

# Harmonization of curriculum with the needs and requests of the Fourth Industrial Revolution: Case of Faculty of Economics and Business Rijeka

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**Abstract** – The Fourth Industrial Revolution and its disruptive technologies shape everyday life and future of society. They have and will have a significant impact not only on the economy, but on each area of human life. Higher education that prepares students for life and professional careers represents a vital part of each economy. It is impacted by the Fourth Industrial Revolution and its technologies. The objective of this research is to determine the level of curriculum harmonization at the Faculty of Economics and Business Rijeka with the needs and requests of the Fourth Industrial Revolution and predictions about the future needs of the labor market. The research data has been collected through questionnaires filled by students and the teaching staff at the Faculty of Economics and Business Rijeka. The results will reveal obstacles and possibilities to increase the level of harmonization.

**Keywords** - Fourth Industrial Revolution, Faculty of Economics and Business Rijeka, education, curriculum, harmonization

## I. INTRODUCTION

Nelson Mandela said that education is the most powerful weapon people can use to change the world. The Fourth Industrial Revolution changes the world and affects education. Academia must respond to the challenges of the Fourth Industrial Revolution. Reference [14] states that education can increase the labor force's human capital, which will improve labor productivity growth. Increasing investments in education by 1%, causes an economic growth increase of 0.14%. Reference [7] states that growth differences are the results of differences in knowledge gained during studies. Education should adapt to changes caused by the Fourth Industrial Revolution. It can be done by harmonizing it with predictions about labor market. Literature provides different definitions of the Fourth Industrial Revolution. Reference [21] states that humanity stands at the brink of a technological revolution that will fundamentally alter the way people live, work and relate to one another. Reference [13] agrees with [21] and concludes that pace of changes is increasing. How can education adapt to changes caused by the Fourth Industrial Revolution? Reference [27] refers to Jack Ma's speech at the annual meeting of the World Economic Forum in Davos. Jack Ma states that teaching methods should be changed because they are knowledge based. Reference [4] estimates that the

Fourth Industrial Revolution will create 123 million new jobs, but will cause the disappearance of 55 million existing jobs. Estimation is that 65% of children which attend primary school will have a job that doesn't exist today. In determining investment locations, 74% of the companies prioritize the availability of skilled local talent. Talent will be created through education that can provide a necessary set of skills for labor market of the 21<sup>st</sup> century. The question is which skills will be necessary? Reference [20] emphasizes these skills: analytical thinking and innovation, active learning and learning strategies, creativity, originality and innovation, system analysis and evaluation technology designing and programming, critical thinking and analysis, complex problem solving, leadership and influence, emotional intelligence, reasoning, problem-solving and ideation. This paper wants to examine the level of curriculum harmonization at the Faculty of Economics and Business Rijeka with the needs and requests of the Fourth Industrial Revolution. One objective is to reveal obstacles and possibilities to increase the level of harmonization. Through analysis, it will try to provide guidelines not only for the Faculty of Economics and Business Rijeka, but for all faculties.

## II. LITERATURE REVIEW

The Fourth Industrial Revolution and education are subjects of huge scientific interest. Reference [25] states that the educational achievement of a country's population is a key determinant of its economic growth. Improving educational attainment is an urgent priority for all countries. Reference [23] concludes that between 75 million to 375 million people will need to switch occupational categories. The technological transformation is clear and now the question is how universities can respond. Reference [15] concludes that the technological age has opened a bright horizon for education offering tools to improve its quality. The computer revolution enabled greater access to learning and larger teaching opportunities. It allows individual progress towards learning goals. However, a problem appears in the period of rapid technological progress, when the gap between technological invention and teacher utilization becomes more noticeable. Reference [26] states that partnerships between governments, educators, training providers, workers and employers have to be enhanced. It leads to better managing of the transformative impact of the

