

REVIEW ARTICLE

Artificial intelligence (AI) applied to public management

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ABSTRACT

The implementation of systems based on artificial intelligence (AI) has passed the barrier of the academic field and due to its potentialities has been developing in other fields such as public management so there is an urgent need to have an updated overview in this regard. This article aims to address the analysis of AI by highlighting its transcendence in the field of management, public administration and government, highlighting the significant opportunities, impact assessment and the potential posed by AI. The present review provides a panoramic and significative overview about AI and its impact on the field of management and public administration, about its achievements, as well as sensitive controversies. Finally, the critical opportunities and challenges of AI application in the public sector are shown.

Keywords: artificial intelligence; public management; digital governance; public administration

1. Introduction

Established as an academic discipline in the 1950s, artificial intelligence (AI) remained an area of relative scientific obscurity and limited practical interest for more than half a century. AI, as an idea, first appeared shortly after humans developed electronic digital computing and has since faced waves of hype and pessimism^[1]. According to Chui^[2], AI refers to the ability of machines to exhibit human-like intelligence, e.g., solve a problem independently of some manufactured software. The breakneck pace of development in AI is providing unprecedented opportunities^[3], which according to Abduljabbar, Dia, Liyanage and Bagloee^[4] innovations introduced by AI include highly advanced

computational methods that mimic the way the human brain works.

Currently, due to the rise of scientific disciplines derived from the application of AI such as big data (storage and handling of huge volumes of data), machine learning, deep learning, have entered the environment of public. According to Dwivedi et al^[5], new advances in algorithmic machine learning and autonomous decision making, which creates new opportunities for continuous innovation. AI is poised to unleash the next wave of digital disruption, and institutions, organizations and/or companies must find themselves ready for it now^[2]. According to Helbing et al^[6], AI offers enormous transformative potential for the augmentation and potential re-

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placement of human tasks and activities within a wide range of industrial, intellectual and social applications.

While the benefits of increased levels of AI adoption in many sectors of the global economy are felt in the context of greater efficiency, improved productivity and reliability, such a context of positive innovation is not entirely universally welcomed or accepted globally; as stated by Dwivedi et al^[5], estimates for labor displacement due to automation suggest that up to one-third of labor activities present today could be affected by 2030.

According to Dwivedi et al^[5], AI is a concept that has been part of the public discourse for decades, often represented in science fiction movies or apocalyptic debates where intelligent machines will take over the world and relegate the human race to a mundane subservient existence in support of the new order imposed by AI. While such representation has a tinge of caricature, the reality is that AI is already present and many of us regularly interact with such technology in our daily lives. What Cath et al^[7], stated about AI, which according to the aforementioned authors is not merely another utility that needs to be regulated only once it is mature; as it is itself a powerful force that is reshaping our lives, our interactions and our environment, will have to be kept in mind.

In order to be able to dimension the panorama regarding AI and its methodologies and its link to public management, we have proceeded to collect and purge scientific works on the subject that cover such problems. For this purpose, the databases EBSCO, Scopus, Medline, Taylor and Francis, Scielo have been consulted using as inclusion criteria key terms related to management and public administration and AI to compile and purge relevant information with a maximum of 5 years old, due to the constant changes to which AI is affected, in order to be able to analyze with a better proximity the current panorama. We have excluded those works that were older than 5 years and others that focused on programming criteria and big data algorithms

(code) for being purely technical in nature.

2. Artificial intelligence in government and public sector

According to Henman^[8], new digital technologies are rapidly changing the landscape of public service delivery, as mobile devices combined with applications bring online public services to wherever the citizen is. Networked and Wi-Fi technologies allow geo-coded information provision and data collection to be integrated with traditional administrative data, creating big data sets to generate knowledge about populations and individuals, which can be processed by AI-based techniques to optimize decision making. Automated administrative decision-making processes are expanding, and AI (through machine learning) provides more nuanced ways of making decisions in complex circumstances. According to Mikhaylov, Esteve and Campion^[9], many public sector organizations are increasingly interested in using data science and AI capabilities to implement policies and generate efficiencies in highly uncertain environments.

