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Preface

Eighth international scientific conference Technics and Informatics in Education – TIE 2020 aims to promote and support research in education of new generations in technical and technological fields at all levels of education and contribute to technology development and education improvement.

Some 64 papers have been submitted within various fields of technical, IT and technology-supported education at all educational levels – primary, secondary, higher education and education for adults. After reviewing, 57 papers were accepted for the current edition of Proceedings in the form of plenary lectures and original scientific papers. Five more papers were accepted to be published in Appendix A of the Proceedings (on Serbian language) for the Symposium "Technics and Informatics in Education: School Teachers for Teachers" that is organized within TIE 2020.

Authors are responsible for any spelling, grammar and stylistic errors in their work.

Articles in the *Proceedings TIE 2020* are organized by the following topics:

- Plenary lectures
- Technics, Technology and Informatics in Education
- Teacher Professional Development and General Education Topics
- IT Education and Practice
- Engineering Education and Practice

Special activities within the Conference are the following:

- Round Table – 45 years of university education of technics and technology teachers in Čačak
- Open discussion and poster-presentation session:
  - Higher Education (HE) development in the realm of technics and technology;
  - Results of HE development projects 2017–2020, programme activities of Ministry of Education, Science and Technological Development (15 projects of the Faculty of Technical Sciences Čačak).

The Scientific and Organizing Committee wishes to express gratitude to all the professionals from various fields who contributed to the Conference.

We would like to thank Partner Institutions which participated as co-organizers of the Conference.

We express special thanks to the Ministry of Education, Science and Technological Development of the Republic of Serbia for financial contribution to this scientific gathering.

Ivan Milićević
Editor

Chairmen's Foreword

Dear participants,

In the light of on-going, worldwide effects of COVID-19 and following the recommendations of international and national health authorities, Faculty of Technical Sciences Čačak organized the eighth international scientific conference 'Technics and Informatics in Education – TIE 2020' as an ONLINE MEETING. Even though this was completely new experience for the organizing committee, all technical details during the conference went on quite well. The scientific and organizing committees put in all necessary effort to organize the conference in new conditions.

The aim of this conference was to improve the exchange of knowledge and experiences between experts, scientific associates and professionals from Serbia and European countries, engaged in the subject matter. The conference provided an analytical review of technical, technological and IT education, as well as education regarding technical, technological and IT achievements including teaching aids, educational assistive technology, student books, etc.

Serbia already has 50 years long tradition of organizing various forms of seminars, workshops and scientific conferences devoted to improvement of those education topics in primary, secondary and higher education.

A series of conferences, entitled Technics and Informatics in Education, organized by our faculty in last 15 years, exhibit a continuous increase and development in this field, bringing to all of us new education technologies. This assembly continues the tradition of gathering scientific associates and professionals in technical, technological and IT education. Those scientific conferences have a huge impact on the development of technical education in Serbia.

Special focus is on the importance of IT in technical and professional education and correlation with natural, social and education sciences. We hope that experience exchanged during the sessions will be very useful for all participants, and that debate and networking was enjoyable.

The conference results also provide the basis for planning development in technics and informatics education in Serbia, as well as the exchange of educational patterns in the region and coordination with European trends in this field.

We hope you had a successful and fruitful meeting. Thank you for your participation.

Nebojša Mitrović
Živadin Micić
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Organization

The 8th International Scientific Conference Technics and Informatics in Education - TIE 2020 is organized by the Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia.
The Conference is held under the patronage of:

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Reminder

45 years of technics teachers' university education in Čačak

1975 – the year when Čačak became a university city

Pedagogical–Technical Faculty Čačak (today Faculty of Technical Sciences) started its activities in 1975, in the times when the actual Socialist Federal Republic of Yugoslavia achieved its highest growth and development. The name of the faculty – Pedagogical–Technical (Pedagoško-tehnički fakultet – PTF) – directly defined and reflected its main domain, and the main direction of the development of the institution.

The Faculty was established in 1974 according to the Decision of the Assembly of the Educational Society of the Republic of Serbia (decision No.01.1235/6-01), as academic unit of the University of Belgrade. The first generation of students was enrolled in 1975, while the education process started in November of the same year. The establishing of the Faculty (PTF) was facilitated by the successful work of the Technical College Čačak during the period of 15 years. The Faculty was founded with the aim of educating and producing **teachers of technical education, teachers of electrical engineering and teachers of mechanical engineering,** since a lack of qualified teachers in these areas was evinced in primary and secondary education. The primary role of the Faculty was to educate and develop these teachers' profiles at university level, in order to develop technical culture and literacy of the generations expected to apply their knowledge in the technical-industrial areas of the country, as well as to continue the development of the technical-industrial area. This has remained as an important orientation of the Faculty since.