Fourth Industrial Revolution on employment, skills and education. The evolving nature of work together with technologies of the Fourth Industrial Revolution will be the biggest change driver. Current technological trends are bringing about an unprecedented rate of change in the core curriculum content of many academic fields, with nearly 50% of subject knowledge acquired during the first year of a four-year technical degree outdated by the time students graduate. Reference [12] agrees with [4] about the necessary skills, which were already mentioned in chapter introduction. Reference [12] states that the skills students will need for the society in which they will work and live shouldn't be thought of as "one more thing to teach", but rather training integrated across all curriculum. References [1] and [16] agree with [12] and conclude that in preparation for their future life, students need to deal with the real-life problems during classes. Through the integration of science, technology, engineering and math, curriculum exemplifies the cross-curricular learning that is the foundation of the 21<sup>st</sup> century education. Reference [22] states that the Fourth Industrial Revolution changes everything. Education as one of the main goals of a sustainable development strategy should adapt to the new situations. Everything becomes digital: consumers, enterprises and operation waves. Reference [22] agrees with previously referred authors about the necessary skills that should be taught. Reference [19] concludes that education must adapt to the Economy 4.0 era, as it was changing due to industrial revolutions. Education 4.0 caters to the needs of society in an innovative era. Learning management must help to develop the learner's ability to apply new technologies which will contribute to increase their knowledge and skills according to the changes in society. Reference [8] agrees with this perspective and mentions nine trends in Education 4.0: learning can take place anytime and anywhere; learning is personalized; students have a choice in determining how they want to learn; students will be exposed to more project-based learning; to more hands-on learning through field experience such as internships, mentoring projects and collaborative projects; to data interpretation in which they are required to apply their theoretical knowledge to numbers and use their reasoning skills to make inferences based on logic and trends from given sets of data; students will be assessed differently, and the conventional platforms to assess students may become irrelevant or insufficient; student's opinion will be considered in designing and updating the curriculum; students will become more independent in their learning, thus forcing teachers to assume a new role as facilitators who will guide the students through their learning process. Reference [2] states that industries and private sector will have to collaborate with the universities to adapt to the requirements of the Fourth Industrial Revolution, because Education 4.0 will combine the real and virtual world. Reference [18] states that each industrial revolution caused changes in education due to demanded skills and technologies and by founding new institutions. The digital environment changes everything. Reference [18] emphasizes the program Stanford 2025 as an example of adapting higher education to the needs and requests of the Fourth Industrial Revolution. Reference [18] agrees with [9] which states that information technology (IT) will be highly incorporated into education. Technologies like

virtual reality (VR) or augmented reality (AR) will be not only part of curriculums, but will provide the way students gain new knowledge. Massive open online courses (MOOCs) will become the future of the classroom experience.

Various authors stress the importance of curriculum harmonization with the Fourth Industrial Revolution. The curriculum has to be changed and more adapted to the real world. One of the questions for Education 4.0 is how to prepare students for the world that nobody knows how it will look like. Universities have to respond and one of the answers is Stanford 2025 [24].

