



National University of Political Studies and Public Administration

**MANAGING THE IMPACT OF DIGITAL TRANSFORMATION ON THE
FUTURE OF WORK. A SECTORAL APPROACH**

(Thesis Summary)

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Abstract

With technology's exponential rate of change, the nature of our jobs is also changing. While starting the industry 5.0 revolution, we see more jobs being augmented and even replaced by automation. Academics and international organizations are paying increased attention to the subject of the future of work, the impact of digital transformation on the future of work, and how both employees and organizations can prepare for this future. Industry 5.0 is characterized by technologies like artificial intelligence, machine learning, and robotic process automation. While automation in the past has impacted manual and repetitive jobs, the new technologies are starting to change creative jobs and even the jobs in the IT industry responsible for driving digital transformation. Information technology is one of the most successful industries in Romania. 130.000 professionals are generating 6% of the GDP. The industry's growth is supported by the tax exemption for software engineers and sustained foreign investment. The main research question is how multifaced factors impact the digital transformation role in work automation and how Romania's digitalization and education policies impact digital transformation, jobs automation, and sustainable management strategies.

The thesis proposes a model for organizations to develop sustainable management strategies adapted to the transformation of IT jobs, reskilling the workforce for the future of work skills and adopting the increasingly agile work models.

With two qualitative studies and quantitative research with 134 IT professionals respondents, the thesis concludes that the digitalization trends of work automation are seen in Romania but lag behind other European countries. That is not the case for the IT industry, which by its nature, is well connected to global trends. The same applies to IT professionals who constantly adapt to frequent technological changes and the fact that the employees constantly need to learn and keep up with the innovation. A significant result of the study is that the local education and digitalization policies are not positively impacting digital transformation, work automation, or the transformation of IT jobs.

A common theme in literature and local research is that building digital and soft skills is the most important strategy for both organizations and employees to prepare for the future of work. That is true for any industry and, in particular, for IT professionals. However, with

no effective governmental policies, it is up to the managers to develop the necessary strategies.

Keywords: future of work, industry 4.0, digital transformation, IT sector, Romania, managerial strategies

1 Introduction

"We are shaping the world faster than we can change ourselves, and we are applying to the present the habits of the past." (Winston Churchill, as cited in Rowe & Laura, 2011, p 282).

The technology of the fourth 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 Future of Jobs Report 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 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).

The future of work is a consequence of a subsequent set of industrial revolutions from Industry 4.0 with steam power's introduction to the implementation of automated and intelligent production representing industry 4.0 (Piccarozzi et al., 2018). The succession of the four industrial revolutions shows the increasing rate of change brought by technology. From the invention of the printing press to the introduction of artificial intelligence, the time between paradigm-shifting technologies decreases exponentially (Kurzweil, 2006). Digital transformation is the hallmark of Industry 4.0, following its exponential curve of processing power (Moore, 2009). According to Manyika et al. (2013), the most important technologies impacting the way we work are the mobile Internet, the 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 work. For example, Frey and Osborne (2017) estimated that technology would displace or transform 47% of

United States jobs. Technology is driving digital transformation by 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 urbanization influence 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 affected by automation (Frey & Osborne, 2013).

In particular, education and lifelong learning (Nania, Bonella, Restuccia, & Taska, 2019a) 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 of creative problem solving, critical thinking, reason, and logic to assess and analyze problems, entrepreneurial mindset, and adaptation to change in complex environments (Nania, Bonella, Restuccia, & Taska, 2019a). Other types of responses to the rapidly changing industry demand are an increase in work flexibility catachresis by the gig economy (Hines, 2019a) and a generally increased adoption of Agile development methodologies (McKenna, 1998) and agile mindset (Nania, Bonella, Restuccia, & Taska, 2019a).

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 places Romania as one of the last countries in the EU to integrate into the digital economy (Wilkinson & Barry, 2020). Romania is the last country in the EU in the rank of people with digital skills (Eurostat, 2019b).