It should be noted from Sun and Medaglia^[10] that, in the case of China, at an early stage, the hype surrounding the introduction of AI in the public sector was inevitably accompanied by a degree of uncertainty, as the application of such technologies in the public sector would follow on from the explosion of AI in the private sector. This is nothing new, since it was the private sector that was the first to adopt AI for the organization, planning and management of its processes. On the other hand, Duan et al^[11], mentioned that the introduction of AI in government actions will enable a wide range of unique opportunities. They likewise remarked that many of them are beginning to stand out in a growing number of views on AI in the public sector.

According to Agarwal^[12], public administrators are not prepared to face the challenges that the transformation/derivation of the application of new technologies demands, especially those related to the management of huge amounts of decision-oriented

information based on AI. Although many current government structures and processes have evolved over the past few decades, they are likely to become irrelevant or outdated in the near future. Because of this, there is a compelling need to lay the groundwork for governments to reconsider how they can better serve their constituents.

The transformative impact of AI has generated significant academic interest with recent studies that according to Dwivedi et al.^[5], have moved from investigating the impacts and consequences of the technology to the performance implications of AI as well as the implementation of AI-based systems in various spheres spanning multiple fields such as economic, military, administrative, education, medical, security, management, among others. According to the work done by Sun and Medaglia^[10] using a case study to analyze the challenges of applying AI in the public sector in the Chinese context, based on the analysis of three groups of stakeholders: government policy makers, hospital managers/physicians, and IT company managers; in order to identify how the challenges of adopting AI in the public sector are perceived in relation to the changes and impact on citizens in the context of political, legal, and policy challenges, as well as national security threats from foreign-owned companies. The results generated showed that different stakeholders have diverse and sometimes contradictory framings of the challenges.

The reasoning put forward by Shava and Hofisi^[13], underpinned by technological advances, was based on the fact that AI is already generating a significant effect on the value of labor, and for major segments of the population, human value is now determined by the cost of equivalent artificial intelligence, therefore, public administration will have to respond to this reality. The introduction of AI in the public sector opens up new scenarios for both practitioners and researchers. One particular example, is the case of China and the United States who have recognized the value of AI for the public sector and its competitiveness in the global economy^[14]. Being able to understand and act in these scenarios now

becomes of paramount importance. According to Galloway & Swiatek^[15], AI can help PR professionals deal with people's emotions while planning implementations. AI offers great opportunities for public administration, including automation of workflow processes, faster information processing, improved service quality, or increased labor efficiency^[16].

One way AI is beginning to be applied in local government is through the introduction of predictive analytics and decision support technologies^[17]. AI applications could make government work more efficiently while freeing up time for employees to build better relationships with citizens.

Given that citizen satisfaction with digital government offerings leaves much to be desired, AI may be a way to bridge the gap while improving citizen engagement and service delivery^[18]. AI such as machine learning, rule-based systems, natural language processing and speech recognition, when adopted in the public sector, have potential implications for various aspects of government action, including the inner workings of government agencies, the relationship between governments and citizens, and the role of governments as regulators^[5].

The study presented by Abbasi and El Hanandeh^[19] on the concrete application of AI in an area related to public administration to ensure proper management of municipal solid waste (MSW) in an Australian town. In this process, they implemented advanced AI-based forecasting systems. In this study, four AI algorithms were compared for their accuracy in predicting waste generation rates. The results showed that AI models provide promising tools that can enable managers to make better decisions to successfully forecast future trends in MSW management, as well as in MSW management planning and design. According to the advances developed in some aspects related to public administration, the implementation and development of AI-based processes have demonstrated superiority to conventional models of MSW management and handling.

Another relevant example is the work devel-

oped by Kouziokas^[20] on improvements in the quality and safety of public transport services in Greece, where he mentioned that the public administration has chosen to apply AI methods to generate predictive models of artificial neural networks in transport areas at high risk of crime, in addition to geographic information systems to perform spatial analysis in order to identify regions with a high concentration of criminal incidents. This study implemented a scaled conjugate gradient algorithm, as a training algorithm, for the generation of the feedback neural network models, as it was considered to be one of the fastest learning algorithms compared to several other equivalent algorithms. Its results showed a very good prediction accuracy, considering it as very promising and may promote safer transportation management policies, especially in cities where crime rates are very high.

