# Industry 4.0 – Opportunities and Risks in the It&C Industry –

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***Abstract:*** *In this paper we describe the challenges posed by Industry 4.0 and analyse the opportunities and risks in the IT&C industry in Romania based on the information available in the specialized literature. Industry 4.0 is characterized by intelligent manufacturing and implementation of Cyber Physical Systems in production which refers to both the built-in sensors, the microcomputer networks and the direct connection of the machines to the value chain. Today, IoT is only a small part of the global phenomenon that can be called "The Internet of Everything". The economic growth in our country was one of the highest in the EU since 2010, with an average rate of 3.0 percent during 2010-18. The 2018 GDP per capita is around 65 percent of the EU28 average, up from 25 percent 20 years ago. The IT&C sector is one of the growth engines of the Romanian economy. In the last years, foreign companies have opened development and support centres in Romania. Of the total workforce in Romania, 2.2% work in IT&C, generating 5.9% of GDP. Digitization generates economic growth. The method used is a descriptive and quantitative one, combined with a SWOT analysis. The goal is to underline the huge possibilities that our IT&C sector has, and how it can impact our national economy given "Industry 4.0". With a well developed IT&C sector, the cost of digitalisation can be much lower for our country compared to those that do not have such capable specialists in this field. Due to the changes brought by "Industry 4.0", the Romanian entities need to look also at examples from other countries in the EU.*

***Keywords:*** Opportunities and risk, SWOT, IT industry, Industry 4.0
**JEL Classification: M12, M14, M54**

**Introduction**

"Digitalization means an entire ecosystem. Digitalization is the new paradigm of our time, deeply affecting the former value chains in industries at a breath-taking speed" (Grigore, A-M., Coman, A., 2018). The digitalization new business models, with a lead to a moral wear at the enterprise level and many changes in all economic processes. Digital technologies transform the main value chains.

The demands of the customers have increased in the last few years. The markets have evolved accordingly and require companies with high precision products and services. Information systems and modern technologies have made it possible to offer such products and services. Thus, real opportunities in the market have only those companies that have the capacity to adapt quickly to innovative technology. The latest industrial revolution, known as Industry 4.0, perceives operations as a holistic system. This is a challenge that must be met and met in order to achieve stability and permanence in the world market (Saucedo Martínez, J. A. et. al., 2017). Industry 4.0 is characterized by intelligent manufacturing and implementation of Cyber Physical Systems (CPS) in production which refers to both the built-in sensors and the microcomputer networks and the direct connection of the machines to the value chain. In addition, it aims at digital enhancement and product redesign (Shamim, 2016).

The new products, which the market demands, are customized according to the requirements and expectations of each important customer. In addition, the market no longer requires only simple products, but solutions. This requires a precise combination of products and services. All these challenges require companies to constantly innovate and improve. Business management plays a vital role in satisfying these new requirements, which must ensure the conditions for dynamic capacity development, effective learning and innovation.

In this paper we describe the challenges imposed by Industry 4.0 and analyze the opportunities and risks in the IT&C industry in Romania based on the information available in the specialized literature.

"Industry 4.0 comes right on the heels of The Internet of Things (IoT) phenomenon" (Herold, 2016). Today, IoT is only a small part of the global phenomenon that can be called "The Internet of Everything". This business environment comprises four components, namely the internet of things, the internet of data, the internet of services, and the internet of people. The phenomenon received this title because it includes things, data, services, machines and people. Industry 4.0 is based on the interconnection of the entire value chain through autonomous systems. These systems are created by intelligent networks of machines and data. Cloud computing is the key that paved the way for this revolution. The high speed at which the changes took place on many levels required a reassessment of the management and leadership style, of the business practices in the workplace and not least of the corporate structures. Managers and leaders pose the problem of changes in strategies, business dynamics and of course, their role. Given that Industry 4.0 involves the replacement of the work performed by people, the choice of strategies and management style are of particular importance.

**The IT&C Industry in EU28**

The value added (VA) of the IT&C sector in the EU in 2016 was 591 billion euros, with 6 million people employed. More than 31 billion euros were spent on R&D. The IT&C sector in the EU represents only 4.0% of the value added. From the total employment, the IT&C sector represents 2.6%. In the total Business Expenditure on Research and Development (BERD), the IT&C sector represents 15.6%. The number of employees working in the R&D departments of the IT&C sector represents 20.4% of the researchers in the EU (Mas, M. et. al., 2019).