In Romania, the IT sector is helped by the software developers' tax exemption from the income tax legislation that successfully limited the brain drain (Manelici & Pantea, 2019a). As a result, 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, and forecasted growth of 22% (ANIS, 2019). Despite the importance of this topic, few studies approach the digital transformation of Romania's IT jobs. The structured search of technical articles was performed on Google Scholar, Web of Science, and Scopus to look for available information on the Romania IT market to supplement that gap. The search did not retrieve specific results. Still, the structured search on the Web of Science and Scopus has identified a single scientific article (Frey et al., 2008) presenting the development of Romania's IT industry from the 2nd world war until 1998. Google Scholar search returned a result (Manelici & Pantea, 2019a) describing the impact of Romania's tax exemption on the local IT industry (Petca, 2019).

The SARS-CoV-2 crisis has changed how we work, and its future impact is yet to be determined. COVID-19 has accelerated the digitalization of work (Kudyba, 2020); it has provided more opportunities to work remotely and accelerates the digitalization of the education process (Zahidi et al., 2020). In addition, the pandemic forced organizations to accelerate digitalization trends identified in previous research.

We see that the impact of technology in changing the work models is attracting increased interest from academia and, in particular, from integration organizations. Reports like the WEF Future of Jobs Report (Schwab et al., 2020) look at the impact of digitalization on different industries, including the information technology sector. However, the IT profession itself, as the industry responsible for digital transformation, is not part of any specific research covered in the semi-structured literature review. Because IT experts are the ones generating the transformation, the perceived innovative nature of the work, and the huge workforce deficit (Loginro, 2022), the perception is that IT specialists are not at immediate risk of being replaced by automation compared to other professions. While most authors agree that IT, in particular, software development jobs, are here to stay (Campa, 2019a; Schwab, 2018), the existing body of research does little to look into how the jobs are being changed by automation. We know from the literature that soft skills and new technologies are critical for employees to prepare for the jobs of Industry 5.0. What specific skills are software developers supposed to learn? How are IT organizations preparing for the new IT profession and for implementing increasingly

automated processes? What government policies are in place to prepare the IT industry for the future?

As for governmental policies, the situation of the IT industry in Romania is well covered by several academics (Manelici & Pantea, 2019b) and industry associations (ANIS, 2022a). The question is to what extent the Romanian government does see the strategic implications of the future of work models. With little evidence of such strategies, Concordia employers association (2020) started a future of work research on the automotive and energy sector. As discussed before, the IT industry was not considered a priority for the study compared to other more vulnerable industries.

Considering the lack of current analysis on the future of work in the Romanian IT sector, we wanted to draw a doctoral research aimed at understanding how the major global themes of the future of work are perceived in Romania and, in particular, how IT organizations and professionals are prepared for future work models and future jobs in IT. The literature review realized in this thesis uncovers the following gaps:

- RG1. The perception of Romania's IT professionals on digital transformation and work automation;
- RG2. Impact of the Romania IT policies on digital transformation;
- RG3. Impact of the Romania IT policies on work automation;
- RG4. Impact of the Romania IT policies on the IT jobs transformation sustainable management strategies;
- RG5. The perception of Romania's IT professionals of work automation on the transformation of IT jobs;
- RG6. The impact of soft and technical skills on preparing the industry and IT specialists for the future of work models;
- RG7. The degree of readiness and preparation of the Romania IT industry for the shift in work models;

To address these gaps, the following research objectives were defined:

- O1. Investigate the key elements of digital transformation and their impact on sustainable management (strategies, approaches) and organizational processes;.

- O2. Investigate 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 digital transformation on the work and management models specific to the Romanian IT industry;
- O4. Formulate an exploratory theoretical model with practical managerial implications for the IT sector, defining the key dimensions and correlations between digital changes and work models. The model is aimed at helping IT managers in building strategies and manage organizational change in the context of changes in work due to digital transformation;
- O5. Formulate specific scenarios based on the exploratory theoretical model to support IT managers in elaborating strategies for digitalization, hiring, and workforce re-skilling.

Building on these aspects, the current study intends to address the antecedents of the IT jobs transformation (i.e., how digital change, government policies, and managerial strategies impact the transformation of IT jobs and how employees and organizations are responding with investment in skills development). In this sense, a questionnaire-based survey with 132 subjects was conducted in July-August 2022. To thorough tackle these issues, the remainder of the thesis brings forward the conceptual background, the methodology used, the research findings, and the main implications of the empirical analysis.

