

AI in Banking

A Primer



Note from IDRBT Director, Dr. A S Ramasastri

AI : A Few Philosophical Thoughts

Intelligence is one of the defining features of being human and it comes in various forms such as linguistic, spatial, mathematical, and emotional. From a purely practical point of view, intelligence can be defined as the capacity to absorb and learn from experiences; it is the ability to deal with and address problems and be able to adapt to new situations.

Learning is the process of acquiring new understanding, knowledge, skills, values, attitudes, and preferences. The ability to learn is possessed by plants in a very limited way, animals to some extent, and human beings on a larger scale. Human learning starts at birth (might even start before) and continues due to continuous interactions with other people and environment. Some learning is immediate, induced by a single event (like burning due to fire), but most other learning accumulates from repeated experiences.

Brain is considered the seat of learning among human beings. It is the most complex organ in the human body; made up of about 86 billion neurons that communicate in trillions of connections called synapses; with whose help it experiences the world and learns. The brain receives inputs, sorts, and stores the data, analyses, builds indexes and links, and when required retrieves it along with all associated information. Despite advancements in neurosciences, several aspects of intelligence and learning exhibited by the brain, remains in the unknown frontier.

Artificial intelligence (AI), unlike the natural intelligence displayed by brain, is intelligence demonstrated by machines. The term AI is used to describe machines that try to mimic cognitive functions possessed by humans, such as learning and problem solving. Yet it is difficult to define what exactly AI is.

AI effect highlights the major difficulty in defining AI. As per the famous Tesler's Theorem, "AI is whatever hasn't been done". AI is an ever-changing goalpost. Plenty of examples exist of the AI effect in action. For example, optical character recognition has become routine technology and is often excluded from AI discussions.

It was once thought that a machine that could beat a grandmaster at chess embodies an AI. Deep Blue achieved this feat in 1997 against chess grandmaster Garry Kasparov. Then the goalpost moved and Go became the game AI needed to beat. (And it did in 2016 when AlphaGo defeated Lee Sedol in four of five games.)

Chatbot that appeared as though it was talking to you was once considered intelligent. But it is not considered now because it does not understand the intent behind your messages. The point is, every time an AI completes a new feat, that feat is no longer a benchmark.

The present AI capabilities may include areas like strategic games, autonomous cars, and military simulations. And possibly certain critical areas in banks like fraud detection, risk management, and customer behaviour.

Banks have been in the forefront of adoption of newer technologies for the past few



decades. Many of the routine activities have already been entrusted to machines. There have been phenomenal improvements in user interfaces, payment channels, internal controls, and useful dashboards. They have also been using AI related systems like robotic process automation, robot receptionists, chatbots, and machine learning techniques. But such adoption can bring in its own questions on ethics.

Ethics of developing artificial beings that have the intelligence of humans has been on the minds of human beings for quite some time. Some people view AI, if it progresses relentlessly, as a threat to humanity. Some fear that AI, unlike past technological revolutions, could risk mass unemployment. The events so far in human history have adequate evidence to allay such fears. Humans have always been successful in tiding over temporary difficulties.

However, while absorbing AI in banking, it is necessary to take adequate precautions to ensure security of the systems. More so, it may be very essential to build internal controls to identify accountability and responsibility in case of large-scale errors creeping into various AI managed functions of banking. The entire ecosystem must address the concerns relating to AI in banks.

Ecosystem for banking technology comprises governments, regulators, academic institutions, major technology companies, emerging financial technology companies (fintech), as well as banks themselves. The need for closer coordination among academia, IT industry, and banks are the greatest in today's world of AI adoption in banking. The publication in your hand is a result of such a collaboration.

The teams from Banks, Microsoft, and IDRBT, who put in their best efforts to bring out this Primer on AI, deserve all compliments. I am sure the Primer will serve as a good reference to all banks in their AI journey.



Note from Microsoft India President Anant Maheshwari

The new normal has accelerated Data and AI adoption manifold and this has clearly shown the benefits of investing in a tech enabled future. This is enabling organizations, individuals and governments across the country and the world to not only rebound stronger from the crisis but to reimagine a new future.

The banking and financial services industry has been at the heart of this change. A critical determinant of India's economic success, we have seen the sector embrace large scale digital transformation in the last few months, paving the way for the future of banking in India.

Harnessing the power of AI will continue to be a vital enabler in that journey. It is becoming existential for every business and will play a key role in India's economic and social value creation. AI has supported the government and businesses with containment efforts, workforce planning and protection, as well as in restarting the economic engine in a systematic and secure manner. Driving utilization of Data and

AI will also be a catalyst in realizing India's 2025 vision of inclusive development, and a recent NASSCOM report shows that it has the potential to deliver \$450-500B for the economy by 2025.

In this environment, building a scalable model for leveraging the full potential of Data and AI will be central to driving unbridled innovation and digital transformation across industries, and particularly in the banking and financial sector. We are already seeing more innovation than ever in fintech as people are depending less on physical wallets and using more of digital payment mechanisms. Financial services organizations have been leveraging AI to enhance customer experience, improve operational efficiency, manage risks, detect frauds, gather data-driven insights, and even streamline regulatory compliance. We are seeing innovative lending products with data driven insights enabling the ability to predict and minimize credit risk as well as analytics-based collection models.

This also has deep implications for financial inclusion and access. Technology platforms built with strong data and AI foundations are enabling contactless banking and remote operability for millions across India. AI is helping build the critical digital infrastructure that will allow every community, urban and rural; every business, small and large; every worker, first-line and knowledge workers; and every person, including people with disabilities to benefit from tech intensity.

AI should be defined not just by what technology can do on its own, but by how it can augment and amplify human effort for people to do more. Banking of tomorrow will combine artificial and human intelligence (AI+HI) to be more collaborative, personalised, inclusive, and to deliver better products and consumer experience, all built on trust. It is an honour to collaborate with IDRBT to introduce this paper and we stay committed to working together with everyone to innovate and reimagine the next phase of growth. Creating an AI ready ecosystem in India that enables everyone to leverage the technology for productivity and growth is an imperative for India to leapfrog into the future. This will accelerate the progress towards the mission to empower every person and every organization in India to achieve more.



TABLE OF CONTENTS

Note from IDRB Director Dr. A S Ramasastry	2
Note from Microsoft India President Anant Maheshwari	4
Objective	6
Section I: Introduction	7
India – in the middle of a digital revolution	7
Section II: Artificial Intelligence	8
Global developments in AI	10
India: Government initiatives to harness AI	11
Section III: AI in banking	13
Introduction	13
Current state in India	13
Use of AI in banking	14
Indian bank case studies	15
Other Use Cases of AI in Banking deployed by Global Banks	23
Section IV: Adoption Strategy of AI in Banking in India	27
Challenges for AI adoption	27
Framework for AI adoption	28
Requirements for AI adoption	28
What do banks need for AI adoption?	29
Recommendations to Banks for adoption of AI	29
AI Maturity Assessment – Call to Action	31
Summary	31
Bibliography	32
Contributors	33

OBJECTIVE

Artificial Intelligence, Blockchain, and Internet of Things are emerging technologies that are impacting various aspects of human life. These technologies have the potential to disrupt the way we interact with each other, operate our businesses, and even how governments work for their citizens.

Amongst these, AI is probably the most ubiquitous and disruptive in nature. The use of AI by organizations and governments, and its deployment in improving customer experience, operational efficiency, fraud detection and cybersecurity is on the rise across the world. Although the adoption of AI varies significantly across geographies, there are pockets of industries even within the developed countries that are increasingly adopting AI to better service their customers and bring in efficiencies of scale. One such industry that has embraced AI across geographies is banking.

Developing AI infrastructure in India is a key priority for the Indian Government. The Indian Government's NITI Aayog (a policy resource centre) formulated the 'National Strategy for AI' in 2018. The strategy seeks to position India as a global leader in AI. This is one of the many initiatives launched by the Indian Government to channel and utilize the potential of AI for India. Outlining the vision and importance of development of AI for India, Prime Minister Narendra Modi remarked, "We need to make artificial intelligence in India and make artificial intelligence work for India."

As India progresses in its economic journey and aims to become a USD 5 trillion economy by 2024, it will require infrastructure to scale up and support this growth. Financial infrastructure will play a fundamental role in this process given India's policy objective of financial inclusion and the banking sector will be an integral part in this journey. The government has stated that for banks to fulfil India's growing needs, they must harness technologies such as AI and big data.

Banks and financial institutions stand to benefit significantly from AI. Whether to improve overall customer experience, take more informed decisions on credit underwriting, detect frauds and defaults early, improve collections or increase employee efficiency, AI has the potential to transform India's banks.

As AI makes inroads into several hitherto untraversed domains, its definition gets blurred. An important objective of this report is to demystify the concept of AI and explain its close relationship with data science. Further, this report explains the applicability of AI to banks in India and recommends steps that could be taken to make them ready to embrace the changes that AI can bring.

Section I: Introduction

India - in the middle of a digital revolution

With the advent of a digital revolution around the globe, India faces a defining moment. With its digital sector estimated to double its output as early as 2025, digitization is expected to foster widespread economic growth and employment through incremental value addition across a variety of sectors including education, logistics, manufacturing, and healthcare.

In the last decade India has witnessed a wave of technological disruptions that have been facilitated by our advanced IT sector and the demographic potential in the country. This has made India the world's second largest digital ecosystem with over 700 million internet users. It has been estimated that this number will increase to 829 million by 2021, with the number of smartphones doubling to approximately 800 million in this period.

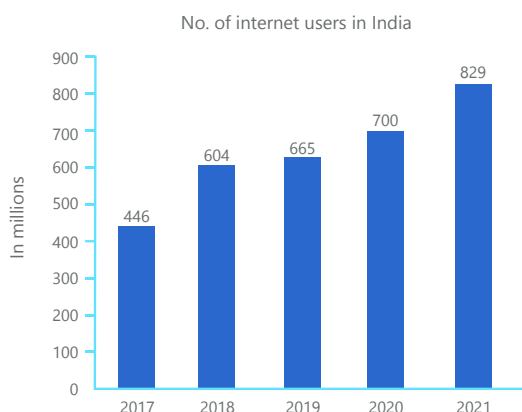


Fig.1: Internet Users in India Source: India Brand Equity Foundation

The rapid pace of digital adoption in India has come about thanks to a mix of factors: the government's commitment to digitising key facets of the economy, innovations in the private sector, and investments to stimulate the use and access of the internet.

The government has played a catalytic role by establishing up a strong national digital foundation by way of public platforms and infrastructure. This has been aided by the launch of several digital

applications and services that have incentivized citizens to come online.¹

These efforts have enabled India, which started off low, to become the second fastest digital adopter among 17 major digital economies. Several factors have contributed towards this achievement - one-governance and digital identity, the growth and penetration of mobile internet access, e-commerce, digital payments, and the rise of digital media among online consumers.

States in India have begun bridging the digital divide with both private and public-sector promoting digital usage through their initiatives. Showing fastest growth in internet infrastructure are lower income states, where base tower stations and internet penetration among new customers is on the rise. This demographic advantage has allowed the country to attract large marquee investments from established foreign technology companies while simultaneously allowing existing Indian companies to venture into this space.

As a consequence of these developments, India's digital economy is expected to stand at USD 250 billion by the end of 2020, double of its size of 125 billion in 2017.² As the Indian government pushes for India to become a USD 5 trillion economy by 2024, it also wants India's digital economy to become USD 1 trillion by 2025.¹

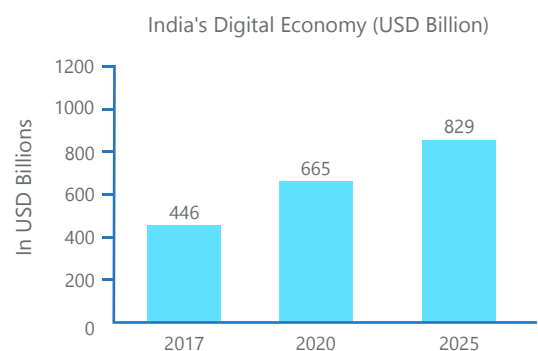


Fig. 2

¹Source: Ministry of Electronics and Information Technology, India's Trillion Dollar Opportunity

Section II: Artificial Intelligence (AI)

AI is the collection of data, algorithms, and computing power to enable machines to emulate human capabilities and act with higher levels of intelligence.³ The ability to learn from patterns in text, speech, images, videos and any other data to provide recommendations has made AI ubiquitous in research and industry, including financial services. Some of the use cases leveraging capabilities of AI in financial services are (i) anomaly detection to flag abnormal data patterns, (ii) recommendations for relevant alternatives based on future predictions, (iii) translation across languages, (iv) optimization (e.g., tuning the cooling temperature based on power consumption in a data centre), (v) fraud detection and risk management and (vi) digitization and automation of services.⁴

Evolution of AI

Although the concept of AI has been around for centuries, it was not until the 1950s when its true possibility was explored. A generation of scientists, mathematicians, and philosophers all had the concept of AI but it was British polymath Alan Turing who suggested that if humans could solve problems and make decisions by using available information and reason, then machines could do it too. Although Turing outlined machines and how to test their intelligence in his paper *Computing Machinery and Intelligence* in 1950, his findings did not advance.

