

TOWARDS A ROMANIAN AI STRATEGY

UNDERSTANDING THE STATUS QUO

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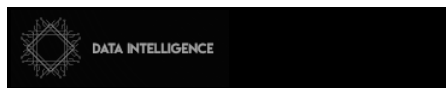


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Preamble

Artificial Intelligence is a disruptive phenomenon which impacts the society and economy at a global level. The importance of the Artificial Intelligence is recognized by the European Commission:

“Artificial Intelligence is developing fast. It will change our lives by improving healthcare (e.g. making diagnosis more precise, enabling better prevention of diseases), increasing the efficiency of farming, contributing to climate change mitigation and adaptation, improving the efficiency of production systems through predictive maintenance, increasing the security of Europeans, and in many other ways that we can only begin to imagine.”¹

Romania must find its niche and capitalize on the Artificial Intelligence capabilities in order to remain competitive and ensure the welfare of its citizens. Failing to do so will only increase an existing gap in the Romanian’s competitiveness and international relevance; along with the degradation of welfare and quality of life of its citizens.

With a good support for network connectivity and a population receptive and open for using Artificial Intelligence at the workplace Romania is shaping up to become a very consumer of the Artificial Intelligence technologies.

With a low degree of digitalization of the society and economy, with a lack of qualified and sufficient talent pool, with low human productivity projections for the future and virtually no specific Artificial Intelligence governance - Romania does not have a positive outlook as an Artificial Intelligence innovation and solution development leader.

While we believe that Romania lacks the capabilities to become a leader in the arena of Artificial Intelligence development, we also firmly believe that Romania can become a proficient adopter of Artificial Intelligence and thus improve its economic and social life, along with advancing its global interests.

¹ White Paper on Artificial Intelligence, A European approach to excellence and trust, https://ec.europa.eu/info/sites/default/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

Understanding the context

In order to understand the Romanian's positioning for the success of Artificial Intelligence adoption, we will analyze Romania's status on several perspectives:

- **Data:** the availability of data along with its quality and dynamics. Understanding and utilization of data as a economic capital and a driver for a data-oriented economy;
- **Infrastructure:** the availability of infrastructure for developing AI applications such as data storage and processing services, computing resources and so forth;
- **Business:** the potential applications of Artificial Intelligence in the business domain and in the economic value creation chain;
- **Society:** the social impact, acceptance and adoption of AI along with the education of society in regards with Artificial Intelligence concepts, benefits and threats;
- **Talent:** the availability of qualified personnel, data citizens, best practices - in short the human and knowledge capital;
- **Governance:** the public governance of Artificial Intelligence use; promoting ethical and beneficial use of Artificial Intelligence along with the regulations protecting the citizens and the state against malicious and unethical utilization of Artificial Intelligence.

Understanding how Romania is positioned from these perspectives is a prerequisite for projecting a future desired state along with the strategy to achieve this.

Where specific data is not available, we will use proxy indicators.

Data Perspective

The data is the main ingredient in having a successful Artificial Intelligence utilization and a strong data driven economy. It is a strong organizational asset and (if properly managed) a form of capital and means of production (a position that gets more and more traction in countries with data intensive economies).²

One of the most important prerequisites for generating diverse, dynamic and high quality data is a digitalization of the economy. A good understanding of the digitalization in Romania can be understood from the Digital Economy and Society Index (DESI) 2020 report:

"Romania ranks 26th out of 28 EU Member States in the 2020 Digital Economy and Society Index (DESI) ... as regards the DESI indicators that are especially relevant for the economic recovery after the COVID-19 crisis, Romania is very advanced on VHCN coverage and is 14th regarding 5G

² "In recent policy documents, including China's 14th Five-Year Plan, released in March, central authorities have designated data as one of a small number of factors of production - national resources that form the backbone of the country's economy."

China is laying the groundwork to nationalize private companies' data, Protocol, <https://www.protocol.com/china/china-national-security-data-exchange>

readiness in the EU. On the other hand, it lags behind in the digital skills indicators, has a weak performance in the digitisation of businesses and in digital public services.”³

In other words Romania has a very good performance on connectivity, yet it severely lags behind in the areas of public & business digitalization and digital skills.

The digital public services sector (a strong factor in ensuring the creation and access of public data along with creation of data driven public policies) has quite a low performance, the DESI 2020 report underlining the main barriers to achieving better results:

- The lack of coordination between public institutions in setting up such services;
- The migration of IT specialists from the public sector to the private sector or to other countries;
- The overall lack of digital skills.⁴

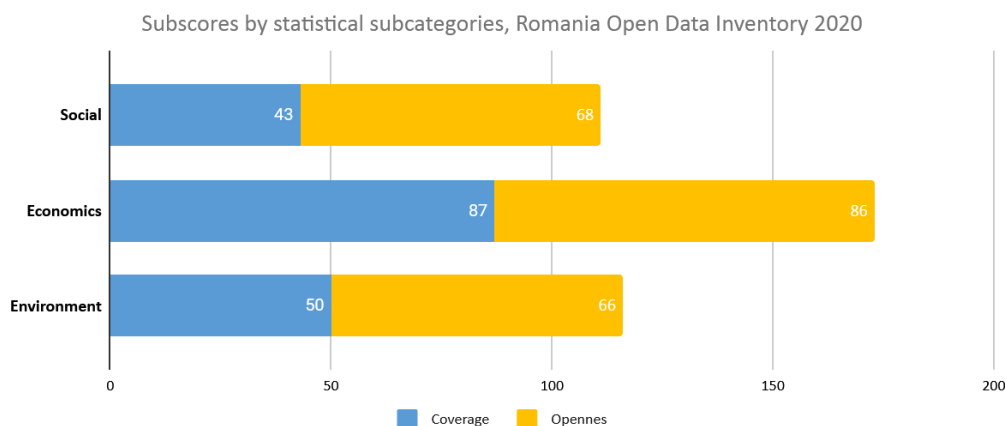


Figure 1: Romania Open Data Inventory, Subscores by statistical subcategories, Romania country profile 2020⁵

From a standpoint of access to open data Romania has a moderately good situation:

- It ranks 36 out of 187 in the Open Data Inventory with a 73 out 100 openness score. Romania scores very well on open data for population & vital statistics, national accounts and financial data. It scores very low on the areas of food security & nutrition, crime & justice and built environment;⁶

³ European Commission, Romania in the Digital Economy and Society Index, Digital Economy and Society Index (DESI) 2020, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=66928

⁴ European Commission, Romania in the Digital Economy and Society Index, Digital Economy and Society Index (DESI) 2020, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=66928

⁵ Based on data from ODIN Open data inventory, Open Data Watch, Country profile: Romania, 2020, <https://odin.opendatawatch.com/Report/countryProfileUpdated/ROU?year=2020>

⁶ ODIN Open data inventory, Open Data Watch, Country profile: Romania, 2020, <https://odin.opendatawatch.com/Report/countryProfileUpdated/ROU?year=2020>

- It ranks 24 out of 94 in the Global Open Data Index (dataset a bit outdated) with a 51% score. Romania scores very well on open data related to government budget, national laws, administrative boundaries and election results. It scores very low on company register, locations data, water quality, government spending and land ownership.⁷

We can observe that Romania has the highest coverage and openness for economics related data while the lowest score is registered for social related data.

For a high level understanding of Romania’s positioning on the digital dimension inside EU28 we will be providing the following information from the DESI 2020 report:

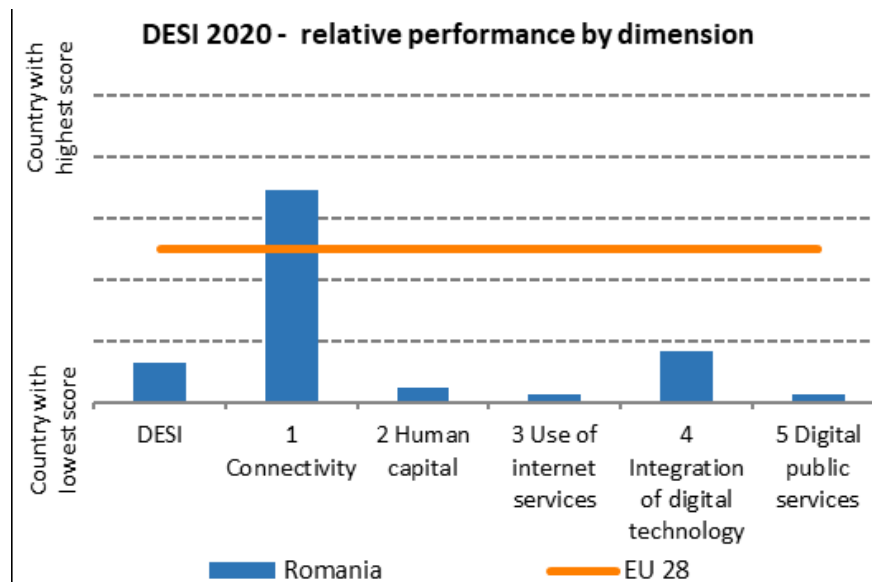


Figure 2: Romania’s DESI 2020 - relative performance by dimension⁸

Romania has very low scores in relation with data generation and consumption services such as integration of digital technology and digital public services. Furthermore, from the standpoint of big data analysis, Romania scores the lowest third score, a low performance on this area:

