BJ O&PM Brazilian Journal of Operations & Production Management

ISSN 2237-8960 (Online)

ABEPRO ASSOCIAÇÃO BRASILEIRA DE ENGENHARIA DE PRODUÇÃO

LITERATURE REVIEW

Influence of artificial intelligence on public employment and its impact on politics: a systematic literature review[1]

João Reis[1,2], Paula Espírito Santo[2], Nuno Melão[3]

[1]University of Aveiro, Department of Economics, Management and Industrial Engineering and Tourism, Research Unit on Governance, Competitiveness and Public Policies – GOVCOPP, Aveiro, Portugal.

[2]University of Lisbon, Institute of Social and Political Sciences – ISCSP, Centro de Administração e Políticas Públicas, Campus Universitário do Alto da Ajuda, Lisbon, Portugal.

[3]Polytechnic Institute of Viseu, Research Centre in Digital Services – CISeD, Campus Politécnico, Viseu, Portugal.

How to cite: Reis, J., Espírito Santo, P. and Melão, N. (2021), "Influence of artificial intelligence on public employment and its impact on politics: a systematic literature review", *Brazilian Journal of Operations & Production Management*, Vol. 18, No. 3, e20211114. https://doi.org/10.14488/BJOPM.2021.010

ABSTRACT

Goal: Public administration is constantly changing in response to new challenges, including the implementation of new technologies such as robotics and artificial intelligence (AI). This new dynamic has caught the attention of political leaders who are finding ways to restrain or regulate AI in public services, but also of scholars who are raising legitimate concerns about its impacts on public employment. In light of the above, the aim of this research is to analyze the influence of AI on public employment and the ways politics are reacting.

Design / Methodology / Approach: We have performed a systematic literature review to disclose the state-of-the-art and to find new avenues for future research.

Results: The results indicate that public services require four kinds of intelligence – mechanical, analytical, intuitive, and empathetic – albeit, with much less expression than in private services.

Limitations of the investigation: This systematic review provides a snapshot of the influence of AI on public employment. Thus, our research does not cover the whole body of knowledge, but it presents a holistic understanding of the phenomenon.

Practical implications: As private companies are typically more advanced in the implementation of AI technologies, the for-profit sector may provide significant contributions in the way states can leverage public services through the deployment of AI technologies.

Originality / Value: This article highlights the need for states to create the necessary conditions to legislate and regulate key technological advances, which, in our opinion, has been done, but at a very slow pace.

Keywords: Artificial Intelligence; Robotics; Policy; Employment; Public Services.

INTRODUCTION

Driven by technological advances and public interest, artificial intelligence (AI) is being considered by some to be an unprecedented revolutionary technology (Brock and Von Wangenheim, 2019). Established as an academic discipline in the 1950s, AI remained an area of relative scientific obscurity and limited practical interest for more than half a century (Haenlein and Kaplan, 2019; Wirtz and Müller, 2019). But recently, the private sector has reversed this

[1] This article is from the XXVI International Conference on Industrial Engineering and Operations Management (IJCIEOM) and was invited to be published in the September/2021 Special Issue of the Brazilian Journal of Operations & Production Management, due to its relevance and contribution to the field.

Financial support: None.
Conflict of interest: The authors have no conflict of interest to declare.
Corresponding author: reis.joao@ua.pt
Received: 23 Nov 2020.
Approved: 1 Dec 2020.
Editor: Luiz Felipe Scavarda.

trend, leveraging AI to another level as it has begun to integrate AI-related technologies into its service delivery systems, thereby reaching to general public (Marr, 2019; Reis et al., 2020a). This game-changing situation has shifted AI from the unique field of computer sciences to areas such as social and management sciences (Rosete et al., 2020). Furthermore, it is well known that the digital Era is not only driving innovation in the business sector, but also seems to influence developments in the public sector as well (Kokkinakos et al., 2016). Public sector digitalization is currently one of the promising topics with more prospects for future development, and yet a small percentage of academic research focuses on this domain, at least for the time being (Gauß, 2020; Reis et al., 2018; Schou and Hjelholt, 2018).

To develop scientific research in the field of study, our intention is to follow the suggestions of Reis et al. (2020b) by proposing a research based on the theory of AI job replacement of Huang and Rust (2018); similar research was developed by Rosete et al. (2020) to analyse whether service robots and AI influenced human employment, the latter focused on the private sector. Rosete et al. (2020) studied the Henn-na hotel, which fully automated its services so that guests would never find staff during their service experience. The findings suggested that, in situations of higher customer contact, service robots were unable to perform human tasks, resulting in a negative experience for guests. The point is that service robots are highly effective at performing analytical-cognitive tasks, but very limited at social-emotional ones. As for the practical implications, the Henn-na hotel had to remove more than half of its robotic workforce because robots were not capable to perform social activities. The point is that, in manufacturing many jobs have been replaced, and even if we witness an employment transition to services, the latter is not likely to be immune to job replacement either (Buera and Kaboski, 2012; Ivanov, 2020; Lu et al., 2020). Although services are known to be more difficult to be replaced, as they imply spontaneous communication interactions (Autor and Dorn, 2013) and emphatic relations (Wirtz et al., 2018), it is likely that this will soon not be the case (Huang and Rust, 2018). Therefore, from the perspective of public services, there are still many questions to answer, for instance: RQ1) Is AI significantly influencing public employment? RQ2) How is the political power expected to deal with AI-related employability issue? Contrary to the article by Rosete et al. (2020), who used the theory of Wirtz et al. (2018), because it focuses specifically on front-line service robots, we used the theory of Huang and Rust (2018). This theory specifies four types of intelligence required for service tasks – mechanical, analytical, intuitive, and empathetic – and is, therefore, better suited to our paper as it is broader and focused on AI in general services. Later on, Huang et al. (2019) merged the analytical and intuitive intelligence into thinking intelligence. To have a more detailed analysis, we will apply the original four types of artificial intelligence (Huang and Rust, 2018).

Last but not least, a statement of public employment and political power must be briefly discussed to properly address the research questions in the next sections. In that regard, we witness that the definition of public employment differs due country-specific regulations and reforms trajectories of public employment regimes and therefore it has not reached universal consensus (Gimpelson and Treisman, 2002, Behar and Mok, 2013). Although imprecise, the definition by Gottschall et al. (2015) seems complete, in that they define the term public employment as a large and heterogeneous group of employees who are directly or indirectly involved in the production and supply of publicly-financed goods and services; other definitions tend to exclude companies owned by the state for operating in the private sphere. Before moving on to the definition of "political power", it is relevant to note that "power" has long been "one of the key concepts in the great Western tradition of thought about political phenomena" (Parsons, 1963, p. 232). Although, it has already been much discussed in the field of political science, it seems that there is also no consensus on its definition. Some recent definitions have a rhetoric keen to coercion, vide Holcombe (2020, p. 4), which defines political power as "the ability to use the institutional framework to credibly threaten to impose costs on people so they will act as those with political power want them to act". As mentioned by Haugaard (2020, p. 1), Carl Schmitt and Rousseau also saw politics as having a sacred element, whereby the leader's pronouncements are analogous to the voice of a God; however, for most liberal and plural-oriented Democrats, this form of charismatic authority represents a threat to the democratic system (Haugaard, 2020, p. 1). If we take into account a more neutral perspective, while remaining modernist, the definition of political power focuses on the contrast between power in terms of agency/State and the way in which social conscience creates conditions for possible for action (Journal of Political Power, 2020).

We have structured this paper into five sections. After the introduction, the subsequent section provides an overview of the topic and discusses the most relevant concepts. This is followed by an explanation of the methodological process. The results of the systematic literature review are also discussed, while the objective is to present conceptual evidence about the influence of AI on public employment and its impact on public policy. Finally, we explore the contributions to theory and practice, as well as suggestions for future research.

CONCEPTUAL BACKGROUND

The AI concept has been defined from different perspectives, so we venture to say that it has triggered the attention of researchers at a multidisciplinary level. In general terms, AI is being coined in the literature as a human behaviour that can be performed by machines, systems or networks (Li and Du, 2017). According to Russell and Norvig (2016), AI may comprise thought processes and reasoning, but also a human behavioural component. That is, the definition must, on the one hand, present a more human-centred approach that should include empirical sciences covering human behaviour notions, and, on the other hand, focus on a combination of mathematical and engineering models. Moreover, some authors argue that AI has gone through three distinct research phases (Darlingtom, 2017; Sharma et al., 2020): the first reflects developments on computing capacity and processing power; the second focus on the development of artificial neural networks, which mainly tries to simulate the human brain; the third wave has been driven by deep learning and real-world applications. Knowing the intentions of AI to mimic the human brain, Turing (1950) tried early to make a distinction between "computing machinery" and "intelligence". The concept of intelligence has continuously evolved and it is generally viewed as the ability to learn from experience, as well as to adapt to the surrounding environment (Sternberg, 1996). In light with the above, Huang and Rust (2018) have also provided some inputs, and presented four different types of intelligence – mechanical, analytical, intuitive, and empathetic – ordered by degree of complexity. The AI job theory asserted that job[2] replacement should occur first at task level, rather than job level due the degree of complexity (i.e. easier tasks can be most easily performed by AI-enabled technologies rather than most complex ones - e.g. intuitive and empathetic). In a seemingly far-fetched context of our reality, AI will also be capable of performing intuitive and empathetic tasks (Huang and Rust, 2020; Rosete et al., 2020).

