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ROBOTIZATION OF BUSINESS PROCESSES AND THE FUTURE OF THE LABOR MARKET IN POLAND – PRELIMINARY RESEARCH

Introduction

The business process management (BPM) literature presents new concepts that improve management processes using modern IT tools and techniques. Artificial intelligence (AI), machine learning (LM), augmented reality, construction of environments in the network based on technology and Internet of things should be included in it. At this point, attention should be paid to the robotic process automation, identified as "an umbrella term for tools that operate on the user interface of other computer systems in the way a human would do" [van der Aalst et al., 2018: 269]. As a result of the increasing computing power of computers and the ability to process an increasing amount of data, the increase in intelligence of smart machines is noticeable [Davenport, Kirby, 2016: 22–23]. According to T.M. Davenport and J. Kirby, the intelligence of machines is gradual and can be perceived on four levels. Based on this juxtaposition, at the first level, defined as support for humans, the authors places the BPM approach in the perform digital tasks category. In turn, the second level, repetitive task automation, includes such tools as a BPM supplement, such as rules engines and robotic process automation (RPA). At this point, it should be emphasized that in the direction identified as the great convergence for the third and fourth level i.e., context awareness and learning as well as self-awareness, the solutions have not been developed yet [Davenport, Kirby, 2016: 22–23]. On this basis, the thesis was formulated that the implementation of Business Process Management has a positive

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effect on the implementation of the robotic process automation tools. It should be understood that in order for the organization to profit consciously from the implementation of robotic process automation, it must determine which activities in the processes or which processes have the highest level of standardization. This in turn requires their identification, formalization and measurement. At the same time, it should be decided which processes should be reconfigured from laminar processes into intelligent processes i.e., those that have a system of using their own knowledge from the organization's environment to optimize the flow of individual operations from the perspective of the results estimated each time [Grajewski, 2012: 59].

Robotic process automation should be considered in two areas – from the perspective of the future of organization and changes in the labor market. The first approach should understood as the occurrence of natural processes in a result of technological development and the rapid pace of knowledge growth and their impact on the economic environment of the organization. The second approach may be identified as reconfiguration of the current and the formation of new, previously unknown workplaces in the labor market.

The main goal of the article was to present the results of the preliminary assessment of the process automation potential on the Polish labor market. The partial objective was to determine the existing state of knowledge regarding the *robotic process automation*. The research objectives formulated in the article were implemented using such research methods as: quantitative and qualitative bibliometric analysis, popularity analysis using the Google Trends tool and the LOESS regression.

1. Literature review

The reason for taking up the issues described in this article was the quantitative and qualitative bibliometric analysis of scientific publications for the *robotic process automation* and *robotics process automation* entries. Based on the results of the analyses performed, a research gap was identified, consisting of a small number of publications regarding the impact of business process automation on the labor market.

The results of the quantitative bibliometric analysis based on the Web of Science and Scopus scientific databases are presented in Table 1.

As a result, it was noticed that the largest share of publications falls for the years 2015–2018. In addition, the majority of publications were assigned to such categories as: computer science and business and management.

In the studied publications, cases of RPA implementation in the organizations were observed [Lacity et al., 2015; Aguirre, Rodriguez, 2017; Moffitt et al., 2018; Ratia et al., 2018]. Noteworthy is also the study presenting the integration with a process approach in management through the match of process mining with RPA [Geyer-Klingeberg

