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Dissertation

On

***Technology Adoption and Governance of
Artificial Intelligence in India***

Under the supervision of

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CERTIFICATE

I have the pleasure to certify that *Naresh Chhabra* has pursued his research work and prepared the present dissertation titled as, *Technology Adoption and Governance of Artificial Intelligence in India*, under my guidance and supervision. The dissertation is result of his own Research and to the best of my knowledge no part of it has earlier comprised in other monograph, dissertation or book.

This is being submitted to the Panjab University Chandigarh for the degree of Master of philosophy in Social Sciences in partial fulfilment of the requirement of the Advanced Professional Programme in Public Administration of Indian Institute of Public Administration New Delhi. I hereby recommend that the dissertation of Naresh Chhabra is worthy of consideration for the award of M Phil degree of Panjab University Chandigarh.

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ABSTRACT

Artificial intelligence (AI) is all geared up to disrupt our society and the industry. AI trend of technological singularity is continuously accelerating and is being employed to the different facets of humanity from education, medicine, business, engineering, arts and the like. Government and private companies have been hooked up with this fast pacing technology. AI may displace some non-digital jobs that performs heavy load and repetitive tasks, but it certainly augments labour shortage by realigning the workforce competitiveness to what the technology requires. The diffusion of AI technology is necessary for mental shift of the government and industry leaders to adopt the technology. Research and development is very promising to uplift mankind to faster productivity and positively affect the industries in Indian context and also international perspective. India is working to adopt AI systems. However, it is yet to be analysed as to how much of it has been adopted in our country and what is seen as a boon to the society should not turn out to be a bane and therefore what is the governance of AI in India?

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Abbreviations

Acronym	Expanded Form
AI	Artificial Intelligence
APA	American Psychological Association
IQ	Intelligence Quotient
NI	Natural Intelligence
ANN	Artificial Neural Networks
FORTTRAN	Formula Translation
LISP	List Processing
NLP	Natural Language Processing
ALPAC	Automatic Language Processing Advisory Committee
WWW	World Wide Web
IE	Internet Explorer
OS	Operating System
GB	GigaByte
AGI	Artificial General Intelligence
USA	United States of America
IoT	Internet of Things
MeitY	Ministry of Electronics and Information Technology
FICCI	Federation Indian Chambers of Commerce Industry
NASSCOM	National Association of Software and Service Companies
DRDO	Defence Research and Development Organisation
CAIR	Centre for Artificial Intelligence and Robotics
IIIT-H	International Institute of Information Technology, Hyderabad
PHFI	Public Health Foundation of India
INAI	Intel AI
IUSSTF	Indo-US Science and Technology Forum
NRF	National Research Fund
NEP	National Education Policy
NCERT	National Council of Educational Research and Training
MoD	Ministry of Defence
UTAUT	Unified Theory of Acceptance and use of Technology
ML	Machine Learning
NITI Aayog	National Institution of Transforming India

TOE Barriers	Technological, Organisational and Environmental Barriers
PTAT Framework	Participation, Transparency, Accountability and Trust framework
UTAUT	Unified Theory of Acceptance and Use of Technology
ITE	Institute of Technical Education
EVA	Exercise Virtual Assistant
WEF	World Economic Forum
NIST	National Institute of Standards and Technology
RMF	Risk Management Framework
OMB	Office of Management and Budget
GPAI	Global Partnership on AI
SNDGO	Smart Nation and Digital Government Office
FTC	Federal Trade Commission
GDPR	General Data Protection Regulation
PDP	Personal Data Protection

CHAPTER 1

INTRODUCTION

By far the greatest danger of Artificial Intelligence is that people conclude too early that they understand it.

Eliezer Yudkowsky

1.1 Overview of Artificial Intelligence (AI)

i) In 2017, Warren Buffet, a leading name amongst the most successful stock market investors in the world was asked a question as to what would be the potential impact of AI? To which Buffet answered “AI is here to disrupt” [38]. Warren Buffet is an expert in investments and not in AI, so should his statement that AI is here to disrupt bother fellow human beings and in reply it can be said that AI is indeed here to disrupt, the very way with which we live our lives. Siri, Alexa, driverless cars, deep learning, automated trading, suggested typing etc have all become part of us, not to talk of AI tools freely made available by Yahoo, Twitter, Amazon and Google. Thus, AI is already here and will make disruptive changes in our society and it is up to us as human beings to ponder as to what needs to be done. Further, it is for the policy makers to think of the futuristic policies to prepare for an AI dominated future.

ii) The history of the human race brings to fore that the civilization which adapted to changes faster were the ones which survived and thrived. Similarly, we as a society should look at the disruptive ability of the Artificial Intelligence and make preparations to adapt to the world full of AI related technologies. If we don't do so, we will be ignoring the current technology and its advantages at our own peril. It is therefore imperative that we as human beings must understand – what is AI and what is not; what can AI do and how will it affect the humans and the society as a whole. What does humans need to learn for an AI dominated world where AI will play a major role in the lives of all human beings? The foremost effect could be its impact on the jobs which is talk of the town. The hot topic is being debated for its effect on the white and blue

collared jobs. It is said that the blue collared jobs which are monotonous and repetitive will be replaced by the AI driven systems definitely and there is a probability that even the thinking, decision making jobs may also be done by AI systems but this will be corroborated in the next few years with new AI research and developments.

iii) There is no denying the fact that the world is presently on the cusp of an industrial revolution with several emerging technologies like Artificial intelligence (AI) and Quantum Computing, 5G, which will finally alter the way we communicate, live, travel, work etc. Technological developments in Computer vision systems have made these systems accurate and effective in computing meta data thereby surpassing performance of human. Similarly, speech recognition systems have an accuracy better than human abilities and are able to decipher languages from phone calls and voice records. Several experts indicate that AI solutions have the potential to transform the present order including as diverse and critical as healthcare, connectivity, education, finance, and energy. As AI continues to progress, one of the challenges India faces is to harness the potential the technology has and utilise it for economic growth/development of the country.

iv) AI and automation has the requirement of huge capital and that is where this dimension of AI is linked to the economics and its success therefore. The capital is becoming the only factor for production which matters instead of it being labor or the productivity. This point raises apprehension that capital intensive AI systems will bring in more inequality and there could be a huge social shift which has not been same in the last decade or so or maybe centuries. All this has got serious implications for the human society and the complete world economy.

v) Factors such as mistrust in AI, probable impact on employment, productivity and capital (finance) are playing a vital role in deciding the adoption of AI as

technology at the same time there is a school of thought which believes that AI is just a fad and therefore following questions arise:-

- (i) Is AI just like any other technologies which swept the world in the past or is it really different?
 - (ii) Is AI just the latest buzzword or is there a possibility that AI will be able to deliver sufficient public goods?
 - (iii) How AI will affect the economy the society and the humans at the individual level?
 - (iv) Is AI a threat to human beings or is AI a supportive emerging technology which will play a huge role in our life in future?
 - (v) If it is supportive in nature as was the case with nuclear energy and genetics, does AI need the rule book of ethics code?
 - (vi) Should AI be regulated at the national level or there is a need of global policy to deal with AI? Or, it is better to left for ‘Self-Regulation’?
 - (vii) Why and when should policy makers start making policies on AI technologies?
 - (viii) Is there a point in time when it will become too late to take regulatory measures for AI?
- vi) There are a lot of speculation, questions about the future of AI and there are many prophecies about the future of AI full of fantasy and uncertainty. A glance at the history of artificial intelligence tells us that there has been the waxing and waning of interest and efforts to bring AI to the fore has been there but it did not succeed. The next chapter deals all about AI, its history, its evolution and also the latest developments in brief.

1.2 Machine Intelligence vs Human Intelligence

(i) Intelligence as defined by Merriam-Webster is the ability to learn or comprehend things or to deal with new or difficult situations whereas American Psychological Association (APA) defines intelligence as intellectual functioning [39]. There are various tests to measure intelligence. One such example is Intelligence Quotient (IQ) tests which compares the performance with other people your age but this test does not measure all kinds of intelligence. It can be further said that these tests fail to identify differences in terms of social intelligences or generational differences. IQ tests results can show improvement with better nutrition, more education and other factors. Presently the talk is about the human intelligence which has origin in biology and is used interchangeably as 'Natural Intelligence' (NI). Animal and human brains function as per natural intelligence but there is more to natural intelligence than neuroscience. For instance, plants and protozoa demonstrates non-neural control; ants, hyenas and even humans demonstrate distributed intelligence. The behavior evolves not only with the bodies function but also with the changing environment. It is therefore must to understand the influence of behavior, environment etc to understand the natural intelligence [40].

(ii) The opposite of Natural Intelligence is Artificial Intelligence. Artificial Intelligence in a layman terms is the intelligence which is created by humans in machines using technology. Owing to their origin, it is obvious that there are going to be differences between AI and NI. The differences are mainly in terms of speed, objectivity, ways to handle complexity and evolution. AI appears to have more speed and also less down time. NI on the other hand is more objective and has inherent biases in their decision making. NI is capable of handling more complex and difficult tasks as compared to AI. Also there is a concept of multitasking which is applicable more to NI

than AI. When it comes to mobility, NI is much superior to AI and therefore can undertake task with a high degree of maneuverability. However, AI is more adaptable because NI pace of evolution is very slow and it may take thousands of years to make the changes as required by the environment. Last but not the least, AI is more costly than NI. This is changing very fast because the cost of creating the infrastructure to have AI is reducing very fast.

(iii) At this juncture, it is important to understand that AI is not a mere computational device or a machines which works on algorithms. The idea behind AI is that of a machine which is human like, a machine which can SENSE, COMREHEND and then ACT. It can handle ambiguous situations as well as humans can and is also able to handle the ‘grey’ areas. In more technical terms, ‘Sense’ is to perceive or read the external signals; ‘Comprehend’ is to hypothesize a relationship between the various signals and ‘Act’ is to respond to a set of new signals using the past experience or knowledge. This is something similar to how a child learns and develop so called intelligence. This learning can be of two types: Supervised and Unsupervised Learning. Inspired by these types of learning, humans made the machines also to learn in almost the same way. In machines this phenomenon of learning is simulated by the software which create artificial neural networks (ANN) that function similar to neurons in the human brain. In the last few years there has been growth in the field of ANNs and has resulted in multi-layered ANNs which has led to the development of ‘Deep Learning’. AlphaGo and AlphaGoZero are some of the examples of this journey.

(iv) All this started in 1950 with Alan Turing devising a test- the Imitation Game- through which an interrogator could determine whether the responder was a human or a machine. This was a part of the paper Turing wrote for the journal Mind. The paper starts with the words, “I propose to consider the question, ‘Can machines think?’”[5].

Though Turing's paper had no role to play in the development of AI but it did indeed generated the idea of thinking machines which no one could dismiss. Six years later, in 1956, John McCarthy conceived an idea for the workshop which is popularly known as Dartmouth workshop. It is at this workshop the term Artificial Intelligence was coined and the problems in AI were defined by the like-minded thinkers. 1960s saw the development of FORTRAN [41] and LISP [42] which enacted as the workhorse of AI research. Natural Language Processing (NLP) saw a lot of activity but 1966 Automatic Language Processing Advisory Committee (ALPAC) committee report was very sceptical or research done in machine translation and suggested for basic research in computational linguistics [43]. This brought research in NLP to a halt, funding was dried up and this was the beginning of first AI winter.

(v) 1970s and 80s saw a massive increase in the computing power of the machines. Machines became less complicated, cheap and were easy to maintain and operate. This led to progress in computer programs and development of new and better computer algorithms. However, the AI remained confined to research laboratories. AI came to the field in late 80s. Ernst Dickmanns along with his team developed a car in 1986 that could navigate through French traffic on its own [44]. In 1996, Deep Blue of IBM by being the first computer program to beat a reigning world champion in chess, Gary Kasparov. While this was unbelievable even to Kasparov himself but those who were watching from outside, it was a bygone conclusion that AI has reached a stage where a machine can outperform human [45].

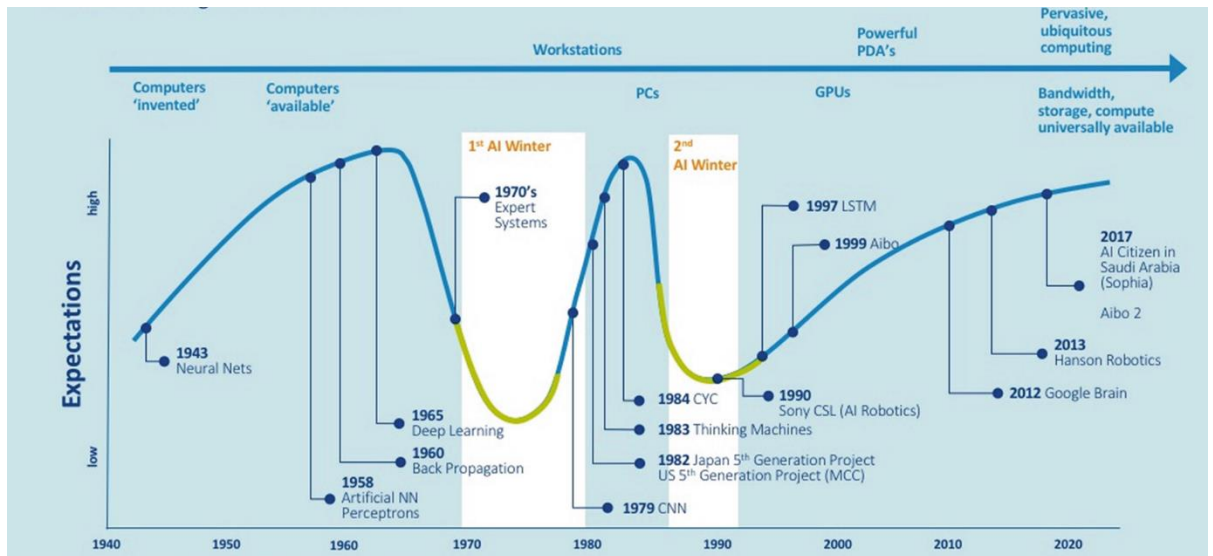


Fig 1: Growth of AI

(Source: John Huffman, Koninklijke Philips N.V., 2004-2018)

(vi) The World Wide Web (WWW) [46] also saw the growth during this time and this helped faster dissemination of information to all. The first web browser Mosaic developed in USA made World Wide Web more acceptable. WWW was used by millions of active users by mid 90s however, Microsoft in 1995 developed its own web browser Internet Explorer (IE) which was an add-on to the Windows 95 Operating System (OS). And later on it was bundled. Then came Mozilla's Firefox, released in 2004 and in 2008 Google launched Chrome. In 2015, Microsoft replaced IE with Edge. With smart phones becoming akin to a computer, led to enhanced usage of web.

(vii) The advent and thereafter quick spread of the internet convinced the computer scientist and the researchers that the computing and applications can be done in a distributed manner. In addition, advances in the field of big data, cloud computing and neural nets made the AI what it is today. The advent of cloud computing significantly decreased the need to own an expensive infrastructure to do AI research. Further, the world's capacity to store information has increased drastically and the cost of storing data has come down tremendously. As on date, Google and other companies allow free

storage up to 15GB data. Convergence of these three factors: quantum change in processing power, cost reduction of data storage and availability of huge amount of data increased the pace of AI development that we are witnessing in the present millennium.

(viii) Out of four characteristics of AI, three have been discussed as the first one being complex algorithms, the second is the ability of the algorithms to make use of Big Data and the third one is the computing capability that can use these algorithms and process this data. The fourth aspect is to define the problem and then solve using the right mix of algorithms, assessing and processing data and that how to solve the problem. Why defining the problem is most vital because current forms of AI are weak [47] or specific to a defined purpose. At this stage, AI machine can do a specific thing because it is designed to tackle a specific problem by using a method which is most appropriate. For instance, NLP or Facial Recognition technologies can be used in sentiment analysis, security applications etc.

(ix) While AI can be categorised as Narrow, Strong and Artificial General Intelligence (AGI) but any machine which is capable of displaying or is equipped with at least one human like ability can be called as artificially intelligent. In general, a machine or an algorithm or a robot that can think and take independent decisions without human guidance is said to have AI. However, the specific or narrow AI can be language based, mathematical ability based, Emotional Intelligence based and Self-Improvement/learning based. In other words, the humans are trying to let the machines mimic natural intelligence. Thus, AI can be defined as the science which is focussing on the development of functions similar to human intelligence namely cognition, reasoning, speech recognition, language skills, problem solving and the ability to respond to the emergency situations. Thus, this science which multidisciplinary in

nature calls for various departments such as computer science, biology, psychology, linguistics, mathematics and engineering have to work together and this is what makes AI unique and differentiates from other technologies.

1.3 AI Adoption: Some Interesting Initiatives

(i) USA has been the cradle of early AI development and continues to be the world leader however China in the last decade has demonstrated continuity in its policy to be leading light in AI. While the growth of AI sector is mainly propelled by the governments objective of dominating AI, there is no denying that companies like Google, Facebook(Meta), Baidu, Alibaba etc have played a significant role.

(ii) Investments are being infused by governments world over and they are also finding out the ways to encourage use of AI. For instance, the USA has pledged to spend around \$6 billion in the field of AI in 2021. “We have to make smart investments in technologies and innovations — including in ... unmanned systems and artificial intelligence — that will be necessary to meet the threats of the future,” said US President Joe Biden during the 2020 presidential campaign [18].

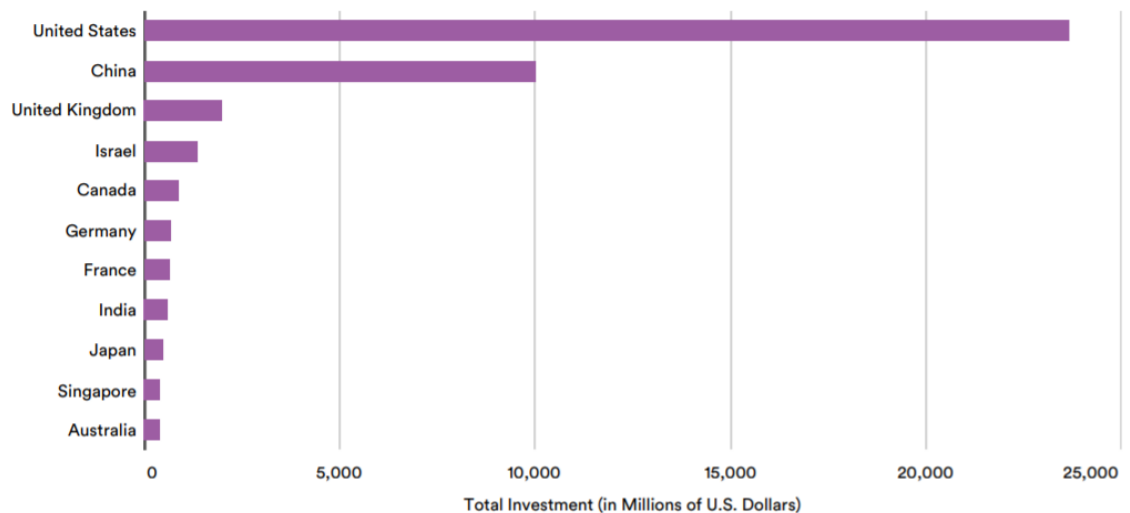


Fig 2: Private Investment in AI by Country, 2020
(Source: CapIQ, Crunchbase, and NetBase Quid, 2020| Chart: 2021 AI Index Report)

(iii) It is evident from Figure 2 that US is in dominant position as far as private AI investment is concerned, at the same time China also saw an exceptionally high amount of private investment but the investment level is less than half that of USA.

(iv) As per Union Budget 2020, the finance package for Digital India was increased to USD 477 million by Indian government in order to give boost to disruptive technologies such as AI, IoT, Big Data, Cybersecurity, ML and Robotics etc. The sole aim to enhance this outlay was to promote e-governance. This gets ratified by the statement of Finance Minister Nirmala Sitharaman in her Union budget of 2019 about offering industry-relevant skill training for 10 million youth in India in technologies like AI, Big Data and robotics [48].

(v) Face recognition and hotspot analysis, biometric identification, criminal investigation, traffic and crowd management, wearables to empower women safety, optimising revenues in the forest, cleaning river, tiger protection, digital agriculture, student progress monitoring, and more are among the use cases of AI in the Indian government, according to a report by AIMResearch titled "How The Indian Government Is Championing The AI Revolution". [49] The research outlines 21 application examples in seven different areas where AI has been actively deployed by the government, including law enforcement, public sector, environment, agriculture, education, energy, and healthcare. According to the report, artificial intelligence (AI) and machine learning will become the most important determinants of growth across the country's main sectors. Improving agriculture and education, eradicating poverty, and enhancing the environment are just a few of the goals.

(vi) In addition, policy initiatives by Niti Aayog and the Ministry of Electronics and Information Technology (MeitY), as well as AI-related programmes by industry associations such as FICCI, NASSCOM, and the Defence Research and Development

Organization (DRDO), have paved the way for future disruption and created a roadmap for AI in India. The DRDO operates a Centre for Artificial Intelligence and Robotics (CAIR) for AI, robotics, command and control, networking, and information and communication security research and development.

(vii) IndiaAI, a dedicated artificial intelligence (AI) portal built jointly by MeitY and NASSCOM, was launched by the Indian government in June 2020 as a central hub for “ all AI initiatives “ . The portal serves as a one-stop shop for all AI-related initiatives and developments in India. Responsible AI for Youth is a national programme [50] for **government schools that aims to empower young people to become AI-ready and close India's talent gap**. The platform, which was created by MeitY's National e-Governance Division, intends to assist students in developing a new-age tech attitude and skill sets.

(viii) In October 2020, the Telangana government partnered with Intel India, the International Institute of Information Technology, Hyderabad (IIIT-H), and the Public Health Foundation of India (PHFI) to launch INAI (Intel AI), an applied AI research centre in Hyderabad [34]. The center's primary goal is to address issues in India's healthcare and smart mobility sectors.

(ix) The Indo-US Science and Technology Forum (IUSSTF) inaugurated the US-India Artificial Intelligence Initiative [51] on March 18, 2021, to stimulate AI innovation by sharing ideas and experiences, discovering new research and development possibilities, and bilateral collaboration.

(x) The National Research Foundation (NRF) has been established as an autonomous body under the new National Education Policy (NEP) 2020 [51] to promote research in all fields, including AI. Prime Minister Narendra Modi said, "Fifty thousand crore rupees have been budgeted for this," when speaking at a webinar on the

proper implementation of Union Budget 2021 provisions on March 3, 2021. This will improve linkages between R&D, academia, and industry, as well as strengthen the governance structure of research-related institutions." In addition, in accordance with the National Education Policy 2020, the National Council of Educational Research and Training (NCERT) has developed a new National Curriculum Framework for School Education. The goal of this project is to introduce a basic AI course to secondary school students.

1.4 Overview of National Policy Framework

(i) Government's world over have a very critical role in not only harnessing the AI technology but also in developing, regulating and also ensuring that society adopts it seamlessly. The disruptive potential of AI technology makes it a part of fourth industrial revolution and it is the responsibility of the government to ensure that AI creates value for society, mitigate the adverse effects(if any), development of skills required and safety of data.

