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

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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...
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 (Darlington, 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 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).

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

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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).

| 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 (Eliazy 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 and 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

| Selected keywords | Scopus – Elsevier |
|-------------------|------------------|
| 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 patterns 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.](image)

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

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).

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

(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).

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                   | AI technology                  | Relevance         |
| Labour               | Literature                     |                   |
|                       | • Type of technology            | • Expected measures|
|                       | • Author(s)                    |                   |
| Public transports     | Autonomous vehicles,           | Restrain: Concerns about traffic safety may slow down the advent of autonomous vehicles (Estlund, 2018) |
| Drivers              | and automated public transport  |                   |
| Financial services   | Low-cost e-payment systems;    | Enforce: Transparency concerns, citizens’ rights and liberties may block some of the AI-enhanced technologies (Lauterbach, 2019) |
| Frontline employees  | online tax and transfer payments; e-finance |                   |
| Analytical           | AI in military and defence – | 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. |
| Defence              | Google Project Maven used AI technologies in the battlefield to improve targeting and |                   |
| Military; Intelligence analysts | Lauterbach (2019) |                   |

Figure 4. Results divided by subject area. Source: Retrieved from Scopus.
Influence of artificial intelligence on public employment and its impact on politics: a systematic literature review

| Type of Intelligence | Cases of Public Job Replacement | Political outlook | Relevance |
|----------------------|---------------------------------|-------------------|-----------|
| AI                   | Labour                          | AI technology     | Literature |
|                      |                                  |                   |            |
| 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.

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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)               |
| Bogowiz 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 Education | 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 | Al'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 | 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                                                                 |
|-------------------------|------|----------------------------------------------------------------------|------------------------------------------------------------------------|
| Kim et al.              | 2018 | BIM-Driven Automated Decision Support System for Safety Planning of Temporary Structures | Communication and Ethics in Society, 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 context: 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 usmjerenja 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 Algorithms or advocacy: does the legal profession have a future in a digital world? | On the Horizon Information and Communications Technology Law |
| Simpson B.              | 2016 | Change Management                                                     | Journal of Open Innovation: Technology, Market, and Complexity |
| Hirsch P.               | 2016 | The Caliphate of numbers                                              | Ethics and Information Technology                 |
| Coeckelbergh M.         | 2015 | The tragedy of the master: automation, vulnerability, and distance     | Computers, Environment and Urban Systems          |
| Jiang et al.            | 2015 | Mining point-of-interest data from social networks for urban land use classification and disaggregation | Ethics and Information Technology                 |
| Loi M.                  | 2015 | Technological unemployment and human disenchantment                    | IEEE Transactions on Consumer Electronics        |
| Amanatiadis et al.      | 2015 | Accelerating single-image super-resolution polynomial regression in mobile devices | Ramon Llull Journal of Applied Ethics            |
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### Influence of artificial intelligence on public employment and its impact on politics: a systematic literature review

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