The thesis starts in Chapter 2 with a semi-structured literature review to address the mentioned-above gaps. The research begins with a literature review of industry 4.0 (Vishwas Dohale & Shashank Kuma, 2003) and the future of work (Mitchell et al., 2022), which helped provide a general overview of the current research themes, key authors, and papers in the field. The core of the research was based on a structured search on Web of Science and Scopus databases. With a significant focus on the future of work, reports by organizations like McKinsey & Company, Boston Consulting Group, Bain & Company, Accenture, PWC, KPMG, and Deloitte were also consulted. Public organizations, OECD in

particular, also cover the topic of the future of work and industry 5.0. In total, 156 research papers, reports, and books have been considered for the study.

Chapter 3 covers the results of the literature research. The research, starting with digital transformation, is seen as the main driver for replacing or changing the jobs' nature. Building on that, we looked into the topic of the future of work and all the factors responsible for the change of jobs. Specific attention was paid to jobs that are disappearing, jobs that are created, and scenarios about future jobs. Considering the focus of the thesis, the literature search includes papers related to the IT profession and the impact automation has on the industry. Special attention was given to strategies for preparing for the shift in work models, focusing on education, future skills, and flexible work models. Romania's IT sector is covered as well. The COVID-19 crisis during the research included the impact of the pandemic situation on the work models.

Based on the theoretical framework developed, Chapter 4 describes the qualitative research methodology applied in two semi-structured interviews. The first interviews were done with 10 IT managers on the topic of the adoption of sustainable management strategies by IT enterprises. The second set of interviews was done with 18 IT professionals on the impact of technology on the future of work. Quantitative research puts everything together by defining the research hypothesis, research design, and research questions and proposing a conceptual model grounded on the literature review and qualitative research. Finally, a model was proposed and validated by quantitative research with the help of a questionnaire-based survey delivered to 132 IT professionals. The results were analyzed with structural equations using SmartPLS¹.

Chapter 5 of the thesis presents the results and the interpretations. The research objective of the first set of interviews is to support the thesis with context on how IT managers see the development of Romania's IT industry from an economic, social, and technological perspective. In addition, the study looks into the key industry factors such as tax deduction, foreign investment, available skills and workforce deficit, and the status of

¹ <https://www.smartpls.com/>

digitalization. In the second qualitative research, interviewees were asked about their perception of how the technology change impacts their work and the skills relevant for them in the future. The qualitative research results, coupled with the theoretical framework, formed the basis for defining the final research hypothesis, the research model, and the quantitative questionnaire. The survey was formed out of 10 constructs, based on which 22 hypotheses were formulated. Out of that, 17 hypotheses have been validated, and 5 rejected.

Chapter 6 covers the research conclusions. It discusses the impact of the research as well as its limitations.

2 Conclusions

2.1 Answering the research questions

This research aimed to fill the research gaps concerning the impact of digital transformation and local Romanian government policies on work automation, job transformation, sustainable managerial strategies, skills development, and future work models. As a result, several research questions have been established. Furthermore, an extensive literature review (Moldoveanu, 2022b) of the research topics has helped identify the research gaps and helped form the research questions, variables, indicators, and models. The key model variables are global and local level factors, digital transformation, local IT policies, work automation, sustainable managerial strategies, building soft and technical skills, and future work models. As a result, all the research objectives were met, and the research questions were answered.

Qualitative research on sustainable managerial strategies has been done with senior leaders in Romania's IT industry (Pînzaru et al., 2021) and discussion in section 5 of the thesis. In addition, questionnaire-based research based on 132 IT professional respondents has been conducted (Moldoveanu, 2022a).