Pedagogical–Technical Faculty became an important lever for the education of university profiles, primarily in Central and Western Serbia, and in 1976 the Faculty became one of the founders (signatories of the founding document) of the University "Svetozar Marković" in Kragujevac, nowadays University of Kragujevac, the academic family to which the Faculty belongs.

The founding of the Faculty was justified by the response of the first generation of students who enrolled in the first year of studies, either as full-time or part-time students. Almost 300 applicants applied for 180 available places for full-time students, and over 200 applied for part-time studies. In the first generation of graduates, in the school year 1979/1980, 22 students gained the title of teacher (five teachers of technical education, fourteen teachers of mechanical engineering and three teachers of electrical engineering), upon which followed years of successful education of future teachers. Another 335 graduates gained the title of teacher by 1987/1988 the school year.

In the years of successful development of technics teacher studies, engineering profiles have been established on rich teaching and research experience of professors and teaching assistants whose professional development followed the development of their students – future teachers.

Besides the education of technical teachers specialised for work in primary and secondary schools, a wide range of engineering profiles were added within the faculty education in the field of technics. This brought about the change in the name of the Faculty to Technical Faculty Čačak in 1988.

Parallelly with changes in the labour market, study programs for the education of teachers of electrical and mechanical engineering were over time replaced by the study programs for graduates in electrical and mechanical engineering. The progress of study programs for the education of teachers of technical education has continued, while the programs for the education

of teachers of technics and information technology have been developed (since 1993), and for teachers of informatics afterwards.

The four-year study programs that students opted for until the introduction of legal changes in September 2005 (when the new Law on Higher Education, containing the so-called Bologna model of education, entered into force) resulted in: 1257 teachers of technical education, 791 teachers of technics and informatics, 168 teachers of mechanical engineering, 122 teachers of electrical engineering and 17 teachers of informatics.

The implementation of the Bologna Declaration brought considerable changes in higher education in Serbia. Due to the accreditation of study programs in 2009, the Technical Faculty was the first in Serbia to develop five-year integrated academic studies for future teachers, which enabled graduates to acquire the academic title of Master teacher of technics and informatics. A number of 347 master teachers have graduated from that study program so far.

Among the teaching staff of almost every school in Serbia, there is a teacher in the field of technics and informatics who has been educated and graduated at the Faculty in Čačak.

Following the achievements in the European education space, the growing presence of modern information and communication technologies in education, and the needs of the education system in Serbia, the Technical Faculty has developed one-year master academic study program in the field of e-learning, upon whose completion students gain the title of Master teacher in technics and informatics for e-learning. Since 2009, 89 students have gained this title. Simultaneously, master academic studies of subject teaching of electrical and mechanical engineering have been developed, which consequently grew into master academic studies of subject teaching for professional courses.

The content of educational, scientific and research activities "outgrew" the framework of the previous activities of the Faculty, bringing about another change of name of the institution in 2012 to the Faculty of Technical Sciences Čačak, University of Kragujevac, where both master teachers of technics and informatics (300 ECTS) and master teachers of professional subjects for different fields (60 ECTS) are educated today.

Changes and trends related to the choice of professions of future students have not bypassed the teaching profession, which evidenced lack of interest in the previous years. One of the aims of this conference is to popularize teaching profession and view it as one of the most valuable and noble professions.

We are proud to bring attention to the fact that to this day more than 2805 teachers and master teachers, educated at the Faculty of Technical Sciences Čačak, have been employed all over Serbia, surrounding countries, and at the institutions of European and non-European education space, and thereby they are promoters of both the technics, and the Faculty.

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Session 1: *Teacher Professional Development and General Education Topics*

Professional paper
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Logistics Education in Universities in 21st Century: New Trends and Challenges

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Abstract: *In this paper has outlined and discusses the need for the application of logistics and logistics information systems in the academic programs at the Universities. One of the inherent characteristics of the global society is a continuous change in area of education. In practice, universities must keep abreast of business and entrepreneurialism. However, within a university's own portfolio, how they design and deliver practical education programs can differ. Only academic programs with productive and valuable educations form can be competitive and relevant to market offer. What real change can occur, dependent of symbiose of study programs and business needs. Logistics is critical for economic activities as it entails the physical movement of people, goods and services. The logistics system is just one of the segments of the information flow of the Supply Chain Management from suppliers and manufacturers to consumers. In the process of globalization, such activities today are unthinkable and unsustainable without information systems. At the heart of economic science is the host's attitude toward resources, and the need to study logistics and supply chain management is considered imperative.*

