THE CENTRE FOR internet & society

AI in Banking and Finance

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Executive Summary

In the last couple of years, the finance and banking sectors in India have increasingly deployed and implemented AI technologies. Such technologies are being implemented for front-end and back end processes – offering solutions for both financial and business management operations. At the moment, the AI landscape appears to be overwhelmingly populated by natural language processing and natural language generation technologies culminating in numerous chatbot initiatives by various banking and financial actors. Arguably more significant – but less documented – is the usage of said technologies for financial decision making on a variety of issues including, credit-scoring, transactions, wealth and risk management, and fraud detection. These trends are largely facilitated by technology service companies – both large-scale firms and startups – that either work with established banking and financial institutions to deploy AI technologies or develop and offer their own financial services directly to consumers.

This report seeks to map the present state of use of AI in the banking and financial sector in India. In doing so, it explores:

- Uses: What is the present use of AI in banking and finance? What is the narrative and discourse around AI and banking/finance in India?

- Actors: Who are the key stakeholders involved in the development, implementation and regulation of AI in the banking/finance sector?

- Impact: What is the potential and existing impact of AI in the banking and finance sectors?

- Regulation: What are the challenges faced in policy making around AI in the banking and finance sectors?

The report first offers an overview of the ways in which AI is being used in the sector. This is followed by an examination of existing challenges to the adoption of AI and the significant legal and ethical concerns that need to be considered in light of these trends. Lastly, the report draws attention to a number of key government actions and initiatives surrounding AI related to the banking and finance industry, discusses challenges to the adoption and implementation of AI and articulates recommendations towards addressing the same.

Methodology

CIS recognizes that the term AI is multiple in its uses and meanings-- and at times contested.[1] For the purposes of this report, a broad understanding of AI as a dynamic learning system that can be used in decision making and actioning is utilized.

The aim of this report is to identify the ways in which AI is being implemented and utilized in the banking and finance sector. Very broadly, the financial institutions in India include banking and non-banking institutions along with regulatory institutions that regulate and manage them. Furthermore, this report aims to identify the key potential policy, ethical, and legal concerns in the development and use of AI in this sector. As part of this, challenges in the development and use of AI are also identified.

The AI and finance ecosystem in India has been outlined, mapping relevant AI developers, government actors, practitioners, funders and investors, and research and industry bodies. These were identified through a combination of a secondary literature review (of academic papers, news items, industry reports and company websites) and inputs derived from roundtable and interviews. Keywords used when searching for relevant literature include:

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1   Artificial Intelligence: Literature Review (2017, December 16). Retrieved January 5, 2018, from https://cis-india.org/internet-governance/blog/artificial-intelligence-literature-review

artificial intelligence, machine learning, chatbots, robo-banking, algorithms, natural language processing, banking, finance, fintech, startups, wallets, and payments. The scope of this report is limited to our research findings as of May 10th 2018.

Introduction

The digital banking and finance sector in India, especially retail banking, benefited from the November 2016 decision by the Government of India to discontinue the use of Rs. 500 and Rs. 1,000 currency notes.[2] However, the expected exponential growth path of digital payment instruments in India seems to be dampened by various factors such as, the widespread limitations of network infrastructure, Point of Sales machines, and a fast transforming landscape of apps and digital payment methods leading to a steep learning/adoption curve for buyers and sellers across the country (especially the small- and medium-scale ones), most evident in the immediate aftermath of demonetisation.[3] The DigiDhan Mission, announced by the Government earlier this year, emerged out of the experience of the demonetisation process, and squarely recognises that "financial inclusion [remains] one of the foremost challenges for India" and that "Digital payments promises access to formal financial services and benefits from e-commerce, especially for those who continue to be excluded."[4] The key opportunities and challenges for implementation of AI for (retail) banking and financial (and investment) services in India is to be understood both in terms of the proliferation of digital payments and banking, creating rich digital trails of financial transaction data that can be mined and learned by banks to better monitor, predict, and respond to consumer behaviour, and also in terms of the rising demand for online and conversational offerings of banking and financial information.

The unparalleled growth of the fintech sector in India can be attributed to the proliferation of mobile technology in India in the recent years. Presently, India has over a billion mobile phones, 330 million internet users and 240 million smartphones.[5] The fintech sector used this growth in digitisation and the change in consumer behaviour that was looking towards convenience, to develop a range of innovative services and products for the changing economy.[6] This resulted in the growth of services such as internet banking, mobile banking and payment apps. This shift in business methods has led to an increase in partnerships between developers of technology and the banks and financial institutions using such technology. The RBL Bank, for example, has the RBL iLabs Hackathon, participates in "Startupbootcamps" and mentors FinTech players.[7]

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2   Rai, S. (2016, November 24). India's Cash Ban Is the Best Thing to Happen to Digital Payments. Retrieved from https://www.bloomberg.com/news/articles/2016-11-23/cash-ban-the-best-thing-to-happen-to-indian-digital-payments

3   Singh, S. (2017, October 03). Is 25 billion digital transaction target for 2017-18 too steep to achieve? Retrieved from https://economictimes.indiatimes.com/news/economy/policy/is-25-billion-digital-transaction-target-for-2017-18-too-steep-to-achieve/articleshow/60915736.cms;

Omidyar Network. (2017, May 16). Currency of Trust: Consumer Behaviors and Attitudes toward Digital Financial Services in India. Retrieved from https://www.omidyar.com/insights/currency-trust

4   Notification - DIGIDHAN Mission. (2017, June 8). Retrieved from http://meity.gov.in/writereaddata/files/digidhan-mission.pdf

5   Banking on the Future: Vision 2020. (2016, September 16). Deloitte. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

6   Ibid.

7   Kannan, Uma. (2017, September 4). Artificial Intelligence to power banking. Deccan Herald. Retrieved from http://www.deccanherald.com/content/631355/artificial-intelligence-power-banking.html

AI in Finance and Banking in India

The Indian banking sector's adoption of artificial intelligence, though in its nascency, has seen a steep increase. In the past year, global investment in AI applications touched $5.1 billion, up from $4.0 billion in 2015.[8] While large commercial and investment banks globally are incorporating AI and blockchain for both back-office and customer facing purposes, in India, widespread adoption of these technologies has not yet come to fruition.

In the past year, several large financial services companies and FinTech startups have collaborated to conduct proof of concepts (POCs) and implement some of these emergent technologies into their operations. Though the deployment of AI technologies is still nascent in the banking sector, the competitive advantage that the technologies bring has been recognized by banks with some developing 'innovation centres' and running hackathons - these initiatives often take the form of partnerships between banks and FinTech companies.[9]

The following section will provide an overview of the key uses of AI in the finance sector in India, delve into key actors and trends that make up the AI ecosystem in the sector, explore legal and ethical implications related to the development and use of AI in finance, and call out challenges that exist to the same.

Use of AI in Banking and Finance

The adoption of AI in the banking and finance sector is a part of the larger digital wave occurring within the sector.[10] The use and deployment of AI in consumer banking, financial products and back-end operations is varied and across different stages of operations. Though it is not always clear from publicly available information the exact type of AI technology that is being used, some technologies that we did find in our research include: Natural Language Processing, Natural Language Generation, Machine Learning (such as Neural networks/deep learning), and Computer Vision.

