Understanding the Effects of Digital Transformation on Employment: A Semi-Systematic Review with a Sectoral Focus

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The future of work is discussed in academic literature and reports starting with 2014. Various studies have identified artificial intelligence, robots, big data, globalization, population pressures, and changed demographic profiles as the main drivers for change in the future of jobs. Also, international organizations did comprehensive analyses of the professions' rapid technology changes. In contrast to the number of consultancy documents, there are not numerous scientific articles on the topic of the future of work. Research performed on the reputable scientific databases return a much larger number of scientific articles on the broader topic of Industry 4.0 (I4.0), including several systematic literature reviews, with 31 scientific articles on the topic. Still, the specific goal of this review is to explore the impact of job automation on the IT professions in Romania's IT industry. Consequently, the present paper is designed as a semi-systematic literature review, building on over one hundred papers written on the topic of Industry 4.0, studies that were done on the particular subject of the future of work, research papers done on the IT industry, and available studies on the IT industry in Romania. The findings are analyzed via various criteria which are meant to provide an accurate image of the state-of-the-art on the topic of interest.

Keywords: Future Of Work, Industry 4.0, Digital Transformation, Information Technology (IT), Jobs, Semi-Systematic Literature Review.

INTRODUCTION

The technology of the 4th industrial revolution has significantly accelerated the pace of change (European Political Strategy Centre, 2019). In this context, we are asking what the impact of the rapid technology changes in the Romania market will be and, in particular, on the Romania IT industry, the very industry responsible for building the tools that are driving such changes. According to the European Union Artificial Intelligence report (Seroz, 2019), the estimation of jobs at risk of automation varies between 14% and 47%, 90% of jobs require IT skills, and 1.75 million positions are expected to be created in information technology by 2030. The change drivers are globalization and digitalization (Seroz, 2019). The

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Future of JobsReport of the World Economic Forum estimates that high-speed mobile Internet, artificial intelligence, robotization, and the distribution of value chains will make 21% of the roles become redundant only by 2020, 54% of the workforce will need to reskill, demanding increased investment in human capital, lifelong learning system and agile learning (Schwab, 2018).

This paper brings forward a semi-systematic literature review done on the topic of the future of work. It is a report on state of the art in academic and consultants' research on the impact of digitalization on jobs at an international and local level, in Romania's IT industry. The inspiration for the research came from Ray Kurzweil's book "The Singularity is Near," describing the exponential growth of innovation and the prediction of technical singularity (Kurzweil, 2008). An influential reading on the topic of technology's impact on the subject of automatization and its impact on the jobs was the World Economic Forum's Future of Jobs Report (Schwab, 2018) as well. In performing the literature review, 131 papers, reports, and books on this topic have been selected and studied in detail.

The research topic attracts significant interest from international and local organizations, scientific articles, and books. Several examples of key organizations and universities most comprehensive pieces of research covering this subject may be mentioned: a. key international reports of international organizations such as OECD - The Risk of Automation for Jobs in OECD Countries (Arntz et al., 2016), World Economic Forum and Boston Consulting Group - Eight Futures of Work (Zahidi et al., 2019), World Bank - Changing Nature Work (Wright, 2018), or International Monetary Fund (IMF, 2018); b. Romanian industry and governmental organization, representative for the local IT industry, like ANIS, Association of Software Industry Employer in Romania, yearly industry study (ANIS, 2019), or Romania National Bank the Study of IT evolution in Romania (Grigoraș et al., 2016); c. major universities: Sandford - The Impact of Artificial Intelligence on the Labor Market (Frank et al., 2019), MIT - What the Digital Future Holds (Agrawal et al., 2018) or SNSPA - Impact of Digitalization on Education in the Knowledge Economy (Bejinaru, 2013).

Consequently, the purpose of the research is to study state of art on the topic of the future of work, implications for all professions, and IT workers in the Romania industry, in particular. It looks as well to identify and extract common themes. That will later enable us to define and execute the Romanian IT market research. From the rapidly increasing body of literature on the topic of the future of work, it should be underscored how much research was done on IT professions and the Romanian industry in particular.