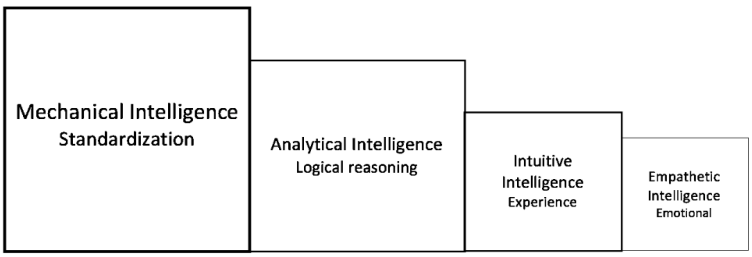

Figure 1. The four types of AI intelligences. Source: Adapted from Huang and Rust (2018).

Thorndike (1920) has divided intelligence in three dimensions: 1) abstract intelligence, which is the ability to manage, understand ideas and symbols (Newsome et al., 2000); 2) mechanism intelligence, that is, the "ability to learn, to understand and manage things and mechanisms" (Thorndike, 1920, p. 228); 3) social intelligence, known as the ability to manage and lead with people (Kihlstrom and Cantor, 2000). Thus, the first level of intelligence in Figure 1 is the mechanical intelligence, which is the ability to manage repetitive tasks.

Sternberg (1996) also divided intelligence in a triadic dimension: 1) analytical intelligence that analyses, compares and evaluates information for problem solving; 2) practical intelligence gained particular relevance in allowing generalization of knowledge from a

[2] A job comprises a set of tasks that an employee performs and tasks are defined as activities involved in an occupation, therefore a job usually includes several tasks (Huang and Rust, 2018)

particular context to other contexts; 3) creative intelligence, which is relevant to novel situations that require skills that may be only loosely on past experiences (Tigner and Tigner, 2000). The second level of intelligence is the analytical intelligence which is the ability to process information to solve problems.

Intuitive intelligence is considered as the ability to analyse alternatives with deeper insight, transcending simple rational thinking (Jarrahi, 2018). This is the third level of intelligence, which requires creative thinking and the capacity to adjust to novel situations (Huang and Rust, 2018).

Concerning the fourth intelligence, emotional intelligence involves recognizing emotions and processing emotional information as part of the overall problem-solving ability (Mayer and Geher, 1996). Other authors have used different terminology than empathetic intelligence (Huang and Rust, 2018). We have used emotional intelligence since it serves as a foundation for empathy (Beauvais et al., 2017). To better understand the aforementioned concepts, we provide an example below (Table 1).

Table 1. Types of intelligences and tasks from banking services

Types of Intelligences	Mechanical intelligence	Analytical intelligence	Intuitive intelligence	Empathetic intelligence
Banking agency	Standardized replies	Logical reasoning	Experience-based understanding	Social-emotional relations

Source: Based on Duffy et al. (2006), Shapiro and Nieman-Gonder (2006), Reis et al. (2019a; 2019b; 2020c).

Consider a frontline employee from a banking agency that replies to a customer complaint by following standardized scripts (Reis et al., 2020c). In practical terms, this type of complaint leads to immediate and standardized answers due to the high level of repeatability (Reis et al., 2019a) – given the nature of the task (mechanical intelligence), the recovery process can be easily replaced by AI. A subsequent phase (analytical intelligence) is represented by a frontline employee that analyses a customer complaint by posting some direct questions to screen and identify an issue. From the aforementioned situation, logical reasoning is required to make a proper decision. In some other cases (intuitive intelligence), the bank employee has to use his/her intuition, experience and contextual interactions to understand the complaint and seek a reasonable answer (Reis et al., 2019b). A more complex situation (empathetic intelligence) is when the bank employee has to show empathy by listening to the complaint, apologizing and calm the customer down (Duffy et al., 2006; Shapiro and Nieman-Gonder, 2006). This last interaction requires social-emotional relationships, which is harder to be replaced by AI. Yet, AI has already substituted human employment in areas that were previously thought to be uncomputerizable (Bruun and Duka, 2018).

In addition to what was previously mentioned, recent developments in robots and AI also herald an unprecedented political, economic and social transformation. In that regard, Boyd and Holton (2018) argue that in the public debate the rhetorical moment in business and policymaking is behind the technological determinists. The relevance of AI in the political-economic-social landscape is well-evidenced in many crises. An example is the recent dispute between the United States of America and China, which resulted in the United States Department of Defence's restrictions on the use of Huawei technologies (Ernst, 2020; Kaplan and Haenlein, 2020; Kapustina et al., 2020) and which has suffered a series of deadlocks. Therefore, those in the race for AI development are likely to dominate the coming decades, especially in terms of economic and geopolitical strength, which will potentially exacerbate tensions between countries (Feijóo et al., 2020). The AI holistic outlook may be summarized to the following countries (Kaplan and Haenlein, 2020): 1) China is using AI improve its economic position worldwide (Brown, 2020); 2) in the USA, AI is being driven by a number of technology companies that ultimately aim to profit (Eliasy and Przychodzen, 2020); 3) in the EU, the focus is on data protection and the privacy of its citizens, as evidenced by the

establishment of the General Data Protection Rule (Allen and Masters, 2020; Bessen et al., 2020; Mercer, 2020), as well as the political stability (Mosteanu, 2020). Thus, according to Kaplan and Haenlein (2020) the underlying challenge is to coordinate these contradictory goals. In addition to the effect of AI on foreign and domestic policy, AI also raises concerns about job replacement or process dehumanization, exacerbating social e economic divisions (West, 2015). Also in that regard, the biggest challenge is unlikely to be the identification of the existing AI dangers, but rather the response of public governance (Dignam, 2020).

METHODOLOGY

This paper follows a qualitative methodology, which analyses the content of retrieved sources from Scopus, one of the world´s largest abstract and citation databases of peer-reviewed research literature. The chosen method for this paper was a systematic literature review, in order to provide an objective and comprehensive summary of the existing literature (Blaxter, 2010; Petticrew and Roberts, 2008). The use of this method is also justified by the recent studies that reinforce the argument that AI research and the technological developments in the public sector, their applications and the results of using these strategies is still scarce and need to be systematized (Sousa et al., 2019). Thus, we present the current state-of-the-art and, at the same time, focus the discussion on the research questions already presented in the introduction. Moreover, following the assumptions of Tranfield et al. (2003), we used a clear set of steps to be replicated, and only one database to enhance transparency. Scopus was chosen from several relevant databases, such as Web of Science (WoS) or EBSCO Host, because, as justified by Reis et al. (2019c, 2020d), has a wider coverage of articles, indexing a broader range of AI journals. With regard to academic search engines, such as Google Scholar, they were excluded because our priority was to select only articles evaluated by peers for reasons of quality and credibility. As such, a Scopus search was conducted on January 3rd, 2020, and started with the inclusion criteria by using the keywords “artificial intelligence” and “employment” in title-abstract-keywords.

Table 2. Literature review process

Scopus – Elsevier		
Selected keywords	**“Artificial Intelligence” AND Employment**	
Search	title-abs-key	783
Language	English	764
Source type	Journals	255
Document type	Articles	229
Subject area	Social Sciences, Management, Engineering	128

Source: The authors.

Although AI job replacement is considered in the academic field as a central topic (Makridakis, 2017; Frank et al., 2019), we found that Scopus did not generate a wide range of research streams, reinforcing the need for studies in this field. To get more accurate results we applied a series of filters, namely: language, source type, document type and subject area (Table 2). Accordingly, the search included articles published in English due to linguistic limitations. The second and third step of the process included journal articles from the perspective of only considering higher quality publications; hence, we have not considered conference proceedings, book chapters, etc. Finally, we focused on areas such as the social and management sciences – mostly to seek the political and public administrators´ perspectives; and engineering – to gain a technical understanding of AI technologies and robotics. Following some of the usual exclusion criteria (i.e. lack of full paper access and articles out of context), it resulted that all the articles were included in the study. Therefore, the final sample included 128 peer-reviewed journal articles (see Appendix A).