2.2 Theoretical contributions

The research is of particular interest to IT managers in Romania. It shows in first place that the global trends of digitalization and workplace automation are also present in Romania but not at the same level as we see in the literature. Adoption of digital technologies lags in Romania compared to western Europe, particularly in public administration. In this context, employees and managers do not have the same sense of awareness, concern, and preparation regarding the impact digitalization had on replacing jobs or changing the nature of jobs and the required skills. This is not the case with the awareness of the impact of digitalization on IT jobs. The IT industry in Romania is well connected to the global industry and IT employees to global organizations. Technologies

and automation are transforming the industry it has built to limit manual repeated labor and increase efficiency.

While global-level factors impact the industry, and digital transformation, in particular, the local-level factors are not impacting either the digital transformation trends, the impact of work automation, or the transformation of the IT profession. The fact that local policies are not impacting digital transformation is seen in Romania's last place on the DESI index. A larger issue is the lack of government policies for preparing the organizations and workforce for the industry 5.0 revolution.

The research adds to the literature a sectorial model of the transformation of IT jobs in Romania in the context of an increased rate of digitization and automation and considering the local conditions and digitalization and education policies. It also models the type of management strategies and changes in the work models generated by the previously mentioned transformations.

2.3 Managerial implications

We live in a world of accelerated technological change (Benedikt et al., 2016). New technologies are reshaping the industry, the way we work (Piccarozzi et al., 2018), 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 what jobs we do today will disappear in the next ten to twenty years and, more interestingly, what new jobs will be created (Manyika et al., 2017). 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.

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

IT professions also see an abundance of new types of jobs, from big data engineers to cloud computing blockchain that is already being established. In addition, new jobs that are barely known are about to become fashionable, as with quantum computing programmers. In particular, Romania benefited from low cost, favorable taxation, and, most notably, a robust educational system encouraging many professionals to join the hi-tech professions. However, 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.

Digital transformation is changing our lives, but more importantly, business processes are becoming more automated and efficient, challenging managerial strategies and approaches simultaneously. The increased efficiency comes with a combination of new tools available for managers and employees to make their work more efficient, up to replacing them completely with physical robots or robotics process automation. The literature review and research have evidenced that the same type of AI technologies is changing not only the traditional manual, repetitive jobs but also the knowledge occupations, particularly IT jobs. Software engineering and other IT professions are increasingly augmented by technology, and some jobs are soon expected to be replaced. Furthermore, the development of novel work models claims for new business and managerial models which are able to keep pace with change and progress.

Companies are currently facing a significant workforce deficit. While engineers are building automation technologies for optimizing development processes, the high demand for technical experts creates potentially false expectations that this trend will continue. The

fact is that IT workers may work on technology that will largely automate their work and potentially leave them without a job.

The adoption of sustainable managerial strategies is very much impacted by digital transformation and local policies. Therefore, organizations must be both aware of the impact of digital transformation and adapt the business processes, organization models, and job profiles. In addition, managers must consider in their strategies the local policies, even if those policies are not seen as having a positive impact on preparing the companies and employees to prepare for the accelerated rate of change.

The changes we see from automation and the digital impact transformation on the transformation of the job are supported by building new digital and soft skills. Managers must invest in skill development in the context of a very competitive talent market and rapid changes impacting the IT profession. The focus is expected to be, in the first place, on the type of soft skills that are most difficult to be replaced by automation. Managers cannot expect public education only to fix the skills shortage. The number of IT graduates in Romania only covers less than half of the industry demand. The education system, inherited from the industrial edge, is seen as a process that generally ends with higher education. It does not cover the managers' and employees' need to adapt and build new skills constantly. For this reason, a sustainable organizational strategy must incorporate the concept of an academy. Organizations must take the initiative to train their workforce as the most important competitive advantage.

We have seen that the public policies in Romania are not impacting digital transformation and automation. In this context, managers must not wait for the government to implement policies supporting the industry with the shift created by digital transformation but develop their own managerial strategies.

In preparation for the future transformation of the jobs, managers do have to consider new work models. Those models are generally characterized by the agility and flexibility of platform workers, remote work, and flexible working arrangements.

Employees see their jobs as both a source of income and meaning. They do see the impact technology has on their jobs. In contrast to other industries, IT employees see job transformation more as an opportunity than a threat. In the technology space, more jobs are

expected to be created than expected to be automated. The changes are expected to happen quickly, with IT jobs being impacted in up to 10 years. While leaving the constant technological change, IT employees are used to the need for constant learning and long life education.

