# UKRAINIAN MARKET OF ARTIFICIAL INTELLIGENCE: A SURVEY OF ATTITUDES AND MAJOR PROBLEMS

by

Oksana Sida

A thesis submitted in partial fulfillment of the requirements for the degree of

MA in Business and Financial Economics

Kyiv School of Economics

2021

Thesis Supervisor: Professor Tymofii Brik

Approved by _____
Head of the KSE Defense Committee, Professor [Type surname, name]

_____

_____

_____

Date _____

# ACKNOWLEDGMENTS

The author wishes to thank Tymofii Brik for his inspiration and support as a Thesis Supervisor; Oleg Ivanytskyi for his recommendations during the questionnaire development and every person who shared the information about the survey and take part in data collection. Without these people, the paper would not be completed.

TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ABBREVIATIONS

**AI** Artificial intelligence

**BRDO** Better Regulation Delivery Office

**EU** the European Union

**IDC** International Data Corporation

**NLP** Natural Language Processing

**PISA** Programme for International Student Assessment

**USA** United States of America

# CHAPTER 1. INTRODUCTION

Artificial intelligence is becoming a common notion nowadays. Even if a person can't explain what Artificial intelligence is, at least everybody has heard this collocation. Frankenfield indicated that the first thing people think about Artificial intelligence is robots. It is due to fiction books and popular movies, that a lot of people tend to believe that Arftificial intelligence is a human-like robot. But it is the time when science fiction becomes science facts. Dillon stated that reading fiction literature helps scientists to diversify the methodological approaches they apply.

The notion of Artificial intelligence first appeared in 1956. At that time people started to explore how computers could solve problems on their own. During the 1980s-2010s, Machine Learnings got popular. And currently, the Deep Learning process is extremely developing.

Artificial intelligence is doubtless a technology of the present and future. McKinsey Global Institute analysis estimated that the adoption of AI could lead to annual productivity growth of about 0.8% - 1.4% for the period 2015-2065. It is rather high in comparison to the previous stages of human development, indicating that the productivity growth from the steam engine was 0.3% and from early robotics is was just 0.4%.

The development of technology bears the fear of widespread automatization of people works. PwC presented the number of 44% of workers with low education to be at risk of automation by the mid-2030s. At the same time Acemoglu presented the idea of two separate effects, he stated that the replacement effect goes together with the productive effect that foreseen the increase in labour demand due to the AI and robotics development. At the same time, the problem of lack of AI specialists is of high importance and could retain the sector development.

Ukraine tends to move alongside worldwide development. And at the end of 2020, the Cabinet of Ministers of Ukraine adopted the Concept of Artificial intelligence development. Thus AI is going to become one of the priorities in the field of science and technology research. The Concept covers AI development in the following spheres: education, science, economics, cybersecurity, information security, defence, public administration, legal regulation and ethics, justice. The Concept implementation is due for the period up to 2030. During this period it is expected for Ukraine to take the leading position in the world scientific environment in the field of AI.

Ukraine moves towards establishing Diia City, a legal framework for the IT industry. People attitude regarding this issue is quite controversal.

In the framework of this paper, there was conducted a survey (in the form of a written questionnaire) to find out the people attitude regarding main problems of the AI market. The main questions of study are the lack of AI specialists and the perception of Diia City. The respondents are the owner/co-owner of employees of the companies that work on AI technology development.

# CHAPTER 2. INDUSTRY OVERVIEW AND RELATED STUDIES

Since the very beginning in 1956, the sphere of Artificial intelligence has been developing all the time.

## 2.1. Economic sector

The Artificial intelligence sector has a great impact on the economy. In the research of PwC, it is indicated, that global GDP could increase by 14% in 2030 due to the AI sector. That is equivalent to an additional $15.7 trillion.

Chen et al. (2016) in 'Global economic impacts associated with artificial intelligence' indicated both direct and indirect aspects that may influence the profound GDP growth due to the AI development. The direct aspect covers the upgrowing change in revenues and employment of the companies that develop AI technologies and indirect aspect cover the increase in revenues of the companies that use the AI technologies in their operation processes. Thus, all the sectors of economy will feel the impact of the AI.

It is not a surprise, that the COVID-19 pandemic caused the AI market to face a slow down in its growth. Still, IDC company predicts the market to reach $500 bln in 2024. And stated the growth in 2020 by 12.3% in comparison to 2019.

Currently, the development of all the countries is not equal. So such a tendency will remain. As PwC suggested, the economy in China would increase the most (up to 26% GDP in 2030). The economy of North America is going to be on the second place (up to 14% increase). The sectors that will gain the most due to AI technologies are retail, financial services and healthcare. The research Global Market Insights highlighted that the usage of AI technologies in healthcare is going to increase by 40% a year in the period of 2017-2024.

AI technologies are used in different spheres to increase productivity, quality and consumption.

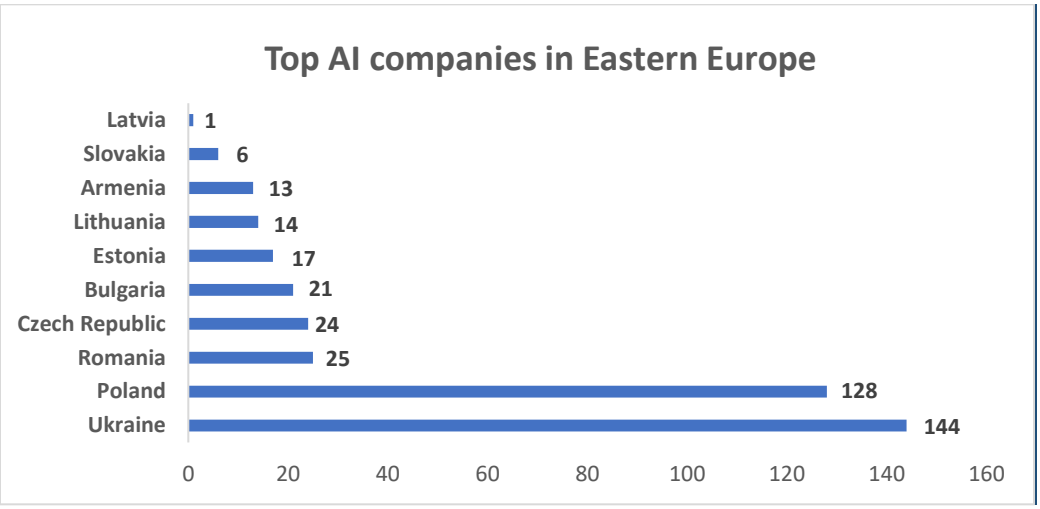
The Cabinet of Ministers of Ukraine even adopted the Concept on the Artificial intelligence development on December 2, 2020. It is stated there that Ukraine should occupy a significant segment in the world market of artificial intelligence technologies.

Consequently, the Ministry of Digital Transformation of Ukraine developed a concept of Diia City (Digital Country), a new legal framework for IT industry. It is aimed to become a virtual country for IT sphere and a place for unlimited investments. It is foreseen for resident companies to steep to special conditions and provide annual audits but at the same time have special defined taxes and special agreement for employees (GIG-agreements). In summer 2021 the first step of Diia City road map was completed: the President of Ukraine signed the Law of Ukraine No. 1667-IX on Stimulation the Development of the Digital Economy in Ukraine. The launch of the Diia City is foreseen for January 2022. By that time there should be the adoption of the Draft Law No. 5376 on Amendments to the Tax Code of Ukraine to Stimulate the Development of the Digital Economy in Ukraine; the adoption of the amendments to the Criminal Procedure Code of Ukraine; and completion of development of regulatory framework of the special regime. The Ministry of Digital Transformation of Ukraine states that the idea of Diia City is already supported by European Business Association, the Federation of Employers of Ukraine, the American Chamber of Commerce and the following companies EPAM, Ajax, Sigma Software, Reface, Genesis, and Laverex.

In 2021 Clutch, the leading rating and reviews platform for IT, Marketing and Business service providers, has listed 393 companies as Top Artificial Intelligence Companies in Eastern Europe that provide services on developing AI sollutions (see Appendix). This region includes the following countries: Armenia, Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia and Ukraine. There are 37% (144) of companies from Ukraine in the list, so Ukraine has a leading position here.