The data analysis followed the content analysis technique (Neuendorf, 2016; Krippendorff, 2018), which began by reading all the 128 selected articles, in order to familiarize

with new concepts and the most relevant ideas. In a second stage, we coded similar words and terms. By grouping the text, it was possible to identify categories and subcategories (Cenamor et al., 2017). The third stage aimed to hierarchize the categories and subcategories to identify new patters and ideas (Given, 2008; Hancock and Algozzine, 2016). The last stage aimed to refine the generated themes and provide a holistic view. The final result can be found in Table 3. As an example, from this table we are able to understand that several excerpts taken from the literature (codes) were grouped in categories under the topic of public transports, these led us to identify a series of associated technologies that are a part of these systems, and the consequences for public employment. A number of proposals and measures to be taken by government agencies were also identified. Moreover, Table 3 cites the examples of selected articles that refer to the topic under study. To assist in the above process, we used qualitative data analysis software, known as NVivo QSR International, Version 11, that allowed to code a large volume of data and to easily identify emerging patterns and ideas (Woolf and Silver, 2017; NVivo, 2020).

Our article is not free of limitations. Since Scopus database is constantly being updated, it is likely that some articles will be left out. In addition, this systematic review provides a snapshot of a given reality, at a particular moment of time. Our research does not cover the whole body of knowledge, largely due to the limited number of keywords. For instance, we could focus on a particular AI technology, such as machine learning, however our goal was to present a holistic and less restricted understanding of the phenomenon. On the other hand, the keyword "employment" is not restrictive either, as it may include private and public employment, although the focus was on the latter. Acknowledging these limitations, we consider that this systematic review will bring added value to the literature, in the extant that it contributes to increase the AI body of knowledge to a specific and quite unexploited area.

FINDINGS

This section summarizes the main findings of the systematic review and presents a discussion on the topic. Our main intention is to provide an overview of the state-of-the-art, answers to the research questions, and to stimulate future research about AI and its influence on public employment. Before starting to discuss the results, which emerged from the content analysis, it is relevant to show some of the general results from Scopus.

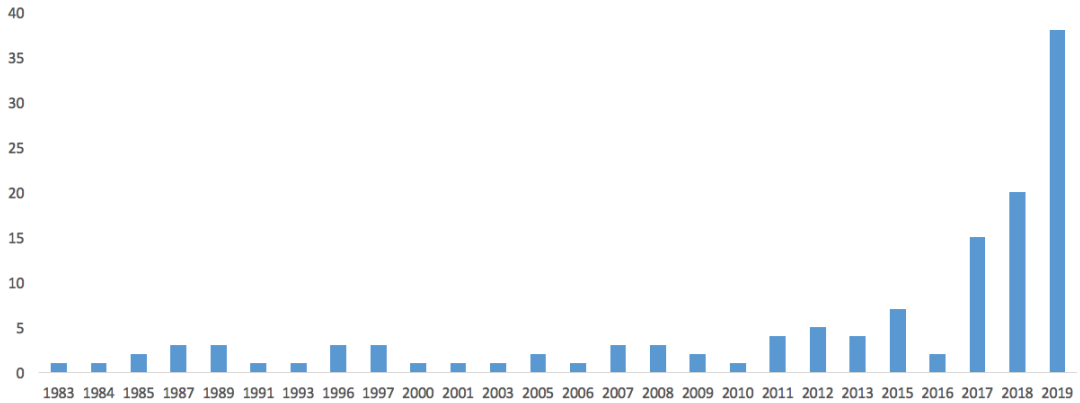

Figure 2. Published documents by year. Source: Retrieved from Scopus.

In recent years, we have witnessed an exponential increase in AI research on employment (Figure 2). In 2019, we found 38 publications, many of which focused on the division of human labour and machines (Hammershøj, 2019); the latter included robotics enhanced by AI-related technologies. Overall, we could find different points of view: – first, some authors are rethinking the effects of machines on future work relations with humans (Lloyd and Payne, 2019); – second, the impact of emotional intelligence is still gaining relevance as it limits the AI job replacement (Kaplan and Haenlein, 2020). A particular attention is also being paid to the impact of machines on industry 4.0 (Marengo, 2019; Tien, 2020) but

not in services at all; an exception is Li et al. (2019), which evaluated hotel employee´s AI and robotics awareness and its impact on turnover intentions.

One of the possible causes that triggered the largest number of articles in the United States (Figure 3) is the phenomenon of having more workers performing routine tasks in similar occupations than in Germany and which have resulted in greater risk of job loss (Arntz et al., 2016). This aspect is in line with the literature that gives rise to a great consensus on the most susceptible types of jobs and workers that are expected to be replaced by AI, and which are mainly "routine" and "low qualified" activities (Hall et al., 2019; Lloyd and Payne, 2019). According to the above, many attempts have been made to measure the impact of robots and AI on employment; one of the most cited research in this context is the article by Frey and Osborne (2017), which is based on a group of "experts" who assess whether individual occupations can be replaced by a robot or AI. The authors concluded that nearly 47% occupations in the United States are at risk of automation in the next two decades. The worst case scenario is accompanied by advances in AI and machine learning, which may be ready to take on not only the routine or repetitive tasks, but also some of the more complex and empathetic tasks (Estlund, 2018).

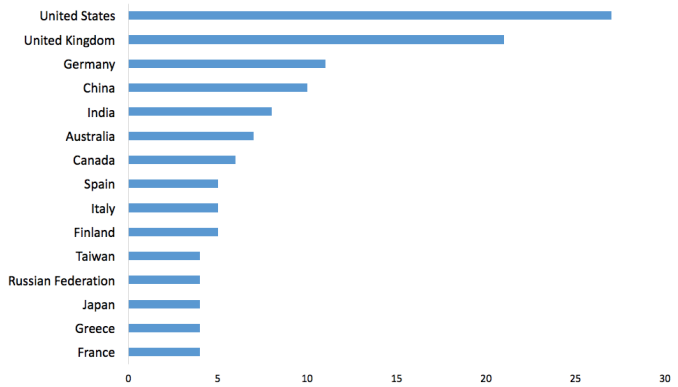

Figure 3. Analyse search results by country. Source: Retrieved from Scopus.

The reality in the United Kingdom is not different from the United States, unlike Germany, which has a long history of using new technologies in the industry, particularly in the context of industry 4.0 (Budanov et al., 2017; Nam, 2019). Germany´s main strategy has been to support the country´s export champions and drive smart services based on machine learning technologies (Lauterbach, 2019). Therefore, one of the aspects is the migration of emerging technologies to services, which is still dominated by human employment.

Frey and Osborne (2017) make two key observations. First, they argue that jobs involving human interaction, such as political and managerial occupations, will remain under human control, which justifies the fact that current research are predominantly under the social sciences domain (Figure 4); Second, highly specialized/technical and scientific competencies will be enhanced by humans with skills to keep machines operational, justifying the research developments in areas such as engineering and computer science.

Concerning RQ1, we have noticed that the various levels of intelligence for service tasks can be replaced by AI in the sphere of public employment (Table 3). Our analysis revealed that mechanical intelligence will tend to be more prone to be replaced by machines than in empathetic intelligence. In the latter case, we found that technologies are assisting decision-making and interaction with humans for choosing political parties based on gathering citizens´ feelings and voting intentions; but these technologies are still a long way from being able to replace politicians, contrary to what European citizens would like (Kaplan and Haenlein, 2020). Unlike empathetic activities, mechanical tasks such as public transports or financial services will tend to become more autonomous due AI developments; however, in these cases we found some restrictions, such as obstacles to use certain AI technologies due to road safety measures (Estlund, 2018), as well as safeguarding citizens´ freedoms and rights

(Lauterbach, 2019). We have generally found that governments can decide whether to retain human labour or force companies to reduce or restrict the use of automation. In France, for example, there are already laws that require electronic platforms to be usable only during business hours (Kaplan and Haenlein, 2020).

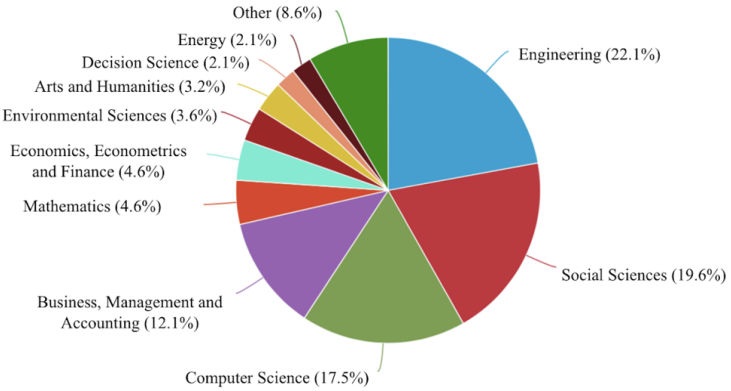

Figure 4. Results divided by subject area. Source: Retrieved from Scopus.