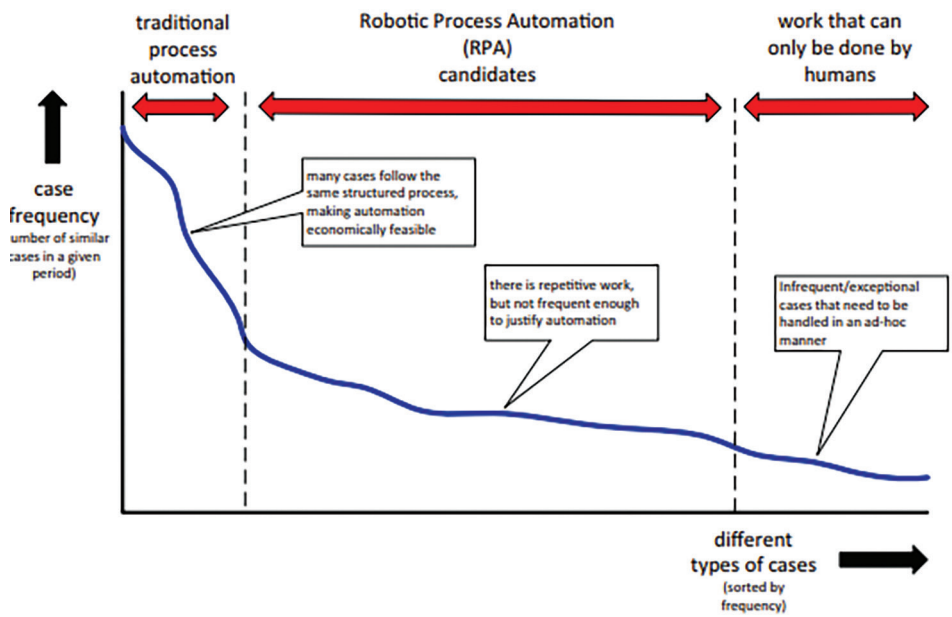
et al., 2018]. In the literature on the subject, RPA is identified as a tool [Tornbohm, 2017; Aguirre, Rodriguez, 2017], which "is a fast-emerging process automation approach that uses software robots to replicate humane task". The authors add that RPA is one of many available pathways to process automation [Geyer-Klingeberg et al., 2018]. Moreover, according to S. Anagnoste, the implementation of RPA tools requires "market maturity". More precisely, RPA in terms of activities in the organization was presented as a division of the activities in the organization of the traditional automation, RPA and work that may be performed only be men (Figure 1).

Table 1. Results of a quantitative bibliometric study in the Web of Science and Scopus databases

Database	Keyword / entry	Number of publications in 1900–2018	
		All	Scientific articles
Web of Science	robotic process automation	12	3
	robotics process automation	1	0
Scopus	robotic process automation	29	8
	robotics process automation	20	6

Source: own study based on data obtained from the Scopus and Web of Science databases, as of 3.12.2018.

Figure 1. Positioning RPA



Source: van der Aalst, Bichler, & Heinzl [2018].

Authors illustrated in Figure 1 that "typically, one sees a Pareto distribution. (…) Automation aims to address the most frequent case types (say 20% of all case types). Less frequent cases are not considered because automation is too expensive. (…) Therefore, the remaining 20% of the cases is often handled manually by humans entering information repeatedly and making decisions. In such settings, humans serve as the 'glue' between different IT systems. However, these remaining 20% of the cases, cover 80% of the case types and are much more time-consuming than the frequent ones" [van der Aalst et al., 2018: 270]. In Figure 1, for the area "work that can only be done by humans" actions that can be carried out only by men have been marked, but it should also be understood as human participation in the phenomena of entropy of automation. Moreover, building such an environment of human cooperation with robotization requires desired reconfiguration, from the perspective of goals and strategy of the organization, the role of employees and leaders based on empowerment in terms of the implementation of processes, which is determined by the greater doze of autonomy in their activity [Brilman, 2002: 344]. In summary, the characteristic implementations of RPA should include the following parameters: trained by the users, working with the client's user interface, undertake structured, repeatable, computer-based tasks, works flawlessly with multiple systems, works with different electronic formats. Performs checks and takes into consideration validation points according to a predefined set of rules, identifies easily exceptions (either against a database, or based on a specific condition inserted in the code), works 24/7 and during holidays and weekends, logs are stored inside the program, but can be configured to be sent by email at a specific point, date or frequency and provides a case for introduction of analytics [Anagnoste, 2017].