Poland is on the second place with 33% and 128 companies. Romania is on the third place with 6% and 25 companies (see Figure 1).

Figure 1. Quantity of Top Artificial Intelligence Companies in Eastern Europe (by countries)




Source: Clutch website

Ukraine and Poland host 70% of all the companies in the region (see Table 1).

Table 1. Quantity of Top Artificial Intelligence Companies in Eastern Europe (by countries)

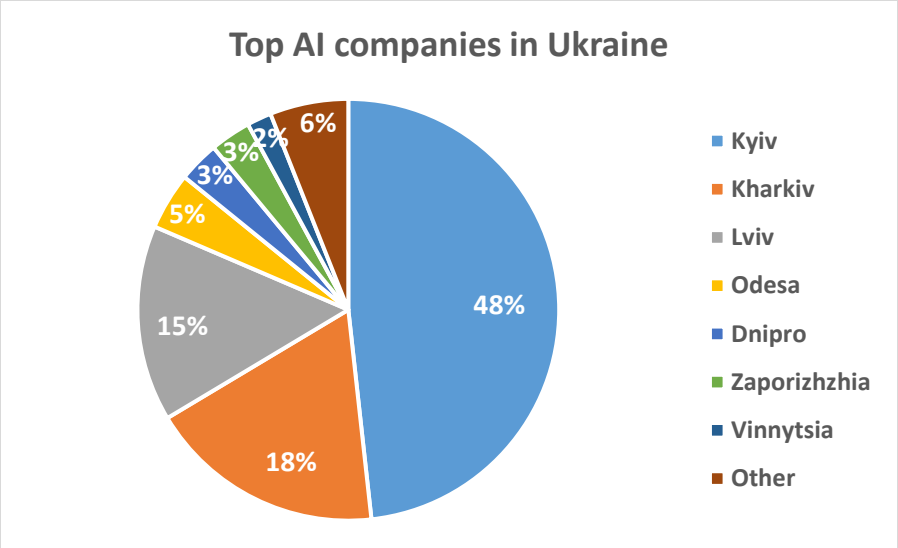
| No. | Country | % |
|---|---|---|
| 1 | Ukraine | 37% |
| 2 | Poland | 33% |
| 3 | Romania | 6% |
| 4 | Czech Republic | 6% |

| | | |
|---|---|---|
| 5 | Bulgaria | 5% |
| 6 | Estonia | 4% |
| 7 | Lithuania | 4% |
| 8 | Armenia | 3% |
| 9 | Slovakia | 2% |
| 10 | Latvia | 0,25% |

Source: Clutch website

Currently, there are 144 companies from Ukraine on the list that can help the business with realizing the AI solutions. The list represents the companies from 16 cities. Kyiv, Kharkiv and Lviv covers more than 80% of all the presented companies. Kyiv itself covers practically 50% (see Figure 2).

Figure 2. Quantity of Top Artificial Intelligence Companies in Ukraine (by cities)




Source: Clutch website

9 cities were represented only by 1-2 companies and were placed in the category "other". They are Sumy, Cherkasy, Chervonohrad, Kherson, Khmelnytskyi, Klevan, Kropyvnytskyi, Kremenchuk and Uzhhorod (see Appendix A).

All the list of Top Artificial Intelligence Companies (presented by Clutch Company) is made up of 3089 companies that represent 89 countries (see Table 2). Taking into account the total quantity of presented companies, it is visible that Ukraine occupies the profound fourth place. The leaders of the Clutch list are United States, India and United Kingdom.

Table 2. Quantity of Top Artificial Intelligence Companies (by countries)

| **No.** | **Country** | **Quantity** | **%** |
|---|---|---|---|
| 1 | United States | 784 | 25% |
| 2 | India | 505 | 16% |
| 3 | United Kingdom | 274 | 9% |
| 4 | Ukraine | 144 | 5% |
| 5 | Poland | 128 | 4% |
| 6 | Canada | 119 | 4% |
| 7 | Australia | 91 | 3% |
| 8 | Germany | 64 | 2% |
| 9 | Pakistan | 55 | 2% |

| | | | |
|---|---|---|---|
| 10 | Belarus | 44 | 1% |
| 11 | Russia | 42 | 1% |
| 12 | Other 78 countries | 839 | 27% |

Source: Clutch website

In 2019 LegalHub.Online indicated that there were only 28 companies from Ukraine in the Clutch list. Thus the quantity of Top Artificial Companies (in Ukraine) has increased 5 times in 2 years.

The AI market has great potential to continue the steady development in Ukraine as well as in other countries. The number of specialists is considered to grow, taking into account the capacity building by opening new departments at the universities and collaboration of the IT companies.

## 2.2. Political/legal sector

At the end of 2020, the Concept on Artificial intelligence development that was adopted by the Cabinet of Ministers of Ukraine. It states the plan for the period of up to 2030 and covers the following spheres: education, science, economics, cybersecurity, information security, defence, public administration, legal regulation and ethics, justice. In accordance with the Concept, AI is going to become one of the priority in the field of science and technology research in Ukraine.

It is planned for Ukraine to implement the requirements and norms stated in "Recommendations on Artificial Intelligence" (adopted by OECD in June 2019).

In December 2018, the European Commission for the Efficiency of Justice adopted the 5 fundamental principles entitled "European Ethical Charter on the use of AI in the judicial systems and their environment" (Principle of respect for fundamental rights, Principle of non-discrimination, Principle of equality and security, Principle of transparency, impartiality and fairness, Principle "under user control")

Such recommendations appears as Artificial intelligence has unstudied opportunities and this unpredictability is bearing some fears.

In 2018 there was a survey on AI conducted by Gorshenin Institute in Ukraine. During face-to-face interviews with 1000 respondents, they found out that 20% of respondents think that AI is a threat for humanity. 3% believe that people should completely stop all the developments in the AI field.

In April 2021, the European Commission proposed new rules for AI use. This is the first legal document that stated that AI should ensure safety and trust. Margrethe Vestager, Executive Vice-President for a Europe fit for the Digital Age, said: "On Artificial Intelligence, trust is a must, not a nice to have. With these landmark rules, the EU is spearheading the development of new global norms to make sure AI can be trusted. By setting the standards, we can pave the way to ethical technology worldwide and ensure that the EU remains competitive along the way. Future-proof and innovation-friendly, our rules will intervene where strictly needed: when the safety and fundamental rights of EU citizens are at stake." The similar concerns of using AI technologies like scanning people in public places where voiced by the U.N. and the administration of President Joe Biden. Together with the development of AI technologies, fundamental human rights should be guaranteed.

Cave et al. in a survey "Scary Robots" in 2019 investigated the AI perception of UK population (1078 respondents) and outlined that 61.8% of respondents disagreed that they are able to influence how AI develops in the future. They stated that the attitude to AI could vary across countries and cultures.

## 2.3. Social sector

The Concept on Artificial intelligence development indicated a number of problems that we have in Ukraine and should deal with at the beginning. Unfortunately, there is a low level of digital literacy in Ukraine. People are not aware of the general aspects, opportunities and risks that AI could bring.

The stream development of AI may highly increase the Unemployment rate. Some jobs may be substituted by new technology. And this arises a problem of further people requalification. That is why it is planned in Ukraine to develop a road map for requalifying people whose work could be automated in the best 5-10 years.

Westerlund in her survey in 2020 investigated public opinion stated in comments to four online news articles about smart robots (320 comments) and concluded that effect on labour is among Top-3 topics that were raised besides Apocalyptic threat and Killer robots. The overall tone was remarkably negative.

McKinsey stated that AI intelligence could be applied in the following industries: advanced electronics/semiconductors, aerospace and defence, agriculture, automotive and assembly, banking, basic materials, chemicals, consumer packaged goods, healthcare systems and services, high tech, insurance, media and entertainment, oil and gas, pharmaceuticals and medical products, public and social sector, retail, telecommunications, transport and logistics, travel.