John McCarthy and Marvin Minsky, considered founding fathers of AI, defined it as “the science and engineering of making intelligent machines” along with a group of researchers in 1956 at Dartmouth College in United States. This group of researchers were attempting to make machines use language, form concepts and solve problems without human intervention. The AI movement began with major design goals to teach and enable machines to⁶:

- i. reason and perform sophisticated mental tasks,
- ii. identify objects, people, and languages so they can interact with the real world as humans do,
- iii. plan and navigate the world around them so they can autonomously move around by navigating themselves,
- iv. process natural language so they can understand language and interpret conversations and
- v. perceive the way humans do using five senses.

Nobel Laureate and Turing Award Winner Herbert Alexander Simon defined Machine Learning (ML) as: *“A process by which a system improves performance from experience. Machine Learning is concerned with computer programs that automatically improve their performance through experience.”*

Geoffrey Hinton, inventor of learning models, said about AI, *“Modern AI is modeled after ideas about how the brain works. The way the brain works is, you have a big network of brain cells, an input comes in and stuff goes on and then you get an output and the output you get depends on the connection strengths between the brain cells. If you change those connection strengths, you change the output you will get for each input. The way AI now works is instead of programming the computer you show it lots of examples it changes the connection strengths and it learns to produce the right answers without you ever programming.”*

However, the absence of the amount of data apart from computing power required for AI disrupted its progress, leading to an AI winter. This has changed since the early 2000s following the dot-com bubble, with AI being increasingly harnessed in multiple fields, driven by innovation through the convergence of various factors such as (i) the unprecedented availability of big data, (ii) powerful and enhanced computing, (iii) uninterrupted mobile connectivity, (iv) cheaper internet, and (v) improvements in ML algorithms. These have enabled AI technologies to be easily embedded and made portable, while managing data within the cloud.

Several breakthrough developments in AI over the decades have been supported by algorithms that were developed many years prior to the actual achievement. The average time from when an AI algorithm was first planned to the time a discovery took place has been recorded as 18 years.¹² This new phenomenon can be called new AI clearly differentiating the symbolism that was the fulcrum of the traditional AI. The timeline of developments in AI is depicted in Figure 1.

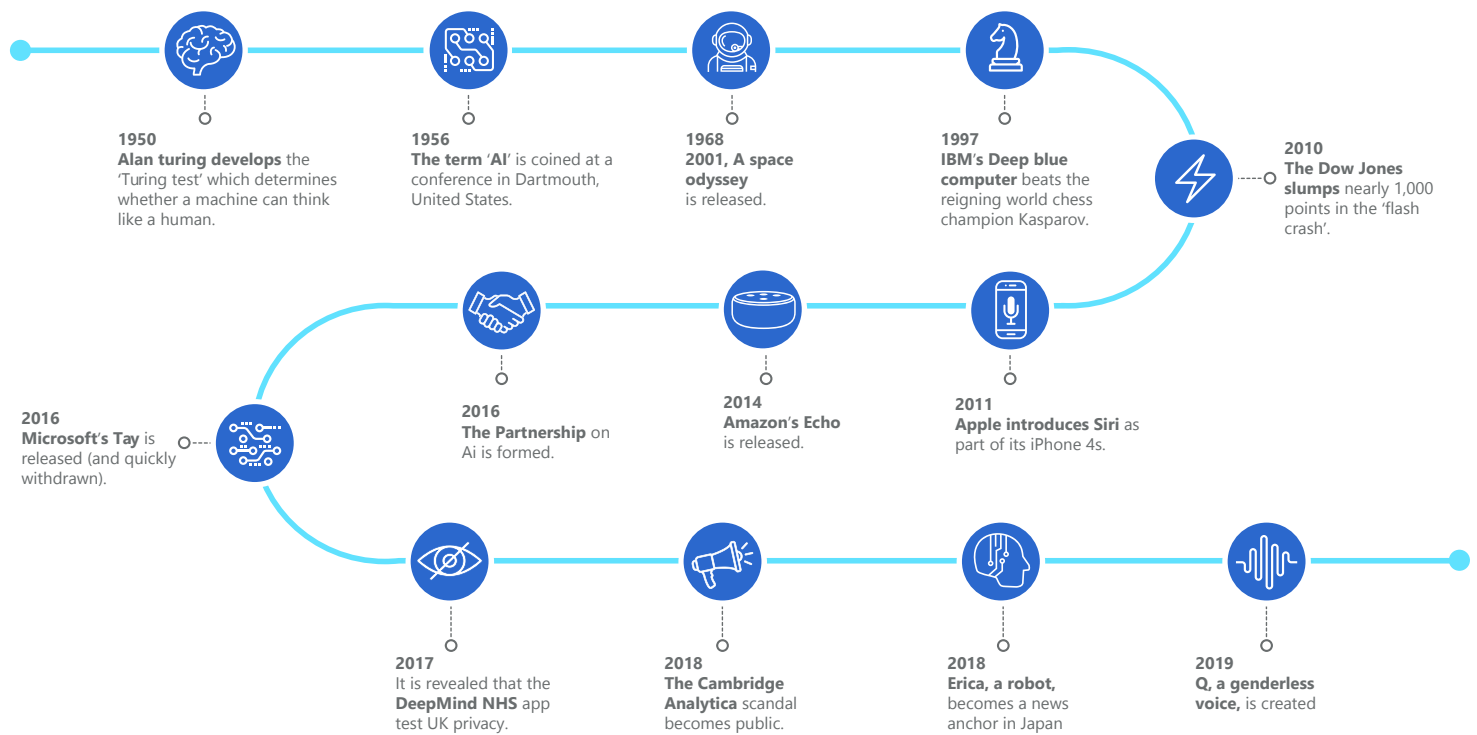


Fig. 3

The challenges and developments in AI indicate the volume, variety, veracity, velocity of data to build analytical models. This dependency on data brings it closer to data science, an umbrella discipline subsuming all three forms of analytics (descriptive, predictive, and prescriptive), big data social media, engineering and AI, as shown in Figure 4. Organisations have been adopting data science, leveraging AI models for improved customer

experience and operational efficiency. It is the ubiquitous presence and requirement of the data that blurs the boundaries between these exciting fields. The close relationship and blurred boundaries between AI/ML and data science is depicted in Fig. 4, Fig. 5, depicts the constituents of ML and Fig. 6 depicts the framework for conducting an AI/ML project. It has a striking similarity with CRISP-DM framework for conducting data mining projects.

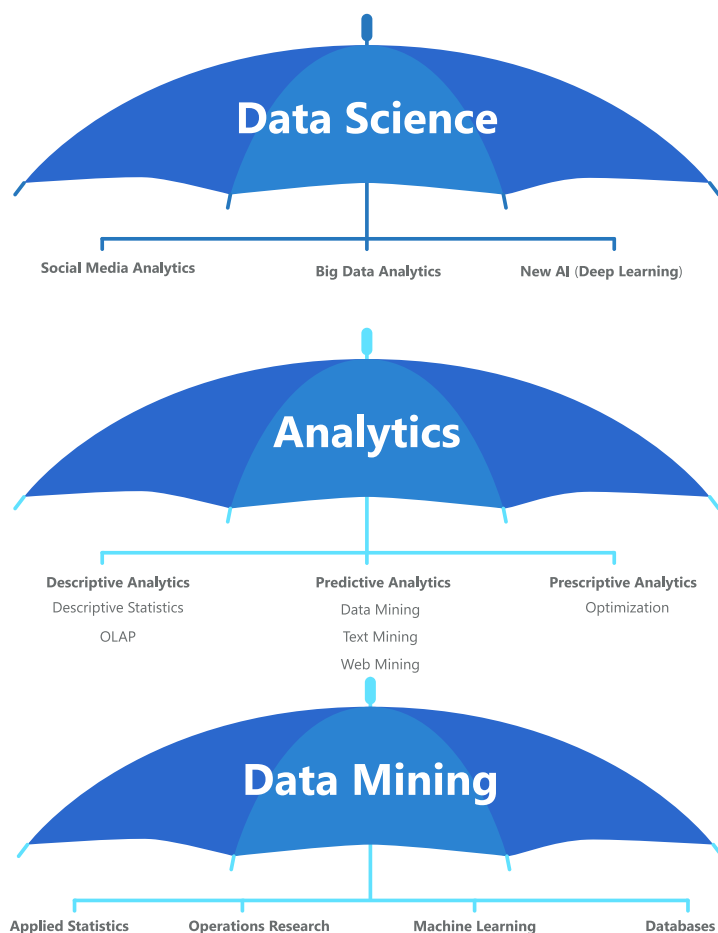


Fig. 4. Close relation between AI/ML and data science

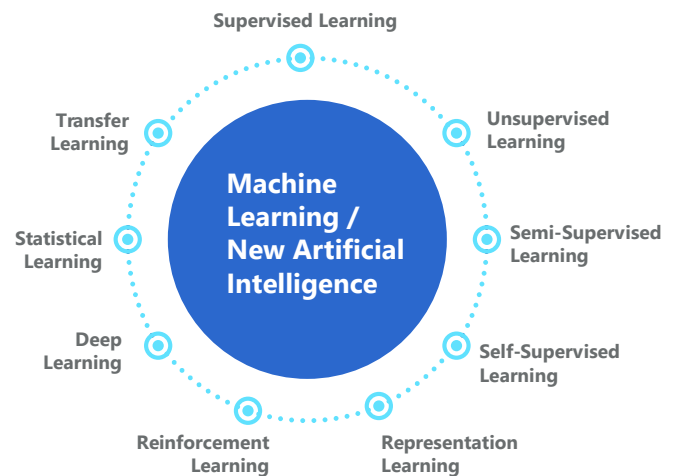


Fig. 5. Constituents of Machine Learning

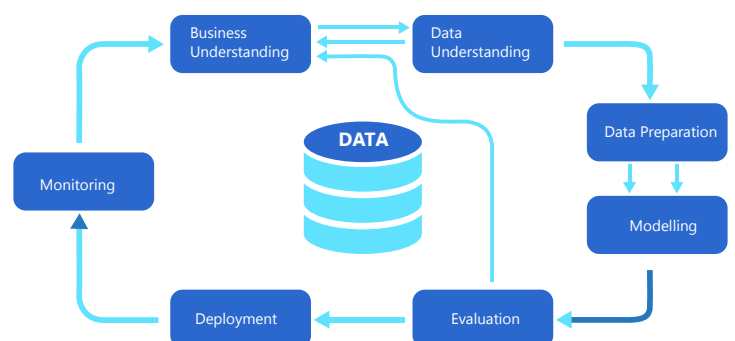


Fig. 6. CRISP-DM framework for AI/ML

Global developments in AI

Developed and developing countries across the globe are coming out with white papers and national strategies on AI. Many of these strategies involve developing ethics and principle-based guidelines for use of AI, and identifying changes needed to existing laws and regulations, in addition to formulating new ones to enable its use. Prominent examples of among these countries are the United Kingdom, China, the United States of America and Singapore. In addition to formulating guidelines for effective use of AI across industries, nations across the world are trying to develop comprehensive regulation for AI to address associated ethical, legal, social and economic issues.

In most countries regulation has struggled to keep pace with accelerating change brought by new technological developments including AI. Specific AI regulations applicable to financial institutions are limited⁹ and existing laws and regulation govern the use of AI. To some extent, corporates self-regulate by adhering to ethical AI guidelines that are voluntary in nature. An example of such would be the voluntary ethical guidelines for AI published by Microsoft.¹⁰ The first intergovernmental standard for AI policies was published by the Organisation for Economic Co-operation and Development (OECD) in May 2019, which has been endorsed by 42 countries.¹¹ However, an international consensus on rules that should govern AI is yet to be reached, given the divergence in ethical approaches of different countries, and given variations in the use of technology.

The section below highlights how major countries are using AI and their strategies for its development.

The United States of America (US): The AI strategy of the US has favoured innovation over regulation, with big technology corporations rapidly developing technology and introducing self-regulation.

American companies such as Microsoft, Google, and IBM have led US's leadership in AI investment. After from the private sector investment in research and development (R&D), it is estimated that the US Government has spent USD 1.2 billion in 2020 for non-classified AI research. The American AI Initiative that was launched in February 2019 by US President Donald Trump was directed towards expanding the role of the US as the world leader in AI. This initiative is the United States' national strategy on AI, which will focus on promoting sustained AI R&D investment, unleashing Federal AI resources, removing barriers to AI innovation, AI-centred opportunities for education and training, and creating an international

ecosystem that supports AI innovation and promotes its responsible use. The initiative has also empowered the National Institute for Standards and Technology (a physical sciences laboratory under the Department of Commerce) to take the lead in defining standards on which sectoral regulators will be able to base their own rules.