(ii) Countries round the world have started waking up to the reality of AI and have devised national strategies to harness the potential of AI. India is no different. According to 2012 report by Prof Deepak Khemani of IIT Madras [53] , AI research was limited to a handful of passionate researchers with a focus on certain areas such as machine translation, natural language etc. A more recent 2018 study (Itihaasa report [54]) shows that AI research has progressed to areas like unsupervised learning, reinforcement learning, blockchain etc. Funding was found to be adequate however, the bottlenecks were identified as the availability of computing infrastructure and good quality data sets. The Indian government as part of its strategy to harness AI had set up National Super Computing Mission [55] in 2015 with a seven year period for implementation and one of the application of these computers is AI.



Fig 3: National AI Strategies

(Source: 2021-AI-Index-Report_Master.pdf/Chapter 7)

(iii) A task force on AI led by Professor Kamakoti V [56] of IIT Madras was set up in Aug 2017 under the aegis of Ministry of commerce to explore areas where AI can be leveraged for economic transformation. The report was presented in Jan 2018 recommending budgetary support for setting up an inter-ministerial National AI mission and identified areas like manufacturing, fintech, health care, agriculture, retails, national security and environment where AI can be utilized for its advantages. There were two more significant developments in 2018, the first one was setting up of a task force by the Department of Defence Production [57], Ministry of Defence (MoD) under the leadership of N Chandrasekaran, chairman TataSons so as to make India's defence sector a significant power in AI; the second development of 2018 was to task NITI Aayog by the Committee of Secretaries to produce a national strategy plan for AI in consultation with ministries, academia and industry.

(iv) NITI Aayog produced a discussion paper titled ‘National Strategy for Artificial Intelligence: #AIForAll’ in June 2018 with the aim to guide the research and development in AI. [58] During same time, MeitY constituted four committees [59] to create a policy framework and to develop the AI ecosystem however these report are still at the draft stage only and yet to be accepted by the authorities. Since then a lot has been done and an ecosystem appears to be fructifying in India and AI is actually transforming in certain sectors. Therefore NITI Aayog has come out with ‘Approach Document for Responsible AI (Principles and Operationalising Principles) in Feb [60] and Aug 21 [61]. Seven principles from the tenets of the Indian Constitution were identified in the approach document on 'Principles of Responsible AI,' which should be the guiding framework for diverse stakeholders in harnessing AI. However to ensure that AI systems adhere to the principles requires the role of government as a policy maker and also the regulator. At the same time, it is important that entire ecosystem of AI should ensure that a trust score is developed because government interventions alone can't play the justified role. The document recommends a multi-disciplinary advisory body to operationalise the principles of AI. The study also suggests strategies for the commercial sector, research, and academic institutions to improve their capacity to assess risks and take necessary action.

(v) AI technology seems to be impacting every aspect of human life and there is no sector untouched. It is therefore that the governments are rushing to embrace this technology whole heartedly but there remains a number of questions about the regulatory framework that should govern AI. The risks related to privacy, security need to be understood by all the stakeholders before it becomes too late. All these issues related to adoption and governance will be examined in the subsequent chapters in detail.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Journey of AI

(i) The term AI was coined in 1955 and since then there have been many AI winters, however the goal of AI has been to enable machines to perform tasks which are complex and require human intelligence. Initially the research was influenced by logic, fiction, philosophy (Buchanan, 2005), later the focus shifted to AI applications. According to CAICT and Gartner (2018), the development of AI experiences three stages viz infancy (1956-1980), industrialization (1980-2000) and flourishing (2000-2018). Though there is rapid development of AI but actual use cases of AI is still abysmal. According to CAICT and Gartner (2018), only 4% of the firms invest on AI and deploy AI technologies. Most of the organisations are still thinking and making plans for AI.

(ii) Considerable amount of research has focussed on understanding the barriers to technology adoption such as that of Cabanillas et al.(2018); Meske et al. (2018); Sadhya et al.(2018). Findings from the literature review include lack of top management support (Cox and Ghoneim, 1996; Mergel, 2018), lack of knowledge and awareness (Ebu et al., 2015), lack of government regulation (Kruse et al., 2016; Mergel, 2018), lack of skills (Ransbotham et al.,2017) etc. There is currently a need, for further exploration of the main barriers that are important in organization with regard to AI adoption in India. AI is an evolving area of work and manner / degree of implementation of principles of AI must provide an enabling environment for promoting a responsible AI ecosystem in India. Measures may be suitably calibrated according to the specific risk associated with different AI applications in a manner that keeps pace with technology advances (NITI Aayog, 2021). While this is an approach document for development of Responsible AI for All, but the document does not talk of the implementation plan, neither does it talk of the barriers which need to be

overcome to provide an enabling environment. The document says about the measures but is silent to indicate which measures.

(iii) The Part 2 of the NITI Aayog document (2021) talks of the role of government and actions for the private sector and research institutions in development of Responsible AI for All. A risk based mechanism for regulating AI in India has been suggested and the paper proposes setting up of an independent, multi-disciplinary advisory body at the apex level, which may cover the entire digital sector. The paper identifies high-quality research as a priority in aiding the implementation of the AI principles, including through government-formulated guidance on measuring the impact made by AI research initiatives.

2.2 Limitation of Literature

(i) As part of literature review a sectoral scan revealed that there are literature available with respect to AI adoption but the data does not belong to India. For instance, (Bhattacharjee, 2020) the author stated that the adoption of AI is an important issue and explores how stakeholders would be able to adopt it. ‘Unified Theory of Acceptance and Use of Technology’ (UTAUT) model has been used. The authors got it validated through survey with the help of feedbacks from useable 329 respondents but the inputs obtained were from non-adopters of AI and the authors concluded to say that use of AI in India is still in a very nascent stage and the result cannot be generalized.

(ii) Similarly there is no uniform perspective on AI policy. A total of 25 AI focused national policy and strategy documents identified spanning a total of four continents to identify differences in perspectives on AI between countries and geographical regions through a systematic comparison of national policy documents was done and findings restated the fact that there is no uniform policy (van Berkel et al., 2020).

(iii) Artificial Intelligence Adoption – Is it more than just hype? A qualitative study of what factors influence an organization’s decision to adopt AI was undertaken to explore what factors influence organizations when they decide to adopt AI, and provide insights into their rationalization of the decision. Study concluded that only two out of eight factors can be deemed influential in relation to the adoption of AI, Presence of champions and Top management support (Blomberg & Moberg, n.d.). This study was focused on Swedish organisations and suggested that large number of interviews would be beneficial.

(iv) When it comes to ethical framework, there is a study which attempts to first build on the need for introduction of an ethical algorithm in the domain of machine learning and then endeavors to provide a conceptual framework to resolve the ethical dilemmas. The study looks at the role of interplay of ML (the hard sciences) and Ethics (the soft sciences) to resolve irregular predicaments that are inadvertently manifested by machines not constrained or controlled by human expectations. (Malhotra et al., 2018)

(v) Marda in her paper(Marda, 2018) wrote that pace of development in the field of AI is quick, nature of development is opaque and the effect of development is profound and irreversible. She suggested that future deliberations, policy making and regulation of AI may be informed/discussed by multiple disciplines. Annexure III refers.

2.3 Identification of Research Gap

(i) While there are many academic articles related to AI but most of them are based on data from abroad. It is only now that AI has/ is being implemented in various applications in India. This has been made possible because of various technological reasons such as improvement in computer vision, computing power and also there is

ecosystem which is conducive to the growth of AI in India. The above literature and those available otherwise indicate that AI technology has been adopted world over. AI has been there around in the world since 1950s and it also saw its winters. A large amount of work could not be done because there was no computing power, there were no sensors to match to the requirement of human sensors, etc. Whatever little development did take place was in bits and pieces and with the organisations abroad which could invest a huge capital. The governments were not involved and therefore there were nil regulations. As the time has gone by and technology has grown leaps and bound, the AI has become relevant and people/ organisation have realised that repetitive and tedious tasks which eat up the constructive time of humans can be done by machines and therefore there is resurrection of the AI. However, the growth is rapid but the governance and the governments are not changing at the same pace as that of technology and therefore there is a vacuum in the governance of AI. This is very relevant in the Indian scenario where the aspiration is there to be an AI leader and there has been inflow of AI technology but the subject has not been studied in Indian context. It is therefore apt to study as to what the AI technology adoption in India is and the regulations which govern its development and implementation. This has also been suggested by NITI Aayog.

(ii) To sum it up, it can be said that there is a research gap with respect to ‘Technology Adoption and Governance of AI in India’ which can be depicted as shown in the diagram:-

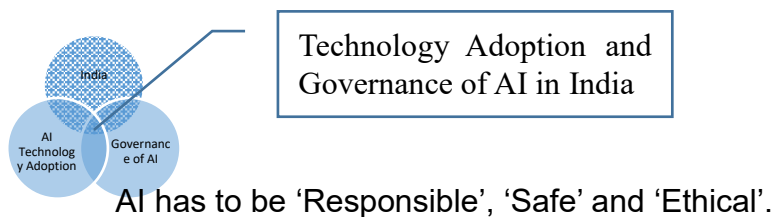


Fig 4. Identification of Research Gap

2.4 Statement of the Problem

AI is transformative in nature and could serve as a valuable tool for inclusive development. However, in India, AI initiatives have been reported in a few sectors such as health, finance, manufacturing and agriculture. Review of literature emphasizes that **AI adoption as a System irrespective of sectors** have a limited scope of implementation in Indian context. **Technology Adoption of AI in India** is impeded due to several factors which can be categorized as Technological, Organizational and Environmental (TOE) Barriers. Technology adoption would be accelerated, if a **national level governance policy** is available to address these factors. Best practices to be obtained from international scan (USA and Singapore). The reason for selecting USA and Singapore for looking the global perspective is because USA ranks first in the adoption of AI. Singapore is also a leader in the adoption AI and also has promulgated AI governing policy.

2.5 Conceptual Framework

The scan of AI ecosystem in India reveals that the major stakeholder for adoption and governance of AI is 'Government (be it Union or State)', the primary stakeholder. Industry also the primary stakeholder at the national and international level also has a major share of interest for their interest in terms operational efficiency in the respective businesses. On the other hand the secondary stakeholders such as Academia, Think Tanks and Industry Association play via medium role to bring issues related to the AI technology and governance to the table for it to get addressed at the appropriate level. Technology in general gets affected with the development in the world and AI technology is no exception. Rather in the case of AI, it has come from Europe and other parts of the world to India and therefore international bodies have a major influence on

its growth, research in the field, its adoption and also governance. While countries have enunciated their AI strategies and also promulgated guidelines for regulation/governance, but one of the common factor in the environment is the Citizen. At this stage, it would be appropriate to consolidate the stakeholders and map them based on the interest they have in the technology and their power to regulate the technology.

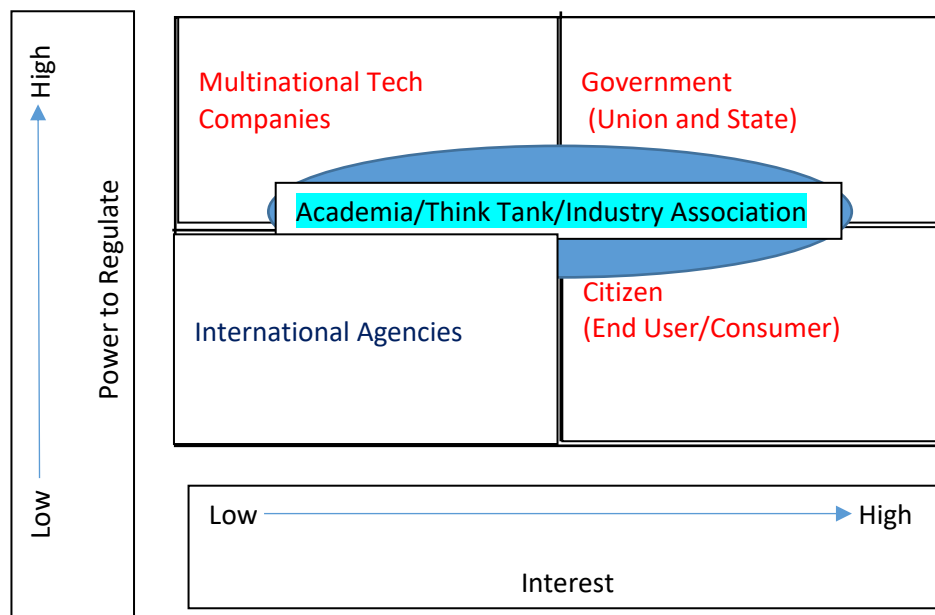


Fig 5 AI Stakeholder Map for Adoption and Governance

Amongst the stakeholders the most primary and important one is the end user or the consumer of the product and therefore the ‘Participation’ of the citizen is the most important factor in the AI technology adoption. The need and the use originates from the citizen and it should be the endeavor of the organization to make the AI ‘Transparent’. Everything which needs to be known by the user or told to the user must be available to the customer without any black transaction. There should be no opacity. The customer should also know as to who is responsible for what and thereby bringing in the ‘Accountability’ in the system. When there is participation of all the stakeholders, transparency in the system and accountability for all deeds, only then the AI will become ‘Trustworthy’ which will make the enhanced adoption of AI. This is what I

call 'PTAT' framework of AI Adoption. What goes hand in hand with all the stages of adoption is the governance. At all instants there is a need of regulations which can regulate and govern the basic principle underlying and bring to notice the shortcomings if any. Governance is required whether at participation stage or to bring in transparency or to make organization and its people accountable and finally the governance is must to develop trust in AI.

Keeping this framework in the background, the study looks at AI adoption in terms of the use cases in various sector. It has been the endeavor to scan all the sectors and narrate the best in the sector. This sector scan gives a birds view of AI adoption in the country. The next parameter is the investment made by the government and other players in the market which indicates the level of adoption. In addition there are other indices such as AI hiring, skill penetration, promulgation of AI strategy and the governance structure which indicate the performance of the country in adopting the AI technology. A lot of the data is available in the open domain through various international agencies and the same have been used. To a very limited extent the data has been collected through the representative sample from India.

Finally the data collected and the data available in the open domain is used to arrive at various findings and observations which are finally used to suggest certain recommendations.

2.6 Research Objectives

The purpose or objectives of the research are as follows:-

- (i) To explore existing AI adoption in India.
- (ii) To identify related factors that impede AI adoption in India.

- (iii) To study the best practices of AI adoption elsewhere (Singapore and USA).
- (iv) To examine the existing governance framework of Artificial Intelligence in Indian and elsewhere (Singapore and USA).
- (v) To suggest policy inputs for optimum adoption of AI in India for march towards Artificial General Intelligence (AGI).

2.7 Rationale or Justification

AI is expected to augment India's economy to \$957 billion by the year 2035 (<http://raise2020.indiaai.gov.in/>). A systematic study, is required to provide greater clarity on adoption of AI, particularly in Indian context. Study of use of AI in various sectors would provide insights relating to the range/scope of use and scalability in the Indian context. A national level framework would serve as a guiding template to assure that AI serves as a tool for inclusive development in the Indian context.

2.8 Scope/Limitations/Delimitations

The research aims to study the adoption and governance of AI systems in India and around the world (limited to USA and Singapore). The current study will not concentrate to a particular sector, instead will study the adoption of **AI systems**. AI systems in any sector will have either direct impact or indirect impact. Effects which are caused because humans are subjected to decisions of a specific AI system are known as Direct Impact. These are studied under **Systems considerations and get manifested owing to system design choices, development and adoption methods** whereas the indirect impact of AI are studied under **Societal Considerations**. (NitiAayog, 2021) It

is pertinent to mention that few initiatives would be studied and presented as case studies.

2.9 Research Questions

The research questions are as follows:-

- (i) What is the adoption of Artificial Intelligence in different sectors with special reference to India?
- (ii) What are the best practices of AI adoption in other countries?
- (iii) Which of these global best practices of AI could be leveraged in Indian context?
- (iv) What are the various national AI policy documents across other countries (Singapore and USA)?
- (v) What are the existing national guidelines/ regulatory AI framework in India?
- (vi) What are the possible recommendations for designing national policy framework for leveraging the benefits of AI in responsible, ethical, safe manner?

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Strategy and Research Design

The research strategy is Quantitative ('Survey'). It is a deductive research approach and is used to answer 'what', 'who', 'how much' questions. Survey strategy will use questionnaire for collection of standardised data from a sizeable population. The research is therefore exploratory and descriptive in nature. Structured / semi-structured observation and interviews (Mark Saunders, 2016) will also be used subject to the pandemic situation.

3.2 Data and Data Collection Method

Owing to research methods used being both **qualitative** and **quantitative**, both Primary and Secondary data has been collected. **Secondary data** is collected from the literature review of articles in refereed academic journals and policy documents, reports released by NITI Aayog, MeitY etc. This facilitated to understand how much AI has been adopted in India and also what is the existing policy framework for the governance of AI in India. A lot of data has been taken from the government sites of Singapore and USA. Details have been provided in the reference section. **With the aim of understanding important aspects of designing a national AI policy**, a survey method using interview **techniques** using a semi-structured tool (Google forms) was envisaged at the time of research proposal stage. The **expected Sample Size was 30/40**. Accordingly, a questionnaire was designed which was addressed to not only the experts from NITI Aayog, MeitY, but also to the Academia and the practitioners. Sampling technique used is judgemental sampling. An attempt has also been made to survey organisations working in the domain of AI to obtain the primary data on Technology adoption of AI and Expectations from Governance of AI in India. While a large number of organisations were approached however only a few agreed to participate. Here

convenience sampling was used and the sample are from practitioners from Business / Start-Ups, Centre of Excellence –CAIR etc.

3.3 Data Collecting Tool and Analysis

The data collection tool is a questionnaire divided into five parts:

Part A: General data of the sample.

Part B: AI Technology Adoption.

Part C: Governance of AI in India

Part D: Future of AI in India

Part E: Miscellaneous Suggestion/Comment/Recommendation

Design of Semi-structured tool (Google Forms) was done using indicators gleaned from review of literature, comprising of both open ended and closed ended questions. Before implementation, pilot test of the survey tool was done by discussing it with the guide from IIPA and others.

Data hence captured has been analysed using appropriate tools as well as presented as case-stories.

CHAPTER 4

AI ADOPTION

4.1 Background

(i) Any technological change has an impact both social and economic to individuals, society, organisations and country as a whole. The decision to adopt or not to adopt a certain technology decides the fate of the organisation. At times adoption gives an edge and takes the organisation to the next level of success and at times adoption is must for survival and there are instances when organisations have perished since they failed to cope up with the technological change. AI is one such technology of the changing times in the era of 4th industrial revolution. As stated earlier AI is a science in which machines can work and respond like humans. AI is an amalgamation of technologies that enable machines to act efficiently, increase productivity and facilitate humans to enhance their capabilities in different activities. However, AI's promise of increased efficiency and production comes with some drawbacks. To achieve their production goals, organisations must not only find but also retain competent talent. At the same time, businesses must be cautious about putting in place safeguards to reduce the hazards associated with AI.

(ii) The increased adoption of AI inevitably raises a question of how much AI will impact business, labour and the economy in general. How is the growth of AI jobs in different countries or is it that the jobs are dwindling? According to the AI Index report 2021 [63], the hiring rate in all sample nations increased in 2020. From 2016 to 2020, the countries with the highest increase in AI hiring include Brazil, India, Canada, Singapore, and South Africa. India has a hiring Index of 2.8, USA 2.1 and Singapore 2.5.

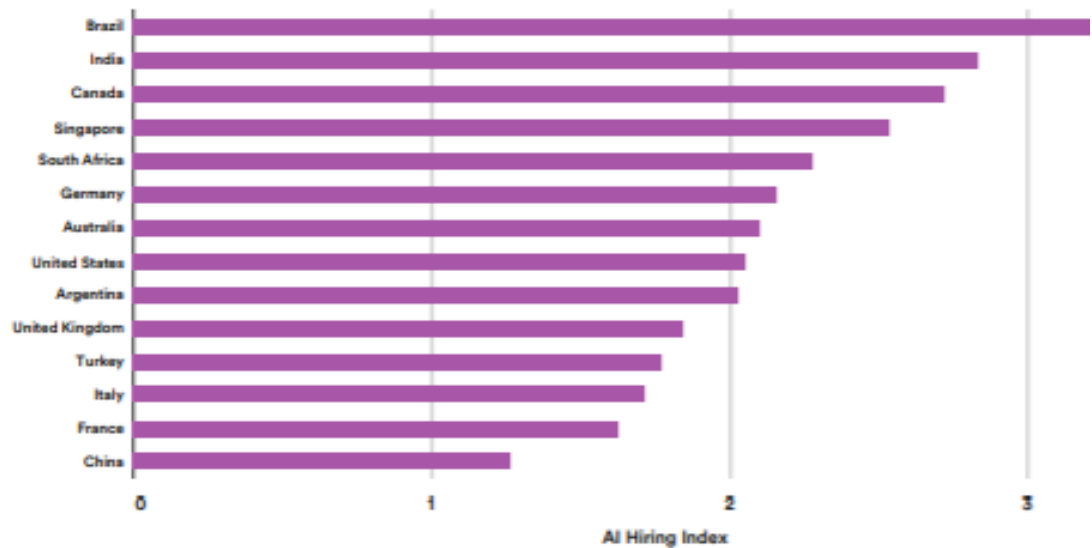


Fig 6: AI Hiring Index by Country, 2020
(Source: LinkedIn, 2020| Chart: 2021 AI Index Report)

(iii) AI Index report also state that AI labor demand has grown significantly in the last seven years in countries namely USA, UK, Canada, Australia, New Zealand and Singapore. Singapore is the fastest-growing of the six countries, with a 13.5-fold increase in AI job posts across all job positions in 2020 compared to 2013. From 2019 to 2020, the United States was the only one of the six countries to see a reduction in AI job posts (in period of 2013-2020). This has been ascribed to the corona virus epidemic or the country's relatively more mature AI labour market, according to the document. The report also brings out that India tops the relative skill penetration rate.

(iv) Investment is one of the measure by which it can be deducted as to what is percentage of adoption. The total global investment in AI which include private investment, public offerings, Merger & Acquisition etc increased in 2020 relative to 2019. This aspect will be deliberated in greater details in the subsequent paragraphs.

(v) McKinsey Global Survey report titled 'The State of AI in 2020' suggest that organisations [61] are using AI as a tool for creating value. The companies are willing to invest more in AI since things are going digital especially in COVID times. Thus there are companies which are AI leaders and there are majority of companies which are struggling to leverage the technology. The companies which are making progress with AI have adopted AI in atleast one function but they are lagging in mitigating the risks of AI. High tech and telecom sector companies are the pioneers in adoption of technology and the automotive and assembly sector is just behind the leaders. As far as business functions are concerned AI is being utilised in service operations, product or service development and marketing and sales taking the top spots.

(vi) The survey report stated that just 16% of respondents have taken deep learning beyond the piloting stage. Here again the high-tech and telecom companies lead the pack and gone ahead with embedding the deep learning techniques. Michael Chui, partner, Mckinsey Global Institute, San Francisco believes that achieving impact at scale is still elusive for many companies not only because of the organizational changes required. He further adds that most companies agree to continue investing in the technology but feels that AI's hype phase has ended and AI is worth the investment but needs to have effective execution to create value.

