UNDERSTANDING SOCIETY 5.0 JOBS FOR IMPROVING EDUCATION 4.0 – AN ANALYSIS IN PYTHON

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Abstract Developments in science and industry have a direct impact on human life by contributing to development of societies throughout human history. Developments in information, internet technologies and Industry 4.0 accelerated the digital transformation of the industry. As a result, factories have been equipped with 'smart' technologies and new skills are needed to use these smart technologies. These skills have changed job descriptions and new graduates now start to work in jobs that never existed in the past. After the transformation from an industrial society to an information society with Industry 4.0, the aim is to reach Society 5.0 as a new level of social development. Therefore, graduates will need to have new skills to adjust to Society 5.0. In this study, International Standard Classification of Education 2020 data were analysed according to gender, age and educational level using machine learning in Python. The types of jobs that are most in demand were identified. Consequently, the sector and job preferences of new graduates were determined according to their educational levels. This study fills a gap in existing literature by analysing the trendiest positions in the industry so universities can prepare their students for these positions within the Education 4.0 framework.

Keywords:
Education 4.0, University 4.0, Society 5.0, digital transformation, data analysis

University of Maribor Press

DOI https://doi.org/10.18690/um.epf.5.2022.17
ISBN 978-961-286-600-6

1 Introduction

Industry 4.0 is a period of knowledge and innovation. The term 'Industry 4.0' was first used in Germany in 2011 during Hannover Messe, the world's largest industry fair (Mosconi, 2015; Aybek, 2017). The German government initiated the project, which was based on high-technology strategies. The internet of things, the internet of services, cyber-physical systems, and smart factories were used to usher in the fourth industrial revolution in industry. This revolution was also positioned as a new level of product lifecycle value chain organisation and management.

Despite the fact that efforts to adopt the concept of Industry 4.0, which was born in Germany in 2011, and continuing criticism of the subject worldwide, Shinzo Abe, the Prime Minister of Japan, one of the leading countries in technology development, mentioned the concept of 'Society 5.0' at the CeBIT 2017 Computer Expo. "Technology should not be viewed as a threat, but rather as a help," urged Shinzo Abe. However, it was earlier reported that Society 5.0 was born out of a strategy plan in the sphere of science and technology in Japan (Saracel & Aksoy, 2020; Develi, 2017; Keidanren, 2016).

The goal of Society 5.0 is to improve people's welfare and, as a result, society's welfare by adapting technology to social life. As a result, rather than a society that fears and hesitates to embrace technology, the goal is to develop one that uses, assimilates and benefits from it (Saracel & Aksoy, 2020; Gokten, 2018). Another goal of the Society 5.0 proposal is to make society ready for and compatible with the Industry 4.0 process, which will inevitably lead to digital transformation. Thus, at the expected social welfare level, everyone will have a safe and harmonious living environment in which they can produce value, regardless of time and place, following the hunter society, agricultural society, industrial society, and information society (Sahin, 2021).

Industry 4.0, along with Society 5.0, will have an impact on the required skills and knowledge of human capital (Puncreobutr, 2016; Aybek, 2017). Individual skill sets and understanding must be updated to meet the demands of the evolving digital world (Sinlarat, 2016; Weber, 2015). In contrast to past periods, a higher level of competence will be required (Bonekamp & Sure, 2015). This means 'people skills, good oral communication and persuasion abilities, critical thinking, coordinating

with others, emotional intelligence, judgement, service orientation, bargaining, and cognitive flexibility,' according to the World Economic Forum (2016). As a result, in order to provide youngsters with all of these new abilities, higher education institutions and universities must undergo a metamorphosis. This brings us to the concept of Education 4.0.

The knowledge economy and Education 4.0 jobs require less and less of what individuals know (concepts and theories) and more and more of how people use digital skills, information and technologies in an interoperable manner. Education 4.0 is promoting a new educational paradigm focused on the use of applicable skills and the need to upgrade and requalify, unlearn and relearn (Hong & Ma, 2020).

