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Big Data: Challenges and Opportunities in Financial Management

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This paper describes the challenges and opportunities of using "big data" in the practice of financial management. The research question addressed in this work is what the major topics in existing research concerning the demand for big data skills are and where the resulting gaps in financial management occur. The experts noticed the transformation of the finance manager profession and predict that in next decade big data skills will be required for financial managers. The purposes of the paper are: to analyze the current state of the financial manager profession in selected labor markets, to identify the number of job positions with big data skills currently needed and to check additional skills and competencies needed in practice. The purpose of the literature study is to highlight the opportunities and challenges of big data technologies in financial management. To present a snapshot of big data skills demand in the European labor market for financial managers, we conducted research which reveals core skills currently needed for this position. We examined the most popular job search websites to find finance managers job openings that require big data skills in selected European countries. In conclusion, we provide potential areas for further research.

Keywords: big data, financial management, accounting, labor market.

Big data: wyzwania i szanse w zarządzaniu finansami

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W niniejszym artykule podjęto próbę opisania wyzwań i możliwości wykorzystania technologii Big Data w praktyce zarządzania finansami. Pytanie badawcze poruszone w artykule dotyczy analizy zapotrzebowania na rynku pracy w zakresie umiejętności Big Data i związanych z nimi luk badawczych w zarządzaniu finansami. Eksperci odnotowują transformację zawodu menedżera finansowego i przewidują, że w następnej dekadzie od menedżerów finansowych będą wymagane umiejętności wykorzystania technologii Big Data. Celem artykułu jest analiza obecnego stanu zawodu menedżera finansowego na rynkach pracy wybranych krajów Europy, identyfikacja liczby ofert pracy zawierających wymagania związane z umiejętnościami w zakresie Big Data oraz sprawdzenie dodatkowych umiejętności i kompetencji potrzebnych w praktyce dla menadżerów finansowych. Celem analizy literatury tematu było podkreślenie możliwości i wyzwań

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wykorzystania technologii Big Data w zakresie zarządzania finansami. Aby przedstawić stan obecny zapotrzebowania na umiejętności Big Data dla menedżerów finansowych na wybranych europejskich rynkach pracy, przeprowadzono badania, które ujawniły kluczowe umiejętności potrzebne obecnie na tym stanowisku. Przeanalizowano najbardziej popularne strony internetowe z ofertami pracy wybranych krajów Europy, aby znaleźć oferty pracy dla menedżerów finansowych, wymagające umiejętności Big Data. Badanie ujawniło różnice w popycie na umiejętności Big Data między badanymi krajami. W podsumowaniu nakreślono potencjalne obszary dalszych badań.

Słowa kluczowe: Big Data, zarządzanie finansami, księgowość, rynek pracy.

JEL: M15, M54

1. Introduction

Currently, almost all industries are driven by big data (BD) and the skills of managing of large data volumes have universal application.

Big data has a complex nature that requires powerful technologies and advanced algorithms. Current big data platforms are supported by various processing, analytical tools as well as dynamic visualization. Such platforms enable the extraction of knowledge and value from a complex dynamic environment. They also support decision-making through recommendations and automatic detection of anomalies, abnormal behavior or new trends (Oussous et al., 2018).

Big data refers to a large volume, high speed and/or a large variety of data sets that require advanced technologies and novel algorithms to enable better process optimization, rule discovery and decision-making.

Through processing and mining accounting and financial information deeply, an enterprise could improve its financial management, lower the cost of capital and make gross profit.

On the other hand, big data brings some challenges to finance and accounting areas (Hussain, 2016) such as: unevenness of data quality, threat to privacy, lack of talents, old culture and infrastructure, using big data in cloud financial and accounting software. According to Andrew Graham, while there are risks associated with using BD in finance and accounting cloud software, on the other hand, BD provides opportunities for accountants to expand into new service areas around cyber security, around fraud and forensics and digital services (Bullock, 2017).