In some cases, we could not find a consensus in the literature. For example, the biggest threat to jobs has been seen in sectors such as public finances. In that regard, Lloyd and Payne (2019) showed that no significant job cuts have been found so far, suggesting an overestimation of academic projections. On the other hand, authors like Sachs (2019) argue that online tax payment systems will tend to replace frontline employees. In short, we have identified some gaps in the literature with regard to public services since the advancements, so far, have been mainly made in the private sector.

Table 3. Influence of artificial intelligence on public employment and its impacts on politics

Type of Intelligence		**Cases of Public Job Replacement**		**Political outlook**
AI	**Labour**	**AI technology**	**Literature**	**Relevance**
Mechanical | *Routine, Standardized and Repetitive tasks*				
• Service	**• Job type**	**• Type of technology**	**• Author(s)**	**• Expected measures**
Public transports	Drivers	Autonomous vehicles, and automated public transport	Estlund (2018); Walsh (2018); Sachs (2019)	Restrain: Concerns about traffic safety may slow down the advent of autonomous vehicles (Estlund, 2018)
Financial services	Frontline employees	Low-cost e-payment systems; online tax and transfer payments; e-finance	Lloyd and Payne (2019); Sachs (2019)	Enforce: Transparency concerns, citizens' rights and liberties may block some of the AI-enhanced technologies (Lauterbach, 2019)
Analytical | *Systematic and Logical Thinking*				
• Service	**• Job type**	**• Type of technology**	**• Author(s)**	**• Expected measures**
Defence	Military; Intelligence analysts	AI in military and defence – Google Project Maven used AI technologies in the battlefield to improve targeting and	Lauterbach (2019)	Regulate: Ethical and legal issues are at stake when using AI lethal weapon systems. There has been social pressure to block the developments of such innovations.

Type of Intelligence		Cases of Public Job Replacement		Political outlook
AI	**Labour**	**AI technology**	**Literature**	**Relevance**
		surveillance capabilities.		
Intuitive | *Contextual and Experience-based Interactions*				
• Service	**• Job type**	**• Type of technology**	**• Author(s)**	**• Expected measures**
Healthcare services	Nursing, Doctors	Remote monitoring of patients; remote diagnostics; expert automated health systems	Lloyd and Payne (2019); Sachs (2019)	Enforce: Transparency concerns, citizens' rights and liberties may block some of the AI-enhanced technologies (Lauterbach, 2019)
Empathetic | *Social and Emotional Interactions*				
• Service	**• Job type**	**• Type of technology**	**• Author(s)**	**• Expected measures**
Governance	Politicians	Current technology did not reach the desirable state to replace political activities; however, tools such as RoboVote are currently aiding citizens to identify the best party to vote for given their political preferences. In the future, policy-related technologies may have greater interaction with citizens such as the development of chatbots and virtual voice assistance.	Kaplan and Haenlein (2020)	Recent surveys suggest that 25% of Europeans would prefer if policy decisions were made by AI instead of politicians, who may turn out to be corrupt or ideologically extreme (Kaplan and Haenlein, 2020) – we did not identify any measure from politics related to this topic – more research is needed in this regard.

Source: Adapted from Huang and Rust (2018)

Regarding RQ2, not surprisingly, there is a lack of studies which could provide credible insights with regard to unemployment caused by technological developments. One exception is Nilsson (1985), which reinforces our previous findings. The author presented several ways to deal with the unemployment issue: first, an attempt can be made to slow down the technological advancements by placing obstacles to delay or prevent unemployment, this technique is also known as "Luddite approach", which will ultimately tend to fail since no government or pressure group has the power to prevent technological progress; a second solution is to create jobs that are either unnecessary or can be easily performed by machines, the underlying objective is to distribute income, but it is unfair to those that really contribute to the economy; a third solution is to follow Kelso and Adler (1958) proposal, who imagined a society in which machines do all the work, or at least most part of it, to provide the wealth necessary for subsistence and for civilization. Therefore, the objective is to allow people to devote more time into value added activities, rather than the mechanical ones. In a modern-day configuration with respect to employability issues, politicians must: 1) demystify the public unemployment due to new technologies; let's look at the case of Uber that created thousands of jobs, although it is expected that in the short term, they will be replaced by autonomous vehicles. Therefore, the question that arises at this level is not whether AI will create unemployment, but whether states will be able to adapt to the short cycles of technological innovation; 2) in addition, states should invest in the creation of specialized employment in activities to support the implementation and management of new technologies and to

strengthen human employment in frontline activities, the latter in greater contact with citizens and where it is needed greater empathetic intelligence; 3) finally, the mechanical activities without added value and which have been increasing the bureaucracy of the state can eventually be migrated to the private sector that has greater know-how in managing big data.

One of the main results of this research is the need for further discussion on the topic and, on the other hand, filling a gap in the literature, since no article to date has mapped the services of a State, in order to identify which areas of government action are being automated. Without a radiograph of the current processes of State services, it is difficult to understand the citizen behaviour and which different areas of government are being automated. Only then, it will be possible to understand the relationship between the implementation of AI technologies and the resulting unemployment rate in public services. As soon as a study of this nature is carried out, it will be possible to clearly understand the necessary measures to be taken by the States and, consequently, to objectively answer the RQ2.

CONCLUSION

Although we acknowledge that empirical data is necessary to reinforce our findings, we believe this research somewhat corroborates Huang and Rust's (2018) four types of intelligence for public services. From the point of view of employability, the question that arises is about the capacity of states to adapt to the technological short innovation cycles. We found some evidences that politicians are restraining or trying to regulate AI applications in public services. Despite the arguments that may eventually be used, it does not seem a good idea to politically slow down the technological innovation. What seems more logical and reasonable is to create the necessary conditions to legislate and regulate the most advanced technologies, which in our opinion has been done so far, but at very slow pace. On the other hand, regulating does not mean to add barriers to the use of AI technologies as has happened with the use of autonomous vehicles in some countries, it means allowing the use of these means in a more responsible way.

As private companies are significantly more advanced in the development of AI technologies, the aforementioned sector may provide significant contributions. The perspective is that future research may eventually focus on outsourcing state services, at least to some degree, by replacing mechanical tasks by machines. On the other hand, politicians should be concerned to create opportunities that bring added value to the political activity or at least to keep public jobs that require empathetic and social skills on human hands. In the current state-of-the-art, it is more appropriate to retain and retrain the existing human workforce, maintaining the personalization of the public services rather than thinking about the possibility to automate tasks which require intuitive or even empathetic skills.

REFERENCES

Allen, R. and Masters, D. (2020), "Artificial Intelligence: the right to protection from discrimination caused by algorithms, machine learning and automated decision-making", *ERA Forum*, Vol. 20, No. 4, pp. 585-598. https://doi.org/10.1007/s12027-019-00582-w.

Arntz, M., Gregory, T. and Zierahn, U. (2016), "The risk of automation for jobs in OECD countries: a comparative analysis", *OECD Social, Employment, and Migration Working Papers*, No. 189, pp. 1-35. https://dx.doi.org/10.1787/5jlz9h56dvq7-em.

Autor, D. and Dorn, D. (2013), "The growth of low-skill service job and the polarization of the US labor market", *The American Economic Review*, Vol. 103, No. 5, pp. 1553-97. http://dx.doi.org/10.1257/aer.103.5.1553.

Beauvais, A., Andreychik, M. and Henkel, L. (2017), "The role of emotional intelligence and empathy in compassionate nursing care", *Mindfulness & Compassion*, Vol. 2, No. 2, pp. 92-100.

Behar, M. and Mok, M. (2013), "Does public-sector employment fully crowd out private-sector employment?", International Monetary Fund, available at: https://www.imf.org/external/pubs/ft/wp/2013/wp13146.pdf (accessed 8 September 2020).

Bessen, J., Impink, S., Reichensperger, L. and Seamans, R. (2020), “GDPR and the importance of data to AI startups”, NYU Stern School of Business. http://dx.doi.org/10.2139/ssrn.3576714.

Blaxter, L. (2010), *How to Research*, McGraw-Hill Education, United Kingdom.

Boyd, R. and Holton, R. (2018), "Technology, innovation, employment and power: Does robotics and artificial intelligence really mean social transformation", *Journal of Sociology*, Vol. 54, No. 3, pp. 331-45.

Brock, J.K.-U. and Von Wangenheim, F. (2019), "Demystifying AI: what digital transformation leaders can teach you about realistic artificial intelligence", *California Management Review*, Vol. 61, No. 4, pp. 110-34. https://doi.org/10.1177/1536504219865226.