An increase in the unemployment rate is a serious issue that evokes fear regarding the development of artificial intelligence. Two opposite scenario could take place, as it is mentioned by Acemoglu and Restrepo. Some jobs that are performed by people now, could soon be performed by robots or AI technologies. It is a replacement effect. Still, while considering the rapid technology development from history, that implied an increase in labor demand. So further development in AI and robotics could increase labor demand

as well. Thus it will be a productivity effect. More employees will be needed for non-automated tasks. Nevertheless, there will be a need for people to acquire new skills in order to match the new positions. The issue of acquiring wrong skills now could bring a problem with requalification later.

PwC in their survey "Will robots really steal our jobs?" indicates that people need to investigate the education sector and invest more there in order to make it easier for people to match the available jobs in future. It is of high importance to apply STEM methodology to the education process. The results of the survey also showed that 37% of respondents (10 000 respondents) are worried about automation putting jobs at risk (there was 33% in 2014). 73% think that technology can never replace the human mind.

The necessity of requalification could soon become a reality for numerous of people. Michael Gibbs in his work stated that technology could either complement the employees and increase their ability to perform some tasks or substitute employees and automate some or all the tasks. Though employees won't have to fulfill routine manual task and it is believed (as PwC stated) that the jobs will become easier. The AI development will bring new job positions. In the Future of Jobs report 2020 (World Economic Forum), it is estimated that due to automation process there will be created 97 million jobs but 85 million jobs will disappear. Still, the creation could be a bit later after the disappearance.

The automation process depends greatly on geography issue. Because of big population and not big number of robots currently used, PwC estimated that China has far limited ability to automate essential part of its workforce by 2030.

Usage of AI technologies could be beneficiar for the companies. McKinsley highlighted that at first companies should understand the point where they currently are and from this point consider how the situation could become different, what the advantages of automation are, how would the cost, throughput, quality and customer

satisfaction change. Understanding of the situation and vision of the future, at least the nearest one, are essential preconditions for change to start.

## 2.4. Potential problems of the sector

The above stated information lead to defining the separate issues that could be further investigated while studying the AI sector of economy in Ukraine.

Nowadays the common issue to study in any sector of economy is Gender gap. It covers the quantity of female versus male employees and the difference in wages on the same position.

A survey conducted by PISA in 2018 stated that there was no difference in knowledge of Mathematics among 15-year old girls and boys in Ukraine. At the same time as it was indicated by CEDOS in 2020 only 23% of all the girls that continued studying entered STEM specialties. Globallogic informed that there were 25% of female working in IT in comparison to male in 2020 and the number of women became higher by 79% in comparison with 2015.

There are other facts that differ the situation, in the Future of Jobs report 2020 (World Economic Forum) it was presented that unemployment rate in the USA at the beginning of the COVID-19 pandemic (December-April 2020) increased by 11% among women and by 9% among men. In Germany the figures were twice different – 1,6% for women's unemployment rate and 0.8% for men's.

Another issue covers the Education. Together with constant development, the market is going to face a bottleneck problem of lack of specialists. Still, BRDO has estimated that in 2024 the number of IT graduates is going to increase by 23% in comparison with 2020. But such an increase will not cover the needs of the sphere.

A poor quality of knowledge is another problem. PISA-2018 highlighted that 38% of people were not able to demonstrate the basic knowledge of Mathematics. In order to improve the situation and to diminish the skills gap, there could be organize the cooperation between universities and IT companies (e.g. by GlobalLogic, SoftServe), trainings for professors and additional studies, organized by the companies (e.g. Intel, Facebook, Google, Microsoft). It is of great importance that students receive quality knowledge from their professors, that is why such study trainings (e.g. organized by EPAM) are the investments into future. At the same time there are cases when professors changed their work at the universities for work at the companies with much higher salary – but such a decision is only a solution for a short period of time, without these professors there would be less students prepared for the further work.

An AI Index survey in 2020 highlighted that the investment in AI education at the world best universities increased over the last years. Still, the research conducted by the Kaggle company showed that only 30% of people working in AI market studied data science or machine learning at the universities and most of respondents get basic knowledge via online-courses.

The change of the environment implies the change of the people skills. Such an adaptation is needed not only for people who are in processes of job finding, but for everybody. Future of Jobs report 2020 (World Economic Forum) indicated that among the skills that will be required are critical thinking and analysis, active learning, problem-solving, self-management, stress tolerance and flexibility. It is also stated that great number of employers already realize that investment into the process of reskilling their employees will bring benefits in upcoming future.

The bottleneck problem of the AI sphere development is insufficient quantity of skilled people in the field. According to the Tractica research, the AI market will reach $105,8 billion in 2025, in 2008 it was just $8,1 billion, so the issue of specialists shortage

will remain. Currently, the average time for finding a person for AI vacancy is more than 100 days.

DOU stated that Ukraine is losing 3%-4% of its specialists every year because of labour migration.

The companies where AI solutions are developed are subdivided into product companies or outsource. Business should always arise a question of profitability and business development. Founders of Grammarly, one of the best-known product company that uses AI technologies and was found in Ukraine, Maksym Lytvyn, Oleksii Shevchenko and Dmytro Lider are among 100 richest people in Ukraine (Forbes). Thus, the business with an idea could lead to great benefits. So, there is a dilemma whether the product company or an outsource one is a better choice to set the business.

At the same time more companies and spheres require the AI solution for their need. Gartner highlighted that the number of companies that use AI solutions in their work increased by 270% during the period 2015-2019. So, the need in outsourcing companies continue to grow.

Rules of AI usage for people safety. The question that arises is whether should people interfere into development and control the process or not. In spring 2021 the European Commission presented draft regulations to be used in the EU. They aim to ensure that AI is used fairly and ethically and that legal, reputational and commercial risks are minimized. Blumberg Capital highlighted that 52% of consumers don't believe that their private information will be protected in case of use of AI technologies. The adoption of the norms could potentially lead to diminishing the speed of AI development.

Another issue is launching Diia City. A new legal framework for IT industry that was developed by the Ministry of Digital Transformation of Ukraine is currently thought not to be obligatory. The Ministry states that Diia City could increase the development of AI sector and Ukraine in general. Right now, a number of companies doesn't have official

employees, specialists are hired as private entrepreneurs and minimum taxes are paid. Special conditions are foreseen for the employees and companies. With GIG-agreements employees will have to pay higher tax than common 5% as private entrepreneurs. Still, addition money that the government may receive via taxes could be reinvested into the development of education system and infrastructure projects.

The listed potential problems are the issues for deeper studying within specific conditions. Considering the above stated information, it was decided to narrow the question of study for this paper to the problem of the lack of specialists and at the same time to distinguish the general attitude towards the potential changes of the future work framework due to the implementation of the Diia City.

# CHAPTER 3. METHODOLOGY

Information that was indicated in the previous chapter shows that the AI market has several issues that could be deeper investigated.

In order to collect data, it was decided to hold a survey. A survey is a great tool when there is a desire to find out "factual information relating to a group of people: what they do, what they think, who they are" as Denscombe highlighted.

Kraemer stated three main characteristics of the survey 1) survey helps to provide a quantitative description, 2) data is collected from people and in such a way survey is always subjective, 3) the obtained results are interpreted for the entire population.

Though the results of the survey are estimates and do not show the exact information of the population, it helps to discover additional details and find out the correlation.

The written survey in the form of a questionnaire was used for the paper (in Ukrainian). The survey was aimed at finding insider information as the respondents might be owners/co-owners or employees of the companies that work with the development of AI technologies.

The issues for further investigation were narrowed to the following questions:

1) The problem of specialist shortage

2) Attitude to Diia City

The first problem of specialist shortage is tending to be a bottleneck problem of the sphere development. At the stage of questionnaire development, it was decided to

outline the sub-issue of the readiness of respondents to participate in the educational process in order to change the situation with the lack of specialists in the market.

Thus, the questionnaire was structured in such a way that it was possible to gather general information about the respondent, general information about the company he/she works for and specific information for the questions of studying.

First of all, the respondents were divided into two groups by their status: whether they are owners/co-owners or employees. There was a block of questions similar to both groups and several questions just for the owners of the companies and a few questions only for employees.

The general information about the company and about the respondents was collected to be used as independent variables in the regression.