This report has identified several uses for which AI is being deployed that are as follows:

Business and Management Operations:

Customer Interface: Various actors across the sector are experimenting with virtual customer assistance as means of offering an alternative form of customer service assistance, processing queries to answer user questions, connecting users to appropriate services and suggesting relevant information via text and speech.[11] Chatbot adoption[12] (text, speech, and

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8   Fintech Trends Report: India 2017. (2017, March 30). Retrieved from https://www.pwc.in/assets/pdfs/publications/2017/fintech-india-report-2017.pdf

9   Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

10   Vishwanathan, V. (2016, May 31). Indian banks seek artificial intelligence. Retrieved from https://www.livemint.com/Money/jQEQNXyfLkW1kY5FihFBHM/Indian-banks-seek-artificial-intelligence.html

11   Digibank by DBS. (2018, April 12). Retrieved from https://www.dbs.com/digibank/in/about.html

12   Mishra, A. (2017, October 11). HDFC Bank experiments voice-activated banking with Amazon's Alexa. *Economic Times*. Retrieved from https://cio.economictimes.indiatimes.com/news/enterprise-services-and-applications/hdfc-bank-experiments-voice-activated-banking-with-amazons-alexa/61033641; ICICI Bank links its Money2India app with Siri for voice-based overseas remittance service. *Economic Times*. (2017, November 2). Retrieved from https://cio.economictimes.indiatimes.com/news/enterprise-services-and-applications/icici-bank-links-its-money2india-app-with-siri-for-voice-based-overseas-remittance-service/61454936

video)[13] by banks and concierge apps[14] have been the most prominent use of AI as seen in our research.. Numerous commercial banks have chatbots available on platforms such as mobile applications and websites,[15] as well as social media platforms such as Facebook Messenger, Telegram, WhatsApp and Twitter.[16]

Customer Insights and Personalization: There have been some reports of AI algorithms being utilized to offer more "personalized engagement" between firms and their customers, utilizing cognitive engagement solutions to anticipate customer needs and demands, and offer suggestions tailored to them.[17] Such technology observes content, behaviour and other data sources and builds models off of which actionable insights will be offered about people and content, matches products and services to consumers, models client behavioral patterns and facilitates the delivery of personalized advice based on digital profiles and transactional history.[18] For example, the startup YayPay uses machine learning to predict customer behaviour by examining their customers' previous payments habits and behaviours.[19] Accenture and Grameen Foundation India have worked together to develop an application that leverages AI technologies, the Emotional Analytics for Social Enterprises, to gain better insights into the emotional and cognitive state of clients.[20] Drawing from video and audio inputs, the application will help microfinance advisors better understand the topics that would cause users to engage or disengage during the microfinance process.[21]

Business and Strategy Insights: AI technology enables nuanced understandings of the large amounts of data maintained by and available to banks and other financial actors. Such analysis can facilitate deeper and real-time insights into internal operations and external market dynamics, informing potential strategies across various departments. Deeper insights into customer data, for example, can facilitate marketing and portfolio strategies.[22] G-Square's Robo analytics tool, G-square Narrator, is a Business Intelligence tool that provides the user with prescriptive analysis and actionable business insights. This in turn

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13 Dash, S. (2028, April 11) Does the Future of Indian Banking Lie in Chatbots?. Entrepreneur India. Retrieved from https://www.entrepreneur.com/article/311795.

14 Haptik. (2018, April 12). Retrieved from https://haptik.ai/; Dunzo. (2018, April 12). Retrieved from https://www.dunzo.in./

15 Baruah, A. (2018, March 27). AI Applications in the Top 4 Indian Banks. Tech Emergence. Retrieved from https://www.techemergence.com/ai-applications-in-the-top-4-indian-banks/

16 Baxi, A. (2017, September 24). How Chatbots And AI Are Helping India's Businesses Boost Their Customer Service. Forbes. Retrieved from https://www.forbes.com/sites/baxiabhishek/2017/09/24/fueled-by-artificial-intelligence-chatbots-help-businesses-evolve-customer-interactions-in-india/#5f4866e06321

17 Schatsky, Muraskin and Gurumurthy. (2015, January 26). Cognitive technologies: The real opportunities for business. *Deloitte.Insights.* Retrieved from https://www2.deloitte.com/insights/us/en/deloitte-review/issue-16/cognitive-technologies-business-applications.html

18 Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

19 Verma, D. (2017, October 19). AI in account receivables: a source of competitive advantage?. *The Global Treasurer.* Retrieved from https://www.theglobaltreasurer.com/2017/10/19/ai-in-account-receivables-a-source-of-competitive-advantage/

20 Accenture Labs and Grameen Foundation India Use Emerging Technologies to Help Increase Adoption of Financial Services Among Low-Income Women. (2018, March 21). Retrieved from https://newsroom.accenture.com/news/accenture-labs-and-grameen-foundation-india-use-emerging-technologies-to-help-increase-adoption-of-financial-services-among-low-income-women.htm

21 Ibid

22 Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

facilitates the identification of gaps, opportunities and strategies that help the financial entities grow.[23] A space where the use of AI analytics can offer key insights is the digital payments landscape, where ample transaction data (users' transactions, searches, and needs) is available.[24] In this landscape it is companies such as Google that have utilized such data - into developing payment solutions such as Google Tez[25].

Facilitating Backend Processes: AI is being utilized to assist with backend office operations that often involve high volume, rules based and highly organized and systematic work. AI technologies can be used to perform "intelligent automation" with customer onboarding, compliance monitoring, automating the writing of investment/earning reports, or extracting functional information from relevant financial documents.[26] Signzy, for example, is helping banks with AI-assisted onboarding solutions.[27] There have been reports of SBI utilizing IBM Watson to perform a "variety of jobs" - though the specificities of these jobs have not been revealed.[28] ICICI has opted for an in-house solution, deploying their Software Robotics initiative to aid with literature formatting, email sorting, text mining, and data entry.[29] Such information can also be relayed through chatbots through CXO dashboards, allowing senior management to use less time to retrieve desired metrics, thus giving them more time for more skilled work.[30]

Financial Operations:

Credit Scoring and Loan Decisions: AI is being harnessed by lenders to calculate credit scores and develop credit profiles. With the use of AI algorithms that draw from various data entries such as an individual's banking transactions, their past decisions, their spending and earning habits and, familial history, mobile data etc. firms can make fast credit decisions for typical and atypical applicants.[31] For example, Loan Frame uses AI and machine learning to examine a borrower's profile and evaluate their creditworthiness.[32] Similarly startups such as Monsoon Credit Tech[33] and Capital Float[34] use AI to assess the creditworthiness of MSMEs to help in reducing the risk of defaulting. AI and machine learning techniques are also being

23   Narrator. (2018, May 09). Retrieved from https://narrator.cloud/

24   How AI and analytics will benefit digital payments. (2017, September 25). Retrieved from http://www.cio.in/opinion/how-ai-and-analytics-will-benefit-digital-payments

25   Ibid

26   Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

27   Signzy. (2018, May 09). Retrieved from https://signzy.com/.

28   Are Machines Replacing Bankers. (2017, August 6). Retrieved from https://www.sbi.co.in/portal/web/sbi/blogdetail?blogId=27271874

29   ICICI Bank introduces 'Software Robotics' to power banking operations. (2016, September 8). Retrieved from https://www.icicibank.com/aboutus/article.page?identifier=news-icici-bank-introduces-software-robotics-to-power-banking-operations-20160809103646464

30   Chatbot: The intelligent banking assistant. Pwc. (2017, July 7). Retrieved from https://www.pwc.in/consulting/financial-services/fintech/fintech-insights/chatbot-the-intelligent-banking-assistant.html

31   Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

32   Loan Frame. (2018, May 09). Retrieved from https://www.loanframe.com/

33   Monsoon. (2018, May 09). Retrieved from https://monsoonfintech.com/products/

34   Capital Float. (2018, May 09). Retrieved from https://www.capitalfloat.com/how-it-works

utilized by microfinance companies such as the Bangalore based Finomena to make lending decisions based on developed risk portfolios.[35]

Fraud Detection and Risk Management: AI is being utilized to proactively monitor and prevent various instances of fraud, money laundering, malpractice and the detection of potential risks. For example, firms draw on individual's spending data and behaviour to determine patterns, enabling them to identify irregular transactions.[36] Mastercard has also worked to include AI technology as a part of their financial service network as a way "identifying identities".[37] Similar methods have been used to determine trading malpractice,[38] but the details and extent of their present use in the Indian context is not widely publicized. The National Stock Exchange of India Ltd (NSE) has identified the benefits of using machine learning to augment existing algorithmic trading activities.[39] The technology's enhanced ability to identify market patterns and automate low complexity tasks have been highlighted by the NSE as significant to their goal of trading risk minimization.[40] The Bombay Stock Exchange has been using AI-assisted solutions for rumour detection since the November of 2016 as a means of detecting risk and reducing information asymmetry.[41]

Wealth Management: While wealth management firms in the past have been among the least tech-literate sectors in the finance industry, they are now at risk of becoming obsolete in many areas due to the increase in adoption of digital technologies that provide algorithm-based portfolio management advice.[42] Predictive models utilise machine learning to analyse data and draw patterns that can help potential investors choose the right product for their portfolio, and give insights on price fluctuations in the future.[43] Other applications see AI-based systems analysing a user's salary, saving, and spending to formulate an efficient financial plan that caters to their needs.[44]

Algorithmic Trading: AI's ability to deal with large unstructured data, complex mathematical models and formulas, as well as automate tasks have found applications in the securities

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35   Microfinance in India – adoption of machine learning is still underway. (2017, January 30). Analyticas India. Retrieved from https://analyticsindiamag.com/microfinance-india-adoption-machine-learning-still-underway/.