CONCEPTUAL AND CONTEXTUAL BACKGROUND

The future of work is a consequence of a subsequent set of industrial revolutions from Industry 4.0 with steam power's introduction to implementing automated and intelligent production representing the industry 4.0 (Piccarozzi et al., 2018). The succession of the four industrial revolutions shows the increasing rate ofchange brought by technology. Starting with the invention of the printing press to the introduction of artificial intelligence, the time between the introduction of paradigm-shifting technologies decreases exponentially (Kurzweil, 2006). Digital transformation is the hallmark of Industry 4.0, following its own exponential curve of processing power (Moore, 2009). According to Manyika et al. (2013), the most important technologies impacting the way we work are mobile Internet, Internet of Things (IoT), machine learning (ML), robot process automation (RPA), and cloud computing. There are different views on the impact of these new technologies on the work. For example, Frey and Osborne (2017) estimate that 47% of United States jobs will be displaced or transformed by technology. Technology is driving the digital transformation, automating repetitive professions. Machine learning has the potential not only to automate repetitive work but to perform highly skilled creative tasks. Besides technology, other factors like globalization, demographics, environment, and urbanizations also influence the occupations (Thornton & Riviera, 2019).

Information technology employees also see their activities changed by their professions (Schwab, 2018; Frey & Osborne, 2017). It is expected to see an increase in engineering professions' demand, starting with software developers and new technologies like machine learning. However, even software engineers' work is increasingly becoming affected by automation (Frey & Osborne, 2017). In particular, education and lifelong learning (Nania et al., 2019) represent the employees' solution to keep up with the changes in demand and build new skills. The skills required in the digital economy are the digital skills corresponding to the emerging technologies but also the soft skills creative problem solving, critical thinking, reason, and logic to assess and analyze problems, entrepreneurial mindset, and adaptation to change in complex environments (Nania et al., 2019). Other types of responses to the rapidly changing industry demand are an increase in work flexibility catachresis by the gig economy (Hines, 2019) and a general an increased adoption of agile development methodologies (McKenna, 1998) and agile mindset (Nania et al., 2019).

For Romania, Sanandaji (2020) shows that the share of “brain jobs” not susceptible to automation is below 4%, putting many jobs at risk. From a digitalization perspective, the European Union Digital Economy and Society Index is placing Romania as the one before the last country in the EU in integrating into the digital economy (Wilkinson & Barry, 2020). Romania is the last country in the EU in the rank of people with digital skills (Eurostat, 2019).

The IT sector is helped by the software developers' tax-exemption from the income tax, legislation that succeeded in limiting the brain drain (Manelici & Pantea, 2019). The industry has a steady growth with a forecasted market volume growth of 25% for the following three years, export volumes having an ascending trend representing 15% of the total county export volumes, forecasted growth to 22% (ANIS, 2019).

The SARS-CoV-2 crisis has changed the way we work, and its future impact is yet to be determined. From the perspective of the future of work, COVID-19 is accelerating the digitalization of work; it provides more opportunities to work remotely, accelerate the digitalization of the education process (Zahidi et al., 2020).

The pandemic forced the organizations to accelerate digitalization trends identified in previous research.

RESEARCH DESIGN

The main research objective is to determine the impact of digital transformation on the future of jobs, focusing on the Romania IT industry. The primary goal is to explore the impact of digital transformation on work and, therefore, on the management strategies that must integrate new skills, knowledge, and jobs. Particular attention will be addressed to the Information Technology (IT) sector, which is both a catalyzer of the digital transformation and a partial result of its influence. In order to gather relevant data and to integrate the findings in possible management recommendations, the following research objectives (abbreviated hereafter „O") will be followed: O1. Investigation of the key elements of the digital transformation and their impact on management (strategies, tactics) and organizational processes; O2. Investigation of the key elements of work models in the context of digital transformation: current status, benefits, and limitations, challenges, and predictions; O3. Investigate the impact of the digital transformation on the work and management models specific to the Romanian IT industry.

The literature review is an essential part of the research in order to identify possible gaps that provide the necessary context for the planned research on Romania's IT industry. Digital transformation with high-speed Internet, artificial intelligence, big data, or cloud technology are the main driving factor in changing the jobs and nature of our work. OECD estimates that around 35% of the jobs are susceptible to automation (Arntz et al., 2016). Finally, we want to understand the impact of automation on Romanian software engineers, the very engineers working to build this technology (Moldoveanu & Pînzaru, 2020).