### III. METHODOLOGY

To examine the level of curriculum harmonization with the needs and requests of the Fourth Industrial Revolution, a questionnaire was used. The sample-set consisted of 255 people: 46 teaching staff, 209 undergraduate and graduate students at the Faculty of Economics and Business Rijeka. While constructing questions, relevant sources were referenced, such as The World Economic Forum, Stanford University, etc. In interpreting the results, questions were grouped into five elements: knowledge about the Fourth Industrial Revolution, knowledge about professions related to the Fourth Industrial Revolution, usage of technology, skills and exams. Curriculum harmonization with the needs and requests of the Fourth Industrial Revolution will be examined through each element. Knowledge about the Fourth Industrial Revolution (know) summarizes questions related to the estimated knowledge about terms and technologies of the Fourth Industrial Revolution. Knowledge about professions related to the Fourth Industrial Revolution (knowpro) summarizes questions related to the estimated level of familiarity with professions created by the Fourth Industrial Revolution. Usage of technologies (tech) summarizes questions related to the usage of the Fourth Industrial Revolution technologies in the teaching process. Skills (skill) summarizes questions related to developing skills necessary for the labor market of the Fourth Industrial Revolution. Exams (exam) summarizes questions related to the harmonization of assessments, questions and tasks with the needs and requests of the Fourth Industrial Revolution. The Likert scale from 1 to 5 was used to measure estimations from respondents. For elements knowledge about the Fourth Industrial Revolution and knowledge about professions related to the Fourth Industrial Revolution, value 1 means that respondents have no knowledge about term or profession. Value 2 represents a basic level where respondents are familiarized with the definition and existence of certain term or profession. Value 3, or intermediate level, means respondents possess theoretical knowledge of the term and job description of the profession. Value 4, or advanced level, means respondents are familiarized with theoretical, technical and basic practical knowledge related to term or profession. Value 5 means respondents possess high theoretical, technical and practical knowledge about the term or profession. For elements technology, skills and exams, values are composed in following way: 1 – strongly disagree, 2 – mostly disagree, 3 – neither agree,

nor disagree, 4 – mostly agree, 5 – strongly agree. In the last group of questions, respondents had to choose between two options about the type of studies they prefer. Option A represents the actual type of studies. Option B represents studies adapted to the Fourth Industrial Revolution. Option B is based on the Stanford 2025 program, which is a new curriculum based on the needs and requests of the Fourth Industrial Revolution created by Stanford University [24]. Descriptive statistics was used to determine the level of curriculum harmonization.

#### IV. RESULTS AND DISCUSSION

Using descriptive statistics, the authors plan to provide insights into the level of curriculum harmonization at the Faculty of Economics and Business Rijeka with the needs and requests of the Fourth Industrial Revolution. The last group of questions will be analyzed just to determine the preferences of respondents regarding the type of studies.

TABLE I. DESCRIPTIVE STATISTICS

Measure	know	knowpro	tech	skill	exam
MODE	4	3	1	4	3
MEAN	2.51	2.94	2.61	3.54	3.16
ST.DEV	0.80788	0.12746	0.15678	0.07395	0.07971

It is interesting to examine the level of knowledge about the Fourth Industrial Revolution and its technologies. Since this element contains 18 questions, it will be divided in two sections: knowledge about the Fourth Industrial Revolution and its technologies, and knowledge about the terms and indicators related to the Fourth Industrial Revolution. Questions in each section have a common denominator. For both sections, the common denominator is the similarity of results in each question and subject of the question. As it is written, the first section is more related to technologies, while the second is more related to indicators and theoretical terms. For this element, mean equals 2.5, while mode equals 4. The reason for this is the very low level of knowledge about terms and indicators related to the Fourth Industrial Revolution. For this section, mean equals 2.1, while mode equals 1. Terms related to the Fourth Industrial Revolution are: Global Competitiveness Index 4.0, Industry 4.0 Index, Global Connectivity Index, Digitalization Index, Index of Economic Complexity, Global Innovation Index, Global Talent Competitiveness Index, Global Information and Communications Technology Development Index, cognitive capitalism and massive open online courses. For the section related to knowledge about technologies of the Fourth Industrial Revolution, mean equals 2.96, while mode equals 4. Technologies of the Fourth Industrial Revolution in this research are: Internet of Things (IoT), Artificial Intelligence (AI), robotics, smart systems, big data, blockchain, 5G, virtual and augmented reality. Respondents do not possess enough knowledge about the indicators that provide insight into digital development of a certain economy. It is very interesting to notice that more than 50% of respondents estimate their knowledge about smart systems, VR, AR, and AI to be at an