Keywords: study program, academic practice, information system, logistics, supply chain management

1. INTRODUCTION

Higher education is part of a marketplace. Education is a subjective, natural, people-centric, and societally driven process. The role of higher education in sustainable economic and social development increase year by year, and this will continue over the next decades. With this in mind, universities engage in wider network to capture ideas and embrace best practice. This aims to inspire students in improving their own futures [1]. Quality higher education, enriched with modern practices and skills, is an essential need for any society. Higher education is broadly defined as one of key drivers of growth performance, prosperity and competitiveness. Higher education can be considered an imperative and focal point of knowledge, and its application will make a great contribution to the economic growth and development of any country by encouraging innovation and increasing knowledge and higher skills.

Quality education is seen as a way to improve the quality of life and solve major social and global problems and challenges. Therefore, higher education is given a special place in the agenda of the world's higher institutions. It stands out as one of the key drivers of performance for growth, prosperity and competitiveness.

In practice, universities must keep abreast of business and entrepreneurialism. However, within a university's own portfolio, how they design and deliver practical education programs can differ. Only academic programs with productive and valuable educations form can be competitive and relevant to market offer. What real change can occur, dependent of symbiose of study programs and business needs.

Today we stand on the cusp of a fourth industrial revolution; one which promises to marry the worlds of production and network connectivity in an "Internet of Things" which makes "Industrie 4.0" a reality. "Smart production" becomes the norm in a world where intelligent ICT-based machines, systems and networks are capable of independently exchanging and responding to information to manage industrial production processes [2]. The currently ongoing 4th Industrial Revolution called Industry 4.0, is setting new standards of life and work, which as a result, cause new requirements for education. That cause new challenges.

Industry 4.0 has been defined as "a name for the current trend of automation and data exchange in manufacturing technologies, including cyber-physical systems, the Internet of things, cloud computing and cognitive computing and creating the smart factory" [3].

Universities need to cooperate with companies in shaping competences. In Industry 4.0, having the proper competences is crucial also for specialist profession, such as logistician [4]. In today's new information order, the smart industry or Industry 4.0 unites, coordinates, manages and controls processes, data and services, unites the real and virtual worlds, which is a new dimension of production and the market. This new dimension of the technological environment, radically transforms

the management of the supply chain and final products, which in logistics creates the dimension of smart logistics systems.

The needs of advanced logistics skills are greater than ever. Companies exposed to the global competition are increasingly involving outsourcing partners to meet imposed market needs. In the current business environment, especially in transport and logistic sector, characterized by dynamic and volatile conditions, employees must be able to address obstacles faced by the firm. The application of robotics, modern tools in information technology impose profiles of employees who have high knowledge of information and communication technology. Although there is a tendency to knowledge and practice to rely on software tools to support problem-solving efforts, managerial input is critical. Therefore, companies must focus on selecting the most qualified, best suited managers to work in what frequently involves a somewhat unique and isolated environment. Analytical and creative abilities of managers, as well as the communication skills necessary to convey problem-solving techniques, will influence firm performance [5].

As we move toward a more competitive global economy, there will be an increasing demand for highly qualified people to create and manage more efficient logistics systems and supply chains [6] As businesses are beginning to recognize the importance of having knowledge in this area they also are beginning to recognize that there will be a shortage of qualified talent: "A growing number of companies have recognized the need to develop this expertise. However, companies face a giant obstacle in achieving this goal: the shortage of trained supply chain management professionals at all levels" [7]. Businesses needing expertise in these areas should have access to well-educated managers with the necessary skills to make responsible and effective decisions.

Most of the students graduating from accredited academic institutions in the Northern Republic of Macedonia probably have little or no knowledge of the area that is vitally important to industry and our economy. Academic knowledge in Logistics and SCM discipline is simply not large enough to provide an adequate number of graduates to meet the managerial needs of business activities, which are made even more acute by increasing global competition. The needs for practical knowledge that will be well defined with the practical teaching in the study programs and will provide the minimum skills for working in these activities are inevitable. A small number of major programs still dominate the discipline, but they are generally found in the same schools that run after many years. Inevitably, the practical segment in academic programs must be predominantly represented, but not in form, but by activities that will be evaluated by companies or practitioners in the relevant fields.

Although the number of programs is gradually increasing, there is no large-scale commitment to the development of this discipline, especially enriched with contemporain and advanced informatics contents. The number of programs, courses, students, and faculty must increase at a faster rate and in more academic disciplines. In the interest of strengthening the business competitive orientation of the Macedonian economy, and to meet the needs of companies with sufficient professional staff and skills in the field of transport and logistics, changes in academic programs with content in the field of logistics and information systems will be necessary.