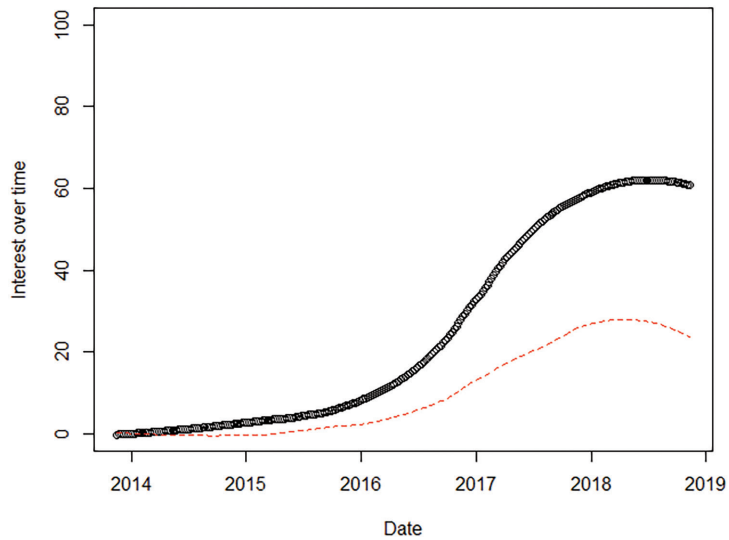
2. Analysis of the popularity of entries using the Google Trends tool

Then, an attempt was made to analyze the popularity of the entries presented in Table 1 using the Google Trends[1] tool. We selected the following parameters for the analysis: search area – world and Poland, analysis period – from 2014 and the category – science. The results of the analysis using the LOESS regression [Cleveland, 1979; 1981; Cleveland, Devlin, 1988, Cleveland et al., 1988] are presented in Figure 2. There were no results for *robotics process automation* and *robotization of processes* (entry presented in Polish).

At this point, it should be emphasized that the analysis resulted in a list of countries in which the robotic process automation entry is the most popular (Table 2).

[1] https://trends.google.com/trends/

Figure 2. Popularity of the robotic process automation entry in Poland and in the world using the LOESS regression with the 50% basis



The bold line shows the popularity of the entry in the world, while the dotted line illustrates its popularity in Poland.

Source: own study based on the Google Trends tool using the R programming language.

Table 2. Popularity of the robotic process automation and process automation entries due to countries

Entry	Criterion	I place	II place	III place	IV place	V place	Poland
							Place
Robotic process automation	Region	St Helena	Singapore	India	Hong Kong	Australia	14.
	City	Bengaluru	Hyderabad	Chennai	Singapore	Mumbai	–
Process automation	Region	St Helena	Singapore	India	Hong Kong	United Arab Emirates	28.
	City	Gurgaon	Bengaluru	Hyderabad	Chennai	Singapore	–

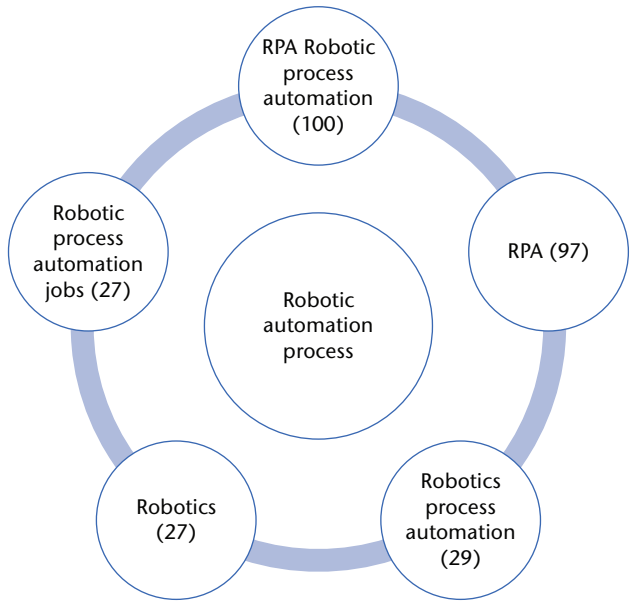
Source: own study based on the Google Trends tools. Category – science, period – 5 years. Date of reading: 15.11.2018.