Considering a research field that is continuously developing at both practical and academic levels, the author had to choose the most appropriate literature review methodology. Three models were considered for the literature review:

systematic, semi- systematic, and integrative (Snyder, 2019). "Traditional literature reviews often lack thoroughness and rigor and are conducted ad hoc, rather than following a specific methodology" (Snyder, 2019, p1) Systematic literature reviews, with strict requirements, are not always the best strategies. A systematic review may hinder when used in studying interdisciplinary broader topics. Instead, semi-systematic reviews can be a better strategy for identifying knowledge gaps in the literature with research questions that require more creative data collection. The impact of digital transformation on the future of jobs is a relatively new topic with the first articles from 2014. A more significant number of papers started to be published only in 2018 when it also attracted more attention from the university researchers. For this reason, the snowball method was used on top of systematic research. This approach enables us to explore further the current academic research gap (Easterby-Smith et al., 2015). The analysis of cross citations of available literature have found seminal research on this topic. That proved particularly useful inbridging the gap between consultancy work and academic literature. 62% of the scientific articles are quoting the research of the six most quoted consultancy authors.

The influence of digitalization on the future of work is an integrative topic covering technology, management, social, and education concepts. Most of the documents are written in the last two years, with a relatively small number of scientific articles. The relevant literature specific to Romania's IT market is even more limited, with only six research papers requiring even more creative research methods, incusing government, and industry association private indexes. In contrast, the topic of digitalization is much better covered. Our research on this topic has identified six systematic literature reviews, two of which from reputable journals.

The research methodology is based on the Industry 4.0 management literature review by Madsen (2019). Madsen points out that the number of scientific articles in Scopus is growing significantly from 2017-2018, gaining the researchers' attention recently. The same review states that consulting firms have been involved in the I4.0 market (Reischauer, 2018), both the strategy-focused consulting firms (e.g., McKinsey & Company, Boston Consulting Group, Bain & Company) as well as the large generalist consulting firms (e.g., Accenture, PWC, KPMG, Deloitte).

Structured research has followed the process of database selection, keyword selection, and exclusion or search criteria to review the selected articles. The final phase of writing the literature review findings was focused on the presentation of the most relevant topics. Web of Science and Scopus were selected as the source for the structured part of the review. The decision is based on the existing Web of Science structured literature reviews (Liao et al., 2017; Piccarozzi et al., 2018; Roblek et al., 2016) on the topic of Industry 4.0. Industry 4.0 is a topic that covers

technology change, digitalization robotization, and to some extent, the impact on jobs and skills.

Considering that it is a relatively new domain of study, the search on the indexed journals returned limited results for scientific articles on the topic of the future of work. According to (Madsen, 2019), the reports of some consulting firms such as McKinsey & Company, Boston Consulting Group, Bain & Company, Accenture, PWC, KPMG, Deloitte are seen as the most important suppliers of new management concepts. Google Scholar was used in the semi-structured part of the research in order to find indexed research outside Scopus and Web of Science, where such research does not exist on Scopus or Web of Science.

International organizations have the mission to "improving the state of the world by engaging business, political, academic and other leaders of society to shape global, regional and industry agendas" (OECD Mission, 2020) for the Economic Co-operation and Development or "build better policies for better lives, to shape policies that foster prosperity, equality, opportunity and wellbeing for all" (World Economic Mission, 2020) in the case of WEF. After consulting the academic sources and consultancy reports, continuing to apply the current method, the author moved to catalogue reports published by international organizations with a role of improving the wellbeing of people and the state of the world. Those and other similar organizations have conducted extensive research on the technology impact on the professions and are cited in all scientific articles. For this reason, we considered as a source the website of OECD,World Economic Forum, World Bank, European Union international, and Romanian professional IT organizations. as well as the National Bank of Romania.