The first step of preparation for the survey is defining the dependent and independent variables that would be used in regressions. In order to investigate the above-stated questions of studying, it was decided to add the following questions and to use the answers as the dependent variables:

1) Does your company feel the problem of shortage of skilled specialists? (Yes/No)

2) Would you like to join the process of education improvement (teach at university, give lectures, create your own studying materials, etc.) (Yes/No/Have already joined)

3) Do you support Diia City (from 1 to 5, where 1- totally against, 5- fully support)

The first regression for studying the problem of the shortage of skilled specialists will proceed with the probit regression. As the answers to the question "Does your

company feel the problem of lack of skilled specialists?" are Yes and No. The regression will be the following:

$$Probit\ (\text{Shortage of skilled specialists}) = \mathrm{F}(x1\beta1 + x2\beta2 + x3\beta3 + x4\beta4 + x5\beta5 + \varepsilon)$$

where:

$x1$ – owner or employee

$x2$ – city

$x3$ – outsource or product company

$x4$ – company focus on AI technologies (100%, more than 50%, 50%-50%, less than 50%)

$x5$ – number of employees

To find more information on the influence on people willingness to join the process of education improvement, the following regression will be used

$$Probit\ (\text{Willingness to join the process of education improvement}) = \mathrm{F}(x1\beta1 + x2\beta2 + x3\beta3 + x4\beta4 + x5\beta5 + x6\beta6 + x7\beta7 + x8\beta8 + x9\beta9 + x10\beta10 + x11\beta11 + x12\beta12 + \varepsilon)$$

where:

$x1$ – owner or employee

$x2$ – age

$x3$ – gender

$x4$ – city

$x5$ – outsource or product company

$x6$ – company focus on AI technologies (100%, more than 50%, 50%-50%, less than 50%)

$x7$ – education (higher, unfinished higher, specialized secondary, secondary)

$x8$ – IT education (yes/no)

$x9$ – permanent work in this sphere (yes/no)

$x10$ – experience

$x11$ – salary

$x12$ – support of Diia City

To study the aspect that may influence the people to decide on the support of Diia City, the following regression will be run:

$$Probit\,(\text{Support of Diia City}) = \mathrm{F}(x1\beta1 + x2\beta2 + x3\beta3 + x4\beta4 + x5\beta5 + x6\beta6 + x7\beta7 + x8\beta8 + x9\beta9 + x10\beta10 + x11\beta11 + x12\beta12 + \varepsilon)$$

where:

$x1$ – owner or employee

$x2$ – age

$x3$ – gender

$x4$ – city

$x5$ – outsource or product company

$x6$ – company focus on AI technologies (100%, more than 50%, 50%-50%, less than 50%)

$x7$ – education (higher, unfinished higher, specialized secondary, secondary)

$x8$ – IT education (yes/no)

$x9$ – permanent work in this sphere (yes/no)

$x10$ – experience

$x11$ – salary

$x12$ – desire to join the process of education improvement

A survey is a great opportunity for receiving additional information that at the first sight is out of the scope of the current study. At the same time, the obtained information could broaden the result or could become a starting point for further study. Thus, to get a better understanding of the market, the questionnaire included additional questions:

- Where have you acquired professional skills for your work (university/ on my own/ courses/ trainings at IT companies/ other)

- What skills do candidates lack (technical education, ability to take responsibility, team work, specific technical knowledge, creative problem solving, knowledge of English, experience, desire to learn, self-consistency, leadership, other)

- What is the sphere you have come from?

- Why have you chosen this sphere?

- How can the government support the development of AI technologies?

- What problems did you face while setting up a company? (for owners/co-owners)

- We would be grateful if you could honestly share the problems that hinder the development of the company

- A significant number of IT specialists work under a simplified tax system. Given the efficient use of the government budget, what should be the tax for employees to pay? (5%, 9%, 22%, other)

- What is your job and position (for employees)

Open questions were not obligatory to answer. The questionnaire could be found in Appendix C.

# CHAPTER 4. DATA

The questionnaires aimed to reach employees and owners/co-owners of the companies that work on the development of AI technologies. The distribution of the questionnaire started from the list of the companies that are found on the Clutch website as Top Artificial Intelligence Companies in Ukraine (see Appendix B). These are the companies that could help with the development of AI solutions. They are mostly outsourcing companies. Currently, the list includes 144 companies from 16 cities in Ukraine. The majority of the companies are located in Kyiv, Kharkiv and Lviv.

The second source of distribution was the placement of the announcement about the survey on DOU website (a popular website on IT). The announcement was read by more than 150 visitors.

The third way of distribution was social media (Facebook, LinkedIn and Telegram). An announcement was placed on personal pages (without giving a direct link – in order to avoid the possibility of reaching the respondents that do not work in this sphere), was sent to AI groups, AI companies and individually to people working on AI technologies.

Altogether 58 answers were collected. 11 company owners and 47 employees participated in the survey. The majority of respondents are pretty young, aged 18-24 (33%). Still there were present people aged 25-30 (26%), 31-35 (17%), 36-40 (21%) and 41-50 (3%).

The majority of people working in the IT sphere are male, the same situation is with our sample – 77,6% are male respondents.

The sample covered the representatives from Kyiv, Kharkiv, Lviv, Vinnytsia and Cherkasy. Two respondents are likely to currently live abroad (one person answered that

he is from London and the second asked why there are only cities from Ukraine mentioned in the answer). The majority is from Kyiv – 69%.

Though, at first, there was a focus on outsource companies as the list of Top AI companies in Ukraine (on Clutch website) presented companies that could provide services of AI development, 62% of respondents work for product companies.

24% of respondents work for companies that focus only on AI technologies. 7% work for companies with a focus on AI technologies of more than 50%, 21% of respondents – focus on AI technologies is near 50% and 41% work for companies with a focus of less than 50%.

90% of respondents got higher education, around 9% have unfinished higher education and around 2% have secondary education. 62% of respondents have IT education. But only 5% stated that they have acquired professional skills for their work only at university.

45% of respondents have changed their specialization and came from another sphere. As for the experience, 24% of respondents work in the sphere up to 2 years, 33% - 2-5 years, 17% - 5-10 years and 26% - more than 10 years.

# CHAPTER 5. RESULTS

## 5.1. Information upon open questions

The open questions in the questionnaire provide extra information about the respondents and the market in general.

The question "Why have you chosen this sphere" provided the statements that it is really interesting, the AI market is developing and the compensation is high.

The question "How can the government support the development of AI technologies?" provided the following statements:

- Not to interrupt
- To make it possible for IT companies to provide technical support to government initiatives
- To improve the system of education. To add practical cases given by the AI specialists to university programs. To encourage universities to open AI specialties and add AI subjects into the program. To support best students with additional scholarship
- To provide research grants (like NLP for Ukrainian)
- To make available data free for use and analysis
- To ensure rule of law
- Simplify the process of company opening, decrease tax burden and increase investments. To have better conditions for start-ups. To have state venture funds for start-ups

- To make data-driven governing. To use AI technologies at state enterprises
- To develop state programs for specialists' requalification
- To organize competitions and hackathons.
- State banks could set special credit terms for AI companies to give incentives to set up new companies

Via the question "What problems did you face while setting up a company?", the owners shared the information that some of them had problems with lack of technical knowledge, with people (employees and co-owners), with defining the sales channels and (technical) problems with the Tax office.

I asked respondents to share the problems that hinder the development of the company and ideas were the following:

- It is better to have long projects. Such projects help to retain employees and broaden one's skills.
- Lack of specialists (both employees and co-owners)
- Because of the high complexity of the area – there are few real projects and customers. More often the orders are R&D than true engineering. There are few interesting business tasks on the world market.
- The problem with personal data – there are legal obstacles
- Lack of data
- Data collection is a crucial issue. It is of high importance and there should be investments into the data collection process.

- There is no investment market
- Not good enough image of Ukraine (with corruption and war) and outsource in general (because of India and Philippines experience)
- There is no ecosystem for creating products
- High price of specialists and equipment
- When the task is new and not studied yet, there is an opportunity for failure.
- Government

5.2. Regression: lack of skilled specialists

Probit regression model with dependent variable "lack of skilled specialists" (yes==0, no == 1) and independent variables: owner/employee, city, outsource/product company, company focus on AI technologies (100%, more than 50%, 50%-50%, less than 50%), number of employees, lack of specific skill (basic technical education, ability to take responsibility, team work, specific technical knowledge, creative problem solving, knowledge of English, experience, desire to learn, self-consistency, leadership) shows that

- People who think that candidates lack specific technical knowledge are more likely to feel that their company have a problem with lack of skilled specialists
- People who think that candidates lack experience are more likely to feel that their company have a problem with lack of skilled specialists

The rest variables in this model turned to be statistically insignificant. Altogether, 55% of respondents think that candidates lack specific technical skills and 40% think that

candidates lack experience. Practically 76% of the sample stated that the company they work for, feels the problem of lack of skilled specialists.