2. ANALYSIS OF THE REAL SITUATION HOW GRADUATES FIT INTO THE LABOR MARKET

Two main factors influence how young higher education staff "cope" with the labor market. The first factor mainly refers to the needs of the labor market and the current development of the economic situation of the country, the employment needs (or unemployment rate) of higher education staff, certain professions that are deficient or surplus, knowledge and skills required, etc. and more. Then, the situation of higher education in the country, primarily professional profiles offered, interest in certain profiles by students, flexibility of educational institutions, aimed at improving certain knowledge, expertise, etc.

According to the data of the State Statistical Office obtained on the basis of received reports, there were 53.677 enrolled students in the Republic of North Macedonia in the academic year 2018/2019, a decrease of 5.7 % compared to the academic year 2017/2018. The number of enrolled female students was 30.352 or 56.6%. The majority of students, 87.0%, were enrolled in public tertiary institutions, while 12.4% were enrolled in private tertiary institutions. In the academic year 2018/2019, there were 13.931 students enrolled in the first year of studies, which is 26% of the total [8].

Only for comparison, in the academic year 2010/2011 enrolled 61.148 students, while enrolled in 2015/2016 the number of students were 58.896. According to the data of the State Statistical Office, obtained on the basis of received reports, the number of graduated students is 7874 at higher vocational schools and faculties in the Republic of North Macedonia. The number of graduated students in 2019 compared to 2018, increased by 2.2%. Of the total number of graduates, 85.5% were full-time students, while 14.4% were part-time students. The share of graduated female students was 57.7%. Of the total number of graduated students, 36.4% have graduated on time, while 63.5% have graduated later than the official duration of education.

The next big problem is the number of unemployed labor force, where Macedonia is counted with a high unemployment rate in Europe. According to the data of the State Statistical Office, in the I quarter of 2020, the labour force in the Republic of North Macedonia numbered 967.733 persons, of which 811.106 were employed, while 156.627 were

unemployed persons. The activity rate in this period was 57.4, the employment rate was 48.1, while the unemployment rate was 16.2 [9].

According to age groups, most of the unemployed (62.9 percent) are between the ages of 25 and 49, while 17.3 percent are in the age group of 15 to 24 and 19.9 percent are in the age group between 50 and 64. Youth unemployment (15-29 years old) remains the biggest problem in the country and the youth unemployment rate of 45.4% is still one of the highest in Europe. This suggests that reducing youth unemployment must be set as a priority and a basis for co-operation between key stakeholders, such as government bodies, educational institutions and businesses / employers.

The situation is worrying with the fact that most young people have been waiting for the job market for more than two years. This results in the obsolescence of their knowledge and qualifications, which makes them less competitive in comparing new "fresh" staff to the labor market. The real risk is that these people cannot find a suitable job at all or have to settle for a position for which higher education is not mandatory, which is a demotivating factor, especially if one knows the time and money these young people spent on studies.

The experience provided by the labor market shows another problem. It is a form of disinterest or rejection towards the new "Bologna" students with 180 ECTS credits. So these young people are at a crossroads, whether to continue their studies and obtain a Master's degree, or to be persistent in their search for a job. Due to the high unemployment rate, an increasing number of these young people are seeking enrollment in master study, especially as they see it as one option for a temporary way out of an unfavorable employment situation.

Due to certain shortcomings in the overall organization of the educational process in the past, certain inadequacies in the transformation of curricula, the readiness of students for a quick entry into the labor market is called into question. On the other hand, many higher education institutions are opening up, which is considered to affect the general decline in the quality of higher education. Certain systemic measures must be found to accept such a critical analysis and aimed at improving the quality and competitiveness of future students.

2.1. Practice and academic programs in high education system in R. N. Macedonia

A very important issue in the educational process in the Republic of Northern Macedonia is the attendance of practical classes by students. In each student year, the student must attend practical classes, which cannot be shorter than 30 days per academic annum, and is a condition for enrollment in the next academic year.

Practical teaching and training of students and their hesitation during the educational process and its application after the completion of a certain cycle is a pillar of new changes in the educational process of the Republic of North Macedonia. Involving students in practical classes is also a form of testing the quality of theoretical and practical knowledge, assessing the competitiveness of certain higher education institutions (public and private), as well as a way of assessing the ability of students to enter the labor market. A lot of feedback is analyzed and focused on improving study programs, the content of certain subjects and the connection with current events and market needs.