advanced or expert level. This means they can apply these technologies on a practical level. Respondents are most familiarized with the Global Competitiveness Index 4.0, Global Innovation Index and Digitalization Index. Even here, results show a very low level of familiarity. Among respondents, 60 - 70% of them are not familiarized with these indexes or just know about their existence. According to responses, the Global Innovation Index is the indicator respondents are most familiarized with. 16.4% of respondents estimate their knowledge about this indicator to be on advanced or expert level. Professions included in this questionnaire are: community manager, content manager, app developer, big data analyst, social media manager, influencer, YouTuber, cloud broker, digital marketing specialist, design team leader, communication assistant, iOS engineer, digital architect, 3D specialist, blockchain manager, bitcoin trader, AR manager, VR developer. Regarding professions, mean equals 2.94, and it is almost at the intermediate level of knowledge with mode value of 3. More than 50% of respondents possess basic, advanced or expert knowledge. For professions like YouTubers or influencers, more than 50% of respondents estimate their familiarity on expert level. Blockchain manager and AR manager are professions with the lowest level of familiarity. 63.9% of respondents are not familiarized at all or are only aware of the existence of these professions, while 10.1% of them estimate their knowledge on advanced or expert level. 66.6% of respondents are not familiarized at all or are only aware of the existence of an AR manager, but only 8.3% of them consider to have advanced or expert level knowledge. However, it is questionable why respondents estimate their level of knowledge and familiarity at such levels. For the second element, usage of technologies of the Fourth Industrial Revolution in the teaching process, mean equals 2.61, while mode equals 1. Respondents strongly agree that information is available online and online studies is enabled. They are generally satisfied with the quality of IT equipment. One of the reasons for this are investments. Faculty invested 337.000 € in hardware and software over the last five years [6]. Respondents strongly disagree with the fact that technologies are used in the teaching process. According to results, Internet of Things has the highest usage rate in the teaching process. Mode equals 3, while mean equals 2.36. For all other technologies, mode equals 1, while mean is smaller than 2. Smart systems are exception, with mode value 3 and mean value 2.36. 91% of respondents strongly or mostly disagree robotics is used in the teaching process, while only 2.8% of them strongly or mostly agree with the statement. 72% of respondents strongly or mostly disagree that AI is used, while nobody strongly agrees that AI and blockchain are used in the teaching process. 78% of respondents strongly or mostly disagree that blockchain is used in the teaching process. 80% of respondents strongly or mostly disagree with the fact that VR and AR are used in the teaching process. Skills included in this research are: creativity, teamwork, critical thinking, discussion and interaction, argument-based conclusion, personalization, problem-solving, working on projects, initiative, analytical thinking, innovativeness and complex problem-solving. Regarding skills necessary for the Fourth Industrial Revolution, mean equals 3.54, while mode equals 4. Respondents consider that discussion and interaction,

teamwork, critical thinking and argument based conclusion are skills that are mostly developed in the teaching process. According to respondents, the skill that is the least developed is innovativeness. 30% of respondents strongly or mostly disagree with the statement that this skill is developed in the teaching process. However, 40% of respondents totally or mostly agree that it is developed in the teaching process. Element exams includes: assessments, types of questions and tasks, such as midterms, seminars, case studies, calculus, essay questions, short questions and multiple choice. Midterms also include estimations about final exams because they are very similar in question types and examining student knowledge. For element exams, mean equals 3.16, while mode equals 3. 53.7% of respondents consider seminars are useful in the preparation for the labor market, while 49.8% of them consider the same for case studies. According to 45.9% of respondents, multiple-choice questions are considered useful for preparation for the labor market of the Fourth Industrial Revolution. 33% of respondents strongly or mostly agree that essay questions are useful in the preparation for the labor market of the Fourth Industrial Revolution, while 34.1% of them consider the same for short questions. These results are not in accordance with relevant literature about developing skills and preparing students for the labor market of the 21<sup>st</sup> century. Reference [3] confirms that the skills questioned in this research are necessary for the Fourth Industrial Revolution. Reference [3] states that standardized facts and procedures belong to the past. Multiple choice and short questions are used to test knowledge of standardized facts which do not belong to the age of the Fourth Industrial Revolution.