The IT&C sector, according to Mas, covers the IT&C producing sector and the IT&C service sector. This means, that in the presented data we have: the manufacture of electronic components and boards, the manufacture of computers and peripheral equipment, the manufacture of communication equipment, the manufacture of consumer electronics, telecommunications and computer and related activities. The presented data does not cover the IT&C trade industry and the manufacture of magnetic and optical media.

The IT&C sector is growing faster than all the other economic sectors of the EU economy. From 1995 until 2016, the IT&C sector multiplied its value added by 3.6 times in real terms. In the same period, the total increase of the whole economy was by 1.4 times. The number of employees in this sector was also growing in the above-mentioned period, but only by 1.5 times. In the PREDICT estimation, we found that the IT&C sector is growing faster than the rest of the economy in 2017 and 2018 for both variables, value added and employment.

Two other important variables, the labour productivity and the expenditures in R&D, have a more dynamic behaviour than the one of the total economy. In addition, the number of researchers in the IT&C sector is growing much faster that the rest of the economy.

The most dynamic part of the IT&C sector is the service sector. The IT&C manufacturing labour productivity, on the other hand, was growing faster than in the IT&C service sector.

Ireland, Malta, Sweden, Finland, Hungary and Romania are in 2016 the six EU countries with the largest IT&C sector (in relative size, presented as value added / GDP), all above 5.0%.

Regarding the labour productivity Denmark, Ireland and Poland were the EU countries with the highest growth rate.

**The IT&C Industry in the world**

The highest IT&C sector share of 16% of the total economy has Taiwan, compared with EU countries and eleven other non-EU countries (like Australia, Brazil, Canada, China, India, Japan, Norway, Russia, South Korea, Switzerland and United States). In the second place, we find South Korea, this being valid for all major variables. In the third position we found Japan for value added and employment, the United States and Norway for the variable BERD.

The EU is in the eighth position, after India, China and Switzerland regarding the variable value added and the ninth position after China regarding the variable BERD.

The United States has the highest labour productivity (calculated per hour worked) in the IT&C manufacturing sector and in the

IT&C service sector. The United State are followed regarding labour productivity per hour worked by Norway, Taiwan and the EU. In China and India, we found the lowest labour productivity per hour worked compared to labour productivity in the total economy.

The most dynamic behaviour in the period 2006 – 2016, in almost all variables, have China and India. In terms of employment, India is followed by Australia, China and Brazil. The dynamics of growth is much lower in the United States and the EU than in the Asian countries. The EU did not entirely achieve the objectives established in the Digital Agenda and that puts it behind the United States regarding some important variables.

The main strength of Taiwan and South Korea is built on the manufacturing of electronic components.

One important information of the EUROSTAT report is that the centre of gravity of the IT&C sector is fast moving towards East, in the direction of Asia. China, for example, is moving fast in the direction of higher value added activities and this includes the IT&C producing sector. China is an important threat due to the size of its economy, not only for the EU, but also for the United States, which up to now is the leading country in the world (Mas, M. et. al., 2019).

**The IT&C Industry in Romania**

The economic growth in our country was one of the highest in the EU since 2010, with an average rate of 3.0 percent during 2010-18. The 2018 GDP per capita is around 65 percent of the EU28 average, up from 25 percent 20 years ago.

The GDP grew at 4.1 percent in 2018, mainly because of the fiscal stimulus implemented in the past years. The estimated GDP growth for 2019 is at 4.2 percent. This is supported by private consumption and private investment. Fiscal policy will likely continue to be pro-cyclical, because of the adopted pension laws and the wage increases. According to the World Bank overview, the challenge is to maintain the fiscal deficit to below 3 percent of GDP in 2019 and beyond (World Bank, 2019). The situation of the budget execution for the first 9 months in 2018 shows a deficit of 16.8 billion lei (1.77% of the GDP). The deficit exceeds in this period more than twice the deficit in the same period of 2017, with 6.8 billion lei (0.79% of the GDP). The deficit 2017 was 2.88%, close to the maximal level of 3% of the GDP stipulated by the Maastricht treaty. The investment plans for 2018 are fulfilled. The reduction of the planned expenditure, including from investments, have a negative impact upon the real and potential economic growth. A sustainable economic growth in the long term cannot happened without real investments and structural reforms (Barbu, 2019).

The electro-IT&C market in our country grows fast, showing a good dynamic in the last years. This is explained, in large part, due to e-commerce. For 2019, the estimation done by "Keys Fin" - experts present an advance of 7.5% (over 36 billion lei) in their report about Romania. The turnover of local electro-IT&C product traders increased by 8% in 2018 compared to the previous year and by 37.6% compared to 2014 (Ciocotisan, 2019).