⁷ Global Open Data Index, Romania, <https://index.okfn.org/place/ro/>, (dataset based on data from 2016 - 2017)

⁸ European Commission, Romania in the Digital Economy and Society Index, Digital Economy and Society Index (DESI) 2020, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=66928

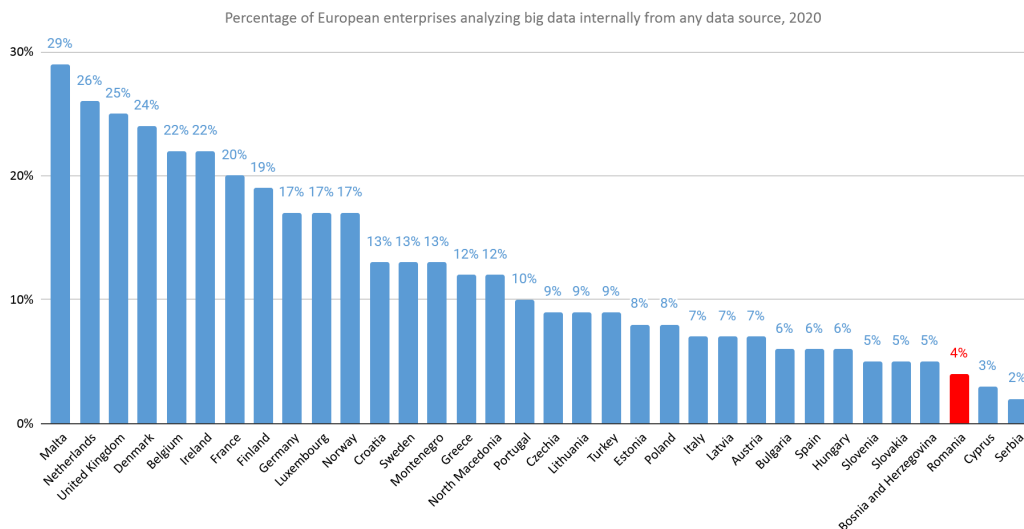


Figure 3: Percentage of European enterprises analyzing big data internally from any data source, 2020⁹

In conclusion, Romania has a mixed score on relevant dimensions and proxy indicators regarding the data perspective. It scores relatively well in the area of open data access, especially in the areas of population, vital statistics and financial data.

Due to very low integration of digital technology and digital public services, Romania scores significantly lower than the European average on dimensions related to data generation and collection, especially lower in regards with data processing and analysis.

Infrastructure Perspective

The infrastructure is an important aspect for successfully applying Artificial Intelligence in practice. In terms of infrastructure we should consider aspects such as data storage, computing power, cloud computing services or dedicated hardware for edge computing.

From the standpoint cloud computing services usages by enterprises 2020, Romania scores very low among the EU states:

⁹ Based on data from Eurostat, Big data analysis, https://ec.europa.eu/eurostat/databrowser/view/ISOC_EB_BD/bookmark/table?lang=en&bookmarkId=d5826125-5033-457f-951a-2bec7e731da2

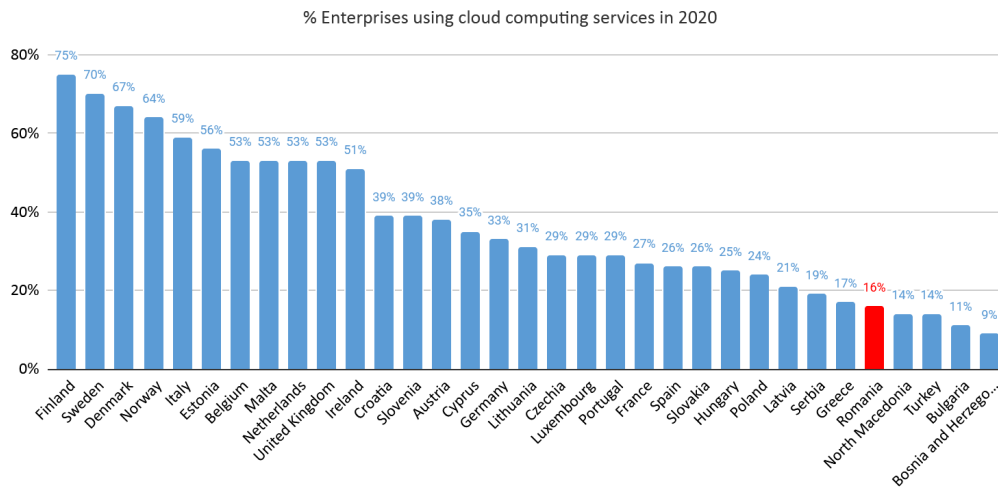


Figure 4: Usage of cloud computing by the EU enterprises in 2020¹⁰

More precisely, only 16% of enterprises in Romania are using cloud service software (average at the EU level being 36%).

Out of all the cloud usage use cases potentially connected to Artificial Intelligence - we have proprietary software (56%), storage of files (34%) and database hosting (31%):

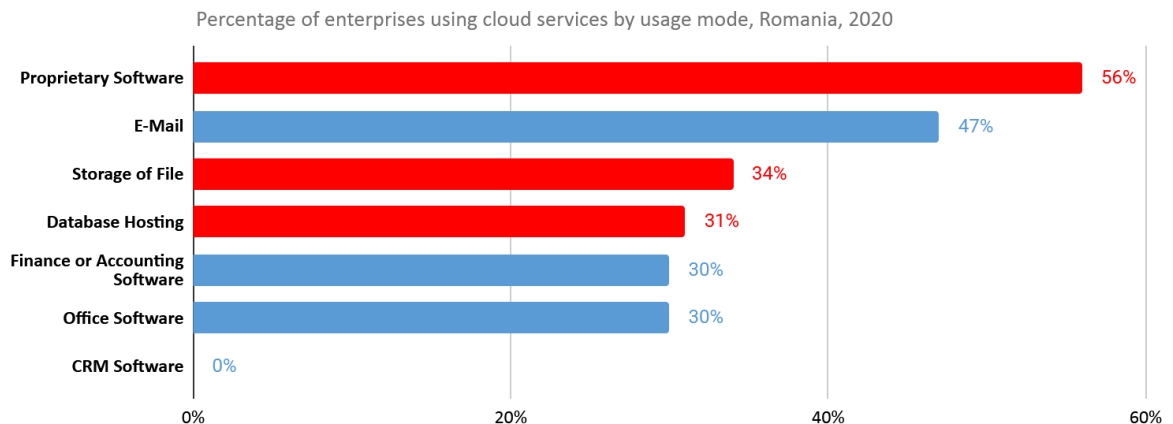


Figure 5: Percentage of enterprises using cloud services by usage mode, Romania, 2020, area related to Artificial Intelligence marked in red¹¹

This reflects a lower affinity of Romanian enterprises with cloud service usage, thus an impediment for a potential cloud services usage for AI application.

¹⁰ Eurostat, Cloud computing - statistics on the use by enterprises, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Cloud_computing_-_statistics_on_the_use_by_enterprises&oldid=322870

¹¹ Based on data from Eurostat, Use of cloud computing services in enterprises, 2020, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Use_of_cloud_computing_services_in_enterprises,_2020.png

Romania ranks 11 out of 30 in EU DESI 2020 - connectivity perspective. Romania's strengths in regards to connectivity are broadband price index (lowest in EU30) and a very good fixed broadband coverage.¹²

From a more detailed perspective Romania ranks 41 out of 79 in Huawei's global connectivity index. In terms of technology enablers it ranks above average on broadband connectivity and it ranks below average in all other areas (lowest score on Artificial Intelligence):

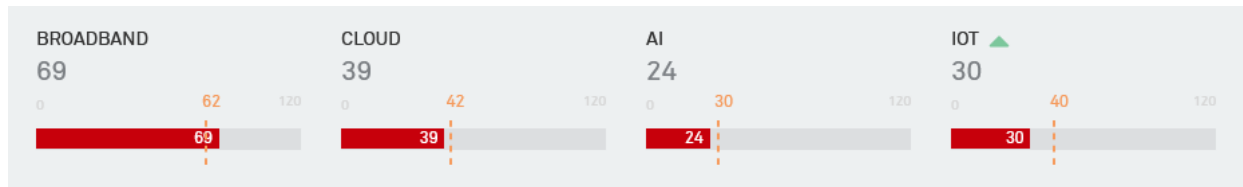


Figure 6: Huawei, Global Connectivity Index 2020, Romania¹³

In terms of 5G readiness, Romania ranks average in the European Union with a score of 21% equal with the European average.¹⁴

As a consequence, from an infrastructure perspective, Romania has a low usage of Cloud Computing and thus associated computing power. There is no public data on edge computing readiness, however we estimate that the readiness on edge computing is low as well. This is balanced by a very good connectivity, Romania is very advanced on VHCN coverage and affordability of broadband networks. On a European level, Romania scores above the European average in the DESI 2020 index in regards to connectivity.