While analyzing the total questionnaire, the authors divided it into two parts: knowledge about the Fourth Industrial Revolution and the teaching process. Knowledge about the Fourth Industrial Revolution includes two elements: knowledge about technologies and terms related to the Fourth Industrial Revolution, and knowledge about professions related to the Fourth Industrial Revolution. The teaching process includes elements: usage of the Fourth Industrial Revolution technologies, developing skills and harmonization of assessments. Common denominators to divide elements into sections are: Likert scale, what it measures and the influence of respondents. In the first two elements, respondents estimated their level of knowledge and familiarity with terms, technologies and professions of the Fourth Industrial Revolution. The Likert scale is organized by the level of knowledge: no knowledge, basic, intermediate, advanced and expert level. The level of knowledge is a result of the teaching process and informal education. Respondents, especially students, have a higher possibility of influence on their knowledge. The teaching process produces knowledge. The Likert scale measures the level of respondent agreeance with the statements related to elements included in this section. Student influence is very low or doesn't exist at all, as they don't define literature, teaching plans, assessment types or questions. The teaching staff has a higher influence because they define literature and teaching plan, but influence is not absolute. The assessment types and

lessons that will be taught are defined by the rules of the Faculty, University and Ministry of Education.

For both sections, mode equals 3. Mean for knowledge equals 2.72, and for the teaching process equals 3.11. The majority of respondents possess basic level of knowledge about terms, technologies and professions related to the Fourth Industrial Revolution. It implies that there is a lack of practice and simulations of real situations in education. Reference [11] states that, in order to increase the employability of students, it is necessary to concentrate on what happens in the real or virtual classroom and changing the formal curriculum. Employers generally prefer to hire people with work experience. One way of increasing student's competitiveness in the labor market is to incorporate practical content into degree programs. Practical usage and real-world simulations can increase student involvement and interest. For the second section, mode and mean value show that the majority of respondents neither agree, nor disagree with the statement. It is a result of the lack of knowledge about the Fourth Industrial Revolution and its requirements. It is especially expressed in responses to the questions regarding element exams, where respondents are not sure, which types of questions are harmonized with the needs and requests of the Fourth Industrial Revolution. These answers imply necessity to combine practical and theoretical lessons in curriculum and train teaching staff for teaching and using technologies of the Fourth Industrial Revolution. Education produces human capital and for this reason it is one of the key determinants of national economy competitiveness. It has to follow trends from the real world. The increasing level of cooperation with private sector can be one of the guidelines to incorporate new technologies and theoretical aspects of the Fourth Industrial Revolution.

The last group of questions was the type of studies respondents prefer. The first type, Option A, is the actual type. The second type, Option B, is harmonized with the needs and requests of the Fourth Industrial Revolution. This type is based on the Stanford 2025 program that is emphasized as a guideline for Higher Education 4.0. The majority of respondents have chosen Option B. Instead of immediately choosing a study and program strictly divided into topics, respondents prefer choosing interdisciplinary projects which would allow them to work during their studies. A university organized in competency hubs where project-based lessons are performed in specialized and equipped classrooms and laboratories is considered a better option than a university strictly divided on faculties and departments where lessons are performed in one room. Respondents prefer stronger cooperation with Alumni, whose members stay in contact with the Faculty as lecturers, project leaders and donors instead just as lecturers only on particular events. Through such projects, students are enabled to study social and global impacts of their projects, communicate with Alumni and future employers instead of being unaware of impacts of their projects and maintain actual communication with employers only through Curriculum Vitae (CV). In this way, employers could track student advancement in adopting necessary skills and students can become more employable. Instead of a job that is unrelated or partially

related to their field of study, respondents prefer an option where their projects are basics for their professional career. In two questions, respondents prefer Option A. Studying three to five years immediately after high school is a better option for 55.7% of respondents than studying six years during whole professional career. Attending defined number of classes through semester that lasts 15 weeks is a better option for 51.8% of respondents than class based on solving project tasks in micro cycles which last maximum one month.