It should be borne in mind that if the Law on Higher Education is thoroughly implemented, all these students must go through practical classes in one of the institutions that are related to the academic environment of the students. 7874 students graduate annually (academic 2018/2019), which means that these young people should be ready to apply practical knowledge to the labor market.

With such statements, two important questions arise: Are the institutions (state, public and private) capable and willing to accept such a large number of students for practical classes, and by which they are obliged by law. Usually, institutions do not have the space and physical possibilities to provide the minimum conditions for accepting students. This is a very bitter issue in the real implementation of the legal norm in higher education institutions. The positive thing in the implementation of this legal norm is that a good part of the students, who performed practical classes, were engaged by these institutions even after the completion of the study, and even included in a permanent employment relationship.

2.2. Striving towards the entrepreneurial and practical programs universities

Another important question is how the institutions have responded to such higher education reforms. Undoubtedly, the numerous ways in which institutions can be seen to promote student employable and enhance the student experience with transferable, real-world activities are required. The goal of this analytical situation is to adjust educational and market policies.

Universities of today now aim to promote strategically, and consistently, present themselves as entrepreneurial institution for the future. For all students, the practical focus of what is needed to start up and grow your business is both motivating and practical [10]. This is through developing vibrant programs, encouraging influential researchers and educators in the field, and voicing enduring rhetoric which endorses entrepreneurial education.

According to Iacobucci and Micozzi [11] one of the ways to stimulate start-up in high-tech sectors could be the spread of entrepreneurship courses in engineering and science faculties. Even in this case they should not exclusively be focused on business plan development (entrepreneurship skills) but

rather on enhancing entrepreneurship attitudes and awareness among students. The aim of stimulating start-up in high-tech sectors could be better fulfilled by post-graduate training programs and structures, which can be addressed to more specific targets and be focused on more specific fields.

At the heart of such reforms are the growing commitment of spin-off companies. What is a spin-off company?- is it a frequently asked question. The most common interpretation for this term is related when a company creates a new independent company by selling or distributing new shares of its existing business, this is called a spinoff. A spinoff is a type of divestiture. A company creates a spinoff expecting that it will be worth more as an independent entitity. A spinoff is also known as a spin out or starbust. The spin-off company is defined as: a company that employs employees, students, alumni who immediately after graduation start running a business, with the help of professional experience and business knowledge of the university staff. Newly formed companies are joining the university program, which allows them to further develop their products / services with the help of university resources.

In conditions where it is difficult to find interested industry partners to commercialize the scientific and technical results obtained at the University, the spin-off company founded by academics and researchers is usually the best way. The formation of spin-off companies means that its owner, in a sense, can be separated from the university, and this can be a difficult and often risky decision. Therefore, teachers working in such companies are usually offered some additional options such as: part-time work, parallel teaching position and work in the company, but without the opportunity to return to the previous position of the university, if the company fails.

In general, a spinoff tries to take advantage of several purposes, such as retaining talent, developing and exploiting new services and technologies discovered at the institution or company and seeking new business opportunities. Three facts about spin-off activities are undeniable. In developed countries with positive experiences, a private company created at the university must leave the university premises if its owner can no longer be hired full time at the university and the university receives a certain percentage of the value of the company. These private companies only pay for utilities and space rentals at best. In this regard, the company cannot be treated as a result of real spin-off activity. This is due to the fact that there are no clear regulations that define the financial and other relations between universities / faculties and companies formed technology parks.

Based on economic indicators such as: consumer confidence, economic climate and purchasing power of the population, economic trends show that the number of spin-off companies is increasing in conditions of expansion. This is logical and expected, but their formation is even more significant when the economic cycle is in recession. Spin-off companies have contributed to the formation of the overall value at the national level - participation in GDP, which in countries with a large number of technology parks, such as the United Kingdom, Germany and Japan reaches a significant level. This is due to the fact that spin-off companies usually come from the high-tech sector, IT sector, biotechnology, logistics and similar activities that create high added value of the final product.

The number of export-oriented spin-off companies that contribute to improving the trade balance of the home country is also significant. But of all the positive impacts, the most significant (especially for countries with higher unemployment rates, such as the Republic of Macedonia) is the hiring of high-quality staff and increased employment. Namely, the spin-off companies usually employ new graduates from the university that formed the technology park and hiring the young educated potential of a country for national benefits is especially useful. This trend can affect the minimization of "brain drain" from the state, and ultimately, it is based on the development of a country.

It’s important to make the students understand the problem’s true environment during education. Contemporian study programs must tackles with the issue of technology transfer and commercialization, based on the experience and conclusions drawn from the design and ongoing implementation of the above mentioned entrepreneurial applied model, and relates it to the literature on the subject. Speed-to-market is considered in relation to the type of organizations involved in implementing technological innovation.