(vii) The insights into companies which have adopted AI reveal that these companies have a road map which clearly prioritize AI initiatives linked to business value across organization. The company has defined AI vision and mission and the senior management is fully aligned and committed to organisation's AI strategy. Last but not the least the AI strategy is in consonance with the corporate strategy.

4.2 AI Adoption in Singapore and USA

4.2.1 AI Adoption in Singapore: To comprehend the level of AI adoption in Singapore, few of the use cases [64] are discussed in brief.

(i) DBS Bank: Leveraging AI to Fight Money Laundering

DBS Bank (DBS) is a Singapore-based international financial services and banking organisation. The bank operates in 18 markets worldwide and has over 100 locations in Singapore. By assets, it is Southeast Asia's most powerful bank. To increase the operational efficiency and effectiveness of its present anti-money laundering monitoring, DBS created and successfully implemented an AI model called the 'Anti-Money Laundering (AML) Filter Model.' The AML Filter Model detects predictive signs of suspicious transactions to reduce the amount of false positives created by non-AI systems, minimising the number of warnings that need to be reviewed manually.

(ii) MSD: Keeping Employees at the Heart of AI Use

MSD develops medicines and vaccines for many of the world's most difficult diseases as a major global biopharmaceutical company with a purpose to save and improve lives. In 2015, MSD opened its Singapore IT Hub with the goal of leveraging digital innovation to improve healthcare outcomes. Manufacturing, human health, and worldwide services are all supported by the IT hub's AI approaches. This enables the business to better allocate resources, increase production, and manage talent. For one of MSD's offices, the IT hub uses AI tools to better evaluate employee engagement and attrition threats. Given the sensitivity of attrition risk assessments, MSD created AI governance processes that emphasised information sharing and clearly defined roles and responsibilities in AI development and deployment.

(iii) Ngee Ann Polytechnic: Admissions Selection Made Easier with Responsible AI

More than 14,000 students study diploma courses at Ngee Ann Polytechnic (NP), a Singaporean college of higher learning. Every year, NP holds an aptitude-based early admissions exercise, which allows graduating Singapore-Cambridge General Certificate of Education Ordinary level (O-level) and Institute of Technical Education (ITE) students to apply for admission before receiving their final marks. This exercise allows NP to be more flexible when it comes to accepting students depending on their aptitudes and interests, allowing for a larger range of abilities to be recognised. Ngee Ann Polytechnic piloted an AI powered platform with predictive analytics in July 2019 to automate and improve the early admissions exercise selection process for three of the polytechnic's schools: Business & Accountancy, Film & Media Studies, and Health Sciences. This platform they named as Early Admissions Exercise Virtual Assistant (EVA). The automated examination of application write-ups took only two hours after the introduction of EVA. EVA also had online "chats" where students may discuss their interests and aptitude for the courses they were interested in. Questions for the admissions interview were compiled from the chat responses. The increased administrative efficiency helped the three schools in saving 135 hours of shortlisting review time which included manual review time.

(iv) UCARE.AI: Accountable AI for Accurate Healthcare Costs

UCARE. AI is a Singapore-based start-up that uses its online AI and machine learning platform to provide predictive insights. UCARE is one of the platform's various solutions. The AI-powered Cost Predictor collaborates with hospitals to provide people with accurate estimates of hospital expenditures. Parkway Pantai was one of these hospitals (Parkway). Parkway employed standard statistical approaches to give bill

estimates before adopting UCARE.AI's Cost Predictor. Because updating the statistical models was costly, they were not updated as frequently as they should have been, increasing error rates. Parkway implemented the Cost Predictor in all four Singapore hospitals in November 2018 to address this issue, and the results were impressive. There have been no customer complaints since implementation, and the Cost Predictor has an average aggregate accuracy of 82 percent.

4.2.2 Above discussed are some of the use cases which indicate that Singapore is one of the leading countries which are adopting AI technology and reaping benefits also. In addition to the use cases there are other indicators too which tell about as to how the individual nation is adopting the technology. They are discussed in the subsequent paragraphs.

- (i) AI hiring indicates the growth of AI jobs in the country which indirectly indicates the adoption of AI technology by the country. Fig 6 shows the AI hiring Index of various countries and it can be seen that the AI hiring index of Singapore is lower than India. It is 2.5 for Singapore whereas India has 2.8. Also the demand for AI labor in Singapore has grown significantly in the last seven years.

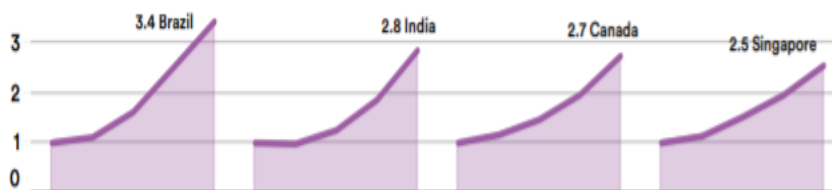


Fig 7: AI Hiring Index of India and Singapore (excerpts from Fig 6)
(Source: LinkedIn, 2020| Chart: 2021 AI Index Report)

(ii) Singapore has the highest percentage growth of AI job listings across all roles in 2020, according to Burning Glass, an analytics business that aggregates postings from over 45000 online job sites [62].

(iii) ‘AI skill penetration’ is another index which tells the prevalence of AI skills across occupations. The AI skill penetration metric indicates the average share of AI skills among the top 50 skills in each occupation. The chart of relative AI skill penetration rate of various countries reveal that India far exceeds the USA and Singapore which are at less than 2 and less than 1 respectively. A relative penetration rate of 2 means that the average penetration of AI skills in that country is 2 times the global average across the same set of occupation.

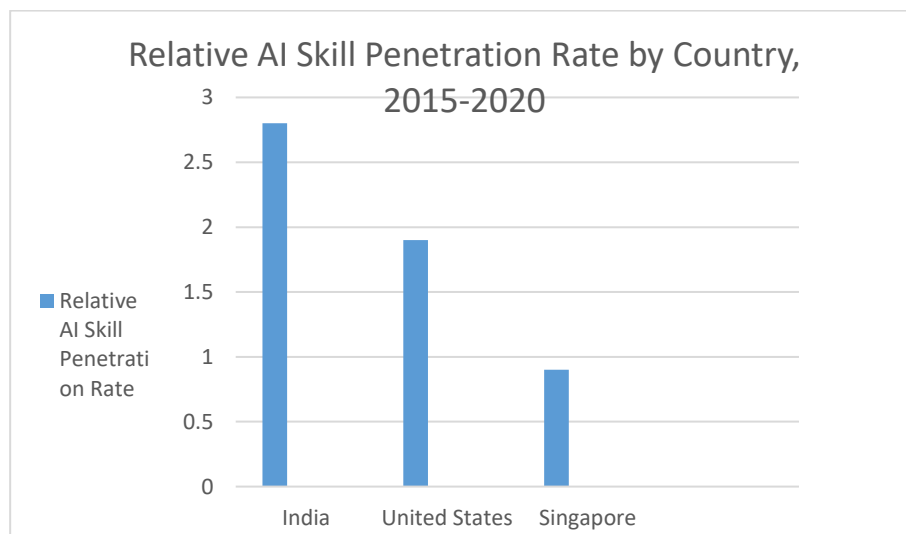


Fig 8: Relative AI Skill Penetration Rate by Country
(Source: LinkedIn, 2020| Chart: 2021 AI Index Report)

(iv) AI being a capital intensive technology requires a lot of funding and therefore investment be it public or private indicates how much of technology

is getting infused in terms of money. As per AI Index report 2021, the total global AI investment increased by 40% in 2020 as compared to 2019 which was USD 67.9 billion. In recent years, private investment in AI has increased dramatically but the pace of growth has decreased. USA remains to be the leading destination for private investment however India is on higher pedestal than Singapore. It is pertinent to mention that private investment in China is much lower than USA but it stands at number 2. China has strong public investments too.

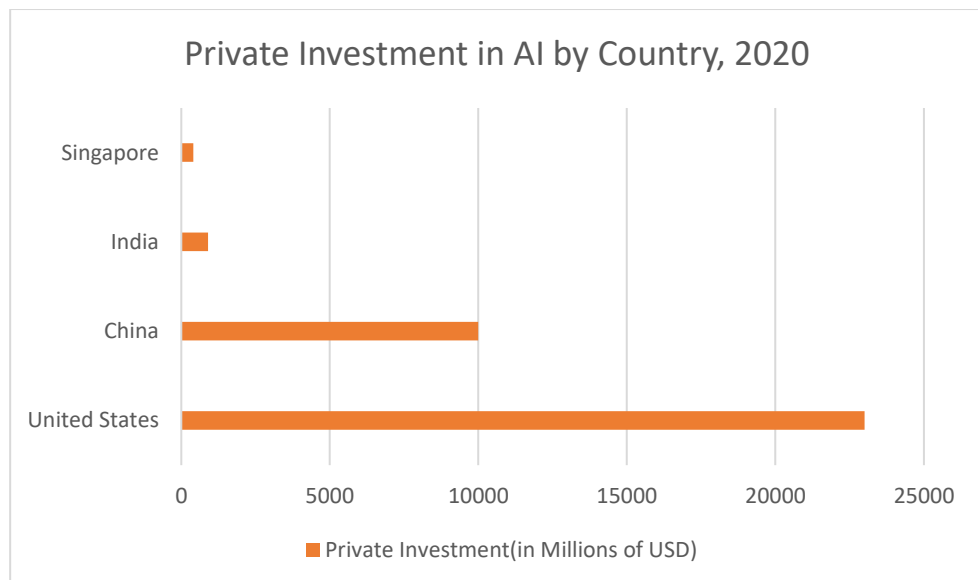


Fig 9: Private Investment in AI by Country, 2020

(Source: CapIQ, Crunchbase, and NetBase Quid, 2020| Chart: 2021 AI Index Report)

(v) Lastly, it is very important that all the stakeholders should have trust in the technology which they need to adopt. This was realized by Singapore much early and therefore in 2018, the Singaporean government ensured the ethical and responsible deployment of AI technologies in coordination with World Economic Forum's Centre for Fourth Industrial Revolution (WEF C4IR) [64]. The Singapore promulgated model framework which has two key principles.

First principle is that decisions made by or with the assistance of AI are ‘Explainable’, ‘Transparent’ and ‘Just’ to consumers and the second one is that AI solutions which are deployed should be ‘Human-centric’. Singapore being the first Asian nation to develop an AI framework makes it not only competitive on a global scale but also makes the country to continue to invest and adopt AI capabilities. This aspect is dealt with in details in the next chapter.

4.2.3 **AI Adoption in USA:** To comprehend the level of AI adoption in USA, few of the use cases [66] are discussed in brief.

(i) **Betterment, NYC** Betterment is an automated financial investment platform and a forerunner of robo-advisor technology that uses artificial intelligence (AI) to learn about an investor and create a tailored profile based on his or her financial goals. Betterment's robo-advisors use algorithms to automate operations like tax loss harvesting, trading, transactions, and portfolio management that formerly required a lot of human effort and knowledge.

(ii) **iRobot, Bedford Massachusetts** The makers of the Roomba, a smarter robotic vacuum, are iRobot, a consumer electronics, software, and hardware company. The Roomba 980 model employs artificial intelligence to scan rooms, identify obstructions, and recall the most efficient cleaning routes. The self-deploying Roomba can also estimate how much vacuuming is required based on the size of a space, and it cleans floors without the need for human intervention.

(iii) **Covera Health, New York** Covera Health is using the proprietary technology framework which combines advanced data science and artificial intelligence for sorting existing diagnostics to provide more accurate symptom data to the practitioners which helps them in making a decision which has a major impact on a patient's life, thereby reducing effects of misguided care and ensuring huge savings for the healthcare industry.

(iv) **Motional, Santa Monica, CA** Motional is using cutting-edge AI and machine learning technologies to make self-driving cars safer, more dependable, and more accessible. Since 2016, Motional has delivered over 100,000 self-driven rides while maintaining a record of zero fault events by combining short-range and long-range LiDAR sensors, radar, smart camera positioning, and proprietary technology in development. The company has collaborated with big ridesharing companies like Lyft, Via, and Cox Automotive to bring its technology to a wider audience, with rollouts expected to begin as early as 2021-22.

(v) **Google, California** Google employs AI in a variety of ways, but its use in Google Maps makes our journeys a little simpler. The search giant's AI-enabled mapping technology scans road data and utilises algorithms to predict the best route to travel, whether on foot, in a car, on a bike, on the bus, or on the train. The production of real-time augmented reality maps, as well as the usage of a voice assistant, has improved the overall experience.

(vi) **Meta, California** AI is heavily integrated in Facebook's platform, whether it's chatbots in Messenger, algorithmic newsfeeds, photo tagging recommendations, or ad targeting. Using billions of public Instagram photographs labelled with hashtags, the company's artificial intelligence team trained an image recognition model to 85 percent accuracy. The technique represents a significant advancement in computer vision modelling. To tackle spam and abuse, Facebook already employs a combination of AI and human moderation. Facebook is depending on artificial intelligence to help it police the world's largest media platform, thanks to advances in picture recognition and a doubling-down on AI research.

(vii) **Twitter, San Francisco** Twitter monitors and categorises video streams based on subject matter using artificial intelligence. The company's image cropping tool also use artificial intelligence to determine how to crop images so that the most interesting parts are highlighted. Recently, Twitter's AI was used to detect hate speech and terroristic terminology in tweets.

(viii) **Amazon, Seattle** Amazon uses artificial intelligence in practically every stage of its business, whether it's in its product suggestions, warehouse robots that grab, sort, and ship things, or web services that power the website itself. The company also produces Alexa, an AI-powered speech assistant.

(ix) **Drift, Boston** It helps businesses plan more meetings, assist clients with product questions, and shorten the sales cycle by utilising chatbots, machine learning, and natural language processing. The technology excels in automating operations that used to take a long time to complete. For example, when a consumer visits a Drift-enabled website, a chatbot will appear, ask questions, and, if they are a lead, instantly place them in a campaign. In addition, the company's "Drift Assistant" automates email responses, lead routing, and contact information updates.

4.2.4 In USA there are many more use cases of AI which indicate that AI has matured to an extent in USA. As was done in the case of Singapore, in the next few paragraphs other indicators are discussed which also tell how USA is adopting the technology.

(i) AI hiring indicates the growth of AI jobs in the country which indirectly indicates the adoption of AI technology by the country. Fig 6 shows the AI hiring Index of various countries and it can be seen that the AI hiring index of United States is lower than India. It is 2.1 for USA whereas India has 2.8. Also the demand for AI labor in USA has grown significantly in the last seven years (2013-2020). However, from 2019 to 2020, the number of AI job posts in the United States fell for the first time in six years

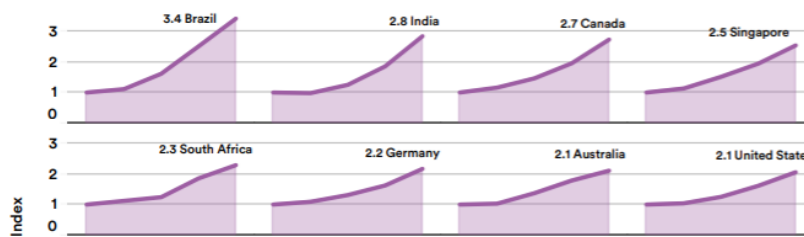


Fig 10 : AI Hiring Index of India, USA and Singapore (excerpts from Fig 6,7)

(ii) According to Burning Glass, an analytics firm that collects job postings from over 45000 online job sites, the United States' share of AI job postings across all roles decreased in 2019-20, either due to the coronavirus pandemic or the country's relatively more developed AI labour market [63]. When looking at demand by skill cluster, it's clear that AI employment grew from 0.03 percent to 0.3 percent between 2013 and 2020.

(iii) 'AI skill penetration' is another index which shows how common AI capabilities are in various occupations. The average share of AI skills among the top 50 skills in each occupation is represented by the AI skill penetration metric. The chart of relative AI skill penetration rate of various countries reveal that India far exceeds the USA which are at less than 2. A relative penetration rate of 2 means that the average penetration of AI skills in that country is 2 times the global average across the same set of occupations (Figure 8 refers). Figure 11 below shows the AI skill penetration in the top five industries namely education, finance, hardware and networking, manufacturing, software and IT.

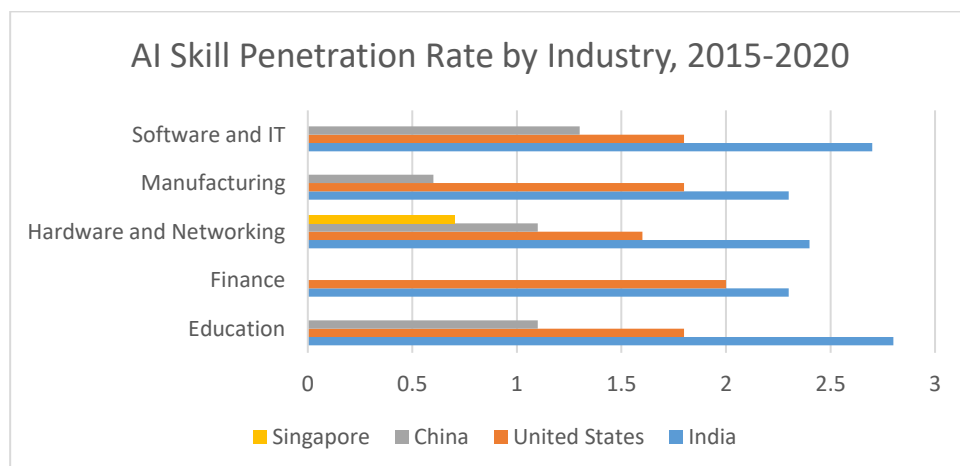


Figure 11: AI Skill Penetration by Industry
(Source: LinkedIn,2020|Chart: 2021 AI Index Report)

(iv) AI being a capital intensive technology requires a lot of funding and therefore investment be it public or private indicates how much of technology is getting infused in terms of money. According to AI Index report 2021, total global AI investment increased by 40% in 2020 compared to 2019, totaling USD 67.9 billion. In recent years, private investment in AI has increased dramatically, but the rate of growth has slowed. USA remains to be the leading destination for private investment however India is on higher pedestal than Singapore (Figure 9 refers).

(v) One thing which cannot be stressed enough is the need of trust for adoption of AI. It is very important that all the stakeholders should have trust in the technology which they need to adopt. Data is the fuel for AI and therefore having the proper data privacy regulatory environment is a fundamental first step in developing the appropriate AI regulatory regime. There are multiple ongoing U.S. Government initiatives significantly impacting how the country approaches and develops the regulatory environment. These include the National Institute of Standards and Technology ('NIST') Risk Management Framework ('RMF'), the Office of Management and Budget ('OMB') Guidance for Regulation of Artificial Intelligence Applications, the Department of Commerce's National AI Advisory Committee, implementation of the American COMPETE Act, and sector-specific policies by agencies. While the U.S. is doing quite a bit in its effort to determine the correct and appropriate approach in regulating AI, there are areas that can stifle the progress that is taking place and potentially put unnecessary hurdles into place at this critical time. This aspect of policy and governance is dealt with, in details, in the next chapter.

4.3 **AI Adoption in India**

(i) Guy Berger the Principal Economist at LinkedIn in 2019 had said that we are seeing a large surge in AI skill prevalence in India. India then had about 143 start ups whereas United States had 1749 and China 486 in their funding and investments. As per AI index Stanford report 2021, India tops the list with respect to AI skill penetration having 2.83 times the global average. However if we look at the research in AI, India ranks low because investment both from the public and private is low. The high initial cost of implementing AI based solutions deter startups from deploying AI technologies. Another issue is the availability of data which, as said earlier, drives the AI systems. The Personal Data Protection bill (PDP bill) recently introduced in parliament is the step in right direction to address the issue of lack of clean data. Further, India has the advantage of its size and availability of AI skilled human resource which can play a vital role in ensuring future jobs for the Indians.

(ii) World Economic Forum's report and its analysis in the 'Future of Jobs' survey[67] reveals that AI is finding the most broad adaptation among the Digital Information and Communication, Financial Services, Healthcare and transportation industries. These new technologies will drive the future growth in the industries and will also increase the scope of jobs. Also the report brings out that technological adoption will impact workers jobs by displacing some tasks performed by machines but that will vary depending on a worker's occupation and skill set. The Future of Jobs report that by 2025 the machines will be primarily focused on the tasks of information and data processing and retrieval, administrative tasks and some aspects of traditional manual labor. The

humans will retain their comparative advantage in managing, advising, decision making, reasoning, communicating and interacting.