The importance of big data technology for Polish enterprises is underlined in a paper by A. Wejnert (Wejnert, 2016, p. 95). The research results presented in the article come from a part of the research project implemented as part of the statutory research of the Department of Strategic Management at the Poznań University of Economics. The research sample amounted to 269 entities that employ over 49 people. The analysis of empirical data showed that 41% of enterprises declared the usage of different big data solutions.

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Magdalena Kalińska-Kula, in her work called "The use of big data in enterprise decision-making processes", emphasizes the importance of BD technology for management decision-making processes (2017).

The traditional static business intelligence tools can no longer be efficient enough to manage a large amount of data. Big data technologies are becoming more common. Big data can bring core advantages for an enterprise. Gartner argues that by 2020, 80 percent of the business processes will be optimized using big data (Prajsnar, n.d.). According to Chartered Professional Accountants of Canada, professional accountants will become familiar with managing and monitoring these technologies and will have more time to focus on more complex, higher-risk, strategic work.

BD skills and cognitive analytics skills will be necessary for high level managers in the next decade (Pilipczuk & Cariowa, 2019). The use of big data technology is of strategic importance for financial management (Ke & Shi, 2014).

A lot of research papers concerning the demand for big data skills in labor markets have been published. Our paper's novelty lies in filling the resulting research gaps in the financial management field. The goals of this paper are: to analyze the current state of the financial manager profession in selected labor markets, to identify the number of job positions with big data skills currently needed and to check additional skills and competencies needed in practice. The purpose of the literature study is to present the current changes in financial management and further expected changes caused by an increasing scale of collection and use of large digital data sets. We conducted research which highlights the current situation in selected European labor markets in order to define the main challenges and opportunities for finance managers in future. We have used the following research methods and technics: literature review, observation, descriptive statistics and graphical results presentation. Job search websites were used as a research tool.

2. Big Data in Financial Management

Analytics is not a new area for financial management. The finance functions already leverage analytics to provide financial insight to enterprise business partners, to predict profit, to analyze investment options, etc. According to a "Bloomberg Businessweek" report, 86 percent of the largest financial institutions in the world declare that BD analytics will be a priority for them in the coming years (Prajsnar, n.d.).

Big data techniques could be a valuable addition when rigorous analytical procedures are combined with the audit techniques and expert judgment. Furthermore, BD will need to be able to explain the reasons of the phenomenon in a more quantitative manner (Wang & Wang, 2016).

Experts have noticed two main trends in financial accounting technologies development: the integration of big data accounting information from different sources and a simultaneous increase of the value of gathered data (Rezaee & Wang, 2017). Currently, the Thomson Reuters Valuation Navigator provides the market data for valuation by collecting scattered financial data into a single repository, which supports pricing automatization and workflow valuation.

Digital assistants help to complete predictable accounting tasks, including responding to common queries about billing and cash flow management, searching accounting policies and procedures and calling subject matter experts in the organization to get the appropriate information (CPA, 2019). Users should be able to manage and monitor these technologies so they will have more time to focus on more complex, higher-risk and strategic targets (CPA, 2019).

Auditors, similar to financial managers, need to collect, extract, and process useful information from data warehouses. This will bring new challenges and will result in complications relating to the acquisition of data, information overload, information relevance, pattern recognition, privacy and security issues.

Due to the rise of BD and the evolution of financial auditing, these challenges could be overcome (Appelbaum, 2016; Appelbaum, Kogan, & Vasarhelyi, 2017; Zhang et al., 2015).

There are numerous opportunities to use big data techniques in auditing, especially when rigorous analytical procedures are combined with traditional audit techniques and expert judgement. Audits could benefit from implementing the improvements in recent big data financial distress and financial fraud models (Gepp et al., 2018). Sentiment analysis and natural language processing are other promising auditing tools that require additional research (Gepp et al., 2018).

