The Promise of Artificial Intelligence in achieving greater effectiveness in the Public Sector

A system review paper

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Abstract

In light of the ability of digital technologies to improve the processes of daily life in both the public and private sector, this paper attempts to examine "The promise of Artificial Intelligence" in creating greater effectiveness in the public sector through employing a systemic review. A systematic review is a method of conducting a literature review that intends to mitigate the biases that regular literature reviews are prone to. The findings of this studie emphasize the need for the public sector to first tackle the administrative challenges and barriers to the implementation, after which the benefits can be enjoyed. The context of this paper is a policy recommendation to policy makers, as well as researchers in the field of public policy.

Introduction

In recent decades, digital technologies have revolutionized the manner in which we interact with each other and the world itself through what is often called the "digital revolution". Our current epoch is often referred to as "The Age of Information" as technologies surround us in what is known as the Internet of Things (IoT) (Wilson et al., 2004; Xia et al., 2012). Aspects such as among others communication, information, entertainment, professional life have all been facilitated by digital technologies, making many of the processes as good as instantaneous. In recent years, more attention has gone to the concepts of Big Data, and Artificial Intelligence, as their potential harbors the ability to engage with most facets of daily life as well (Ogunsola, 2005; Harris, 1999; Castro and New, 2016).

Much research has been done on the applications of AI in the medical field, business and in politics (Allam and Dhunny, 2019). It is often said Artificial Intelligence technologies can be much more efficient and less impartial than their flesh and blood counterparts, as the academic debate illustrates (Jaharri, 2018; Arias, 2020; Hacker, 2018). The field of public management continuously strives to improve processes such as public service delivery, through creating greater efficiency in the distribution and allocation of such public services. In a similar vein to preceding digital technologies that spurred on revolutionary transformations in the last decades, Artificial Intelligence is prospected to substantially contribute to beneficial outputs in both the public as well as the private sector (Wirtz et al. 2019). For instance, Artificial Intelligence is said to replicate labor processes at speeds and capacities beyond those considered humanly possible (2019, p.596).

Simultaneously, academics has increasingly highlighted the challenges that the public sector is facing (Gerton and Mitchell, 2019; Colombo, 2018; Shava and Hofisi, 2017). In essence, nearly the entirety of public management and organizations are focused on the performance and

effectiveness of the public sector, as it influences the overall quality of government and consequently that of the lives of its citizens (Lee and Whitford, 2009). Yet, the changing nature of the public sphere as consequence of the emergence of the information society, involvement of new actors, dynamics and the subsequent power fragmentation have inherently altered the manner in which activities in the public sphere are organized, further complicating the pursuit of government effectiveness (Colombo and Eliantonio, 2018).

Gerton and Mitchell (2019) for one state that current 'grand' challenges inhibiting the achievement of higher government effectiveness include but are not limited to: The protection and advancing of democracy, the strengthening social and economic development, the guarantee of environmental sustainability, and the managing of Technological changes. In a similar vein, Agarwal (2018, p.919-920) emphasizes the need for Public Administrators to anticipate the effects of electric government services, the labor market, economy, and social welfare, taxing surrounding new technologies, protection of consumers, and the protection of privacy.

While new technologies stemming from information society manifest challenges to the public sector, its potential uses also gives rise to the opportunity to circumvent current and future challenges to the field of Public Administration. Hence, this article sets out to offer a concise overview to policy makers and scholars in the field of public management as to how digital technologies, of which particularly "Artificial Intelligence", can contribute to the pursuit of greater efficiency in the public sector. In other words: In light of the continuous endeavors in public management to create more efficiency in the functioning of government and procurement, provision and allocation of public services, this paper will synthesize the manners in which Artificial Intelligence can be harnessed to contribute to such pursuits by means of a systemic

review. The guiding questions from which to initiate the systemic review are formulated as follows:

- How can the public sector prepare itself for the adaptation of AI technologies?
- In what ways can Artificial Intelligence technologies contribute to greater efficiency in the public sector?