36   Gordon, N. Artificial Intelligence for Banking & Finance Industry. *CenturySoft: Blog*. Retrieved from https://www.centurysoft.com/blog/artificial-intelligence-for-banking.html

37   How MasterCard is reinventing itself in the age of digital payments and artificial intelligence. (2017, November 20). Retrieved from http://in.pcmag.com/digital-payment/117656/feature/how-mastercard-is-reinventing-itself-in-the-age-of-digital-p

38   Fonetic Extends Its Relationship with BBVA. (2015, February 19). Retrieved from http://www.speechtechmag.com/Articles/News/Speech-Technology-Digest/Fonetic-Extends-Its-Relationship-with-BBVA-102185.aspx

39   D'Monte, L. NSE bets big on AI, blockchain to mitigate algo-trading risks. (2018, March 26). LiveMint, Retrieved from https://www.livemint.com/Money/yVXE5LBuDzLbHhoxOntvZI/NSE-bets-big-on-AI-blockchain-to-mitigate-algotrading-risk.html

40   Ibid.

41   BSE implements artificial intelligence mechanism for rumour detection. (2016, November 21). Retrieved from https://www.bseindia.com/markets/marketinfo/DispMediaRels.aspx?page=d3784583-0810-4bef-8754-087b60832bfa.

42   Srivastava, M. (2017, June 7). Artificial intelligence to disrupt wealth management business: PwC. *Business Standard.* Retrieved from http://www.business-standard.com/article/companies/artificial-intelligence-to-disrupt-wealth-management-business-pwc-116060601023_1.html

43   Chugh and Jaiswal. (2018, April 12). How AI is Disrupting the Banking Sector in India. *Silicon India.* Retrieved from https://technology.siliconindiamagazine.com/viewpoint/ceo-insights/how-ai-is-disrupting-the-banking-sector-in-india-nwid-9820.html

44   Chugh and Jaiswal. (2018, April 12). How AI is Disrupting the Banking Sector in India. *Silicon India.* Retrieved from https://technology.siliconindiamagazine.com/viewpoint/ceo-insights/how-ai-is-disrupting-the-banking-sector-in-india-nwid-9820.html

market. [45] Beyond wealth management applications (discussed above), the potential for such technologies to further facilitate algorithmic trading is being explored. AI technology is being used by companies such as Trade Rays to provide user-friendly algorithmic trading services.[46]

Transactions: AI technology is being used to facilitate transactions. Most significantly, it is being used as a way to secure transactions using voice recognition via banking applications.[47] Furthermore, AI personal assistants and similar applications are being integrated with transactions in an attempt to offer a more "unified form of transaction" devoid of extra verification steps. For example, Niki.ai is currently working on such a project with HDFC Bank.[48] Although the details of said project are not publicly available, it has been highlighted that AI will be utilized to offer a conversational interface that will streamline the transaction process.[49]

Stakeholder Ecosystem

There are a number of stakeholders that make up the banking and finance ecosystem and that work together for the successful adoption and implementation of AI in this sector. In order to map the stakeholder ecosystem, we began by identifying the key stakeholders that have an impact on use of AI in banking and finance. The stakeholders were divided into five categories: developers, government, funders/investors, users, academic, consultancy and industry agencies: The developer mapping was further categorized on the basis of the type of company, sector, focus area and AI solution offered. The mapping also covered the various conferences that were held in India on topics relating to AI and banking and finance. The data about the stakeholders was derived from publicly available information on websites, newspaper reports and conferences. A google scholar search was also done to identify the key academic works being published in India in the sector. The data was then further categorized based on our mapping parameters. As a note, the intention of this mapping is to provide a snapshot of the AI in the financial ecosystem in India and does not attempt to be exhaustive. The list of stakeholders identified as well as a brief summary of our findings is as presented below. The complete mapping can be found at the end of this Report in Annex 1.

Developers: In our attempt to map the significant developers of AI solutions in banking and finance, we were able to identify fifty three companies that had developed products that use AI. Out of the fifty three companies identified, forty one were domestic companies and twelve were international. These companies were further divided based on their focus areas. The focus areas identified in our study ranged from customer interface, automation of backend processes to fraud detection, and credit scoring. The mapping of the key developers of AI based on their focus area helped us identify the key trends in AI development in the banking and finance. Our mapping identified nineteen companies that are in the field of providing customer interface solutions such as virtual assistants and chatbots. Out of these nineteen, four of the developers are international companies, out of which DBS Bank[50] is an international bank that has developed AI powered chatbots. The domestic developers

45   Goudarzi, S, and Khaniejo, N. AI in Governance. (2018, April 19). Retrieved from https://cis-india.org/internet-governance/files/ai-in-governance.

46   Traderays (2018, May 05). Retrieved from https://traderays.com/

47   Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

48   Indian banks seek artificial intelligence. *Livemint.* (2016, May 31). Retrieved from https://www.livemint.com/Money/jQEQNXyfLkW1kY5FihFBHM/Indian-banks-seek-artificial-intelligence.html

49   Ibid.

50   DBS. (2018, April 12). Retrieved from https://www.dbs.com/in/index/default.page

include startups such as Niki Ai[51], 3LOQ[52], and Jubi.ai[53], which are being used by banks and payment apps to provide customer assistance. In the area of risk management and fraud detection our study identified three domestic developers in each of these areas - Quantx Technologies[54], NextAngels[55], Accuracap[56] and Fluid Ai[57], Thirdwatch[58], and Instamojo[59], respectively. Five domestic developers and one international developer has developed AI that provides personalised services to customers. These systems used data to analyse the customers preferences and provide services based on them. Startups such as Earlysalary[60], Rupeeland[61] and Paymatrix[62] are making significant impact in this area. In the area of credit scoring, out of the four identified developers, startups such as MonsoonCreditTech[63] that are providing agricultural loans. It was also identified that AI is also being developed to reduce manual work and to increase efficiency of the financial institutions through applications such as assessing credit worthiness (CreditWatch[64]), verifying credentials (Signzy)[65], automating approvals (Slicepay)[66] etc. eight such developers were identified. Another field where AI is being used is in providing business strategy insights, our study identified three such companies that are using data and AI to help the banks in business strategies such as customer retention. Finally, six developers were identified that provided services across focus areas. These developers develop virtual assistants, provide business insights and at times looked into credit assessment. Examples include Yana AI,[67] Infosys Finacle,[68] and Fundexpert.[69]

Government: The financial system in India consists of government actors that play a key role in regulating banking, insurance, capital markets and other sectors. Our study identified eight key stakeholders, out of which three of them had a direct impact on AI in banking and finance. The Reserve Bank of India (RBI), the key financial regulatory body in India has set up an Inter-regulatory Working Group on FinTech and Digital Banking.[70] This working group has

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51   Niki AI. (2018, April 12). Retrieved from https://www.niki.ai/