The good connectivity allows Romanian companies to use cloud Artificial Intelligence solutions from the main cloud platform vendors such as Amazon or Microsoft. This offsets the lack of computing power offered at the national level; even if it constitutes a barrier to the adoption of edge computing.

In conclusion Romania scores very well in terms of connectivity (especially broadband connectivity). It has great potential for the activation and exploitation of the 5G technology.

Even if many prerequisites are in place, the high connectivity capability does not seem yet to be used for Artificial Intelligence purposes (low scores on cloud, AI and IOT technologies usage).

¹² European Commission, DESI - Connectivity 2020, <https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2020>

¹³ Huawei, Global Connectivity Index 2020, Romania, <https://www.huawei.com/minisite/gci/en/country-profile-ro.html>

¹⁴ European Commission, DESI 2020, Romania Country Profile, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=66928

Business Perspective

Adoption of Artificial Intelligence by the business sector is another critical success factor for ensuring the large-scale adoption of Artificial Intelligence. In the long run, along with the adoption of Artificial Intelligence by society, it will be a critical sustainability factor as well.

Romania scores above EU27 average on all critical indicators regarding Artificial Intelligence adoption by the businesses:

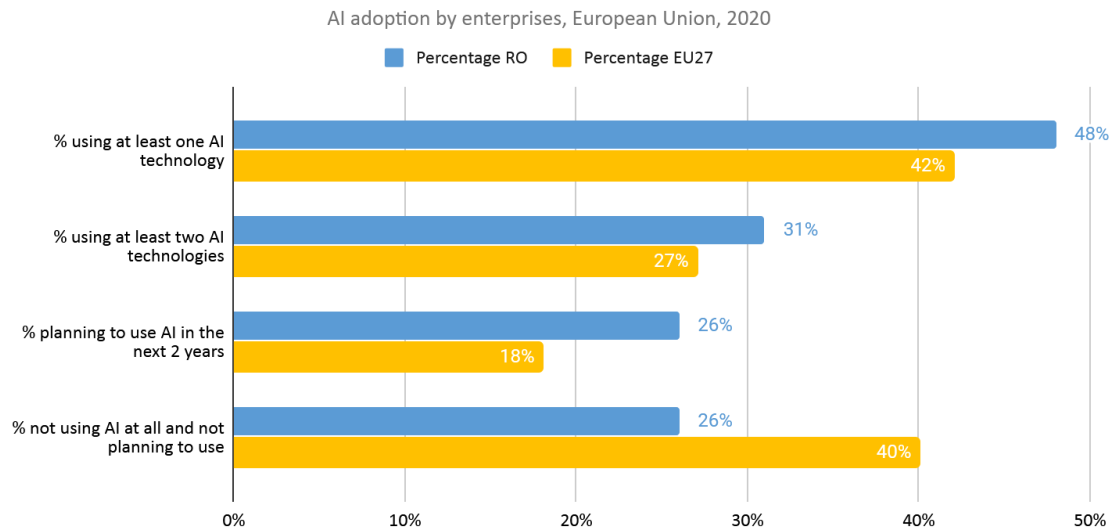


Figure 7: AI adoption by enterprises, European Union, 2020¹⁵

This creates a very good environment for adoption and large scale utilization of Artificial Intelligence in Romania. Additionally, in regards to the percentage of companies planning to use AI in the next two years Romania scores the third place in Europe.

Another important perspective in regards to the adoption of Artificial Intelligence in business is represented by the type of its business applications.

The top three business applications for which Romania has adopted Artificial Intelligence are Process Automation, Process or Equipment Optimisation and Recommendation or Personalisation Engines. The business applications that are the least impacted by Artificial Intelligence are Computer Vision, Creative & Experimentation Activities and Sentiment Analysis.

¹⁵ Based on data from European enterprise survey on the use of technologies based on artificial intelligence, Final Report, European Commission, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=68488

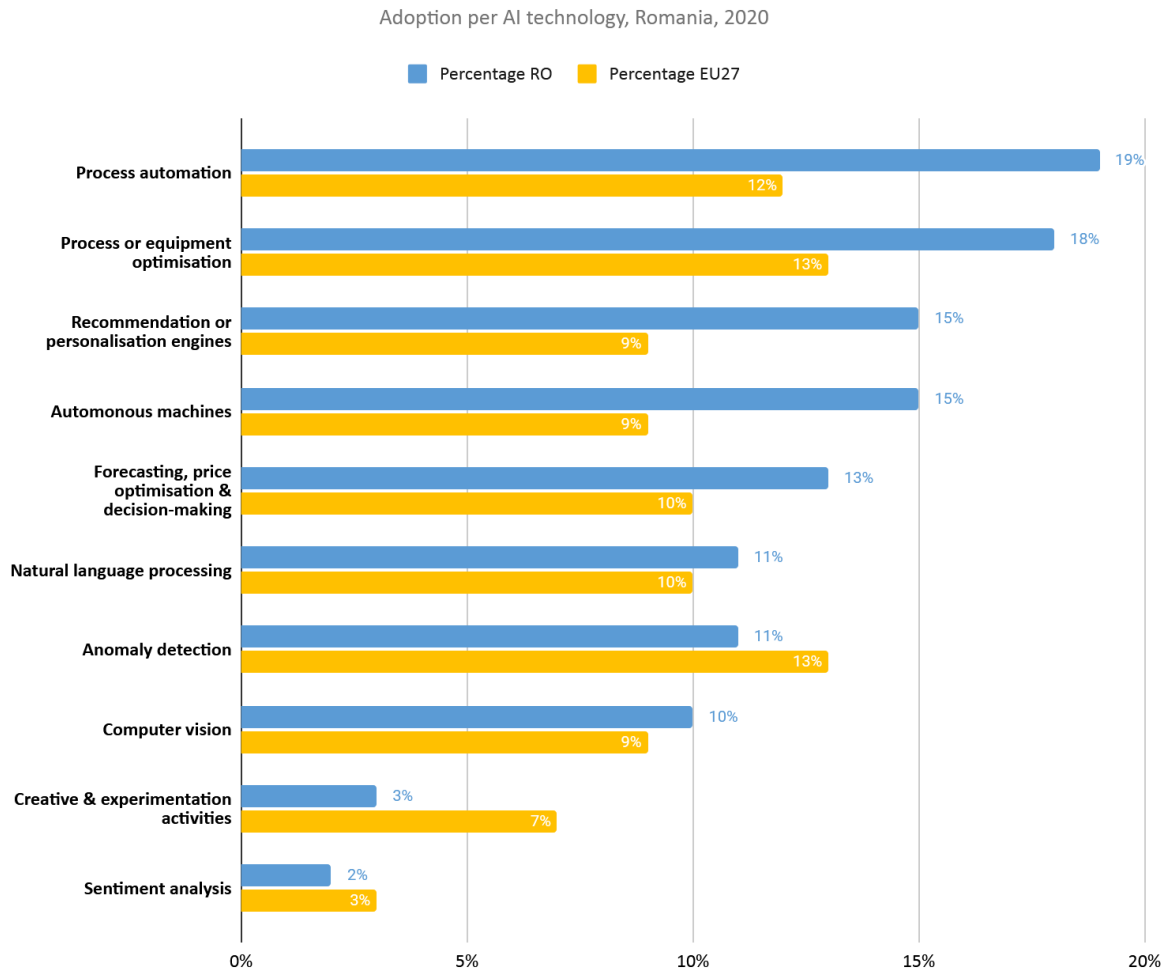


Figure 8: Adoption per AI technology, Romania, 2020¹⁶

Compared to the European Union (EU27), Romania is most advanced in the area of Process Automation (+7%) and the least advanced in Creative & Experimentation Activities (-4%). It indicates that Romania is mostly interested in using Artificial Intelligence in business for optimization of business processes, while the interest for implementing creative solutions and experimentation is relatively low.

This is coherent with our assumption that Romania is mostly engaged on a Artificial Intelligence consumer profile trajectory, rather than solution creator.

In order to understand the business growth potential for Artificial Intelligence it is important to identify the economic sectors that have the highest impact on Romania's GDP.

¹⁶ Based on data from European enterprise survey on the use of technologies based on artificial intelligence, Final Report, European Commission, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=68488

We can easily observe that the largest contribution to Romania's GDP in Q2 2021 is generated by the services sector, followed (at a large distance) by Industry & Manufacturing. Therefore, from a purely statistical chance perspective, the services sector should be the main focus for identifying the early niches where Artificial Intelligence can enter and expand.