The paper will be structured as follows. The section following the introduction describes the framework through which the systemic review will be organized, drawing upon methodologies put forward by Petticrew et al. (2005) and Tranfield et al. (2003). Next, the paper will delineate the selection criteria and data collection processes for the studies taken into consideration for the systemic review. Finally, the results will be presented through a visual presentation of the study selection, followed by a synthesis of the findings, which will be further deliberated on by means of a discussion containing conclusions and encountered limitations.

Methodology

The framework utilized in this paper is the systemic review, which can be understood to be an evidence-based method of mapping out large bodies of information (Petticrew et al., 2005, p.2). The method is closely contingent on scientific methods meant to limit the bias that is regularly found with conventional literature reviews (2005, p.9). This is done through first setting constraints and specifying methods of selection after which identification, appraisal, and synthetization of all relevant studies with the set goal of answering a particular question offers a replicable, synthesis of information regarding a related topic with a mitigation of the usual selection bias and potential information overload (2005, p.9-10). As policymakers have increasingly become interested in

evidence-based decision making, the results of systemic reviews can be of great use in the information needed to formulate policy (2005, p.11).

Drawing upon Tranfield et al. (2003) and De Vries et al. (2016), the method consulted from hereafter involves the identification of keywords and search terms based on the studied subject, the search strategy based on eligibility criteria, data extraction, synthesis of the results, after which the results will be reported on and findings will be put into practice. Furthermore, in facilitation of the systemic review the 'Preferred Reporting Items for Systematic Reviews and Meta-Analysis' (PRISMA) will be consulted and included in Appendix I.

Literature search

In order to identify studies adherent to the eligibility criteria, the following strategy was employed: First, a search query was initiated on Web of Science, due to its lower propensity to display duplicates as well as its wide array of sources with detailed information as to the topic, background among other details of publications. Due to the pre-determined scope of the research, limited time and resources, the search query consisted of the Topics "Artificial Intelligence" AND "Public sector" which yielded 115 results. Excluding duplicates, papers not related to the topic, or in other languages decreased the number of sources by 89 to a new total of 26 sources. After then excluding the paper that had not yet been released the new total becomes 25 sources. The abstracts of the paper were checked to verify whether these were adherent to the Eligibility criteria, after which 20 sources remained eligible for further study. The final search was ran on the sixteenth of December 2020.

Despite using a search strategy, the use of the specific topics of "Artificial intelligence" and "Public sector" and the use Web of Science as sole database creates the possibility that we

have missed studies that respectively were worded differently or were not available on Web of Science. Including synonyms of the terms would have been possible but would have resulted in search results with numbers beyond the scope of this research, in addition to potentially obfuscating more relevant sources in the process. Furthermore, limiting the results to merely include sources in the English language can further exacerbate any potential biases. Moreover, the use of more terms and several databases or different means of study selections would have been significantly more time- and resource consuming than this research allows. For that reason, this review has decided to limit itself to Web of Science as sole database, and "Artificial Intelligence" and "Public sector" as sole topics.

Eligibility Criteria

In order to set the boundaries of the searches taken into the system review and to stay consistent with the PRISMA, we opted to select studies based on the following criteria:

- Field: The studies included are on the use of Artificial Intelligence in relation to the public sector. The relevant fields in this case include Public Administration, Public Management, Public policy, and similar fields pertaining to research on activities in the public sector. With Artificial Intelligence we utilize the definition as put forward by Wirtz et al. (2019, p.599): "The capability of a computer system to show human-like intelligent behavior characterized by certain core competencies, including perception, understanding, action and learning". More specifically, the use of Artificial Intelligence is often characterized by its human-computer, and data-based interactions.