The literature research was focused on the three idioms included in our research title, "Managing the impact of digital transformation on the future of jobs. A sectoral approach": future of work, digital transformation and Romania IT industry. The search results from Web of Science and Scopus were filtered for English peer-reviewed articles from international journals. A filter was applied for articles in management, economics, and technology domains.

The final review was done by reading all the titles returned in the search, abstracts, and the full article, when the abstract indicated the papers to be relevant for the research topic. All articles relevant to the selected topics are included in the final set of papers to support the research effort. There have been reviewed a total number of 137 papers, business reports, and books covering the three research topics mentioned above. The selected papers were indexed in an excel file recoding the: index number, article or book name, the primary author, source database, type of work, Organization, consultants or scientific articles, the country where the paper was written, publication year, and the keywords relevant for our research. Mendeley software was used to index all the papers, support annotating the documents, and use the Microsoft word plugin to insert citations in APA format and bibliography.

The literature review was conducted between November 2019 and June 2020. Web of Science search alerts has been enabled for the main keywords, using the same query used in the research's central part. This approach enabled the notification for new relevant papers published after June 2020. Those new papers were reviewed, and those found to be relevant were included in the research.

THE ANALYSIS OF RESULTS BASED ON MULTIPLE CRITERIA

Research topics

Forty-nine scientific articles, representing 38% of the research material, cover the main topic of the future of work search results. The eighteen scientific articles on the concept of industry 4.0 are linked to the future of work but covering a broader range of perspectives from economy and public policies. Twenty-seven documents on digital transformation and technology changes are included. Management evolution and response to market forces do represent a significant percentage of the research material with ten articles.

The data specific to Romania's digitalization is much smaller, with only nine documents. That is primarily because the same factors are influencing Romania as an EU member as the rest of the western world. It is also a smaller industry than the United States, the United Kingdom, and Germany. While research tends to focus on big world economies, understanding a local market's particularities is attractive for the local industry. This interest is proven by the Association of IT Software and Services Industry Employers Association's research efforts, shown in their yearly study (ANIS, 2019).

A small number of articles on specific niche topics are included from the main articles' quotations (Figure 1).

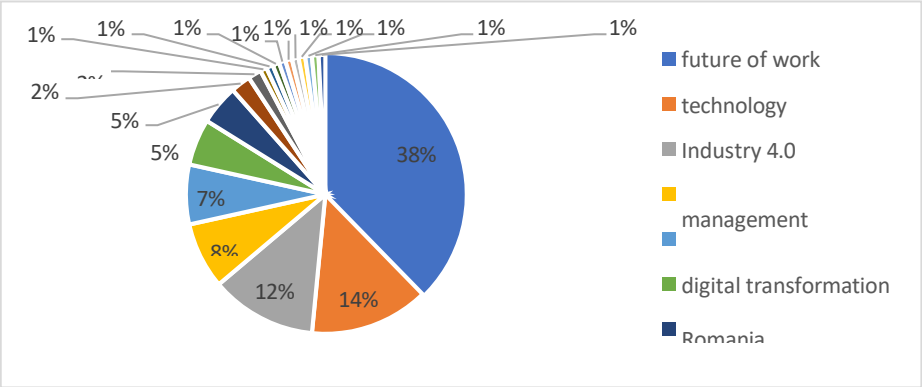

Figure 1. Research topics

The chart does not represent the actual balance of literature on these topics in general. There is generally a more significant number of scientific articles on the topic of and digitalization and industry 4.0 compared to the number of titles on the

future of work. More academic and private research is performed on digitalization than the narrower future of work subject. The fact is highlighted in the previous chapter, describing the research methodology. We have included significantly more titles on our research theme simply because we need to go into much greater detail.

Data sources

58% of the articles are from academic sources mostly, 40 out of 73 titles returned by a structured database search in Web of Science and Scopus. Google Scholar, as an academic search engine, returns only two articles. Thirteen scientific articles dedicated to the topic of the future of work are downloaded from an MIT Sloan research organization. One or two scientific articles are downloaded from Oxford, Harvard, or SNSPA websites. 33% of the material is originated from consulting firms, international governmental, and private organizations with research groups (Figure 2).