52   3LOQ. (2018, April 12). Retrieved from https://3loq.com/

53   Jubi. (2018, April 12). Retrieved from https://www.jubi.ai/

54   QTX Robo Trading. (2018, April 12). Retrieved from http://www.quantxindia.com/products/qtx-robo-trading/

55   Next Angles. (2018, April 12). Retrieved from https://nextangles.com/

56   AccuraCap. (2018, April 12). Retrieved from http://www.accuracap.com/

57   Fluid AI. (2018, April 12). Retrieved from http://fluid.ai/

58   Thridwatch. (2018, April 12). Retrieved from https://www.thirdwatch.ai/

59   Instamojo. (2018, April 12). Retrieved from https://www.instamojo.com/

60   Early Salary. (2018, April 12). Retrieved from http://earlysalary.com/#why-earlysalary

61   Rupeelend. (2018, April 12). Retrieved from https://www.rupeelend.com/

62   Paymatrix. (2018, April 12). Retrieved from https://paymatrix.in/

63   Monsoon. (2018, April 12). Retrieved from https://monsoonfintech.com/products/

64   Credit Watch. (2018, April 12). Retrieved from http://crediwatch.com/

65   Signzy. (2018, April 12). Retrieved from https://signzy.com/

66   SlicePay. (2018, April 12). Retrieved from https://slicepay.in/

67   Yana. (2018, April 12). Retrieved from http://www.getyana.com/solutions/

68   Infosys launches Finacle 11E. (2018, April 12). *Infosys*. Retrieved from https://www.infosys.com/newsroom/features/Pages/advanced-universal-banking-solution.aspx

69   Fund Expert. (2018, April 12). Retrieved from https://www.fundexpert.in/

70   Report of the Working Group on FinTech and Digital Banking. (2018, February 8). Retrieved from https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=892

recognised the importance and the use of AI in banking. In addition to publishing research papers on AI and banking[71] RBI has established the Institute for Development and Research in Banking Technology in Hyderabad that is instrumental in the area of research on the use of AI and related technologies in banking and finance.[72] SEBI has also set up the Committee on Financial and Regulatory Technologies (CFRT) which is set to look at the use of AI in securities and trading.[73] The other initiatives of the government such as Digital India and the AI task force, though did not specifically mention leveraging AI in banking and finance can be considered to be other key initiatives that can affect the use of AI in this sector.

Funders/Investors: The startups working on AI in banking and finance have been funded by various investors that encourage development of AI in this sector. Our study identified thirty seven investors/funders who have funded a range of AI startups. It was also noted that ten of the identified startups were funded by more than one investor. The key investors identified were Omidyar Network[74], VentureWorks India[75], Sequoia[76] and Indian Angel Network[77]. IIT Hyderabad[78] was the only academic institution that had invested in a startup.

User: In our study, we identified twenty four financial institutions such as banks, payment apps, and finance companies that were using AI. The list of banks included Bank of Baroda[79], ICICI Bank[80], SBI[81] and Kotak Mahindra Bank[82]. These banks are using AI in the form of chatbots as well as for automating some of the backend tasks. Even for financial institutions

71   Nag, A., & Mitra, A. (1999). Neural networks and early warning indicators of currency crisis. *Reserve Bank of India Occasional Papers*, *20*(2), 183-222.

72   Institute for Development and Research in Banking Technology. (2018, April 12). Retrieved from http://www.idrbt.ac.in/

73   SEBI constitutes 'Committee on Financial and Regulatory Technologies (CFRT)'. (2017, August 3). Retrieved from https://www.sebi.gov.in/media/press-releases/aug-2017/sebi-constitutes-committee-on-financial-and-regulatory-technologies-cfrt-_35526.html

74   Chopra, A. (2017, February 15). ZestMoney raises $6.5 million. *Mint*. Retrieved from https://www.livemint.com/Companies/L3TTxcgDCALg1XbQwr5XLP/ZestMoney-raises-65-million.html

75   Pitchiah, V. (2017, October 10). Fraud prevention startup ThirdWatch raises seed funding from IAN, others. *VCCircle*. Retrieved from https://www.vccircle.com/fraud-prevention-startup-thirdwatch-raises-seed-funding-from-ian-others/

76   Bhalla, T. (2017, August 21). Capital Float raises $45M in Series C, takes total funds raised in the past year to $112M. *Your Story*. Retrieved from https://yourstory.com/2017/08/capital-float-raises-45m-series-c/

77   Pitchiah, V. (2017, October 10). Fraud prevention startup ThirdWatch raises seed funding from IAN, others. *VCCircle*. Retrieved from https://www.vccircle.com/fraud-prevention-startup-thirdwatch-raises-seed-funding-from-ian-others/

78   Paymatrix - Funding. (2018, April 12). Retrieved from https://www.cbinsights.com/company/paymatrix-funding

79   Urs, A. (2017, August 13), Banks exploring use of artificial intelligence in operations. *Business Line*. Retrieved from https://www.thehindubusinessline.com/money-and-banking/banks-exploring-use-of-artificial-intelligence-in-operations/article9816427.ece

80   Maru, P. (2017, October 17). ICICI Bank's AI chatbot iPal empowers customers with information and financial services. *Economic Times*. Retrieved from https://cio.economictimes.indiatimes.com/news/enterprise-services-and-applications/icici-banks-ai-chatbot-ipal-empowers-customers-with-information-and-financial-services/61118452

81   SBI launches chatbot to help customers in banking services. *Mint*. (2017, September 25). Retrieved from https://www.livemint.com/Industry/68ipadKiLQwxGUKTxXd3pL/SBI-launches-chatbot-to-help-customers-in-banking-services.html

82   Urs, A. (2017, August 13), Banks exploring use of artificial intelligence in operations. *Business Line*. Retrieved from https://www.thehindubusinessline.com/money-and-banking/banks-exploring-use-of-artificial-intelligence-in-operations/article9816427.ece

such as Tata Capital[83] and Microsec Finance[84] the most prominent use of AI is in the form of chatbots. The Bombay Stock Exchange[85] has also started using data analytics and AI based system to track the social media updates of the listed companies. In terms of the payment apps, Paytm[86], Instamojo[87] and Oxygen wallet[88] are using AI to improve their customer interface and detect frauds.

Academic, Consultancy and Industry Agencies: Our study identified thirty academic, consultancies and industry agencies that have published research on AI in the banking and finance. Out of the academic institutions identified IIM Calcutta[89], IDBRT Hyderabad[90], and Amrita Vishwa Vidyapeetham[91] have published papers on the various aspects of the use of AI in the financial sector. Our study also identified the RBI[92] as a key publisher of research on AI in the banking sector. Out of the industry bodies identified the key reports on this issue were published by Infosys, PWC[93], Deloitte,[94] ADB[95] and Swissnex India[96]. HDFC Bank[97] has also shown its interest in industry-academia partnership, by launching an initiative with management institutions to provide students knowledge of AI in the banking sector.

Conferences: In our attempt to map out the AI and Banking and Finance ecosystem in India, our study identified sixteen conferences that were held or were slated to be held in India.

83   Tata Capital launches artificial intelligence-based online chatbot. (2017, April 18). Retrieved from http://www.tata.com/company/releasesinside/tata-capital-ai-online-chatbot

84   Chowdhary, S. (2017, March 8). Fashion e-retailers get AI-powered boost, courtesy Staqu. *Financial Express.* Retrieved from http://www.financialexpress.com/industry/fashion-e-retailers-get-ai-powered-boost-courtesy-staqu/578723/

85   BSE implements artificial intelligence mechanism for rumour detection. (2016, November 21). Retrieved from https://www.bseindia.com/markets/marketinfo/DispMediaRels.aspx?page=d3784583-0810-4bef-8754-087b60832bfa .