Another outstanding achievement is the work developed by Abduljabbar et al^[4], on the application of AI in the field of transportation aiming to overcome the challenges of increasing travel demand, carbon dioxide emissions, safety issues and environmental degradation. Transportation problems become a challenge when the system and user behavior is too difficult to model and predict travel patterns. By using a large amount of quantitative and qualitative data on transportation system characteristics and variables and AI-based methods such as artificial neural networks, genetic algorithms, among others, the results of the analysis showed that AI can be conveniently employed to solve the challenge of increasing travel demand, CO emissions, safety issues and fuel wastage.

According to the aforementioned researchers, the next promising application of AI in transportation will be connected and autonomous vehicles, which will aim to improve productivity by reducing the number of accidents on the roads. The applicability of AI in the management of urban transport is very promising for transport authorities, as it will allow them to determine how to manage processes and problems in the sector with a feasibility above classic studies, a fact that could translate into quality

services, risk mitigation, better productivity of vital assets and by default a greater acceptance of the process implemented by the population.

3. Challenges of artificial intelligence in the public sector

Public administration can hardly keep up with the rapid development of AI, which is reflected in the lack of concrete AI governance and legislation programs. While the challenges of AI and possible adverse effects on society have potential adverse effects on society have begun to attract the attention of researchers^[14]. Objectively, determined trends and needs regarding the introduction of AI into the public administration system and process have been established or reflected in many conceptual, doctrinal and programmatic documents in the field of public administration in Great Britain and other countries in the European region^[21].

As AI advances, the potential applications to administration work will multiply, even though governments often slow down the adoption of new technologies^[22]. While the potential future use cases for AI in government remain limited by government resources, the most obvious and immediately beneficial opportunities are those where AI can reduce administrative burdens, helping to solve resource allocation problems and take on significantly complex tasks^[18]. According to Nadikattu^[23] AI would perform the more general part that directly impacts on making public relations practice more efficient and user-friendly, thus improving an organization's bottom line.

According to Dwivedi et al^[5], the impacts of AI, on public management, contemplate three aspects. First, on the public sector workforce, by delegating decision making to AI would result in a clear classic threat of labor substitution. Second, addressing the increased dynamics of AI-supported public decision making, because AI applications tend to introduce non-diagnostic aspects by reducing the ability of non-experts to audit the mechanisms leading to decision outcomes. Third, the decrease of opacity is-

sues regarding AI performance and affordability with the population; as AI algorithms tend to suggest that the level of transparency, tractability and explainability are inversely proportional to their complexity.

In resource-constrained environments, public organizations do not bet on investing in massive upgrade processes for the hardware and software employed; however, as costs become more accessible and AI gains in replicability, scalability and efficiency, the same pressures that delay the technological leap in public management could catalyze such tools to become attractive investments due to their connoted efficiency^[24]. According to the proposal of Merh et al, if any public entity would be interested in implementing AI-based processes they can learn from AI implementation processes by the private sector. In addition, the aforementioned authors remarked that such an entity should consider the following strategies to apply AI to its field of action: making AI part of a citizen-centric and goal-based program; obtaining citizen feedback; leveraging existing resources; being prepared for data processing and taking care of privacy; mitigating ethical risks.

Another relevant aspect is made known by Al-lam and Dhunny^[25] on the progress of cities which, inevitably, are turning more and more towards specialized technologies to address issues related to society, ecology, morphology and many others. On such a basis emerges the emerging concept of Smart Cities, which greatly fosters this perspective by promoting the incorporation of sensors and Big Data through the so-called Internet of Things^[26]. This inevitable surge of data brings new possibilities in the design and management of cities as well as economic perspectives. AI-mediated big data processing can greatly contribute to the development of the urban fabric in the dimensions of sustainability and livability.

The use of AI by state entities to perform various tasks, could be very relevant, as it would lead to developing a more attractive perspective for its implementation; however, it is still impossible to talk

about the integrated, fully tested and properly regulated implementation of this type of technology therefore, it is suggested to delve into this topic from a theoretical (prognostic) point of view, taking into account the possible directions and possibilities regarding the use of such technology and units^[27,28].