- Topic: Eligible studies should have the words "Artificial Intelligence" and "Public sector" in their title, abstract or contents. As we aim to offer insights for policymakers, this initial study relates to the public sector overall rather than a search on specific topics of the public
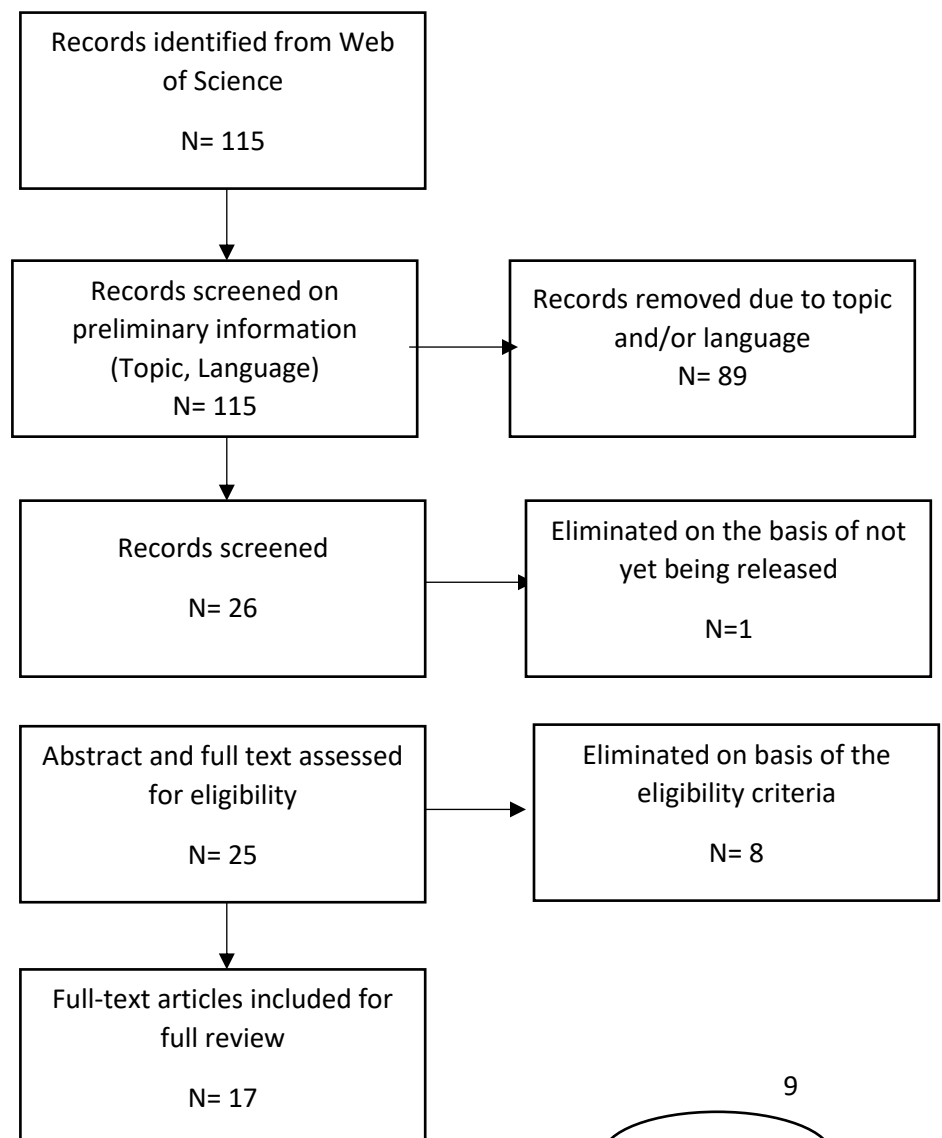
sector such as health, education, and other studies. Hence, we used the overarching search terms of AI and the Public sector to generate the selection obtained. Yet, studies pertaining to different fields but containing the eligible topics are still taken into consideration.