United Kingdom (UK): The UK released its industrial strategy in November 2017, stating a goal of propelling the UK to global leadership in four futuristic industries of AI, big data, clean energy, and self-driving vehicles.¹² The strategy seeks to put UK at the forefront of AI and data revolution. To oversee the execution of this goal, three dedicated public offices have been instituted – the Centre for Data Ethics and Innovation, the Office of AI, and the AI Council. Further, in April 2018 the AI Sector Deal was launched with the purpose of increasing investments in AI-related R&D to 2.4% of GDP by 2027, and improving the AI talent pool in the country by providing financial support for 1,000 PhDs in the realm of AI, with an additional funding of GBP 90 billion to research institutes. The UK has also adopted a responsible AI guiding principle to guide these policies.

European Union (EU): Western Europe is dominating AI readiness; 11 of the top 20 governments in AI readiness are from Western Europe, according to the AI Readiness Index. National strategies on AI of different countries such as France and Germany and private sector innovation across the region are responsible for this. In March 2018, France unveiled its national AI strategy that seeks to transform the country into an innovative 'start-up nation' and includes USD 1.7 billion investment in AI research. Germany's AI strategy, published in 2018, plans to spend around USD 3.4 billion in the areas of R&D and developing socially responsible AI principles. In the EU, member states have agreed to cooperate to resolve the 'social, economic, ethical and legal questions' of AI. The European Commission formed a High-Level Expert Group to advise it on AI. In April 2019, this group presented a report on 'Ethics Guidelines for Trustworthy AI'.¹³ These guidelines recommend that the trustworthy use of AI should be lawful, ethical and robust. The recommendations include several ethical principles for AI. These have been expanded into 10 main requirements for trustworthy AI and include suggestions on methods to implement these requirements. The Group, along with the Commission is exploring policies based on these recommendations.

China: The Chinese government launched a 'New Generation AI Development Plan' in 2017.¹⁴ The plan

outlines China's strategy to become the world's premier AI innovation centre by 2030 by establishing its domestic AI industry worth nearly USD 150 billion over the next few years. The domestic industry will include a national fund that supports research on critical AI projects. China has granted government funding to its top nine universities to establish AI schools and the remaining 32 will include an AI program as part of their curriculum for which funding has been provided. China's Ministry of Industry and Information Technology is looking at investing in strategic AI projects for State Owned Enterprises and the public sector as well, with an annual budget of nearly USD 950 million.

Japan: In March 2017, Japan released its 'Artificial Intelligence Technology Strategy'¹⁵ that includes a roadmap for industrialization and AI development, which is in three phases: (i) the use and application of data-driven AI developed across domains (through 2020); (ii) public use of AI (from 2025-2030); and (iii) creating AI ecosystem of multiplying domains.

Singapore: Singapore has led the way in drafting principles for use of AI, particularly in the financial services industry. In 2018, Singapore's financial services regulator Monetary Authority of Singapore (MAS) published the FEAT principles to promote fairness, ethics, accountability and transparency in the use of AI in data analytics, specifically with respect to the finance sector in Singapore.¹⁶ Following this in January 2019, the Personal Data Protection Commission (PDPC) of Singapore released a sector-agnostic, cross-cutting set of principles and guidelines for AI called 'Model AI Governance Framework'.¹⁷ A second edition of this framework was released in January 2020.¹⁸

India: Government initiatives to harness AI

Expressing its intent to invest in AI, the Indian government, in its 2018 Union Budget, doubled its past allocation to the Digital India initiative (USD 480 million or Rs 3,703 crore) for the growth of digital technologies. The Government's commitment includes extensive investment in research, training, and skill development in areas such as AI, big data intelligence, robotics, digital manufacturing, and quantum communications. These initiatives could be joint projects, internal programs, or part of the AI Task Force. While most initiatives relate to implementation beyond AI, there are many initiatives that specifically or indirectly impact the banking and finance industry. This following section looks at both types of initiatives.

The AI Task Force: The Ministry of Commerce & Industry set up the AI Task Force to carve the path forward for use of AI in the country; the Task Force includes members from the private sector, including banking and finance. In March 2018, the Task Force released its report that identified 10 key domains where AI could play a crucial role in India's socio-economic development. The fintech industry is part of the 10 identified domains. According to the report, the use of AI in fintech will help expand the existing efforts of IndiaStack, which enables and promotes digital payments and paperless transactions. The report says that if the banking and financial sector leveraged AI, it would help small and medium enterprises apart from enabling better risk assessment. Other sectors identified by the task force include manufacturing, agriculture, healthcare, national security, environment, public utility services, technology for the differently abled, retail and customer relationship, and education. In continuation of setting up this task force, the Government of India launched a comprehensive portal <https://indiaai.in>, on AI and India's initiatives on AI.

The Ministry of Electronics and Information Technology report on AI: MeitY has set up the following committees to suggest a policy framework for AI:

- Platforms and Data on AI
- Leveraging AI for identifying national missions in key sectors
- Mapping technological capabilities, key policy enablers required across sectors, skilling, re-skilling, and research and development
- Cybersecurity, safety, legal, and ethical issues

The Ministry's report on leveraging AI for identifying National Missions in key sectors identifies finance as a sector where AI can be leveraged efficiently. Further, it identifies fraud detection and the use of predictive analysis for identifying potential Non-Performing Assets (NPAs) and bad loans as examples of the use of AI in the financial sector.

NITI Aayog - National AI Strategy: In the 2018-19 Budget, NITI Aayog was tasked to chart out a National Program on AI. Towards this, the think tank released a discussion paper on National Strategy for AI. The 'AI for All' strategy was focused on leveraging AI for inclusive growth aligned with the Government's aim of development for everyone. The report clearly outlines what the government needs to do, which includes developing the research ecosystem, promoting adoption, and addressing skilling challenges. Important issues such as ethics, bias, and privacy issues related to AI have also been

In addition to the initiatives highlighted above, several government departments at both the state and central level are already using or planning to use AI in a major way. Some of these are:

- **IndiaStack:** IndiaStack is a set of Application Program Interfaces (APIs) that empowers governments, businesses, start-ups, and developers to use a unique digital infrastructure that facilitates the digital delivery of public goods and services. The largest open API in the world, IndiaStack operates using four technology layers: the Presenceless Layer (that involves biometric data storage); the Paperless Layer (that associates personal records with one's online identity); the Cashless Layer (a single interface for all national banks and online wallets); and the Consent Layer (that secures and controls personal data). The use of AI and a fuzzy learning algorithm with the Aadhaar database is reportedly a part of the platform's Presenceless technology layer and will facilitate identity authentication of Aadhaar holders.

of Maharashtra announced the implementation of AI-based solutions for agriculture to reduce agricultural risks for farmers. The technology will be used to mitigate cultivation hazards that occur due to unreliable rains or pests, and to predict crop-wise and area-wise yield. The use of satellite imagery helps understand the crop area, crop condition and crop yield at district levels. Several other states are planning to use AI in a similar manner.

Section III: AI in Banking

Introduction

Global financial bodies and committees view emerging technologies such as AI as enablers in the growth and customization of financial services. In 2017, the Financial Stability Board (FSB), an international body that monitors and makes recommendations about the global financial system, set out different applications of AI in the financial sector, such as in the verticals of portfolio management, client due diligence, credit scoring, and regulatory compliance. The FSB also outlined possible benefits for retail customers and small and medium-sized enterprises (SMEs), as well as efficiency gains in back-office procedures carried out by banks. In a 2018 report, the Basel Committee on Banking Supervision (BCBS) - a committee of banking supervisory authorities and the primary global standard setter for the prudential regulation of banks - encouraged banks to harness emerging technologies such as AI to increase their efficiency in responding to fintech-related risks. The Committee then commenced discussions with regulators and the industry on risk management and AI systems, including through a workshop hosted by its Supervision and Implementation Group (SIG) in Tokyo in October 2019.

India's digital banking (including retail banking) and finance sector has witnessed immense growth in the past two decades. This transformation has been primarily driven by an increase in digital payments across sectors and industries. The country's established financial institutions are now deploying fintech to provide end users agile, efficient, and differentiated experiences along the complete value chain of financial services. The rise in fintech use will bring in financial innovations and transform India's financial landscape in two primary ways: (i) consumers will have a larger set of options at competitive prices, and (ii) lower operational costs can improve efficiency at financial institutions. The Government of India's 'DigiDhan Mission' recognizes that financial inclusion remains one of the foremost challenges for India and that digital payments promise access to formal financial services and benefits, especially to those who continue to be excluded.²⁰ AI models are being used to detect fraudulent accounts and improve the efficacy of the scheme.

Current state in India

India is already at the forefront of the fintech revolution. The proliferation of mobile technology in India in recent years has contributed to the unparalleled growth of India's fintech sector. The

sector has leveraged the changing consumer preferences that have emerged from this growth in digitisation to develop an array of innovative services and products for the changing economy. These include internet banking, mobile banking and payment apps. This shift in business methods has led to an increase in partnerships between technology developers, banks, and financial institutions using such technologies.

Banks can mine the financial transaction data generated by the proliferation of digital payments and banking to better monitor, predict and respond to consumer behaviour. The rising demand for online banking and financial information offerings has created opportunities for AI implementation in India's retail banking, financial, and investment services sector. In 2019, an inter-ministerial panel on fintech suggested a comprehensive legal framework to protect consumers of digital services. The panel also suggested increasing the levels of automation using AI, cognitive analytics, and ML in their back-end processes.

Reserve Bank of India: The Reserve Bank of India set up an Inter-Regulatory Working Group to study issues relating to fintech and digital banking in India. The Working Group set out to understand the important innovations in the fintech industry and how various actors in the financial sectors were using new methods, products, and technologies. Released in February 2018, the Group's report categorizes the use of AI and robotics in data analytics and risk management as one of the major fintech innovations. The report states that the digital transformation of the banking and financial sector would ride on three pillars: blockchain, AI and the Internet of Things (IoT). The report also stated that when devices get interconnected and use self-learning and evolving AI, the banking sector will expand beyond apps, websites or physical branches.

Institute for Development and Research in Banking Technology (IDRBT):

Contributions to AI, ML, and data science in the banking space started at IDRBT in 2005 itself under the aegis of Centre of Excellence in Analytics. The centre is involved in advanced research, training, teaching, developing POCs and guiding Indian banks on their AI journey for several areas. These areas include segmentation of customers, NPA prediction, credit scoring, market basket analysis (cross-sell/upsell), detection of fraud, sentiment analysis, analytics for credit recovery, and big data analytics.

Over 1,000 executives from the IT and business segments of public and private sector banks have already been trained in these areas. The hallmark of these customized training programmes has been the rigorous hands-on component on state-of-the-art commercial and open source tools. This work is recognized by the Government of India on <https://indiaai.in>

Use of AI in banking

AI is demonstrating a huge impact on the banking sector, impacting the working of organizations at three fundamental levels: (i) the processes they adopt (ii) the products and services they sell and (iii) the user experiences they offer to their customers and employees. Globally, banks are already starting to adopt AI at a massive scale. According to a UBS Evidence Lab report²³, 75% of respondents at banks with over USD 100 billion in assets say they are currently implementing AI strategies compared to 46% at banks with less than USD 100 billion in assets.