In addition, Figure 3 presents the related queries for the *robotic automation process* entry. In turn, the following were qualified among the related topic[2] *automation* (100),

[2] Related queries/topic – users searching for the term also searched for these queries/topics. The most popular search queries/topic. Scoring is on a relative scale where a value of 100 is the most commonly searched query/topic, 50 is a query/topic searched half as often as the most popular query, and so on (Google Trends).

robotic process automation (99), *business process* (93), *tool* (6) and *job* (5)[3]. Based on the presented issues, an attempt was made to verify the popularity of the entry of *robotics process automation jobs.* As a result, it was noticed that this entry is the most popular in India and the United States.

Figure 3. Relate queries of robotic automation process



Source: own study based on Google Trends, reading on 15.11.2018.

3. Analysis of the potential of process automation

Robotization of business processes is a function of several factors resulting from the organization's flexibility, process maturity of the organization as well as the implementation of IT solutions and the level of process standardization. It should be emphasized that so far only a few issues have been published regarding the nature of the problem of labor market potential analysis for robotization of processes and the impact of implementing modern solutions on their performance. A small number

[3] Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means that there were not enough data for this term (Google Trends).

of scientific publications and reports only allows to outline the potential of robotization of processes. In this article, the potential of process automation is identified as a set of features describing the action or actions carried out during the course of the process by man, which can be replaced by the RPA tool without reducing the level of process quality.

When defining RPA as a tool aimed at improving business processes, it should be highlighted that from the perspective of process maturity models, it is possible at the fourth or fifth level of process maturity of the organization [Maull et al., 2003: 596–624; Fisher, 2004: 11–15; Rosemann, de Bruin, 2005; Lee et al., 2007: 384–39; Rohloff, 2009: 128–142; Grajewski, 2016: 122; Sliż, 2018a: 90–91]. When analyzing the result of the assessment of the maturity of contemporary organizations in Poland [Sliż, 2018b: 155], it should be emphasized that almost 70% of Polish organizations qualified to the first and second level. On this basis, one can formulate a research hypothesis that the higher the level of process maturity, the greater the organization's potential for the implementation of robotic process automation. Such a hypothesis requires the implementation of in-depth research of the organization both in the area for assessing the maturity of processes as well as determining the potential or the actual degree of RPA implementation.

Moving to the issue of RPA implementation in the organization, it is necessary to present a developed business function statement by S. Anagnoste, who used two parameters of process automation potential and potential time savings to assess the overall potential. According to the author, regarding the first parameter, the following business functions have the highest potential: human resources (60–80%), source to pay (50–70%), order to cash (40–60%), finances (30–50%). In turn, taking process automation potential as the parameter, the following auxiliary processes (sub-processes) were indicated: tax (40–60%), financial planning and analysis (25–50%), customer master data management (25–30%), credit management (25–30%), customer service support (25–30%), account receivables management (25–30%) [Anagnoste, 2018: 59–60].