- Study design: This systemic review aims to include mostly empirical methods to identify the manners in which Artificial Intelligence can contribute to greater effectiveness in the Public sector. However, as the field of Artificial Intelligence is rapidly developing, some studies involve future projections based on current technologies. Hence, peer-reviewed exploratory study designs form part of the studies considered eligible. Considering the projections are founded on empirical or actual applications of AI technology, it is unlikely that the results will be deviating from the intended objective standards set by this systemic review. Other than reviews, due to possible overlap in source information, all types of study designs are considered valid.

- Year of publication: As Artificial Intelligence by itself is a relatively new phenomenon that has only recently gained traction in academics, there is no pre-determined timespan in order to guarantee no relevant studies were excluded. Instead, the available sources as per the eligibility criteria will determine the timespan of the review, which I do not expect to be beyond the period 2010-2020.

- Language: Considering the scope of this research and the availability of resources, this review will only include sources in the English language.

- Publication status: Due to limited resources, the only studies considered are those publicly available and accessible through Web of Science, with institutional access granted by Leiden University. Scholarly, published, peer-reviewed articles were considered for the selection.

Findings

Study selection

In accordance with the eligibility criteria as stipulated by the PRISMA method, the initial search of 115 sources was reduced to 20 sources in adherence with the criteria. Figure 1.1 exhibits the exclusion of studies and on what grounds by means of a flow chart. In this stage, an examination of the Title, abstract, and research methods involved was performed, after which a further two sources were eliminated on the basis of being reviews; and one on the basis of not being an academic article making the new amount of sources 17 in total. Further deliberation as to the literature search and earlier described selection process can be found in the "Literature search" section.

Records identified from Web of Science

N= 115

Records screened on preliminary information (Topic, Language)
N= 115

Records removed due to topic and/or language
N= 89

Records screened

N= 26

Eliminated on the basis of not yet being released

N=1

Abstract and full text assessed for eligibility

N= 25

Eliminated on basis of the eligibility criteria

N= 8

Full-text articles included for full review

N= 17

9

Figure 1.1

Results

Journals

An examination of the results exhibits that out of 17 articles, two (11.765%) were from the Government Information Quarterly Journal, with the rest of the sources being evenly distributed (5.882%) among 15 other journals: Asia Pacific Journal of Public Administration, Business Horizons, Computer, Computer Journal, Economic Analysis and Policy, European Planning Studies, International Journal of Public Administration, Journal of Mechanics of Continua and Mathematical Physical and Engineering Sciences, Philosophical transactions of the royal Society A Mathematical Physical and Engineering Sciences, Public Policy and Administration, Regional Environmental Change, RUSI Journal, Sustainability, Telecommunications Policy and Yale Journal on Regulation.

Additionally, when considering the countries of origin in which the studies were produced, we encounter 5 (29.412%) sources from the USA, 4 (23.529%) from England, 4 (23.529%) from Spain, 3 from Germany (17.647%), 3 (17.647%) from Australia, 2 (11.765%) from the Netherlands, and further evenly distributed in frequencies of one (5.556%): Denmark, Japan, Norway, Pakistan, Peoples Republic of China, South Korea, and Switzerland. As become apparent, some countries are mentioned more often due to international collaborations.

Moreover, out of seventeen studies, 10 (58.824%) were published in 2020, 5 (29.412%) in 2019, one (5.882%) in 2018 and one (5.882%) in 2017.

When examining the Research Categories, we can distinguish between the field of Public Administration making up 4 (23.529%) studies total, Environmental sciences ecology accounting for 3 (17,647%), Information science accounting for 3 (17.647%), frequencies of two (11.765%)

for Businesses economics, Computer Science, Government Law, and Science technology/other, and then frequencies of one (5.882%) for Geography, Mechanics, Telecommunications and Urban Studies. Considering the primary research interest went out to Public Administration, it was anticipated this would make up the largest category.

