AI Solutions Implementation Analysis using T-O-E Framework

Mirela-Simina MIHAI,
Ph. D. Student, Bucharest University of Economic Studies,
e-mail: mihaimirela15@stud.ase.ro

Abstract

The author studied the impact of technological, organizational and environmental contexts on the way of implementing solutions based on Artificial Intelligence. The importance of this topic is given by the increasing interest of companies in all fields of activity in adopting solutions based on Artificial Intelligence to help achieve the desired results.

The objective pursued in this research is to carry out an analysis of the current situation of financial services regarding how to implement solutions based on Artificial Intelligence, as well as a practical guide for companies that want to implement Artificial Intelligence.

The Technological-Organizational-Environmental framework is a complex and comprehensive research framework for technological solutions. The technology context includes technologies in financial sector companies as well as those provided by technology companies. Organizational context refers to organizational preparation and management support in implementing such solutions. Environmental context refers to industrial characteristics and government regulations.

In Romania, there are enough solutions based on Artificial Intelligence, and companies have the necessary infrastructure to implement them. The top management is interested in providing the necessary support for the implementation of solutions based on Artificial Intelligence. Legislative instability does not prevent the implementation process of Artificial Intelligence, but slows it down.

Key words: *artificial intelligence; digitalization; automation; financial services; technological solutions;*

JEL Classification: *M40, M41, M48*

Introduction

Nowadays, in all sectors of activity, solutions such as digitization, automation and Artificial Intelligence represent a determining force for the desired profit.

The financial sector is one of the first and most accessible sectors of activity where these technologies produce changes and their implementation is on an upward trend. Solutions based on Artificial Intelligence are the key to success for companies that offer financial services and want to be competitive on the market; IT companies, who want to develop and offer the best solutions to their customers; the government, which wants to provide the necessary support for companies in this unstable environment and for customers who want to work with the best specialists and get more consulting and support services.

The most appropriate way to do this analysis is by examining the big picture where each stakeholder is an influencer for the desired success. This is why in this study valuable structured interview responses from 29 financial specialists and IT service providers were collected and analyzed using the Technology-Organizational-Environmental (T-O-E) Framework. As a result, this study provides the reader with useful insights and a starting point when deciding to implement AI-based solutions.

The ability of a machine to imitate human actions is called Artificial Intelligence (Luo et al., 2018). AI represents one of the most important technologies for the process of creating a better future (Andrews, 2017). AI has Machine Learning (ML) and Deep Learning as subcategories (Ahmad et al., 2019; Lin, 2019).

ML is a subfield of AI that uses statistical models to develop predictions. ML uses algorithms to collect empirical and historical data to analyze and generate results based on the algorithms it uses (AlSheibani, 2018, Ling, 2020).

ML puts programs through a learning process that is of two kinds:

- *Supervised*. In this case a human provides solutions to the program when it detects errors.

- *Unsupervised*. In this case, the program learns automatically and can be said to imitate human intelligence (Cutting et al., 2021; May et al., 2019).

The impact of ML in the financial sector:

a) In the audit
  - o Machine learning expertise
  - o Reduced audit staff
  - o Improved fraud detection
  - o Emphasis on internal control

b) Tax compliance
  - o Reduced time for checking the material
  - o New opportunities for tax planning
  - o Machine learning expertise
  - o Improved services

c) Fiscal advisory services
  - o Reduced information processing time
  - o Improved accuracy and reduced costs
  - o Machine learning expertise
  - o Emphasis will be placed on value-added services within the company

d) Accounting
  - o Reduced time for invoice processing and other repetitive activities
  - o More complex reports generated on time
  - o Consulting for clients (Izhar et al., 2020).

Deep learning is a sub-category of ML that uses neural networks to generate desired results. It works like a human neural network. If using ML we can analyze data through a linear function, Deep Learning allows us to analyze data using non-linear functions (Chollet, 2017).

Figure no. 1 shows the relationship between the three concepts most used in specialized studies; some of the studies, however, consider that they do not overlap, but intersect (Cutting et al., 2021; Massaro et al., 2016).

This study presents a qualitative analysis based on a structured interview that follows the three basic concepts of the Technology-Organization-Environment (T-O-E) framework. The work is divided into four parts: the specialized literature, in which the characteristics of High-Tech companies are presented, the methodology, where the T-O-E Framework and the research framework are presented, and the conclusions, which briefly present the most important findings and future research directions.