Romania is a top electronics producer in Central and Eastern Europe. In the past 20 years, Romania has also grown into a major centre for mobile technology, information

security, and related hardware research. The country is a regional leader in fields such as IT and motor vehicle production. According to the Labour Ledger as at 1 January 2018, the active civilian population amounted to 8 717 900 persons, representing 44.7% of the resident population. Out of the total active population, 54.7% were men and 45.3% were women (EURES, 2019).

The IT&C sector is one of the growth engines of the Romanian economy. Important companies from abroad have opened in the last year's development and support centres in Romania. These companies came to Romania, because the workforce is better prepared than in other countries. According to Bogdan Belciu (management consulting partner at PWC Romania) the IT&C sector in Romania has a larger contribution to the GDP than the European average. Of the total workforce in Romania, 2.2% work in IT&C, generating 5.9% of GDP. The labour force share is lower than the share in the GDP and this shows that this sector creates a high value added. Digitization contributes to the speed of economic growth (Ziarul financiar, 2018).

**Methodology**

The present paper includes an analysis of the documentation found in various publications and scientific articles in order to define the opportunities and risks of the Romanian IT&C industry in the context of "Industry 4.0".

Therefore, we used a comprehensive search into numerous sources of secondary data, such as statistics, articles, reports and books regarding the IT&C industry in the context of "Industry 4.0" and management.

The electronic databases, which we took into consideration, were Academia.edu, Springer, Invest Romania, Eurostat, BRILL and Wiley Online Library. Other sources were the archives of different journals and conferences, such us the journal "Manager", the conference "BASIQ", "ICBE" and "ETIMM".

The method used is a descriptive and quantitative one, combined with a SWOT analysis. A SWOT analysis is a comprehensive look at strengths and weaknesses, or internal factors, as well as external factors in the market. A SWOT analysis starts by studying its strengths and weaknesses. Subsequently, an external environment SWOT analysis enables to determine how strengths can be exploit and weaknesses minimize. The external environment SWOT analysis is a detailed look at the industry. One facet of an external SWOT analysis is studying various opportunities in the marketplace. Opportunities can include an unfulfilled need of consumers or new technological arrivals, according to the article "SWOT Analysis" at quickmba.com. For example, the Internet became a new way to market products in the mid-1990s. An external environment SWOT analysis also enables us to examine various threats in the industry (Suttle, 2019).

**Results and discussions**

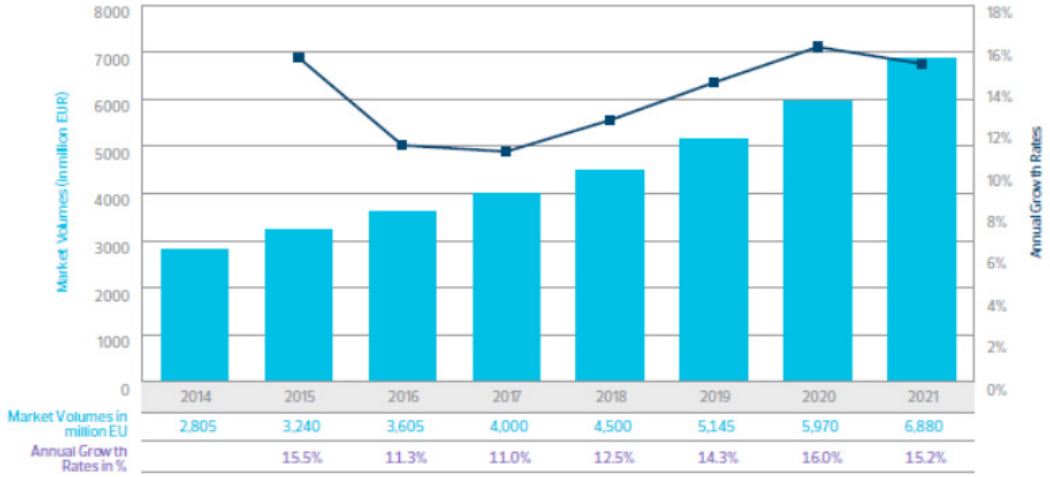
**The opportunities and risks analysis of the Romanian IT&C Industry**

The fact that the IT&C industry is developing much faster than any other sector of the economy is mainly related to the changes brought by Industry 4.0. The investments in information technologies is a major factor for the performance of a firm, no matter of the sector of economy in which it is working

(Gabor, M. R. et. al., 2019). The knowledge society is experiencing a full swing of development. According to the EUROSTAT indicators, the impact of IT&C is already very important, but this is only the beginning.