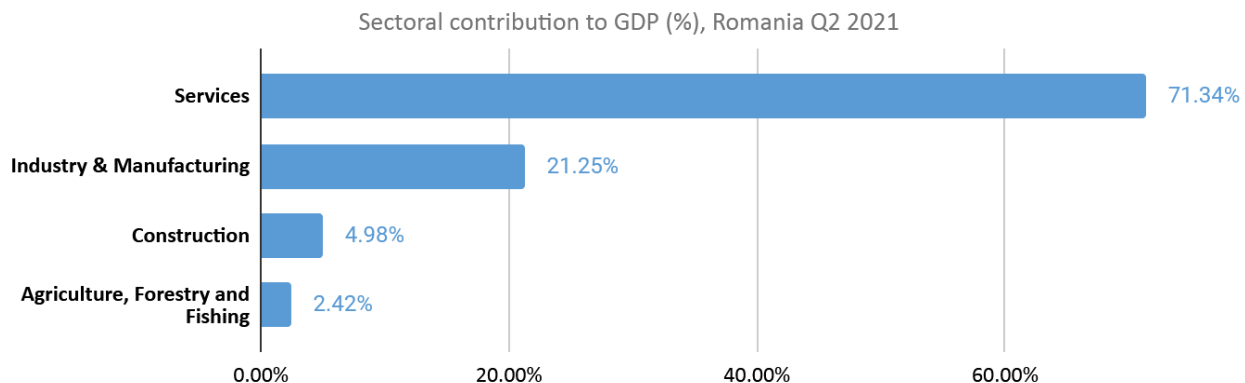


Figure 9: Sectoral contribution to GDP (%), Romania Q2 2021¹⁷

Therefore we must understand which are the most relevant types of services (according to their impact on GDP):

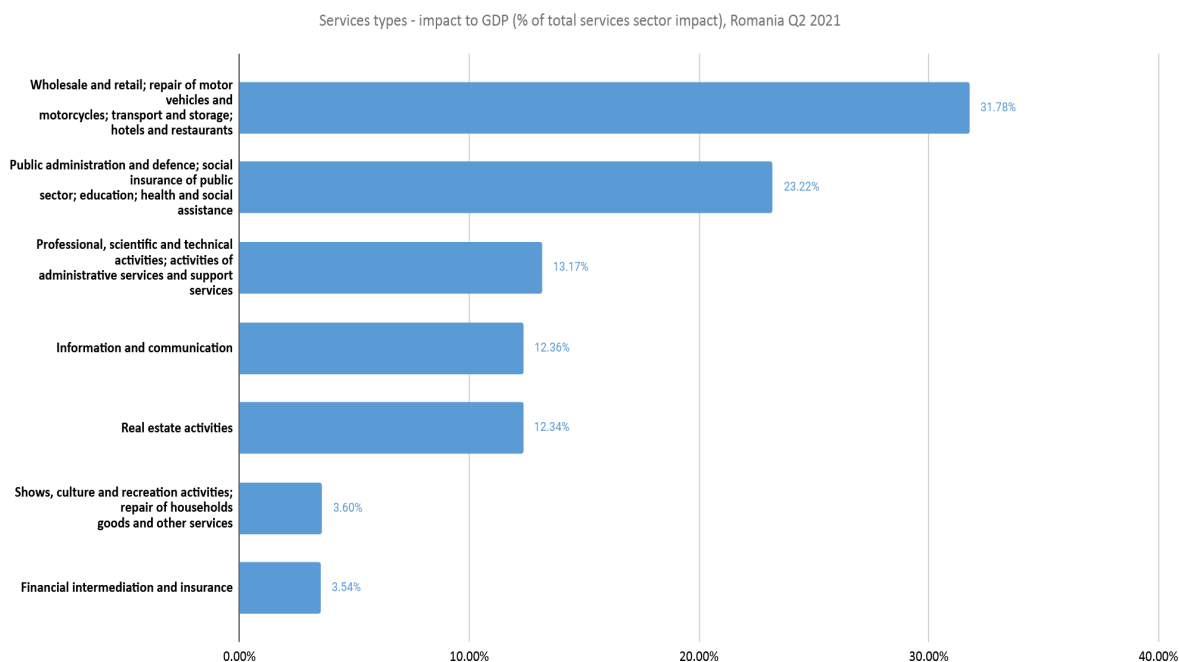


Figure 10: Services types - impact to GDP (% of total services sector impact), Romania Q2 2021¹⁸

¹⁷ Based on data from Romanian Institute of Statistics, Quarterly Gross Domestic Product Q2 2021, https://insse.ro/cms/files/statistici/pib%20trim/PIB_trimestrial_ESA_2010_Q2_2_2021.xlsx

¹⁸ Ibidem

Based on this data and also on a empirical observation we can conclude that the possible best candidates from services sectors are as follows:

- Commerce (wholesale and retail);
- Health;
- Education;
- Social Assistance;
- Transportation.

In our expert opinion the commerce services (especially e-commerce) presents the first tier (highest potential) for Artificial Intelligence adoption. It presents significant opportunities in areas such as sales & inventory optimization, customer segmentation & retention, automated content creation or conversational interfaces.

This potential is amplified by a large volume of available COTS products (that only need integration) and by the pandemic situation which enforces more and more digital interaction.

The second tier (in regards with the potential of the Artificial Intelligence adoption) is constituted by the Health, Education and Social Assistance sectors. The COVID-19 pandemic has disrupted these sectors, either by imposing unprecedented pressure on their day by day activities (e.g. influx of patients to hospitals) or drastically changing the nature of interaction (e.g. sudden transition from physical to online presence in the classrooms).

For Health and Social Assistance sectors there are good opportunities to create Artificial Intelligence solutions that alleviate the pressure on the day-by-day operations (such as automated patient triage, automated patient screening, conversational interfaces and AI-aided diagnosis). In the long term - along with the emergence of the data-citizen class in Romania - there is a good potential for development of solutions that support the creation and execution of data driven policies.

The Education sector is impacted by the sudden transition from physical to virtual presence, by the lack of highly qualified personnel (especially in the rural and small-urban areas) and by long interruptions in the educational processes (due to COVID-19 pandemic and shortages related to the digital infrastructure for education). In combination with LMS platforms¹⁹, Artificial Intelligence allows the creation of solutions for curricula personalization, enhanced student experience, conversational interfaces (such as chatbots for Q&A support or examinations) and even automated content generation for educational purposes.

The third tier is represented by the transportation and logistics services. There is already a basic digitalization of business processes in place (such as fleet tracking devices and fleet management solutions); this creates opportunities to develop Artificial Intelligence solutions that optimize these processes in order to optimize costs (both transportation and storage), reduce the environmental impact and support transitioning towards a green economy.

While looking good on paper, we believe that the Public Administration and Hospitality Industry services, along with the Manufacturing sector are not yet strong candidates in regards with the potential for Artificial Intelligence adoption.

¹⁹ Learning Management System platforms such as Moodle (<https://moodle.org/>)

The Public Administration sector lacks the necessary digitalization and interconnectivity capable to generate sufficient data in order to enable adoption of integrated AI solutions (for example in 2020 only 10% of Romanian citizens used government sites for obtaining information²⁰).

There are limited opportunities in the area of interaction with the general public: such as usage of chatbots (conversational interfaces), automated document processing (process automation) and process optimization tools. Yet, these solutions would be applicable mostly to public institutions having at least a medium degree of digitalization and addressing a digitally-enabled public; for now - such institutions are relatively few (mostly in large-urban areas).

The Hospitality Industry lacks the necessary sophistication to be a relevant consumer for Artificial Intelligence. There is simply not enough critical mass to ensure a meaningful adoption and utilization of Artificial Intelligence.

Finally, the Industry & Manufacturing sector is less and less relevant as a percent contribution to Romania's GDP (from 30% in 1991 to 15% in 2020²¹); being mostly represented by the automotive, gas & oil processing and food processing sectors. Yet, the majority of the investments in this sector are driven by low cost of workforce, proximity of resources (local processing) and proximity to parent companies (nearshoring).

These drivers (especially the low cost of workforce) are not creating a good environment for Artificial Intelligence adoption because:

- The low cost of workforce does not encourage the adoption of automation (and therefore of Artificial Intelligence), simply put transition to automation does not ensure a good ROI;
- As the focus of manufacturing - at large - is on subassemblies and low tech components, the need for complex automation and Artificial Intelligence is relatively low as well. This does not ensure an environment where Artificial Intelligence can be adopted and generate significant value.

Therefore, the Industry & Manufacturing sector does not create yet a good environment for adoption and implementation of Artificial Intelligence solutions at scale.

There is a niche for Artificial Intelligence solutions in the area of transition towards Green Economy, however at this point this transition did not reach a significant momentum.