Figure no. 1. The relationship between AI, ML and Deep Learning
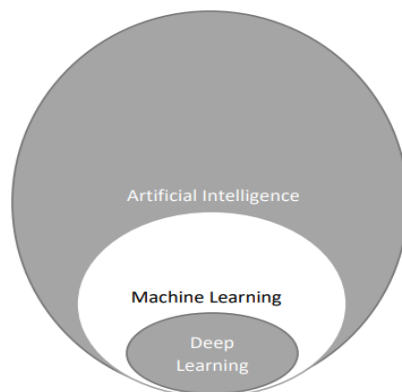
Source: Cutting et. al. 2021

1. Analysis of specialized literature

In the case of High-Tech companies, we can talk about a whole history of investments in digitization, automation and cloud computing. These actions can be considered drivers for the implementation of AI solutions (Chen et al., 2016). But more important are the digital mindset and resources that extend across the organization. In this way CFOs who work in High Tech companies have an advantage compared to their CFO colleagues who work in companies where such solutions are not implemented. They have the opportunity to use data differently to bring value and provide important insights to clients (ACCA, 2020).

High Tech companies have the resources to use modern tools such as AI, ML, Deep Learning to help their company grow (IFAC, 2020).

A study conducted by Accenture in 2022 with 1,300 CFOs from various industries showed that teams in High Tech companies have all the resources to apply and use these new technologies, compared to their colleagues in other companies. In High Tech 81% of CFOs use ML in financial data processing, compared to 68% of all CFOs included in the study. And 38% of them found an operational increase in efficiency due to the use of AI solutions together with other technologies (Inn, 2016; Kruse et al., 2019).

In the financial sector, CFOs working in High Tech companies use digital tools to increase their ability to collaborate with the entire business. This helps them overcome difficult business periods more easily by using

AI solutions combined with real-time data to have a better view of end-to-end value chains and make faster and more informed decisions (Huang et al., 2021).

With this useful information, they will be able to understand and find the roots that cause deviations, errors and loss of value. They are engaged in a learning process designed to understand new ways to use the value of data, in providing meaningful insights used to collaborate across the enterprise and increase efficiency. Financial organizations use these capabilities to be more agile to market change and improve forecast accuracy (Accenture, 2022).

CFOs in High Tech companies have a greater ability to support colleagues in other departments with significant insight for decision-making compared to other CFOs. In their case, 81% provided useful data for risk analysis, and in the case of the other CFOs, only 70% could provide this information. Technology helped them improve their relationships with colleagues in supply chain and operations (Luo et al., 2018).

Accenture's survey shows a wide gap between finance and supply chain and business operations departments, an area where finance teams need to invest time and energy to foster a better relationship. 20% of CFOs in High tech companies help the business manage operational risk using the data provided and only 35% use it to find ways to deal with business volatility (Massaro et al., 2016).

Financial organizations using AI solutions and other technologies need to run analytics on both internal and external data to understand business vulnerabilities and

measure the potential impact on business revenue forecasts earlier. Financial professionals at these companies have expertise in analytics that, used with access to data, can predict supply chain risk and potential revenue impact. They can use technology to help the organization sense future opportunities and threats, according to an article published by CECCAR in 2019.

2. Research methodology

The first step is an international analysis of the literature of the last 10 years, scientific articles from databases such as: Elsevier, Taylor and Emerald.

Wanting to observe how Romania applies technology, we conducted a structured interview to which a sample of 29 participants with managerial or executive roles in the financial and technological field of activity responded, according to Annex A. Interview respondents.

Interviews were conducted by telephone and lasted between 45 minutes and one hour. The answers to the interview were written by hand in Romanian, and after the interview they were translated into English in the Excel program, where the analysis of this study was carried out.