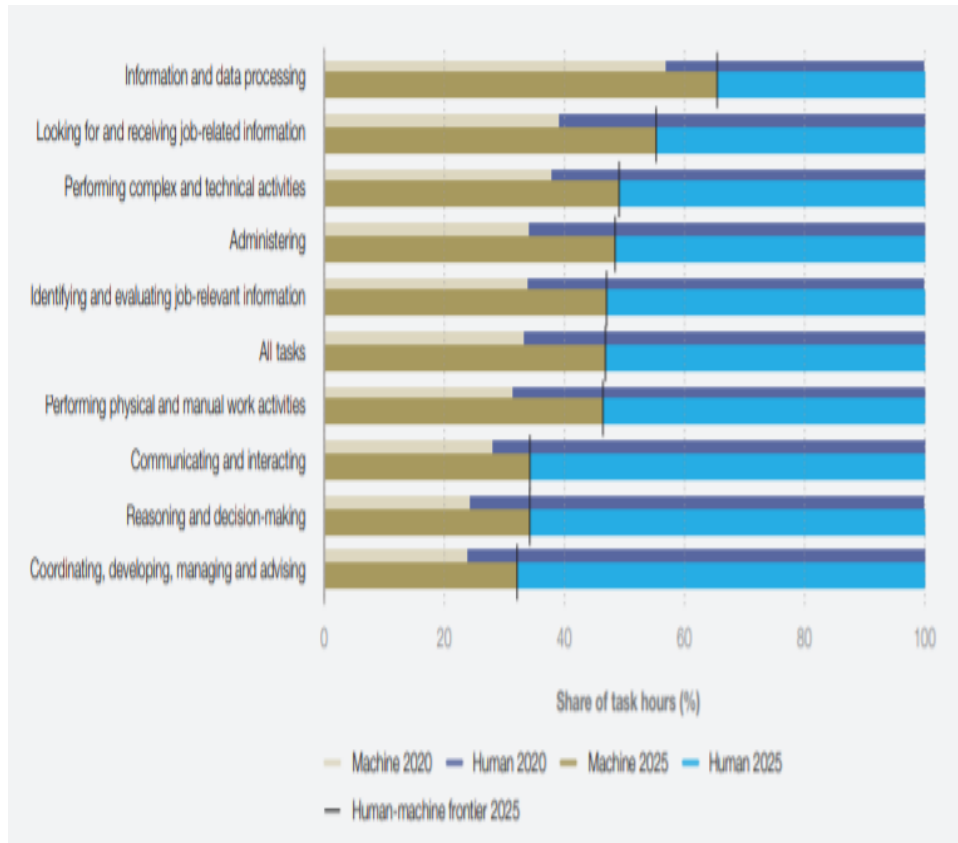


Fig 12 Share of tasks performed by Humans vs Machines
(Source: Future of Jobs Survey 2020, world Economic Forum)

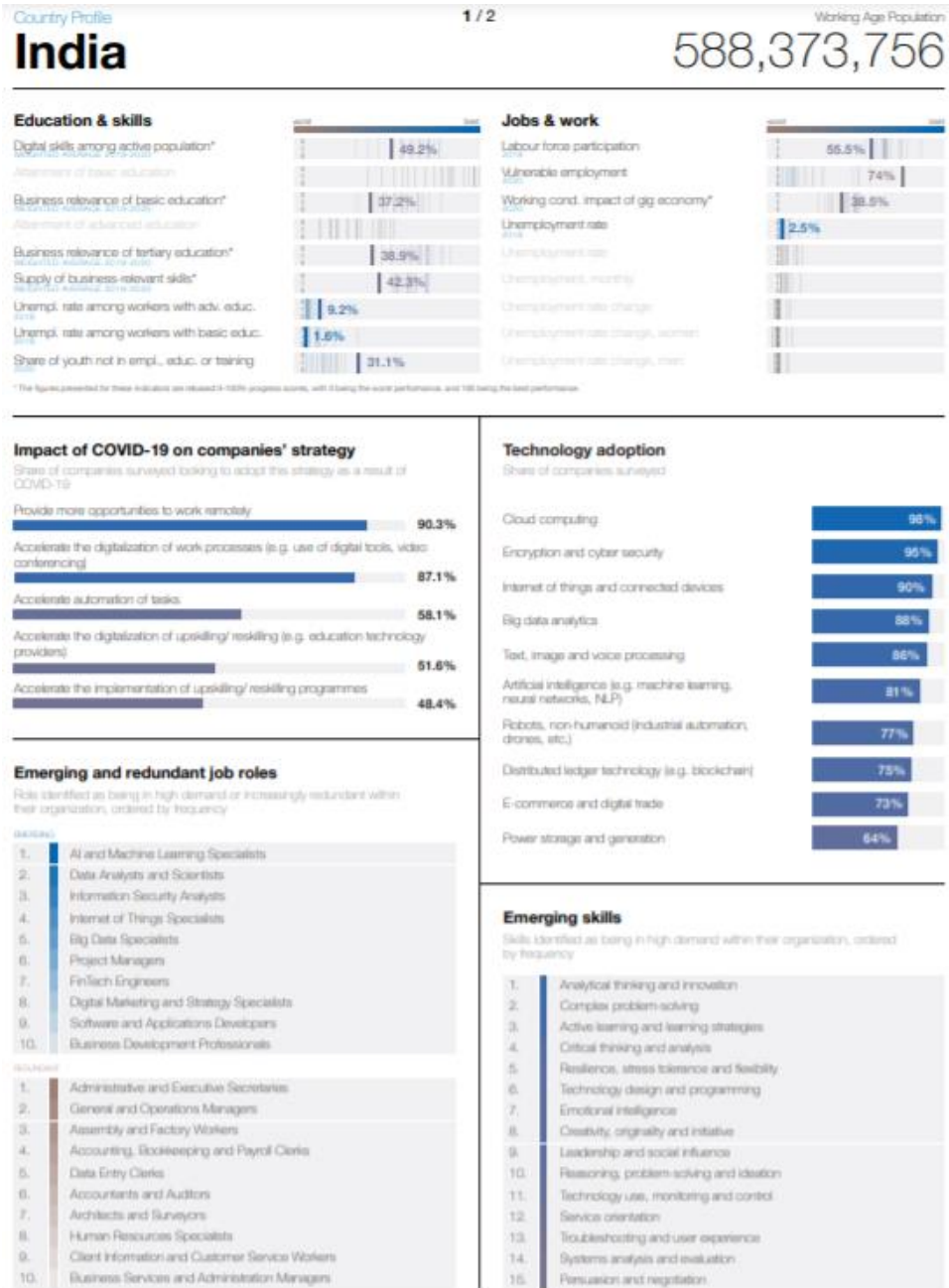


Fig 13 Country Profile of India indicating the Technology Adoption, Emerging skills and job roles (Source: Future of Jobs Survey 2020, World Economic Forum)

(iii) At this point it would be apt if the initiatives taken by the central and state governments be discussed/listed to indicate the level of AI Adoption in India [29].

Table 1: AI Adoption by the initiatives of Central Government

Dept/Ministry of Central	Initiative/Project	Description
Ministry of Housing and Urban Affairs	Monitor e-measurement book(MB)	To develop a meticulous error free fair and transparent system of tendering and management of smart cities, parks and public facilities.
Dept of Space/ISRO	Chandrayaan 2: AI powered 'Pragyan' Rover	A robotic vehicle powered with AI tools which acted as rover in the launch vehicle of Chandrayaan-2 spacecraft as part of second lunar mission.

	AI-enabled monitoring system for forest conservation	AI based monitoring system which can detect even the smallest of deforestation activity within a hectare through improved satellite imagery resolution.
Ministry of Home Affairs	Intelligence Traffic Management System (ITMS)	A system using cameras and Laser sensors to detect over speeding vehicles and red light jumping. The data collected can be used to develop a predictive algorithm of traffic using AI software.
Ministry of Earth Sciences	AI-based system to forecast flood in Chennai	A system that utilizes the data of around 700 flood situations to predict a flood seven days in advance.

Ministry of Finance	New unit formed by RBI to track AI and Blockchain	An Initiative by RBI to understand new technologies that can be cause of concern like blockchain, cryptocurrency and draft rules to deal with them and also to predict parameters like inflation, bank regulations etc.
	Project Insight	A tax tracker system that uses AI to understand patterns of bank transactions by collecting financial data to avoid tax theft.
Ministry of Science and Technology	Interdisciplinary Cyber Physical Systems (ICPS)	To resolve problems associated with various sectors like education, agriculture, health, environment, industry etc. by using AI and data analytics.

Ministry of Electronics and Information Technology	Digidhan Mitra Chatbot	An AI based chatbot which provides the user with personalized information by studying his data through voice and text based conversation.
Ministry of Agriculture	AI sensors for smart farming	Microsoft has created an AI based App which will help small farmers to do precision farming by telling them the optimal dates for sowing seeds, thus reducing the uncertainty due to untimely monsoons.
Ministry of Railways	AI and ML powered app for travellers	“Rail Mitra” app has been launched by railways to provide services like live train status updates, PNR status, seat availability, confirmation probability, online

		food ordering in train etc.
	AI-enabled robots to enhance the safety in trains	Indian Railways has developed an AI based robot “USTAAD-Under gear Surveillance Through Artificial intelligence Assisted Droid” which can provide real time panoramic view of trains through videos and photographs to the railway authorities for prompt action increasing safety in trains.

Table 2: AI Adoption by the initiatives of State Governments

State	Initiative/Project	Field/Technology
Tamil Nadu	Smart conversation assistant Face Recognition system	Chatbot, NLP, Face Recognition
Uttar Pradesh	AI Video Surveillance System	Video Analytics

Karnataka	AI for Digital Agriculture	Agritech, Weather Forecasting
Telangana	Use of AI in eye care screening Drone based delivery in healthcare supply	Healthcare, Medical Diagnosis Healthcare, AI for social good
Maharashtra	Predictive Policing Software Wadhvani AI Automatic Weather Stations AI enabled chatbot to provide information on 1400 public services	Predictive Analytics AI for social good, Agriculture, Healthcare Weather Forecasting and predictive Analytics Chatbots, NLP

(iv) The above glimpses of AI in India brings to fore that India is still at a stage of dealing with ‘Narrow AI’. AI is revolutionizing the service delivery mechanism but there are some fears such as displacement of existing manpower due to automation, bias in the decision making, threat of a machine controlled system [13]. AI being a data-driven technology will lead to major flaws in the system if there is even a minor inconsistency in the input data. There is a need to have a regulatory framework on which to an extent the work has commenced and is dealt with in the next chapter.

4.4 Barriers of Technology Adoption

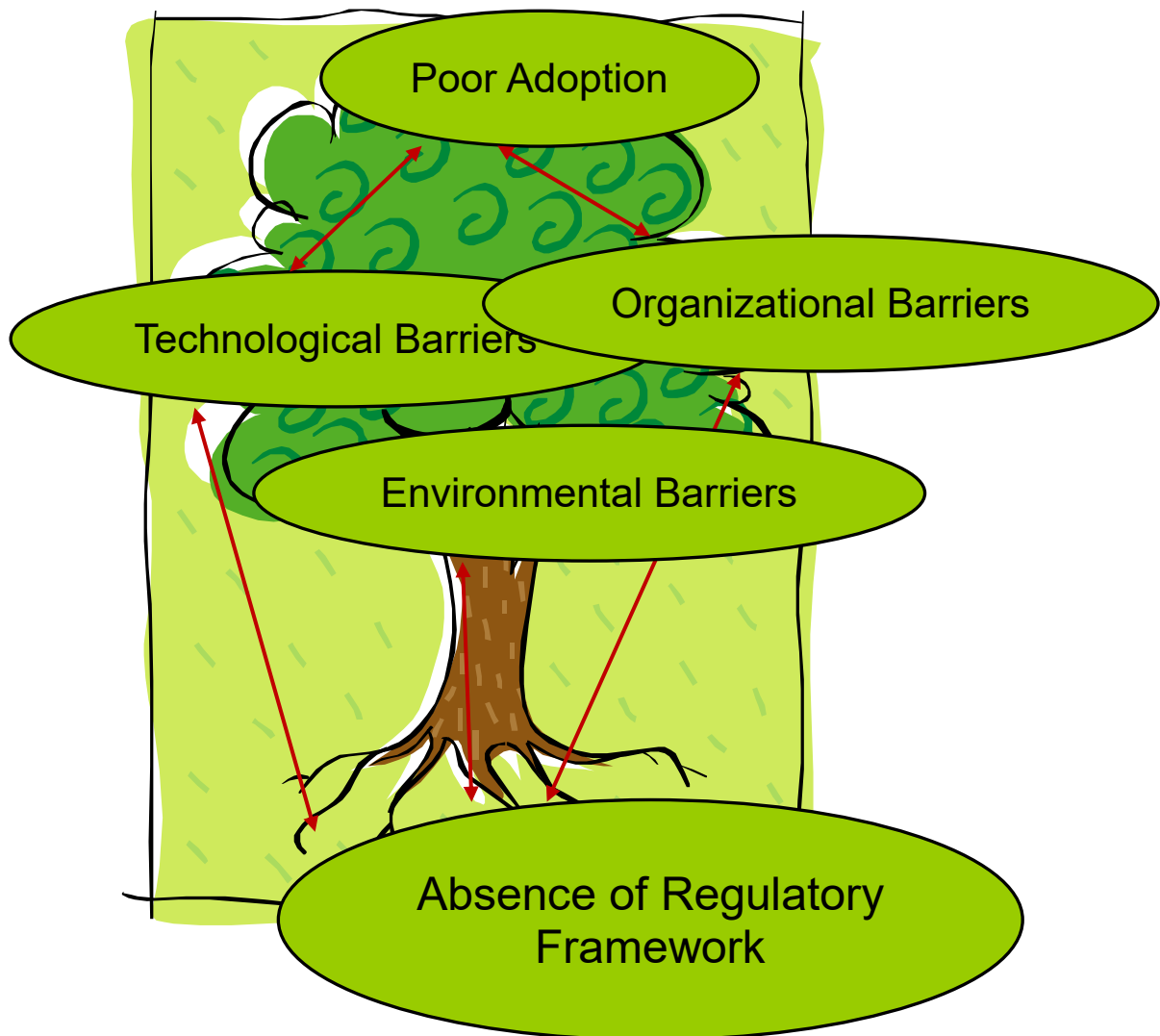


Fig 14 Factors inhibiting the AI Adoption

(i) Technology including the AI technology is impeded due to several factors. There are studies which have focused on understanding the barriers to technology adoption such as Cabanillas et al. (2018); Meske et al. (2018); Sadhya et al. (2018); Caguiat et al. (2017) and Ngah et al. (2015). Preliminary investigation of the literature on adoption innovation reveals that there are various barriers at the organizational level that need to be considered. Some of them are lack of top management support (Cox and Ghoneim, 1996; Mergel, 2018), lack of knowledge and awareness (Ebu et al., 2015),

lack of government regulation (Cox and Ghoneim, 1996; Kruse et al., 2016; Mergel, 2018), lack of skills (Ransbotham et al., 2017), resistance to change (Kruse et al., 2016; Mergel, 2018), incompatibility and interoperability problems, initial cost, and security and privacy risks (Cox and Ghoneim, 1996; Mergel, 2018; Ransbotham et al., 2017). While these factors and many more could be a research topic in itself but I have looked at the Technology-Organisation-Environment (TOE) framework (Tornatzky and Fleischer, 1990) very briefly.

(ii) The technology capabilities of the organization and the security aspects related to it decides the technological barriers (Bughin et al., 2017; Ransbotham et al., 2017). Technology capabilities refer to the availability of the essential organizational resources for AI adoption because a new technology can only be built on the existing foundation. Further, the security is another factor which has come to the fore during the global development of AI and its adoption (Brynjolfsson and McAfee, 2018).

(iii) Lack of top management support, a lack of AI skills and fear of change (Bughin et al., 2017; Ransbotham et al., 2017; Sikka, 2017) can be categorized as the Organisation barriers. AI adoption happens well if there is strong support from top management (Chui and Francisco, 2017). Top management's inclination towards innovation has a positive influence on the adoption of new technology and will require the development of new skills. Thus, when organizations face barriers in terms of making organizational change, that there is a need to develop a business case for AI implementation and this should include the strategy to make the organization ready to accept the change seamlessly.

(iv) Consumer trust, and regulatory acceptance are the main environmental barrier (Grosz et al., 2016; Ransbotham et al., 2017). The ability of AI to mimic the human intelligence has led to a whole gambit of management and legal issues. On top of this,

there is lack of governmental guidelines or regulations, thus a common man on the streets either is not made aware of or is not comfortable to create value using AI. This aspect takes to second part of the dissertation which argues that governmental regulation or governance is a must for building trust in AI and accelerated adoption of AI technology.

CHAPTER 5

GOVERNANCE OF AI

5.1 Background

(i) Governance or regulation of anything has always been a controversial subject because of the measure of effectiveness and the right and optimal quantum of governance. To put regulations in place and to ensure effective governance, a large number of questions arise and each one of them have merit and therefore needs to be answered so as to have consensus built. The first question is about the very need of it. If we need the regulations then, what are the contours of the governance? What should be the objectives, scope, and structure? Should the governance be complete or something which is safety critical or security concerned be governed and rest be left to the organisations to self-regulate?

(ii) The next question which need answer is how much regulation is good enough because this amount of regulation will decide the eco system for the development of the technology. It should not happen that the regulations become counterproductive and kill the enthusiasm of the industry to invest in the technology and this will be a great deterrent to the adoption of the technology.

(iii) Post deciding the quantum of governance, the challenge lies in the part of ensuring that the organisation's comply with the regulation and if they don't what is the methodology to correct and ensure that regulations are complied with. In all this, it is important as to who the regulator is? Is it the government itself or an independent regulator? In case it is an autonomous regulator, is there a need to regulate the regulator, because in the event of any disputes or grievances, what will be redressal mechanism?

(iv) Above are some of the questions, but it is also a fact that in spite of detailed planning, no regulation is perfect and does require to be visited as the ecosystem

changes. One can take the instance of finance sector wherein there was lack of regulations when the risk models, complex derivatives, virtual financial assets etc were driving the economy and eventually led to the financial crisis of 2008[67]. No one thought that regulation is must and no one even knew that a regulator may provide the direction. Thus 2008 financial crisis is the classic example where markets waited until the crisis occurred and then warmed up to the regulations. So do we want the same fate for AI? Will it be worth to wait for an ‘AI crisis’ to happen before realizing the need of governance in this sector?

(v) It is quite likely that a regulation when come into being may appear to slow down things a bit but a well thought out and properly enacted governance is not likely to have a big negative outcome instead it will focus on practical and industrial applications which can minimize the adverse impact on the human beings. This is because that AI is not free of bias and anyone would expect machines to be free of bias, fair. Actually, the bias get into AI algorithms because data on which algorithms run is accumulated by humans, the codes are written by humans and the machines are developed by machines. The bias are inherent and may not be deliberate but if its gets institutionalized then it can be catastrophic.

(vi) Another related issue is the lack of transparency which can be related to the human right issue. We do not understand the algorithms and algorithms are becoming advanced, complex and self-learning/correcting. Now why is this vital and answer is that we can fix the accountability only when we know what has gone wrong and when did it go wrong? Thus comes the concept of TAT i.e Transparency, Accountability and the Trust. If there is transparency, comes the accountability and this will lead to

enhanced trust in the technology which will go a long way in the adoption and willing partnership of all.

(vii) The point which is being made is that AI is still at its infancy and as it matures, more applications get embedded into the systems. These applications will impact the individual and the society will feel the results as a whole and therefore it is important that there should be a debate to have proper regulations on AI so that it can follow the PTAT model. It is also important to discuss the counter view which is that absence of governance is a boon because it creates an equal, free and democratic environment for the development of AI. But these opinion gets defeated by the argument that who decides what is acceptable in this area of research, development and then adoption, who decides that there are no inherent biases inbuilt and does not bring in inequity and exclusivity , who in the absence of regulations, will be able to handle the rogue elements in the AI field?

(viii) This is all the more important because there is a big divide in today's society, divide between rich and poor, divide between conservatives and liberals, divide between rural and urban populace, divide between technology friendly and technology averse people. Let alone the lack of technological awareness, there is lack of awareness of the AI developments and there is very minimal awareness of the ethics related to it. At this point, it would not be wrong to draw parallel between AI and the history of biotechnology and genetics. About 30-40 years ago when biotech and genetics was at similar stage the field showed promise and ability to alter the future course of human development but even then there was apprehensions, there were fears, initially the adoption was less, but the efforts were made to educate the common citizen through workshops, media programs and regulations were put in place. Governance through

regulator brought in Participation, Transparency, Accountability and the Trust (PTAT). Similarly AI is a complex and complicated technology which if used in a positive manner has a great promise for human kind but there are complex questions with respect to the ethics of AI. There is a need to ensure that correct and undistorted information is disseminated for the public. This will also ensure that our policy makers make informed opinion and come out with a well thought out action plan.

(ix) The subject is vast and there could be things which are unimaginable at this point but it is worthwhile to deliberate what we can think of and find a way forward. Thus let's look at the critical question of control, human rights, privacy, security, IPR, transparency and accountability as the basis for initiating a dialogue for the governance. Also it would be prudent to do a global scan so as to learn from the global best practices and see what can be contextualized in the Indian scenario. In the next section, global scan with a focus on how Singapore and USA have dealt with the issue of governance is peeped into.

5.2 Global Framework (Singapore and USA)

(i) As stated earlier, the ethical challenges and the need for governance is all time high with AI powered innovations making their way into our lives because some view this as privacy intrusion, bias based on gender, race, sex; opaque decision making etc. Further, the time is apt for addressing these ethical challenges and putting governance in place to build responsible and fair AI systems which follow the proposed Participation, Transparency, Accountability and the Trust (PTAT) framework/ concept / model.

(ii) Review of literature brings out very clearly that there is limited reference material on the subject and there are almost negligible benchmarks that can be used as a measure of relationship between the discussions and the development of regulations for the development of the technology. Policy makers the world over are aware of the concerns of AI but they don't have any quantitative science based evidence to manage the same.

(iii) This is evident from the fact that European Commission's white paper on AI came out in 2020. Formation of AI ethics committee formed by the UN is yet another proof of the same. The head start for managing the ethical concerns of AI happened in 2015 with governments, private companies etc producing normative documents to manage the ethical challenges of AI applications. These publications of AI principles by the organisations is indicative of the fact that they are paying heed to and desire to establish the AI governance. Some people opine that guidelines have no legal binding and it is agreeable that the abstract principles fail to offer directions on how to implement the ethics guidelines for the AI system. The data reveals that 2018 was the year when maximum number of AI principles were rolled out.

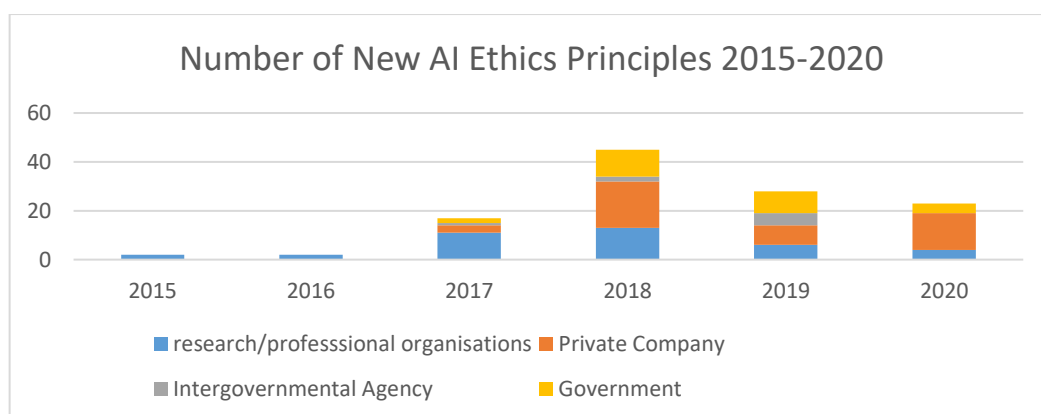


Fig 15 Number of New Ethics Principles by Organisation Type, 2015-2020
(Source: AI Ethics Lab, 2020|Chart: 2021 AI Index Report)

(iv) According to the AI Index Report 2021, Canada released the world's first national AI strategy in 2017, and more than 30 other governments and regions have followed suit as of December 2020. In addition, the introduction of the Global Partnership on AI (GPAI) and the Organisation for Economic Co-operation and Development (OECD) AI Policy Observatory and Network of Experts on AI in 2020 bolstered intergovernmental efforts to encourage AI development for all. The White House is responsible for the United States AI Strategy, titled the 'American AI Initiative.' In February 2020, the United States released its first annual report, which was followed in November by the first guidance memorandum for federal agencies on regulating artificial intelligence applications in the private sector, which included principles to encourage AI innovation and growth while also increasing public trust and confidence in AI technologies. The American AI Initiative emphasises the need of the federal government investing in AI research and development, reducing obstacles to federal resources, and ensuring technical standards for the safe creation, testing, and deployment of AI technology. The White House also highlights the development of an AI-ready workforce and commits to collaborate with foreign partners while supporting and ensuring U.S. leadership in AI. However, the initiative does not specify the program's timeline, possibility of additional research dedicated to AI development, and other practical concerns. Similarly Singapore AI Strategy is known as 'National Artificial Intelligence Strategy' and the Smart Nation and Digital Government Office (SNDGO) is in charge of it. The strategy, which was released by Smart Nation Singapore, a government agency tasked with transforming Singapore's economy and ushering in a new digital era, identifies five national AI projects in the areas of transportation and logistics, smart cities and estates, health care, education, and safety and security.