Brown, J. (2020), “An exploration of the nascent ai race dynamics between the United States and China”, *MUNDI*, Vol. 1 No. 1, pp. 1-40.

Bruun, E. and Duka, A. (2018), "Artificial intelligence, jobs and the future of work: racing with the machines", *Basic Income Studies*, Vol. 13, No. 2. http://dx.doi.org/10.1515/bis-2018-0018.

Budanov, V., Aseeva, I. and Zvonova, E. (2017), “Industry 4.0.: socio-economic junctures”, *Economic Annals-XXI*, Vol. 168, No. 11-12, pp. 33-37. https://doi.org/10.21003/ea.V168-07.

Buera, F. and Kaboski, J. (2012), "The rise of the service economy", *The American Economic Review*, Vol. 102, No. 6, pp. 2540-69.

Cenamor, J., Sjödin, D. and Parida, V. (2017), "Adopting a platform approach in servitization: Leveraging the value of digitalization", *International Journal of Production Economics*, Vol. 192, pp. 54-65.

Darlingtom, K. (2017), “The emergence of the age of AI”, OpenMind, available at: https://www.bbvaopenmind.com/en/technology/artificial-intelligence/the-emergence-of-the-age-of-ai/ (accessed 7 January 2020).

Dignam, A. (2020), "Artificial intelligence, tech corporate governance and the public interest regulatory response", *Cambridge Journal of Regions, Economy and Society*, Vol. 13, No. 1, pp. 37-54.

Duffy, J., Miller, J. and Bexley, J. (2006), "Banking customers’ varied reactions to service recovery strategies", *International Journal of Bank Marketing*, Vol. 24, No. 2, pp. 112-32.

Eliasy, A. and Przychodzen, J. (2020), "The role of AI in capital structure to enhance corporate funding strategies", *Array*, Vol. 6, 100017.

Ernst, D. (2020), *Competing in Artificial Intelligence Chips: China’s Challenge amid Technology War*, Centre for International Governance Innovation, Special Report, available at: https://ssrn.com/abstract=3564669 (accessed 24 May 2020).

Estlund, C. (2018), "What should we do after work? Automation and employment Law", *The Yale Law Journal*, Vol. 128, No. 2, pp. 254-326. http://dx.doi.org/10.2139/ssrn.3007972.

Feijóo, C., Kwon, Y., Bauer, J. et al. (2020), "Harnessing artificial intelligence (AI) to increase wellbeing for all: the case for a new technology diplomacy", *Telecommunications Policy*, Vol. 44, No. 6, 101988. http://dx.doi.org/10.1016/j.telpol.2020.101988.

Frank, M., Autor, D., Bessen, J. et al. (2019), "Toward understanding the impact of artificial intelligence on labor", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 116, No. 14, pp. 6531-9. http://dx.doi.org/10.1073/pnas.1900949116.

Frey, C. and Osborne, M. (2017), "The future of employment: how susceptible are jobs to computerisation", *Technological Forecasting and Social Change*, Vol. 114, pp. 254-80. http://dx.doi.org/10.1016/j.techfore.2016.08.019.

Gauß, V. (2020), “The challenges of digitalization for the (German) State”, in Feldner, D. (Ed.), *Redesigning Organizations*, Springer, Cham, pp. 207-214. http://dx.doi.org/10.1007/978-3-030-27957-8_15.

Gimpelson, V. and Treisman, D. (2002), "Fiscal games and public employment: a theory with evidence from Russia", *World Politics*, Vol. 54, No. 2, pp. 145-83. http://dx.doi.org/10.1353/wp.2002.0003.

Given, L. (2008), *The SAGE Encyclopedia of Qualitative Research Methods*, Sage Publications, Los Angeles.

Gottschall, K., Kittel, B., Briken, K. et al. (2015), “Public employment regimes in OECD countries”, in Gottschall, K., Kittel, B., Briken, K. et al. (Eds.), *Public Sector Employment Regimes*, Palgrave Macmillan, London, pp. 69-106.

Haenlein, M. and Kaplan, A. (2019), "A brief history of artificial intelligence: on the past, present, and future of artificial intelligence", *California Management Review*, Vol. 61, No. 4, pp. 5-14. http://dx.doi.org/10.1177/0008125619864925.

Hall, R., Ashford, R., Ashford, N. et al. (2019), "Universal Basic Income and Inclusive Capitalism: consequences for Sustainability", *Sustainability*, Vol. 11, No. 16, pp. 4481. http://dx.doi.org/10.3390/su11164481.

Hammershøj, L. (2019), "The new division of labor between human and machine and its educational implications", *Technology in Society*, Vol. 59, 101142. http://dx.doi.org/10.1016/j.techsoc.2019.05.006.

Hancock, D. and Algozzine, B. (2016), *Doing Case Study Research: a Practical Guide for Beginning Researchers*, Teachers College Press, New York.

Haugaard, M. (2020), "The faces of power, resistance and justification in a changing world", *Journal of Political Power*, Vol. 13, No. 1, pp. 1-5. http://dx.doi.org/10.1080/2158379X.2020.1723954.

Holcombe, R. (2020), "Political power", in Holcombe, R.G. (Ed.), *Coordination, Cooperation, and Control*, Palgrave Macmillan, Cham, pp. 21-44. http://dx.doi.org/10.1007/978-3-030-48667-9_2.

Huang, M. and Rust, R. (2018), "Artificial intelligence in service", *Journal of Service Research*, Vol. 21, No. 2, pp. 155-72. http://dx.doi.org/10.1177/1094670517752459.

Huang, M. and Rust, R. (2020), "Engaged to a robot? The role of ai in service", *Journal of Service Research*, In press. http://dx.doi.org/10.1177/1094670520902266.

Huang, M., Rust, R. and Maksimovic, V. (2019), "The feeling economy: managing in the next generation of Artificial Intelligence (AI)", *California Management Review*, Vol. 61, No. 4, pp. 43-65. http://dx.doi.org/10.1177/0008125619863436.

Ivanov, S. (2020), "The impact of automation on tourism and hospitality jobs", *Information Technology & Tourism*, Vol. 22, pp. 205-215. http://dx.doi.org/10.1007/s40558-020-00175-1.

Jarrahi, M. (2018), "Artificial intelligence and the future of work: human-AI symbiosis in organizational decision making", *Business Horizons*, Vol. 61, No. 4, pp. 577-86. http://dx.doi.org/10.1016/j.bushor.2018.03.007.

Journal of Political Power (2020), "Aim and scope", available at: https://www.tandfonline.com/action/journalInformation?show=aimsScope&journalCode=rpow21 (accessed 8 September 2020).

Kaplan, A. and Haenlein, M. (2020), "Rulers of the world, unite! The challenges and opportunities of artificial intelligence", *Business Horizons*, Vol. 63, No. 1, pp. 37-50. http://dx.doi.org/10.1016/j.bushor.2019.09.003.

Kapustina, L., Lipková, L., Silin, Y. et al. (2020), "US-China trade war: causes and outcomes", *SHS Web of Conferences*, Vol. 73, 01012. http://dx.doi.org/10.1051/shsconf/20207301012.

Kelso, L. and Adler, M. (1958), *The Capitalist Manifesto*, Random House, New York.

Kihlstrom, J. and Cantor, N. (2000), "Social intelligence", *Handbook of Intelligence*, Vol. 2, pp. 359-379. http://dx.doi.org/10.1017/CBO9780511807947.017.

Kokkinakos, P., Markaki, O., Koussouris, S. et al. (2016), "Digital transformation: is public sector following the enterprise 2.0 paradigm?", in Chugunov, A., Bolgov, R., Kabanov, Y. et al. (Eds.), *Digital Transformation and Global Society*, Springer, Cham, pp. 96-105. http://dx.doi.org/10.1007/978-3-319-49700-6_11.

Krippendorff, K. (2018), *Content Analysis: an Introduction to its Methodology*, Sage Publications, Beverly Hills.

Lauterbach, A. (2019), "Artificial intelligence and policy: quo vadis", *Digital Policy, Regulation and Governance*, Vol. 21, No. 3, pp. 238-63. http://dx.doi.org/10.1108/DPRG-09-2018-0054.

Li, D. and Du, Y. (2017), *Artificial Intelligence with Uncertainty*, CRC Press, Beijing.

Li, J., Bonn, M. and Ye, B. (2019), "Hotel employee's artificial intelligence and robotics awareness and its impact on turnover intention: the moderating roles of perceived organizational support and competitive psychological climate", *Tourism Management*, Vol. 73, pp. 172-81. http://dx.doi.org/10.1016/j.tourman.2019.02.006.

Lloyd, C. and Payne, J. (2019), "Rethinking country effects: robotics, AI and work futures in Norway and the UK", *New Technology, Work and Employment*, Vol. 34, No. 3, pp. 208-25.

