Artificial Intelligence for Governance in India: Prioritizing the Challenges using Analytic Hierarchy Process (AHP)

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Abstract: The aim of the present study is to find the relative importance of related challenges of implementing artificial intelligence (AI) in governance within the context of India. Eight sub-dimensions of challenges categorized under three main dimensions are considered for prioritization. The analytic hierarchy process (AHP) methodology is employed to prioritize the challenges. The primary data pertaining to pair-wise comparisons of various factors and sub-factors has been obtained from 170 government officials by using convenience sampling. The results indicate that concerns related to data security, acquisition and storage are the major challenges in implementing AI assisted governance. Additionally, ethical considerations related to unethical use of data and lack of trust are other challenges which may act as barriers in diffusing AI in governance.

Keywords : Artificial intelligence, Governance, Analytic Hierarchy Process, Prioritization

I. INTRODUCTION

With the intervention of artificial intelligence (AI), countries across the world are moving from digital governance or e-governance to intelligent governance. With media streaming services such as Netflix and Youtube, navigation services like Google or Apple maps, and smart assistants like Google assistant, Alexa and Siri, we have begun to interact with AI, almost on a daily basis. AI is now poised to seep into the ways we interact with the government. AI can transform the way the governments work. There are a number of AI technologies which can be used to improve citizen services and boost the governance. For example, citizens can interact with chatbots for their queries related to billing, or tax related transactions. Real time sensors and cameras can help managing traffic smartly by predicting traffic flows and optimizing the traffic light timings. Similarly data analytics can be used to optimize medical emergency responses. Drones can be integrated with surveillance cameras for providing predictive policing and public security.

Many countries are developing plans to exploit AI for improving governance and citizen services. While countries like the United States, the United Kingdom, Canada, China, and Japan, have already taken high-profile steps towards advancing AI over the past few years, many other countries are working meticulously to take the advantage of this emerging technology (New, 2017). Being the fastest growing economy, India has a big stake in the AI revolution. Recognizing AI's potential to transform the economy and society for the better, the Indian government has envisaged a national programme on AI (Niti Ayog, 2018). Through this programme, the government is planning to implement AI driven delivery of public services in eight focus areas including healthcare, agriculture, transports and logistics, retail, manufacturing, energy, smart cities and education.

The benefits of implementing AI in governance are manifold. AI enabled services will not only reduce administrative burdens on the government offices but will also help reducing the long wait times of citizens. AI can help solve issues related with low transparency and accountability of the government. It help in effective and efficient working of the government while freeing up government officials to engage in more productive and higher-value tasks and building better relationships with citizens. Given the significance of AI in the governance, it is vital for researchers and government leaders to identify the challenges related to the implementation of AI in governance, so that the governments can be prepared for AI deployment and use. Though AI is gaining popularity in governance, the field is still young for researchers. There is a dearth of literature focusing on the related challenges of adopting AI in governance, especially in the context of India. Therefore a study exploring the challenges of implementing AI in Indian governance is timely and relevant, as the topic has yet to be explored. This paper first identifies the challenges of AI in governance on the basis of extant literature. Then the challenges are prioritized by using Analytic Hierarchy Process (AHP) approach, which is a multi-criteria decision making (MCDM) technique. This empirical examination of the challenges is a novel contribution of the study as the existing studies exploring the challenges of adopting AI are majorly qualitative in nature.

II. LITERATURE REVIEW

The term 'Artificial Intelligence' was coined in 1956 to refer to an emerging research field involving researchers from different areas including brain physiology, computer engineers and formal analysts of propositional logic (Tzafestas, 2016).

AI is defined as the abilities of machines to carry out tasks by displaying intelligent, human-like behaviour; and to behave rationally by perceiving the environment and taking actions to achieve some goals (Russell and Norvig, 2016).

AI has recently gained momentum in many commercial areas, such as retail, media, financial, automotive, and travel. The public sector in developed nations has also started adopting AI technologies for automating various services including education, social policy, and health care (Yang et al., 2012). Since AI in the area of governance is at a very nascent stage, there is some degree of uncertainty attached to its implementation (Sun and Medaglia, 2017). On one hand, AI applications in governance are considered to increase efficiency and effectiveness in service delivery (Eggers et al., 2017). On the other hand, the implementation of AI is accompanied by issues and challenges related to security, privacy, and unemployment (Wirtz et al., 2018).