(v) Despite AI's ubiquity even the USA did not have comprehensive federal legislation as late as 2020. It's only in 2021 there have been movements in this area. In Feb 2020, the Electronic Privacy Information Center petitioned the Federal Trade Commission (FTC) to conduct rulemaking concerning the use of AI in commerce in order to prevent any harm to the consumer resulting from AI products [68]. Meanwhile, the governing legal framework, all this while, was the cross application of rules and regulations governing traditional disciplines such as product liability, data privacy, intellectual property, discrimination etc. Self-regulation and standards groups contributed phenomenally to the governing framework during this time. This was augmented by the Executive Order 13859 in Nov 2020 and post establishment of AI initiative, [whitehouse.gov/ai](https://www.whitehouse.gov/ai) was launched.

(vi) The aim of the Executive Order 13859 was to maintain American Leadership in Artificial Intelligence. The order mandated the Director of the Office of Management and Budget (OMB), in collaboration with the Director of the Office of Science and Technology Policy, the Director of the Domestic Policy Council, and the Director of the National Economic Council, issue a memorandum that provides guidance to all Federal agencies on the development of regulatory and non-regulatory approaches to technologies and industrial sectors that are empowered or enabled by artificial intelligence (AI).

(vii) The scope of the Memorandum was to set out policy considerations that should guide approaches to AI applications developed and deployed. It is important to mention that the definition of AI has been codified in statute 2. It defines AI as "narrow" (also known as "weak") AI, which is to achieve a specific computational task by extracting information from data sets and other sources of information.

(viii) Executive Order 13859 considered the amount of regulation so as not to stunt the innovation and growth and therefore, stated that the importance of developing and deploying AI necessitates a regulatory framework that supports innovation and growth and trust, while safeguarding basic American values, through both regulatory and non-regulatory actions and removes needless impediments to the development and deployment of AI. Towards this aim, Federal agencies must refrain from taking regulatory or non-regulatory actions that obstruct AI innovation and growth. When evaluating whether and how to regulate in an area that may affect AI applications, agencies should consider the impact of the proposed legislation on AI innovation and growth. The identifiable risks can be addressed by narrowly tailored and evidence-based regulations and it is also possible that we attain our aim of providing enabling environment for US companies to maintain global competitiveness but it must avoid adopting a precautionary approach that holds AI systems to an impossibly high standard, preventing society from benefiting from their benefits and jeopardising America's position as the global leader in AI innovation. In cases where AI poses a risk, authorities should weigh the benefits and costs of using AI versus the systems it was supposed to supplement or replace. In addition, agencies must assess the impact of federal regulation on existing or possible actions by state and local governments in the context of AI, as they must in other circumstances.

(ix) Following are the principles of AI applications which can be seen in the Executive order:-

(a) Public Trust in AI

(b) Public Participation

(c) Scientific Integrity and Information Quality

(d) Risk Assessment and Management

(e) Benefits and Costs

(f) Flexibility

(g) Fairness and Non Discrimination

(h) Disclosure and Transparency

(i) Safety and Security

(j) Interagency Coordination

(x) The principles stated above are interrelated and reflect the goals and principles. To maximise net benefits, agencies should calibrate their approaches to these principles and take into account case-specific circumstances. In some circumstances, abstaining from new regulations to promote AI innovation and growth may be appropriate. In such cases, the agency may consider either not taking any action or, instead, identify non-regulatory approaches that may be appropriate to address the risk posed by certain AI applications.

(xi) The non-regulatory approaches include sector-specific policy guidance or frameworks, pilot programs/experiments, voluntary consensus standards and framework for adherence. It is quite possible that certain areas may require more regulatory clarity and that should be provided within the existing regulations and by the

existing statutory authority. Certain waivers and deviations be allowed to allow pilot programs for safe and specific AI applications. Private sector and other stakeholders can come together to develop voluntary consensus standards that concern AI applications. However this option requires agencies to give preference to voluntary consensus standards consistent with OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities" [26]. This will work as a voluntary framework to promote, leverage, or develop datasets, tools, credentialing, and guidelines to accelerate understanding, innovation, and trust in AI.

(xii) The executive order suggested that all agencies should work to improve public access to government data and models where possible, in accordance with the Open, Public, Electronic, and Necessary Government Data Act [30], "Managing Information as a Strategic Resource"[27], and OMB Memorandum M-13-13, "Open Data Policy Managing Information as an Asset"[28]. Also regulatory and non-regulatory approaches to AI applications should be communicated to the public so as to promote public trust and understanding of AI. This will have a significant positive impact on public perceptions of AI and its adoption.

(xiii) Stakeholder participation (as also suggested in Indian context) in the development and application of Voluntary Consensus Standards is another component of the AI governance framework in the United States. Regulations mandate that the federal government participate in the development of technological standards and related instruments to enable the development of dependable, resilient, and trustworthy AI-based systems. Standards could cover various technical aspects of AI performance, measurement, safety, security, privacy, interoperability, robustness, trustworthiness,

and governance to facilitate innovation, use, and adoption of AI applications. Furthermore, collaboration between the federal government and the private sector on the establishment of voluntary consensus standards will aid agencies in developing AI knowledge and identifying practical standards for regulatory usage. In USA, there is a National Institute of Standards and Technology (NIST) which developed a plan for Federal engagement in AI standards [24].

(xiv) There is also a provision for International Regulatory Cooperation in the regulations. "Appropriate strategies for engaging in the development of regulatory approaches through international regulatory collaboration, particularly in emerging technology fields," according to Executive Orders 13609 and 12866, "Promoting International Regulatory Cooperation." [17] As a result, agencies should engage in to encourage compatible regulatory approaches to AI and to support American AI innovation while safeguarding privacy, civil rights, civil liberties, and American values. Such dialogues, which might include the entire public, can give vital chances to share best practices, data, and lessons learned, ensuring that America remains at the forefront of AI development. They can also reduce the possibility of unnecessarily divergent regulatory approaches from risk-based techniques used by important US institutions.

(xv) The next question is that of implementation and therefore the executive order gave a firm timeline for each of the agency plans submission date, and where it is to be sent/made available. The regulations promulgated vide executive order had the technical guidance on Rule making which talked of impact analysis, public consultation, assessing and managing risk.

(xvi) While we discussed the International regulatory cooperation but at the same time it is pertinent to mention that bilateral or multilateral instruments have relevance in the AI context. For instance, EU General Data Protection Regulation (GDPR) will likely affect AI companies that meet the establishment criteria for the European Union. Article 22 of the GDPR states that a "data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her", unless certain conditions are present. One permitted condition is based on express and informed consent by the data subject. This will likely affect how companies approach AI transparency and bias.

(xvii) The National AI Initiative Act of 2020 (DIVISION E, SEC. 5001) became law on January 1, 2021^[70], providing for a coordinated program across the entire Federal government to accelerate AI research and application for the Nation's economic prosperity and national security. Very briefly, few sections of the law are being discussed to know as to how USA aims to govern the AI.

(xviii) Section 5101 of the act brings out the purpose and the activities to be undertaken. Goal to retain the leadership in AI research, development and deployment is reiterated. The act establishes an advisory committee and states it reshuffling/reconstitution every three years. Considering the plausibility of future impact of AI on the workforce, the act includes study by NSF and NAS and give recommendations to congress two years after the enactment of the law. Section 5106 establishes the AI taskforce to propose a roadmap detailing how resources should be established and sustained. The act authorizes/establishes an AI Research Institute program at NSF for AI projects (unfunded). The act has tasked NIST to develop

frameworks, standards and guidelines, including technical standards to test for bias. A time period of two years has been given to develop risk management framework, which includes data sharing best practices and documentation of data sets.

(xix) Let's shift attention to Singapore as to how they wanted to govern their AI and their objective to do so. National research Foundation in the Prime Minister's Office Singapore in the press release of 03 May 2017 brought out the launch of ALSG [70] an initiative driven by a government-wide partnership comprising NRF, the Smart Nation and Digital Government Office (SNDGO), the Economic Development Board (EDB), the Infocomm Media Development Authority (IMDA), SGInnovate, and the Integrated Health Information Systems (IHIS). This initiative builds on Singapore's vision of becoming a Smart Nation and aims to build stronger digital capabilities, so that Singapore and Singaporeans better seize the growth opportunities offered by the digital economy. ALSG aims to use AI to address major challenges that affect society and industry; invest in deep capabilities to catch the next wave of scientific innovation; broaden adoption and use of AI and ML within industry. At that point of time NRF had announced to invest up to \$150 million over five years in ALSG. In June 2018, the government announced three new initiatives on AI governance and ethics. The new Advisory Council on the Ethical Use of AI and Data to help the Government develop standards and governance frameworks for the ethics of AI. A discussion paper issued by the Personal Data Protection Commission (PDPC) in June 2018 led to the making of Model Framework. The Model Framework is a collection of a set of principles, organises them around key unifying themes, and suggests an easily understandable and applicable structure thereby equipping its user with the tools to anticipate and eventually overcome potential challenges.

(xx) The Model Framework of Singapore was a pioneer in its attempt and contributed significantly to the global discussion on the ethics of AI. It provided a framework which translated ethical principles into pragmatic measures that businesses can adopt. S Iswaran Minister for Communication and Information in June 2019 stated that “there are big questions related to AI needs to be answered, and even bigger ones yet to be asked. The Model Framework may not have all the answers, but it represents a firm start and provides an opportunity for all – individuals and organisations alike – to grapple with fundamental ideas and practices that may prove to be key in determining the development of AI in the years to come.”

(xxi) The Model Framework focuses primarily on four broad areas: internal governance, decision-making models, operations management, and customer relationship management. It applies to the design, application and use of AI in general. It does not focus on specific systems, software or technology, and applies regardless of development language and data storage method; and it serves as a baseline set of considerations and measures for organisations operating in any sector to adopt. The framework gives liberty to specific sectors or organisations to include additional considerations and measures or adapt this baseline set to meet their needs.

(xxii) Considering a number of issues that are closely interrelated to the ethical use and deployment of AI, the Model Framework does not focus on ethics because these specific issues warrant separate study and treatment. Instead the Model Framework compiles a glossary on ethics from the existing literature. For data sharing the Model Framework brings out that IMDA’s Trusted Data Sharing Framework and the Guide to Data Valuation for Data Sharing are relevant. Issues related to the legal liabilities associated with AI, intellectual property rights and societal impacts of AI, e.g. on

employment, competition, unequal access to AI products and services by different segments of society, AI technologies falling into the hands of the wrong people, etc are considered pertinent but have not been dealt in the framework instead they will be explored separately through the Centre for AI and Data Governance established in the Singapore Management University School of Law or other relevant forums.

(xxiii) It is really surprising to note that the Model Framework is not intended for organisations that are deploying updated commercial off-the-shelf software packages that happen to now incorporate AI in their feature sets and also that this is a voluntary framework which provides guidance on the issues to be considered and measures implemented. The document while predicting the extent to which organisations will adopt the recommendations state that the adoption of this framework will depend on several factors, including the nature and complexity of the AI used by the organisations, the extent to which AI is employed in the organisations' decision-making, and the severity and probability of the impact of the autonomous decision on individuals.

(xxiv) As AI can amplify human capabilities, the protection of the interests of human beings, including their well-being and safety, is and should be the primary considerations in the design, development and deployment of AI and therefore the main guiding principle of the Model framework is that '**AI should be human-centric**'; other principle is that '**AI solutions should be explainable, transparent and fair**' because organisations use AI in decision making process. When compared to PTAT model as proposed in the study, the framework does not mention for AI to be trustworthy literally but it does hints for AI to be trustworthy by saying it to be human centric.

(xxv) As stated earlier that the Model Framework focuses primarily on four broad areas: internal governance, decision-making models, operations management, and

customer relationship management but our focus will be limited to Internal Governance Structures and Measures.

(xxvi) Model Framework takes into account that Organisations will already have internal governance structures which are to be aligned and put in place new measures to ensure robust oversight of the organisation's use of AI. The organisation's existing internal governance structures can be adapted, and/or new structures can be implemented if necessary. For example, risks associated with the use of AI can be managed within the enterprise risk management structure, while ethical considerations can be introduced as corporate values and managed through ethics review boards or similar structures. Organisations should also determine the appropriate features in their internal governance structures. For example, when relying completely on a centralised governance mechanism is not optimal, a de-centralised one could be considered to incorporate ethical considerations into day-to-day decision-making at the operational level, if necessary. The sponsorship, support and participation of the organisation's top management and its Board in the organisation's AI governance are crucial. The framework advises that organisation should include clear roles and responsibilities for the ethical development of AI and Risk Management controls. This internal governance structure should be reviewed periodically to ensure continued relevance and effectiveness.

(xxvii) The framework suggests that organisations before deploying AI solutions should decide the commercial objectives and weigh them against the risks of using AI in the organisation's decision making. The risk management approach of the framework identifies three broad decision making models with varying degree of human oversight namely Human-in-the-loop, Human-out-of-the-loop and Human-over-the-loop. These deployable AI solutions are actually the algorithms which have

been reiterated to produce the best or the optimal result for the use case. These algorithms are actually applied on training datasets for analysis purposes and therefore these datasets are crucial for the success of the AI solution. As said many times, if a model is built using biased, inaccurate or non-representative data, the risks of unintended discriminatory decisions from the solution will increase. The Model Framework discusses the good data accountability practices and introduces the need to understand the lineage of data; ensuring data quality; minimise inherent bias; select different datasets for training, testing and validation and lastly review and update the datasets periodically.

(xxviii)The algorithm which uses datasets having followed good data accountability practices is likely to be more explainable, repetitive and could be traced. The algorithm is explainable if it can explain how it functions and how it arrives at a particular decision/prediction. Framework allows organisations to provide different levels of detail in their explanation based on the technical sophistication of the intended recipient and the type of the AI solution that is used. It further categorises the explanations into implicit and explicit and also caters to the situations where it may not be practical to provide information in relation to an algorithm for instance anti money laundering detection, information security and fraud prevention algorithms etc. The algorithms where explainability may not be possible practically should go for repeatability of the results produced by the AI system. Repeatability will depict the consistency in performance and may provide the AI users the trust which is must for its adoption. Lastly the AI system should have the traceability for its decision making process. It has another advantage of providing the data (obtained from audit log) which can be used as a training dataset in future.

(xxix) The Model framework also suggests that organisations should have internal policy in place to perform regular monitoring to cater to the changes required and therefore there should be active monitoring, review and tuning on as required basis.

(xxx) The Model Framework as part of its customer relationship management suggests that organisations should make general disclosure and inform the consumers/users whether AI is used in their product or services. They may also disclose the manner in which an AI decision may affect the individuals. Organisations should develop a policy by which they can provide the explanations on how AI works, how a specific decision was made and the reasons behind that decision etc. The increased transparency will lead to building greater confidence and acceptance of AI. In the case of safety critical systems, organisations may consider giving the option of opting out to the individuals who are likely to have direct impact.

(xxxi) The framework conclude by saying that this is by no means exhaustive and would be periodically reviewed based on the feedback on ethical and governance issues so that it remains relevant and useful to organisations adopting AI solutions.

5.3 Policy Framework for Governance of AI in India

(i) The history of computing in India dates back to 1955 as brought by V Rajaraman in his book 'History of Computing in India' [36]. This is the same time period when the world coined the term 'Artificial Intelligence' and started to work on it. However, the actual work on AI in recent times in India started with setting up of AI Task Force in 2017 with an aim of India to become one of the leaders of AI-rich economies [1]. The task force identified 10 domains of focus which included Manufacturing, Fintech, Healthcare, Agriculture, Education, Retails/Customer Engagement, Public Utility Services, Accessibility Technology, Environment, and National Security. The report stated that ensuring responsible use of AI both in terms

of Ethics and Social Safety is the most difficult aspect of AI because it disrupts the current social norms and ways of thinking. Further the report suggested that legal and social constructs need to be evolved to deal with AI systems. The task force acknowledged the challenges of data sharing and accessibility of data by third parties. The task force also did sectoral analysis but the impact of AI technologies on the exercise of fundamental freedom was not deliberated. The issue of privacy was also left untouched however the same is being addressed through Personal Data Protection (PDP) Bill. How data is to be handled and what effect will it have on AI ecosystem is a subject for discussion separately.

(ii) In 2018, Union Ministry of Electronics and Information Technology (MeitY) set up four committees to prepare a report on Platforms, Key Sectors, Research and Development, and Cyber-n-legal and Ethical issues. The reports have been finalised in Jul 2019^[72] but the recommendations given in the reports are yet to be implemented. One of the recommendation of the report was to open a National AI resource Platform (NAIRP) which could be the central hub for integration of knowledge and also could be used for dissemination of information in AI. This is be similar to AI Singapore and could consolidate the efforts of data.gov.in and National Digital Library of India. MeitY report on key sectors bring out the problems in each sector where solution is important for the sector, as well as amenable to AI. The report brings out that our education lacks problem solving approach and is rote learning oriented. Indian students are much poorer in their comprehension of subject compared to Russian or Chinese students but are highly creative (jugaad), except that the creativity seldom finds organized expression. Another problem which it highlights is the availability of data to researchers and later for deploying the developed solutions. The solution of data availability problem is yet to be found even in 2021. Not that the data is not available, it is available in large amount in a plethora of sectors. However, it mostly resides in standalone mode without it being used effectively. Even when it is used, it gets used only in silos. For benefits of data integration to be realized fully, data should be hosted on cloud platforms in well-defined data formats. Much of the data can be made open, taking care of the privacy and security concerns. Probably this issue will get addressed once the PDP bill becomes an act since it has the provisions of anonymised data and also sharing of data for research purposes and to third parties to deployment etc.

(iii) There are several academic and non-Government institutions that have been active in AI and related areas for long. According to a study done by Excubator, that tracks 2300+ companies across the world, 85% of world's AI startups are based in just 10 countries. India is now among the world's top-10 countries in the number of AI Startups [73].

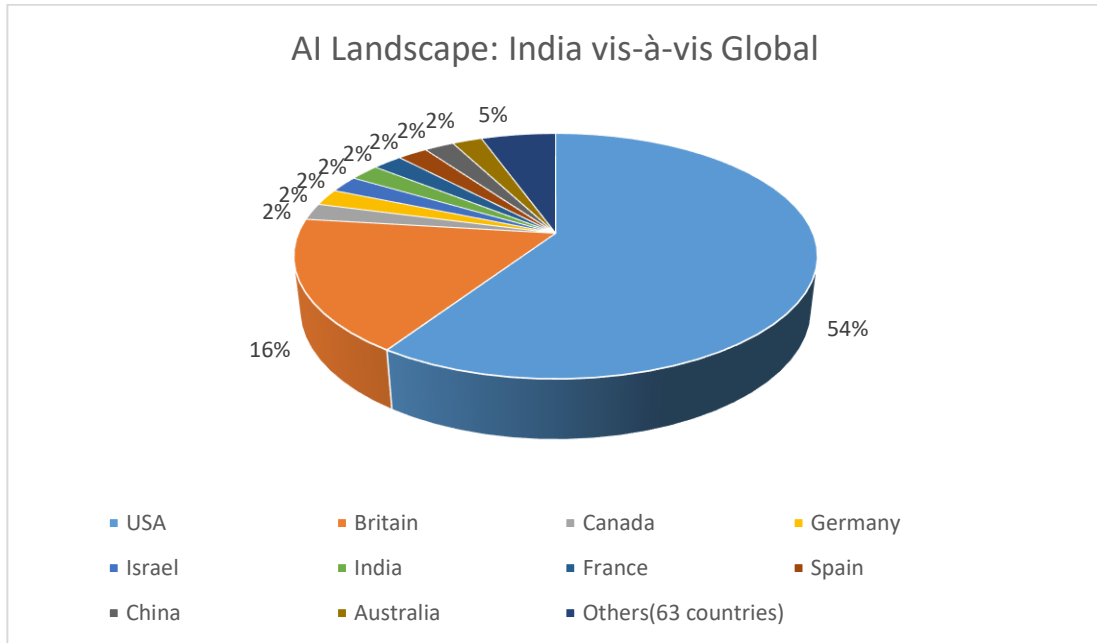


Fig 16: AI Landscape: India vis-à-vis Global

Source: MeitY Committees_C-Report-on Research and Development

(iv) The report suggested that an appropriate institutional structure is extremely important to drive creation and usage of AI so as to address the social and strategic challenges of the nation. These challenges relate to R&D, Skilling, Reskilling, establishing Collaborative frameworks for National Missions and creating a regulatory environment for creation and adoption of AI systems. An overarching Governance structure is imperative to ensure cohesive action and coordination across diverse streams and multiple National Missions. This structure is also vital to enable and facilitate collaboration between government, industry, academia and nongovernmental entities which is a must condition for successful development and deployment of transformative AI-based solutions in the country.

5.3.1 NITI Aayog's Approach Document for Responsible AI (Principles and Operationalising Principles)

(i) NITI Aayog or the National Institute for Transforming India in a discussion paper released in June 2018[74] stated that the goal of national AI strategy is to 'leverage AI for economic growth, social development and inclusive growth'. This paper identified five primary sectors namely education, agriculture, healthcare, smart cities and infrastructure, and smart mobility and transportation where government should play a leading role to have a positive social impact. The paper further highlighted the challenges that plagued the focus sectors:-

- a) Lack of enabling data ecosystem
- b) Low intensity of AI core research and then transforming it into market applications
- c) Inadequate availability of AI skilled manpower and related opportunities
- d) Capital Intensive and lack of awareness for adopting AI in business
- e) Absence of privacy, and ethical regulations
- f) Need to incentivise research and adoption of AI

(ii) The paper concluded by recommending setting up centre of Research Excellence for AI (COREs) for core research and International Centres for Transformational AI (ICTAIs) for applied research. It also recommended setting up of common compute platform for AI research, Analytics and Knowledge Assimilation Platform (AIRAWAT). This and many more suggestions were made. Since then a lot has been done and an ecosystem appears to be fructifying in India and AI is actually transforming in certain sectors. Therefore NITI Aayog has come out with 'Approach Document for Responsible AI (Principles and Operationalising Principles) in Feb and Aug 21. Approach document on 'Principles of Responsible AI' identified seven principles from the tenets of Indian Constitution which should be the guiding framework for various stakeholders in leveraging AI. However to ensure that AI systems adhere to the principles requires the role of government as a policy maker and also the regulator. At the same time, it is important that entire ecosystem of AI should ensure that a trust score is developed because government interventions alone can't

play the justified role. The document recommends a multi-disciplinary advisory body to operationalise the principles of AI. The document also recommends measures for the private sector, research and academic institutes to build capacity to evaluate the risks and undertake actions to appropriately address them.

5.3.2 Existing Framework

(i) Presently India is on a path of uncoordinated, parallel efforts for development of AI. Either there is none or if there is, then, it is fragmented policies in the making. As of now there is no single regulatory body, ministry or the department which is looking into the implications and opportunities associated with AI as technology. AI is presently seen as the driver of economic growth and development, though NITI Aayog document does mention the role of AI as transformative force as far as societal needs are concerned. This consideration of AI as a market opportunity and its transformational role in economics is driving the policy making in India however, it is important that India as nation also considers the ethical, social and legal implications of AI on everyday life on equal footing because policy if not made to deal with it, will have impact which will be irreversible.