Today's companies have the opportunity to apply e-business in all business processes. In practice, most companies are gradually introducing certain components of e-commerce into individual business processes. The main reason for the gradual introduction of electronic operations in companies is the gradual development of automation of business processes. In order for a company to introduce an electronic business process, the appropriate business process in the company must be automated in advance.

The use of information technology to exchange data between buyers and suppliers is in fact the creation of a virtual supply chain, which is always based on information rather than real stock.

Success in sharing specific information between supply chain partners can be enhanced through joint customer and seller collaboration, joint

product development, and information system development.

This is also the case with large transnational companies that put the demands of large users of their services in the first place, with which they strive to reach multi-year cooperation agreements. The advantage of the electronic supply chain is in reducing cycle time, closer relationships with partners, revenue growth, cost reduction and production time, optimized inventory management, efficient distribution and collaborative process.

3. MEANING OF LOGISTICS AND SCM FOR ECONOMICAL STUDY PROGRAMS

Students of high business schools and faculties of Economics and Information Technology must have a clear idea of what logistics is today for a company, a nation, a region, the enormous dimension in running the businesses of logistics information systems and what the complexity of supply chain management is. Logistics/SCM is a broad field of study, and people see it from different perspectives and view it as having differing needs.

Logistics and supply chain management are not new ideas. From the construction of pyramids in ancient Egypt to military doctrines and the supply of military units with a variety of equipment, to the supply of hungry people in Africa, the principles of supporting the effective flow of materials and information to meet customer requirements have changed little historically. Over time, the term logistics began to be applied in the field of industry, in the discipline known as "Business logistics". Its significance could be briefly interpreted as the ability to deliver materials and products to maintain the stability and continuity of delivery.

Logistics has always been considered one of the central and essential expressions of economic activity, but lately it has begun to attract serious attention in both theoretical and practical work.

According to Ozment and Keller [12] as we move toward a more competitive global economy, there will be an increasing demand for highly qualified people to create and manage more efficient logistics systems and supply chains. Businesses needing expertise in these areas should have access to well-educated managers with the necessary skills to make responsible and effective decisions. According to Tseng [13] at all logistics services comprise physical activities (e.g. transport, storage) as well as non-physical activities (e.g. supply chain design, selection of contractors, freightage negotiations). Most activities of logistics services are bi-direction. Information systems include modelling and management of decision making, and more important issues are tracking and tracing. It provides essential data and consultation in each step of the interaction among logistics services and the target stations. The information flow interlaces between different stakeholders within the system. Each stakeholder can communicate with the others directly to maximum their profitability. Reverse logistics will be adopted in various modes and applications in the future due to its efficiency and benefits in environment protection.

We can find many study in the literature on the conceptual definition and scope of logistics information systems. Some authors treat this issue as „Interconnected hardware and software systems design to support logistics elements"; e.g., coordination of logistics activities, material flow, and inventory replenishment. Logistics information systems are a subset of the firm's total information system, and it is directed to the particular problems of logistics decision making. There are three distinct elements that make up this system: a) the input; b) the database and its associated manipulations; and c) the output.

Supply chain performance has never been as important as it is today because in an economy where supply chains companies, competes with one another, it is the performance of supply chain that determines who will win the competition. Many companies are still not aware of the performance of their supply chains or they even don't know what kind of supply chain they have [14].

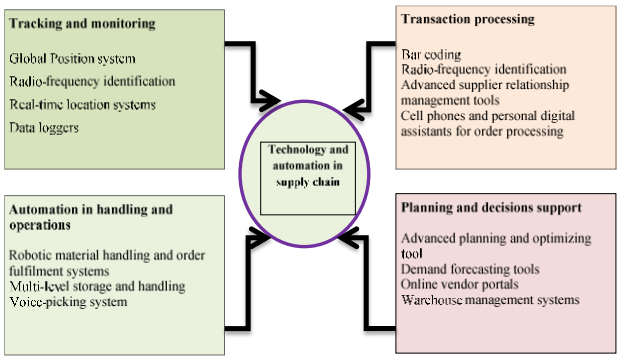

Figure 1. *Areas of technologies and automation adoption in supply chain*

But today companies expanded their activities outside of logistics systems, fully entering into the dimension of the management of the supply chain. Purchasing chain management is a very complex activity, due to the increasing volume and intensity of global movements, complex company structures, increasing the number of partners, suppliers and functional teams. This number will continue to rise as the global market continues to expand. In order for companies to keep pace with this expansion, supply chain management will require systemic change, a step that will contribute to even more operational activities. (Temjanovski, 2020).