Lu, V., Wirtz, J., Kunz, W. et al. (2020), "Service robots, customers and service employees: what can we learn from the academic literature and where are the gaps", *Journal of Service Theory and Practice*, Vol. 30, No. 3, pp. 361-391. http://dx.doi.org/10.1108/JSTP-04-2019-0088.

Makridakis, S. (2017), "The forthcoming Artificial Intelligence (AI) revolution: its impact on society and firms", *Futures*, Vol. 90, pp. 46-60. http://dx.doi.org/10.1016/j.futures.2017.03.006.

Marengo, L. (2019), "Is this time different? A note on automation and labour in the fourth industrial revolution", *Economia e Politica Industriale*, Vol. 46, No. 3, pp. 323-31. http://dx.doi.org/10.1007/s40812-019-00123-z.

Marr, B. (2019), *Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems*, John Wiley & Sons, Chichester.

Mayer, J. and Geher, G. (1996), "Emotional intelligence and the identification of emotion", *Intelligence*, Vol. 22, No. 2, pp. 89-113. http://dx.doi.org/10.1016/S0160-2896(96)90011-2.

Mercer, S. (2020), "The limitations of european data protection as a model for global privacy regulation", *AJIL Unbound*, Vol. 114, pp. 20-5. http://dx.doi.org/10.1017/aju.2019.83.

Mosteanu, N. (2020), "Artificial intelligence and cyber security: a shield against cyberattack as a risk business management tool–case of european countries", *Calitatea*, Vol. 21, No. 175, pp. 148-56.

Nam, T. (2019), "Technology usage, expected job sustainability, and perceived job insecurity", *Technological Forecasting and Social Change*, Vol. 138, pp. 155-65. http://dx.doi.org/10.1016/j.techfore.2018.08.017.

Neuendorf, K. (2016), *The Content Analysis Guidebook*, Sage Publications, Los Angeles.

Newsome, S., Day, A. and Catano, V. (2000), "Assessing the predictive validity of emotional intelligence", *Personality and Individual Differences*, Vol. 29, No. 6, pp. 1005-16. http://dx.doi.org/10.1016/S0191-8869(99)00250-0.

Nilsson, N. (1985), "Artificial intelligence, employment, and income", *Human Systems Management*, Vol. 5, No. 2, pp. 123-35. http://dx.doi.org/10.3233/HSM-1985-5205.

NVivo (2020), "Fueling academic research", QSR International, available at: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/about/nvivo/who-its-for/academia (accessed 24 May 2020).

Parsons, T. (1963), "On the concept of political power", *Proceedings of the American Philosophical Society*, Vol. 107, No. 3, pp. 232-62.

Petticrew, M. and Roberts, H. (2008), *Systematic Reviews in the Social Sciences: A Practical Guide*, John Wiley & Sons, Oxford.

Reis, J., Amorim, M., Melão, N. et al. (2018), "Digital transformation: a literature review and guidelines for future research", in Rocha, A., Adeli, H., Reis, L. et al. (Eds.), *World Conference on Information Systems and Technologies*, Springer, Cham, pp. 411-421. http://dx.doi.org/10.1007/978-3-319-77703-0_41.

Reis, J., Amorim, M. and Melão, N. (2019a), "Multichannel service failure and recovery in a O2O era: a qualitative multi-method research in the banking services industry", *International Journal of Production Economics*, Vol. 215, pp. 24-33. http://dx.doi.org/10.1016/j.ijpe.2018.07.001.

Reis, J., Amorim, M. and Melão, N. (2019b), "Service failure and recovery in technology-based business networks", *International Journal of Quality and Service Sciences*, Vol. 11, No. 1, pp. 2-15. http://dx.doi.org/10.1108/IJQSS-10-2017-0094.

Reis, J., Santo, P. and Melão, N. (2019c), "Impacts of artificial intelligence on public administration: a systematic literature review", in *Proceedings of the 14th IEEE Iberian Conference on Information Systems and Technologies*, IEEE, Coimbra, Portugal, pp. 1-7. http://dx.doi.org/10.23919/CISTI.2019.8760893.

Reis, J., Amorim, M., Cohen, Y. et al. (2020a), "Artificial intelligence in service delivery systems: a systematic literature review", in Rocha, A., Adeli, H., Reis, L. et al. (Eds.), *Trends and Innovations in Information Systems and Technologies, WorldCIST 2020, Advances in Intelligent Systems and Computing*, Vol. 1159, Springer, Cham, pp. 222-233. https://doi.org/10.1007/978-3-030-45688-7_23.

Reis, J., Santo, P. and Melão, N. (2020b), "Artificial intelligence theory in service management", in in Nóvoa, H., Drăgoicea, M., Kühl, N. (Eds.), *International Conference on Exploring Services Science*, Springer, Cham, pp. 137-149. http://dx.doi.org/10.1007/978-3-030-38724-2_10.

Reis, J., Amorim, M. and Melão, N. (2020c), "Emergent digital strategies and networks: advancements to service management research", *Journal of Reviews on Global Economics*, Vol. 8, pp. 1689-708. http://dx.doi.org/10.6000/1929-7092.2019.08.152.

Reis, J., Santo, P. and Melão, N. (2020d), "Impact of artificial intelligence research on politics of the European Union member states: the case study of Portugal", *Sustainability*, Vol. 12, No. 17, pp. 6708. http://dx.doi.org/10.3390/su12176708.

Rosete, A., Soares, B., Salvadorinho, J. et al. (2020), “Service robots in the hospitality industry: an exploratory literature review”, in Nóvoa, H., Drăgoicea, M., Kühl, N. (Eds.), *International Conference on Exploring Services Science*, Springer, Cham, pp. 174-186. http://dx.doi.org/10.1007/978-3-030-38724-2_13.

Russell, S. and Norvig, P. (2016), *Artificial Intelligence: a Modern Approach*, Pearson, Education Limited.

Sachs, J. (2019), "Some brief reflections on digital technologies and economic development", *Ethics & International Affairs*, Vol. 33, No. 2, pp. 159-67. http://dx.doi.org/10.1017/S0892679419000133.

Schou, J. and Hjelholt, M. (2018), *Digitalization and Public Sector Transformations*, Palgrave, Copenhagen. http://dx.doi.org/10.1007/978-3-319-76291-3.

Shapiro, T. and Nieman-Gonder, J. (2006), "Effect of communication mode in justice-based service recovery", *Managing Service Quality*, Vol. 16, No. 2, pp. 124-44. http://dx.doi.org/10.1108/09604520610650619.

Sharma, G., Yadav, A. and Chopra, R. (2020), "Artificial intelligence and effective governance: a review, critique and research agenda", *Sustainable Futures*, Vol. 2, pp. 100004. http://dx.doi.org/10.1016/j.sftr.2019.100004.

Sousa, W., Melo, E., Bermejo, P. et al. (2019), "How and where is artificial intelligence in the public sector going? A literature review and research agenda", *Government Information Quarterly*, Vol. 36, No. 4, pp. 101392. http://dx.doi.org/10.1016/j.giq.2019.07.004.

Sternberg, R. (1996), *Successful Intelligence: How Practical and Creative Intelligence Determine Success in Life*, Simon & Schuster, New York.

Thorndike, E. (1920), “Intelligence and its uses”, *Harper's Magazine*, Vol. 140, pp. 227-235.

Tien, J. (2020), "Toward the Fourth Industrial Revolution on Real-Time Customization", *Journal of Systems Science and Systems Engineering*, Vol. 29, No. 2, pp. 127-42. http://dx.doi.org/10.1007/s11518-019-5433-9.

Tigner, R. and Tigner, S. (2000), "Triarchic theories of intelligence: Aristotle and Sternberg", *History of Psychology*, Vol. 3, No. 2, pp. 168-76. http://dx.doi.org/10.1037/1093-4510.3.2.168.

Tranfield, D., Denyer, D. and Smart, P. (2003), "Towards a methodology for developing evidence-informed management knowledge by means of systematic review", *British Journal of Management*, Vol. 14, No. 3, pp. 207-22. http://dx.doi.org/10.1111/1467-8551.00375.

Turing, A. (1950), "Computing machinery and intelligence", *Mind*, Vol. 59, No. 236, pp. 433-60. http://dx.doi.org/10.1093/mind/LIX.236.433.

Walsh, T. (2018), "Expert and non-expert opinion about technological unemployment", *International Journal of Automation and Computing*, Vol. 15, No. 5, pp. 637-42. http://dx.doi.org/10.1007/s11633-018-1127-x.

West, D. (2015), *What Happens if Robots Take the Jobs? The Impact of Emerging Technologies on Employment and Public Policy*, Centre for Technology Innovation at Brookings, Washington DC.