Romania has a great potential for adoption of Artificial Intelligence by the business. It scores above EU27 critical indicators for Artificial Intelligence adoption by enterprises.

From the business perspective, the services sector generates the most opportunities for Artificial Intelligence adoption. We estimate that the most opportunities are generated by the Commerce, Health and Education sectors.

²⁰ Share of persons in the EU that obtained information from government websites in 2020 by country, Eurostat,

<https://ec.europa.eu/eurostat/documents/4187653/11571499/Share+of+persons+in+the+EU+that+obtained+information+from+government+websites+in+2020+by+country.png/50dc141f-300b-4163-98ce-25c37adfd1f6?t=1614840370116>

²¹ Manufacturing, value added (% of GDP) - Romania, WorldBank,
<https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=RO>

For now, the Industry & Manufacturing sectors are not generating significant opportunities for Artificial Intelligence adoption in Romania (that may change once the transition to Green Economy takes significant momentum).

Society Perspective

There are no direct indicators in regards to AI adoption at the society level. In this case we will proceed by identifying a series of proxy indicators. One of the most relevant set of proxy indicators are related to critical skills in a digital economy: information skills, software skills and digitalization skills.

Romania scores low on all these indicators, the highest gap being registered for digital skills:

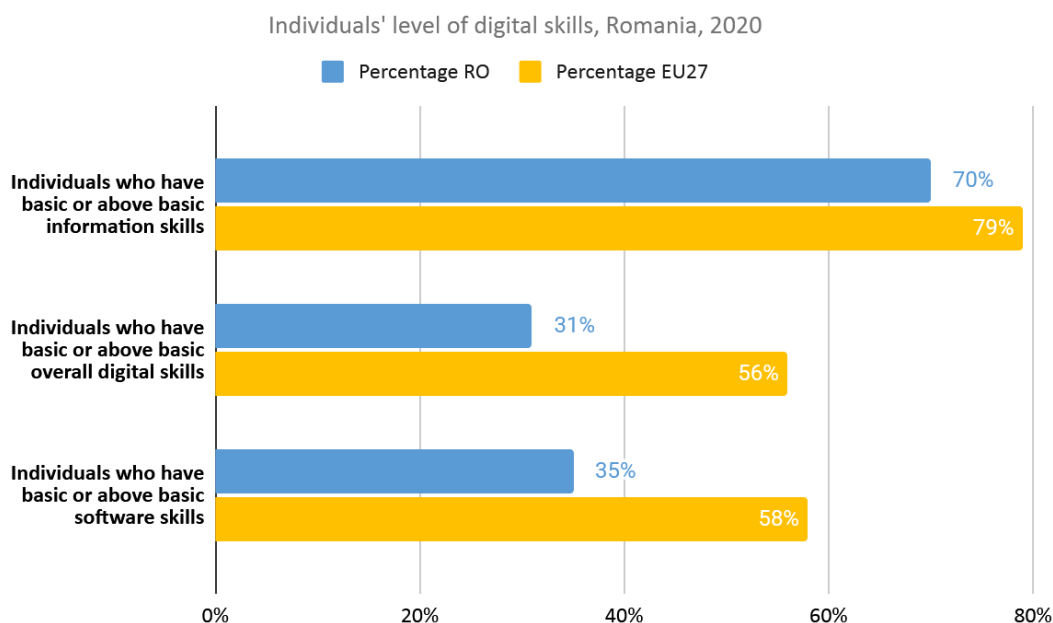


Figure 11: Individuals' level of digital skills, Romania, 2020²²

The low values for digital and software skills are strong indicators for a lower Artificial Intelligence capability. Once again, the low degree of digitalization in society and economy constitutes a major barrier for consciously and meaningfully using Artificial Intelligence at large in society²³.

While there are very few data sources about the perception of AI in regards with the general population, there are several studies in regards with perception of AI by young individuals in

²² Based on data from Eurostat, Individuals' level of digital skills (custom dataset), <https://ec.europa.eu/eurostat/databrowser/bookmark/dd6acb82-c6c0-45c3-ac3e-867e99fc88d1?lang=en&page=time:2019>

²³ Artificial Intelligence is currently used unknowingly by the general population; such features are seamlessly embedded in applications from Social Media or E-Commerce

Romania. We can use this information as a proxy indicator to understand the perceptions and expectations in regards with Artificial Intelligence of millennials and generation Z.

One of these studies was performed in 2019 on a sample of 288 Romanian young people (average age being 27 years)²⁴. This study indicates several interesting facts, first one being related to the perceived level of knowledge about AI:

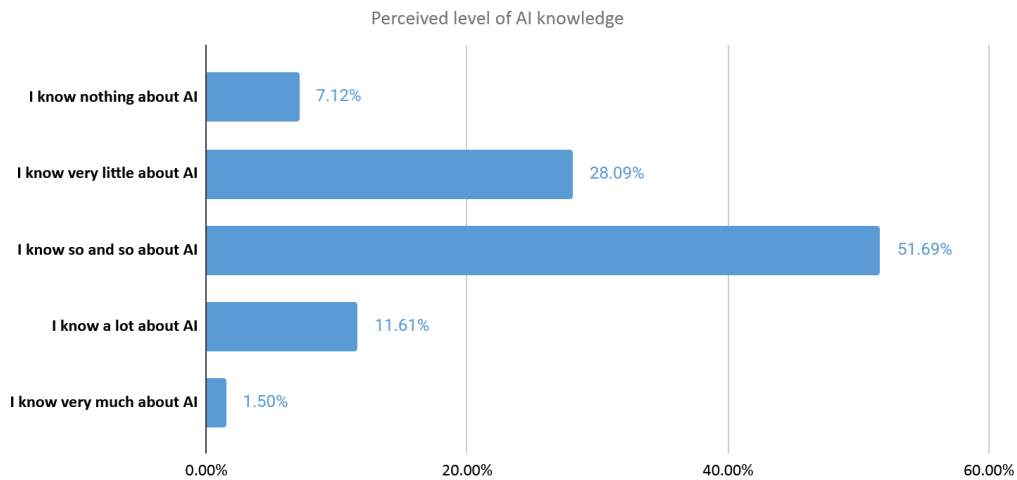


Figure 12: Perceived level of AI knowledge, survey responses of young individuals, Romania, 2019

We can observe that the perceived level of knowledge is medium to low, the study author's claiming that "... the Romanian students' knowledge about AI is fairly limited and does not stem from formal education but rather is founded on social media finds".²⁵

In relation to difficulties to adapt towards an Artificial Intelligence work environment, most of the the study's respondents have a quite low level of concern:

²⁴ Artificial Intelligence In Education - Romanian Students' Attitudes Toward Artificial Intelligence And Its Impact On Their Career Development, Sivia Fotea, Ioan Fotea, Emanuel Tundrea, 2019, <https://www.researchgate.net/publication/338104741>

²⁵ Ibidem

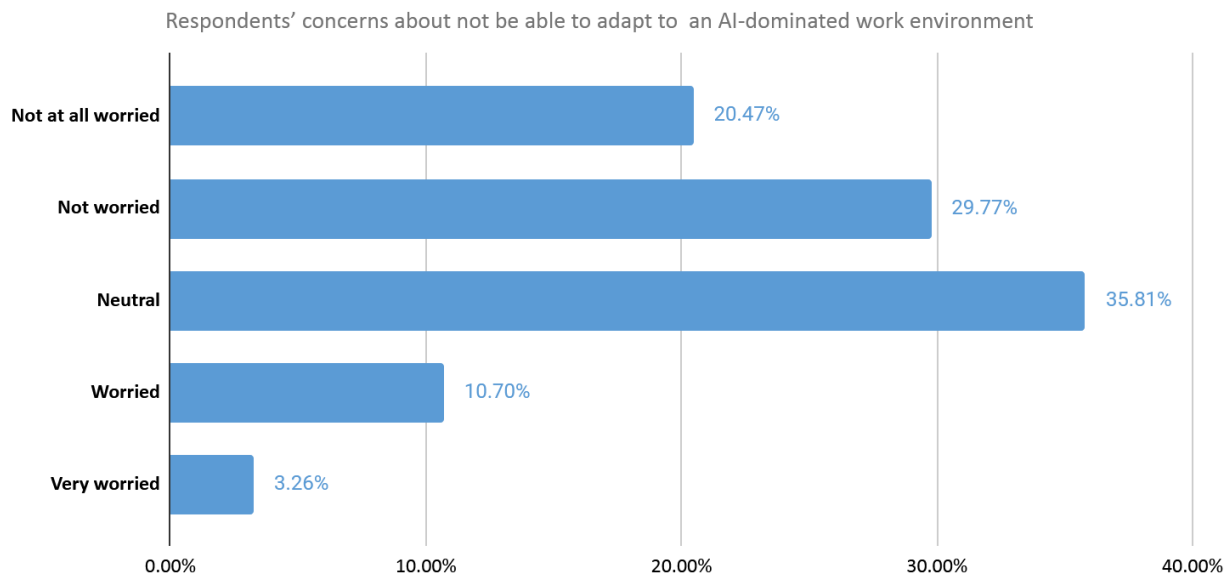


Figure 13: Respondents' concerns about not be able to adapt to an AI-dominated work environment, Romania, 2019²⁶

With more than 85% of the respondents being unconcerned or neutral about being able to adapt to an Artificial Intelligence dominated work environment, we may be able to conclude that at least the younger individuals in Romania will not be opposed to the emergence of work environments where Artificial Intelligence have a significant footprint. However, according to the study, more than half of the respondents are unsure about being able to succeed in such a workplace.