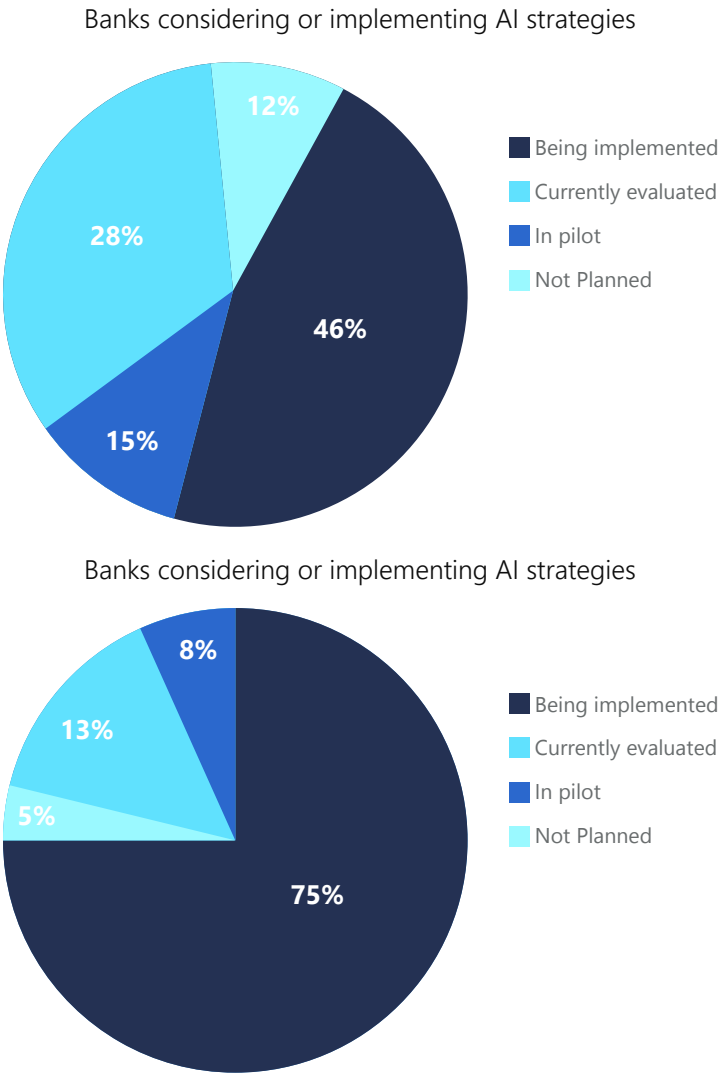


Fig. 7: Assest Size: Above USD 100 Billion

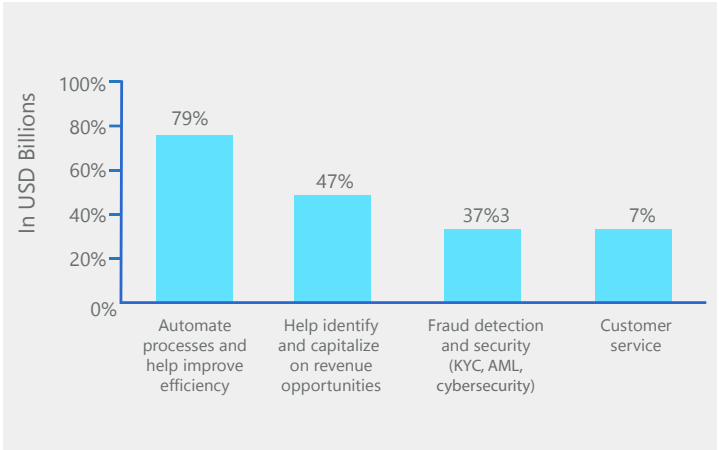
A Microsoft Asia and IDC Asia/Pacific study specific to the Financial Services Industry (FSI) found that

organizations in the Asia-Pacific that deploy AI expect to see 41% improvement in competitiveness in three years.²⁴ Further, 52% of FSI organizations in Asia-Pacific have started on their AI journeys, and are ahead of other industries in the region. FSI organizations that have already started on their AI journeys saw improvements in the range of 17% to 26% in areas such as better customer engagement, higher competitiveness, accelerated innovation, higher margins, and improved business intelligence.

The aggregate potential cost savings for banks from the application of AI in front, middle, and back offices is estimated at USD 447 billion by 2023.²⁵ Of this, middle office operations will account for close to 50% of the cost savings opportunity, and front and back offices will account for 45% and 7%, respectively. Key use cases across these three offices in banks include:

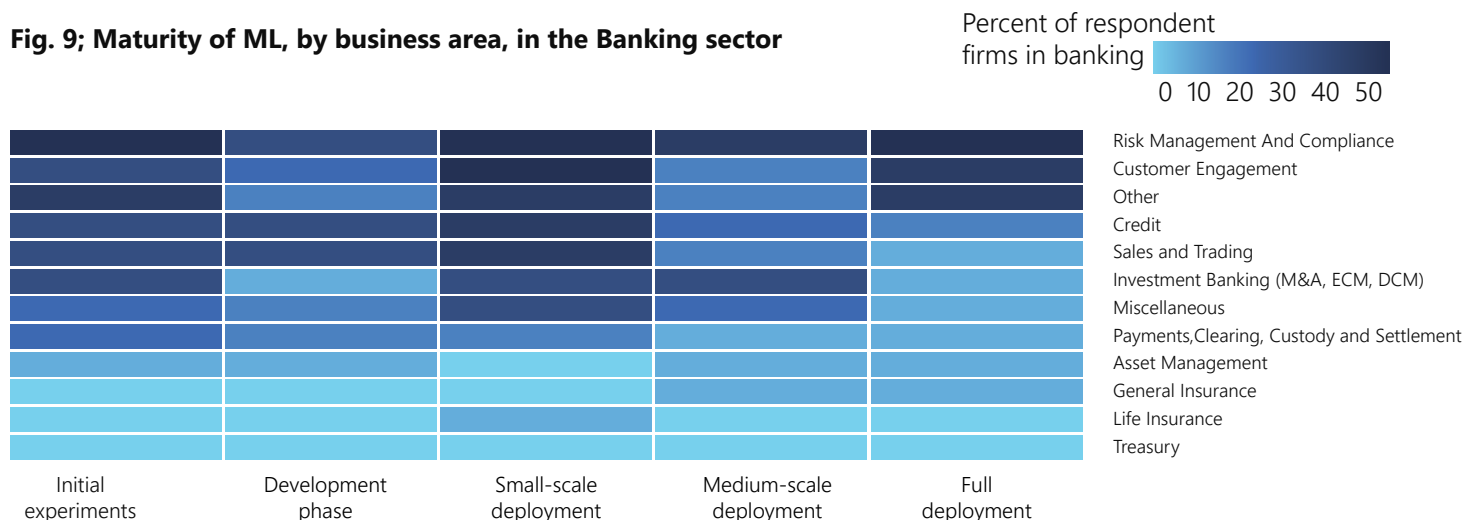
- **Front office:** Customer interface; personalized insights; authentication and identification of customers using biometrics; and wealth management.
- **Middle office:** Payment fraud detection and risk management; Know Your Customer (KYC) and Anti Money Laundering (AML); and credit rating services and loan decisions.
- **Back office:** Business and strategy insights; simplifying backend processes; and regulatory compliance.

Fig. 8; In a survey by the UBS Evidence Lab, bank executives recognized the four most beneficial uses of AI.



An important application or subset of AI is machine learning (ML), which enables a computer system to use historical data to make predictions or take decisions without being explicitly programmed to do so. ML algorithms use structured and semi-structured data to develop models that can generate accurate results or make predictions using this data. The adoption of ML and its usage is spreading across different business areas in the banking sector. The figure below illustrates the maturity in the use of ML by business area in the banking sector.

Fig. 9; Maturity of ML, by business area, in the Banking sector



Case studies of Indian Banks

State Bank of India

The State Bank of India (SBI) began using analytics in 2014. It collaborated with the Indian Institute of Management Bangalore (IIMB) and the Indian Institute of Management Kolkata (IIM-K) from 2014-15. It also received trainings from the Institute for Development & Research in Banking Technology (IDRBT) and Manipal University in 2016.

Upon commencing its use of analytics, SBI recruited 19 data scientists; Today, the bank has a comprehensive organizational structure in place. Headed by a Deputy General Manager (Analytics), General Manager (Data & Analytics), CGM (ESS), DMD & CIO in that order, the bank has accomplished many milestones in its journey of integrating AI, ML and analytics to address a variety of business and operational problems. The details are as follows:

TECHNIQUES

- Collaborative filtering
- XG Boost
- Natural Language Processing
- Geo-Location Analysis
- String Matching
- Random Forest
- K-Means Clustering
- Network Analytics
- Natural Language Processing

MODELS DEVELOPED

- Recommendation Engine -For CPS Customers
- Early Warning System(P-Seg)
- ATM Win-back Analysis
- Predictive Analysis for CA Growth
- Identification of Fraud prone Branches
- ATM chargeback suspicious complaints model
- CSP Model



Open-source De-facto standard

Fig. 10

TECHNIQUES

Linear prediction
K-means Clustering

Netural Network
Logistic regression

Random Forest
CHAID

Data Scrubbing

MODELS DEVELOPED

Footfall Reduction

Project Shikhar
CA Chum Prediction Leads

Early warning System(SME)

GST based SME Leads
SMS Cost Analysis
SME Leads
IOCL Konnect Campaign

SPSS

Fig. 11

Fig.12; AI/ML models for Business Growth # 1

Project Shikhar

- Aim : Pre-Paid Credit Card Issuance Model
- Tech : XGboost, with Ensemble Learning
- USP : A very successful model, won the 2020 Stevie's Award in LA (USA)
- Success : Accounted for nearly half of BANCA card issues, increased SBI Cards Value

Pre-Approved Personal Loan

- Aim : Digital Personal Loan, availed via YONO
- Tech : RSM, Propensity Model
- USP : Digital Insta-Loan, reduces Branch Workload & reduces risk
- Success : Generated a large, low-NPA portfolio with minimal branch load

Personal-Gold Loan

- Aim : Generate leads for increasing P-Gold Loan Portfolio
- Tech : NLP, Propensity Model
- USP : Identified base set of customers who possibly have Gold assets
- Success : Large number of loans issued based on these leads

Agri Gold Loan

- Aim : Generate leads for increasing Agri-Gold Loan Portfolio
- Tech : XGBoost
- USP : YONO Krishi app based lending
- Success : Large number of loans issued based on these leads

Recommendation Engine

- Aim : Gives personalised, ranked product recommendations
- Tech : Cutting Edge Collaborative Filtering Technique used
- USP : Run across SBI's entire Portfolio of Salaried Customers
- Success : Adopted by front line employees, generated large asset portfolio

PAML

- Aim : 1st of its kind end-to-end digital SME lending
- Tech : Clustering & Neural Network
- USP : Holistic, uses 1400+ variables like transactions, Digital footprint
- Success : Self-service loans, without branch effort/marketing won 'ET Rise Award - 2020

Fig. 13; AI/ML models for Business Growth # 2

Pre-Approved Car Loan	<ul style="list-style-type: none"> • Aim : To generate pre-approved leads for Car Loans • Tech : Recommendation + RSM • USP : All leads are pre-approved, thereby reducing chances of customer being rejected • Success : Several Loans issued through this model
SME Takeover	<ul style="list-style-type: none"> • Aim : To Identify customers who have migrated to other banks, for takeover of loans • Tech : Scrub of data - Credit Information Companies • USP : Identifies Customers having active loans in other banks • Success : Several Customers were 'won' back
Non CCP Pension Leads	<ul style="list-style-type: none"> • Aim : Identify customers without PPOs in SBI for Pension loan • Tech : NLP, transaction analysis • USP : Identifies pensioners without PPOs • Success : Several loans issued through this model
New to Bank CA Leads	<ul style="list-style-type: none"> • Aim : Identify non-SBI customers with higher SBI-customer interaction (for takeover) • Tech : NLP, network analysis, RPA • USP : Identifies new-to-bank customers using internal data, tags them using open data • Success : Trend-setting innovation by ensemble of several models, open data
Pre Approved Business Loans	<ul style="list-style-type: none"> • Aim : Create a cash-flow based digital loan offering for SME • Tech : Clustering, XGBoost • USP : Loans up to INR 50 lakhs offered digitally • Success : A game changing Prescriptive model
BSBD Loans	<ul style="list-style-type: none"> • Aim : Pre-approved loans to BSBD customers • Tech : XGBoost • USP : Marks the entry of SBI into micro-finance • Success : E2E journey using CSPs, providing micro-finance without increasing branch workload

Fig. 14; AI/ML models for Business Growth # 2

Branch Football Reduction	<ul style="list-style-type: none"> • Aim : Identify high-traffic branches, optimisation tool for channel mix • Tech : Clustering, custom optimisation tool • USP : Creates a single-page branch summary for strategy, tool for optimising channel • Success : Enabled shift of customers to digital channels, adopted for branch redesign and staffing across India
Intelligent sampling of OVVR	<ul style="list-style-type: none"> • Aim : Generate a daily sample of transactions based on parameters that identify risk • Tech : XG boost and Clustering • USP : 200 features used to identify risk • Success : Adopted across India
Income leakage in processing & facility fee	<ul style="list-style-type: none"> • Aim : Identify instances where processing fees has not been recovered in SME loan • Tech : NLP & fuzzy string matching • USP : Targets processing fees, which contributes significantly to other income • Success : Many instances of leakage identified and amount recovered
ATM Winback	<ul style="list-style-type: none"> • Aim : Identify non-SBI ATMs attracting SBI customers and identify root-cause • Tech : Geo-spatial analytics • USP : Provides a satellite view of non-SBI ATMs, nearby SBI ATMs and landmarks/businesses • Success : Regions adopting the model showed marked reduction in ATM interchange fees
Charges Analysis	<ul style="list-style-type: none"> • Aim : Identifying cases where charges (overheads) were filed suspiciously • Tech : NLP & XGBoost • USP : Comprehensive tool to control operating expenses at all levels • Success : Several instances of outliers/missclassification provided to business for correction

Punjab National Bank

Punjab National Bank has set up an in-house Data Analytics Centre to operationalize analytics and leverage significant untapped value-creation potential in both product and process. The bank embarked on a mission to leverage Big Data, AI and ML models to deploy end-to-end solutions in: (i) product, sales and customer acquisition, (ii) channel and campaign management, (iii) customer lifetime

value, (iv) sentiment analysis for improving customer satisfaction, (v) adoption of digital services across the customer lifecycle journey, (vi) branch performance management, (vii) operations, customer service and processes, (viii) risk, collections and compliance, and (ix) fraud detection and prevention.