Wirtz, B. and Müller, W. (2019), "An integrated artificial intelligence framework for public management", *Public Management Review*, Vol. 21, No. 7, pp. 1076-100. http://dx.doi.org/10.1080/14719037.2018.1549268.

Wirtz, J., Patterson, P., Kunz, W. et al. (2018), "Brave new world: service robots in the frontline", *Journal of Service Management*, Vol. 29, No. 5, pp. 907-31. http://dx.doi.org/10.1108/JOSM-04-2018-0119.

Woolf, N. and Silver, C. (2017), *Qualitative Analysis Using NVivo: the Five-Level QDA® Method*, Routledge, Taylor & Francis Group, New York.

Authors contributions: All authors contributed equally to this paper.

APPENDIX A. ARTICLE INFORMATION

Authors	Year	Title	Source
Lloyd C. and Payne J.	2019	Rethinking country effects: robotics, AI and work futures in Norway and the UK	New Technology, Work and Employment
Hammershøj L.	2019	The new division of labor between human and machine and its educational implications	Technology in Society
Xu et al.	2019	Are emotionally intelligent people more creative? A meta-analysis of the emotional intelligence-creativity link	Sustainability (Switzerland)
Bogoviz et al.	2019	Diversification of educational services in the conditions of industry 4.0 on the basis of AI training	On the Horizon
AlZu'bi et al.	2019	An efficient employment of internet of multimedia things in smart and future agriculture	Multimedia Tools and Applications
Rasiah et al.	2019	The impact of emotional intelligence on work performance: Perceptions and reflections from academics in Malaysian higher EducationObitat endiaest que	Contemporary Economics
Marengo L.	2019	Is this time different? A note on automation and labour in the fourth industrial revolution	Journal of Industrial and Business Economics
Li et al.	2019	Hotel employee's artificial intelligence and robotics awareness and its impact on turnover intention: The moderating roles of perceived organizational support and competitive psychological climate	Tourism Management
Hall et al.	2019	Universal basic income and inclusive capitalism: Consequences for sustainability	Sustainability (Switzerland)
Marinoudi et al.	2019	Robotics and labour in agriculture. A context consideration	Biosystems Engineering
Ravi Chander et al.	2019	Modeling and model analysis of an industrial robot arm for pick and drop circular motion using different materials	International Journal of Engineering and Advanced Technology
Morgan J.	2019	Will we work in twenty-first century capitalism? A critique of the fourth industrial revolution literature	Economy and Society
Sahota N. and Ashley M.	2019	When Robots Replace Human Managers: Introducing the Quantifiable Workplace	IEEE Engineering Management Review
Nazim Sha S. and Rajeswari M.	2019	Creating a brand value and consumer satisfaction in E-commerce business using artificial intelligence with the help of vosag technology	International Journal of Innovative Technology and Exploring Engineering

Authors	Year	Title	Source
Lauterbach A.	2019	Artificial intelligence and policy: quo vadis?	Digital Policy, Regulation and Governance
Garcia-Murillo M. and MacInnes I.	2019	AI's path to the present and the painful transitions along the way	Digital Policy, Regulation and Governance
Verma S. and Sharma A.	2019	Artificial intelligence: employment and society	International Journal of Innovative Technology and Exploring Engineering
Ravi et al.	2019	Artificial intelligence-will it hasten or hamper women career progression	International Journal of Recent Technology and Engineering
Ilie et al.	2019	Sustainability through the use of modern simulation methods-Applied artificial intelligence	Sustainability (Switzerland)
Chen et al.	2019	An enhanced lightweight dynamic pseudonym identity based authentication and key agreement scheme using wireless sensor networks for agriculture monitoring	Sensors (Switzerland)
Richardson L. and Bissell D.	2019	Geographies of digital skill	Geoforum
Liu T. and Wang C.	2019	Intangible welfare? The new economy and social policy in China	Journal of Asian Public Policy
Zhou et al.	2019	The effect of artificial intelligence on China's labor market	China Economic Journal
Kovacova et al.	2019	Automating gender roles at work: How digital disruption and artificial intelligence alter industry structures and sex-based divisions of labor	Journal of Research in Gender Studies
Kaplan A. and Haenlein M.	2019	Rulers of the world, unite! The challenges and opportunities of artificial intelligence	Business Horizons
Hrustek et al.	2019	Developing and validating measurement instrument for various aspects of digital economy: E-commerce, E-banking, E-work and E-employment	International Journal of E-Services and Mobile Applications
Sachs J.	2019	Some Brief Reflections on Digital Technologies and Economic Development	Ethics and International Affairs
Fleming P.	2019	Robots and Organization Studies: Why Robots Might Not Want to Steal Your Job	Organization Studies
Tien J.	2019	Toward the Fourth Industrial Revolution on Real-Time Customization	Journal of Systems Science and Systems Engineering
Nam T.	2019	Technology usage, expected job sustainability, and perceived job insecurity	Technological Forecasting and Social Change

Authors	Year	Title	Source
Udell et al.	2019	Towards a smart automated society: Cognitive technologies, knowledge production, and economic growth	Economics, Management, and Financial Markets
Esser et al.	2019	The labour market for the port of the future. A case study for the port of Antwerp	Case Studies on Transport Policy
Sutherland E.	2019	The Fourth Industrial Revolution–The Case of South Africa	Politikon
Vasant et al.	2019	Nature-inspired meta-heuristics approaches for charging plug-in hybrid electric vehicle	Wireless Networks
Kim et al.	2019	Learning-based screening of hematologic disorders using quantitative phase imaging of individual red blood cells	Biosensors and Bioelectronics
Pipitone et al.	2019	Building an ANFIS-Based Decision Support System for Regional Growth: The Case of European Regions	IEEE Transactions on Engineering Management
Hoffmann C. and Dahlinger A.	2019	How capitalism abolishes itself in the digital era in favour of robo-economic systems: socio-economic implications of decentralized autonomous self-owned businesses	Foresight
Hipel et al.	2019	The Graph Model for Conflict Resolution: Reflections on Three Decades of Development	Group Decision and Negotiation
Mamedov et al.	2018	Sustainable economic development and post-economy of artificial intelligence	Entrepreneurship and Sustainability Issues
Yang et al.	2018	Active Learning for Wireless IoT Intrusion Detection	IEEE Wireless Communications
Birtchnell T. and Elliott A.	2018	Automating the black art: Creative places for artificial intelligence in audio mastering	Geoforum
Estlund C.	2018	What should we do after work? Automation and employment law	Yale Law Journal
Walsh T.	2018	Expert and Non-expert Opinion About Technological Unemployment	International Journal of Automation and Computing
Berger et al.	2018	Intelligent co-simulation: neural network vs. proper orthogonal decomposition applied to a 2D diffusive problem	Journal of Building Performance Simulation
Boyd R. and Holton R.	2018	Technology, innovation, employment and power: Does robotics and artificial intelligence really mean social transformation?	Journal of Sociology
Michailidis M.	2018	The challenges of AI and blockchain on HR recruiting practices	Cyprus Review
De Mauro et al.	2018	Human resources for Big Data professions: A systematic classification of job roles and required skill sets	Information Processing and Management
Turner Lee N.	2018	Detecting racial bias in algorithms and machine learning	Journal of Information,

Authors	Year	Title	Source
			Communication and Ethics in Society
Kim et al.	2018	BIM-Driven Automated Decision Support System for Safety Planning of Temporary Structures	Journal of Construction Engineering and Management
Avis J.	2018	Socio-technical imaginary of the fourth industrial revolution and its implications for vocational education and training: a literature review	Journal of Vocational Education and Training
Pham et al.	2018	The Impact of Robotics and Automation on Working Conditions and Employment	IEEE Robotics and Automation Magazine
Dalenberg D.	2018	Preventing discrimination in the automated targeting of job advertisements	Computer Law and Security Review
Stringer J.	2018	Changing character, changing con text: Enhancing operational airpower employment in the RAF's second century	RUSI Journal
Huang M.-H., Rust R.T.,	2018	Artificial Intelligence in Service	Journal of Service Research
Boldsen et al.	2018	Better diffusion segmentation in acute ischemic stroke through automatic tree learning anomaly segmentation	Frontiers in Neuroinformatics
Nica et al.	2018	A laborless society? How highly automated environments and breakthroughs in artificial intelligence bring about innovative kinds of skills and employment disruptions, altering the nature of business process and affecting the path of economic growth	Journal of Self-Governance and Management Economics
Frank et al.	2018	Small cities face greater impact from automation	Journal of the Royal Society Interface
Budanov et al.	2018	Industry 4.0.: Socio-economic junctures	Economic Annals-XXI
Nakatani et al.	2017	Promotion of self-growth of students by PBL-type manufacturing practice	Journal of Robotics and Mechatronics
Peker et al.	2017	A new fuzzy logic based career guidance system: WEB-CGS [Novi sustav profesionalnog usmjeravanja zasnovan na neizrazitoj logici: WEB-CGS]	Tehnicki Vjesnik
McCrum D.	2017	Evaluation of creative problem-solving abilities in undergraduate structural engineers through interdisciplinary problem-based learning	European Journal of Engineering Education
Fox S.	2017	Mass imagineering: Combining human imagination and automated engineering from early education to digital afterlife	Technology in Society
Arlitsch K. and Newell B.	2017	Thriving in the Age of Accelerations: A Brief Look at the Societal Effects of Artificial Intelligence and the Opportunities for Libraries	Journal of Library Administration

