modern society. An integral part of the sustainability of economic development is

digital technology and its extensive implementation in all spheres of life and around the world. As not every aspect of digitalization is simple and requires significant changes in business operations, some segments as SMEs showed difficulties and lagging in successfully adopting ICT. Based on a review of literature focusing on SMEs' business operations, this study aimed to evaluate the effects of digitalization in SMEs on economic growth. The paper defines the digital level of SMEs as a multi-dimensional phenomenon that includes both the availability of information and communication technologies and solutions offered by Industry 4.0 and the application and level of skills to use these technologies. The single Eurostat database is used to assess all digital level indicators using quantitative measures. In addition, structural equation modeling was used to test the assumed relationship between the digital level of SMEs and economic development.

The obtained results confirmed the connection between the digital level of SMEs and GDP per capita. Thus, there is no doubt that the digital economy substantially impacts economic development and that this assumption applies to SMEs as well. Digitization of business processes stimulates economic growth through the improvement of production infrastructure and productivity as well as increasing employment and the level of competencies of employees.

It is important to point out the weaker influence of "ERP software" and "ICT specialists" indicators on the observed variable "Digital level SMEs", which are retained in the model. This result and previous research indicate that a skilled workforce is required to adopt and implement new technologies in SMEs. Appropriate qualifications are related to knowledge and skills in electrical engineering, informatics and software development [10].

Furthermore, adequate economic and policy support is necessary for developing critical competencies in SMEs for Industry 4.0 tolls and its implementation in order to face both the demand generated by large companies and competing SMEs.

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