## V. CONCLUDING REMARKS AND CONTRIBUTIONS

In this paper, the authors wanted to examine if curriculums at the Faculty of Economics and Business Rijeka are harmonized with the needs and requests of the Fourth Industrial Revolution. According to the data, authors got through statistical analysis, the curriculum is mostly harmonized in the element skills. This means the curriculum prepares students to be competitive in the labor market of the Fourth Industrial Revolution. According to relevant literature, Faculty follows global trends. The element with the lowest level of harmonization is the usage of technologies of the Fourth Industrial Revolution in the teaching process. The authors noticed an interesting comparison of the results for knowledge about technologies and usage of technologies. For element knowledge, mode equals 4, while mean equals 2.97. For element usage of technologies mode equals 1, while mean equals 1.5. This raises the question: How did respondents learn about these technologies? The question remains unanswered and the authors consider it as one of the limitations of this research. In these elements, the curriculum needs certain improvements in order to be harmonized with the needs and requests of the Fourth Industrial Revolution. Lack of knowledge about the indicators like Global Competitiveness Index 4.0, Global Talent Competitiveness Index, Index of Economic Complexity indicates that the Faculty should increase efforts in educating students about them. These indexes and all other indicators are very important for the estimation of a certain market and students should be familiarized with them. Regarding knowledge about professions created by the Fourth Industrial Revolution, mode and mean value prove that students are familiarized with theoretical basics and job descriptions, but there is a lack of practical knowledge. This is another reason to incorporate these technologies into the teaching process. According to respondents, assessments need certain improvements. Before answering the question about the possibility of improvements, the authors would like to mention other limitations of this research. One limitation can be respondent biases. The authors can't be sure if respondents gave honest answers, especially in the element exams. Answers about the type of questions can be exposed to biases, especially because respondents can prefer a certain type. Another limitation is the knowledge of the first year, undergraduate students, about the teaching process after just one semester. The last limitation is the previous knowledge of respondents about elements taken into consideration. This is why their answers might be a result of a lack of knowledge. This is especially emphasized in the element exams, where they

can't be sure if a certain type of assessment, task or question is adapted to the Fourth Industrial Revolution. This is one of the reasons why the majority of respondents answered that they neither agree, nor disagree with the statement.

The main contribution of this paper is revealing respondent preferences in the organization of the studies and harmonization of curriculum with the needs and requests of the Fourth Industrial Revolution. By providing answers on different types of questions, Faculty could see in which areas it is necessary to increase harmonization efforts. With the last group of questions about the type of studies respondents prefer, paper provides insights about the possibility of changes the Faculty could take in the future. Recommendation for the Faculty would be the creation of a strategic plan for transformation to Education 4.0. Its main goals would be an adaptation to the new technological age and increasing the competitiveness of the Faculty. One of the key pillars of the Faculty competitiveness should be the higher competitiveness level of its students within the labor market, especially in the area of technology usage. These technologies are already incorporated in the curriculums of other universities and colleges. It is very important to develop and maintain stronger relations with Alumni and private sector not only in organizing classes, but also through projects. Efforts should be increased in all elements of the curriculum in order to increase knowledge about the Fourth Industrial Revolution and its technologies. It will enable transformation towards project-based learning. This type of learning enables better simulation of real situations and better development of skills necessary for the labor market [17]. Project-based learning can solve problems like the lack of theoretical knowledge regarding indicators of the Fourth Industrial Revolution through case studies, seminars and workshops. Knowledge of market research will always be required in companies. Reference [10] states that it is a key mechanism through which service companies understand their current as well as potential customers. It is the functional link between marketing management and an organization's ultimate customer base. As globalization level increases, service companies will need to know how to utilize market research approaches that enable them to stay close to these worldwide and diverse customer segments. It is impossible to expect a transformation process will last for a short period. It demands training of the teaching staff and preparation for new types of teaching, adaptation of learning outcomes, preparation of students and cooperation between faculties, universities and private sector.

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