The analysis of the potential of process automation on the Polish market was presented in reports prepared by Mc Kinsey & Company, whose aim was to analyze the potential of process automation in Poland and its impact on the labor market and the economy. The following reports were published: "Digital Poland", "Digital Poles", "5 tasks for Poland", and "AI revolution", as well as "Hand in hand with the robot", "How to use the potential of automation in Poland"[4]. It should be mentioned that in these reports, robotization is understood very broadly, and RPA is identified with the automation of processes including industrial robots. Nevertheless, as a result

[4] The reports presented are available in electronic version: *Publikacje*, McKinsey & Company, https://mckinsey.pl/wydarzenia-i-publikacje/publikacje/ (12.11.2018).

of a detailed reports analysis, a common ground with the results of the study by S. Anagoste is visible. This means that there exists an indication in the reports of the automation potential given the types of activities including the robotic process automation, according to the article's definition. Data processing (71%), data collection (65%), use of knowledge and experience (29%) and human management (9%) were mentioned among them. Moreover, the discussed report underlines the potential of automation according to industries, including: administration (40%), telecommunications (36%), finance and insurance (36%), and the professional, scientific and technical activity (33%).

Table 3. The number of people working in Poland according to sectors as of 31.12.2017

Specification	Working in thousands (as of 31XII)	Potential	Number of employees with the potential of automation in thousands
	2017		
Information and communication	366.5	0.36	131.94
Financial and insurance activity	353.3	0.36	127.188
Real estate market service	224.3	0.42	94.206
Professional, scientific and technical activities	680	0.33	224.4
Administration	589.2	0.4	235.68

Source: own study based on CSO data and the report "Hand in hand with a robot".

Based on the CSO data contained in the report entitled "Employees and remuneration in the national economy in 2017 in Poland" [GUS, 2018], the main sectors with high potential for automation taking into account the number of employees were estimated.

4. Analysis of the labor market in Poland in terms of new job positions related to RPA

When discussing implementation of process automation, it should be accentuated that in addition to the changing labor market as a result of the use of modern tools aimed at automating the standardized activities in the implementation of processes, new workplaces are also being created. In order to verify it, job offers on the Polish market were verified based on the website pracuj.pl data[5] (Table 4).

[5] As of 17.11.2018.

Table 4. Job offers for the RPA and robotic process automation entries in Poland

Province/ Entry	Robotics process automation (number of offers)	RPA (number of offers)	Robotics process automation (in %)	RPA (in %)
Dolnoslaskie	4	9	11.11	11.84
Kujawsko-Pomorskie	1	1	2.78	1.32
Lubelskie	1	1	2.78	1.32
Lubuskie	1		2.78	0.00
Lodzkie	2	4	5.56	5.26
Malopolskie	5	14	13.89	18.42
Mazowieckie	1	28	2.78	36.84
Opolskie	1	1	2.78	1.32
Pomorskie	1	3	2.78	3.95
Podkarpackie	2	1	5.56	1.32
Slaskie	5	6	13.89	7.89
Wielkopolskie	7	6	19.44	7.89
Zachodniopomorskie	2	2	5.56	2.63
Warminsko-Mazurskie	1	0	2.78	0.00
Podlaskie	1	0	2.78	0.00
Swietokrzyskie	1	0	2.78	0.00
In total	36	76	100.00	100.00

Source: own study based on the analysis of job offers on the pracuj.pl website.

The analysis revealed that the most common work categories for the entries: *robotics process automation* include: engineering and production, while for *RPA*: IT – development of software, IT – administration, engineering, research and development, while for process automation: IT – development of software, engineering and production. In turn, the offers for the *robotics process automation* entry were directed only to specialists (100%), RPA to specialists (82.89%), managers (10.53%) and others (6.58%).

Conclusions

When analyzing the contemporary market realities of organizations in Poland, determined by high fluctuation and shortage of employees in some sectors, development of advanced technologies and the need to dynamically adapt to prosumer expectations, one can assume that in the coming years the demand for robotization will grow. Based on the conducted study, three general conclusions were formulated.

First of all, robotization can be included in projects oriented towards the standardization of processes, while also increasing intelligent processes in the area of activities that can only be performed by man. This is directly related to the need to reconfigure the desired role of the employee, from the perspective of the organization's goals and strategies, into the intelligent process structure. This means high validation of operations' contractors focused around the activities generating the added value in the value chain, implementing new processes using the reengineering principles and building, shaping all factors of the organization in order to increase the flexibility of activities and increase their degree of independence in designing processes [Grajewski, 2012: 61].