86   Tyagi, C. (2016, November 21). From fashion to cancer detection: Staqu has big plans for AI. *Economic Times.* Retrieved from https://economictimes.indiatimes.com/small-biz/startups/from-fashion-to-cancer-detection-staqu-has-big-plans-for-ai/articleshow/55534751.cms

87   Singh, P. (2017, October 12). How Data-Driven Instamojo is Solving Issues Around Digital Payments. *Analytics India.* Retrieved from https://analyticsindiamag.com/how-data-driven-instamojo-is-solving-issues-around-digital-payments/

88   Oxigen Wallet's Artificial Intelligent Chatbot launched in collaboration with Niki.ai. *Economic Times.* (2017, January 12). Retrieved from https://cio.economictimes.indiatimes.com/news/enterprise-services-and-applications/oxigen-wallets-artificial-intelligent-chatbot-launched-in-collaboration-with-niki-ai/56494807

89   IIM Calcutta. (2018, April 12). Retrieved from https://www.iimcal.ac.in/

90   Institute of Development and Research in Banking Research. (2018, April 12). Retrieved from http://www.idrbt.ac.in/

91   Amrita Vishwa Vidyapeetham. (2018, April 12). Retrieved from https://www.amrita.edu/

92   Reserve Bank of India. (2018, April 12). Retrieved from https://www.rbi.org.in/

93   Fintech Trends Report: India 2017. (2017, March 30). Retrieved from https://www.pwc.in/assets/pdfs/publications/2017/fintech-india-report-2017.pdf

94   Banking on the Future: Vision 2020. (2016, September 16). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

95   Financial Inclusion in the Digital Economy. *Asian Development Bank.* (2017, January). Retrieved from https://www.adb.org/sites/default/files/publication/200001/financial-inclusion-digital-economy.pdf

96   Fintech in India. *Swissnex India.* (2016, October). Retrieved from https://www.swissnexindia.org/wp-content/uploads/sites/5/2016/10/Fintech-Report-2016.pdf

97   Industry Academia. (2018, April 12). Retrieved from https://www.hdfcbank.com/htdocs/common/Industry_Academia/about_program.html

Although these conferences were not on the topic of AI in the financial sector, they had sessions which discussed the use of AI as an emerging technology in Banking and Finance. These conferences discussed topics such as robo-banking, automated decision making and analytics. The organizers of these conferences included industry bodies such as the FICCI[98], JMR Infotech[99] and India Fintech Forum[100], stakeholder in media such as Businessworld and Mint and Institutions such as IIM Calcutta[101]. With regard to the venue for these conferences, it was found that Mumbai was the venue for twelve out of the sixteen conferences identified. The other venues were New Delhi, Goa, and Bangalore.

Government Initiatives

In India, the government has recently expressed its intent to invest heavily in Artificial Intelligence. The 2018 budget allocates $480 Mn (Rs. 3,703 Crore) to the Digital India programme, effectively doubling its past investment.[102] During the Budget session, the government announced that it would extensively invest in research, training, and skill development in inter alia robotics, AI, digital manufacturing, Big Data intelligence and Quantum communications.[103] Some of these initiatives are seen in the form of joint projects, internal programs, and the AI Task Force. While most of these initiatives concern a broader implementation of AI, there are several initiatives specific to, and others that indirectly affect the banking and finance industry. This section will cover both these types of initiatives.

AI Task Force: The AI Task Force set up by the Ministry of Commerce & Industry, includes distinguished members from a number of sectors including Banking and Finance.[104] The Report of the task force, released in March 2018, identified ten key domains where AI could be an enabler of social and economic development for India. The Fintech industry was one of the domains identified for the inclusion of AI towards furthering India's development. The Report stated that the use of AI in Fintech will help and expand the existing efforts of India Stack, an enabler of digital payments and paperless transactions. The Report also found that leveraging AI in the banking and finance sector will help in providing assistance to small and medium enterprises as well as help in risk assessment. The task force also identified two key challenges towards the spread of AI in this sector - balancing scale and innovation and anticipation of market demand.[105] The other significant challenges identified were data confidentiality and access to financial services.[106] The Report also identified the key enablers for AI development and commercialisation in the Fintech sector will be the availability of data, open application programming interfaces, decision making and smart analytics.[107]

98 Kochhar, C. (2018, January 10). Finance in Digital Era: Navigating the knowns and unknowns. *FICCI Blog*. Retrieved from http://blog.ficci.com/finance-digital-era-navigating-knowns-unknowns/7912/

99 Fintech Summit India 2017. (2018, April 12). Retrieved from https://www.jmrinfotech.com/events/fintech-summit-india/

100 KS, Ashwin. (2017, July 3). Highlights of RBS Fintech Meetup at Gurgaon. *India FinTech Forum*. Retrieved from https://blog.indiafintech.com/2017/07/03/highlights-of-rbs-fintech-meetup-at-gurgaon/

101 AI, Machine Learning and Sentiment Analysis Applied to Financial Markets Retail and Consumer Markets. (2018, April 12). Retrieved from http://conferences.unicom.co.uk/sentiment-analysis-bangalore-2018/

102 Jaitley, A. (2018, February 1). Budget 2018-2019: Speech of Arun Jaitley, MInister of Finance. Retrieved from https://www.incometaxindia.gov.in/budgets%20and%20bills/2018/budget-speed-2018.pdf

103 Mukherjee, S. (2018, February 1). Budget 2018: Govt. Still Strong On Digital India; Allocates $480 Mn To Promote AI, ML, IoT Inc 42. Retrieved from https://inc42.com/buzz/budget-2018-ai-ml/

104 Report of Task Force on Artificial Intelligence. (2018, March 21). Ministry of Commerce and Industry. Retrieved from http://dipp.nic.in/whats-new/report-task-force-artificial-intelligence

105 Ibid.

106 Ibid.

107 Ibid.

Ministry of Corporate Affairs: The Ministry of Corporate Affairs has proposed that they will use Artificial Intelligence to detect financial fraud, and shell companies.[108] The MCA plans to use AI in the Ministry's portal to detect anomalies that would otherwise go undetected when traditional systems are used. These anomalies and suspicious activities can hence be used to weed out companies engaging in making fraudulent balance sheets as well as shell companies. The AI software is proposed to be matched with the balance sheet of the company in order to ensure that if any discrepancy is detected, action can be taken against those companies.

Reserve Bank of India: The Reserve Bank of India has set up an Inter-Regulatory Working Group to study issues relating to fintech and digital banking in India.[109] The working group aims at understanding the important innovations in fintech industry and how the various actors in the financial sectors are using new methods, products and technologies. The Report of the Inter-Regulatory Working Group on FinTech and Digital Banking released in February 2018, categorizes the use of Artificial Intelligence and Robotics in data analytics and risk management as one of the major Fintech Innovations.[110] The report states that the digital transformation of the Banking and Financial Sector will ride on the three pillars - BlockChain, Artificial Intelligence and Internet of Things.[111] The report also states that when devices get interconnected and use self-learning and evolving AI the banking sector will expand beyond apps, websites or physical branches.[112] Stating also that the widespread adoption of biometric authentication and AI based voice enabled financial and advisory services may make banking relatively 'invisible'. Apart from the Working Group the RBI , had set up the Institute for Development and Research in Banking Technology (IDRBT) in 1994, as an organization that conducts research in emerging technologies and its application in banking.[113] The IDRBT has been instrumental in conducting research in the use of AI in Banking and Finance.[114] The RBI is also looking to tap into insights that Big Data analytics can provide and use them in its exercise of its policy making powers; an RBI Data Sciences Lab is proposed to be fully operational by December 2018.[115]

National Institute of Financial Management: A report by the National Institute of Financial Management, under the Ministry of Finance, looks at the contemporary market trading practices, benefits and areas of concern, and makes recommendations towards a policy framework for Algo or High Frequency Trading.[116] Some of key regulatory issues identified in the report are contribution to price volatility, market noise (excessive order entry

108   Shah, A. (2018, March 18). Corporate affairs ministry plans to use Artificial Intelligence to detect fraud, says P P Chaudhary. *DNA*. Retrieved from http://www.dnaindia.com/business/interview-corporate-affairs-ministry-plans-to-use-artificial-intelligence-to-detect-fraud-says-p-p-chaudhary-2595512

109   Report of the Inter-Regulatory Working Group on FinTech and Digital Banking. (2018, February 8). Retrieved from https://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=43097

110   Report of the Working Group on FinTech and Digital Banking. (2018, February 8). Retrieved from https://www.rbi.org.in/Scripts/PublicationReportDetails.aspx?UrlPage=&ID=892

111   Ibid.

112   Ibid.

113   Institute of Development and Research in Banking Research. (2018, April 12). Retrieved from http://www.idrbt.ac.in/

114   Ibid.

115   Reserve Bank of India. Statement on Developmental and Regulatory Policies. (2018, April 5). p. 16. Retrieved from https://rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=43574

116   A Study on Algorithm Trading/High Frequency Trading in the Indian Capital Market. National Institute for Financial Management. Retrieved from https://dea.gov.in/sites/default/files/NIFM%20Report%20on%20Algo%20trading.pdf

and cancellation), cost that high-frequency trading imposes on other market users, technological arms race, limited opportunities for regulators to intervene during high volatility, strengthening of surveillance mechanism, and enabling fair, transparent and non-discriminatory access. Algo trading and high frequency trading lead to improvements in transactions costs, volatility, buy-sell imbalance improved price discovery, reduced latency and levels the playing field among competing high frequency market makers.