Table 3. Results of Regression: lack of skilled specialists

| Coefficients | Estimate |
|---|---|
| Employee | 1.8331 |
| Basic technical education | -0.7092 |
| Ability to take responsibility | -1.2910 |
| Team work | -0.8736 |
| Specific technical knowledge | -1.6510 * |
| Creative problem solving | 1.1030 |
| Knowledge of English | -0.5061 |
| Experience | -1.5071 . |
| Desire to learn | -0.6570 |
| Self-consistency | 0.5760 |
| Leadership | -0.4170 |
| Other skills | -2.4827 |
| Kharkiv | -0.3916 |

| | |
|---|---|
| Lviv | -0.5211 |
| Vinnytsia | -0.2272 |
| Cherkasy | -0.5220 |
| Not Ukraine | 2.6157 |
| Product company | 0.5581 |
| Company focus on AI technologies is more than 50% | -1.8289 |
| Company focus on AI technologies is about 50% | 1.2303 |
| Company focus on AI technologies is less than 50% | 0.9105 |
| Company focus on AI technologies is "difficult to answer" | 0.4497 |
| 10-49 employees | -0.2168 |
| 50-249 employees | 0.1762 |
| 250-999 employees | -0.2422 |
| More than 1000 employees | -0.2401 |
| Note | . p<0.1; *p<0.05; **p<0.01; ***p<0.001 |

5.3. Regression: readiness to join the process of education improvement

Probit regression with the dependent variable of readiness to join the process of education improvement (yes + already joined == 0, no == 1) and independent variables owner/employee, age, gender, city, outsource/product company, focus on AI technologies, education (higher, unfinished higher, specialized secondary, secondary), IT education (yes/no), permanent work in this sphere (yes/no), experience, salary, support of Diia City indicated the fact that people with secondary education are less likely to join the process of education improvement (relative to people with higher education). The rest of the variables turned to be statistically insignificant.

Table 4. Results of Regression: readiness to join the process of education improvement

| Coefficients | Estimate |
|---|---|
| Employee | -0.3155 |
| 25-30 years old | -1.1862 |
| 31-35 years old | -0.2433 |
| 36-40 years old | 1.3008 |
| 41-45 years old | -0.5386 |
| Female | -0.6620 |
| Kharkiv | 0.1450 |
| Lviv | -2.0512 |

| | |
|---|---|
| Vinnytsia | 1.0267 |
| Cherkasy | -0.6757 |
| Not Ukraine | -0.2546 |
| Product company | -0.2978 |
| Company focus on AI technologies is more than 50% | -0.6863 |
| Company focus on AI technologies is about 50% | 0.3478 |
| Company focus on AI technologies is less than 50% | -0.7917 |
| Company focus on AI technologies is "difficult to answer" | 0.1548 |
| Unfinished higher education | 2.0271 |
| Secondary education | 4.6511 . |
| Don't have IT education | 1.51634 |
| Not always work in this sphere | 0.0186 |
| 2-5 years of experience | -0.7298 |
| 5-10 years of experience | 0.4549 |

| | |
|---|---|
| More than 10 years of experience | -0.8981 |
| Salary $600-$1500 | 1.1845 |
| Salary $1500-$3000 | 0.2192 |
| Salary $3000-$5000 | -1.5762 |
| Salary more than $5000 | 0.1064 |
| Salary: no answer | 1.7590 |
| Support Diia City | -0.3909 |
| Neutral to Diia City | 1.1207 |
| Note | . p<0.1; *p<0.05; **p<0.01; ***p<0.001 |

5.4 Regression: lack skills

OLS model with the number of lack skills as a dependent variable. There was a choice for respondents to choose skills that candidates lack from the list: basic technical education, ability to take responsibility, team work, specific technical knowledge, creative problem solving, knowledge of English, experience, desire to learn, self-consistency, leadership or other. As for the other answer there were mentioned soft skills, personality and communication skills.

Table 5. Skills that candidates lack

| Skill | Percentage of respondent think candidates lack this skill |
|---|---|
| Basic technical education | 36% |
| Ability to take responsibility | 45% |
| Team work | 17% |
| Specific technical knowledge | 55% |
| Creative problem solving | 31% |
| Knowledge of English | 40% |
| Experience | 40% |
| Desire to learn | 21% |
| Self-consistency | 16% |
| Leadership | 22% |

Independent variables of the regression are: owner/employee, age, gender, city, outsource/product company, possibility of joining the process of education improvement, focus on AI technologies, education (higher, unfinished higher, specialized secondary, secondary), IT education (yes/no), permanent always in this sphere (yes/no), experience, salary and support of Diia City.

The results of the regression indicated that

- People who work in Kharkiv, Lviv and abroad are more likely to define fewer skills that candidates lack in comparison with people who work in Kyiv

- In comparison to people with higher education, those with secondary education tend to define fewer skills that candidates lack

- People who support Diia City tend to define fewer skills that candidates lack in comparison to those who are against Diia City

Table 6. Results of Regression: lack skills

| Coefficients | Estimate |
|---|---|
| Employee | 1.6852 |
| 25-30 years old | -1.0432 |
| 31-35 years old | -1.0301 |
| 36-40 years old | -1.7978 |
| 41-45 years old | 0.3654 |
| Female | 0.9858 |
| Kharkiv | -1.7901 . |
| Lviv | -1.8241 . |
| Vinnytsia | 0.0469 |
| Cherkasy | -2.6456 |

| | |
|---|---|
| Not Ukraine | -2.8298 . |
| Product company | -0.7151 |
| No desire to join the process of education improvement | 0.4931 |
| Has already joined the process of education improvement | -0.2598 |
| Company focus on AI technologies is more than 50% | -1.2725 |
| Company focus on AI technologies is about 50% | 0.3767 |
| Company focus on AI technologies is less than 50% | 0.4624 |
| Company focus on AI technologies is "difficult to answer" | -0.5556 |
| Unfinished higher education | 0.3200 |
| Secondary education | -3.8372 . |
| Don't have IT education | 0.4156 |
| Not always work in this sphere | 0.5285 |
| 2-5 years of experience | 0.5582 |

| | |
|---|---|
| 5-10 years of experience | 2.2249 |
| More than 10 years of experience | 1.1497 |
| Salary $600-$1500 | -2.5104 |
| Salary $1500-$3000 | -3.5990 |
| Salary $3000-$5000 | -1.8992 |
| Salary more than $5000 | -0.6093 |
| Salary: no answer | -1.3110 |
| Support Diia City | -1.7630 * |
| Neutral to Diia City | -0.1521 |
| Note | . p<0.1; *p<0.05; **p<0.01; ***p<0.001 |

5.5 Regression: support of Diia City

Probit regression with the dependent variable support of Diia City (against == 0, support ==1), has the following independent variables: owner/employee, age, gender, city, outsource/product company, focus on AI technologies, education, IT education, permanent work in this sphere, experience, salary, desire to join the process of education improvement. the Probit regression shows that

- People who don't have IT education are more likely to support Diia City (relatively to those with IT education)

- People who work in Kharkiv are less likely to support Diia City in comparison with people who work in Kyiv

- People aged 36-40 are less likely to support Diia City in comparison with people aged 18-24.