Another conclusion is that the high level of robotization and automation of activities in business processes is associated with the domination of conceptual skills to design process over the employees' implementation skills. This means that the "high level of intelligence of business processes is connected with the combination of implementation and conceptual skills in one process link for designing process" [Grajewski, 2012: 62–63].

To sum up, due to global trends related to the development of technology, the interest in the robotic process automation will most probably grow, which will contribute to the reconfiguration of the labor market in Poland, the formation of new or expansion of the current directions of education, as well as retraining of employees.

References

[1] Aguirre S., Rodriguez A. [2017], *Automation of a business process using robotic process automation (RPA): A case study*, Workshop on Engineering Applications, Springer, Cham.

[2] Anagnoste S. [2017], *Robotic automation process – the next major revolution in terms of back office operations improvement*, Presented at of the 11th International Conference on Business Excellence.

[3] Anagnoste S. [2018], *Robotic automation process – the operating system for the digital enterprise*, Presented at 12th International Conference on Business Excellence, Sciendo.

[4] Brilman J. [2002], *Nowoczesne koncepcje i metody zarządzania*, Polskie Wydawnictwo Ekonomiczne, Warsaw.

[5] Cleveland W.S. [1979], Robust locally weighted regression and smoothing scatterplots, *Journal of the American Statistical Association* 74(368).

[6] Cleveland W.S. [1981], *Lowess:* A program for smoothing scatterplots by robust locally weighted regression, *American Statistician* 35(1).

[7] Cleveland W.S., Devlin S.J. [1988], Locally weighted regression: An approach to regression analysis by local fitting, *Journal of the American Statistical Association* 83(403).

[8] Cleveland W.S., Devlin S.J., Grosse E. [1988], Regression by local fitting: Methods, properties, and computational algorithms, *Journal of Econometrics* 37(1).

[9] Davenport T.H., Kirby J. [2016], Just how smart are smart machines? *MIT Sloan Management Review* 57(3).

[10] Fisher D.M. [2014], The business process maturity model: A practical approach for identifying opportunities for optimization, *Business Process Trends* 9(4).

[11] Geyer-Klingeberg J., Nakladal J., Baldauf F., Veit F. [2018], *Process mining and robotic process automation: A perfect match*, Presented at 16th International Conference on Business Process Management (BPM), Sydney.

[12] Grajewski P. [2012], *Procesowe zarządzanie organizacją (A process-oriented organisational management)*, PWE, Warsaw.

[13] Grajewski P. [2016], *Organizacja procesowa* (*A process-oriented organization*), 2nd ed., PWE, Warsaw.

[14] GUS [2018], *Pracujący i wynagrodzenia w gospodarce narodowej w 2017 r. – dane ostateczne*, Central Statistical Office, 30.11.2018, http://stat.gov.pl/obszary-tematyczne/rynek-pracy/pracujacy-zatrudnieni-wynagrodzenia-koszty-pracy/pracujacy-i-wynagrodzenia-w-gospodarce-narodowej-w-2017-r-dane-ostateczne,17,2.html (1.12.2018).

[15] Lacity M., Willcocks L.P., Craig A. [2015], *Robotic process automation at Telefonica O2*, The Outsourcing Unit Working Research Paper Series, Paper 15/02.

[16] Lee J., Lee D., Kang S. [2007], An overview of the business process maturity model (BPMM), in: Shan H., China J. (eds.), *Advances in web and network technologies, and information management* 4537, Berlin.

[17] Maull R.S., Tranfield D.R., Maull W. [2003], Factors characterising the maturity of BPR programmes, *International Journal of Operations & Production Management* 23(6).

[18] Moffitt K.C., Rozario A.M., Vasarhelyi M.A. [2018], Robotic process automation for auditing, *Journal of Emerging Technologies in Accounting* 15(1).