The bank has utilized AI/ML and data analytics tools and techniques to address the following:

OBJECTIVE	OBJECTIVE	OBJECTIVE
Credit Card Default Prediction	Predictive analysis through Regression and Decision Tree models. Identification of early warning signals based on patterns observed in the data.	Identifies major segment of borrowers with maximum default tendency in various segments. The insight is used for issuing cards to higher-rated customers.
Review of various rating tools	Parametric Analysis of rating variables to assess risk of customers	Rationalizes weightage according to the predictive power of each parameter, based on historical data.
NACH (National Automated Clearing House) Mandate Analysis	Supervised the ML models utilized, such as logistic regression, random forest, and Gradient Boosting.	Identified accounts and took action for arresting the takeover of such accounts.
Slippages in MUDRA loans		Initiated targeted monitoring on predicted accounts to arrest slippages.
Identifying next-best offers for various customers segments	Cluster analysis of customers	Improved upselling in many products and customer segments.
Targeted selling of third party of products		Improved sales of tax-saving fixed deposits.
Identifying fraudulent transaction activities through various channels	Enterprise Fraud Risk Management (EFRM) solution integrating different channels (Bank and digital platform), which triggers an alert, based on different scenarios	Helped in identifying unusual behaviour of retail customers that could be a sign of fraudulent activity.

Bank of Baroda

The Analytics Center of Excellence (ACoE) has built a petabyte-scale Big Data Lake (BDL) platform, which can process large volumes of structured and unstructured data. Leveraging the BDL, several predictive and ML-based analytics models are developed with self-service decision dashboards, which help the bank increase revenue, reduce cost, and improve risk profile. This Big Data Lake has a cutting-edge architecture, allowing it to seamlessly scale horizontally and vertically. Having taken these successful steps, the bank plans to leverage this platform to further its journey of data-driven transformation.

Analytics and ML have been at the core of the bank's revenue programs over the past two years. The bank's cross-selling and upselling opportunities in Retail, MSME, Liability and Wealth Management are driven by a significant number of ML and predictive models to deliver cross-channel go-to-market strategies. Driving a culture of data-driven decision-making is one of the key tenets of the ACoE program. Self-service campaign tracking dashboards provide near-real-time updates on different campaigns.

The bank has taken an ecosystem-based view for large corporate departments. The internal and external data available for the bank's large corporate

customers enables the relationship management team to not only tap into direct banking opportunities with these clients, but also to provide banking services to their ecosystem of vendors, dealers and employees.

To support the collection department in prioritizing its efforts, more than five predictive collection models are built to indicate high-risk cases. These models are augmenting the bank's collection efforts, bringing down overall collection cost, and lowering NPA slippages. To ensure a bank-wide drive in managing delinquent customers, a self-service NPA and delinquency dashboard is deployed for all its branches. It allows them to take corrective action at the right time, thus bringing down costs related to delinquent assets.

There are multiple risk-related improvements that can be driven through statistical models, which have higher predictive ability. IND AS 109 models were the first set of models to be deployed for better prediction of expected credit loss. They allow for more accurate provisioning. The ML-based models for predicting core deposit balances allow the bank to better manage its ALM. An automated daily capital charge computation for Market Risk and daily CRAR computation through smart data visualisations are developed. While over 60 Early Warning Signals

(EWS) have been built through the aggregation of internal and external data, the current focus is on improving the bank's ability to ensure AML triggers, detect fraud, and drive regulatory compliance.

The bank has recognized that AI is a long journey with a few successful strides. Several initiatives are being planned for the coming years. These include multiple new use-cases in complex areas of digital enablement of stakeholders; hyper-personalization of offers and activities; automation of decision-making; uptake of digital channels; and the continued integration of internal and external data sources to power these.

ICICI Bank

Some of ICICI Bank's use cases for AI and ML include:

A. Zero Credit Touch strategies

The Bank was trying to develop "Zero Credit Touch" (ZCT) strategies where without any credit intervention and additional information taken from customers, credit facilities can be provided. Following challenges are faced in the creation of ZCT strategies using traditional credit underwriting models.

1. Credit models which are combination of business rules and scorecards do not qualify a significant proportion of existing ICICI Bank customers.
2. Wherever customers do not have a salary account with the Bank, estimated income is lower leading to customer being offered an amount lower than his/her requirement
 - To overcome this issue, machine learning models have been developed by considering all possible information available about the customers within the bank namely savings bank account transaction data, credit card behavior, repayment track information from credit bureau and other profile related information captured in various CRM / internal platforms.
 - Machine learning based income estimation model developed to predict income for customers wherever it is not available.

These initiatives led to significant proportion of personal loan and credit card sourcing happening through ZCT strategies.

B. Portfolio management

For prudent debt service management

1. The bank uses segmentation models and business rules to identify potential defaulters so that proactive engagement strategies can be employed to control delinquency.

2. From the early delinquent customer pool, identification of self-cure customers for cost savings.
3. For non-performing customers,
 - a. Determining the appropriate settlement offer.
 - b. Identifying additional contact details from the non-contactable pool of customers.

Both machine learning and deep learning models were employed to identify customers for specific engagement. Fuzzy matching logic employed for finding additional contact details of the non-contactable customers.

These models are embedded in the bank's debt management process and helped in controlling NPA and post NPA recovery.

HDFC Bank

The key processes HDFC Bank followed in its journey towards AI adoption have included building business alignment; creating platforms and infrastructure; building integration with open source/cognitive analytics tools; integrating the E2E workflow; building essential skills and competencies; adopting the right tools and technologies; managing projects efficiently; structuring a robust team; and building a pipeline to hire the right skills. The following section expands upon some of these processes:

Business Alignment: AI implementation requires a strategic approach, setting objectives aligned to the bank's business, identifying key performance indicators, and tracking return on investment to profitability.

Platform and Infrastructure: Critical components of the banks' AI adoption include data handling, storage, compute, scaling, extensibility, and security. Safeguarding the customer's personally identifiable information (PII) is a key challenge.

Integration with Open source / Cognitive analytics Tools: Implementing AI solutions also depends on how well the cognitive solution integrates with existing infrastructure and business functions.

Integrated E2E workflow: Many of the advanced analytics tools (Spark, Python R, Knime, H2O, Impala and Altair) are rapidly evolving open source applications. An integrated end-to-end data workflows and business processes is required.

Skills & Competency: It takes effort and time for banks to find well-trained professionals with the right skill sets who can build an enterprise's AI solutions from the ground up.

AI/ML solution/technique adopted

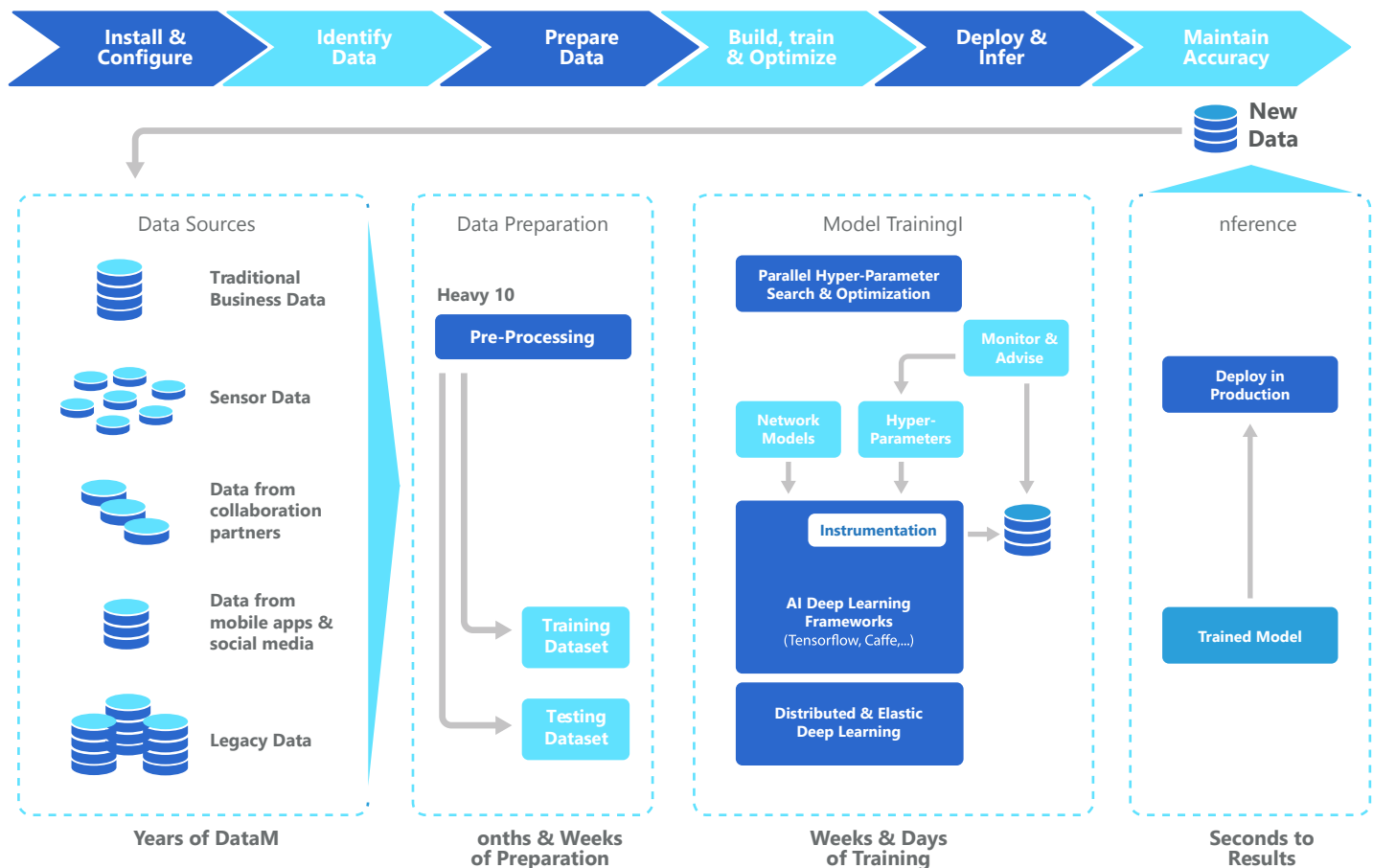


Figure 15: Reference Architecture followed

Tools and Technology: Banks must choose the right combination of open source, enterprise open source, and enterprise software to promote innovation, stability, and support.

HDFC Bank uses ML solutions (Python, R, SAS, Spark, TensorFlow, and Altair) and GPU-enabled computing frameworks (CUDA and Dask-cuDF). It has also implemented in-house data platforms to integrate the organization's data with a distributed computing data platform and GPU system for ML computes. The bank centralized storage resources and sharing with multiple users while isolating compute with Docker implementation. Finally, the bank has improved performance by distributing workloads such as data ingest and preparation and model training across multiple GPUs and Hadoop clusters.

Structuring the Team: The bank has devised the following framework to structuring the ML roles and skills:

A ML Product Manager works with the ML development team, business functions and end-users. This person designs docs, creates wireframes, and comes up with the plan to prioritize and execute ML projects.

The DevOps Engineer deploys and monitors

production systems. This person handles the infrastructure that runs the deployed ML product.

The Data Engineer builds a data pipeline, aggregates, and collects from data storage, and monitors data behaviour. This person works with distributed systems such as Hadoop, Kafka, Airflow etc.

The ML Engineer trains and deploys prediction models. This person uses tools like TensorFlow and Docker to work with prediction systems running on real data in production.

The ML Researcher trains prediction models that are often forward-looking or not production critical. This person uses tools like TensorFlow, PyTorch and Jupyter to build models and reports on findings from their experiments.

The Data Scientist is a blanket term used to describe all the roles above. In some organizations, this role entails answering business questions via analytics.

So far, there is no consensus on the right way to structure a ML team. However, with the understanding that these roles were all critical, HDFC Bank has hired for them.