There are also a few other new research directions for auditing such as: real-time information settings, and collaborative platforms and peer-to-peer marketplaces (Gepp et al., 2018).

Nowadays, tax systems are extensively supported by artificial intelligence technologies. Completed with artificial intelligence, they work smarter, not only in guiding accountants through the calculations and highlighting areas they might need to review, but also in providing advice and guidance for the client (Baron, 2017). Furthermore, casual sales on eBay or Amazon are becoming quite common and many taxpayers do not realize that these transactions should be reviewed for potential income tax consequences. With the IRS obtaining credit, debit, and PayPal records, matching transactions to taxpayers or small businesses is easy (Koskinen et al., 2015). If being audited, this is something that should not be discussed online. In short, taxpayers need to be very cognizant of their online profile in the age of big data analytics (Houser, 2018).

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Analysts draw the benefit of efficiencies in mass data collection and the potential to locate tax evaders (Koskinen et al. 2015). The IRS has indicated that it will continue to invest in data technologies to identify tax return errors and address issues with taxpayers as early as possible.

BD has become very popular in the banking area as well. According to the Global Transaction Banking, 62% of banks agree that big data is critical to their success (Forest et al., 2014). As a result of advanced automation, banks can experience significant cost savings and reduce the risks of failure by eliminating the human factor from some critical processes (Manish, 2018).

According to the NGData study carried out in 183 banks around the world, 71 percent of financial institutions have acknowledged that thanks to big data, they better understand the needs of their clients, which has contributed to increased profits (Prajsnar, n.d.).

In recent years, the convergence of big data and AI in finance and accounting areas has been gaining popularity. When it comes to financial management, the future of cognitive computing will revolutionize the audit process because it can be used to provide assisted decision-making for auditors (Baron, 2017).

Current cognitive assistants are great tools for business situations when users need information retrieval support from a large number of knowledge sources (Li & Vasarhelyi, 2018). Cognitive assistants are often speech-enabled technologies that understand voice commands, recognize the conversation context, and answer questions in a personable manner (Garrido et al., 2010; Myers et al., 2007).

Automated algorithms need human support and the lack of human interaction may lead to errors and a rapid fall in the stock market (Hurwitz et al., 2015).

The use of cognitive big data technology brings many advantages to many finance and accounting firms that do not have access to capital in order to make large-scale investments in technologies like cognitive computing (Baron, 2017). Currently, mostly Big 4 firms, banks and insurance companies are investing incessantly in emerging cognitive technologies (Greenman, 2017).

3. BD Skills in the Practice of Financial Management

Finance managers need to collect, extract, and process useful information from data warehouses. This will result in complications relating to the acquisition of skills of data and information management, pattern recognition, privacy and security management and will bring new challenges to the labor market. According to expert opinions, with the big data change, the skills required in the accounting profession should be considered in the ways managers can enhance their knowledge and skills to prepare for the big data challenge (Rezaee, 2017).

The 2016 survey presented by Gartner revealed that 59 percent of employers consider that data science and analytic skills will be necessary for finance and accounting managers by 2020 (Hare et al. 2016).

Finance managers' skills needed for the next decade are (Wang & Wang, 2016; Chua, 2013, p. 6):

- Knowledge of data extraction tools, data mining and business intelligence;
- Use of tools that support data modeling and analysis;
- Knowledge management skills;
- Project management skills;
- Change management skills;
- Knowledge of new approaches to funding and product development;
- Ability to use technology to attract, develop, and manage talent;
- Knowledge of emerging payment platforms;
- Better working knowledge of connectivity and IT security;
- Knowledge on how IT applications integrate.

In Poland, in the case of managers, accountants and auditors, a profession revolution is also approaching. At international scientific forums, the twilight of the accounting and auditing profession is now much more actively discussed, compared to the past. Regardless of the scale of target changes, some of their signals are already visible (Łada, 2016, p. 204). Domański and Jędrzejczak underline that big data is changing not just the nature of the evidence, but also the ways in which it is presented, and the skills needed for its interpretation.