(ii) AI is all about innovating and therefore it is considered essential that ethical choices should be made part of the innovative technologies like AI and this should be governed by the policies in the making because at times ethics get compromised when it comes to innovate. This is only feasible if we involve the human element which is the backbone of these immersive technologies. The social and ethical considerations of AI should be made only in consultation with the civil society whereas in India the discussions, the task force and the approach documents have been made by the authorities with few inputs from the academia and industry. Majorly the outcome of such documents has been to have automation and technology as the solution of all of our systemic and societal problems which is not the case always because most of the automated processing and technological solutions have limitations which need to be considered prior implementing the suggested solution. The data driven decision is not always just, fair, accurate and appropriate. It is therefore imperative that the limitations of a data driven decision making, the social and ethical impacts should be considered towards making India's AI policy.

(iii) The sector scan of AI in India reveals that police (law enforcement agencies in general), defence (national security) are two major users of AI tools and techniques however the situation on ground as of now is that the contours within which such use is permitted has not been formulated. The responsibilities and limitations are neither understood nor specified. Thus there is a need to have a framework which helps exploration of data driven decisions. This framework will also have to cater to the challenges such as lack of enabling data ecosystem, low intensity of AI research, inadequate availability of AI expertise, privacy, security and ethical regulations, IPR etc. There are certain sector specific frameworks that have been identified for development and use of AI. In finance, SEBI issued a circular in Jan 2019 to Stock Brokers, Depository Participants, Recognized Stock Exchanges and Depositories and in May 2019 to All Mutual Funds (MFs)/ Asset Management companies (AMCs)/ Trustee Companies/ Board of Trustees of Mutual Funds/ Association of Mutual Funds in India (AMFI) on reporting requirements for Artificial Intelligence (AI) and Machine Learning (ML) applications and systems offered and used. The reporting is towards creating an inventory of AI systems in the market and guide future policies [75,76]. The strategy for National Digital Health Mission (NDHM) identifies the need for creation of guidance and standards to ensure reliability of AI systems in health[77]. The Data Empowerment and Protection Architecture (DEPA) by NITI Aayog presents a technical framework for people to retain control of their personal data, and the means to leverage it to avail services and benefits [78]. PDP bill is under process which will pave the way for data driven society and sooner than later akin to DPA, there may be discussion for AI also.

Thus, the study has brought the current scenario with respect to AI Technology adoption and governance in India giving a comparative with USA and Singapore as model representatives. In the next section let's correlate the data from the secondary sources to the primary data and analyse to seek answers to the research questions.

CHAPTER 6

DATA ANALYSIS

AND INFERENCES

6.1 The research questions were addressed on the basis of findings of primary data, review of literature and data gleaned from secondary sources. A comprehensive review of the literature was conducted to collect the secondary data which was followed by a quantitative approach using a survey to collect primary data. The questionnaire for the present study was designed based on the guidelines stated in the literature to provide a good starting point for an in-depth exploration. The study did take cognizance of validated measures of the previous research from the literature to relate to the adoption of AI pilot tested on select IIPA faculty and some other experts to validate it. Necessary suggestions were duly incorporated.

6.2 An online questionnaire was distributed by sending the link to potential respondents using online survey tool. The online questionnaire was distributed between Dec 2021 and Feb 2022. In total 110 organizations were randomly selected based on judgmental sampling, comprising Indian industry (from various levels and sectors), academia/think tanks, Policy makers etc. This technique helped gain representation from various levels, backgrounds, gender and age groups, and from a wide geographical area. In total, 41 participants participated in the research; all the responses were found valid and complete on all regards giving a response rate of 37.27%.

6.3 The questionnaire was divided into five parts:

Part A: General data of the sample.

Part B: AI Technology Adoption.

Part C: Governance of AI in India

Part D: Future of AI in India

Part E: Miscellaneous Suggestion/Comment/Recommendation

The questionnaire comprised of both open and closed ended questions. Data hence captured has been analysed in the subsequent paragraphs.

6.4 Respondents' profile is as shown in the following tables:-

Table 3: Descriptive Analysis Matrix of Demographic Variables

Demographic Variable		Percentage
Age	< 30 years	24.4%
	30-40 years	29.3%
	40-50 years	36.3%
	>50 years	9.8%
Gender	Male	73.2%
	Female	26.8%
Geographic Location	North (Delhi/NCR/Northern India)	58.5%
	East (NE/Orissa/Eastern India)	4.8%
	West (Pune/Goa/Jamnagar /Western India)	14.6%
	South (Bengaluru/Kochi/Southern India)	14.6%
	Abroad (USA/Dubai)	7.2%
	Organisation	Government
	Academia/Think Tank	14.63%
	Major Industry	17.03%

	Startups	19.5%
	MSME	7.31%
	Observer/End User	7.31%
	Inputs from Abroad (Academia/Major Companies)	7.31%
Industry Categorisation(Sector)	Space	4.9%
	Health	12.2%
	Automotive Transport	12.2%
	Agriculture	2.4%
	Education	12.2%
	E-Commerce	7.3%
	Entertainment	2.4%
	Robotics	7.3%
	Fintech	9.8%
	Defence	14.7%
	Others	14.6%
Job Title	Owner	20%
	Employer	80%

Results

- a) The findings show that maximum respondents are male and they belong to the age group of 40-50 years of age. This can be interpreted to say that people are getting into AI technology after a certain numbers of years of work behind them. 24.4% of the respondents <30 years of age are in the field of AI.
- b) The findings show that maximum number of respondents (58.5%) are from North (Delhi/NCR/Northern India). This is followed by western and southern India however the adoption of AI in Eastern part of India is less.
- c) Respondents worked primarily in the government organisations. Majority of the respondents were from government. This is due to fact that AI in India is being

promoted by the government and accordingly inputs were sought from the respondents one each from organisations like NTRO, Army, Navy, Airforce, DRDO, etc. At the same time response was also elicited from others too. An equally high percentage of respondents were represented from Startups, followed by industry. The rest included MSME, Academia, Industry association, Think Tanks etc.

d) AI has touched all the possible sectors in India in which, at present defence, health, automotive and education are most prominent.

e) Among the respondents, 80% are the employees in the organisation who hold the position of mid-level AI specialists. 20% of the respondents were owners themselves and therefore indicative that the future industrialists will be tech savvy.

6.5 Analysis of Adoption Variables

Table 4: Descriptive Analysis Matrix of AI Adoption Variables

AI Adoption variables		Percentage
1. AI Adoption on level of	Deploy AI	43.9%
	Not Adopt AI	36.6%
	May be(do so)	19.5%
2.Type of AI	Weak/Narrow AI	58.5%
	Strong AI	41.5%
3. Safety Critical Systems using AI	Yes	22%
	No	53.7%
	May be	24.7%
4. Responsibility in the event of failure of Safety Critical Systems	Government	22%
	Organisation	65.9%
	Others	12.1%
Finance	Capital Intensive	range
Ease of Data Availability	Yes	22%

	No	51.2%
	Others	26.8%
Impact of proposed PDP bill on adoption of AI	Yes	68.3%
	No	31.7%
Hurdle towards AI adoption (Technological Barrier)	Lowest	36.6%
	Low	22%
	Neutral	24.4%
	Large	4.9%
	Largest	9.8%
Hurdle towards AI adoption (Financial Barrier)	Lowest	9.5%
	Low	31%
	Neutral	31%
	Large	11.9%
	Largest	14.3%
Hurdle towards AI adoption (Regulatory Barrier)	Lowest	7.1%
	Low	23.8%
	Neutral	31%
	Large	19%
	Largest	11.9%
Hurdle towards AI adoption (Lack of Skilled personnel)	Lowest	11.9%
	Low	31%
	Neutral	16.7%
	Large	23.8%
	Largest	9.5%
Hurdle towards AI adoption (Lack of trust in AI)	Lowest	14.3%
	Low	21.4%

	Neutral	40.5%
	Large	14.3%
	Largest	7.1%

Results

- a) The descriptive statistics of the current state of AI adoption is illustrated in the table above. 43.9% of the respondents indicate that they have adopted AI, and 36.6 % have not deployed AI. However, there is a minority of 19.5% who are either not aware or may do so in future.
- b) The primary data clearly brings out that AI in India is still the ‘Narrow AI’. 58.5% respondents confirm the same. The percentage of respondents indicating ‘Strong AI’ is also sufficiently large (41%) and this little difference -could be because of non-comprehension of correct definition. It is also plausible that some of them are trying their hands and is therefore a matter of further investigation by future researchers.
- c) Owing to AI at the nascent stage, the organizations are not using it for the safety critical systems, however a significant minority of 22% stated that AI is being used for such systems too. Most of such use is in the government sector and thus, the responsibility in the event of failure lies with the government. At the same time the responses also reflect that the responsibility will lie with the organization which is using the system.
- d) Inputs using B7 question was sought to gauge the amount of finance required for adoption of AI. The data reveals and confirms the fact that AI adoption is capital intensive and therefore it is difficult tasks for the small scale players to bring in the high end technology till government sponsors it or incentivize it.
- e) The survey brought to the fore that data is the fuel for AI and as of now data availability in India is not easy. 51.2 % respondents stated that data was not easily

available and they had to face difficulties. Why go far, even to do this study, in addition to time constraints, to seek data from the industry and the government is equally challenge. Even it may be available, the information is not readily available. Further, the respondents opined that enactment of Personal Data Protection(PDP) bill will ease the availability of the data for innovation and also research.

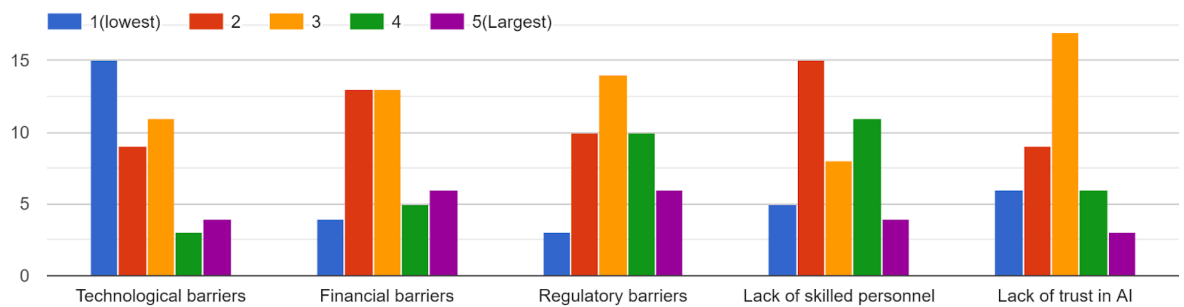


Fig 16A: Barriers in AI Adoption

f) The barriers found in the study fall into five groups based on the level of AI adoption. The influence of barriers within the organizations surveyed were remarkably different as shown in the table above. It can be seen that significant numbers (36.6%) of respondents have not adopted AI which indicate that there are some hurdles or barriers to the adoption of AI in the organization. While the barriers were identified as part of the literature survey, 36.6% respondents felt that technological barrier is the lowest hurdle; 14.3% people believed that financial barrier is the largest; around 12% opined that regulatory barrier is the largest. About 21% feel that trust in AI is the largest hurdle in its adoption and this supports the proposed PTAT framework in this study. Also, 10% people feel that lack of skilled personnel is also an issue though this data is not supported by the UN's World AI index report (2021), Since the primary aim of this study was not to delve on the barriers to the adoption of AI, therefore future research could collect more data in this respect and undertake a correlation to provide rich

understanding of effect of these hurdles/barriers to the AI deployment by the organizations.

6.6 Analysis of Governance Variables

Responses were also elicited on governance issues which is the main force to propel the direction of this study. The data obtained is as shown in the table below.

Table 5: Descriptive Analysis Matrix of AI Governance Variables

AI Governance variables		Percentage
Awareness of regulations promulgated by ministry/department	Yes	41.5%
	No	58.5%
Guidelines issued by Organization	Yes	34.1%
	No	65.9%
Need of Regulations for AI in India	Strongly Disagree	2.4%
	Disagree	4.9%
	Neutral	22%
	Agree	12.2%
	Strongly Agree	58.5%
Who should be regulate AI in India?	Government	46.3%
	Private sector	7.3%
	Autonomous regulator	36.6%
	Others	9.8%

a) The study findings reveal that Indian organizations are cognizant of the value of AI adoption and appreciate the significant benefits that can result from such an implementation. This study found that 43.9 % people have deployed or adopted AI technology. At the same time while studying the barriers of AI adoption 12 % people opined that regulatory barriers are the biggest hurdle towards adoption of AI. This is consistent with the data that almost 59% respondents were not aware if there was any guidelines or regulations related to AI or their adoption. 66 % respondents replied to say that there were none regulations issued or promulgated by the organizations. And thus 59% people feel the need of having governance of AI. 46 % of the respondents stated that governance should be the governing authority whereas 37 % respondents

said that there should be an autonomous regulator for AI. This is little inconsistent with the NITI Aayog's recommendation of self-regulation and also suggestion of an independent organization for governance of AI.

b) It was very pertinent to seek opinion of the respondents in the national policy framework (Question C5, refer Annexure I). These recommendations could be incorporated in the national policy framework for leveraging the benefits of AI in the responsible ethical, safe manner. Majority of the respondents have given very useful suggestion which have been put in the next chapter as part of the final recommendations.

6.7 An endeavor was also made to elicit response about the future of AI in India and the results obtained are as shown in the table below.

Table 6: Descriptive Analysis Matrix of Variables related to Future of AI in India

Variables related to Future of AI in India		Percentage
Negative Impact of AI on employment	Yes	17.1%
	No	61%
	May be	22%
Moving to Strong AI in next five years	Yes	56.1%
	No	22%
	Maybe	22%
India as world leader in AI by 2030	Yes	36.6%
	No	29.3%
	May be	34.1%

Results

To look ahead and to peep into the future of AI in India, data was also collected to assess what the respondents feel AI in India heading into. First and foremost, a question was asked with respect to impact of AI on employment and it was heartening to see that 61% stated that there won't be any negative impact. Today the subject of debate and also a field of research is to study the effect of AI on employment. 56 % respondents

feel that India will shift its focus to Strong AI in the next five years and 36.6 % of respondents have the confidence to say that India will be world leader (amongst first three nations) by 2030. Whether this confidence exuberates from the PM's vision of India being the AI workshop for the world or otherwise, time will only tell.

Validation Using SPSS

The aim of the study was to limit to descriptive statistics as shown above. This is in consonance with the approved research and at that point itself, it was decided that data sample will be limited to 35 and therefore sample size would be a limiting factor to undertake pure quantitative research and quantitative analysis. Notwithstanding the above fact, SPSS has been used within the constraints to verify the details. An Excel sheet is prepared of the inputs received and thereafter codified. This sheet was used to undertake the descriptive analysis using SPSS. The bar charts and frequency tables obtained are appended at Annexure II.

CHAPTER 7

RECOMMENDATIONS

7.1 Conclusion and Way Forward

(i) This study aimed to obtain an insight into AI adoption in different sectors with special reference to India. It also explored the best practices of AI adoption in other countries (USA and Singapore) and suggests what can be inducted for our country too. The study provides a brief insight into the significant barriers to AI adoption. The identified barriers are grouped into organizational, environmental and technical barriers. The promise of AI cannot be fully realised if these hurdles are not overcome. As secondary survey reveals that both promises and risks of AI are likely to have impact and therefore, it is vital for the governments to be proactive in harnessing of AI for not only economic growth but also for making AI a driver of social change – a change which can eliminate poverty; a change which can bring inclusiveness; a change which can protect our environment; a change in the way we get healthcare; a change in the way we educate our children and many more such changes.

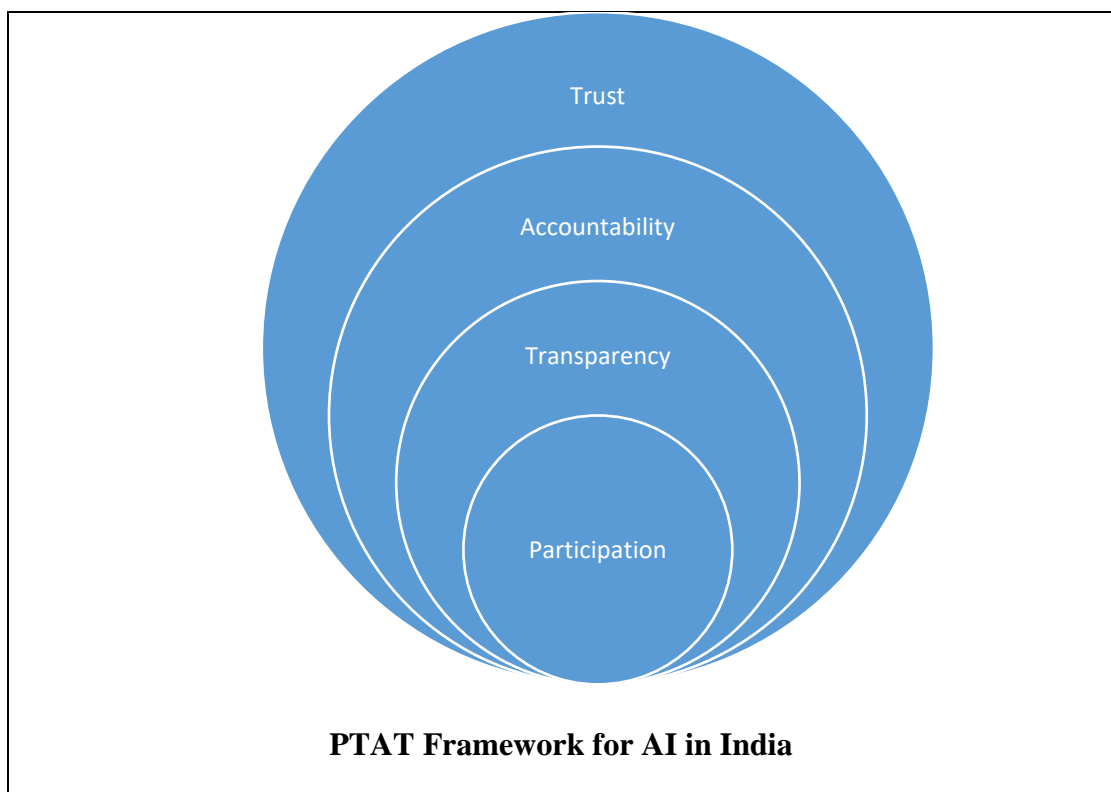
(ii) The secondary survey supported by primary data brings out that wave of change in terms of AI adoption is already happening. Therefore, it is important that government puts in place regulations on priority to ensure that citizens are protected from the threats posed by AI. The recommendations suggested in the primary survey brings out that regulations should not be so stringent that it kills the innovation itself; they should be flexible and agile to address the possibilities and problems which may arise in future; it should protect the citizens but not impede the technological breakthrough. Effective governance should be based on knowledge, infrastructure and a robust delivery mechanism.

Proposed Conceptual Framework of Adoption and Implementation

(iii) There is a saying that no one is perfect and no one is complete and it is therefore we collaborate to achieve that completeness and become perfect. Similarly countries, societies, organisations across the globe will and should collaborate at all levels to ensure adoption of AI and also to formulate regulatory framework that address all issues related to AI.

(iv) This study suggested the framework of **Participation, Transparency, Accountability and Trust (PTAT)** (page 31, chapter 2 refers) which is considered suitable to meet the requirements of the day. This is said post taking the findings from secondary survey and is also supported by primary data. The framework is elaborated further in the succeeding paragraphs.

Fig 17: PTAT Framework



Level	Stage	Requirements
Level 1	Participation	Physical Infrastructure, Processing Power , Cloud Technology, Open Platforms, AI Skilling , Appropriate Funding, Data availability, Data banks, Tax incentives
Level 2	Transparency	Open algorithms, declaration of decision making process, defined standards, level playing field
Level 3	Accountability	Regulations, policies, guidelines, cyber security, managerial and leadership skills, diamond model of people, process and technology
Level 4	Trust in AI, leading to enhanced AI adoption	

Participation Layer or ‘P’ Layer

(v) The first level suggested in the framework is the ‘P layer’ which though stands for participation but requires physical infrastructure, nodal agencies, funding, curriculum, CoEs etc as enablers to ensure that all stakeholders **Participate**. This is the most important component because from here need is generated. In addition to the physical infrastructure, AI needs data. Although India has a National Data and Accessibility Policy (NDSAP, 2012), it still does not have a robust and comprehensive open data sets across sectors and fields. This is true for both public and private entities. There are ‘Data sandboxes’ (access to large anonymized data sets) which are being promoted as tools for enabling innovation while protecting privacy and security. But still data availability is an issue and till we have indigenous data AI solutions for India will not be contextual. While government has done a lot however, government should/ may consider establishing **data banks** in order to ensure availability of data readily. Probably government may think of setting up market places/exchanges where cross-industry data is available at affordable rates for the purposes of research as well as innovation.

(vi) **Institutionalizing AI** Distributed focus will not yield the desired goals, therefore, one of the task force in its report had suggested formation of 'Inter-ministerial National AI Mission (NAIM) which will act as a nodal agency for coordinating AI related activities in India and this mission must be adequately funded. This will help organisations to overcome the organisational barrier and AI adoption rate will be enhanced, as clearly enumerated earlier. The study also captures the need for a central nodal agency to coordinate AI activities in India.

(vii) **Centers of Excellence (CoEs)** Government should set up interdisciplinary Centers of Excellence for various reasons such as to facilitate understanding of the feasibility and possible implications of AI adoption; for identification and assessment of risks while using AI based systems; and for defining the framework for design and development of risk mitigation/contingency plans. Indian Navy is in the process of establishing one of its technical units as the CoE of AI. DRDO has CAIR as the nodal centre. It would be good for the nation to have a central body to synergise the efforts of various inhouse units working in the field.

(viii) **Tax Holiday** Government may also think of giving tax incentives and also ensure availability of easy finance for adoption of AI technologies and applications. This will require a lot of inter-ministerial coordination. AI being a capital intensive technology will require great hand holding and therefore funding the projects will be a step in the right direction. As of now Startups are already beneficiaries of some tax-rebates, however, extensive support is still required as the venture capital requirement may be much higher in the case of AI.

(ix) **AI Skilled Professionals** The World Index Report (2021) states that India leads the global order in terms of skilled human index and to maintain this lead, Ministry of Education in consultation with National Skill Development Corporation (NSDC) should develop the human resource development strategy so as to meet the demand of the AI based professionals. Further, AI adoption can be mapped across different levels of professional education and accordingly AI related curriculum can be designed for the school and higher education institutes. This is already happening to some extent however a coordinated effort may be ensured.

(x) **Multilateral Partnerships** India in coordination with USA, Japan and other countries is already exchanging notes with respect to AI. MeitY and MEA (Ministry of External Affairs) have played a very vital and proactive role in facilitating our nation to participate in capacity building and also discussions on the international policy on governance of AI technologies. Bilateral partnerships can be further enhanced to develop AI solutions for common social problems.

(xi) Though there can be many more actionable points but the most important of them is the involvement of all stakeholders in the AI ecosystem starting from deliberation to the implementation stage. Figure 5 lists out the stakeholders and if all the inputs are derived from them and given the information back to the consumers (biggest stakeholder), this will bring in the much required 'Transparency'.