Managing the projects: ML projects are managed probabilistically. For instance, HDFC Bank has followed the below strategy:

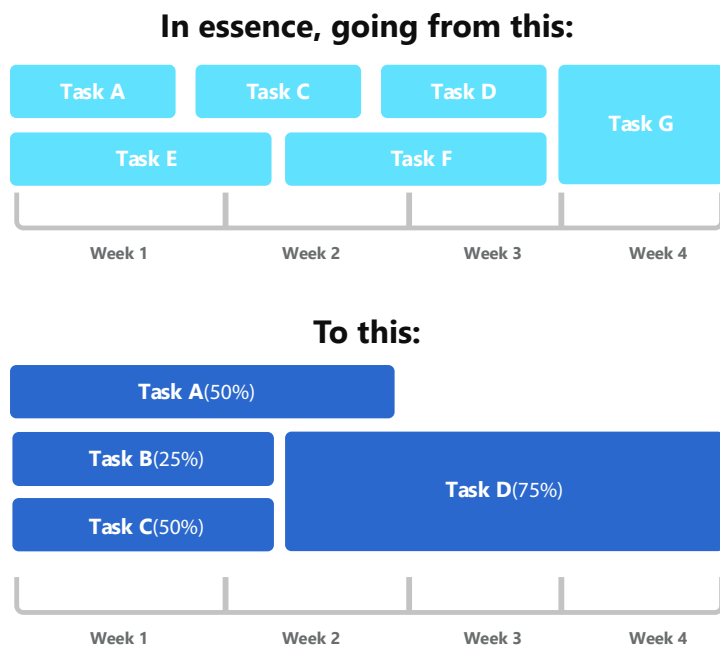


Fig. 16

Other good practices include attempting a portfolio of approaches; measuring progress based on inputs and not results; bringing researchers and engineers to work together; and getting end-to-end pipelines together quickly to demonstrate quick wins.

Hiring the Talent: HDFC Bank hires data scientists for their software engineering skills, keen interest in ML, and their desire to learn. The bank also aims for junior roles; considering that most postgraduates in Computer Science, Statistics or Economics have ML experience are specific about what they want to work on (e.g. not every ML engineer needs to work in DevOps).

As a new and evolving discipline for most traditional organizations, the creation of ML teams can present known and unknown challenges.

Citi Bank

Citi Bank uses logistic regression models that are part of AI and ML to identify high propensity customers to target their products. The bank also uses similar models to estimate prices for eligible customers by taking care of propensity and risk-based pricing.

The ML models are being used for cash optimization at the ATM level to identify cash demand and optimize the idle cash level in the ATM network, thereby bringing down the idle cash in ATMs by around 15%.

TransUnion CIBIL

Apart from using novel concepts such as constrained regression (LASSO and Ridge Regression), reject inferencing, proxy inferencing, in-credit scoring models, TransUnion CIBIL is using advanced AI techniques. These include the use of alternative data to augment the existing data in its repositories.

**There are several sources of alternative data.
Here are a few..**

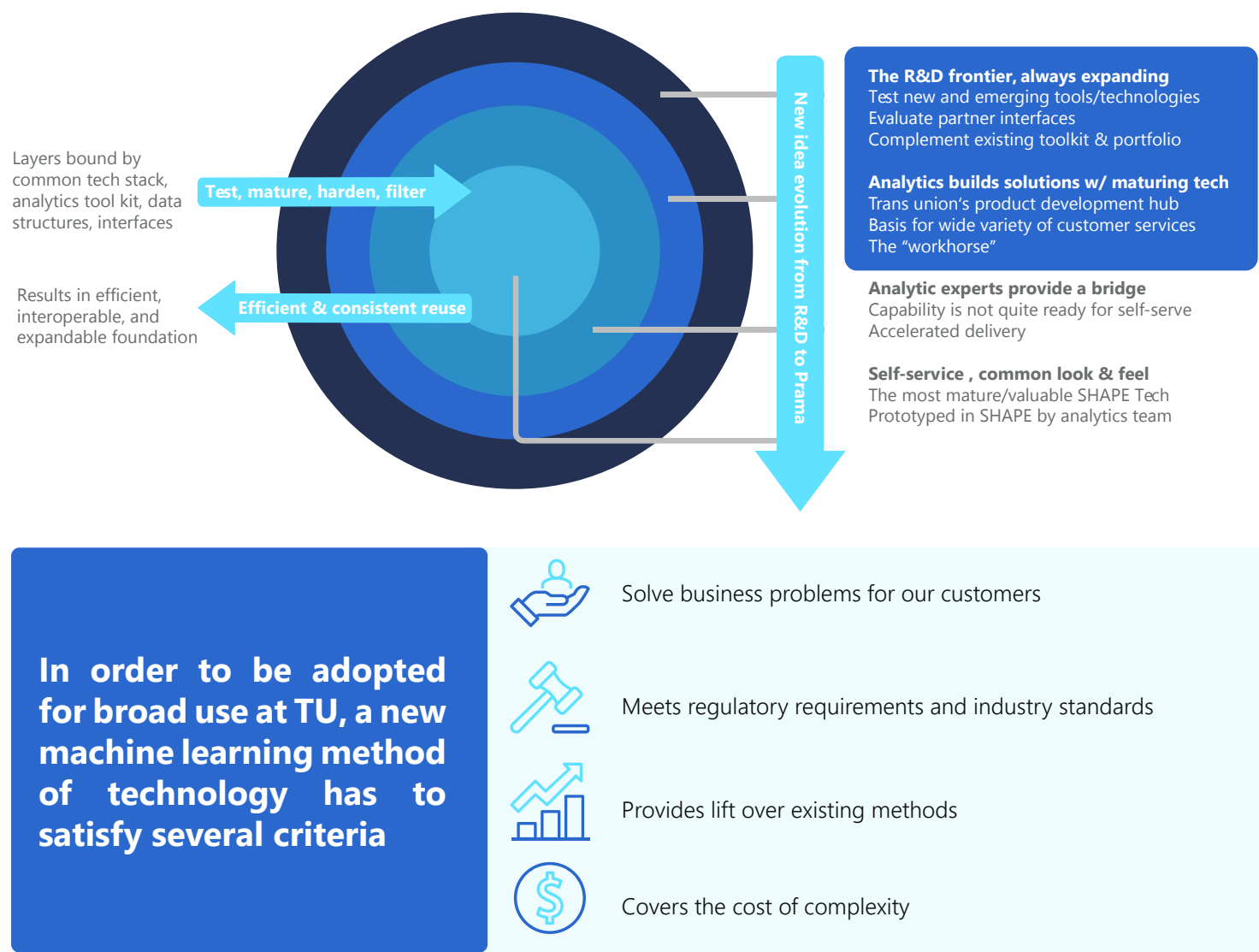


Fig. 17

Myriad approaches to incorporating alternative credit data in processes:

- Direct inclusion of the existing alternative credit data score as an attribute in an otherwise standard model
- Alternative credit data attributes added to the pool of all variables
- Cascading when there is little to no traditional credit data
- Matrix alternative credit data score and traditional score
- Treating alternative credit data separately from traditional credit data

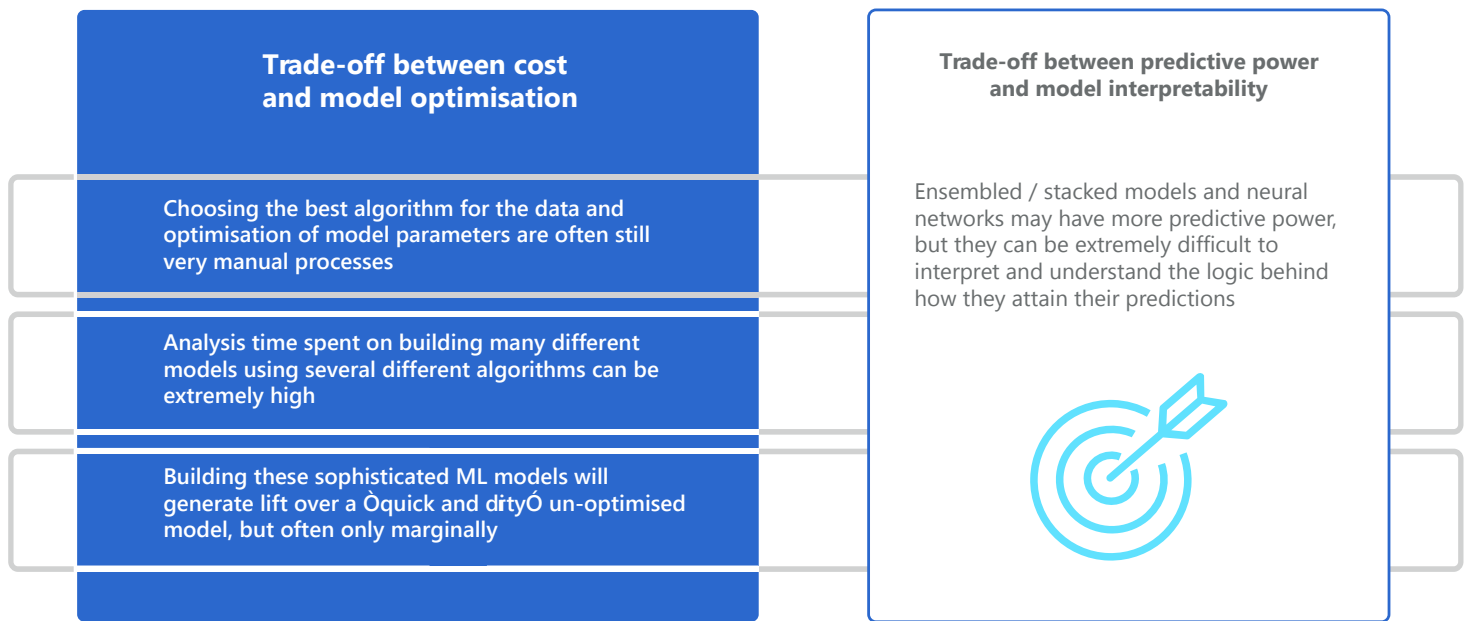
Fig. 18; TransUnion Analytics conducts applied AI/ML research on our analytic platform, SHAPE



Case Study: Collection Recovery Model results

	Model	KS	Top 20% Capture Rate	Top 20% Cuml. Recovery
KS Measures how well the model separates good and bad classes. Higher values are better.	GBM depth 1 (champion)	41.1	41.7% ²	1.5%
	Neural network	45.0	45.4%	27.2%
	Weighted ensemble (GBM, RF, SVM)	43.3	43.6%	22.0%
Top 20% Capture Rate The percentage of all good accounts in the top 20% scoring accounts	RF stacked model (GBM, RF, SVM)	43.3	46.8%	25.5%
	GLM stacked model (GBM, RF, SVM)	43.2	44.1%	23.0%
	GBM Depth 2	43.0	44.3%	24.0%
Top 20% Cuml. Recovery The percentage of all dollars recovered in the top 20% scoring accounts	Two-stage ensemble (GBM Classification * Amount prediction)	42.4	45.4%	31.7%
	Two-stage ensemble baseline (GBM Classification * Past Due Amount)	42.4	44.4%	28.9%
	RF	42.3	42.4%	20.2%
	SVM	31.2	40.2%	22.7%

Fig. 19; Regardless of the method, the trade-offs must be thoroughly examined in order to determine the real benefit of machine learning



Other Use Cases of AI in Banking deployed by Global Banks

The use cases of AI in banking can broadly be classified into three categories:

- Customer experience
- AI empowered employees
- AI powered Insights

The table below illustrates the sub-categories under these three categories.

Customer Experience		AI Empowered Employees		AI Powered Insights	
	Identity Protection		Relationship Managers		KYC Fraud Prevention
	B2C and B2B Digital Assistants		Wealth Advisory		Payments/ AML Fraud Prevention
	Digitized Customer Service		Risk and Compliance		Customer Retention
	Next Best Action/ Targeted Offers		Robotic Process Automation		Cross-sell/Upsell opportunities
	New Banking Products		Financial Forecasting		Market Surveillance
	Credit Scoring		Credit department		It entails profiles of prospective creditworthy customers.
	Better products and services identified by sentiment analysis		Marketing and planning department		Shortcomings of the extant products & services and 360o view of the customers

The section below details these use cases (and use cases similar in nature have been clubbed together for ease of explanation).

I. Customer Interface – Virtual/ Digital Assistants or Chatbots:

The use of virtual customer assistants as an alternative to customer service assistants is one of the most common use-cases of AI in banking. These chatbots or transactional bots, simulate conversations with human customer service agents to process customer queries; they answer user questions, connect users to appropriate services in a bank, and suggest relevant information via text and speech. Commercial banks have made chatbots available on different platforms including mobile applications and websites, and on their social media handles. These virtual assistants use ML and Natural Language Processing (NLP) – a type of ML that understands human language and processes data accordingly – to offer customers personalized experiences. It is estimated that by 2022, conversational assistants could help cut operational costs by over USD eight billion across global banks, compared with only USD 20 million in 2017.¹⁵ A key contributor to this will be the reduction in costs in terms of hiring personnel.