The development of big data technology has influenced the practice of management accounting. The acquisition of large data requires understanding the enterprise and its needs, developing new skills and tracking new trends by accounting managers (Burnet-Wyrwa, 2017, p. 51).

In order to check the current demand for financial managers and skills required in the selected European labor markets, we conducted the research presented in the next part of the paper.

4. The Analysis of Current Demand for Finance Managers' Skills on Selected European Labor Markets

4.1. The Research

The research was conducted according to the framework presented in Figure 1.

The research was conducted in July-August 2019. First data were collected at the beginning of July, and after that results were checked two times until the beginning of August, totally during a one-month period. We did not notice any changes in the offers; therefore, we did not calculate the mean and the standard deviation.

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We examined the labor markets of the following selected European regions: one from Western Europe, one from Central Europe and one from Eastern Europe. The selection criteria were presented by geographical differentiation according to European regions, GDP differentiation and population similarity. The following 3 countries were taken into consideration: Poland, the United Kingdom and Ukraine.

At the beginning, we selected the most popular job search websites according to local rankings. We used the following selection criteria: 1) the largest number of financial manager posts, 2) ability to provide "advanced search" with the finding options which allow the searching key words to be highlighted in the textual content of job posts.

We analyzed about 20 thousand job posts. We used the same research procedure for all selected countries.

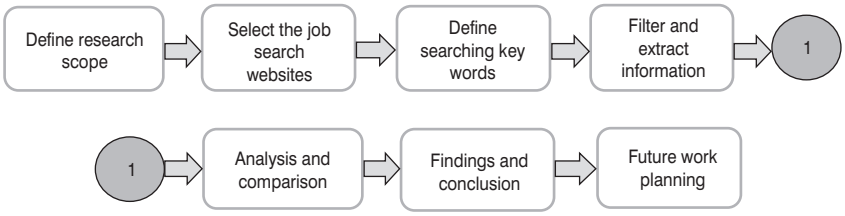

Fig. 1. Research framework. Source: Own study.

To filter the job offers, we used the website searching mechanism. For this purpose, we entered in the search fields the following keywords: "big data", "large data", "large data sets", "large amounts of data" for skills analysis and, simultaneously, words "finance manager", "finance director" and similar for position analysis. On the basis of the list of obtained job posts, we calculated the number of job offers for the finance manager (FM) position with big data skills requirements. We also identified additional core competencies and skills required.

Results for Poland

We analyzed the most popular Polish job portals. Only two of them contained job offers for finance managers with big data skills requirements; they are: pracuj.pl and praca.money.pl.

By introducing the key words presented above, we found several relevant positions, for example: Finance Manager, Finance Manager EMEIA, RTR Team Leader, Chief Accountant with French, Accounting Manager, EMEA Operations Manager, Deputy Manager of the Controlling Department, Operational Project Manager in the Area of Project and Financial Management, Manager in the Accounting and Controlling Department, Manager of Controlling, Tax Manager, etc.

In the next step, we calculated the number of above-mentioned offers (Table 1).

	Pracuj.pl	Praca.money.pl
Number of job offers for FM with BD skills	12	2

Tab. 1. BD skills analysis results in the Polish labor market. Source: Own study.

Furthermore, we analyzed the locations of positions presented in Table 1. 28% of job positions were from Wroclaw, 29% from Warsaw and 43% from other different cities (Fig. 2).

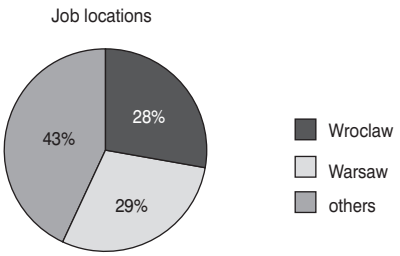

Fig. 2. Job position locations in Poland. Source: Own study.