Boyd and Wilson (2017) pointed out that assuring safe and secure performance of AI is one of the important risk factors which should be considered while executing AI driven solutions. Bostrom and Yudkowsky (2014) highlighted the necessity of safeguarding AI solutions against adverse manipulation by humans. Thierer et al. (2017) emphasized that data is the fundamental driver of AI systems. Therefore, low quality data is an area of concern for organizations (EY, 2018). Similarly, the collection, integration, and storage, of unbiased and trusted data are necessary for implementing AI within the public sector, as poor or low quality data may lead to failures (Mehr, 2017). Financial feasibility is another aspect which is of primary concern for organizations while initiating AI based solutions (EY, 2018). There are two main cost drivers that make AI implementation financially challenging: one is the costs associated with huge technological infrastructures required for collect and store data and the other is the costs associated with the high salaries of experts required for developing AI solutions (Roberts, 2017). Few researchers opine that lack of AI experts who can support and develop AI solutions, represent a big challenge for implementing AI (Holdren and Smith, 2016). Holdren and Smith (2016) argue that governments need to place special emphasis on developing skilled workforce in order to produce a competent knowledge base for implementing AI driven solutions. Pertaining to the challenges associated with AI law and regulations, Bostrom and Yudkowsky (2014) opine that responsible and beneficial governance of AI is one of the long-term issues of AI, as it is associated with a wide variety of legal issues concerning data, infrastructures and human beings. Wirtz et al. (2018) proposed four major dimensions of AI challenges in public sector, including AI technology implementation, AI law and regulation, AI ethics, and AI society. Sun and Medaglia (2017) summarized the challenges of AI in healthcare services in seven dimensions, namely social challenges; economic challenges; ethical challenges; legal and policy related challenges; organizational challenges; data challenges; and technological challenges.

The existing studies on the challenges of AI in governance or public sector are qualitative studies which are either based on the literature reviews or interviews of different stakeholders. Moreover, the studies consider AI challenges individually focusing on specific areas such as health care (Sun and Medaglia, 2017). Also, the existing studies present all the challenges at the same level; they don't prioritize the severity of these challenges.

In order to address this gap, the present study empirically examines the relative importance of various challenges associated with the implementation of AI in governance, within the context of India. The study proposes a model of three main dimensions of challenges which are sub-divided into eight sub-dimensions as discussed in the next section. The study also finds the relative importance of these challenges by employing the analytic hierarchy process (AHP) approach.

III. CONCEPTUAL FRAMEWORK

Based on the extant literature, the present study has identified three main challenges that may act as barriers in the implementation of AI in governance, namely data challenges, organizational challenges and ethical challenges. These dimensions of challenges are further divided into sub-dimensions as indicated in fig.1. All the dimensions along with their sub dimensions are discussed below:
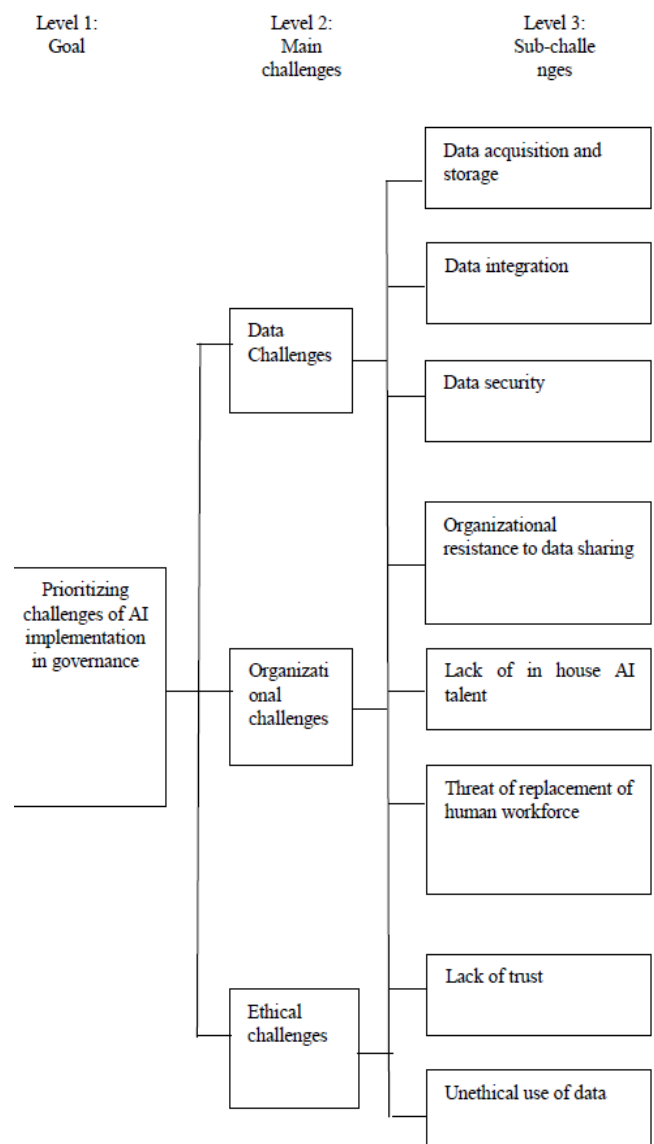
Fig. 1: The AHP Hierarchy