The steps followed in the analysis of the structured interview are presented in *Figure no. 2*.
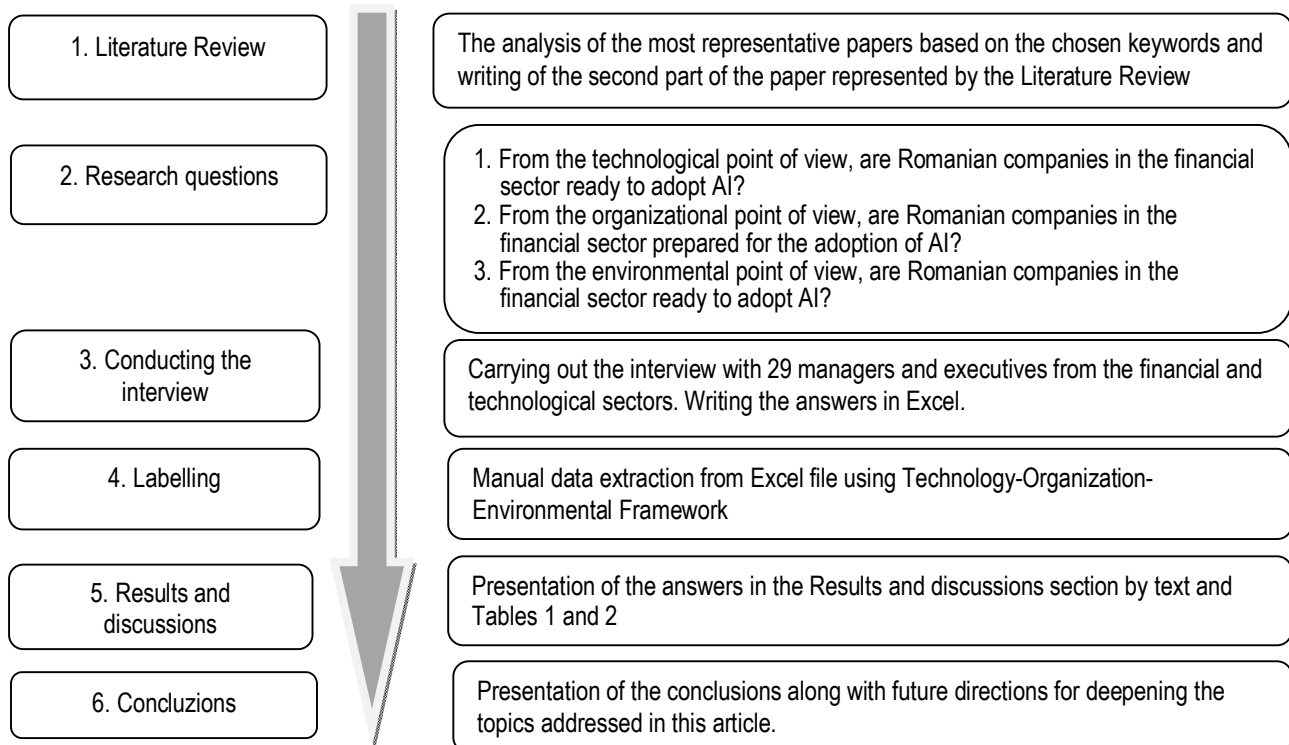
2.1. Research framework

Three research questions were defined, the answers of which were centralized in Excel, where the coding was also carried out. The answers that were found in the majority of respondents are presented in **Tables no. 1** and **2** of the "Results and Discussion" section.

Research question no. 1: From a technological point of view, are Romanian companies in the financial sector ready for the adoption of AI?

Research question no. 2: From an organizational point of view, are Romanian companies in the financial sector prepared for the adoption of AI?

Research question no. 3: From an environmental point of view, are Romanian companies in the financial sector ready to adopt AI?

Figure no. 2. The steps followed in the analysis of the structured interview

| 1. Literature Review | The analysis of the most representative papers based on the chosen keywords and writing of the second part of the paper represented by the Literature Review |

| 2. Research questions | 1. From the technological point of view, are Romanian companies in the financial sector ready to adopt AI? 2. From the organizational point of view, are Romanian companies in the financial sector prepared for the adoption of AI? 3. From the environmental point of view, are Romanian companies in the financial sector ready to adopt AI? |

| 3. Conducting the interview | Carrying out the interview with 29 managers and executives from the financial and technological sectors. Writing the answers in Excel. |

| 4. Labelling | Manual data extraction from Excel file using Technology-Organization-Environmental Framework |

| 5. Results and discussions | Presentation of the answers in the Results and discussions section by text and Tables 1 and 2 |

| 6. Concluzions | Presentation of the conclusions along with future directions for deepening the topics addressed in this article. |

Source: Adaptation from Kallio et al., (2016), Massaro et al. (2016), Stoica et al. (2022)

To ensure a structured way of analyzing the results of the interviews, the Technology-Organization-Environment Framework (TOE) was used as a research method in this article.