According to Manyika et al^[29], there is a positive relationship between the benefits and adoption levels of AI in various sectors of the global economy, which translate in the context of increased efficiency, improved productivity and reliability. But Jarrahi^[30] mentioned that such a positive image of innovation is not fully accepted as estimates for labor displacement resulting from the introduction of AI or equivalent mechanisms (big data, machine learning) forecast that up to one third of the current labor market could be seriously compromised by 2030.

While it is true that a number of AI-based applications are emerging for the public sector, which promises great value with respect to workforce and productivity, another fact that cannot be denied is that it comes with significant challenges that are crucial for its successful implementation and use. In this regard, Wirtz et al^[14], noted pressing challenges regarding the accountability and implementation of AI, as well as the social and ethical issues that potentially threaten the successful use of AI and the respective value creation for the public sector and society as a whole. If this challenge seeks a constant growth, as it has been happening with the field of AI and its possibilities, it is a fact that this will lead to a gestation of diverse and new problems that will probably compromise sensitive sectors of society and this problem would have to worsen since AI is a technology that transcends the hollowness of the bulk of the population, being this aspect one of those that catalyze the seriousness of possible situations of intensive implementation of AI in society.

As new AI-based technological devices tend to replace human labor in the long run, the future of public administration is threatened, therefore, governments must undertake initiatives to train workers in the use of such technology^[13]. As mentioned by

Bullock^[22] converges the trend that, with current technologies, many tasks performed by human actors can already be performed more efficiently and effectively by AI. This suggests that tasks performed by human bureaucrats, in many domains, can be augmented or automated by AI. As the digital debate progresses, various governments, especially in the developing world, should voice their concerns rather than simply allowing developed states to dictate the path of development to them. States should be able to integrate relevant stakeholders, including private sector organization, and chart the way forward in terms of how it should be adopted and to what extent.

4. Conclusions

Technology-driven disruption is occurring at a pace and scale never before seen in history. Waves of technology, such as big data and machine learning, which enable the purposeful processing of huge volumes of data because millions of pieces of data are generated every minute that, if processed under such technologies, would provide relevant and pertinent information for proper decision making, are profoundly reshaping the global *modus vivendi*. A new world is emerging in which many of today's job classes will disappear, while new ones emerge that require completely different skill sets.

The world is on the brink of the long-awaited digital transformation orchestrated by the Fourth Industrial Revolution, which is based in part on the development and applications of AI. Despite the perceived benefits of increased efficiency and effectiveness in service delivery, the Fourth Industrial Revolution largely presents numerous challenges for public administration in developing countries that lack sufficient human and material resources to execute the ensuing huge technological advances. This aspect must be understood from the reality of the absence of experts in the field in adequate numbers for an effective implementation process to take place, in addition to taking into account the limiting factor of the economies of the region that very rarely bet on the technical-scientific training of cadres who lead

such possibilities and can work on it. Perhaps this delicate aspect is one of the most critical ones that exceed expectations, since its solution responds to the policies adopted by the current administration.

The growing use of AI is likely to challenge cultural norms and act as a potential barrier within certain sectors of the population. There is also the latent risk that AI may surpass human performance in many jobs and could inevitably replace them. There is no doubt that AI will continue to improve its capabilities and infiltrate many more domains of societal endeavor; hence the growing concern that AI will usurp or extinguish jobs and replace human employees will hinder building people's trust in AI; but that, due to its effectiveness, such a trend will be quasi-inevitable. In fact, being a trend and being present in one way or another in social life, it is an ineluctable fact that the shift towards AI-mediated processes in various fields and activities will materialize, but the radical question is "how prepared are we in this regard?" And in the case of access to mechanisms and processes based on AI, we should ask ourselves: are there sufficiently trained professionals to be able to take advantage of AI and adapt it to national development processes; and on the other hand, in the local context and assuming the levels of education of the countries of the region and the cultural gaps, how and how much would be the level of acceptance/rejection of the implementation of AI in public management on the part of the population? These dilemmas, from which we cannot be exempt, will be part of the next research agenda regarding the field of possibilities and implications of the adequacy of AI in our developing countries.

Conflict of interest

The authors declare no conflict of interest.

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