A. Data challenges

'Data' is the key driver behind any AI based solution. Acquiring right kind of base data as well as having a system to dynamically update the data is a critical requirement for the success of AI projects (Mehr, 2017). In addition, integration of the data is a challenge in the way of implementing AI technology, as the information is usually available in multiple data formats such as text, image, audio, and video. Similarly data protection to ensure its security and privacy is also required. Therefore challenges related to data influence the implementation of AI. The following three data challenges are considered in the present study:

Data acquisition and storage

The machine learning algorithms in AI need a large amount of data for deep learning or training. Acquiring these large data sets is a big challenge for implementing AI in governance (Vincent, 2016). Moreover, the absence of data standards regarding the formats in which the data needs to be collected and stored creates further issues in designing AI based solutions. Since AI for governance is in the pre-inception stage in India, government and AI developers don't know what data will be required and in which format it will be stored. Therefore the problems pertaining to data acquisition and storage impose big challenges for implementing AI in governance.

Data integration

Data integration refers to taking data from different sources and combining it to make it usable. The problems in data integration arise because the sources, from which the data is taken, are independent of each other which have been designed for specific applications (EY, 2018). These sources store data in their own formats (Mehr, 2017). Therefore combining various structured and unstructured data taken from independent sources and formats is a major concern in the way of implementing AI enabled governance.

Data security

The AI enabled services involve security concerns also, as the data is subjected to cyber security threats. The cyber hackers can misuse the mass-collected data and raise concerns for digital security, political security and physical security. Moreover, the guidelines regarding the security and privacy of data are still unclear, especially in India (Niti Ayog, 2018). The existing legal standards require significant reevaluations to accommodate AI enabled technologies (Davis and Osaba, 2016). Therefore, data security is another challenge in implementing AI in the governance sector.

B. Organizational challenges

Though AI solutions for governance will be developed by external agencies, but the solutions will be executed by the government organizations only. Therefore, tremendous support from within the government organizations and their employees will be required for successful diffusion of AI driven services. If the government departments and public sector organizations will not cooperate with each other, then implementing AI will be difficult. The following organizational and managerial challenges are considered for the present study.

Organizational resistance to data sharing

Collecting data from different departments, citizens and organizations, who may not be willing to share the same, is a huge task for implementing AI based solutions. Currently data required for implementing AI enabled governance, are owned by different stakeholders viz. citizens, agencies, government departments and organizations. Sharing the data with some other organization not only involves security/ privacy concerns but it also raises a dilemma regarding the ownership of the data (Sun and Medaglia, 2017). Hence different stakeholders may resist from sharing their data with others which may act as barrier in smooth implementation of AI driven services.

Lack of in house AI talent

Presently, there is an AI skills gap, which can greatly impact the implementation of AI driven governance. Even though the government uses readymade AI solutions, there will be a requirement of sufficiently trained and skilled workforce to deploy those solutions. AI adoption in governance needs employees who have interdisciplinary knowledge of technological aspects as well as governance. The existing employees in government sectors are not trained enough to manage the AI based services. Training the existing employees or attracting new workforce specialized in AI technologies, will put strain on existing budgets. Hence lack of required talent is one of the main challenges for adopting AI in governance (Sun and Medaglia, 2017).

Threat of replacement of human workforce

Another challenge for adopting AI in governance is posed by AI's threat to replace the existing workforce (Boyd & Wilson, 2017). There is a common fear that AI will displace human workers and lead to unemployment (Mehr, 2017; Thierer et al., 2017). Employees fear that they might lose their jobs as AI enabled machines will take their places. Because of such fears, employees may form negative attitudes towards AI which may restrain them from adopting AI based solutions.

C. Ethical challenges

Most of the AI applications are based on machine learning techniques which are susceptible to bias as they are based on computer systems which are programmed / trained to learn on their own. If the data is flawed or the computer programme that guides the machine learning is not properly configured, then the results could go remarkably wrong which could lead to unethical implications (Drew et al., 2018). For the present study, the following ethical challenges are considered:

Lack of trust

One of the ethical challenges is concerned with trust on AI assisted governance (Fast & Horvitz, 2017). The citizens in India are used to interacting with government officials or employees for availing various services. This personal interaction provides a sense of human connect which in turn generates trust in citizens for the government. On the other hand, in AI enabled services, the citizens will interact with robots or digital assistants. It will be difficult for citizens to trust the decisions taken by such artificial agents because of the biasness underlying the machine learning algorithms which are used to design them (Osoba and Welser, 2017). Hence, lack of trust will act as a barrier in implementing AI enabled governance.