Often, managers are busy with daily tasks or achieving quarterly objectives. It is hard for managers to notice the larger trends in the industry while dealing with daily emergencies, budget problems, or upset customers. The Romanian government is also dealing with the pandemic, inflation, energy crises, and, obviously, the elections in two years. While we keep focusing on mundane issues, a revolution is happening. We see the impact of technology on making processes more efficient, simplifying customer interactions, and reducing costs. However, like the proverbial frog, slowly boiling in the water and not seeing the danger until it is too late, we see the risk of managers not preparing their organizations for a point when automation will replace human work or the new professions generating even a bigger skills scarcity. The technology change rate is increasing exponentially with the corresponding impact on the transformation of jobs. During the first three industrial revolutions, it was typical for employees to have one lifelong career. Looking back at IT professions 10-20 years ago, we see how much the industry has changed. Many IT professions today are linked to technologies not available a decade ago. The Romanian database of occupations COR (Ministerul Muncii și Solidarității Sociale, 2022) publishes every year a list of new professions (Ziarul Financiar, 2022), including IT. Yet, as the proverbial frog going to work every day, we tend not to perceive the change. With an exponential rate of change, the time between significant technological shifts is expected to shrink from decades to years and days. However, then it may be too late to implement effective strategies.

The research shows that Romanian IT employees and managers see how technology transforms IT jobs. Consequently, they see the need to conceive and implement sustainable strategies. However, managers are also aware that the policies implemented by the Romanian government are not having an impact, and it is not expected that this will change soon. Therefore, the question remains if the organizations are ready to allocate resources from short, to long-term strategic planning in a world where even the concept of work may

have a completely different meaning. People, including most managers, struggle to perceive exponential growth correctly. We tend to imagine linear development. Our mental model is that the future will be a linear regression of the past. Managers must consider the S-curve of their business models and the fact that, as seen with many technology companies in the past (Janke & Mislser-Behr, 2016), the models that made them successful may convert from a competitive advantage to a competitive disadvantage (Foster, 2016). Technology is often presented as an opportunity or a threat, but it is neither. It is up to management to find the right strategy. While facing rapid and significant changes, organizations must work with data, stay flexible, and keep learning.

Neils Bohr said, “Prediction is very difficult, especially if it's about the future” (Paul Thomson et al., 2017). This thesis has looked at digital transformation and different scenarios of how future IT work models will change. We have looked at how the IT industry is changed by automation because this is the industry responsible for the fourth and maybe the fifth industrial revolutions. We also looked at how the local policies of the Romanian government are supporting, or rather not supporting, this transformation. We have seen increased interest from organizations like World Economic Forum, consultancy companies, and some major universities, researchers, and not so much from the Romanian government or private organizations. Finally, we looked at how IT professionals in Romania see this future and prepare for it. Of course, we cannot pretend we know what that future will look like. Black swan events (Taleb, 2010) may lead to completely unexpected outcomes. Regardless of what happens, managers must remain agile and sharpen the skills of critical thinking, active learning, creativity, emotional intelligence, and leadership, skills that cannot be replaced by any form of automation we can now envisage today. In the words of Steve Jobs, managers must “Stay Hungry Stay Foolish.”

2.4 Limitations and future research

The report has several limitations. The first one comes from the limited sample size. Using the convenience sample, the research included mostly respondents with more than ten years of experience, considering the convenience sample approach and the fact that

senior engineers will bring more of their experience to the research. Employees with more years of experience have had the opportunity to experience more of the changes in the industry and their professions. This sampling method is not correlated with the industry's demographics, mostly represented by gen Z and millennials. While the research included young professionals and students with potentially different views, the sample size is not large enough to allow for statistically relevant results for different age groups. The same applies to different roles. Qualitative research has been done separately on employees and managers, but the qualitative data sample size does not allow for independent analysis of the two segments or show the potential alignment or miss alignment of perspectives between the two categories.

The Concordia confederation study on the future of work for other industries in Romania will provide a good opportunity to validate the results of the aspects of this study related to local policies and provide opportunities for future research.

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