In terms of general concerns about the Artificial Intelligence the study claims²⁷:

"In terms of general concern related to the advancements in AI technology and its applications, the participants in this study, Romanian young people, show low levels of concern. 18.18% of respondents claim they have absolutely no concern regarding AI evolution, 38.64% are only slightly worried, while 28.18% are neutral in their concern. The top five potential negative outcomes of AI applications that worries respondents are: the threat to personal data privacy and security (12.66%), cyber-attacks and computer hacking (12.48%), job losses (12.29%) and the criminal use of AI technologies (11.92%)."

A somehow similar result was provided by an alternate study performed on a sample of 928 students from Timisoara's local universities²⁸.

²⁶ Ibidem

²⁷ Ibidem

²⁸ Technical and Humanities Students' Perspectives on the Development and Sustainability of Artificial Intelligence (AI), Vasile Gherhes, Ciprian Obrad, MDPI - Sustainability, 2018, https://mdpi-res.com/d_attachment/sustainability/sustainability-10-03066/article_deploy/sustainability-10-03066.pdf

According to the study, the respondents "manifest a generally positive attitude towards the emergence of AI, 58.3% considering that it will have a positive influence on the society. Most respondents (28.2%) claim to be optimistic when thinking about society in the age of artificial intelligence. Nevertheless, the percentage of those confessing to being confused is almost as big".

On the other hand, the respondents consider that the "greatest fears are related to the probability that intelligent devices might destroy humankind (for one third of students) and might replace people in certain activities and jobs. The disappearance of workplaces is considered by approximately 33.2% of the respondents to be one of the threats triggered by AI development".

We are observing the same trend of a generic positive perception in regards to Artificial Intelligence adoption, even if there is a high degree of confusion on what Artificial Intelligence really is. Another common point is a concern that Artificial Intelligence will lead to the disappearance of jobs and also to a lower chance of success at the workplace (even if paradoxically a large set of respondents are not concerned about adapting to Artificial Intelligence dominated workplaces).

Finally, from the standpoint of public groups dedicated to Artificial Intelligence, at the time of writing (October 2021) Romania has 20 groups containing 11.476 members²⁹; these groups are mostly based in Bucharest and Iasi. Most of these groups have a very local character and only few of them are truly active.

This sizing is modest; it exceeds the sizing of some Eastern European countries (e.g. Hungary having 19 groups with 8.855 members or Bulgaria having 8 groups with 3.422 members), yet it is far smaller than similar groups in other Western European Countries (e.g. Germany having 412 groups with 234.966 members or France having 173 groups with 155.759 members).³⁰ This concludes that interest in artificial intelligence, as expressed by the proxy indicator "number of AI meeting groups" is relatively modest compared to other European countries; being mainly concentrated on cities with a predominant IT industry: Bucharest, Iasi and Cluj.

In conclusion, Romanian society (at large) has a medium to low degree of understanding of Artificial Intelligence along with its impact in the society and economy. There are a few technology centers where the interest and expertise is higher; the rest of the society being relatively unaware of Artificial Intelligence (this is correlated with a low degree of digitalization in society and economy). Society gets most of the information about Artificial Intelligence from social media (including the high degree of bias and hype associated with such sources).

From the standpoint of public opinion, Romanian society is relatively favorable to a higher presence of Artificial Intelligence in day-to-day life. Respondents showed a relatively low concern related to adaptation to workplaces where Artificial Intelligence has a higher impact, even if there are some fears related to the disappearance of jobs and to the success chance in such workplaces.

²⁹ Artificial Intelligence Groups in Romania, Meetup, <https://www.meetup.com/topics/ai/ro/> (retrieved in October 2021)

³⁰ Data retrieved in October 2021

Talent Perspective

Access to Artificial Intelligence expertise and talented people is essential for successfully creating Artificial Intelligence solutions. The access to talented people (Artificial Intelligence Creators) is essential for companies that are the beginning of their Artificial Intelligence journey:

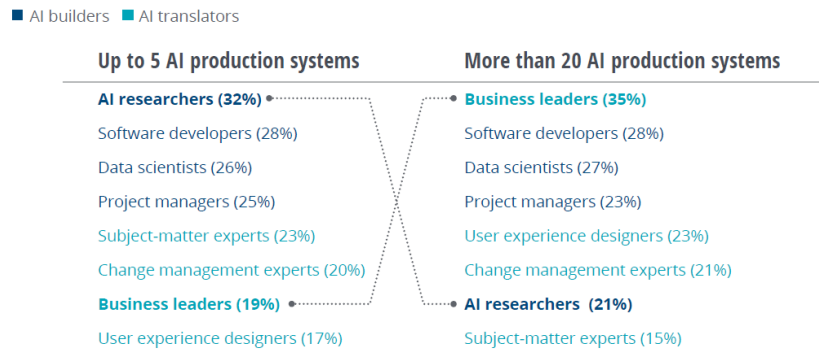


Figure 14: Top two skills needed by the companies in order to fill their Artificial Intelligence knowledge gap³¹

As most of the Romanian companies are at the beginning of their Artificial Intelligence journey - the most in demand skills remain AI researchers, Data Scientists and Data Engineers. According to an European Artificial Intelligence survey, two most important barriers for Artificial Intelligence adoption are "Lack of skills among existing staff" and "It is difficult to hire new staff with the right skills"³².

The "Big data management skills", "Machine learning or modelling skills" and "Programming skills" are the most in-demand skills:

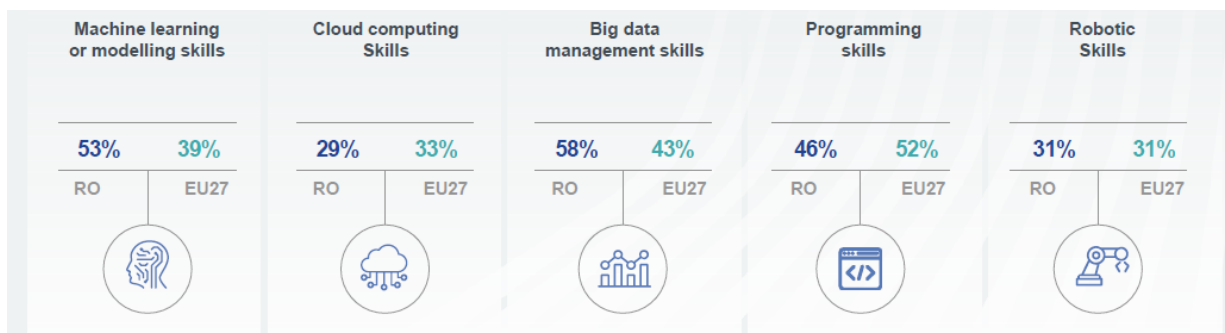


Figure 15 Romanian enterprises facing lack of skills as a barrier to AI adoption³³

³¹Talent and workforce effects in the age of AI, Deloitte Insights, Deloitte analysis based on Deloitte's AI in the Enterprise, 2nd Edition survey of 1900 AI early adopters in seven countries https://www2.deloitte.com/content/dam/insights/us/articles/6546_talent-and-workforce-effects-in-the-age-of-ai/DI_Talent-and-workforce-effects-in-the-age-of-AI.pdf

³² European enterprise survey on the use of technologies based on artificial intelligence, Eurostat, <https://ec.europa.eu/newsroom/dae/redirection/document/68488>

³³ Ibidem

An additional proxy indicator is the percentage of ICT specialists employed as % of total employment:

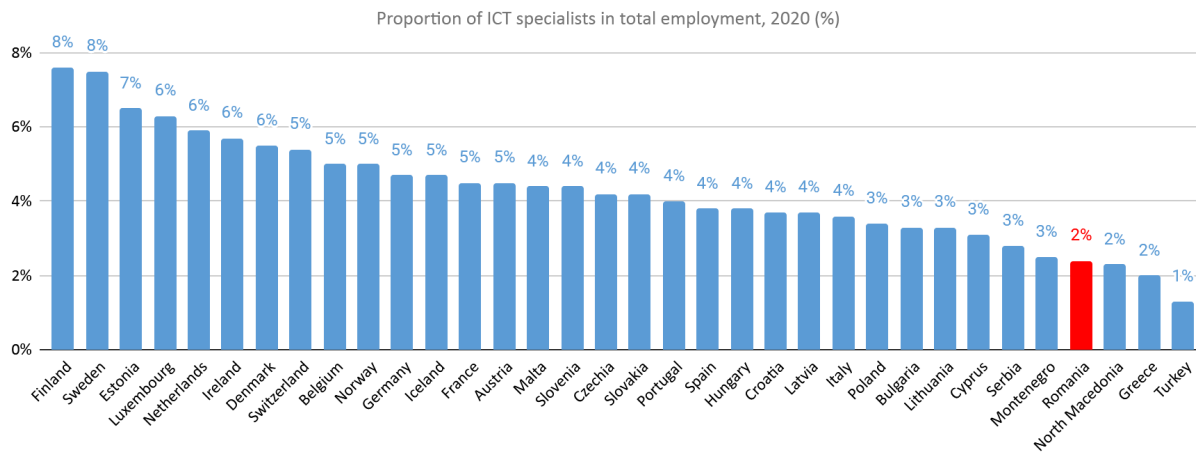


Figure 16 Proportion of ICT specialists in total employment, 2020 (%)³⁴

Romania has a low proportion of ICT specialists in total employment (2%) compared to Europe's baseline value (4%). By extrapolation, this indicates a low performance in regards to AI talent.