We also analyzed core competencies and skills required. The core competencies needed for finance managers in the Polish labor market are: project management skills and experience, management of IT software, supply chain management, business process management and data flows modeling, change management skills, experience in ERP systems, especially SAP and MS Dynamics AX, advanced Excel skills. The experience in IT software required for finance managers in Poland is shown in Figure 3.

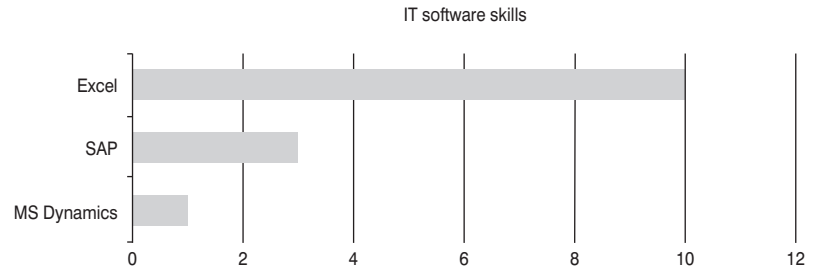

Fig. 3. The experience in IT software required for finance managers in Poland. Source: Own study.

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Results for the United Kingdom

Similar to Poland, for the UK we chose two most popular job portals according to current ratings and our criteria: britishjobs.co.uk and reed.co.uk. Thereafter, we calculated the number of offers with big data skills requirements for finance managers (Table 2).

	Britishjobs.co.uk	Reed.co.uk
The number of job offers for FM with BD skills	11	13

Tab. 2. BD skills analysis results in the United Kingdom labor market. Source: Own study.

Subsequently, we obtained several relevant positions on Britishjobs.co.uk website, for example: Finance Manager, Payroll Manager, Commercial, Finance Business Partner, Commercial FP&A Manager, Senior Manager/ Director, etc.

In the next step, we analyzed the locations of positions presented in Table 2. At britishjobs.co.uk, 55% of offers were from London, 45% from other cities (Figure 4).

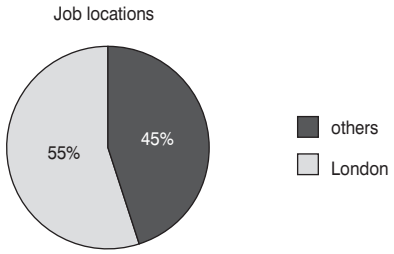

Fig. 4. Job position locations on britishjobs.co.uk. Source: Own study.

This webpage gave us the possibility to calculate the number of CVs submitted. We noticed a small number of job applications: for 4 job offers – fewer than 10 CVs, for others – 0 CVs. Only UK companies provided constantly the salaries for the job posts. For this reason, a comparative analysis of salaries was not possible between different countries. 92% of these offers were published by large companies within the salary range from 50 to 90 000 pounds.

On Reed.co.uk website, we obtained the results for the following positions: Finance Manager, Head of Commercial Finance, Head of Financial Planning and Analysis, Commercial Finance Partner, Strategic Finance Business Partner, Commercial Finance Manager, FP&A Manager, Financial Planning & Analysis Manager, Financial Modelling Manager, Senior Finance Manager, Royalties Manager, etc.

92% of these offers were posted by large companies with the salary range from 50 000 to 80 000 pounds. 54% of job offers were from London, 23% from Birmingham, 23% from other cities (Figure 5).

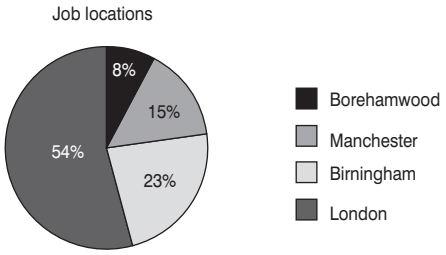

Fig. 5. Jobs position locations on reed.co.uk. Source: Own study.