In today's economics, supply chains play a key role. The most critical element of the supply chain, as well as the logistic process is production and serving the production. This means that serving modern production lines with determined elements significantly affects the turnaround time and costs. In today's economic environment – especially thanks to unique mass production – the modern production systems require flexible and effective production solutions. This is especially true in the

case of small scale producing of different unique products. The distribution of tasks to individual (flexible) production lines even today is often based on experience. This can lead to increased turnaround time, which leads to increases in logistical expenses, and thus decreases the company's profits. [15]

According to Michael Porter, Purchasing Chain Management consists of a chain of activities, from which each member of the chain adds value to the company's products or services. The model shares the organization's tasks in core activities (inbound logistics, operations, output logistics, marketing and sales, and services) and support activities (administration and management, human resources, technology and procurement).

Finally, experts have concluded that the supply chain management covers the entire process of production and distribution of physical goods, from supplier to customer. The business functions that fall within the scope of supply chain management include: forecasting and planning, procurement and purchasing, manufacturing and installation, storage and distribution, transportation and transportation, and management inventory. Or, simply put, supply chain management includes the following functions: planning, buying, giving, storing, moving, selling, and returning.

4. ARTIFICIAL INTELLIGENCE AND LOGISTICS SYSTEMS

We are witnessing numerous articles about artificial intelligence (AI) in daily newspapers and information of numerous companies. Despite the great benefits of these technological advances, mentioning the terms artificial intelligence in scientific circles is nothing new. The term was coined in 1956 by John McCarthy, a Stanford computer science professor who organized an academic conference on the topic at Dartmouth College in the summer of that year.

AI is like a system, that is based on the ability to estimate and categorize the multitude of data obtained, process it, and then draw conclusions from this. The output of this process is insight, decision, projection or conclusion.

AI is a branch of information technology that deals with the automation of intelligent behavior. AI is the attempt to program a computer so that it is able to process problems independently, similar to the way a human with the appropriate training would. On the one hand, artiicial intelligence could form the basis for huge productivity gains and improved quality of life. On the other hand, as with all new technologies, it could lead to a radical change in the world of work, comparable to the introduction of the conveyor belt. That is to say nothing of the ethical and societal issues that we must consider if machines acquire greater and greater intellectual capacity.[16]

Artificial intelligence can be defined as human intelligence exhibited by machines; systems that approximate, mimic, replicate, automate, and eventually improve on human thinking. Throughout the past half-century a few key components of AI were established as essential: the ability to perceive, understand, learn, problem solve, and reason [17] According to Hofmann S., Knell T**.** [18] the term Artificial Intelligence refers to the ability of machines to interpret different problems and to independently develop suitable solutions. Instead of working through rigid algorithms AI-Machines make their decisions afterwards and can therefore acquire a well-founded wealth of experience. With its help, they can develop ever better solutions and even make predictions.

Artificial information systems function as neural networks to solve complex problems in which a large amount of information is collected. Nervous networks reveal this knowledge through the use of hardware and software that is analogous to the processing of biological or human brain. Application of such sophisticated neural networks is in medicine, financial business, logistics, which covers problems in the field of template classification, forecasting, financial analysis and control and optimization of commodity turnover**.** [19]

Artificial intelligence is very much present in today's logistics operations. The main goal of these systems is to use computer programs to broadcast people's behavior in the decision-making process, but also to perform the most complex digital processes.

In the global, macro and microeconomic systems, there are and continue to be a number of specialized logistics systems, which at various levels, more or less successfully, effectively and rationally, produce special types of logistics products. The structure of the general logistics system consists of numerous interconnected, compatible, complementary, complex, stochastic and dynamically specific (sweat) systems. Some of the (general) systems of the general or universal logistics system are larger and some smaller, others are more complex, and still others are simpler, but some are more important than other subsystems [20]. The general logistics system is a system of interconnected and interconnected subsystems and elements that, through logistics infrastructure, over-structure and intellectual capital in a highly sophisticated industry, enable successful and efficient production of logistics products. The structure of the logistics system is made up of a number of subsystems, some of which are larger, some more important, more complex.

A lot of enterprises like Google, Amazon, and Intel start to invest their resources into AI. Actually, this technology allows saving time and money because it offers to automate various time-consuming processes.