According to the OECD (2018b), students will be required to use their knowledge in new conditions in a world that is rapidly evolving, and they will require a diverse combination of cognitive, social, emotional, practical and physical skills to do so. The World Economic Forum's Future of Jobs 2020 Report (WEF, 2020b) also notes that the COVID-19 pandemic and the resulting worldwide economic collapse hastened the advent of the future of work. According to the World Economic Forum (WEF, 2016b, 2020a), 65% of 21st century pupils will work in occupations that do not yet exist when they start school, and they will also require digital skills to satisfy the demands of the new Fourth Industrial Revolution jobs. Industrial revolutions have historically not only influenced production but also education (Azmi et al., 2018).

The training of teachers and the organisation of educational institutions must be considered as part of Education 4.0. According to Goh and Abdul-Wahab (2020), teachers are at the forefront of student education, and they must be trained in new teaching approaches for digital students in a digitalised environment. Educational institutions, on the other hand, must move away from traditional methods of knowledge transmission and give instructors autonomy, as well as experiment with new pedagogies for students and allow them to set their own learning pace, all with the aid of technology. Overall, universities must prepare students for jobs and technology that have yet to be invented, as well as for solving issues that have yet to be anticipated (OECD, 2018b).

The goal of this study is to compare the education and working areas of university graduates according to the business lines that are required for Industry 4.0, according to the results of a survey conducted among 16,755 people with a bachelor's degree as a minimum. International Standard Classification of Education 2020 data was used for this study. By analysing these data, the types of jobs demanded by Society 5.0 can be forecast. Thus, in line with Education 4.0, universities can transform themselves to prepare their students for these jobs. This study adds to existing literature by analysing the jobs of recent graduates and, as a result, identifying the future jobs required by corporations. Therefore, by looking at the results of these analyses, higher institutions can adjust their curriculum and prepare their graduates to achieve the skills that are essential for Society 5.0.

2 Methods and analysis

For the purposes of this study, an analysis was carried out in Python using the International Standard Classification of Education 2020 data using machine learning. The demographic factors such as age, gender and educational level are classified. In addition, the jobs that the graduates are currently doing are distributed according to their age and educational level. The jobs based on Industry 4.0 are shown in Table 1 below.

Table 1: Industry 4.0 Jobs

Autonomous robots
Cybersecurty
Big data
Augmented reality
Cloud Computing
System integration
Internet of things
Simulation
Additive manufacturing

The data set was visualised using Python software and data visualisation libraries according to the educational status of the graduates, as shown in Figure 1.

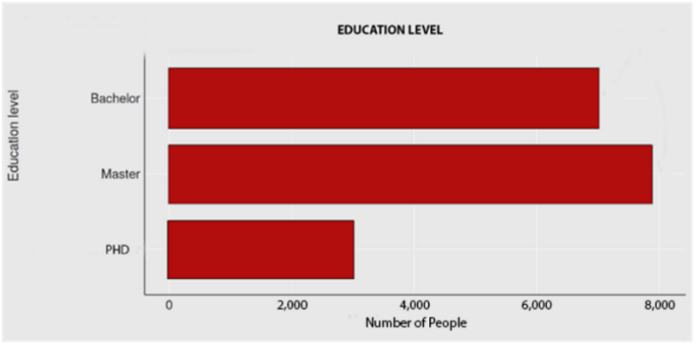

Figure 1: Number of graduates by educational level
Source: own.

Figure 2 shows that university graduates are classified by gender and education. The level of education is very similar for both genders in all the levels. The point worth mentioning in Figure 2 is that the proportion of graduates at the doctoral level is low compared to those who achieved bachelor's and master's degrees.