### 2.2. Technology-Organization-Environment Framework (TOE)

The *T-O-E Framework* method was developed by Tornatzky and Fleischer in 1990 with the aim of studying the context of technological innovation. This framework is used in the context of innovations and has gained strong empirical endorsement in this context. It represents an organization-wide theory, having three main elements used: technology, organization and environment. These elements have an impact on the processes of technology adoption and implementation in a company.

The technological context is represented by the internal and external technologies that can be implemented by a company. A company's current technological level represents internal technologies and influences the level and pace of technological change that the company is able to undertake. External technologies are represented by the technological solutions available on the market and also their characteristics: price, customization option, complexity, promised results (Zhu et al., 2004).

The context of the organization presents some characteristics of the company: size, organizational model, managerial structures, human resources.

The environmental context is represented by the structures in a particular industry and regulations. It includes factors such as: competitors, customers, community and government (Baker, 2011).

Figure no. 3. TOE Framework Representation
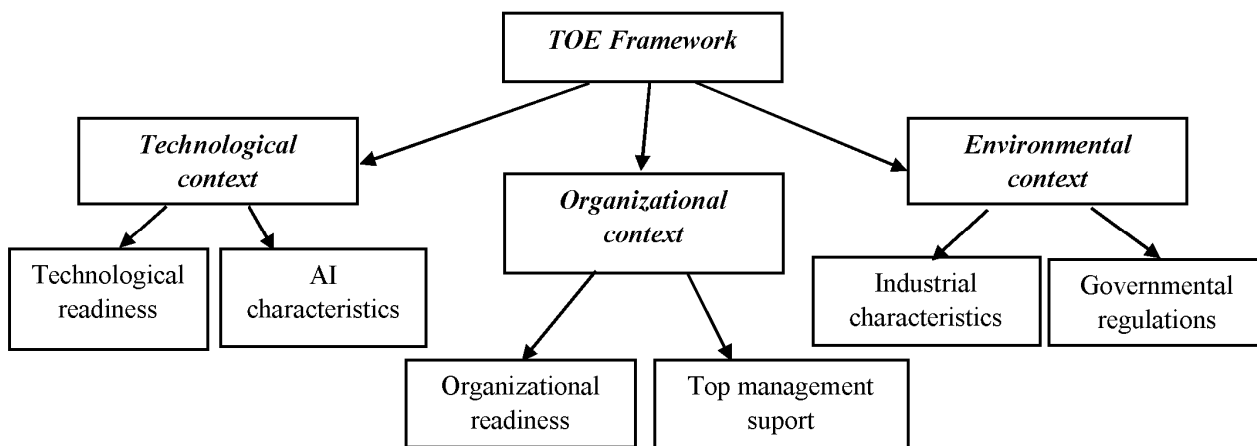
Source: Author's representation using Tornatzky et. al. (1990), Baker (2011)

3. Results and Discussion

The three elements of the framework are divided into two subcategories each, as represented in *Figure no. 3* and the answers obtained to the research questions are summarized in Table no. 1 and Table no. 2.

3.1. The technological context

For this aspect we used Research question no. 1: "From a technological point of view, are Romanian companies in the financial sector ready for the adoption of AI?"

The technology background is divided into *Technology Readiness* and *AI Features*. *Technological Preparation* represents the companies' internal technologies. *AI features* are external technologies provided by technology provider companies.

Technological preparation

In the technology context, looking at external technologies, we can see that there are enough AI solutions in the market that are being used by companies and have really helped them perform better.

In the case of internal technologies, companies have the necessary physical infrastructures and most are at least digitized and automated, and 50% also use AI solutions. At least half of the company's data is stored in the cloud from external providers.

AI Features

AI solutions are expensive in the short term, but in the long term they will provide cost savings. These solutions have a lot of benefits that are very well known by the respondents, such as: shorter processing time, higher efficiency, higher accuracy, higher quantity and quality of processed data. Technological readiness will increase in case of its adoption by companies and this will help them adopt new technological solutions more quickly and easily.

3.2. The organizational context

For this aspect, we used Research question no. 2: "From an organizational point of view, are Romanian companies in the financial sector prepared for the adoption of AI?"

The organizational context is divided into *Organizational Preparation* and *Top Management Support*.

Organizational training

Managers and executives believe that jobs involving repetitive tasks will be replaced by AI solutions in the next 10 years. Managers who have had the chance to be part of a High-Tech organization already use AI solutions and know very well the advantages and opportunities created by these technologies. They also know that the human factor will not be fully replaced by technology, but the lack of adequate knowledge in using AI solutions and also in conducting financial activities is a threat.