Transparency Layer or 'T' Layer

(xii) **Open Algorithms** The second level of the PTAT framework is the 'T layer' wherein the algorithms should be known to all, the decision making system should be

based on defined processes and rules, a level playing field should be provided to all the stakeholders and also disclosures should be made mandatory.

(xiii) **Standards for AI Systems** For transparency to materialise, there is a need to establish the standards for AI based systems for enhanced AI adoption and also for ease of governance. Primary survey brought out that a large set of respondents do not know the guidelines, the prevailing standards and they have no one to fall upon for guidance. There is therefore a genuine requirement to have standards in place. Towards this, Bureau Indian Standards (BIS) should participate in standards working group globally so as to be in the forefront for establishing the international standards for AI based systems. This could be in consultation with other concerned agencies such as MeitY etc

(xiv) **Capacity Building of Top Management / Leadership** As AI increasingly captures the world, a fundamental transformation is happening overcoming the usual constraints of scale, processing power, or even learning. It is creating a huge, mammoth opportunities at the same time bringing in uncertainties which is causing an extraordinary turbulence in the ecosystem. The challenges posed by these changing times require a new set of managerial and leadership qualities to steer organisations to new ventures with disruptive technologies and also to make regulatory bodies more of communities and forum to enable more and more innovation and development.

Accountability Layer or 'A' Layer

(xv) **Data Transparency, Ethics and Deterrence** The fuel for AI is data and in India till date there is no data protection law and this is the reason why there is no AI ethics/governance document issued by the government. Even in the countries where

there are AI ethics and governance documents, they do not have the force of binding law probably except USA which has the executive order and the act in existence. The government regulations without the teeth will be mere ‘window dressing’ and unethical use by organisations having vested interest will continue. Thus the governments should formulate the governing regulations with sufficient deterrent so as to prevent the deployment of unethical, and unsafe AI. This forms the third layer called as ‘A Layer’ of the PTAT framework.

(xvi) **Responsibility Matrix** To usher in the era of AI, the country as whole will need an act or an executive order which will lay down the actions and the authority responsible for the action. This could be learnt from USA which had an executive order and then led to passing an act which is binding on all. Such similar regulations are must for a country like India which aspires to be the workshop of AI and also a world leader.

Trust Layer or ‘T’ Layer

(xvii) If ‘P’, ‘T’ and ‘A’ layer works well then it is expected that people will have trust in AI which is a must for ensuring enhanced adoption of its technologies immersing our lives. It includes all the ethical and other socio-cultural issues which as of now are hindrances/barriers to its adoption. This could be a research topic in future and requires an independent study.

AI Readiness Index by NITI Aayog

The respondents of the primary survey did give some suggestions and the most relevant is for NITI Aayog to design a State level **AI Readiness Index** to measure the readiness of different states across India to adopt AI. This can be used as yet another performance

indicators of the state. This will inculcate a spirit of competitiveness amongst states to outdo others and be the leader in the domestic circuit. This could also be a reference to fund the state for innovating and implementing AI for Ease of Doing business.

Proposed Governance Framework

The power of AI lies not merely in the financial growth but also in the tremendous transformative potential to address social challenges. Be it healthcare, education, banking, land registry or agriculture, AI holds the potential for bringing disruptive changes to the existing processes and maximize gains in all sectors. The growth in AI and its application in different sectors are still taking shape in India. However, the larger question of creating a regulatory framework which facilitates the growth of AI technologies in a constructive and ethical manner is of paramount importance. The usage of AI is pre-supposed on data and digital connectivity. Thus, facilitating implementation of 5G is extremely crucial to take advantage of AI. The area of digital connectivity also brings up the risk of potential cyber-crime/hacking etc. Similarly, the enormous amount of data will always remain an area of concern and protecting privacy will be one of the primary ethical concerns. The stakes for artificial intelligence in India are high, yet it trails behind many other developed countries. This is despite the fact that India has a large talent pool with AI skills. To fully seize the opportunities presented by AI, India's policy makers, universities, corporations, entrepreneurs and extension workers need to come together and do much more. The regulatory frame work for the AI in India need to focus on following areas:

- (a) **Strategic Public Private Partnership** Encourage an innovative private sector with a supportive eco-system, policy and regulatory framework to work in collaboration with the public sector to achieve the national goals.

(b) **Promulgation of AI Policy** Undertake a debate on the pros and cons of AI and promulgate a set of guiding principles on “Responsible AI” which should be based on strong ethics, human-centric design, with accountability, fairness and transparency. #AI for all by NITI Aayog is the step in this direction. Indian policy makers need to pursue the twin goals of promoting trust and preserving maximum flexibility to innovate and this requires smart regulation that adapts to the shorter innovation cycles of AI.

(d) **Accountability Matrix** There is a need for greater accountability of the tech companies using AI. They are in possession of huge volume of personal data including financial transactions, bank details and personal preferences. Any data breach is likely to impact a large number of individuals and to that extent, the accountability needs to be ensured. This could be promulgated as part of the AI Policy itself in sync with the proposed Data Protection Bill.

(e) **Nodal AI Authority** Creation of an Authority to be the nodal point for AI. Towards prioritizing interventions and implementing a roadmap for use of AI, creation of an independent Authority with joint participation of all the stakeholders and Ministry of Electronics and Information Technology (MeitY) as the nodal ministry would reap the benefits and make India the AI workshop of the world. The mandate of the Authority could be:

aa) To facilitate, promote adoption of AI in the Country. The Authority would recommend enabling policies, guidelines, promotional measures for facilitating wider adoption.

- ab) To organize the physical infrastructure; monitor and plan data management activities in coordination with DPA, existing ICT applications and portals. The Authority could also implement activities relating to monitoring and evaluation so as to measure achievements and identify priority/focus areas.
- ac) To interact and coordinate with State Governments to leverage AI.

Last but not the least India's goal of being '*Atmanirbhar* Bharat' should be embedded and integrated with India's AI strategy so as to make India attain global AI leadership which is totally indigenous.

Combined Framework for Adoption and Governance of AI in India

The above discussion of 'PTAT framework' and 'governance framework' can be merged to give a combined framework which as understood, is relevant for successful implementation of AI in India. As on now, various organisations have undertaken work emanating out of their individual, independent framework but the ideal would be to have a cohesive, standard policy framework which must govern these advents in a systematic, uniform manner. Such a uniform framework shall ensure participation, support the transparency in processes and inculcate accountability. These factors, in return shall lead to trust in AI and only this trust will ensure seamless transition to an AI enabled ecosystem.

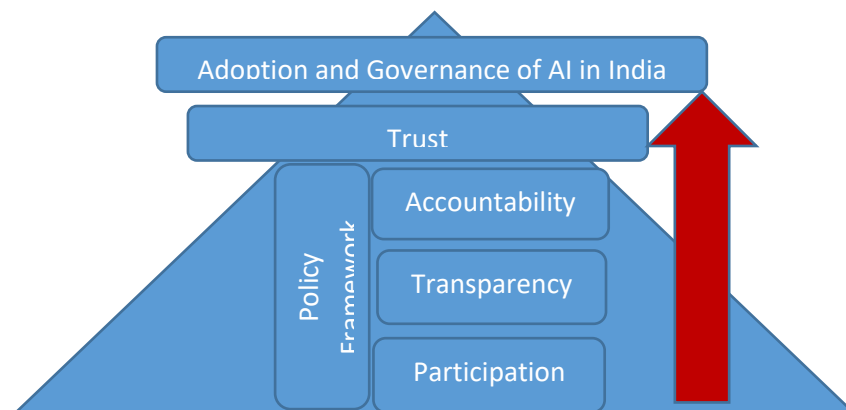


Fig 17A Combined Framework

In a Nutshell

Kentaro Toyama said “Technology-no matter how well designed -is only a magnifier of human intent and capacity.” The present study has laid the emphasis that the adoption is dependent on two factors – Participation by People and Processes that yield participation, transparency, accountability. It is the people who define the processes. It is the people who have to overcome the barriers of adoption of AI. It is the people who have to govern in such a manner that AI adoption is successful. AI is surely poised to be an agent of social change. This promise can also turn its face and make it a disaster if the ill effects of AI society are not examined well. There is a need to understand the threat posed by the possibility of emergence of Digital Super Intelligence. There is a need to consider the possibility of its development and therefore act accordingly.

In other words, if there are perceived advantages expected of AI , then there is also a possibility of risk and therefore government along with all stakeholders should put in place the much needed regulations so as to provide governance and help in development of trust in the end user. This governance framework should not only address the challenges and risks posed by AI but also provide an enabling ecosystem for innovation, research, development and growth of AI in the country. This democratization of development of AI should be based on equality, inclusivity and should assign ownership by framing transparent rules, thus AI should be seen as a scalable problem solver of the society, by the society, for the society.

7.2 Future Scope

Though the study has been conducted systematically, there are limitations to this work. The first limitation is the time constraint for such a vast topic. The second constraint is that of data availability and the lack of people’s participation in the research work.

Further, the inputs and results obtained are based on few organizations, thus, future research should examine the generalizability of findings given that the current sample is not expected to be distinctive and representative of all organizations in general. Future research could involve a more in-depth investigation of the phenomenon by examining AI barriers with regard to a specific industry (e.g., healthcare, education, etc.). For example, organizations relating to information, media and telecommunications might, in general, possess a higher adoption rate as they have constantly been confronted with, and utilize, large amounts of data and also have access to more IT skills than many other industries such as manufacturing or transportation. The domains could be the guiding start for more research on barriers to AI. Future research could combine the findings of this study with case study research focusing on the overcoming of barriers and the development of barriers recommendation. This research does not explicitly incorporate cultural and industry specific factors because the study was aimed to be done based on system considerations. A sector specific research may be done in future to get detailed insights.

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Annexure I: Questionnaire

Technology Adoption and Governance of Artificial Intelligence in India

Dear all,

I am pursuing my MPhil from Indian Institute of Public Administration New Delhi and as part of dissertation I am studying 'Technology Adoption and Governance of Artificial Intelligence in India'.

This is a survey to gauge the level of Artificial Intelligence (AI) Technology Adoption and Governance of AI in India. The following survey will give me, greater insights into how the AI has been adopted in various sectors in India. Also, it is aimed to get insights as to what is the governance of AI as it exists today and what is required in the future. Through this I am aiming to get the views of stakeholders which will help me to formulate the final recommendations which may be used by the concerned authorities to formulate the policies.

The survey form is divided in five sections. The first section (A) seeks background information, second section (B) take insights into technology adoption, section three (C) deals with governance/policy of AI, section four(D) deals with future of AI and Section five(E) seeks suggestions/recommendations.

To complete the survey, please circle/check the response that most accurately reflects your opinion. Only a few questions will require you to give detailed inputs. Please feel free to give recommendations as applicable.

May I request you to take time out to fill the following questionnaire.

Participation in this research study is voluntary and the information provided will be anonymised. The anonymised information can be quoted in the research outputs. Personal information if any will be kept confidential and will not be shared with anyone. The data provided will be archived and may be used for future research.

Regards,

Naresh Chhabra
Commodore
Indian Navy

Questionnaire

Section A: Background Information

A1: Name (Optional)

A2: Age

A3: Gender

1. Male
2. Female
3. Other

A4: Name of the organisation

A5: Which best describes your geographic location?

1. Delhi/NCR
2. Other(please specify)

A6: Which of the following describes your exposure to your AI/ nature of Organisation?

1. Academia/Think Tank
2. Government
3. Industry Association(please specify)
4. Startup
5. MSME
6. Major Company/Industry(National/Multinational)
7. NGO
8. Observer(i.e. follow in media, discuss in informal conversation etc)
9. Other(Please specify)

A7: Which of the following best describes your current position in your organisation?
(Please tick the option)

1. Owner
2. Employee

A8: If you are an Employee, Please indicate Designation

A9: Which of the following describes your organisation?

1. OEM
2. Solution Provider
3. System Integrator
4. Independent Software Vendor (ISV)
5. Other (Please Specify)

A10: Which of the following best describes the primary industry classification of your organisation?

1. Space and Astronomy
2. Healthcare
3. Automotive and Transport
4. Agriculture
5. Education
6. E Commerce

7. Entertainment
8. Robotics
9. Social Media
10. Fintech
11. Gaming
12. Other(Please Specify)

Section B: AI Technology Adoption

- B1: Please describe your current or most recently completed project in few words?
- B2: Are you using Artificial Intelligence (AI) tools in your systems/software/product?
1. Yes
 2. No
- B3: Which type of AI do you think you work upon?
1. Weak or Narrow AI
 2. Strong AI
- B4: Does your organisation undertake safety critical projects using AI? (Safety critical projects are those in which failure may cause injury or death of human beings, damage to property or environment harm)
1. Yes
 2. No
 3. Don't know
- B5: Who do you think will be responsible in the event of failure of safety critical system?
1. Government
 2. Organisation
 3. Team Leader
 4. Project Engineer
 5. Data Scientist
 6. Other(Please Specify)
- B6: What is the time duration in years or months for delivery of an AI based product from the conception stage?
- B7: What is the average capital investment for the AI based project you have undertaken?
- B8: Was data easily available for training the AI system?
1. Yes

2. No
3. If No then specify, the source of data

B9: Do you think that proposed Personal Data Protection (PDP) bill recently introduced in parliament will have positive impact on adoption of AI in India?

1. Yes
2. No

B10: What do you think is the largest hurdle towards adoption of AI in India?

SNo	Factor	1(lowest)	2	3	4	5(largest)
1.	Technological barriers					
2.	Financial barriers					
3.	Regulatory barriers					
4.	Lack of skilled personnel					
5.	Lack of trust in AI					
6.	Any other, Please specify					

B11: Suggest atleast one measure/recommendation which if done will make the adoption of AI easy in India?

Section C: Governance of AI in India

C1: Are you aware of rules and regulations pertaining to use of AI in your sector promulgated by the ministry/department?

1. Yes
2. No

C2: Do you have any guidelines issued by the organisation?

1. Yes

2. No

C3: Do you agree that there is a need for regulations for AI in the country?

1(Strongly Agree)	2(Agree)	3(Neutral)	4(Disagree)	5(Strongly Disagree)

C4: If you feel that there should be regulated use of AI in the country, then who do you think should regulate it?

1. Government
2. Private Sector
3. Autonomous Regulator
4. Other(Please Specify)

C5: Suggest atleast one recommendation to be incorporated in the national policy framework for leveraging the benefits of AI in responsible, ethical, safe manner.

Section D: Future of AI in India

D1: Do you think AI will have a negative impact on employment?

1. Yes
2. No
3. Can't say

D2: Do you think India will move to 'Strong AI' in next five years?

1. Yes
2. No
3. Can't say

D3: Do you think India will be world leader in AI (amongst first three nations) by 2030?

1. Yes
2. No
3. Can't say

Section E: Miscellaneous

E1: Any other suggestion/comment/recommendation

Thank you for completing the survey!

ANNEXURE II: STATISTICS RESULTS USING SPSS

		Statistics					
		AGE	GENDER	POSITION	AI USAGE	AI TYPE	AI SAFETY
N	Valid	41	41	41	41	41	41
	Missing	1	1	1	1	1	1
Mean		2.32	1.27	4.17	1.76	1.41	2.02
Median		2.00	1.00	2.00	2.00	1.00	2.00
Mode		3	1	2	1	1	2
Std. Deviation		.960	.449	15.185	.767	.499	.689
Variance		.922	.201	230.595	.589	.249	.474
Skewness		.018	1.086	6.396	.455	.360	-.031
Std. Error of Skewness		.369	.369	.369	.369	.369	.369
Kurtosis		-.998	-.865	40.939	-1.138	-1.969	-.790
Std. Error of Kurtosis		.724	.724	.724	.724	.724	.724
Range		3	1	98	2	1	2
Minimum		1	1	1	1	1	1
Maximum		4	2	99	3	2	3

		DATA AVAILABILITY	PDP IMPACT	Technological barriers	Financial barriers	Regulatory barriers
N	Valid	41	41	41	41	41
	Missing	1	1	1	1	1
Mean		2.05	1.32	4.63	2.90	7.73
Median		2.00	1.00	2.00	3.00	3.00
Mode		2	1	1	2 ^a	3
Std. Deviation		.705	.471	15.160	1.200	20.955
Variance		.498	.222	229.838	1.440	439.101
Skewness		-.069	.816	6.331	.379	4.330
Std. Error of Skewness		.369	.369	.369	.369	.369
Kurtosis		-.905	-1.405	40.368	-.656	17.673
Std. Error of Kurtosis		.724	.724	.724	.724	.724
Range		2	1	98	4	98
Minimum		1	1	1	1	1
Maximum		3	2	99	5	99

Table 7: Statistics results using SPSS

		Skilled/unskilled	Trust AI	RULE AWARENESS	GUIDELINES ISSUED	REGULATION NEED FOR AI
N	Valid	39	41	41	41	41
	Missing	3	1	1	1	1
Mean		2.87	2.78	1.59	1.66	4.20
Median		3.00	3.00	2.00	2.00	5.00
Mode		2	3	2	2	5
Std. Deviation		1.239	1.107	.499	.480	1.100
Variance		1.536	1.226	.249	.230	1.211
Skewness		.168	.111	-.360	-.694	-1.117
Std. Error of Skewness		.378	.369	.369	.369	.369
Kurtosis		-1.068	-.343	-1.969	-1.598	.309
Std. Error of Kurtosis		.741	.724	.724	.724	.724
Range		4	4	1	1	4
Minimum		1	1	1	1	1
Maximum		5	5	2	2	5

		REGULATORY BODY	NEGATIVE IMPACT OF AI ON EMPLOYMENT	STRONG AI IN INDIA	INDIA AS A LEADER IN AI
N	Valid	41	41	41	41
	Missing	1	1	1	1
Mean		2.10	2.05	1.66	1.98
Median		2.00	2.00	1.00	2.00
Mode		1	2	1	1
Std. Deviation		1.114	.631	.825	.851
Variance		1.240	.398	.680	.724
Skewness		.256	-.035	.726	.048
Std. Error of Skewness		.369	.369	.369	.369
Kurtosis		-1.541	-.328	-1.132	-1.633
Std. Error of Kurtosis		.724	.724	.724	.724
Range		3	2	2	2
Minimum		1	1	1	1
Maximum		4	3	3	3

a. Multiple modes exist. The smallest value is shown

Table 7(cntd): Statistics results using SPSS

Frequency Table

		AGE			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 30 years	10	23.8	24.4	24.4
	Between 30-40 years	12	28.6	29.3	53.7
	Between 40-50 years	15	35.7	36.6	90.2
	More than 50 years	4	9.5	9.8	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
	Total	42	100.0		

		GENDER			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	30	71.4	73.2	73.2
	Female	11	26.2	26.8	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
	Total	42	100.0		

		POSITION			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Owner	8	19.0	19.5	19.5
	Employee	32	76.2	78.0	97.6
	99	1	2.4	2.4	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
	Total	42	100.0		

Table 8: Frequency Table of Age, Gender and Position

AI USAGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	18	42.9	43.9	43.9
	No	15	35.7	36.6	80.5
	Maybe	8	19.0	19.5	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

AI TYPE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Weak AI	24	57.1	58.5	58.5
	Strong AI	17	40.5	41.5	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

AI SAFETY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	21.4	22.0	22.0
	No	22	52.4	53.7	75.6
	Maybe	10	23.8	24.4	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

DATA AVAILABILITY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	21.4	22.0	22.0
	No	21	50.0	51.2	73.2
	Other	11	26.2	26.8	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

PDP IMPACT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	28	66.7	68.3	68.3
	No	13	31.0	31.7	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Table 9: Frequency Table of AI Usage, Type, Safety, Data Availability, PDP Impact

Technological barriers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest	15	35.7	36.6	36.6
	low	9	21.4	22.0	58.5
	Neutral	10	23.8	24.4	82.9
	large	2	4.8	4.9	87.8
	Largest	4	9.5	9.8	97.6
	99	1	2.4	2.4	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Financial barriers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest	4	9.5	9.8	9.8
	low	13	31.0	31.7	41.5
	Neutral	13	31.0	31.7	73.2
	large	5	11.9	12.2	85.4
	Largest	6	14.3	14.6	100.0
	Total	41	97.6	100.0	
	Missing	System	1	2.4	
Total		42	100.0		

Regulatory barriers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest	3	7.1	7.3	7.3
	low	10	23.8	24.4	31.7
	Neutral	13	31.0	31.7	63.4
	large	8	19.0	19.5	82.9
	Largest	5	11.9	12.2	95.1
	99	2	4.8	4.9	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Skilled/unskilled					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest	5	11.9	12.8	12.8
	low	13	31.0	33.3	46.2
	Neutral	7	16.7	17.9	64.1
	large	10	23.8	25.6	89.7
	Largest	4	9.5	10.3	100.0
	Total	39	92.9	100.0	
	Missing	99	2	4.8	
	System	1	2.4		
	Total	3	7.1		
Total		42	100.0		

Trust AI					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lowest	6	14.3	14.6	14.6
	low	9	21.4	22.0	36.6
	Neutral	17	40.5	41.5	78.0
	large	6	14.3	14.6	92.7
	Largest	3	7.1	7.3	100.0
	Total	41	97.6	100.0	
	Missing	System	1	2.4	
Total		42	100.0		

Table 10: TOE Barriers

RULE AWARENESS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	40.5	41.5	41.5
	No	24	57.1	58.5	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

GUIDELINES ISSUED

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	14	33.3	34.1	34.1
	No	27	64.3	65.9	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

REGULATION NEED FOR AI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly disagree	1	2.4	2.4	2.4
	disagree	2	4.8	4.9	7.3
	neutral	9	21.4	22.0	29.3
	agree	5	11.9	12.2	41.5
	strongly agree	24	57.1	58.5	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

REGULATORY BODY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government	19	45.2	46.3	46.3
	Private Sector	3	7.1	7.3	53.7
	Autonomous Regulator	15	35.7	36.6	90.2
	other	4	9.5	9.8	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Table 11: Frequency Table of Rule Awareness, Guidelines issued, Regulation Need and Regulatory body

NEGATIVE IMPACT OF AI ON EMPLOYMENT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	7	16.7	17.1	17.1
	no	25	59.5	61.0	78.0
	maybe	9	21.4	22.0	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

STRONG AI IN INDIA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	54.8	56.1	56.1
	no	9	21.4	22.0	78.0
	maybe	9	21.4	22.0	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

INDIA AS A LEADER IN AI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	15	35.7	36.6	36.6
	no	12	28.6	29.3	65.9
	maybe	14	33.3	34.1	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Table 12: Frequency Table of Impact of AI on employment, strong AI and India as leader in AI