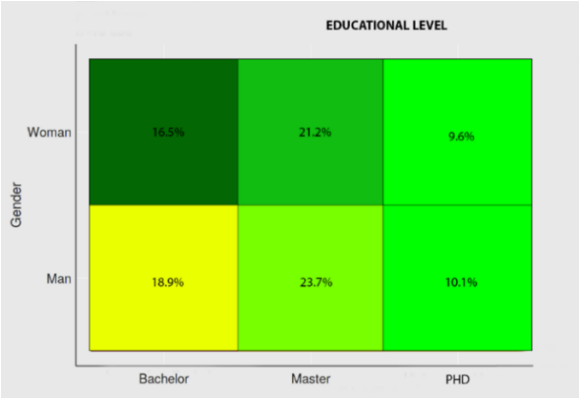

Figure 2: Distribution of graduates' educational status by gender
Source: own.

As shown in Figure 3, it is necessary to be of a certain age to reach a certain level of education. People with a bachelor's degree are mostly between the ages of 18-29, while those with a master's degree are usually between the ages of 35-39. Those at the PhD level, which is the highest form of education, are mostly in the age range of 30-50 and above.

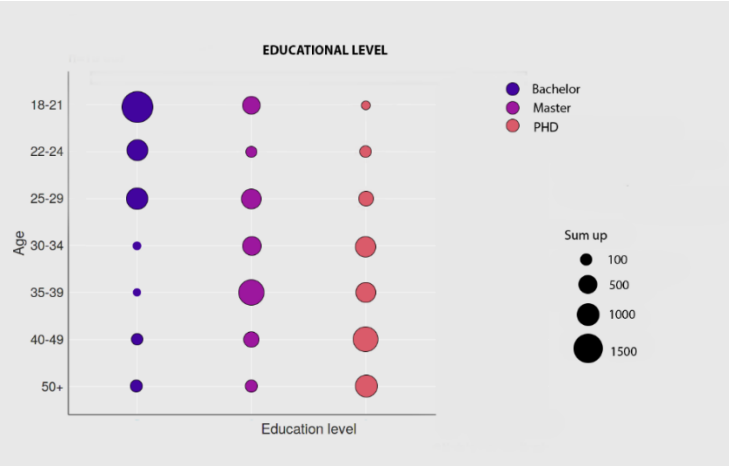

Figure 3: Distribution of graduates' educational status by age
Source: own.

3 Results and discussion

According to an analysis of the results of the data set shown in Figure 4, the distribution results of the graduates' age status according to the sectors in which they work after graduation show that the sector preferences of those graduates with a bachelor's degree are mostly on system integration and Cloud-based systems. As can be seen in Figure 4, the sector preferences show that master's graduates prefer to work in the fields of cybersecurity, big data, additive manufacturing and the internet of things. Doctoral graduates, meanwhile, mostly work on virtual reality and autonomous systems.

As a result, according to the International Standard Classification of Education 2020 data, the general preference of graduates in the sector after COVID-19 is virtual reality and Cloud-based remote working systems, as well as application areas that lead to living in isolation such as the internet of things.