Authors	Year	Title	Source
Etzkowitz A. and Etzkowitz H.	2017	Counter-cyclical public venture capital: Debt-funding as an anti-austerity innovation strategy	Social Science Information
Jiang et al.	2017	Machine Learning Paradigms for Next-Generation Wireless Networks	IEEE Wireless Communications
Morikawa M.	2017	Firms´ Expectations about the Impact of AI and Robotics: Evidence from a Survey	Economic Inquiry
Dabirian et al.	2017	A great place to work!? Understanding crowdsourced employer branding	Business Horizons
Zhu C.	2017	Construction and research on the personalized employment recommendation system for college students based on hadoop platform	Boletin Tecnico/Technical Bulletin
Mansell R.	2017	The mediation of hope: Communication technologies and inequality in perspective	International Journal of Communication
Gratton L.	2017	Change Management	London Business School Review
Pyka A.	2017	Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy	Journal of Open Innovation: Technology, Market, and Complexity
Chien et al.	2017	Injury severity measures for predicting return-to-work after a traumatic brain injury	Accident Analysis and Prevention
Swanson J.	2017	The future of student life: working	On the Horizon
Simpson B.	2016	Algorithms or advocacy: does the legal profession have a future in a digital world?	Information and Communications Technology Law
Hirsch P.	2016	The Caliphate of numbers	Journal of Business Strategy
Coeckelbergh M.	2015	The tragedy of the master: automation, vulnerability, and distance	Ethics and Information Technology
Jiang et al.	2015	Mining point-of-interest data from social networks for urban land use classification and disaggregation	Computers, Environment and Urban Systems
Loi M.	2015	Technological unemployment and human disenhancement	Ethics and Information Technology
Amanatiadis et al.	2015	Accelerating single-image super-resolution polynomial regression in mobile devices	IEEE Transactions on Consumer Electronics
Gelashvili et al.	2015	The profitability of socially responsible companies: Public subsidies for sheltered employment centers	Ramon Llull Journal of Applied Ethics
Singh K. and Mehta C.	2015	Decision support system for estimating operating costs and break-even units of farm machinery	AMA, Agricultural Mechanization in Asia, Africa and Latin America
Zadorozhnaya et al.	2015	Water pollution monitoring by an artificial sensory system performing in terms of Vibrio fischeri bacteria	Sensors and Actuators, B: Chemical

Authors	Year	Title	Source
Mattar E.	2013	A survey of bio-inspired robotics hands implementation: New directions in dexterous manipulation	Robotics and Autonomous Systems
Weber et al.	2013	A study on scale factor/crossover interaction in distributed differential evolution	Artificial Intelligence Review
Jayachandran et al.	2013	Application of fuzzy logic in PWM technique and dc link voltage control for a UPQC system	International Review on Modelling and Simulations
Sun L. and Chen W.	2013	The improved ChinaCCS decision support system: A case study for Beijing-Tianjin-Hebei Region of China	Applied Energy
Barzanti L. and Giove S.	2012	A decision support system for fund raising management based on the Choquet integral methodology	Expert Systems
Gromov V. and Shulga A.	2012	Chaotic time series prediction with employment of ant colony optimization	Expert Systems with Applications
Derrac et al.	2012	Integrating instance selection, instance weighting, and feature weighting for nearest neighbor classifiers by coevolutionary algorithms	IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics
Huang et al.	2012	Determining the number of new employees with learning, forgetting and variable wage with a Newsvendor model in pull systems	Journal of Intelligent Manufacturing
den Herder et al.	2012	Sustainability impact assessment on the production and use of different wood and fossil fuels employed for energy production in North Karelia, Finland	Energies
Padma T. and Balasubramanie P.	2011	A fuzzy analytic hierarchy processing decision support system to analyze occupational menace forecasting the spawning of shoulder and neck pain	Expert Systems with Applications
Kripakaran et al.	2011	A genetic algorithm for design of moment-resisting steel frames	Structural and Multidisciplinary Optimization
Kaklauskas et al.	2011	Recommended biometric stress management system	Expert Systems with Applications
Weber et al.	2011	A study on scale factor in distributed differential evolution	Information Sciences
Beetz et al.	2010	Towards performing everyday manipulation activities	Robotics and Autonomous Systems
Yamagishi et al.	2009	Service cost and utilization rate optimization in service systems	Journal of Integrated Design and Process Science
Papakiriakopoulos et al.	2009	A decision support system for detecting products missing from the shelf based on heuristic rules	Decision Support Systems
Chang H.	2008	Intelligent agent's technology characteristics applied to online	Technovation

Authors	Year	Title	Source
		auctions' task: A combined model of TTF and TAM	
Meng et al.	2008	Nonlinear dimensionality reduction of data lying on the multicluster manifold	IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics
Blanco et al.	2008	Decision support system for micro-hydro power plants in the Amazon region under a sustainable development perspective	Energy for Sustainable Development
Machado et al.	2007	Ambient intelligence via multiagent systems in the medical arena	Engineering Intelligent Systems
Dobrzański et al.	2007	The use of neural networks for the classification of casting defect	International Journal of Computational Materials Science and Surface Engineering
Cao et al.	2007	Assembly planning using a novel immune approach	International Journal of Advanced Manufacturing Technology
Amigoni et al.	2006	Agencies for perception in environmental monitoring	IEEE Transactions on Instrumentation and Measurement
Yagci et al.	2005	Artificial intelligence methods in breakwater damage ratio estimation	Ocean Engineering
Gustavsson E.	2005	Virtual servants: Stereotyping female front-office employees on the Internet	Gender, Work and Organization
Šef T. and Gams M.	2003	Speaker (GOVOREC): A complete Slovenian text-to speech system	International Journal of Speech Technology
Li et al.	2001	A Web-based tool and a heuristic method for cooperation of manufacturing supply chain decisions	Journal of Intelligent Manufacturing
Gams M. and Sef T.	2000	A speech module in an agent system	International Journal of Engineering Intelligent Systems for Electrical Engineering and Communications
Schell C.	1997	Working at Uncle Sam's	IEEE Potentials
Akama et al.	1997	Common structure of semi-thue systems, petri nets, and other rewriting systems	IEICE Transactions on Information and Systems
Karagiannidis et al.	1997	Adaptation in IMMPS as a decision making process	Computer Standards and Interfaces
Gondles Jr.	1996	A frontline view of the future of prisons	Prison Journal
Binbasioglu et al.	1996	A synthesizing framework for decision support systems applications	Journal of Computer

Authors	Year	Title	Source
			Information Systems
Blitch J.	1996	Artificial intelligence technologies for robot assisted urban search and rescue	Expert Systems with Applications
Frank P. and Kiupel N.	1993	Fuzzy supervision and application to lean production	International Journal of Systems Science
Sycara et al.	1991	Distributed constrained heuristic search	IEEE Transactions on Systems, Man and Cybernetics
Benhabib et al.	1989	Integrated manufacturing work cell management system	Manufacturing review
Bruce M. and Adam A.	1989	Expert systems and women's lives: A technology assessment	Futures
Morris A. and Walton K.	1989	Shortage of expert system personnel in the UK — hype or reality?	Expert Systems
Diederich et al.	1987	KRITON: a knowledge-acquisition tool for expert systems	International Journal of Man-Machine Studies
Chisholm A.	1987	The social effects of intelligent manufacturing systems	Robotics and Computer Integrated Manufacturing
Laurig W.	1987	Do you believe in the advantage of expert systems in industrial ergonomics?	International Journal of Industrial Ergonomics
Nilsson N.	1985	Artificial intelligence, employment, and income	Human Systems Management
Gurstein M.	1985	Social impacts of selected artificial intelligence applications. The Canadian context	Futures
Baráth E. and Futó I.	1984	A regional planning system based on artificial intelligence concepts	Papers of the Regional Science Association
Von Tomkewitsch R.	1983	Fire detector systems with 'distributed intelligence' the pulse polling system	Fire Safety Journal