Management support

Managers and directors who are part of High-Tech companies must be prepared for the implementation of new technological solutions if this is a decision taken by the group. In most answers, the conclusion is that managers are interested in reducing costs and saving time, team managers do not always agree with new solutions that want to reduce the number of jobs.

3.3. Environmental context

For this aspect, we used Research question no. 3: "From an environmental point of view, are Romanian companies in the financial sector ready for the adoption of AI?" and is divided into two subcategories: *Industrial Features* and *Government Regulations.*

Industry characteristics are also an important factor for analyzing the implementation of AI solutions. In addition to the available solutions and the ability of companies to use them, they are also influenced by other external factors. Competition is an important one because a company that is able to double its work capacity and simplify customer interaction will surely win more customers. Employees are willing to work for companies that understand the importance of AI solutions, especially for young employees who have grown up in such an environment and easily get bored with repetitive tasks. They also change jobs very often if they don't like them.

Customers are interested in having an easy interaction with financial companies. They want to upload documents like invoices online because it's easier and faster. They also want to receive advice for important decisions they make, such as company development.

Government regulations

The change in legislation is still an impediment even after the pandemic crisis, when the ghişeul.ro platform was used by 1 million Romanians to pay taxes online and other digitization actions were taken.

The Romanian state was keen to support the continuity of business activity during the pandemic in a telework context, by introducing the Digital Signature at the beginning of 2020, through OUG no. 38/2020. After this decision companies were able to interact with customers using online documents. This is a first digitization step, which will support the following processes of automation of legislative processes.

In the area of financial services, respondents consider the change in legislation as an impediment to the introduction of AI solutions. This situation is explained in the following answer: "*Month by month ANAF adds a new feature to the legislation. Software companies have to make changes every month based on new legislation."*

Other respondents found that although the process of digitalization of legislation has started and is in continuous evolution, they still have to physically go to the counters for some activities, such as setting up a company.

Table no 1. Challenges faced by financial and accounting services	
Technological context	
Technological readiness	1. In Romania there are qualitative and available professional training sources (ACCA, CECCAR, free courses offered by Microsoft and other companies).
	2. Romania is well known for having well trained IT people.
	3. People are informed about the advantages and disadvantages of using AI solutions from the company or through their own decision to prepare for a new work reality.
AI Characteristics	4. AI solutions may seem expensive in the short term, but in the long term the result will be cost reduction.
	5. AI solutions will bring efficiency, reduction of working time and costs, a smaller number of errors, more amount of processed data, more complex reports and higher profit because it will allow the company to have more customers.
	6. On the Romanian market there are enough technology providers that have AI solutions in their portfolio and case studies with success stories in companies from the financial sector.
Organizational context	
Organizational readiness	7. Managers consider it necessary for an employee to use analytical and critical thinking for new roles. They must also have technological skills along with communication and sales skills and theoretical knowledge of accounting.
	8. In addition to the workforce, company representatives must also know how to properly manage financial resources, this being a factor that slows down the process of implementing new solutions.
Top management support	9. More than 65% of top management and executives are open to implementing AI solutions. They already know from the organization or from their own experience the benefits of AI and are able and willing to provide support to employees involved in this process. The rest of the managers are not yet open to adopting AI solutions.
Environmental context	
Industrial Characteristics	10. The most important acceleration drivers of the adoption of AI solutions are: competition, more customers, mindset and desire to grow, available technology, higher workload, times of crisis, war, telecommuting, the need for hire fewer people.
Governmental Regulations	11. Romanian legislation is constantly changing. Digitization projects are underway and in 75% of cases legislation is considered not to prevent the adoption of AI solutions, but to slow it down.

Source: Author's representation using TOE framework

To help the financial sector eager to implement AI solutions, we have developed a practical guide using the T-O-E Framework. The first step, as mentioned, was to conduct a literature review using the T-O-E Framework. For this we used a structured interview with 29 financial specialists and technological service providers with managerial and executive roles in their companies, some of them with Romanian capital and multinationals, presented in *Appendix A*.