Our research reveals that core skills currently needed in the UK labor market for Financial Managers with competency in BD are: forecasting, planning, maintaining financial models, budgeting, accurate reporting and data management skills, business processes management, experience and involvement in deploying and integrating new systems, change management, quality management, strong IT and systems knowledge, supply chain management, program management, project management, IT system implementation skills, delivering efficiencies in financial processing, ability to understand the "big picture". Most of the companies also require experience in: SAP, Microsoft Dynamics AX, Sage accounting software: Sage Intacct, Sage 50 accounts, Sage 200 etc., Opera Accounting Systems, Oracle, CRM, NetSuite, Axiom, COGNOS (Figure 6).

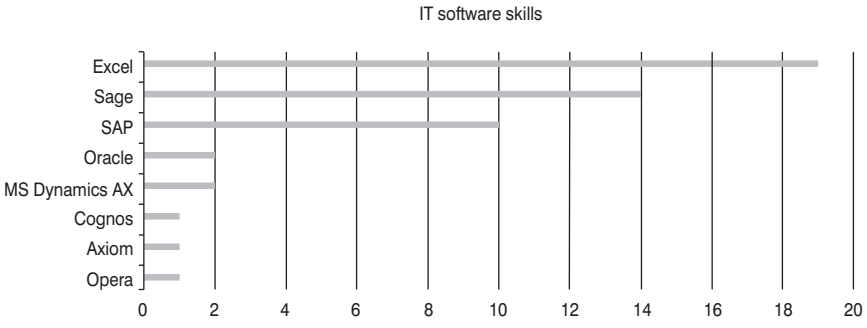

Fig. 6. The experience in IT software required for finance managers in the UK. Source: Own study.

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Results for Ukraine

In order to analyze the job offers in Ukraine, we chose, as in the previous research, two most popular job portals according to current ratings. Only the website work.ua contained the required information.

The analyzed positions were mostly intended for finance managers or finance directors in large international companies. We found 11 offers with big data skills requirements.

82% of offers were from the capital of the country – Kiev, only 2 offers were from other cities (Figure 7).

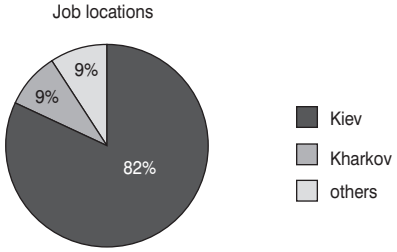

Fig. 7. Jobs position locations in Ukraine. Source: Own study.

We noticed that all job posts contained the requirements for MS Excel skills. Another software tools (for example, SAP software, MS Dynamics) were mentioned as an additional advantage.

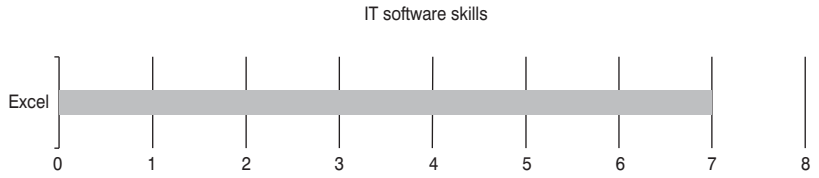

Fig. 8. The experience in IT software required for finance managers in Ukraine. Source: Own study.

4.2. Findings

The situation in various European labor markets is different. The research reveals differences in big data skills demand among the studied countries. The numbers of offers with big data skills requirements for finance managers were similar in Poland and Ukraine. In the UK, the number of these offers was twice as high as in the abovementioned countries.

Job offers with BD skills requirements currently represent about 2% or less of all offers for BD positions. On the other hand, in the UK and

Poland, finance mangers are expected to have more advanced IT skills. In Ukraine, these skills are currently not required as much. The most popular IT tool for managing a large amount of data in Ukraine is Microsoft Excel.

By comparing the data from different countries, we obtained the following results (Figure 9, Figure 10). Presently, the number of job offers with BD skills requirements are twice higher in the United Kingdom. The IT requirements are much higher in the United Kingdom.