The new industrial revolution brings also an important risk regarding poverty. This risk is related to the fact, that in the next period, robots will cover a big number of jobs that today are done by humans. At the UN Summit for Sustainable Development, which took place in 2015 in New York, the participants adopted the 2030 Agenda for Sustainable Development. This agenda is a commitment to poverty eradication and sustainable development by 2030, worldwide (Târțiu, V. E. et. al., 2019).

*Figure 1: Total Romanian SITC industry (Audoin, 2018)*




The export of products and services generated by the Romanian IT industry will reach 77% of the total IT market in 2017, a significant increase compared to the share of 69% in 2015 (Audoin, 2018). Compared with the export, as a percentage, the consumption of products and services in the local market is decreasing from 31% in 2015 to 23% in 2017. A market consolidation is expected. The estimation says that the market will increase from € 4.1 billion in 2017 to approximately € 5.5 billion in 2020 (Raveica, 2019). The decisive growth factor is represented by all exports, which will rise to a share of 79% of the IT market in 2020. The stagnation of technology consumption has an impact on the competitiveness and productivity of the public sector, but especially on the private sector. Therefore, we have specialists, but the local market is in a relative stagnation of technology consumption (Audoin, 2018).

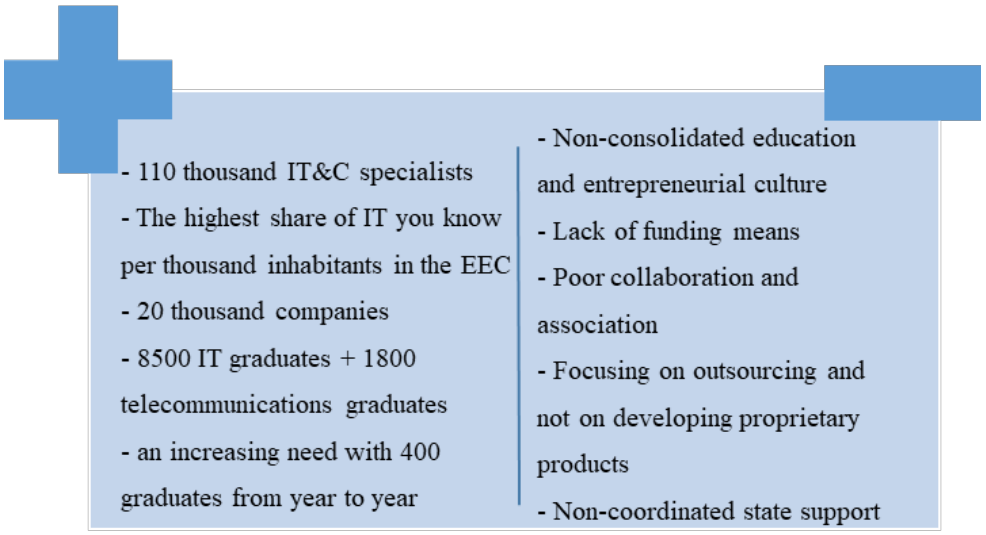
The number of employees increased in the last fifteen years from 14,000 to 100,000. The productivity reached 50,000 euros / employee in 2018, but it is still under the EU average. The IT sector is 2.2 times more productive than the total Romanian economy. Moreover, Romanian IT provides 24% of the country's annual output with only 2% of the total employees. The number of specialists

graduating annually is about 7,000 people / year. In 2018, Romania had already a deficit of 18,000 IT specialists. Although there is a high demand, the number of graduates could not be increased. In the last 15 years, the schooling figures have unfortunately remained behind the growth of the industry (Pavel, 2019).

In the export of IT solutions, we face sometimes a paradox. This export is an export of Romanian intelligence, but it is for the benefit of multinational companies.

The Romanian IT-specialist is happy to get a good "salary" from a multinational company. Specialists are not ready to take risk and build their own companies. Nevertheless, this is not everything. Romanian specialist creates some of the products that we buy from multinational companies. The multinationals are growing, because our specialists are not interested in their own intellectual property. This means that, the local consumption of technology uses the suppliers, foreign companies, which appeal to Romanian specialists, so we export products and services that we sometimes contract just from those who have accessed the Romanian specialists. In this case, the registration of export figures, respectively the local market, may be affected by the export to foreign companies, that own the property, and than sell back to the Romanian market. Mostly, Romanian developers work in the "lohn" system. This is also caused by the insufficient local consumption (Raveica, 2019).