The Romania's future generations productivity is low and expected to be lower:

"A child born in Romania today will be 58 percent as productive when she grows up as she could be if she enjoyed complete education and full health. This is lower than the average for Europe & Central Asia region and High income countries. Between 2010 and 2020, the HCI value for Romania decreased from 0.60 to 0.58 ."³⁵

Implementing Artificial Intelligence solutions depends significantly on an educated and productive workforce; unfortunately Romania's low HCI value does not encourage a positive outlook in this regard.

Finally, from an outsourcing perspective Romania's outlook remains negative. Once the digital resonance factor was considered in the Kearney Global Services Location Index (GLSI) - Romania went down ten positions in 2019 (rank: 28) compared to 2017 (rank: 10).³⁶ In 2021 Romania score degrades even further (score: 32) being placed between Pakistan and Bangladesh.³⁷

³⁴ Based on data from Eurostat, Proportion of ICT specialists in total employment, 2020 (%), <https://ec.europa.eu/eurostat/databrowser/bookmark/2cb2b5ed-6e65-42d1-9061-1300f2690f90?lang=en>

³⁵ Worldbank, Human Capital Index 2020, October 2020, https://databank.worldbank.org/data/download/hci/HCI_2pager_ROU.pdf

³⁶ Kearney, The 2019 Kearney Global Services Location Index, <https://www.kearney.com/digital/gslis/2019-full-report>

³⁷ Kearney, The 2021 Kearney Global Services Location Index, <https://www.kearney.com/digital/article/?/a/the-2021-kearney-global-services-location-index>

In conclusion, from a talent availability perspective, the outlook for Romania is not positive (at least to the medium term). Romanian companies are mentioning that availability of skilled personnel is one of the highest barriers for business growth, Romania's HCI value is lower than Central Europe's average and Romania has a very low percentage of ICT employees compared to the total workforce. Also, Romania's attractiveness, from an outsourcing perspective, is in a continuous decline as well.

Governance Perspective

The moral, ethical and legal use of Artificial Intelligence is the foundation for social trust and adoption of this technology. In an unregulated environment Artificial Intelligence will raise the concerns of algorithmic discrimination, social bias, replacement of human jobs and fears related to protection of fundamental rights.

The importance of governance is recognized by the European Union in the proposed Artificial Intelligence Act that focuses on regulating the Artificial Intelligence usage over entire Europe:

"A Union legal framework laying down harmonised rules on artificial intelligence is therefore needed to foster the development, use and uptake of artificial intelligence in the internal market that at the same time meets a high level of protection of public interests, such as health and safety and the protection of fundamental rights, as recognised and protected by Union law."³⁸

At the time of writing (November 2021) Romania did not introduce any specific laws and regulation specific to Artificial Intelligence. However, in September 2020 the Chamber of Deputies adopted a decision to support a legislative framework that encourages Artificial Intelligence in Romania.³⁹ There are some important highlights in this decision:

- Imminent creation of a regulatory framework regarding informing the user about the Artificial Intelligence usage in mobile, digital and public services areas;
- Recognizes the importance for creation of an environment of trust for medical applications using Artificial Intelligence, so the risk of harm is minimized;
- Recognizes the need to support a formal and informal lifetime learning in the area of Artificial Intelligence, given the importance of this area in the global market;
- Recommends the standardization of data structures and data fluxes, recognized standardization as a central component in data driven economies;

³⁸ European Commission, Proposal for a regulation of the European parliament and of the council laying down harmonised rules on artificial intelligence (artificial intelligence act) and amending certain union legislative acts,

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206>

³⁹ Camera Deputatilor, HOTĂRĂRE nr. 28 din 8 septembrie 2020 privind adoptarea opiniei referitoare la Cartea albă - Inteligența artificială - O abordare europeană axată pe excelență și încredere - COM (2020) 65 (DECISION no. 28 from 8 September 2020 regarding the adoption of the opinion on the White Paper on Artificial Intelligence - A European Approach to Excellence and Trust), <http://legislatie.just.ro/Public/DetaliiDocument/229861> (in Romanian)

- Points out the necessity to ensure an ecosystem of supporting SMEs and startups, guaranteeing financing and market access schemes - so that they act as a catalyst in Artificial Intelligence adoption and value creation.

A special mention is given to the Agriculture sector; there is a recommendation that small farms from rural areas will be supported by Artificial Intelligence solutions.

Even so, from a conceptual perspective, the Romanian legislation does not provide any definition of Artificial Intelligence - thus making the mentioned highlights a relatively moot point.

The Artificial Intelligence algorithms are protected under the Copyright Law, the author rights being granted to the computer program itself (either in source or binary form) but not on the ideas and mathematical formulas behind these algorithms⁴⁰.

The Romanian legislation does not grant any legal status to, nor does it recognize the Artificial Intelligence personas. Therefore, any content produced by Artificial Intelligence is not protected by the copyright law (can be freely distributed and used); the Romanian legislation offers copyright protection only to creations (including software programs) belonging to natural persons.

Finally, there are no special legal provisions regarding the liability for damages generated by the usage of Artificial Intelligence. The issue of damage and liability would be covered by the provisions of the Civil Code, which in itself is poorly adapted to an environment in which Artificial Intelligence is a major factor. For example, the victim must demonstrate a causal link between the damage and the Artificial Intelligence system; this is very difficult as the Romanian legislation has no provisions for algorithmic explainability.

From a strategy perspective, there is no official strategy in regards to Artificial Intelligence. There are several strategies proposed or intending to be proposed by various actors such as the ones proposed by Romanian Business Leaders⁴¹, AI Romania⁴², AI4RO⁴³.

In conclusion, Romania is lagging behind in the area of governance in regards to Artificial Intelligence. While there are provisions for personal data protection (GDPR regulations), there is basically no legal framework applicable to Artificial Intelligence and its impact on society and economy. The protection against liability or unethical usage of Artificial Intelligence remains low - with no specific legal provisions to address such topics.

The Romanian Chamber of Deputies recognizes the need for regulation in regards to Artificial Intelligence; it remains to be seen if this will become a priority.

⁴⁰ Law on Copyright and Neighboring Rights, No. 8 of March 14, 1996, Chapter 9, <https://wipolex-res.wipo.int/edocs/lexdocs/laws/en/ro/ro007en.pdf>

⁴¹ Repatriot, RePatriot AI: Sprijinim elaborarea și implementarea Strategiei de Inteligență Artificială a României, <https://repatriot.ro/inteligenta-artificiala/> (document in Romanian)

⁴² AI Romania, Towards a national AI strategy for Romania, <https://www.airomania.eu/projects/ai-strategy>

⁴³ Business Review, An independent group of Romanian experts launches AI4RO, an initiative to supporting the development of Artificial Intelligence in Romania, <https://business-review.eu/tech/an-independent-group-of-romanian-experts-launches-ai4ro-an-initiative-to-supporting-the-development-of-artificial-intelligence-in-romania-216065>

Conclusions

At this point we have analyzed Romania's AI readiness from the standpoint of multiple dimensions: data, infrastructure, business, society, talent and governance.

We will briefly summarize the conclusions we reached in all these dimensions.



DATA

- **Relatively good access to open data;**
- **Good open data coverage in the areas of population, vital statistics and financial data.**

- **Poor data generation and collection capabilities;**
- **Overall low capabilities in regards with data processing and analysis.**

Romania scores relatively well in the area of open data access, especially in the areas of population, vital statistics and financial data.

Due to a very low integration of digital technology and digital public services, Romania scores significantly lower than the European average on dimensions related to data generation and collection, especially lower in regards with data processing and analysis.