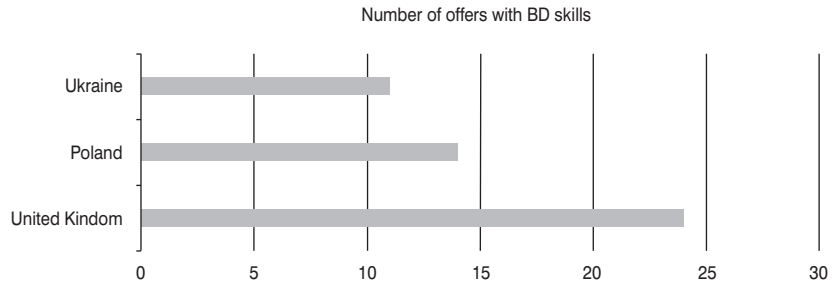

Fig. 9. The comparison of offers with BD skills required among countries. Source: Own study.

100% of UK companies require financial managers to be familiar with ERP systems. In Poland, such enterprises constitute about 30%. In Ukraine, the advanced knowledge of ERP systems is not mandatory, it is only an advantage.

Furthermore, we confirm the experts' opinion (Wang and Wang, 2016; Chua, 2013, p. 6) on finance managers' core competences. The exception to this statement is the ability to use technology to attract, develop, and manage talent. Additionally, we noted the increase of popularity of the new ability "to understand the big picture" in the UK.

Fig. 10. The comparison of ERP skills required among countries. Source: Own study.

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The main tasks for financial managers in the IT sphere are:

- To monitor the day-to-day financial processes and operations and report the results,
- To stay up to date with technological advances and accounting software which are used for financial purposes and also to be able to use IT in practice.

It should be emphasized that most offers did not specify which skills in big data technology are needed for finance managers. Such information was provided only in the case of analysis of managerial positions in the field of financial reporting.

We found that the candidates for the post of Head of Financial Reporting or Controls should have higher qualifications than finance managers. For instance: to be a fully qualified accountant, ideally trained within a Big Four or Top 10 accountancy practices, and to have significant financial reporting experience within a large corporation. It is also required to have experience with ERP and SQL, data science and machine learning skills or interest. Moreover, the experience in using Python and R is considered as an advantage.

The location analysis reveals that in all countries, financial managers with big data skills were sought mainly in large cities, including the capital, especially in Ukraine. Such concentration may affect market supply. For managers, this fact may involve the need to move to another city, which can significantly extend the time of the employer's search of the specialist.

To wrap up, we conclude that this is true for all analyzed countries that all posted jobs which target highly qualified high-paid specialists are located mostly in capitals and the largest cities.

One of our research limitations was the difference in the precision of skills requirements description among countries. Another difficulty was to avoid the repetition of offers checked on the basis of company titles and company names. In the case of a small number of offers, it was possible to select the appropriate ones. However, over time, if the number of offers increases, the research could become more complicated.

5. Conclusion

BD technologies are coming into practice in Europe. Financial managers are in a unique position as business leaders and advisors who aim to maximize big data opportunities and insights. This can only happen if they embrace AI and are proactive in enhancing their skillsets to meet the needs of an AI and big data powered world (CPA, 2019).

We conclude that finance managers need to stay up to date with technological advances and accounting software used for financial purposes. However, finance managers should be strong not only technically, but also should be commercially orientated in order to support the Board with the

key strategic decision-making and to drive the business forward through increased profitability as well as strategic acquisitions. For multi-department companies and bank managers, additional skills such as geographical analysis and knowledge of multidimensional visualization tools are required.

In the future, we are going to extend our research to other European countries and also to Canada and the United States, where technological development is at a more advanced level. Such a comparison will reveal the BD technology geographical spread directions. It may also help universities to prepare educational programs for the next decade in fields of study related to financial management.

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