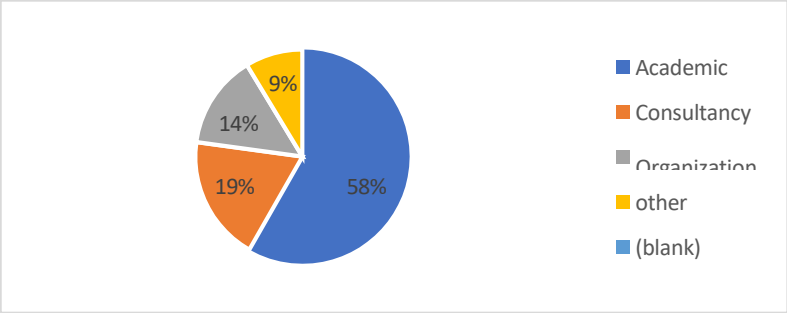

Figure 2. Literature reviews, types of data sources

Type of papers

Academic research papers represent 61% of the documents, 25% are business, and public organization reports 10% literature review, 6% books, and a few other sources like web sites and non-academic journals (Figure 3).

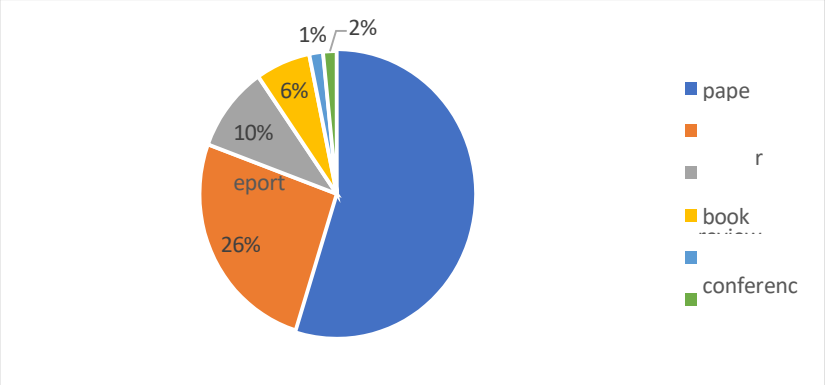

Figure 3. Type of paper

Publication dates

The oldest article we found on the topic of digital transformation and the future of work is "The Future of Work: How the New Order of Business Will Shape Your Organization, Your Management Style and Your Life" (Malone, 2004), published by MIT. All other reports included in the review are dated after 2011, with a rapid increase in volume starting with 2015. The trend shows that the future of work research started to pick up two years behind industry 4.0 (Figure 4).

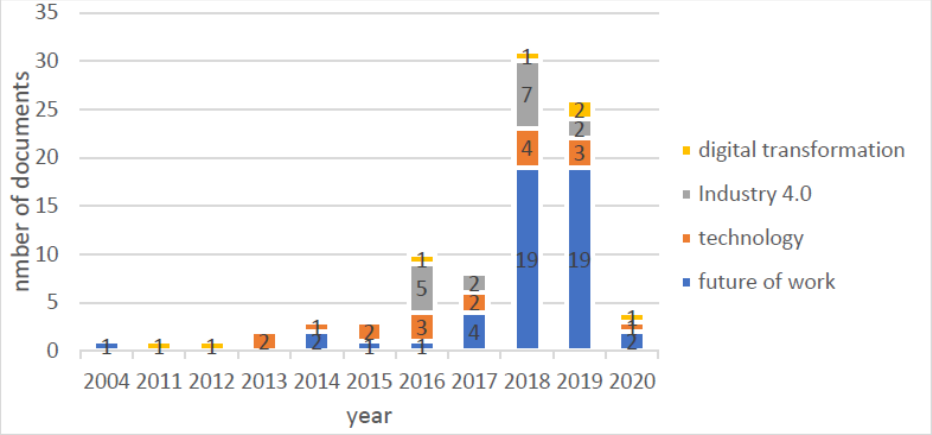

Figure 4. Publication dates by topic

The growing interest in the topic of Industry 4.0 and Future of Work is showed as well by the increasing number of Google searched on the above terms (Figure 5).