Use cases in developing virtual assistants for banks

I. A financial services group in South Africa

- **Challenge:** A financial services group in South Africa that offers wholesale and retail banking services was looking to grow revenue in mass affluent customer segment with conversational commerce but without increasing the number of human agents.
- **Solution:** The bank, in collaboration with Microsoft developed a digital assistant to service affluent customers. The digital assistant is deployed with LUIS and Microsoft Azure Bot Framework, a comprehensive framework for developing enterprise-grade conversational AI experiences.
- **Benefits:** The resultant benefits were an estimated 90% savings in transactional costs and improved efficiency without increasing the number of actual persons involved.

II. A not-for-profit institution that provides financial well-being and banking services in United States and Puerto Rico

- **Challenge:** 65 call centre agents of the institution were serving 250,000 customers and its members preferred to call for customer service. The bank wanted to achieve the following outcomes: (i) ensure all products bring measurable value;

(ii) deliver 95% of all transactions using self-service; (iii) grow the business by over 20% year-over-year; and (iv) achieve scalable servicing excellence.

- **Solution:** The bank deployed an AI-powered conversation intelligence platform to convert its unstructured call centre into actionable insights. The platform is a cloud-based solution in Microsoft Azure. It leverages the power, scalability, and security of Microsoft Azure to scale on demand, thereby ensuring flexible and reliable cloud computing. The bank also deployed new member evaluation and review processes.
- **Benefits:** The use of the AI-powered conversation intelligence platform is providing insights to help the bank take strategic business decisions. It has also helped the bank reduce call monitoring time by 80% and boosted membership and agent insights by 3,000%.

II. Payment Fraud Detection and Risk Management:

Online payment fraud losses are expected to jump to USD 48 billion per annum by 2023, compared with an estimated USD 22 billion per annum in 2018. In such a scenario, it is expected that the use of AI to proactively monitor and identify various instances of fraud, money laundering, malpractices, and prevent them in real time will increase greatly. An example of this is identifying irregular transactions by examining patterns based on an individual's spending data and behaviour. The ability of technology to decode patterns and continuously adapt to recognize new fraud tactics will help banks bolster fraud detection and prevention efficiency and significantly cut costs.

III. Business and Strategy Insights: AI technology has the potential to analyse large amounts of data collected and maintained by banks and offer insights to transform business processes and drive informed decision-making. Deeper and real-time insights into customer data can facilitate marketing and portfolio strategies.¹² Identification of gaps and suggested actionable business insights based on assessment of data trends using AI can help banks implement measures to boost their growth. Another area where AI analytics can help assist with business decisions is digital payments, where transaction data, including users' transactions, searches, and needs can be mined to derive actionable insights.

IV. Credit Rating Services and Loan Decisions:

Efforts towards financial inclusion, a top priority for the Government of India, can be accelerated using AI to identify individuals who are outside the financial

system and therefore, do not have a credit history.²⁶ AI enables fintech companies to use alternative sources of information, including data from spending and earning habits, family history, and mobile data usage to build a credit score for such individuals. Banks in turn depend on these scores to identify and onboard more customers. For existing customers, AI algorithms draw insights from various data entries, such as an individual's banking transactions, their past financial decisions, social media usage, web browser history, and psychometric tests to enable banks to determine accurate creditworthiness and make fast loan decisions.

- **Fintech:** Fintech company Loan Frame uses AI and ML to examine a borrower's profile and evaluate their creditworthiness.ⁱ
- **Start-ups:** Start-ups such as Monsoon Credit Techⁱⁱ and Capital Floatⁱⁱⁱ use AI to assess the creditworthiness of MSMEs to help in reducing the risk of defaulting.
- **Microfinance:** Finomena, a Bangalore-based microfinance company, is using AI and ML techniques to make lending decisions based on risk portfolios.

V. Regulatory Compliance: Financial reporting for purposes of compliance is a burdensome and complex activity that banks must regularly undertake. It requires banks to invest in extensive human resources, as errors in compliance can have significant repercussions on a banking entity. AI technology can be harnessed to automate compliance procedures, processing vast amounts of data into dashboards. Dashboards assist companies in better understanding and decision making and enable regulators to maintain closer oversight at lesser cost.²⁷ AI technology also makes it easier to identify suspicious transactions, which further helps with better compliance.¹⁷ Automation of compliance procedures also reduce the time and costs involved in interpreting and implementing new reporting requirements.²⁸

- A British multinational investment bank and financial services holding company has partnered with start-ups for developing solutions to identify money laundering activity.
- A Spanish multinational financial services company uses data science and ML to fight financial crime, to screen government sanctions list and media and monitor transactions.

VI. Personalized Insights and Digitized Customer Service: AI algorithms have the potential to deliver personalized insights to customers, using chatbots

that assess customer queries, wealth management applications that oversee customer portfolio, and mobile banking applications that offer personal finance management. Use of AI over time will enable banks to anticipate customer needs and demands more effectively by gathering and analysing digital profiles and transactional history. This in turn will help them provide personalized product offers and recommendations to clients. Further, better knowledge management of customer data will allow bank employees to deliver insights to their customers more swiftly. The time they save in the process can be utilized on other activities, such as building relationships with existing customers and expanding their pool of users.

- A leading American multinational investment bank and financial services holding company has deployed a next-generation customer-centric data analytics platform that allows it to capture and process customer data in real time. This platform is relevant and timely with personalized offers and recommendations for clients across Asia, using a series of ML models and geolocation.

VII. Know Your Customer (KYC) and Anti Money Laundering (AML): Non-compliance with sanctions, Know Your Customer (KYC), and Anti Money Laundering (AML) has resulted in global financial regulators issuing fines worth USD 26 billion to financial institutions, including banks in the past decade.¹⁵ To reduce manpower and resource spent on compliance, banks are investing in AI to streamline their KYC processes and detect AML activities. Banks are using AI to oversee transactions in real time and adopt regulatory changes swiftly to ensure compliance in a time-bound manner.

- **HSBC Bank:** A British multinational investment bank and financial services holding company has deployed a cloud based Anti-Money Laundering (AML) system that leverages data analytics in partnership with Google Cloud. The system helps the bank analyse client data across the board, flag anomalies in customer behaviour, and analyse its clients' transactions and networks to detect financial crimes in their wider network.

VIII. Identity Protection : Use of AI will allow banks to improve speed and efficiency in authenticating and identifying customers. It has been estimated that by the end of 2020, AI will be used by 1.9 billion consumers globally for mobile app authentication, ATM cash withdrawals, and digital onboarding.¹⁵ Client authentication is carried out using physical and behavioural biometrics. AI systems analyse

physical biometrics, including a person's fingertip, iris or voice and behavioural biometrics, such as a person's posture or typing rhythm to recognize them and further authenticate.

- **Large American Financial Services:** An American multinational financial services company allows commercial clients to view bank account balances, make deposits, and approve payments using their mobile devices. Advanced security features including biometrics eye print, encryption, secondary authentication, and token generation are built into the system.

IX. Wealth Management: Banks advise their customers on wealth management based on their portfolio and other attributes. AI helps in understanding customers' needs and risk-taking appetite, helping in the delivery of customized products. AI makes identification of market trends easier and credible, and gives insights on price fluctuations in the future, helping potential investors choose the right product for their portfolio. In addition to providing algorithm-based portfolio management advice, AI systems can analyse salary, savings, and spending data of customers and draw patterns to formulate customized financial plans catering to a specific individual's needs.

- All major banks now use chatbots to tell customers how to manage their investment portfolio using AI, ML, and predictive analysis. The bots analyse the customer's previous investments, salary, and spending patterns to suggest the best possible investment strategies. In 2018, Goldman Sachs acquired personal finance app ClarityMoney. Spanish bank BBVA partnered with Google to use recurrent neural networks for personal finance management.

X. Simplify Backend Processes: AI can be used to automate back-end office operations such as customer onboarding, compliance monitoring automating the writing of investment/earning reports, or extracting functional information from relevant financial documents.¹² Since these tasks usually involve high volumes of data, AI helps streamline and expedite the process without manual interventions.

As workplaces have become remote during the COVID pandemic, AI is being used in many, different office functions. Many workplaces, including banks, have incorporated AI into their human resource function. AI is being used for onboarding employees, offering them a personalised experience, and facilitating their learning and training.

- II. <https://www.loanframe.com/>
- III. <https://www.monsoonfintech.com/>
- IV. <https://capitalfloat.com/>

Section IV: Adoption Strategy of AI in Banking in India

Challenges for AI adoption

The banking sector in India is now increasingly adopting AI. According to a joint research conducted by the National Business Research Institute and Narrative Science, about 32% of financial service providers in India are already using AI technologies such as predictive analytics and voice recognition.²⁹ Banks such as SBI, Bank of Baroda, HDFC, ICICI, Yes Bank and others are already deploying AI to streamline their regular processes. According to a recent report, 83% of Indian bankers – higher than the global average of 79% – believe that AI will work alongside humans in the next two years.³⁰ However, the report also noted that 77% of Indian bankers agreed that they have to effectively develop and/or implement AI tools in banking services. The adoption of AI in the Indian banking and finance industry can be further enhanced by addressing the following challenges:

- **Trained manpower:** The unavailability of professionals with the requisite data science skills means that only a small number of good data scientists are available in the country to work on AI. In addition to the scarcity of trained human resources, the existing workforce in banks is not familiar with the latest tools and applications. The financial services industry needs to work with Indian universities to develop skilled data scientists and develop in-house training programs to train employees in successful implementation of AI technologies for banking functions. Universities in various countries, including the US and UK, are beginning to adapt to the changes that AI is bringing about in the finance sector by offering undergraduate and masters programmes in fintech. In India, HDFC Bank has launched a programme in partnership with engineering and MBA colleges to educate students on emerging banking technologies.³¹
- **Importance of data standardisation :** Independent banks and other financial organisations are in the process of developing internal practices by using XBRL and other data standards. Data standards would expedite mainstream adoption of AI in the financial sector. Non-uniform digitisation of data will lead to issues on interoperability of the individual services as well as their usability. This will also improve regulatory compliance and adaptability to changing requirements.
- **Differing enforcement approaches:** The lack of harmonisation in enforcement approaches across different countries and regulators creates challenges for financial firms employing AI solutions. Differing enforcement approaches make it hard for firms to adopt effective global standards and to quantify their risk of rolling out AI innovations internationally.
- **User capacity:** Articulating queries/requests in a manner that is comprehensible to AI is challenge³² The problem is compounded by the vast diversity among customers who use banking services and their differing levels of digital literacy. A financial/banking service is effective only when the data provided by a customer is useful and can be comprehended by the AI systems in use. The AI systems can then recognise their queries and respond to them in a satisfactory manner.
- **Multiple languages:** Given the multiplicity of languages in India, the most effective AI-enabled communication services will be those that reach majority of Indians in their first/preferred languages. However, this is a challenge at present owing to limited machine-readable corpus of vernacular languages for training natural-language-processing-and-generation algorithms. Presently, there are wide gaps between AI that operates in English or bilingual mode, and AI that can process and comprehend local languages. An effective AI-based communication platform intending to provide banking or financial services must be able to comprehend the consumer's spoken language and respond to the consumer in the same language.
- **Data protection and privacy:** AI systems require huge amounts of training data as inputs. Consumer data is continuously collected by tracking online and offline consumer behaviour, stored, merged with other data sources, to generate big data sets and extract further information about consumers through profiling. Recording the online actions of individuals can create huge databases. These data sets typically contain information about an individual's transactions, email, video, search

queries, health records and social networking interactions. Often, loopholes and unprotected servers result in unauthorised access to this data. According to a report by the Data Security Council of India, India faced the second-highest number of cyber-attacks between 2016 and 2018.

Framework for AI adoption

The Data, People, Process and Technology framework developed by IDRBT in association with technobankers and analytical industry experts is very relevant to the adoption of AI in the Indian banking industry.

The data dimension is quintessential to the success of the AI/ML journey in a bank. Since data is critical to any AI/ML model building, a bank has to strive hard to cleanse the customer data perpetually; employ master data management tools to take data quality to the next level; and eventually establish a data governance system.

As regards the people dimension, new specialist positions will have to be created within a bank that aspires to become AI/ML/Data-Science-compliant. Banks must recognise the fact that this is a specialist's job and not "anybody" can perform it competently. The new titles include data scientist, AI/ML specialist/engineer, data engineer, data steward, information architect, segment manager, channel manager, BI specialist and others.

Process dimension too plays a paramount role in the AI/ML adoption. Primarily, there should be compelling business reasons that trigger the adoption of AI in Indian banks. Once these reasons or requirements are discovered and listed, the bank must perform cost-benefit analysis on the adoption of AI. If it turns out that the benefits outweigh the costs, business process reengineering (BPR) should be undertaken with due diligence. BPR entails the reengineering of business processes to ensure smooth/seamless adoption of AI and its measurement of success. Business processes could benefit either the customers or the bank or both. They include workflows too. Secondly, the bank must be transformed into an analytics-savvy and AI-savvy entity through a series of brainstorming sessions within the bank. This makes the bank immune to the cultural shocks emanating for the implementation of AI. Thirdly, the organisation structure should be tweaked to facilitate smooth implementation of AI. This is necessary because the IT department, the business department and the AI/ML/Data Science professionals will have to work synergistically. One must remember the fact that the adoption of AI in a bank is a long journey and never a one-off project.