Findings

Definitions

Artificial Intelligence is often equated with machine learning or machine intelligence and is stated to be a field of its own (Abbas et al. 2019; Wirtz et al., 2019). Moreover, AI is said to enhance the process of reaching goals through exercise of its "cognitive" functions. The twenty-first century is said to have heralded a new era of AI, in which it has become a solution to many computer systems that can be harnessed to further develop technologies. Artificial is often mentioned as a transformative technology that is both beneficial, as well as the source of a number of challenges (Butcher and Beridze, 2019; Campion et al., 2020). The field of AI is often convoluted with information on data or Big Data, as AI applications are heavily data-dependent (Campion et al, 2020). AI has lived a rich history since its conceptualization in the 1950s, but swiftly left the academic debate due to technical constraints, until recent times (Desouza et al., 2020).

Current uses of AI mostly pertain to the application of breakthroughs of the past decades concerning deep learning and other facilitating technologies such as reinforcement learning and transfer learning onto new fields and problems (2020, p. 205). This recent resurge in AI applications is at times attributed to multinational companies such as Amazon, Google, Facebook etc. and is linked to the Internet of Things, big data and blockchain technologies (Engin and

Treleaven, 2018). Big data is supplied to the increased use of networked and wi-fi technologies in combination with online public services and mobile devices and refers to the mass-accumulation of user data (Henman, 2020; Pencheva et al., 2020). Another terminology contingent on AI is Digitalization, which refers to the process of digitizing or harnessing the abilities of technology to make analogous processes digital (Gupta et al., 2020).

In a similar vein to other selected studies Desouza et al. (2020, p.206) emphasizes the position of AI within a larger set of cognitive computing systems due to their essence stemming from learning functions. There is certain characteristics that differentiate such AI systems from other systems: Learning from data and human interaction for successful deployment, context-sensitive and learning from environmental characteristics (precedents, prior data), recalling history in the formulation of advice and computations, interaction with humans through language, confidence-weighted recommendations that can be acted upon by humans (2002, p.207; Sun and Medaglia, 2019). Some practical uses of AI include chatbots, real-time translation, crime probability systems, not all of which effective (2002, p.207-208). The public sector has increasingly become interest in utilizing big data and artificial intelligence for the goal of policy delivery and increase of efficiency (Mikhaylov et al., 2018).

Preparing the Public Sector for the use of Artificial Intelligence

The field of AI can be regarded as unorganized, with multiple stakeholders from different sectors attempting to influence the trajectory of AI governance in what can be interpreted as a conflict of interests (Butcher and Beridze, 2019, p.89-90). As the public sector has the citizen's welfare in mind, it is set on more carefully deliberating the policies surrounding AI whereas the private sector would like it to advance it as quicky as possible to gain profit maximalization (2019, p.89). Challenges in the adoption of AI can be seen to be stemming from seven categories: social,

economic, technological, data, organizational and managerial, ethical, political legal and policy (Campion et al., 2020). As it stands, the public sector invests significantly in the research and development of artificial intelligence, making the stakes higher in establishing an effective framework (2020, p.3-4). One common problem in the adaptation of AI technologies in the public sector derive from privacy concerns, biased datasets, lack of transparency and ethical questions of security, surveillance, ownership and exploitation, legality, due process, administrative justice (Engin and Treleaven, 2018; Henman, 2020). Abbas et al. (2019), found that one of the great challenges stems from the private abuse of such technologies, prompting the need for strong regulations and monitoring of the private sector.