[19] *Publikacje*, McKinsey & Company, https://mckinsey.pl/wydarzenia-i-publikacje/publikacje/ (15.12.2018).

[20] Ratia M., Myllärniemi J., Helander N. [2018], *Robotic process automation-creating value by digitalizing work in the private healthcare?* Proceedings of the 22nd International Academic Mindtrek Conference.

[21] Rohloff M. [2009], Case study and maturity model for business process management implementation, in: Dayal U., Eder J., Koehler J., Reijers H.A. (eds.), *Business Process Management. BPM 2009*, Lecture Notes in Computer Science 5701, Berlin.

[22] Rosemann M., de Bruin T. [2005], Towards a business process management maturity model, in: Bartmann D., Rajola F., Kallinikos J., Avison D., Winter R., Ein-Dor P., et al. (eds.), *ECIS 2005 Proceedings of the 13th European conference on information systems*, 26–28 May, Regensburg.

[23] Sliż P. [2018a], Concept of the organization process maturity assessment, *Journal of Economics & Management* 33.

[24] Sliż P. [2018b], *Dojrzałość procesowa współczesnych organizacji w Polsce*, Wydawnictwo Uniwersytetu Gdańskiego, Sopot.

[25] Tornbohm C. [2017], Market guide for robotic process automation software, http://images.abbyy.com/India/market_guide_for_robotic_pro_319864%20(002).pdf (15.12.2018).

[26] van der Aalst W.M.P., Bichler M., Heinzl A. [2018], Robotic process automation, *Business & Information Systems Engineering* 60(4).

ROBOTIZATION OF BUSINESS PROCESSES AND THE FUTURE OF THE LABOUR MARKET IN POLAND – PRELIMINARY RESEARCH

Abstract

The main goal of the article was to present the results of the preliminary assessment of the process automation potential on the Polish labor market. The partial objective was to determine the existing state of knowledge regarding the robotic process automation. The research objectives formulated in the article were implemented using such research methods as: quantitative and qualitative bibliometric analysis of statistical methods (LOESS regression). The first part of the article describes the results of the literature review. The second point presents the results of the analysis of the popularity of the robotic process automation entry using the Google Trends tool. Then, the results of the secondary research were characterized and the job offers related to RPA were presented quantitatively. As a result of the conducted research, a growing interest in the robotic process automation was observed in the field of management and quality sciences, as well as business practice.

Keywords: robotic process automation, RPA, process approach, BPM, labor market

JEL classification codes: O300, O320, O330

ROBOTYZACJA PROCESÓW BIZNESOWYCH A PRZYSZŁOŚĆ RYNKU PRACY W POLSCE – BADANIA WSTĘPNE

Streszczenie

Głównym celem artykułu jest przedstawienie wyników wstępnej oceny potencjału robotyzacji procesów na polskim rynku pracy. Celem cząstkowym jest określenie istniejącego stanu wiedzy, dotyczącego *robotic process automation*. Sformułowane w artykule cele badawcze zrealizowano przy wykorzystaniu metod badawczych, jak takich: ilościowa i jakościowa analiza bibliometryczna metody statystyczne (regresja LOESS). W pierwszej części artykułu opisano wyniki przeglądu literatury. W drugiej przedstawiono wyniki analizy popularności hasła *robotic process automation* przy wykorzystaniu narzędzia Google Trends. Następnie scharakteryzowano wyniki badań wtórnych i ilościowo, przedstawiono oferty pracy związane z RPA. W rezultacie przeprowadzonego badania zaobserwowano rosnące zainteresowanie problematyką i jakością *robotic process automation* w dyscyplinie nauk o zarządzaniu oraz w praktyce biznesowej.

Słowa kluczowe: robotyzacja procesów, RPA, podejście procesowe, zarządzanie procesami, rynek pracy

Kody klasyfikacji JEL: O300, O320, O330