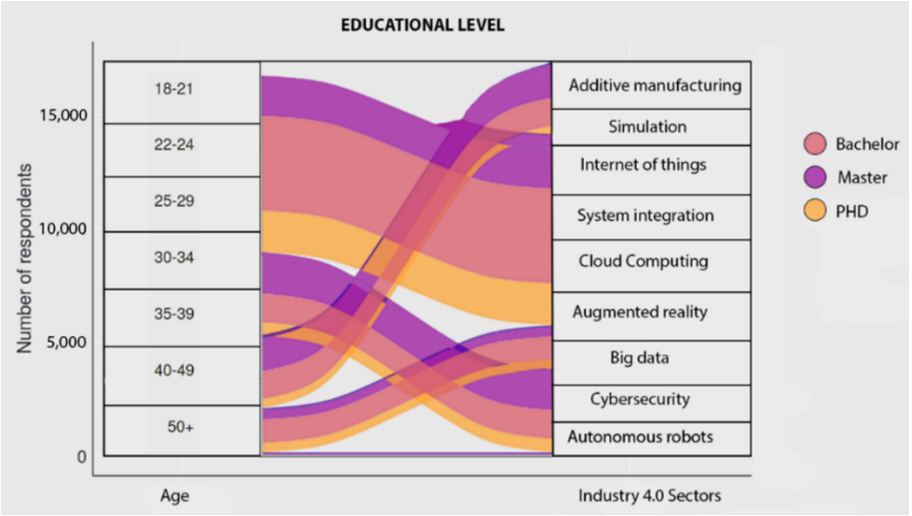

Figure 4: Distribution of the age of graduates according to the sectors in which they work
Source: own.

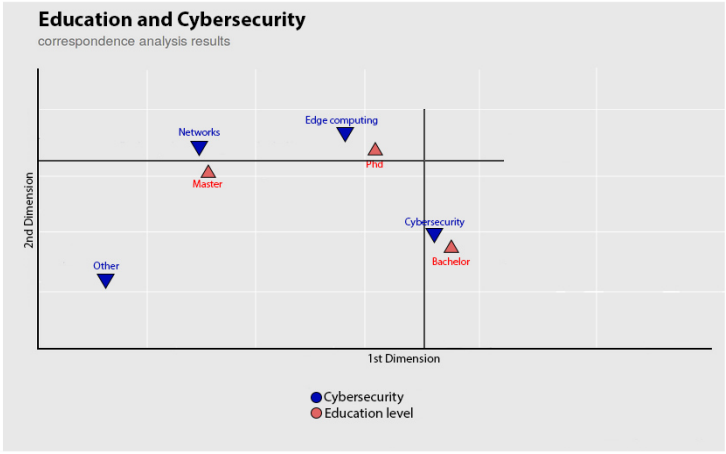

Figure 5: Comparison of demand between education and cybersecurity

As can be seen in Figure 5, undergraduate graduates mostly work in the field of cybersecurity. In the higher educational level groups, the lowest educational level was at the master's level for those working on network and at the doctorate level for those working in Edge computing.

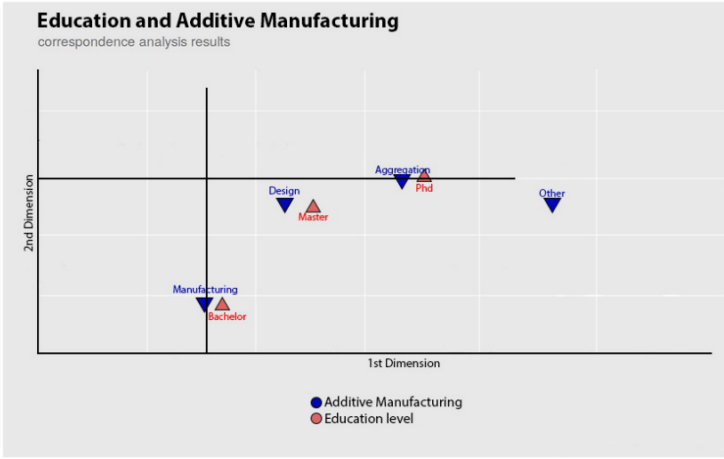

Figure 6: Comparison of demand between education and the additive manufacturing sector

As can be seen in Figure 6, graduates with doctoral degrees mostly work in the field of aggregation. In the next educational level groups, the lowest educational level was at the master's level for those working on design and at the undergraduate level for those working in the field of manufacturing.