Table 7. Results of Regression: support of Diia City

| Coefficients | Estimate |
|---|---|
| Employee | 0.3530 |
| 25-30 years old | -0.0682 |
| 31-35 years old | 1.3257 |
| 36-40 years old | -2.6920 . |
| 41-45 years old | -1.7596 |
| Female | 0.2952 |
| Kharkiv | -7.9983 * |
| Lviv | 0.2631 |
| Vinnytsia | -0.8955 |
| Cherkasy | -0.6427 |
| Product company | -0.9623 |

| | |
|---|---|
| Company focus on AI technologies is more than 50% | -0.1117 |
| Company focus on AI technologies is about 50% | -0.5134 |
| Company focus on AI technologies is less than 50% | -0.7649 |
| Company focus on AI technologies is "difficult to answer" | 0.1857 |
| Unfinished higher education | 0.1967 |
| Secondary education | 0.2399 |
| Don't have IT education | 2.7958 * |
| Not always work in this sphere | -0.5885 |
| 2-5 years of experience | 0.1980 |
| 5-10 years of experience | 1.4662 |
| More than 10 years of experience | -0.2485 |
| Salary $600-$1500 | 0.2717 |
| Salary $1500-$3000 | -0.9636 |
| Salary $3000-$5000 | -0.0696 |

| | |
|---|---|
| Salary more than $5000 | 1.2154 |
| Salary: no answer | -0.5807 |
| No desire to join the process of education improvement | 1.1823 |
| Has already joined the process of education improvement | 0.6125 |
| Tax – 9% | 1.0017 |
| Tax – 22% | -0.6466 |
| Note | . p<0.1; *p<0.05; **p<0.01; ***p<0.001 |

# CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

The survey that was conducted in the framework of this paper made it possible to observe the attitude of the owners, co-owners and employees towards the problems that may arise in the AI sector.

One of the main problems of the market is the lack of skilled specialists. This issue is supposed to be a bottleneck problem that occurs all over the world and will hinder market development. Less than 9% of the respondents stated that the company they work for does not feel the lack of skilled specialists. At the same time, it is predicted that AI will continuously grow. So, there should be developed a complex approach for improving the situation. 31% of respondents don't have an IT education but are currently working in the sphere. Furthermore, 45% of respondents have come from another sphere.

Nowadays, it is visible that the development of technology may influence the workforce. It is not so scary, it would not end just by replacing people with robots or AI technologies. Soon it will result in a productive effect (Acemoglu) with an increase in labour demand. It is estimated to have around 97 million new jobs (Future of Jobs report). So, the process of requalification could take place.

The respondents were asked to define the skills that candidates lack. Understanding the gaps may assist in preparation for the requalification process. The main skill that was chosen by 55% of respondents is lack of specific technical knowledge. It is followed by a lack of ability to take responsibility (45%), lack of experience (40%), knowledge of English (40%) and lack of basic technical education (36%). In such a case it is visible that candidates lack hard skills. The solution implies reform in the educational sector. It could be both formal and informal. The bottleneck problem should stimulate businesses to participate in the process of educational improvement.

The respondents were asked whether they would like to join the process of education improvement (like teaching at universities, giving lectures on courses or creating their own studying materials). Practically 20% of respondents answered that they have already joined and 48% would like to join. The regression showed that people with higher education are more likely to express a desire to join the process of education improvement in comparison to those with secondary education. Thus people (practically 70%) are the resource that could be used in dealing with the pressing problem. Only 5% of the current sample acquired professional skills just at university.

Another question that was studied during the survey is people's attitude towards Diia City implementation. The full adoption of the idea that preliminary will launch in 2022 is controversial. Some companies have already stated the support for Diia City and others are totally against it. The question in the questionnaire "Do you support Diia City?" has the answers of the range from 1 to 5, where 1- totally against and 5 – fully support. Thus, 3 is neutral attitude towards the issue. 38% of respondents are in a neutral position, 33% are against and 29% support Diia City. The regression shows the result, that people without IT education are more likely to support Diia City (in comparison with those with IT education), people aged 18-24 are more likely to support Diia City (in comparison with people aged 36-40) and people from Kyiv are more likely to support Diia City (in comparison with those from Kharkiv). Thus, the government should better communicate the benefits that Diia City may bring. Still, there is the problem of trust and belief in state inefficiency. Some people don't like the idea of a change of tax systems as a great number of specialists work under a simplified system of taxation. So, the question about taxes was added to the questionnaire: "Given the efficient use of government budget, what should be the tax for employees to pay?". The optional answers were 5%, 9% and 22%, there was also a possibility for personal answers. 61.5% of people who answered the question believe that tax rate should be 5%, 27% voted for 9% tax rate and 13.5% - for 22% tax rate. One of the outlined ideas was that it is a complex issue and first there should be an efficient use of budget and after this – the increase of tax rate for specialists.

The open questions that were added to the questions are a great source for recommendations.

The common recommendation for all Ukraine is to ensure rule of law. With the defined and honest rules, businesses will be more confident with their strategies of development.

It was stated again that Ukraine needs the improvement of the system of education. A better system will generate more skilled specialists and stimulate market development.

An essential problem that hinders the development of the AI sphere is lack of data. The more data we have the better opportunities there would be for success and progress. This market requires a lot of data, so it would be a profound step to make the collected data available for use and analysis. But at first, this issue should be thoroughly studied not to uncover personal information.

The AI market could not stop in the development. The question is what the speed is going to be. We will see pretty soon.

# REFERENCES


100 richest Ukrainians in 2021. *Forbes*. May 2021 https://forbes.ua/ratings/100-bogateyshikh-ukraintsev-2021-06052021-1536

Acemoglu Daron, and Pascual Restrepo. 2018. Artificial intelligence, automation and work. National bureau of economic research. Cambridge https://www.nber.org/system/files/working_papers/w24196/w24196.pdf

Active work on the development of the conditions for the development of AI has started in Ukraine. *LegalHub* https://legalhub.online/investytsiyi-sfery-biznesu/v-ukrayini-pochaly-aktyvno-pratsyuvaty-nad-umovamy-rozvytku-shtuchnogo-intelektu/

Agarwal Shubhham, Karthik Gopalakrishnan and Preetesh Sharma. Using Analytics to Hire AI talent. Talent Analytics Quarterly| Fourth Quarter 2018 https://emtemp.gcom.cloud/ngw/globalassets/en/human-resources/documents/trends/hiring-ai-talent.pdf

Analysis of IT education in the higher education institutions of Ukraine. BRDO https://brdo.com.ua/wp-content/uploads/2021/02/Analiz_IT_osvity_u_vyshah_Ukrai-ny_Print.pdf

Artificial Intelligence in 2019: getting past the adoption tipping point. Blumberg Capital. January 2019 https://blumbergcapital.com/ai-in-2019/

Artificial Intelligence Index Report 2021. Stanford University Human-Centered Artificial Intelligence https://aiindex.stanford.edu/wp-content/uploads/2021/03/2021-AI-Index-Report_Master.pdf

Artificial Intelligence technology market will grow this year up to $156.5 bln. *Mind* https://mind.ua/news/20214273-rinok-tehnologij-shtuchnogo-intelektu-cogo-roku-viroste-do-1565-mlrd

Artificial Intelligence: Ukrainian Dimension. Gorshenin Institute (2018).

Cave Stephan, Kate Coughlan, and Kanta Dihal. Scary Robots. Examining Public Responses to AI. *BBC*. 2019 https://dl.acm.org/doi/pdf/10.1145/3306618.3314232

Chen N, Christensen L, Gallagher K, Mate R, Rafert G. Global Economic Impacts Associated with Artificial Intelligence. Economic Impact Study, February 2016

https://www.analysisgroup.com/globalassets/content/insights/publishing/ag_full_report_economic_impact_of_ai.pdf

Concept of the development of the artificial intelligence in Ukraine. Approved by the Order No. 1556-p of the Cabinet of Ministers of Ukraine on December 2, 2020.