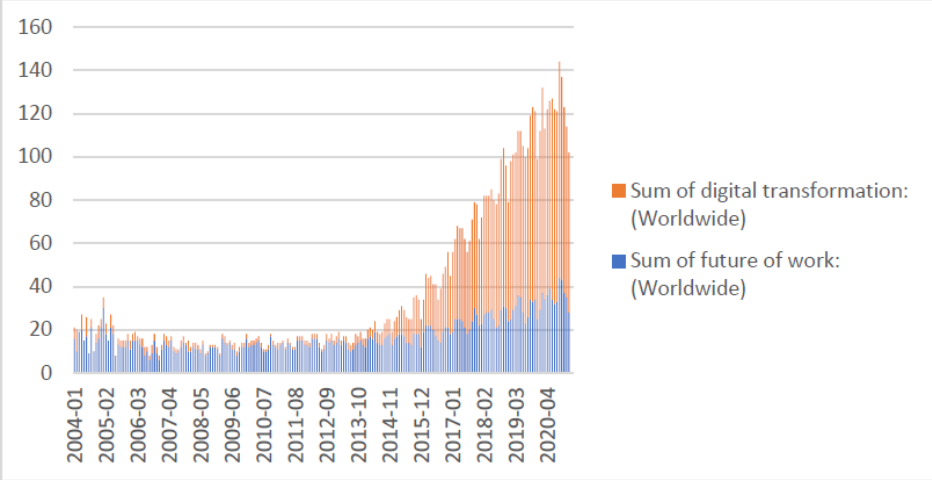

Figure 5. Google trends 2014 to 2020 for the main research keywords
Source: https://trends.google.com (retrieved September 9th, 2020)

Papers by country

61% of the articles are originated in the US, 8% in the UK. Most of the research is done in the Anglo-Saxon countries. The research is based in a

subnational way on data from international governmental bodies as well as public companies' research organizations, most of them based in the US. 6% of the papers are from German articles representing the literature linked to the concept of Industry 4.0, established by the German government. 6% of the literature is sourced from Romanian universities and institutions, considering the need to research Romania's IT sector data. 3% of the research is based on data from EU institutions. The articles database includes a smaller number of papers from Austria, Switzerland, Canada, Poland, Switzerland, India, Spain, Israel, Brazil, Turkey, and Greece.

Most of the documents are in the English language, except for four German and two Spanish papers. The absence of more extensive literature from APAC countries is a question that remains to be investigated in future research. The technology adoption rate in the Asian region is known to be faster than other parts of the world, and the Korean of Japanese research can provide a model for European countries assuming it is published in an international language.

Romania is part of the EU and partners with the Unities States. The economy of the country and more critical culture is dependent on a higher degree to the Western markets. At the same time, we are part of an interconnected global world (Castells, 1999). With the sizable number of IT employees and many IT corporations, India doescompete with the Romania IT industry. Including the perspective on this subject of the Asian economies, India, in particular, can be helpful.

Number of authors

Most papers have one, two, or three authors. The articles with more than three authors are typically from non-indexed journals. More than nine authors are from the reports developed by large organizations with research teams rather than the work of a small research team (Figure 6).

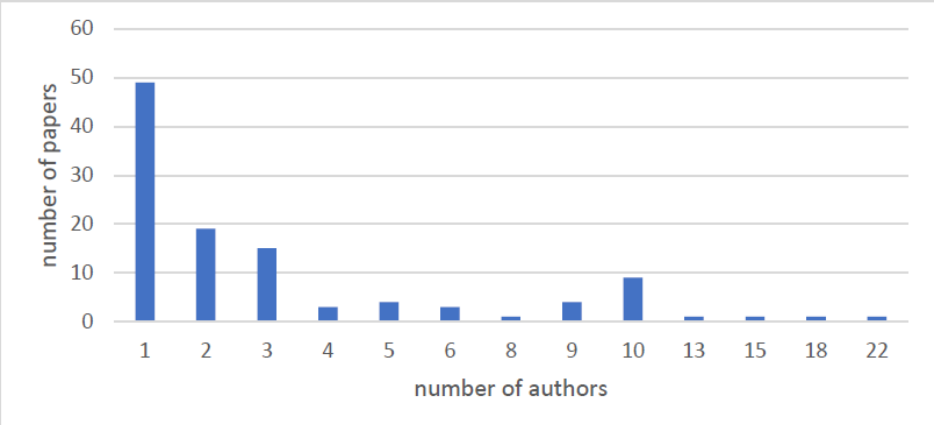

Figure 6. Number of papers by the number of authors

The above analysis of the results based on different criteria was meant to provide an articulate view on the way the focal topics of interest were approached by the extant studies as a necessary step for performing further conceptual and empirical investigations.