However, technical capacity and resources are required for it, which is lacking. This has led to systemic risks. Fat finger or faulty algorithms can cause huge deviations from healthy prices. Such trading can give rise to price fluctuations and short term volatility. Further, colocation facility can be expensive and gives rise to market inequity. Algorithmic trading has also been used to manipulate markets using techniques like quote stuffing, layering (spoofing) and momentum ignition.

Digital India, Make in India, Skill India Initiatives: The Digital India and Make in India initiatives have given a major boost to the use of AI and IoT in the banking and finance sector especially with the push towards digital payments.[117] India has taken a huge step towards the adoption and development of Industry 4.0 which aims to completely digitise various sectors including banking with the use of IoT, AI and Big Data analytics. Furthermore, the Skill India initiative[118] will help in reskilling workforce towards performing new and high skilled tasks that will be key to the successful implementation of AI in the finance sector. A report by the National Skill Development Authority titled 'Human Resource and Skill Requirements in the Banking and Financial Services Insurance Industry' examines the BFSI sector in India, including the key stakeholders, risks and the key trends in this sector. The Report then looks at the changing skill requirements for workers in this sector, stating that traditionally the banking industry employs highly skilled people with a specialised educational qualification. The report also states that with the evolving nature of the industry, and especially due to the adoption of new technologies, the sector workforce needs to update their skills.Although the Report does not state explicitly the skills that are required for the sector, it emphasises on the need to computerise various aspects of banking.

Niti Aayog: Niti Ayog is working on a national policy on artificial intelligence to outline the scope of adoption and commercialisation of AI in India. Under the policy, deadlines for commercial rollout of AI may also be proposed in areas like agriculture, health, education, banking, retail and transportation. The policy is expected to chalk out short-medium and long term goals to be achieved by 2022, 2026 and 2030.[119] These deadlines include those for the commercial use of AI in banking.[120]

IndiaStack: The digital platform project, spearheaded by various government actors and the technology think tank iSpirt, comprises API based infrastructure that would enable the development of technologies built around eKYC, eSign, DigiLocker, UPI and Aadhaar authentication.[121] The utilization of a fuzzy learning algorithm with the Aadhaar database has been reported as part of the platform's presencless technology layer to facilitate identity

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117   Digital India. (2018, April 12). Retrieved from http://www.digitalindia.gov.in/rural.

118   PM Modi Launches Skill India Initiative That Aims to Train 40 Crore People. *NDTV*. (2015, July 16). Retrieved from https://www.ndtv.com/india-news/pm-modi-launches-skill-india-initiative-that-aims-to-train-40-crore-people-781897.

119   Sharma and Agarwal. (2018, March 21). Niti Aayog to come out with national policy on artificial intelligence soon. *Economic Times.* Retrieved from https://economictimes.indiatimes.com/news/economy/policy/niti-aayog-to-come-out-with-national-policy-on-artificial-intelligence-soon/articleshow/63387764.cms.

120   Ibid.

121   About India Stack. Retrieved from http://indiastack.org/about/.

authentication of Aadhaar holders.[122] The platform, particularly UPI, has the potential to host numerous AI-driven services and products.

Legal and Ethical Considerations

At the moment, there are no dedicated overarching policies or governance structures regarding AI in India. There are existing laws which would be applicable to certain aspects of AI in finance, however, they have not been framed with a view towards specifically regulating AI. Towards understanding the legal, policy, and ethical implications of AI, the following section provides an overview of the regulatory framework for the finance sector and examines key legal and ethical considerations pertaining to the use of AI technologies. In doing so, the section calls out relevant existing policy or the lack thereof.

Existing Regulatory Framework

Although the term "bank" is widely applied to different types of financial institutions, there are important differences. In India, banking is defined[123] as an activity *"for the purpose of lending or investment of deposits of money from the public, repayable on demand or otherwise and withdrawable by demand by cheque, draft or otherwise"*.[124] Banking company is defined[125] as, *"any company which transacts the business of banking in India"*.[126]

The commercial banking structure in the country is made up by scheduled and non-scheduled banks.[127] The commercial banking environment predominantly consists of private and public Indian banks along with a small number of foreign banks.[128] This banking landscape also includes both urban and rural co-operative banks -- banks registered under the Cooperative Societies Act, 1912 -- as well as the Regional Rural Banks Act, 1976 -- that serve rural areas and agricultural sectors with basic banking and other financial services.[129] The regulatory and supervisory agency over banks is the RBI — the Reserve Bank of India, acting as the central bank and the monetary authority.[130] RBI was established in 1934 with the passing of the Reserve Bank of India Act, 1934 and presently maintains the largest regulatory scope and power in the banking sector. [131]

It should, however, be emphasized that this landscape has changed significantly in the last few years due to the evolution of financial technologies in conjunction with the liberalization of the financial system. Banks have traditionally been the dominant financial intermediary,

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122   India Stack – The Bedrock of a Digital India (2016, December 7). Retrieved from http://indiastack.org/india-stack-the-bedrock-of-a-digital-india/.

123   Section 5(1)(b) of the Banking Regulation Act 1949.

124   Machiraju, H.R. Indian Financial System (2010, October 1).

125   Section 5(1)(c) of the Banking Regulation Act 1949.

126   Machiraju, H.R. Indian Financial System (2010, October 1).

127   Scheduled banks are those that have been included in the Second Schedule of the Reserve Bank of India Act, 1934 and fulfill certain capital and corporation requirements. Banks that are not included in the Second Schedule of the Reserve Bank of India Act are considered non-scheduled banks. See also, Parameswaran, R. Indian Banking (2001).

128   Topic-wise Solved Papers for IBPS/ SBI Bank PO/ Clerk Prelim & Mains By Disha Experts.

129   Topic-wise Solved Papers for IBPS/ SBI Bank PO/ Clerk Prelim & Mains By Disha Experts.

130   Machiraju, H.R. Indian Financial System (2010, October 1).

131   Reserve Bank of India: Functions and Working. Retrieved from https://rbidocs.rbi.org.in/rdocs/Content/PDFs/FUNCWWE080910.pdf

but the landscape has seen the rapid rise of alternative payment and banking services, as well as fintech startups focused on offering financial services. The growth of e-commerce in India has seen the emergence of digital financial services and intermediaries that are rapidly gaining traction among the Indian public. This growth, in conjunction with the red tape associated with "traditional" banks' has seen their market share for payments and loans e decline as a result. Non-banking finance companies (NBFCs) contribution to the Indian economy has increased from 8.4 percent in 2006 to more than 14 percent in the March of 2015 and their continued growth is projected.[132] Furthermore, in order to facilitate financial inclusion, RBI "had created a framework for licensing Payments Banks/Small Banks and other differentiated banks".[133]

The beginning of NBFCs in India can formally be traced back to the 1964, where Chapter III B of the RBI Act, 1934 was "introduced to regulate deposit-accepting NBFCs".[134] In 1996 and 1997, the RBI developed a more "enhanced framework", including "introduction of entry point norms, stricter and more detailed regulations with respect to acceptance of deposits", "maintenance of a portion of deposits in liquid assets, creation of a reserve fund, etc". [135] In 2006, RBI began to focus more on non-deposit accepting NBFCs.[136] Since then, a number of diverse committees have been appointed by the the RBI as means of determining recommended regulatory changes related to NBFCs.[137] It should be noted that although the RBI is the predominant entity regulating NBFCs -- other regulatory authorities exist depending on the specific activities (see Annex).[138]

The Securities Exchange Board of India (SEBI) is the other important regulator and its main regulatory objective is the protection of investor and the regulation of the financial system, having significant regulatory power in regards to the primary and secondary securities markets, the intermediaries operating in these markets, mutual funds. Furthermore, the Insurance Regulatory and Development Authority (IRDA) Bill was passed by the Indian Parliament in December 1999, and the IRDA became a statutory body the following year.[139] The institution both frames regulations and registers private sector insurance companies.