Current situation with IT education in Ukraine. Express analysis from the Ministry of Digital Transformation of Ukraine. DOU. July 2021 https://dou.ua/forums/topic/34182/

Denscombe, M. (2010) "The Good Research Guide for Small-Scale Social Research Projects" fourth edition, Butterworth-Heinemann

Development of the Ukrainian IT-industry. BRDO https://brdo.com.ua/wp-content/uploads/2018/12/IT_report_ua_F-1.pdf

Dillon, Sarah. On the Influence of Literature on Science. *Configurations*, 26(3), 311-316. (2018). http://lcfi.ac.uk/media/uploads/files/Dillon_On_the_Influence_of_Lit_on_Science_Configurations.pdf

Economic impacts of artificial intelligence (AI). European Parliament. 2019. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637967/EPRS_BRI(2019)637967_EN.pdf

Edelman AI survey. 2019 https://web.archive.org/web/20191009122715/https://www.edelman.com/sites/g/files/aatuss191/files/2019-03/2019_Edelman_AI_Survey_Whitepaper.pdf

Europe fit for the Digital Age: Commissions proposes new rules and actions for excellence and trust in Artificial Intelligence. European Commission. Press release. Published on April 21, 2021. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_1682

European ethical Charter on the use of Artificial Intelligence in judicial system and their environment. European Commission for the Efficiency of Justice. Adopted at the 31st plenary meeting of the CEPEJ (Strasbourg, 3-4 December 2018) https://rm.coe.int/ethical-charter-en-for-publication-4-december-2018/16808f699c

Frankenfield Jake. Artificial Intelligence (AI). *Investopedia* 2021. https://www.investopedia.com/terms/a/artificial-intelligence-ai.asp

Freeman Richard B. Who owns the robots rules the world. *IZA World of Labor* https://wol.iza.org/articles/who-owns-the-robots-rules-the-world/long

Gibbs Michael. 2017. How is new technology changing job design? *IZA World of Labor*. https://wol.iza.org/articles/how-is-new-technology-changing-job-design/long

Glasow Priscilla A. Fundamentals of Survey Research Methodology. April 2005 https://www.mitre.org/sites/default/files/pdf/05_0638.pdf

Harnessing automation for a future that works. McKinsey Global Institute. McKinsey&Company. January 2017 https://www.mckinsey.com/~/media/mckinsey/featured%20insights/digital%20disruption/harnessing%20automation%20for%20a%20future%20that%20works/mgi-a-future-that-works_full-report.pdf

IDC Forecasts Improved Growth for Global AI Market in 2021. February 2021. IDC https://www.idc.com/getdoc.jsp?containerId=prUS47482321

IDC Forecasts Strong 12.3% Growth for AI Market in 2020 Amidst Challenging Circumstances. August 2020. IDC https://www.idc.com/getdoc.jsp?containerId=prUS46757920

In 5 years, the number of programmers in Ukraine has doubled, and women in IT – by 79%. GlobalLogic. https://www.globallogic.com/ua/about/news/programmers-in-ukraine/

Kirkpatrick Keith, and Aditya Kaul. Tractica Report: Artificial Intelligence (AI) Use Cases. March 2019 https://www.itprotoday.com/artificial-intelligence/tractica-report-artificial-intelligence-ai-use-cases

Notes from the AI Frontier, insights from hundreds of use cases. McKinsey Global Institute. McKinsey&Company. April 2018 https://www.mckinsey.com/~/media/mckinsey/featured%20insights/artificial%20intelligence/notes%20from%20the%20ai%20frontier%20applications%20and%20value%20of%20deep%20learning/notes-from-the-ai-frontier-insights-from-hundreds-of-use-cases-discussion-paper.ashx

O'Brien Matt and James Keaten. UN urges moratorium, on use of AI that imperils human rights. AP News. September 15, 2021 https://apnews.com/article/technology-business-laws-united-nations-artificial-intelligence-efafd7b1a5bf47afb1376e198842e69d?utm_medium=AP_Europe&utm_campaign=SocialFlow&utm_source=Twitter

O'Brien Matt. White House proposes tech 'bill of rights' to limit AI harms. AP News. October 9, 2021 https://apnews.com/article/joe-biden-science-technology-business-biometrics-b9dbf5fee3bf0e407b988b31e21f5300

Programme for International Student Assessment (PISA). Results from PISA 2018. Ukraine https://www.oecd.org/pisa/publications/PISA2018_CN_UKR.pdf

Recommendation of the Council on Artificial Intelligence. OECD Legal Instruments https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449

Sizing the price. PwC's Global Artificial Intelligence Study: Exploiting the AI Revolution. What's the real value of AI for your business and how can you capitalize? PwC. 2017 https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

Slobodian Oleksandra. Higher education and gender stereotypes: why girls don't choose technical specialties. CEDOS. January 2021 https://cedos.org.ua/vyshha-osvita-ta-genderni-stereotypy-chomu-divchata-ne-obyrayut-tehnichni-speczialnosti/

Stamford, Conn. Gartner survey shows 37% of organizations have implemented AI in some form. *Press Releases.* Gartner. January 2019 https://www.gartner.com/en/newsroom/press-releases/2019-01-21-gartner-survey-shows-37-percent-of-organizations-have

The EU has developed rules to protect people against manipulation of artificial intelligence. UkrInform
https://www.ukrinform.ua/rubric-technology/3232380-v-es-rozrobili-pravila-dla-zahistu-ludej-vid-manipulacij-stucnogo-intelektu.html

The Future of Jobs Report. World Economic Forum. October 2020 https://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf

Waters Richard. How machine learning creates new professions – and problems. *Financial Times.* November 2017 https://www.ft.com/content/49e81ebe-cbc3-11e7-8536-d321d0d897a3

Westerlund Mika. The Ethical Dimensions of Public Opinion on Smart Robots. February 2020. *Technology Innovation Management Review* 10(2):25-36
https://www.researchgate.net/publication/339645775_The_Ethical_Dimensions_of_Public_Opinion_on_Smart_Robots

Will robots really steal our jobs? An international analysis of the potential long-term impact of automation. PwC. 2018 https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf

# APPENDIX A

Table 8. Quantity of Top Artificial Intelligence Companies in Ukraine (by cities)

| **No.** | **City** | **Quantity of companies** | **%** |
|---|---|---|---|
| 1 | Kyiv | 65 | 47% |
| 2 | Kharkiv | 25 | 18% |
| 3 | Lviv | 22 | 16% |
| 4 | Odesa | 7 | 5% |
| 5 | Dnipro | 4 | 3% |
| 6 | Vinnytsia | 3 | 2% |
| 7 | Zaporizhzhia | 3 | 2% |
| 8 | Cherkasy | 1 | 1% |
| 9 | Chervonohrad | 1 | 1% |
| 10 | Kherson | 1 | 1% |
| 11 | Khmelnytskyi | 1 | 1% |
| 12 | Kropyvnytskyi | 1 | 1% |
| 13 | Klevan | 1 | 1% |
| 14 | Kremenchuk | 1 | 1% |
| 15 | Sumy | 1 | 1% |

| | | | |
|---|---|---|---|
| 16 | Uzhhorod | 1 | 1% |

## APPENDIX B

Table 9. Top Artificial Intelligence companies from Ukraine

| No. | Company | City |
|---|---|---|
| 1 | Master of Code Global | Cherkasy |
| 2 | MobiDev | Kharkiv |
| 3 | Postindustria | Kherson |
| 4 | APRO Software | Kyiv |
| 5 | BotsCrew | Lviv |
| 6 | Chatbots.Studio | Lviv |
| 7 | ITRex Group | Kyiv |
| 8 | DataRoot Labs | Kyiv |
| 9 | Softengi | Kyiv |
| 10 | Zfort Group | Kharkiv |
| 11 | It-Jim | Kharkiv |
| 12 | Abto Software | Lviv |
| 13 | Unicsoft | Kyiv |
| 14 | Intellias | Lviv |
| 15 | Anadea | Dnipro |
| 16 | Integrio Systems | Kharkiv |
| 17 | Intersog | Kyiv |
| 18 | Pro Vision Lab | Kyiv |
| 19 | Intetics Inc. | Kharkiv |
| 20 | WeAreBrain | Kyiv |
| 21 | Waverley Software | Lviv |
| 22 | Quantum | Kharkiv |