Engstrom and Ho emphasize the need for humans to remain involved in the review process regarding solutions established by AI systems, as human discretion can prevent the emergence of false positives and negatives (2020, p.41-42). In a similar vein, Fatima et al. (2020), point to the use of policy tools in preparing governments to anticipate harness the disruptive technology of AI. Each country has their own strengths and weaknesses in this regard, and thus the use of policy tools is context specific. Scholars however point to the possibility that the government oversteps the applications of AI in gaining more power, compliance, and control of its citizens. Hence, there needs to be a careful deliberation of the efficiency, legal ,social and ethical implications of the application of AI technology (Henman, 2020, p.215). The risks of the power creating functions of AI additionally concern the framing trap, portability trap, formalism trap, ripple effect trap and the solutionism trap (Kuziemski and Misucara, 2020, p.4). Perhaps the most mentioned problem pertains to the accountability, who is responsible when an algorithm or AI system makes mistakes. For one it could be the developer, the user, or the system itself (Mikhaylov et al., 2018). Four of

the major overarching policy areas that need extra attention in the development of AI involve AI technology implementation, AI law and regulation, AI ethics, and AI society (Wirtz et al., 2018).

Opportunities for AI to improve the activities of the Public sector

The selected scholarship presents the application of AI as substantially beneficial to the public sector. Abbas et al. (2019) state that the innovation of the public sector is of great importance and supersedes potential concerns over cost pressures. The use of AI could lead to the better planning of resources, a reduce of transaction costs both in forms of times as well as financial resources and could conduct organization in a more productive manner (2019). Aoki (2020) found that the use of AI chatbots can foster more public trust in the public sector through a greater uniformity of response quality and timeliness in responding. Moreover, Biesbroek et al (2020) their findings exhibit the manner in which AI can also serve as a beneficial tool in the field of policy research, through a faster computation and analysis of data related to public policies. Similar to earlier digital technologies, AI is said to improve the efficiency of organizations and might potentially regenerate earlier human mistakes such as corruption. Yet, this does require the management of the new technologies and the correct addressing of security concerns Desouza et al. (2020, p.209-212).

AI technologies are already employed for applications such as customer service, predictive analysis for the detection of fraud, decision-support systems, logistical machines and autonomous systems in transport, defense, and healthcare (Desouza et al., 2020, p.206). Additionally, AI is deployed to enhance public scrutiny and governance, the detection of illicit trade, the diagnose of diseases in health care, the enhancement of treatment procedures, the protection of critical government infrastructures, the navigation of among others complex policies as well as the analysis of policy problems (Henman, 2020 ,p.212). In the future this

could be expanded upon through the use of Internet of Things systems to collect real-time data for the organization of public infrastructure, policy modeling using big data to transform the process of decision-making, albeit with human oversight (Engin and Treleaven, 2019). Moreover, the use of AI could aid in the achievement of Sustainable Development goals (Gupta et al., 2020).

Conclusions

In light of digital technologies revolutionizing the manner in which public- and private life are performed on a daily basis, these studies attempted to offer a systemic review on how the public sector can prepare itself to reap the benefits of the use of Artificial Intelligence. The findings of the systemic review emphasize the need for the public sector to address privacy and security concerns, as well as managerial issues, problems of accountability and transparency, data biases and possible transgressions of power that Artificial Intelligence applications can harbor. Yet, the review also managed to highlighted the versatile uses and benefits that AI technology can bring in the increasing of efficiency in the public sector through automation of processes, lowered transaction costs and greater overall efficiency in several fields of public policies. As this systemic review set out to offer a coherent oversight for policy makers and scholars of public policy alike, we will conclude with a set of Policy recommendations and the limitations encountered in this studies as well as pointers for future research.

Policy recommendations

Based on these findings, there is several policy recommendations that can be formulated:

- Priorities should lay in the thorough but swift legislation surrounding AI technologies, as their applications by public- and private actors alike can harbor threats to citizens and government systems alike

- At present, human oversight and accountability structures are of significant importance to the application of AI due to potential biased data, false- negatives and -positives, and the general pervasiveness AI applications can enact.