OVERALL SCORE: **LOW**



INFRASTRUCTURE

- **Excellent connectivity capabilities, especially broadband connectivity;**
- **Broadband and mobile connectivity provided at low cost;**
- **Very good potential in regards with the activation and exploitation of the 5G technology.**

- **Low cloud computing technology usage in relation with Artificial Intelligence;**
- **The potential of 5G technology is not activated and utilized;**
- **Low connectivity coverage in rural and remote areas.**

Romania scores very well in terms of connectivity (especially broadband connectivity). It has great potential for the activation and exploitation of the 5G technology.

Even if many prerequisites are in place, the high connectivity capability does not seem yet to be used for Artificial Intelligence purposes (low scores on cloud, AI and IOT technologies usage).

OVERALL SCORE: **HIGH**



BUSINESS

- **Above EU average indicators for adopting Artificial Intelligence by the Romanian enterprises;**
- **Excellent perspectives for adopting Artificial Intelligence by (E)Commerce. Good perspectives for the Health and the Education sectors.**

- **Industry and Manufacturing sectors, along with the Agriculture, Fishing and Forestry have a lower potential for Artificial Intelligence adoption;**
- **Low complexity manufacturing outputs and low wages are deterrents for Artificial Intelligence and Automation adoption.**

Romania has a great potential for adoption of Artificial Intelligence by the business. It scores above EU27 critical indicators for Artificial Intelligence adoption by enterprises. From the business perspective, the services sector generates the most opportunities for Artificial Intelligence adoption. We estimate that the most opportunities are generated by the Commerce, Health and Education sectors. For now, the Industry & Manufacturing sectors are not generating significant opportunities for Artificial Intelligence adoption in Romania (that may change once the transition to Green Economy takes significant momentum).

OVERALL SCORE: MEDIUM



SOCIETY

- **The society is receptive to Artificial Intelligence technologies - neutral to favorable towards Artificial Intelligence;**
- **Excellent perspectives for adopting Artificial Intelligence by (E)Commerce. Good perspectives for the Health and the Education sectors.**

- **The low levels of digital skills is creating an impediment for adopting Artificial Intelligence by the society at large;**
- **The society has a low degree of information in regards to Artificial Intelligence - mostly coming from social media sources.**

Romanian society (at large) has a medium to low degree of understanding of Artificial Intelligence along with its impact in the society and economy. Society gets most of the information about Artificial Intelligence from social media (including the high degree of bias and hype associated with such sources). From the standpoint of public opinion, Romanian society is relatively favorable to a higher presence of Artificial Intelligence in day-to-day life. Respondents showed a relatively low concern related to adaptation to workplaces where Artificial Intelligence has a higher impact, even if there are some fears related to the disappearance of jobs and to the success chance in such workplaces.

OVERALL SCORE: MEDIUM



TALENT

- **There are valuable AI capabilities in universities, these can be leveraged via technology transfer;**
- **There are limited pockets of Artificial Intelligence capabilities, mostly in cities specialized in the IT outsourcing business.**

- **Lack of skilled personnel availability is one of the main impediments for Artificial Intelligence business growth;**
- **The projected productivity for future generations is rather pessimistic;**
- **Romania’s attractiveness for outsourcing is in a continuous degradation.**

From a talent availability perspective, the outlook for Romania is not positive (at least to the medium term). Romanian companies are mentioning that availability of skilled personnel is one of the highest barriers for business growth. Skilled personnel would rather work abroad or nearshoring.

Romania’s HCI value is lower than Central Europe’s average and Romania has a very low percentage of ICT employees compared to the total workforce.

Also, Romania’s attractiveness, from an outsourcing perspective, is in a continuous decline as well.

OVERALL SCORE: VERY LOW



GOVERNANCE

- **There is a stated interest from the legislative authorities to define a legal framework for Artificial Intelligence;**
- **There is a stated interest from the Romanian authorities for defining and implementing an Artificial Intelligence related strategy.**

- **The concept of Artificial Intelligence is not defined by the Romanian legislation;**
- **There are no specific laws that protect works created by Artificial Intelligence;**
- **There are no specific laws that protect consumers from the damages and misuse of Artificial Intelligence;**
- **There is no official strategy in regards to Artificial Intelligence adoption.**

Romania is lagging behind in the area of governance in regards to Artificial Intelligence. There is basically no legal framework applicable to Artificial Intelligence and its impact on society and economy. The protection against liability or unethical usage of Artificial Intelligence remains low - with no specific legal provisions.

The Romanian Chamber of Deputies recognizes the need for regulation in regards to Artificial Intelligence; it remains to be seen if this will become a priority.

Also - no official strategy in regards with Artificial Intelligence has been adopted at this point.

OVERALL SCORE: VERY LOW

A synthetic view of the status quo regarding the performance of Artificial Intelligence adoption in Romania, based on different performance dimensions, can be presented in the following form:

| Area | Very Low | Low | Medium | High | Very High | Trend |
|----------------|----------|-----|--------|------|-----------|-------|
| Data | | ■ | | | | = |
| Infrastructure | | | | ■ | | ▼ |
| Business | | | ■ | | | ▲ |
| Society | | | ■ | | | ▲ |
| Talent | ■ | | | | | = |
| Governance | ■ | | | | | ▲ |

Figure 17 Synthetic view of the coordinates related to Artificial Intelligence adoption in Romania

With a good performance on Infrastructure dimension and a medium performance on the Business and Society adoption (both on a positive trend) Romania shapes itself as a good consumer of Artificial Intelligence technologies. In other words, Romania has a good potential to become a good market for Artificial Intelligence solutions.

This potential is hampered - for now - by a very low performance on the Governance area which may lead to distrust and abuse in regards with Artificial Intelligence usage.

We will analyze the Romania's status quo in regards with Artificial Intelligence from the perspective of the two major pillars: excellence and trust⁴⁴.

From the excellence perspective: the low performance on Data and Talent dimensions creates an environment which is not favorable to Artificial Intelligence solutions development. This situation is amplified by the low interest of Romanian companies to invest in creative Artificial Intelligence solutions (basically a low interest in R&D for Artificial Intelligence).

Consequently, Romania's potential to become an Artificial Intelligence solutions developer is low. Romania lacks the necessary sophistication for meaningful data collection and processing, it lacks the critical mass of skilled personnel (talent), thus it is unlikely to create a vibrant industry based on Artificial Intelligence solutions development. Still, there is a possibility that we may witness the occurrence of fast growth and highly valuable startups (i.e. financial unicorns⁴⁵), yet these occurrences will be extremely rare and with minimal impact on the overall economic situation.

From the trust perspective: the low performance on the Governance dimension does not favor a trustworthy environment in regards with the Artificial Intelligence utilization.

⁴⁴European Commission, A European approach to artificial intelligence, <https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence>

⁴⁵Investopedia, Unicorn, <https://www.investopedia.com/terms/u/unicorn.asp>

The current Romanian legislation does not offer an adequate protection to consumers in regards with the liabilities associated with the Artificial Intelligence usage; this may raise the concerns of algorithmic discrimination, social bias, replacement of human jobs and fears related to protection of the human fundamental rights.

Regarding the protection of Artificial Intelligence algorithms - they are protected as programs (either source or binary form), however the concepts and mathematical formulas behind these algorithms are not protected by author rights. Furthermore, the content generated by Artificial Intelligence is not protected at all - there is no legal status for Artificial Intelligence personas. The Romanian legislation does not even have a clear definition for the Artificial Intelligence concept, making legal provisions in regards with Artificial Intelligence a moot point (incidentally, the European Union has a general definition of the Artificial Intelligence concept⁴⁶).

In conclusion, Romania's profile is that of an importer of Artificial Intelligence solutions with a low level of protection for users and consumers.

We foresee an increased demand from both the economy and the society for Artificial Intelligence solutions; Romania does not have the capabilities to create meaningful Artificial Intelligence solutions at scale. There is an opportunity however for Romanian companies to address the segments with a lower demand of specialization such as customizing & integrating off-the-shelf solutions or data collection and processing. As Artificial Intelligence will continue its democratization trend, Romania may create a future niche to occupy and expand.

It is however imperative for the Romanian legislature to elaborate a legal framework for Artificial Intelligence in order to ensure an environment of trust and predictability. First of all, it should protect the legitimate interests of users and consumers against misuse and liabilities associated with Artificial Intelligence; subsequently it must ensure a solid protection for the interests of the investors and developers of Artificial Intelligence algorithms and products.

Looking forward, Romania has a good potential for Artificial Intelligence adoption, even if this potential may not be fulfilled by the Romanian companies. In time and with good stewardship Romania's Artificial Intelligence industry has a good chance to find a niche and develop as well.

⁴⁶ The European Commission's, High-level expert group on Artificial Intelligence, A definition of AI: main capabilities and scientific disciplines, https://ec.europa.eu/futurium/en/system/files/ged/ai_hleg_definition_of_ai_18_december_1.pdf