Unethical use of data

The implementation of AI required a lot of data from citizens, other government departments and organizations.

This data needs to be shared amongst different government agencies. Hence there are chances that the data is subjected to unethical use, which is an area of concern (Bostrom et al., 2016). Citizens may fear that their personal data may be used unethically for commercial purposes. Hence unethical use of shared data is a challenge while implementing AI enabled governance.

IV. RESEARCH METHOD

The present study employs AHP methodology for prioritizing various dimensions and sub-dimensions of challenges related to AI adoption in governance. AHP is an MCDM technique which is applied for selecting alternatives or taking decisions on the basis of multiple criteria. Though AHP was designed for taking complex decisions, but it has been used by many researchers for prioritizing factors in various contexts, including service quality factors (Green and Ramroop, 2014), factors for organizational readiness in executing knowledge management (Sadeghi et al., 2013), factors influencing adoption of e-government (Gupta et al., 2017), and influencing factors of whistle-blowing intention of teachers (Gupta and Chaudhary, 2017).

The AHP technique involves breaking down the decision problem into a hierarchy consisting of at least three levels: goal, criteria, and alternatives (Saaty, 1980). For the present study, the decision problem under consideration is to prioritize the challenges related to implementation of AI in governance. As depicted in fig. 1, the AHP hierarchy of the present problem consists of three levels. The first level represents the goal which is "to prioritize the challenges of AI implementation in governance"; the second level represents the main challenges (or criteria); and the third level represents the sub-challenges (or sub-criteria) categorized under the main challenges. The hierarchy doesn't have any alternatives as the present problem is confined to prioritization of challenges only.

After presenting the problem in the form of AHP hierarchy, data pertaining to pair-wise comparisons of various factors and sub-factors are required for calculating the priorities (or weights) of the factors (Saaty, 1980). For the present study, data were collected from 170 government officials working with different government organizations within the National Capital Region (NCR) of Delhi, India. The convenience sampling technique was used to select the respondents. All the respondents had at least 10 years of work-experience with governance sector. A structured questionnaire consisting of questions on pair-wise comparisons of challenges was used to collect the data (see annexure A). The comparisons were captured using Saaty's nine point scale of relative importance (see table I).

After collecting the data, the weights of all the dimensions and sub-dimensions of related challenges of AI implementation in governance, were determined. The procedure for calculating the weights is described in the subsequent section.

V. DATA ANALYSIS AND FINDINGS

On the basis of the collected data on pair-wise comparisons, reciprocative comparison matrices were obtained for each of the 70 respondents. The matrices of individual respondents were then aggregated by taking geometric means (Forman and Peniwati 1998; Saaty, 1980). Four comparison matrices were obtained after aggregation: one for comparing the main dimensions of challenges with each other; one for comparing the sub-dimensions of "data challenges"; one for comparing the sub-dimensions of "organizational challenges"; and one for comparing the sub-dimensions of "ethical challenges".

Next, the comparison matrices were normalized by dividing each element in a matrix by respective column sum. The relative weights or priorities were then calculated by averaging the elements of rows in normalized matrices (Saaty, 1980). In order to ensure the acceptability of the weights, the consistencies of all the comparison matrices were checked by using the consistency ratio (CR) (Saaty, 1980). The detailed method of calculating CR is described in the annexure B.

Tables II-V depict the comparison matrices, along with the weights and CR values. As the CR values for all the matrices are less than 0.10, the comparison matrices are consistent and hence, the weights obtained are acceptable (Saaty, 1980).

Table II indicates that data challenges (weight=0.61) followed by ethical challenges (weight=0.27) are more important than organizational challenges (weight=0.12) for implementing AI in governance.

Table III indicates that within data challenges, data security (weight=0.44) and data acquisition and storage (weight=0.39) are more important than data integration (weight=0.17).

Table IV indicates that within organizational challenges, organizational resistance to data sharing (weight=0.74) is the most important challenge whereas lack of in house AI talent (weight=0.20) and threat of replacement of human workforce (weight=0.07) are less important challenges in implementing AI for governance.

Table V indicates that within ethical challenges, unethical use of data (weight=0.61) is more important than lack of trust (weight=0.39).