The financial regulations mentioned here have all been developed with traditional banking and finance sector actors in mind. However, the applicability of these regulations to the fintech sector is not entirely clear. It has been observed that RBI has been fairly instrumental in enabling the development of fintech sector. Furthermore, fintech companies have generally challenged the existing regulatory framework, as they do not clearly fall under existing regulations.[140]

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132   Non-Banking Finance Companies: The Changing Landscape. (2016, April 29). PWC. Retrieved from https://www.pwc.in/assets/pdfs/publications/2016/non-banking-finance-companies-the-changing-landscape.pdf.

133   Topic-wise Solved Papers for IBPS/ SBI Bank PO/ Clerk Prelim & Mains By Disha Experts.

134   Non-Banking Finance Companies: The Changing Landscape. (2016, April 29). PWC. Retrieved from https://www.pwc.in/assets/pdfs/publications/2016/non-banking-finance-companies-the-changing-landscape.pdf.

135   Ibid.

136   Ibid.

137   Ibid.

138   Reserve Bank of India Report on Trend and Progress of Banking in India 2003-2004. Retrieved from: https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=Trend+and+Progress+of+Banking+in+India

139   Bhole. Financial Institutions & Markets 5E. (2004).

140   FinTech in India: A Global Growth Story. (2016, June). KPMG. Retrieved from https://assets.kpmg.com/content/dam/kpmg/pdf/2016/06/FinTech-new.pdf

Privacy: As is the case with Big Data, artificial intelligence has the ability to bring together and use vast amounts of granular traditional and non-traditional data points and pivot around these for different forms of analysis and decision making. In the finance sector this could include social profiling, financial profiling, location based profiling, and behavioral analysis. Such practices raise questions about traditional privacy principles including consent, notice, purpose limitation, collection limitation, and disclosure. Relevant policy around privacy that would need to be revisited in light of the development and application of AI includes:

• **Section 43A and associated rules, Information Technology Act, 2000[141]:** The large quantities of sensitive personal data/information - including financial information - utilized by various AI strategies warrants the applicability of Section 43A of the Information and Technology Act, 2000 ("IT Act") and associated Rules. The Section requires body corporate to develop and follow reasonable security measures during the handling of such data, with the requirement of such information being protected from "unauthorised access, damage, use, modification, disclosure or impairments", the failure of which will be required compensation to those affected. There are many aspects of the Rules that would need to be revisited and added in light of AI in the finance sector. These include the mechanisms around collection, consent, notice, purpose limitation and disclosure. Furthermore, the scope and applicability of the rules would need to be revisited as would the definition of financial information[142]. The Rules would also need to address automated decision making and anonymisation.

  The need for a more comprehensive data protection framework has been recognized and the Ministry of Electronics and Information Technology established a committee (Srikrishna Committee) to identify data protection issues and possible means to addressing them.[143] The committee has identified AI as one of the technological developments constituting a "Big Data ecosystem" that warrants developing regulations.[144] It has been recommended by "the Committee that the data protection laws should cover both manual and automated processing".[145] Similarly, the RBI working group on Fintech and Digital Banking put out a Report for their Working Group on Fintech and Digital Banking and stated that in regards to data protection, the onus of consumer data protection lies with such fintech companies, "ranging from data Preservation, Confidentiality, Integrity, and Availability" irrespective of the ways in which data is stored or moved.[146] The working group recognized the risk to personal data that comes with innovations in Fintech the report also emphasizes the potential need for an "exhaustive stand-alone legislation on data protection"

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141   Information Technology (Reasonable security practices and procedures and sensitive personal data or information) Rules, 2011.

142   Currently, financial information as used in the Rules is defined as " financial information such as Bank account or credit card or debit card or other payment instrument details". Given the range of data that can be collected through AI by financial institutions and potentially new forms of financial data emerging through the combination of different data points, the definition of 'financial information' may need to be further articulated to clearly distinguish types of financial data.

143   Paul, Y. Hickok, E. Sinha, A. & Tiwari, U. (2018, January 26). Artificial Intelligence in the Healthcare Industry in India. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/ai-and-healthcare-report

144   White Paper of the Committee of Experts on a Data Protection Framework for India. Retrieved from http://meity.gov.in/writereaddata/files/white_paper_on_data_protection_in_india_18122017_final_v2.1.pdf

145   Paul, Y. Hickok, E. Sinha, A. & Tiwari, U. Artificial Intelligence in the Healthcare Industry in India. (2018, January 26). Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/ai-and-healthcare-report

146   Report of the Working Group on FinTech and Digital Banking. (2017, November). Reserve Bank of India. Retrieved from https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/WGFR68AA1890D7334D8F8F72CC2399A27F4A.PDF

- **Credit Information Companies (Regulation) Act 2005 and 2006:** The Credit Information Companies (Regulation) Act 2005 and 2006 establishes a framework to govern and regulate the use of credit information. In the 2006 regulation, if a borrower is denied credit, the credit company must send notice of rejection to the individual. The notice must state the specific reasons for rejection, include a copy of the credit report, and provide the name and address of any Credit Information Company that issued the report, along with any other information that was used in making the decision.[147] In the context of AI, credit decisions will be automated and the data used and logic of the algorithm unclear. The provision may need to be revisited and strengthened to ensure that individuals have a clear right to explanation and right to have the decision reviewed by a human.

  The Credit Information Companies Act 2005 defines credit information as the amounts and nature of loans, the nature of securities taken, the guarantee furnished or any other non-funding based facility granted by a credit institution to establish the creditworthiness of any borrower.[148] In light of the variety of data that can now be used by AI in reaching a decision on creditworthiness, this definition may need to be revisited.

- **Securities and Exchange Board of India (Investment Advisers) Regulations, 2013:** Currently, specific rules pertaining to robo-advisers have not been formulated by the SEBI, however it has released a consultation paper which seeks to address this issue.[149]

  The proposals in the consultation paper, while mentioning the SEC approach in the US, do not go on to envision a similar framework where robo-advisers will have to separately registered. Instead, they seem to have only taken into account scenarios where robo-advisers assists human advisers in dispensing investment advice. Indeed, they regard the robo-advisers as 'tools'. This approach could possibly have been developed to fit robo-advisers within the extant regime. It could also be looked at as acknowledgement of the tricky nature of regulating algorithms within a framework created to regulate human behavior.

  However, the consultation paper proposes a regime where there will be several compliance requirements on the part of the investment adviser using the robo-adviser and goes on to suggest that the "investment adviser using the tool shall be held responsible for the advice." Additionally, this ties into the existing position of law on the fiduciary obligation of investment advisers towards their clients.[150]

- **Payment and Settlement Systems Act, 2007**: The payments space in India is perhaps one of the most regulated, under the purview of the Payment and Settlement Act, 2007 and the Payment and Settlement Systems Regulations, 2008. These regulations apply to all payments actors – including fintech entities

  Various sections of the Payments and Settlements Act (for example, Section 18 and Section 10(c)) enable RBI to determine policy and standards related to the regulation and management of electronic payments domestically but they have yet to offer anything specific on artificial intelligence or the use of algorithms as it relates to these issues. All actors authorised to operate payments systems and involved in the issuance of pre-paid payment instruments (PPI) in India are required to comply with RBI's Policy Guidelines on

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147   Section 9.5.1, Credit Information Companies (Regulation) Act (2006).