Benefit of artificial intelligence in the logistics field: [21]

- Automated Warehousing – AI transform warehousing operations such as collecting and analyzing information or inventory processing. As a result, AI assists in increasing efficiency and getting profit. Artificial intelligence is used to predict the demand for certain products. After that, the company delivers demanding items to the regional warehouses reducing the transportation costs.
- Autonomous Vehicles - There is nothing more exciting than the field of autonomous transport for SCM. We've all known for many years that driverless trucks have major potential to affect supply chain management and logistics.
- Smart Roads or route optimization. The customers drivers and vehicles submit data to the machine, which then uses algorithms to creates the most up-to-date optimal routes depending on road conditions and other objective factors.
- AI algorithm can forecast when orders will arrive and leave a warehouse - The AI algorithm can forecast when orders will arrive and leave a warehouse, which means employees can put the pallets in the right position.
- Artificial Intelligence of the Back-Office Operations - AI and RPA (Robotic Process Automation) allow employees to speed up the working processes. For example, there are some data-related tasks that repeat every day. They can be automated. The companies with supply chains can save time and money since back office automation.
- AI to Predict the Demand and Improve Customer Experience - Artificial intelligence allows following the necessary factors to increase the accuracy of demand prediction. After that, this information can make warehouse management easier. Additionally, AI improves customer experience. Due to the implementation of this technology, clients can get a more personalized experience and, as a result, trust the company more.

Furthermore, logistics needs to predict consumer needs, goods demand, simplifying and speeding up daily administrative processes and streamlined workflow to remain unhindered and profitable. According to Blake Morgan [22] AI combines historical delivery information with customer feedback, weather reports and logistics to give an accurate prediction of when products will get to customers. The result is a more cohesive company that is able to make decisions faster and satisfied customers who knows just when their products will arrive.

AI provides for increasing process efficiencies, supplies most accurate prediction models and enables an unprecedented ability to adapt to changing markets - no surprise that last year more than $ 40 billion were invested in the research of Artificial Intelligence globally. Many people regard it as one of the most important growth drivers for logistics over the next few years and as the most important key to competitiveness. [23]

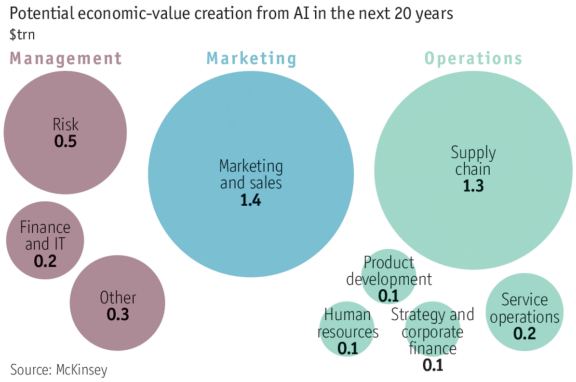

Figure 2. *Potential economic-value creation from AI in the next 20 years*

Undoubtedly, integrating AI into the complex web of production and distribution—the supply chain—will have a bigger economic impact than any other application of the technology and affect a larger number of businesses. McKinsey [24] estimates that firms will derive between $1.3trn and $2trn a year in economic value from using AI in supply chains and manufacturing. Many firms are already using robots powered by machine learning to improve the running of their factories and warehouses. But AI will transform several other aspects of supply chains as well.

5. CONCLUSION

Quality higher education, enriched with modern practices and skills, is an essential need for any society. The roles of higher education in sustainable economic and social development increase year by year, and this will continue over the next decades. In practice, universities must keep abreast of business and entrepreneurialism. However, within a university's own portfolio, how they design and deliver practical education programs can differ. Only academic programs with productive and valuable educations form can be competitive and relevant to market offer. What real change can occur, dependent of symbiose of study programs and business needs.

As we move toward a more competitive global economy, there will be an increasing demand for highly qualified people to create and manage more efficient logistics systems and supply chains. Students of high business schools and faculties of Economics and Information Technology must have a clear idea of what logistics is today for a company, a nation, a region, the enormous dimension in running the businesses of logistics information systems and what the complexity of supply chain management is.

Nowadays, AI uses the full potential of data to better predict a multitude of processes, events, and threats. In its algorithmic portfolio it focuses on avoiding risks and creating optimal solutions. This allows organizations to better manage their resources to optimize resources for maximum benefit. AI brings efficiency to the supply chain and logistics technology. Its advantages can be employed for end-to-end solutions. From planning, tracking, control procedures, and implementation,

logistics improves current operations and make the best business solutions. Data collection can be a by-product of other activities, eliminating the need for effort in form filling. It is also highly desirable for high-end costly items such are specialized engineering parts that require enhanced tracking given the value of items. It also finds opportunities that may exist in production, storing, distribution, and transporting. Forecasting engines with machine learning offer an entirely new level of intelligence and predictive analysis of big data sets that provides an optimal loop of forecasting, overhauling the way we manage inventory and the way we create new strategies for our industries.

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