| | | |
|---|---|---|
| 23 | CHI Software | Kharkiv |
| 24 | Preste | Kyiv |
| 25 | Lucid Reality Labs | Kyiv |
| 26 | Dex Technologies | Kyiv |
| 27 | Zpoken | Kyiv |
| 28 | Infopulse | Kyiv |
| 29 | Hey Machine Learning | Kharkiv |
| 30 | Unibot | Kyiv |
| 31 | The APP Solutions | Kyiv |
| 32 | iomico | Lviv |
| 33 | Data Science UA | Kyiv |
| 34 | MindCraft.ai | Lviv |
| 35 | Botodata | Vinnytsia |
| 36 | Label Your Data | Kyiv |
| 37 | Envion Software | Odesa |
| 38 | ZenBit | Odesa |
| 39 | SOLVVE | Dnipro |
| 40 | Lemberg Solutions | Lviv |
| 41 | Yotalabs | Uzhhorod |
| 42 | Evergreen | Kyiv |
| 43 | DB2 Limited | Kyiv |
| 44 | DevRain | Klevan |
| 45 | Honeycomb Software | Lviv |
| 46 | UDEV HUB | Kyiv |
| 47 | Go Wombat | Dnipro |
| 48 | Agiliway | Lviv |
| 49 | Team Harbour | Kyiv |
| 50 | Flyaps | Dnipro |

| | | |
|---|---|---|
| 51 | DataMix | Kyiv |
| 52 | Intellink | Kyiv |
| 53 | SOFTUUP, LLC | Kyiv |
| 54 | Fortifier | Kharkiv |
| 55 | Singularika | Odesa |
| 56 | HUSPI | Kyiv |
| 57 | Mellivora Software | Odesa |
| 58 | Uinno | Zaporizhzhia |
| 59 | Clover Dynamics | Lviv |
| 60 | Morebis | Lviv |
| 61 | Webdevelop PRO | Kyiv |
| 62 | Software Service & Innovation | Chervonohrad |
| 63 | Muteki Group | Kharkiv |
| 64 | Dewais | Kharkiv |
| 65 | 20 Thousand Leagues | Kyiv |
| 66 | CleverCrew | Kharkiv |
| 67 | AppWell.Health | Lviv |
| 68 | Storypoint | Kyiv |
| 69 | Idealogic | Kyiv |
| 70 | SourceX | Kyiv |
| 71 | HumanIT | Kyiv |
| 72 | Axles | Lviv |
| 73 | CodePillow | Lviv |
| 74 | Faifly, LLC | Kharkiv |
| 75 | MintyMint | Kyiv |
| 76 | EXB Soft | Kharkiv |
| 77 | Nolt technologies | Khmelnytskyi |
| 78 | Business Automatics JSC | Kharkiv |

| | | |
|---|---|---|
| 79 | Prostir | Kyiv |
| 80 | Winstars technology LLC | Vinnytsia |
| 81 | 2021.AI | Kyiv |
| 82 | Outforz | Kyiv |
| 83 | Widelogics | Kyiv |
| 84 | LET'S DATA | Lviv |
| 85 | Astraoutsourcing | Kyiv |
| 86 | Ukrlogika | Kharkiv |
| 87 | DevPace | Kharkiv |
| 88 | RPA Lab | Lviv |
| 89 | IoT Factory | Kyiv |
| 90 | Shatava Digital Studio | Sumy |
| 91 | Adimen | Odesa |
| 92 | RedDuck | Kharkiv |
| 93 | Remarkable Technology | Kyiv |
| 94 | Distancematrix.ai | Kharkiv |
| 95 | Chudovo OU | Kyiv |
| 96 | Apollo | Kyiv |
| 97 | Postdata | Kyiv |
| 98 | Innohub | Kyiv |
| 99 | Yael Acceptic | Kharkiv |
| 100 | Skillkeepers | Kyiv |
| 101 | Outstaffing AS | Kyiv |
| 102 | Youwe | Kyiv |
| 103 | Trusted Software Development Company | Kyiv |
| 104 | Codeska | Odesa |
| 105 | RBC Group | Kyiv |
| 106 | BotsBand | Kyiv |

| | | |
|---|---|---|
| 107 | DeepDive.Tech | Kyiv |
| 108 | WonderLabs Ukraine | Kyiv |
| 109 | First Bridge | Kyiv |
| 110 | Anthill WorldWide | Kyiv |
| 111 | PerceptionBox | Odesa |
| 112 | Arsmoon | Vinnytsia |
| 113 | UA Software LLC | Kirovohrad |
| 114 | webromance | Kyiv |
| 115 | Modex Analytics | Kyiv |
| 116 | SmartPipl | Zaporizhzhia |
| 117 | VIV MEDIA | Kyiv |
| 118 | Acrovations | Zaporizhzhia |
| 119 | Datagazer | Kyiv |
| 120 | Vitasoft Ukraine | Kyiv |
| 121 | Zitoune Dev | Lviv |
| 122 | Blitz SD | Kyiv |
| 123 | Holorise Studio | Kharkiv |
| 124 | Mindy Support | Kyiv |
| 125 | Apriorit | Dnipro |
| 126 | Symphony Solutions | Lviv |
| 127 | Light IT | Zaporizhzhia |
| 128 | Adoriasoft | Kharkiv |
| 129 | Bruno Development | Zaporizhzhia |
| 130 | Gargoyle | Kharkiv |
| 131 | EdIcasoft | Kyiv |
| 132 | abstractR | Kyiv |
| 133 | rinf.tech | Kyiv |
| 134 | Intellica | Kyiv |

| | | |
|---|---|---|
| 135 | Data Pro Software | Kyiv |
| 136 | 8allocate | Kyiv |
| 137 | Vareger Group | Kyiv |
| 138 | WWG | Lviv |
| 139 | Rocketlab | Sumy |
| 140 | Jazzros | Kharkiv |
| 141 | Xoresearch | Kyiv |
| 142 | TeamDev Ltd. | Kharkiv |
| 143 | wplace.tech | Kyiv |
| 144 | GigaNeo | Kyiv |

APPENDIX C

Questionnaire

- Are you an owner/co-owner or an employee?
    - Owner/co-owner
    - Employee
- Your age:
    - 18-24
    - 25-30
    - 31-35
    - 36-40
    - 41-50
    - 51-60
    - More than 60
- Your gender
    - Male
    - Female
    - Other

- What city do you work in?
    - Kyiv
    - Kharkiv
    - Lviv
    - Odesa
    - Vinnytsia
    - Zaporizhzhia
    - Other
- Do you work for a product company or an outsource one?
    - Product company
    - Outsource company
    - Other
- How many employees are there in your company?
    - 2-9
    - 10-49
    - 50-249
    - 250-999

    - More than 1000
    - (difficult to answer)

- Does your company focus only on AI technologies?
    - Yes
    - 50%-50%
    - More than 50%
    - Less than 50%
    - Difficult to answer
- Your education
    - Secondary
    - Specialized secondary
    - Unfinished higher
    - Higher
- Do you have an IT education?
    - Yes
    - No
- Where have you acquired professional skills for your work?

    - University
    - On my own
    - Courses
    - Trainings (workshops) at IT companies
    - Other

- Does your company feel the problem of lack of skilled specialists?
    - Yes
    - No
    - (difficult to answer)
- What skills do candidates lack?
    - basic technical education
    - ability to take responsibility
    - team work
    - specific technical knowledge
    - creative problem solving
    - knowledge of English
    - experience

    - desire to learn
    - self-consistency
    - leadership
    - other

- Would you like to join the process of education improvement (teaching at university, give lectures on courses, create own studying materials, etc.)
    - Yes
    - No
    - Have already joined
- Have you always been working in this sphere?
    - Yes
    - No, have come from another sphere
- What is the sphere you have come from?
- Your experience in the sphere
    - Up to 2 years
    - 2-5 years
    - 5-10 years
    - More than 10 years

- Why have you chosen this sphere?

- Do you support Diia City?

    - 1-5, 1- totally against, 5- fully support

- A significant number of IT specialists work under a simplified tax system. Given the efficient use of the government budget, what should be the tax for employees to pay?

    - 5%

    - 9%

    - 22%

    - Other

- How can the government support the development of AI technologies?

- We would be grateful if you could honestly share the problems that hinder development of the company.

- What company do you work for? (optional answer)

*For owners/co-owners only:*

- What problems did you face while setting-up a company?

*For employees only:*

- What is your job?

    - Data Scientist

    - Data Analyst
    - Data Engineer
    - Machine Learning Engineer
    - Developer
    - Business Analyst
    - MLOps
    - Researcher
    - Other

- What is your position?
    - Junior
    - Middle
    - Senior
    - Other

- What is your salary?
    - Up to $600
    - $600 - $1500
    - $1500 - $3000

- $3000 - $5000
- More than $5000
- Don't want to answer