*Figure 2: Opportunities and risks in the Romanian IT&C sector (Raveica, 2019)*



Companies like Orange increased their segment of IT&C services for B2B (Business-to-Business) customers by 27% in 2019. The predefined machine learning algorithms give unlimited business application possibilities. Orange launched a public cloud service, called Flexible Engine. This is an option for B2B customers to quickly optimize, transform and develop business applications. The main request from Orange customers referred to solutions of hosting (hosting), state-of-the-art Wi-Fi technology and network security (Popa, 2019). This example is another confirmation of the huge potential of our market and on the other hand of the new challenges regarding the cyber security.

The safety of performed operations is today an important issue due to the migration to the digital environment. This issue is important for everybody, final consumer, business and the state. The cyber-attacks are not any more a subject for storytellers. We expect that in the future, private business and the state will allocate a lot of time in developing solution and implementing them to defend from cyber-attacks. The Law 362/2018, based on the NIS Directive, is the foundation for the security of network and information systems. Everybody needs to take all the measures necessary to reduce the risks of cyber-attacks. This means that business, state and consumers need to invest in cyber security systems and services (RePatriot, 2019).

This new issue is not only important for the IT&C sector, but for all the sectors of the economy using, or planning to use the new technologies. That is a way we have to think also about risk management when we analyse the threats. "The development of risk response strategies is a distinct stage in the risk management process in projects and has different names from one methodology / standard to another" (Ciocoiu, N., Irimescu, E. C., Stefan, V. E., 2019). The main task is to select the best solution for the future and to estimate the impact of the new strategy in all affected activity sectors.

In Industry 4.0 oriented Production Management strategies and approaches, the Production Activity Control Mechanisms (PACM) plays an important role because it facilitates management's meeting of goals, solving problems, meeting cost requirements, ensuring product quality and the accomplishment of production orders. (Costa, D. et. al., 2019).

**Conclusion**

McElroy used in her work the questions of the possibility that Romania could be "The Silicon Valley of Europe" (McElroy, 2019). In the last fifteen years, the Romania IT&C sector developed immensely. McElroy is not the only one looking at Romania as the possible technology hub of Europe. After analysing our opportunities in this sector, we have to improve very soon our strengths and to minimise the threats.

The goal of this paper is to underline the huge possibilities that our IT&C sector has, and based on this, the opportunities of our national economy has in the context of "Industry 4.0". With a good developed IT&C sector, the cost of digitalisation can be much lower for our country than for those that do not have such capable specialists in this field.

First, we need to improve the level of digitalisation in the public sector, then, to support the Romanian specialists to build up start-ups and to sell the creation of theirs minds as their own intellectual property in

Romania and abroad. In parallel, the gap between the numbers of IT&C specialist which are coming out every year must be increased. The number of 18.000 IT specialist that are needed today in the labour market is calculated based on the real demand of IT companies. "Industry 4.0" needs a much bigger number of specialists in this field. Due to the changes brought by "Industry 4.0", the Romanian entities need to look also at examples from other countries in the EU.

In the next stage, it is mandatory to study and define the necessary and accepted measures of private companies, institutions and authorities for ensuring and maintaining the extraordinary position of our country, the leader in the European Union in terms of the number of IT& C employees per capita.