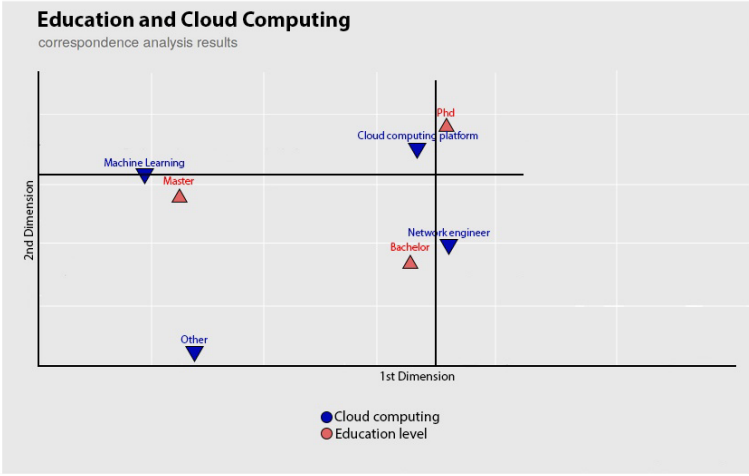

Figure 7: Comparison of demand between education and the Cloud computing
Source: own.

As can be seen in Figure 7, the majority of graduates with doctorate and undergraduate degrees in the Cloud sector work in the field of Cloud computing and network engineering. In the next educational level groups, the lowest educational level was at the undergraduate level in the field of machine learning.

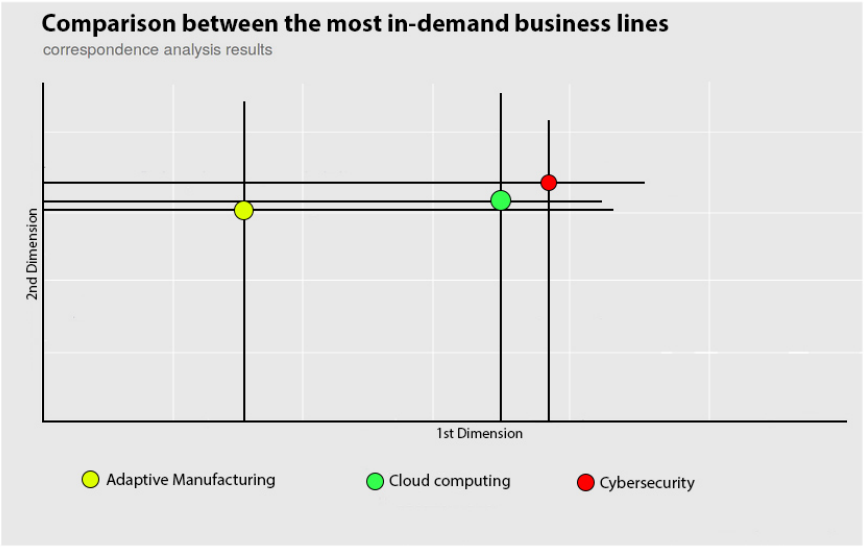

Figure 8: Comparison of intersections between the three most demanding sectors
Source: own.

As shown in Figure 8, based on the intersections of the three sectors analysed, the most in-demand business line with the highest average educational level was identified in the field of cybersecurity. The industry with the least demand and the lowest average educational level was adaptive manufacturing.

4 Conclusions

In conclusion, the results of the analysis carried out in this study indicate that cybersecurity, additive manufacturing, Cloud-based systems, system integration, big data, the internet of things, virtual reality and autonomous systems are currently the trendiest industries preferred by graduates. Therefore, the skills needed in these positions should be defined and universities should revise their curriculums to equip their students with those skills. Since the COVID-19 pandemic, digital

transformation has accelerated in universities. However, University 4.0 does not only mean digital transformation, rather it is a concept that provides the necessary skills to students who are future employees in order to prepare them and the whole of society for Society 5.0, which is a new level of social development.

The limitations of this study are that the results of the analysis were obtained using only one of the machine learning algorithms used for the data set. The business lines of Industry 4.0 should be described separately, and the fact that data visualisation is not added graphically is one of the other limitations of this study. For future studies, by using different types of machine learning algorithms, the 'accuracy' scores can be compared to the analysis results on the same data set, thus the algorithm that gives the best result can be selected.

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