Table I: Scale of Relative Importance

Intensity of Importance	Definition
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Extremely Strong Importance
2,4,6,8	Intermediate Values (For compromise between the above values)

Table II: Weight analysis for main challenges

	Data challenges	Organizational challenges	Ethical challenges	Weights	Consistency ratio
Data challenges	1.00	4.00	3.00	0.61	
Organizational challenges	0.25	1.00	0.33	0.12	CR= 0.06<.10
Ethical challenges	0.33	3.00	1.00	0.27	

Table III: Weight analysis for sub-challenges of "Data challenges"

	Data acquisition and storage	Data integration	Data security	Weights	Consistency ratio
Data acquisition and storage	1.00	2.00	1.00	0.39	
Data integration	0.50	1.00	0.33	0.17	CR= 0.02<.10
Data security	1.00	3.00	1.00	0.44	

Table IV: Weight analysis for sub- challenges of "Organizational challenges"

	Organizational resistance to data sharing	Lack of in house AI talent	Threat of replacement of human workforce	Weights	Consistency ratio
Organizational resistance to data sharing	1.00	5.00	9.00	0.74	
Lack of in house AI talent	0.20	1.00	4.00	0.20	CR= 0.06<.10
Threat of replacement of human workforce	0.11	0.25	1.00	0.07	

Table V: Weight analysis for sub- challenges of "Ethical challenges"

	Lack of trust	Unethical use of data	Weights	Consistency ratio
Lack of trust	1.00	0.63	0.39	
Unethical use of data	1.59	1.00	0.61	CR= 0.00<.10

Apart from the local weights within the main dimensions and sub-dimensions of challenges, the global weights of the challenges were also calculated, as indicated in table 6. Considering the global weights of sub-dimensions of the main challenges, it is found that issues related to data security (global weight=0.27, overall rank=1) and data acquisition and storage (global weight=0.24, overall rank=2) are most important challenges for implementing AI in governance sector. This implies that collection of relevant and trusted data and protecting it from security threats is required for successfully implementing AI enabled governance. Since AI systems are vulnerable to cyber attacks, data security can represent a major challenge for implementing AI in governance. Apart from data challenges, ethical considerations such as unethical use of data (global weight=0.17, overall rank =3) and lack of trust (global weight=0.11, overall rank=4) are also considered to be important by the government officials. This indicates that assuring the stakeholders for privacy and confidentiality of their data and making them believe that their data will not be mis-utilized, will be a challenge while implementing AI in

governance sector. Similarly, generating trust in citizens for AI enabled governance will be an important issue to be handled. The lower ranks of aspects related to organizational challenges indicate that though these issues will be encountered while implementing AI in governance, but they can be tackled internally within the organizations and hence are of less priority than other challenges related to data and ethics which are external and less controllable.

Table 6: Local and global weights

Main challenges	Weights	Sub-challenges	Local weights	Global weights	Overall rank
Data challenges	0.61	Data acquisition and storage	0.39	0.24	2.00
		Data integration	0.17	0.10	5.00
		Data security	0.44	0.27	1.00
Organizational challenges	0.12	Organizational resistance to data sharing	0.74	0.09	6.00
		Lack of in house AI talent	0.20	0.02	7.00
		Threat of replacement of human workforce	0.07	0.01	8.00
Ethical challenges	0.27	Lack of trust	0.39	0.11	4.00
		Unethical use of data	0.61	0.17	3.00

VI. CONCLUSION

The aim of the present study was to find the relative importance of related challenges of implementing AI in governance within the context of India. Eight sub-challenges categorized under three main challenges were considered for prioritization. The AHP methodology was employed to prioritize the challenges, on the basis of primary data obtained from 170 government officials. The results indicate that concerns related to security, acquisition and storage of data are the major challenges in implementing AI assisted governance. Additionally, ethical considerations related to unethical use of data and lack of trust are other challenges which may act as barriers in diffusing AI in governance.

The study provides few practical implications for government leaders and policy makers. Firstly, the government leaders need to implement appropriate cyber security precautions to ensure data security. Secondly, legislation and policymaking need to be changed as per the requirements of AI for handling cybercrimes and unethical usage. Thirdly, AI developers must develop security mechanisms to ensure that AI systems don't learn negative or unethical behaviour from the environment or misunderstand the surroundings.

The present study was based on the perceptions of government officials. Future studies may consider the perceptions of general citizens on the expectations and challenges of AI enabled governance. The present study has considered only three major dimensions of challenges. Future studies may focus on other challenges also such as financial feasibility and social acceptance of AI in governance.

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