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**REFERENCES:**

1. **Audoin, P**., 2018. *Software & IT Services in Romania 2018*, Bucharest: ANIS Romania.
2. **Barbu, C.-M.**, 2019. *Romania in 2018 – Failure Signs on the Dashboard*. ARTECO Journal. Socio-Economic Researches and Studies, 2(1), pp. 11 - 22.
3. **Ciocoiu, N., Irimescu, E. C., Stefan, V. E.,** 2019. *Development and Selection of Risk Response Strategy in Projects: An Analysis of Recent Literature*. Journal of Financial Studies & Research, Band 2019, pp. 1 - 10.
4. **Ciocotisan, B.**, 2019. *Analiza: Piata de electro IT&C va trece de 36 miliarde lei in 2019, in crestere cu 7,5%*. [Online], Available at: http://www.1asig.ro/Analiza-Piata-de-electro-IT-amp%3BC-va-trece-de-36-miliarde-lei-in-2019-in-crestere-cu-7-5-articol-3,102-61793.htm, [Accessed 12 November 2019].
5. **Costa, D. et. al.**, 2019. *ANALYSIS OF PRODUCTION ACTIVITY CONTROL MECHANISMS FOR INDUSTRY 4.0.* International Journal of Mechatronics and Applied Mechanics, Issue 5, pp. 194 - 205.
6. EURES, 2019. *The European Job Mobility Portal.* [Online], Available at: https://ec.europa.eu/eures/main.jsp?catId=9545&acro=lmi&lang=en&countryId=RO&regionId=RO0&nuts2Code=null&nuts3Code=null&regionName=National%20Level, [Accessed 12 November 2019].
7. **Gabor, M. R. et. al**., 2019. *Comparative Study concerning the Impact of IT&C Indicators on Performances of Organizations in the Industry.* s.l., Elsevier Ltd., pp. 627 - 633.
8. **Grigore, A-M., Coman, A**., 2018. *THE HOURGLASS EFFECT: LEADERSHIP TRANSFORMATIONS IN THE DIGITAL ERA.* Bucharest, s.n., pp. 603 - 610.
9. **Herold, G**., 2016. *Leadership in the Fourth Industrial Revolution*, San Francisco: Staton Chase.
10. **Huber, V.,** 2018. *Lohnt sich Gender-Diversity?*. Springer Gabler Hrsg. St. Gallen: Christian Keuschnigg.
11. **Mas, M. et. al.**, 2019. *The 2019 PREDICT Key Facts Report*. An Analysis of ICT R&D in the EU and Beyond. JRC Technical Reports, pp. 1 - 131.
12. **McElroy, E. M.**, 2019. *Unbecoming Silicon Valley: Techno Imaginaries and Materialities in Postsocialist Romania.* UC Santa Cruz Electronic Theses and Dissertations, pp. 1 - 416.

13. **Pavel, C**., 2019. *Provocări pentru industria IT&C din Români.* [Online] Available at: https://www.universuljuridic.ro/conferinta-provocari-pentru-industria-itc-din-romania/, [Accessed 12 November 2019].

14. **Popa, F.,** 2019. *Segmentul de servicii IT&C pentru clienții B2B ai Orange România a crescut cu 27% în 2019*. [Online], Available at: https://financialintelligence.ro/segmentul-de-servicii-itc-pentru-clientii-b2b-ai-orange-romania-a-crescut-cu-27-in-2019/, [Accessed 10 November 2019].

15. **Raveica, A.**, 2019. *IT-ul românesc, o industrie cu câteva paradoxuri.* [Online] Available at: https://www.pinmagazine.ro/2019/04/24/constantin-magdalina-it-ul-romanesc-o-industrie-cu-cateva-paradoxuri/, [Accessed 12 November 2019].

16. **RePatriot,** 2019. *Securitate cibernetică, infrastructuri critice și noi tehnologii în afaceri.* [Online], Available at: https://repatriot.ro/2019-itc-summit/, [Accessed 12 November 2019].

17. **Saucedo Martínez, J. A. et. al**., 2017. *Industry 4.0 framework for management and operations: a review.* Journal of Ambient Intelligence and Humanized Computing, June.pp. 1 - 14.

18. **Shamim, S. e. a.,** 2016. *Management Approaches for Industry 4.0 – A human resources management perspectiv.* s.l., https://www.researchgate.net/publication/311251654, pp. 5309-5314.

19. **Suttle, R.,** 2019. *External Environment SWOT Analysis.* [Online], Availableat: https://smallbusiness.chron.com/external-environment-swot-analysis-1421.html, [Accessed 12 November 2019].

20. **Târțiu, V. E. et. al.**, 2019. *Tranziția către o economie circulară. De la managementul deșeurilor la o economie verde în România*, Bucharest: Institutul European din România.

21. World Bank, 2019. *The World Bank in Romania*. [Online], Available at: https://www.worldbank.org/en/country/romania/overview#3, [Accessed 12 November 2019].

22. Ziarul financiar, 2018. I*ndustria IT&C poate ajunge în 5 ani la o pondere de 10% din PIB. Statul nu exclude apariția unor jucători noi la licitația 5G din 2019.* [Online] Available at: https://www.zf.ro/business-hi-tech/zf-digital-summit-2018-industria-it-c-poate-ajunge-in-5-ani-la-o-pondere-de-10-din-pib-statul-nu-exclude-aparitia-unor-jucatori-noi-la-licitatia-5g-din-2019-17557826, [Accessed 12 November 2019].