Quite understandably, technology is the last but important dimension to be addressed. While the other three dimensions take pre-eminence, the technology dimension is deliberately relegated to the last preference because of its quick obsolescence. Mature, time-tested, reliable technology artefacts must be implemented for the guaranteed success of the journey. In this dimension, as far as the storage is concerned, data lake is preferable given that it can simultaneously accommodate structured, unstructured and semi-structured data in its native format and cluster computing and/or GPU processor based servers would be necessary for the compute purpose.

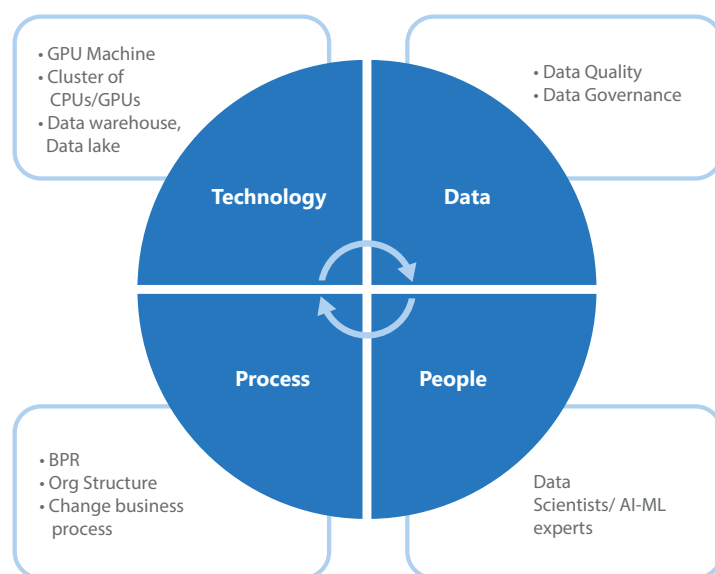


Figure 20

Requirements for AI adoption

According to a McKinsey Global Survey, the adoption of AI has been a key topic of interest for organisations, including banks. Most respondents in the study, who deployed AI in a specific function, reported achieving moderate or significant value from that use; only 21% of the respondents reported embedding AI into multiple business units or functions. Despite the interest expressed by Indian bankers about AI adoption, almost 77% of Indian bankers agree that most firms are not prepared to deal with mass AI usage. The major reason for this is the low risk appetite for AI adoption, as it is a new and emerging technology. This section discusses why and how banks should look to adopt and integrate AI in their existing systems.

Why should financial institutions adopt AI?

- **Improved growth:** Apart from deploying AI in a decisive manner to meet the needs of their consumers, financial institutions are preparing to address competition from tech companies such as Google and Apple that offer payments systems.

Most banks have found that adoption of digital technology has led to better risk management and reduction of risk and has improved growth potential for them.

- **Adapt to the modern business environment:** Digital alternatives to lending have emerged from the need to address multiple customer needs. Fintech companies seek to fill this gap by innovatively using technology to construct alternative credit scores based on social profiles. This is highly relevant in India, as an increasing number of digital fintech companies are competing with banks in providing services that traditionally fell in the latter's domain. Banks must, therefore, compete with these companies and innovate so that they are not left behind in the ongoing digital revolution.
- **Enable societal benefits through the banking sector:** The evolution of banking has allowed for the creation of a fairer, more inclusive financial system. AI is being viewed as a technology that will help smaller firms compete better. AI and related technologies are expected to become more affordable with time. This will enable individuals and small businesses to compete with big firms, which have greater manpower and experience. With digital adoption on the rise, customers in rural areas, who hitherto had restricted access to several levels of banking benefits, credit options, and wealth management products, will now have greater access to these facilities. The wealth management industry, particularly, is expected to prosper; it is already undergoing significant disruption due to a wave of homegrown "WealthTech" innovations. This trend is likely to continue given that more than 77% of Indian households are expected to fall within the lower middle-income and upper middle-income brackets by 2030. However, a gender gap still remains even though access to financial services for women has increased in recent years - about six percent fewer women than men own bank accounts. The technology disruption is expected to address this disparity.

What do banks need for AI adoption?

- **AI strategy:** In order to successfully adopt disruptive technologies, organisations need to have a clear vision on what they want this technology to achieve; how they want to integrate it within their organisation; the feasibility and impact of the technology; and its possible consequences for the internal dynamics of the

organisation. According to the aforementioned McKinsey survey, about 17% of the respondents said that their companies have mapped out where, across the organisation, all potential AI opportunities lie. Only 18% of the respondents said that their companies have a clear strategy in place for sourcing the data that enables AI to work.

- **Data collection:** To take advantage of AI's enormous potential, an organisation needs to invest in the creation and storage of a large amounts of data to train AI algorithms. The dividends yielded by AI are related to the quality and the quantity of the data that has been recorded or stored by these companies.
- **Internal digitization:** A large impact of AI on business is in the improvement and streamlining of cumbersome internal processes. Organisations that are looking to adopt AI should undertake internal digitisation, promote a pro-technology culture and familiarise their employees with emerging technologies.
- **Talent creation:** Acquisition of talent is one of the biggest challenges to AI adoption. To gain advantage in AI, most organisations either hire AI experts or train them. Due to competition among firms for AI experts, and the unique needs of each organisation, most companies prefer to develop their own talent pools.
- **Developing safe systems:** The banking ecosystem functions on trust. This makes it imperative for banks to invest in cybersecurity and to develop AI systems. Due to the sensitive nature of data stored by banks, they are prone to data breaches by online hackers. Banks need to increasingly invest in cybersecurity collaborations with technology firms to identify and plug potential threats.

Recommendations to Banks for adoption of AI

Pre-adoption

- **Organizational culture and readiness:** Fear of job loss is yet another major impediment to adoption of AI by banks. Organisations should make their employees understand that AI will not replace them but will complement their work. If workers feel less threatened by new technology, they will help in improving the organization's productivity by using that technology.

- **Feasibility/Impact assessment:** An impact/feasibility assessment is used by many leading organisations to think through decision-making processes about possible projects. This is particularly relevant to AI, as it requires large investments in data storage, talent hiring, and security. Organisations that do not carefully assess investments in AI and witness unexpected returns often become averse to its adoption.
- **Fairness, Accountability and Transparency in AI:** With AI/ML making inroads into every sphere of human activity, due importance should be accorded to ethics, transparency, and accountability in AI adoption in banking. Otherwise, we end up with models that are biased towards a particular section of people. Such a bias could, for example, adversely impact those sections of people not getting a loan. Bias primarily occurs due to the fact the underlying data itself is biased. If the bias occurs in the target variable, the phenomenon is usually referred to as “unbalanced data”, which occurs quite naturally owing to the nature of the business. For instance, in business problems such as churn prediction, fraud detection and NPA prediction, the number of churners, fraudsters and defaulters is disproportionately low compared to the number of loyal customers, genuine users and regular payers, respectively. This bias present in the target variable is natural and can be tackled with data-balancing techniques. But if the bias present in the explanatory variables comes to light during and after the model-building, then it could have serious repercussions because a particular section of the people could be exposed.

During adoption

- **Privacy:** Data access and data privacy are central aspects of any AI work that banks do. Protecting data assets is of paramount importance, with the introduction of regulations around the world. Organisations should be mindful of privacy and data protection from ethical, business, and security standpoints.
- **Training to use AI:** Organisations adopting AI should make sure that employees are trained on how to use it. Although AI is presently used in a complementary capacity, it is expected to significantly disrupt the future workplace and be a process-changer. Use of AI could entail considerable re-skilling for employees, and training on how to use the technology in a pro-technology environment.
- **Key enablers:** The foundational enablers needed to derive value from AI at scale include top-management sponsorship; development of an enterprise-wide portfolio view of AI opportunities; action to close talent gaps; and the implementation of a sophisticated data strategy. Strategic thinking around AI programs is needed for the development of these enablers.
- **Ethical design:** Given their deep learning capabilities, AI-based systems can cause unintentional harm. This makes it important to hire experts who have knowledge and experience in algorithms. Algorithm bias can lead to incorrect decision-making. AI solutions should be implemented ethically with transparency built into the process. To identify frauds by customers more accurately and efficiently, organizations must build AI solutions that can be audited and those that are compliant with regulations.

This calls for incorporation of ethical guidelines in the modeling procedures. There were some adversarial instances. Amazon scrapped its AI recruitment tool because it was biased against women. Microsoft removed the social AI chatbot “Tay”, which, within 24 hours of its introduction, had begun tweeting a slew of racist, misogynistic, and offensive comments. So, when a bank decides to deploy conversational AI (also known as chatbot), it is imperative that the bank adopts ethical principles so that the AI will be acceptable to the public. Some of the standards to accomplish this include: (i) Protect consumer data and privacy; (ii) Be transparent about the use of AI; (iii) Harness diversity and inclusivity.

These principles will make sure that the societal bias does not creep into the model or get exposed by the model. An inclusive team of professionals from diverse backgrounds and ethnicity will mitigate this bias to a great extent. The “What-If” tool from Google could prove useful here.⁴²

AI Maturity Assessment - Call to Action

Today, most banks in India are either planning to use AI for improving their operational efficiencies and/or increasing their customer effectiveness, or they have already experimented with some AI/ML models. However, it is important for individual organisations to assess where they are in their AI journey, and what their level of maturity is for creating and owning a production-grade AI/ML system. Based on the level of maturity identified, the bank can then decide on the way forward.

AI Maturity Model

Foundational

Questioning AI and how to apply it

Wrong expectations
low digitisation basic analytical capabilities

Approaching

Hopeful on AI and its promise

Digitisation underway looking to increase or optimise processes cautious about disruption

Aspirational

Experimented and applied AI

High digitisation desires new business models achieved a data culture

Mature

Emerging data science and ops capability

Understands model life-cycle and management Building a foundational data architecture

An AI Maturity Model³⁵ enables organisations to measure themselves against four key axes – strategy, culture, organisation, and capabilities – to define their maturity score and identify the next best action to adopt AI for digital transformation.

AI Maturity Model Defined

Strategy

Considers ethics in strategy formulation

Considers collaboration , openness

Considers tactical versus strategic thinking

Culture

Considers tolerance for risk

Considers data culture
Considers employee empowerment

Organization

Considers talent and people

Considers potential for iterative experiments

Considers regulatory compliance

Capabilities

Considers ability to deploy

Considers digitization and digitalization

Considers understanding of iterative, agile experimentation

Maturity Score

Summary

The Indian government is deeply committed to the research and usage of AI in the country. India recently joined the Global Partnership on Artificial Intelligence (GPAI) as a founding member. Along with 15 other nations, which include the US, UK, Australia, Canada, and France, the GPAI has been formed as an initiative to manage the responsible development and use of AI. The GPAI is a first-of-its-kind initiative for better understanding the challenges and opportunities around AI by using the experience of the diverse nations.

India's digital banking and finance sector, including retail banking, has witnessed immense growth

in the past two decades. This transformation has primarily been driven by an increase in the use of digital payments across sectors and industries. Furthermore, the Government of India has acknowledged that digital payments promise access to formal financial services and benefits to those who continue to be excluded.

The proliferation of digital payments and banking – which has helped generate financial transaction data that banks can use to monitor, predict, and respond to consumer behaviour better – and the rising demand for online offerings of banking and financial information have opened up opportunities for AI implementation in retail banking and financial

and investment services in India. The use of AI in banks and financial institutions has the potential to transform how these entities operate. The banking industry is a critical backbone for India's economic development. Adoption of AI by banks will help them scale and improve access. It will also aid banks in achieving better performance, higher profitability and reduction in risk. Data-driven decision-making using AI can help banks lend to priority sectors, increase client base and develop products that are suited to customer needs.

AI can be deployed in banks across a range of functions for improving overall customer experience, making more informed decisions on credit underwriting, detecting frauds and defaults early, improving collections and increasing employee efficiency.

There are some challenges that need to be addressed to increase the adoption of AI in the Indian banking and finance industry. These include training existing

manpower in new skills; making the current banking processes adaptable with AI; increasing the capacity of customers to use AI systems; and ensuring data protection and privacy.

Banks and financial institutions stand to gain from the adoption of AI. It can lead to better risk management in these institutions, thereby improving their growth potential. Furthermore, AI can help banks adapt to the modern business environment and address various customer needs through product differentiation and the generation new insights from data. AI is also being seen as an equaliser that will help in the creation of a fairer, more inclusive financial system. With the use of AI, banks can offer customers – especially those in rural areas, who are presently unable to access the desired levels of banking benefits – greater access to banking facilities, credit options, and wealth management products.

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