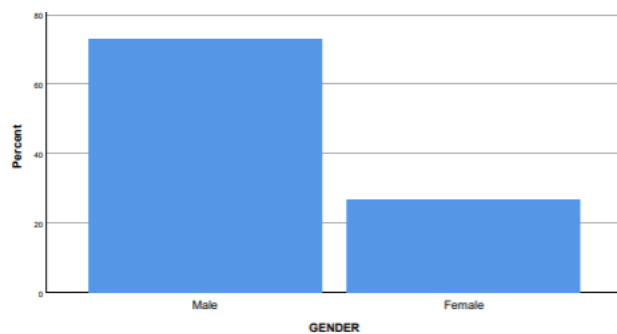
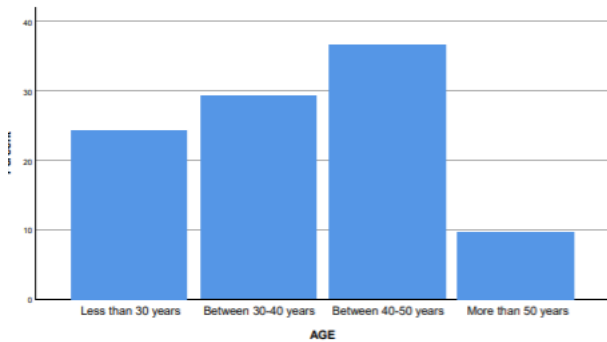


Fig 18-19: Bar Chart of Age and Gender respectively

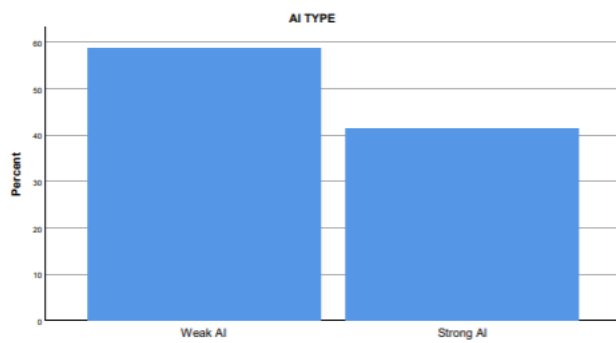
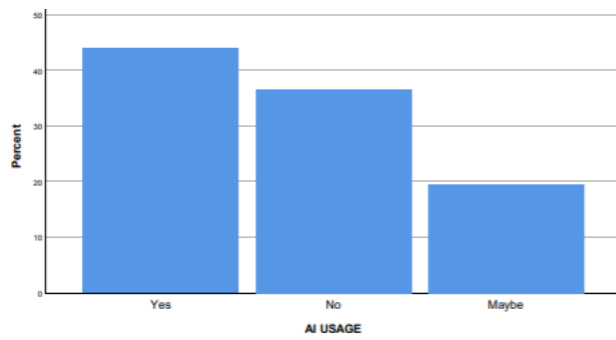
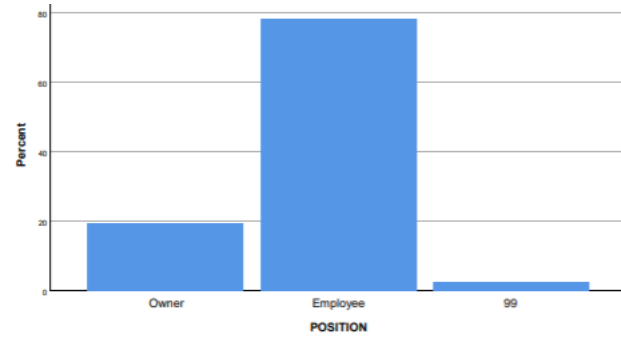


Fig 20-22: Bar Chart of Position, AI Usage and AI Type respectively

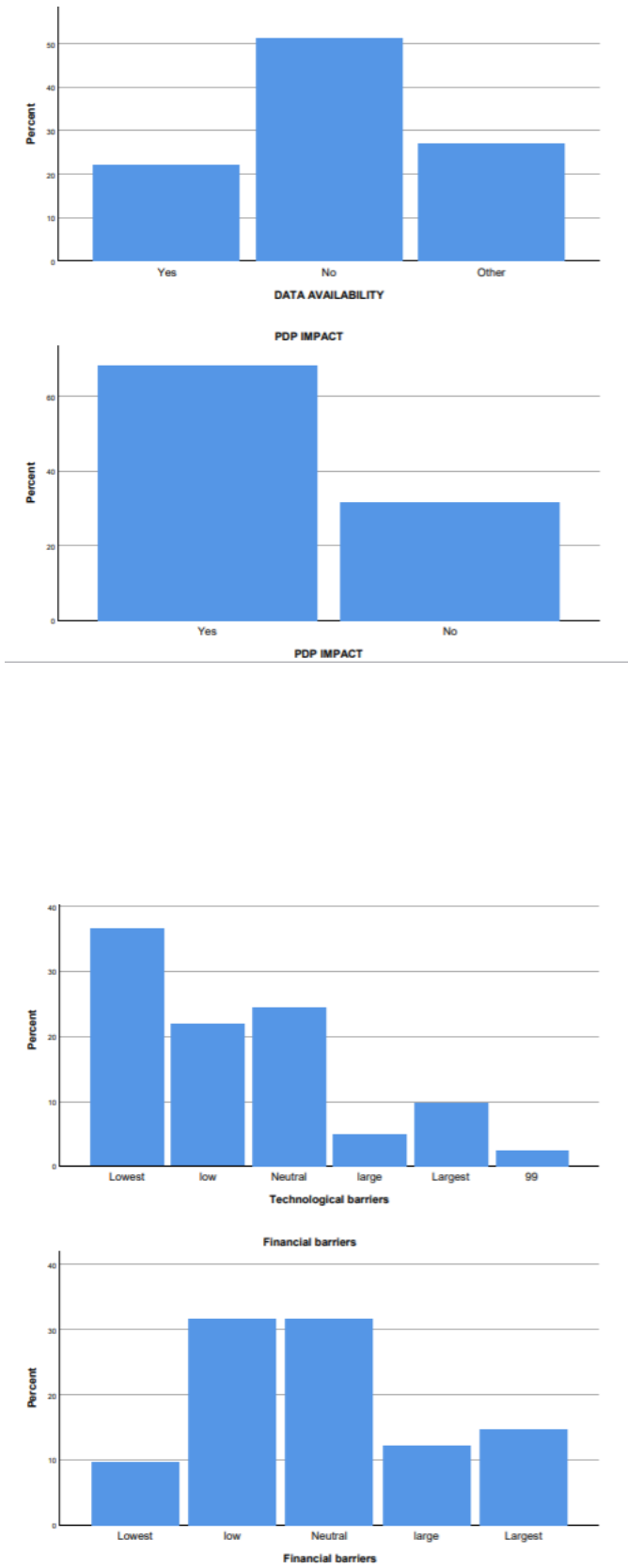


Fig 23-26: Bar Chart of Data Availability, PDP Impact, Technological Barriers, Financial Barriers respectively

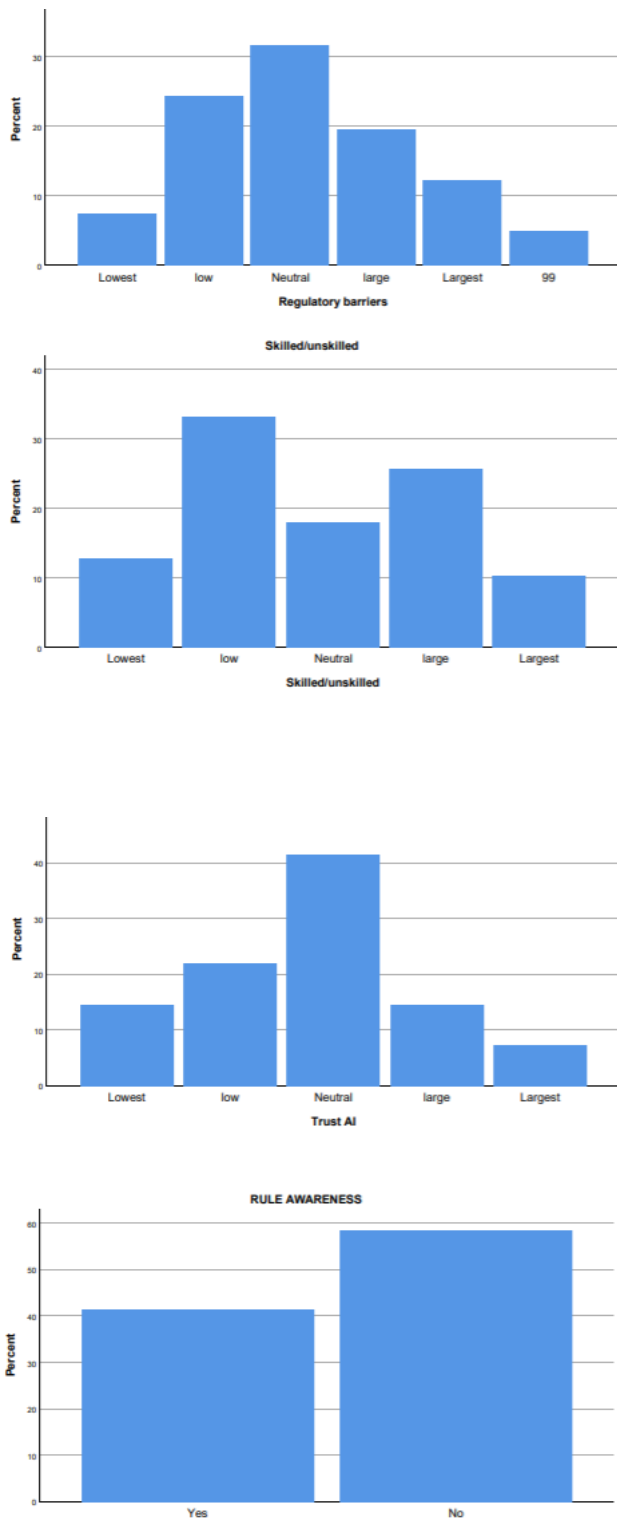


Fig 27-30: Bar Chart of Regulatory Barriers, Skilled/unskilled, Trust AI and Rule Awareness respectively

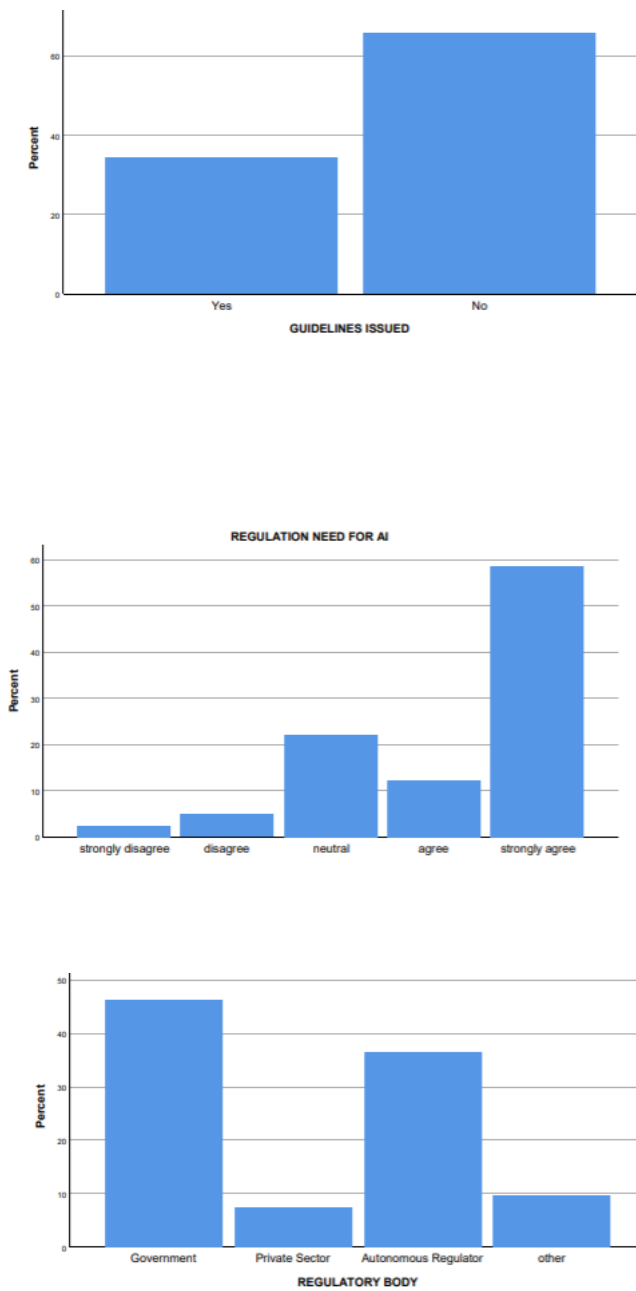


Fig 31-33: Bar Chart of Guidelines Issued, Regulation need for AI, Regulatory body respectively

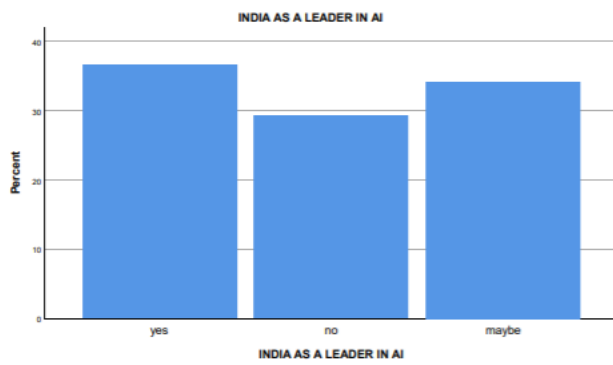
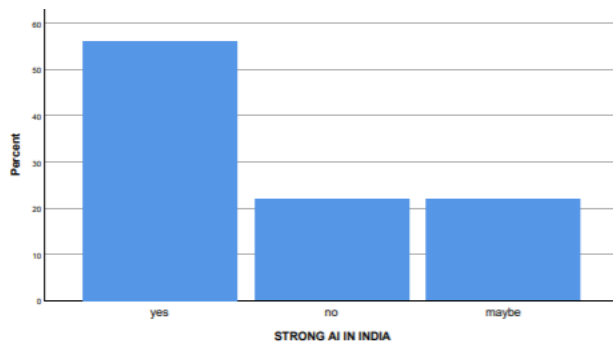
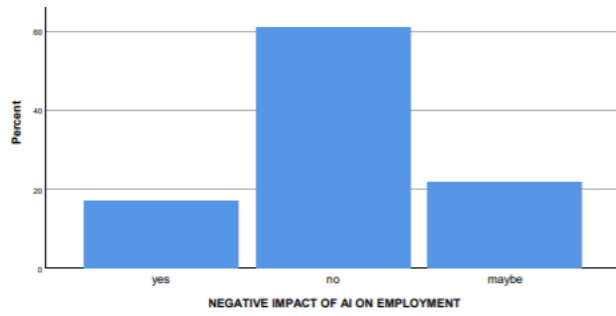


Fig 34-36: Bar Chart of Impact of AI on Employment, Strong AI and India as Leader in AI respectively

Annexure III: Tabulated Review of Literature

Year	Author and Title	Objectives and issues discussed	Research Methods adopted	Findings	Research gap identified
2021 (Feb)	Niti Aayog Responsible AI # AI FOR ALL Part I	To develop the Responsible AI for All approach document. <ol style="list-style-type: none"> 1. Need for Responsible AI 2. Exploring the Ethical Considerations 3. Systems' Considerations 4. Legal and Regulatory Approaches for Managing AI Systems 5. Technology Based Approach for Managing AI Systems 	Brainstorming : amongst national and global experts from IIT-Chennai, World Economic Forum Centre (WEF), Microsoft, Wadhvani Institute for AI etc. Inputs also provided by various Ministries/ Departments of the Government of India and	Evolving area of work. Manner and degree of implementation of principles of AI must provide an enabling environment for promoting a responsible AI ecosystem in India. Measures may be suitably calibrated according to the specific risk associated with different AI applications in a manner that keeps pace with technology advances.	Approach paper limited to 'Narrow AI' Need for Part-2 of the Paper that would provide the approach towards ongoing update of Principles and enforcement mechanisms of the responsible AI in the public sector, private sector and academia.

		Principles for Responsible Management of AI Systems	regulatory institutions- MeitY, DST, DBT, PSA's Office, RBI		
2021 (Aug)	Niti Aayog Responsible AI # AI FOR ALL Part 2	<ol style="list-style-type: none"> 1. Principles for Responsible AI- A Background 2. Responsible AI and India 3. Role of Government <p>Actions for the Private Sector and Research Institutions</p>	- Same as above -	<p>A risk-based mechanism for regulating AI in India. Presently, policy and regulation-building on AI is being explored by various limbs of government</p> <p>The paper proposes the setting up of an independent, multi-disciplinary advisory body at the apex-level, which may cover the entire digital sector.</p>	<p>The paper identifies high-quality research as a priority in aiding the implementation of the AI principles, including through government-formulated guidance on measuring the impact made by AI research initiatives.</p> <p>The paper recognizes that responsible AI principles should be a critical consideration for the research itself.</p>

2020	Sheshadri Chatterjee and Kalyan Kumar Bhattacharjee Adoption of artificial intelligence in higher education: a quantitative analysis using structural equation modelling	The question of adoption of AI in higher education is an important issue and this study explores how stakeholders would be able to adopt it. 'Unified Theory of Acceptance and Use of Technology' (UTAUT) model has been used.	Quantitative	Authors have developed hypotheses and a conceptual model and got it validated through survey with the help of feedbacks from useable 329 respondents.	In India, use of AI in higher education is in crawling stage. No adopters of AI in higher education are found till date in India. Hence, all the syntheses are predictive. In the survey works, we obtained 329 usable responses. All these inputs obtained were from non-adopters of AI in higher education. Thus, this result cannot be generalised.
2020	Hong Chen , Ling Li & Yong Chen Explore success factors that impact artificial intelligence adoption on telecom industry in China	Paper proposes a framework to explore the impacts of success factors on AI adoption in telecom industry in China by integrating the technology, organization, and environment (TOE) framework and diffusion of innovation (DOI) theory.	Quantitative	The study provides support for firms' decision-making and resource allocation regarding AI adoption	This research does not incorporate cultural and industry-specific factors into the research model. Comparisons between industries and countries could provide significant insights into the differences caused by industries and regions.

2020	Niels van Berkel et al. A systematic Assessment of National AI Policies: Perspectives from Nordics and Beyond	To identify differences in perspectives on AI between countries and geographical regions through a systematic comparison of national policy documents.	A structured search strategy based on PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta Analysis extension for Scoping reviews).	A total of 25 AI focused national policy and strategy documents identified spanning a total of four continents Uniform perspective on AI doesn't exist.	Future work can explore the analysed corpus qualitatively to obtain an understanding of the motivations of different countries.
2019	Sulaiman Alsheiabni, Yen Cheung, Chris Messom Factors Inhibiting the Adoption of Artificial Intelligence at organizational-level: A Preliminary Investigation	Despite benefits of AI adoption, many organizations still struggle to drive their AI adoption forward. This study leads to the closing of this gap by conducting a thorough analysis of the current state of AI adoption and the main barriers to AI adoption among Australian organizations.	Quantitative Qualitative Exploratory	The study offers insights and a research agenda to help executives and top-level managers prepare for AI adoption, and to make informed decisions to speed up the adoption process.	Results are based on Australian organizations, thus, future research should examine the generalizability of findings given that the current sample is not expected to be distinctive and representative of organizations in general and in other countries.

2019	Edvin Blomberg Fredrik Moberg Artificial Intelligence Adoption – Is it more than just hype? A qualitative study of what factors influence an organization’s decision to adopt AI	Aims to explore what factors influence organizations when they decide to adopt AI, and provide insights into their rationalization of the decision.	Qualitative Exploratory Technology-Organizations-Environment (TOE) framework adapted.	Study concludes that only two out of eight factors can be deemed influential in relation to the adoption of AI, Presence of champions and Top management support.	Study could not conclude the factor’s influence on the adoption of AI. This study interviewed five respondents, a larger number of interviews would be beneficial. Study focused on Swedish organizations, while a broader group might generate different insights.
2019	Daly, Angela et al AI Governance and Ethics: Global Perspectives	The authors have combined interdisciplinary and international expertise on AI Policy, ethics and governance to give an overview of some of our countries and regions approaches to the topic of AI and ethics.	Qualitative Exploratory	The report presents a snapshot of how some countries and regions especially large ones like China, Europe, India and the USA, are or are not addressing the issue of AI Policy, ethics and governance.	Contributions from countries from Africa, Latin America, the middle east, Russia so as to cover more countries and approaches to AI ethics. Further work may be continued to track the emerging new AI ethics and governance initiatives as well as appraise how existing initiatives are being implemented.

2019	Webb, Amy, “The Big Nine: How the tech titans and their thinking machines could warp humanity”,	The journey of artificial intelligence and the prospect of it developing into artificial super-intelligence – a stage at which human beings would remain completely dependent on machines.	Qualitative, Exploratory	The way humanity will move will be dependent on the way the tech companies and US and China use the AI	While the book identifies the potential impact of AI, the way in which the emerging technologies could be leveraged by developing economies is not available.
2018	Dr Charru Malhotra, “Role of Digital Technologies in Governance”	Discusses the evolution of digital technology in governance in different phases from 1990 till date and concludes that, “to sustain these digital initiatives, the governance agencies must provide citizens with what exactly they need and aspire rather than just an aped model where ‘one size fits all’.	Qualitative Exploratory	Keeping ‘citizens’ as the nucleus of governance / e-Governance systems would help us to achieve a more sustainable and equitable global economy, where digital technologies act as an expedient means and not an ‘end’.	Absence of a policy by the government. Building in considerations of ethical use of AI, cyber security

2018	Charru Malhotra, Vinod Kotwal, Surabhi Dalal Ethical Framework for Machine Learning	The study looks at the role of interplay of ML (the hard sciences) and Ethics (the soft sciences) to resolve irregular predicaments that are inadvertently manifested by machines not constrained or controlled by human Expectations. framework to resolve the ethical dilemmas.	Descriptive, Exploratory, and Analytical in nature based on review of literature.	The paper attempts to first build on the need for introduction of an ethical algorithm in the domain of machine learning and then endeavors to provide a conceptual framework to resolve the ethical dilemmas	There is need for an ethical framework, which can be standardized for implementation in all the intelligent machines in the world. In which some basic parameters are same while other parameter can vary as per country and region to consider their ethical concerns. Based on ethical framework standardization need of an authority (internationally and nation wise) which monitors all ethical issues related to machine and periodically checks ethical index.
2018	Vidhusi Marda AI Policy in India: a framework for engaging the limits of data driven decision-making	The objective is intended to influence existing AI policy deliberation in India and invite a cross-disciplinary discussion on the issue	Qualitative Exploratory	Pace of development is quick, nature of development is opaque, and the effect of development is profound and irreversible.	Future deliberation, policy making and regulation of AI may be informed/discussed by multiple disciplines.

2018	Malhotra, Charru, Anand Rashmi, Accelerating Public Service Delivery in India: Application of Artificial Intelligence in Agriculture	Explores current and future application of Artificial Intelligence in government. It suggests government to adopt an explicit AI policy to drive innovation, adaptation, and proliferation attempt	Qualitative Exploratory	The paper identifies huge potential of application of AI in different sectors including in agriculture. Govt to have an AI policy	1) The AI applications have largely been in private sector- Govt needs to lay down policy framework, re-orient education policy to leverage AI. 2) The scope of application of emerging technologies are much higher and only a few applications have been discussed.
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