- Assuming proper legislation, the benefits of AI outweigh the negatives, prompting a higher degree of funding in pursuit of increased effectiveness in the public sector

Limitations and Future Research Agenda

While the use of a systemic review supplemented by the PRISMA method is intended to reduce bias as much as possible, there is still a likelihood that there are subjective traces in the procurement and processing of studies. In advancement of the field, it would be beneficial to the public sector if similar studies were conducted with greater resources, time, and funding. Moreover, a replication of this studies would prove extra useful at a time in which the application of AI has advanced more than the moment these studies were performed. This would give a more accurate and in-depth approach to exactly how AI technologies can advance the activities of the public sector

Bibliography

Abbas, S. K., & Aftab, M. (2019). Fostering Conditions for Innovative Reforms in Public Sector Organizations and Their Response to Artificial Intelligence.

Agarwal, P. K. (2018). Public administration challenges in the world of AI and Bots. *Public Administration Review*, *78*(6), 917-921.

Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, *89*, 80-91.

Aoki, N. (2020). An experimental study of public trust in AI chatbots in the public sector. *Government Information Quarterly*, *37*(4), 101490.

Arias, P. C. (2020). Artificial Intelligence & Machine Learning: a model for a new judicial system?. *Revista Internacional Jurídica y Empresarial*, (3), 81-91.

Biesbroek, R., Badloe, S., & Athanasiadis, I. N. (2020). Machine learning for research on climate change adaptation policy integration: an exploratory UK case study. *Regional Environmental Change*, *20*(3), 1-13.

Butcher, J., & Beridze, I. (2019). What is the State of Artificial Intelligence Governance Globally?. *The RUSI Journal*, *164*(5-6), 88-96.

Castro, D., & New, J. (2016). The promise of artificial intelligence. *Center for Data Innovation*, 1-48.

Campion, A., Hernandez, M. G., Jankin, S. M., & Esteve, M. (2020). Managing Artificial Intelligence Deployment in the Public Sector. *Computer*, *53*(10), 28-37.

Colombo, C. M. & Eliantonio, M. (2018). The Changing Nature of the Public Administration: Innovations and Challenges for Public Lawyers. *European Public Law*, *24*(3).

Cooke, P. (2017). 'Digital tech'and the public sector: what new role after public funding?. *European Planning Studies*, *25*(5), 739-754.

Desouza, K. C., Dawson, G. S., & Chenok, D. (2020). Designing, developing, and deploying artificial intelligence systems: Lessons from and for the public sector. *Business Horizons*, *63*(2), 205-213.

De Vries, Hanna, Victor Bekkers, and Lars Tummers. 2016. "Innovation in the public sector: A systematic review and future research agenda." Public Administration 94 (1):146-166.

Engin, Z., & Treleaven, P. (2019). Algorithmic government: Automating public services and supporting civil servants in using data science technologies. *The Computer Journal*, *62*(3), 448-460.

Engstrom, D. F., & Ho, D. E. (2020). Algorithmic Accountability in the Administrative State. *Yale Journal on Regulation, Forthcoming*.

Fatima, S., Desouza, K. C., & Dawson, G. S. (2020). National strategic artificial intelligence plans: A multi-dimensional analysis. *Economic Analysis and Policy*, *67*, 178-194.

Gerton, T., & Mitchell, J. P. (2019). Grand challenges in public administration: Implications for public service education, training, and research.

Gupta, S., Motlagh, M., & Rhyner, J. (2020). The Digitalization Sustainability Matrix: A Participatory Research Tool for Investigating Digitainability. *Sustainability*, *12*(21), 9283.

Hacker, P. (2018). Teaching fairness to artificial intelligence: Existing and novel strategies against algorithmic discrimination under EU law.

Harris, J. (1999). Globalisation and the technological transformation of capitalism. *Race & Class*, *40*(2-3), 21-35.

Henman, P. (2020). Improving public services using artificial intelligence: possibilities, pitfalls, governance. *Asia Pacific Journal of Public Administration*, *42*(4), 209-221.

Jarrahi, M. H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons*, *61*(4), 577-586.