Table no. 2. Practical guideline for accounting companies	
Technological context	
Technological readiness	1. There are enough AI solutions available on the Romanian market and abroad. As a country, Romania is well known for its talented IT workforce and IT companies that are now expanding globally. The largest of them in 2021, UiPath, the Romanian unicorn, is now located in the United States. 2. IT companies offer software, infrastructure, customized solutions, maintenance, free courses. 3.If company representatives have an IT department and enough resources for research and development, they can develop their own AI solutions.
AI Characteristics	4. Managers and executives open to change find AI solutions a great alternative for repetitive tasks. They know the benefits and are willing to bring such alternatives for junior roles. But they must also prepare the workforce for this decision. The rest of the managers who implement new solutions if the decision comes from the group level must provide the employees with the necessary support to adapt to the changes.
Organizational context	
Organizational readiness	5. Businesses need to hire and invest in workforce skills, such as technology skills, and there are already many companies doing this. They must ensure the transition to AI in an ethical and cyber-secure manner. 6. He also needs to find and balance the company's resources: financial, manpower, technological.
Top management support	7. The company's top management must allocate the necessary budget for the implementation of AI solutions in their companies in advance and have a very clear long-term implementation and maintenance plan.
Environmental context	
Industrial Characteristics	8. Employees must be informed about the benefits of AI solutions. 9. Companies need to look carefully at their competitors as AI solutions provide them with a lot of support to grow rapidly. 10. Businesses need to ask their customers what they need from them at the end of the month and what additional services and support they need to grow and are willing to pay for. In an era of speed, no one can afford to waste time and resources.
Governmental Regulations	11. The financial and technological sector must create space for innovation, constantly adapting to legislative changes.

Source: Author's representation using TOE framework

Conclusions

According to the T-O-E Framework, the bottom line is that the decision to implement an AI solution is very complex and must take into account a big picture of the business and the environment. Company representatives must look from the point of view of technological readiness at: employee knowledge, available physical infrastructure and financial resources.

From an AI Features perspective, company representatives need to find a custom AI solution provider that best fits their needs and available resources. The companies providing technological solutions are both global and local in a very large number and the solutions offered are very well tested and yield results. Of course, the prices are commensurate with the solutions and support that companies need for: implementation, maintenance, constant support, training for employees.

The Organizational Context considers the management's ability to properly use the company's resources to increase profit. It also studies the level of openness of management to adopt new technological solutions to increase the company's productivity and reduce costs.

The Environmental Context also affects companies and is equally important in the analysis of a company that wants to implement new technology solutions. Companies cannot afford to just let competitors adopt solutions that increase their work capacity because they risk losing customers or not providing them with the services they need.

The limitations of the study are given by the small number of respondents.

For this research, the next step is to create a questionnaire that will be distributed to companies in the financial sector with CAEN Code 692 - Accounting and financial audit activities; tax consultancy. With the help of this questionnaire, we aim to study how the level of implementation of AI solutions is determined by the technological, organizational and environmental contexts. As a representative sample, we aim to obtain a minimum of 130 responses, representing the largest Romanian companies in the financial field.

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Appendix A. Interview respondents

No	Role in the company	Activity field	No. of employees
1	CEO	Financial services provider	Over 250
2	IT Section Leader RPA	IT Provider	Over 250
3	Managing partner, administrator	Financial services provider	Between 10-50
4	Business owner, Auditor	Financial services provider	Between 10-50
5	Team manager accounts payable	Financial services provider	Over 250
6	Executive finance director	Financial services provider	Over 250
7	RPS & Financial analyst	Financial services provider	Over 250
8	Financial Analyst	Financial services provider	Over 250
9	Owner and administrator	Financial services provider	Between 10-50
10	Enterprise resource planning project manager	Financial services provider	Over 250
11	Independent M&A director	Financial services provider	Over 250
12	Deputy manager in M&A	Financial services provider	Over 250
13	CEO, Founder	IT Provider	Between 10-50
14	RPA manager	IT Service Provider	Over 250
15	Financial Systems Manager	Financial services provider	Over 250
16	CEO, robot's programmer, assistant professor	IT Provider	Over 250
17	Managing partner	Financial services provider	Over 250
18	CEO, owner	Application developer and business owner	Over 250
19	Managing partner, senior	Financial services provider	Over 250
20	CEO	Financial services provider	Between 10-50
21	Managing partner and accounting expert	Financial services provider	Over 250
22	Managing partner	Financial services provider	Over 250
23	Manager	IT provider	Over 250
24	Audit manager	Financial services provider	Over 250
25	RPA manager	IT provider	Between 10-50
26	IT section manager	IT provider	Over 250
27	Manager RPA	IT provider	Over 250
28	Acquisitions manager	IT provider	Over 250
29	Program development manager	IT provider	Between 10-50