CONCLUSIONS OF THE SEMI-SYSTEMATIC LITERATURE REVIEW AND FURTHER RESEARCH STEPS

We live in a world of accelerated technology change (Benedikt et al., 2016). New technologies are changing the industry (Piccarozzi et al., 2018) but also the way we work and the jobs we do (IMF, 2018). Starting from Industry 1.0, driven by mechanization and steam power, up to hi-tech Industry 4.0 in the current time, our lives and work have changed dramatically. Many of the jobs we do today, like software engineers, big data specialists, or, why not, virtual-world designers, were not even envisioned 40 years ago. WEF estimates that 65% of children starting primary school today will do jobs that are not yet invented. Some professions have entirely disappeared. Nobody works anymore as a switchboard operator or lamplighter (Jobs That Have Disappeared in the 21st Century, 2020). We ask ourselves what jobs we do today and will disappear in the next ten to twenty yearsand, more interestingly, what new jobs will be created. Manyika et al. (2017) from McKinsey estimates that automation will also create 250 million jobs by 2030. Because IT employees' work creates the IT revolution, the question is how their professions are likely to be impacted.

This semi-systematic review covers an extensive range of academic research publications to reports developed by world organizations like WEF, OECD, IMF to large consultancy firms as McKinsey and Deloitte, all having a growing interest in the subject. Research into the topic of the future of work started to pick up only in 2016. The study of the specific topic of the future of work gained momentum only in 2018. Stanford and MIT have shown interest in this field, but the research is only at the beginning.

There is a consensus that manual predictive work will be replaced by automation, even in two to four years. The debate is on the extent the artificial intelligence will be able to replace creative work, potentially taking over any type of job, or it will create new professions and augment current existing occupations. From the available research, one thing is clear, that for employees developing social and creative skills, it will give them the best chances to at least delay the possibility of their job being taken by a robot. For this to happen, educational reform policies and lifelong learning approaches to build new skills are the best solutions.

IT professions also see an abundance of new types of jobs from big data engineers, cold computing blockchain that are already being established. New jobs that are barely known are about to become fashionable, as is the case with

quantum computing programmers. In particular, Romania had the benefit of low cost, favorable taxation, and, most notably, a robust educational system encouraging many professionals to join the hi-tech professions. At the same time, the low level of digitalization and the fact that brain jobs (Prainsack & Buyx, 2018) are mostly limited to the Bucharest area (Frey et al., 2008) is a threat to the country's ability to adapt to the rapid shift in technology with the corresponding implications on the jobs market.

Oztemel and Gursev's (2018) industry 4.0 literature review shows that the concept is just launched. Another review on industry 4.0 (Kamble et al., 2018) has identified between one and six papers: 14 from 2012 to 2014, 14 in 2015, 23 in 2016, and 41 in 2017. The review shows that research is new and significantly increasing every year. The current literature review confirms that high-tech research on the future of work topic is even more recent. The author found out that between two and four papers between 2014 and 2017 with 19 papers in 2018 and 2019. The trend in the number of papers written on this topic follows a similar trend with the industry it is studying. For this reason, the research must continue. A review of industry 4.0 literature is not a one-time exercise but an activity that has to be repeated every year.

Most of the available research is based on government databases (Arntz et al., 2016), expert opinions (Hines, 2019), and CEO-level functions (Hagel et al., 2017). No research from the ones included in this review addresses IT manager's and IT professionals' specific perceptions in general. While there are studies in the development of the industry (Grigoraș et al., 2016), there is no known research onthe future of Romania's IT professions. From limited research done with Romanian IT professionals, we only see that digitalization is the most important factor that is likely to impact their future. With time passing, the future comes. Future research needs to confirm the current research's suppositions and review future forecasts based on new information.

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