Kuziemski, M., & Misuraca, G. (2020). AI governance in the public sector: Three tales from the frontiers of automated decision-making in democratic settings. *Telecommunications Policy*, 101976.

Lee, S. Y., & Whitford, A. B. (2009). Government effectiveness in comparative perspective. *Journal of Comparative Policy Analysis*, *11*(2), 249-281.

Mikhaylov, S. J., Esteve, M., & Campion, A. (2018). Artificial intelligence for the public sector: opportunities and challenges of cross-sector collaboration. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *376*(2128), 20170357.

Ogunsola, L. A. (2005). Information and communication technologies and the effects of globalization: Twenty-first century "digital slavery" for developing countries—myth or reality?.

Pencheva, I., Esteve, M., & Mikhaylov, S. J. (2020). Big Data and AI–A transformational shift for government: So, what next for research?. *Public Policy and Administration*, *35*(1), 24-44.

Petticrew, Mark, and Roberts, Helen. 2005. Systematic Reviews in the Social Sciences : A Practical Guide. Williston: John Wiley & Sons, Incorporated. Accessed July 29, 2020. ProQuest Ebook Central.

Shava, E., & Hofisi, C. (2017). Challenges and opportunities for public administration in the fourth industrial revolution. *African Journal of Public Affairs*, *9*(9), 203-215.

Sun, T. Q., & Medaglia, R. (2019). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*, *36*(2), 368 383.

Tranfield, David, David Denyer, and Palminder Smart. 2003. "Towards a methodology for developing evidence-informed management knowledge by means of systematic review." British journal of management 14 (3):207-222.

Wilson III, E. J., Goethals, G. R., Sorenson, G., & Burns, J. M. (2004). Leadership in the digital age. *Encyclopedia of leadership*, *4*, 858-861.

Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2019). Artificial intelligence and the public sector applications and challenges. *International Journal of Public Administration*, *42*(7), 596 -615.

Xia, F., Yang, L. T., Wang, L., & Vinel, A. (2012). Internet of things. *International journal of communication systems*, *25*(9), 1101.

Appendix I

PRISMA statement by Moher et al. (2009)
Adopted from De Vries et al. (2016) appendixS1. Available from
https://onlinelibrary.wiley.com/doi/abs/10.1111/padm.12209

Put a page # of your assignment

TITLE			page
Title	1	Identify the report as a systematic review, meta-analysis or both.	4
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address) and, if available, provide registration information including registration number.	NA
Eligibility criteria	6	Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale.	7-8
Information sources	7	Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6
Study selection	9	State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	9
Data collection process	10	Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	10
Data items	11	List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made.	NA
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias in individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	NA
Summary measures	13	State the principal summary measures (e.g. risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods for handling data and combining results of studies, if done, including measures of consistency (e.g. I) for each meta-analysis.	NA
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies).	6-7
Additional analyses	16	Describe methods of additional analyses (e.g. sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9

~~Study characteristics~~	~~18~~	~~For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations.~~	NA
~~Risk of bias within studies~~	~~19~~	~~Present data on risk of bias for each study and, if available, any outcome level assessment (see item 12).~~	NA
~~Results of individual studies~~	~~20~~	~~For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.~~	NA
Synthesis of results	21	Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency	10-15
~~Risk of bias across studies~~	~~22~~	~~Present results of any assessment of risk of bias across studies (see Item 15).~~	NA
~~Additional analysis~~	~~23~~	~~Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression [see Item 16]).~~	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers).	15
Limitations	25	Discuss limitations at study and outcome level (e.g. risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	15
FUNDING			
~~Funding~~	~~27~~	~~Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.~~	NA

De Vries, H., Bekkers, V., & Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. *Public Administration, 94*(1), 146-166.

Moher, D., Liberati, A., Tetzlaff, J., et al. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS med, 6*(7), e1000097.