148   Section 2(d), Credit Information Companies (Regulation) Act (2006)

149   Consultation Paper on Amendments/Clarifications to the SEBI (Investment Advisers) Regulations, 2013. (2017, June 22). Securities Exchange Board of India. Retrieved from https://www.sebi. gov.in/sebi_data/attachdocs/1475839876350.pdf

150   Regulation 15(1) of the Securities and Exchange Board of India (Investment Advisers) Regulations, 2013.

Issuance and Operations of Prepaid Payment Instruments in India (PPI Guidelines). Under these Guidelines, 'information and data security infrastructure and systems' are required to be put in place by PPI issuers.[151]

In addition to provisions around confidentiality and secrecy, the Act allow the Reserve Bank of India to undertake audits and inspections of payment systems or participants. The RBI has formulated the draft Master Directions on Issuance and Operation of Prepaid Payment Instruments in India that when enforced, will supercede Policy Guidelines on Issuance and Operations of Prepaid Payment Instruments in India.[152] Most noteworthy is its addressing of fraud prevention and security standards, positing the any issuer to "put in place adequate information and data security infrastructure and systems for prevention and detection of frauds."[153] These guidelines also contain stipulation for review and monitoring, information security policy as well as security incident protocols.[154]

2017 also saw the release of the draft rules for Security of Prepaid Payment Instruments under provisions of the IT Act, 2000, relating to the security of PPIs such as digital wallets. These draft rules focus on the protection of personal information as well on ensuring merchants handling authentication data have the appropriate security measures in place.[155]

- **The Banking Regulation Act 1949:** Banks must identify the customer and verify his/ her identity by using reliable, independent source documents, data or information. 'The nature of information/documents required to identify individuals should depend on the type of customer (individual, corporate etc.) For customers that are natural persons, the banks should obtain sufficient identification data to verify the identity of the customer, his address/location, and also his recent photograph. For customers that are legal persons or entities, the bank should (i) verify the legal status of the legal person/ entity through proper and relevant documents (ii) verify that any person purporting to act on behalf of the legal person/entity is so authorized and identify and verify the identity of that person, (iii) understand the ownership and control structure of the customer and determine who are the natural persons who ultimately control the legal person.'

  Banks are permitted to create customer profiles based on risk categorization that include information pertaining to the customer's identity, social and financial status, nature of business, and customers clients. Banks should only collect information that is relevant and not intrusive. The customer profile cannot be divulged or shared. Comprehensive coverage of information that "regulated entities" can collect for the process of verification is defined in the RBI's Master Direction - Know Your Customer (KYC) Direction, 2016[156]. As AI enables the use of traditional and non-traditional data

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151   Master Circular – Policy Guidelines on Issuance and Operation of Pre-paid Payment Instruments in India. (2016, July 1). Retrieved from https://www.rbi.org.in/Scripts/BS_ViewMasCirculardetails.aspx?id=10510

152   Master Directions on Issuance and Operation of Prepaid Payment Instruments in India. (2017, March 20). Retrieved from https://www.rbi.org.in/Scripts/bs_viewcontent.aspx?Id=3325

153   Ibid.

154   Ibid.

155   Draft rules for Security of Prepaid Payment Instruments under provisions of IT Act 2000. (2018, April 13). Retrieved from http://meity.gov.in/draft-rules-security-prepaid-payment-instruments-under-provisions-it-act-2000

156   Master Direction - Know Your Customer (KYC) Direction, 2016. (2016, February 25). Reserve Bank of India. Retrieved from https://rbi.org.in/scripts/BS_ViewMasDirections.aspx?id=10292

points, these provisions may need to be revisited to ensure that they enable innovation while protecting rights.

Security: There are not legislative provisions which deal specifically with the information security of financial data. However, the RBI has taken various steps to ensure better security of the financial instruments. Directions to address issues on information security and cyber security have been put in place by RBI. While said directions are applicable to banks they will also apply to some fintech entities such as digital payment banks and fintechs operated by banks.[157] RBI, in 2011, established the Information Security, Electronic Banking, Technology Risk Management and Cyber Frauds committee. From their recommendations, RBI issued guidelines on nine areas: IT Governance, Information Security, IS Audits, IT Operations, IT Services Outsourcing, Cyber Fraud, Business Continuity Planning, Customer Awareness programmes and Legal aspects.[158] These guidelines define the information security requirements all banks needs to follow. They require Banks to maintain a Board approved information security policy and posit that banks should implement "appropriate security measures to ensure protection of such information".[159] 2016 saw RBI issuing another set of guidelines, the Cyber Security Framework in Banks. This Framework requires banks to have a board-approved cyber-security policy, the monitoring and assessment mechanisms as well as a certain cyber crisis management plan.[160] It should be recognized that the cyber security policy should be distinct and separate from the information security policy as to promote the identification of risks from cyber threats and take appropriate measures to deal with them.[161] All actors authorised to operate payments systems and involved in the issuance of pre-paid payment instruments (PPI) in India are required to comply with RBI's Policy Guidelines on Issuance and Operations of Prepaid Payment Instruments in India (PPI Guidelines).[162] Under these Guidelines, 'information and data security infrastructure and systems' are required to be put in place by PPI issuers.[163] Furthermore, RBI has also notified the Master Directions on Issuance and Operation of Prepaid Payment Instruments in India that supercede Policy Guidelines on Issuance and Operations of Prepaid Payment Instruments in India.[164] Most noteworthy is its addressing of fraud prevention and security standards, positing the issuer to "put in place adequate information and data security infrastructure and systems for prevention and detection of frauds."[165] These guidelines also contain stipulation for review and monitoring, information security policy as well as security incident protocols.[166] 2017 also saw the release of the draft rules for Security of Prepaid Payment Instruments under

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157   Master Direction - Information Technology Framework for the NBFC Sector. (2017, June 08). Reserve Bank of India. Retrieved from https://rbi.org.in/scripts/BS_ViewMasDirections. aspx?id=10999#C3

158   Working Group on Information Security, Electronic Banking, Technology Risk Management and Cyber Frauds- Implementation of recommendations. (2011, April 11). Retrieved from https://www.rbi.org. in/scripts/NotificationUser.aspx?Id=6366&Mode=0

159   Ibid.

160   Cyber Security Framework in Banks. (2016, June 2). Retrieved from https://www.rbi.org.in/ scripts/NotificationUser.aspx?Id=10435&Mode=0

161   Circular - Cyber Security Framework in Banks. (2016, June 2). Retrieved from https://www.rbi. org.in/scripts/BS_CircularIndexDisplay.aspx?Id=10435

162   Master Circular – Policy Guidelines on Issuance and Operation of Pre-paid Payment Instruments in India. (2016, July 1). Retrieved from https://www.rbi.org.in/Scripts/BS_ ViewMasCirculardetails.aspx?id=10510

163   Ibid.

164   Master Directions on Issuance and Operation of Prepaid Payment Instruments in India. (2017, March 20). Retrieved from https://www.rbi.org.in/Scripts/bs_viewcontent.aspx?Id=3325

165   Ibid.

166   Ibid.

provisions of the IT Act, 2000, relating to the security of PPIs such as digital wallets. These rules, notified in 2018 focus on the protection of personal information as well on ensuring merchants handling authentication data have the appropriate security measures in place.[167] Furthermore, in their 2016 report, the Watal Committee -- set up by the government to examine existing digital payments infrastructure -- recommended the updating of the Payments and Settlements Systems Act, 2007 to include explicit mandate for data protection and security.[168] RBI has issued guidelines for NBFCs on the the Information Technology and Information Security Framework. More specifically, RBI issued a set of master directions regulatory framework for P2P lending in 2017. These guidelines require businesses of an NBFC-P2P to have "adequate safeguards" in place to ensure IT systems are protected against "unauthorized access, alteration, destruction, disclosure or dissemination of records and data" . They also call for a board approved Business Continuity Plan to ensure the "safekeeping of information and documents" and mandate regular information system audits.[169]

Indian Computer Emergency Response Team (CERT-In): The IT Act gives authority to CERT-In as a national agency to deal with cyber security incidents, empowering the organization to take on preventive as well as incident reporting and response tasks. CERT-In's most important mandate is to forecast and alert cyber security incidents however, the body is also charged with providing Information Security Assurance (ISA) services to relevant stakeholders.[170]

National Critical Information Infrastructure Protection Centre (NCIIPC): The National Critical Information Infrastructure Protection Centre (NCIIPC) is India's national nodal agency focused on the country's critical information infrastructure protection. The body has developed a security framework for Critical Information Infrastructure (CII) in India.[171] Furthermore, the NCIIPC is tasked with providing strategic leadership and coherence to the government to respond to cyber threats to CII.[172]

Though the security requirements defined above would extend to the use of AI technologies, these policies may need to be revisited in light of specific security concerns that AI brings about such as reverse engineering, reliance on the cloud, location of data, backdoors, single points of failure etc.

- **Algorithmic decision-making:**
  - **SEBI Guidelines:** The Securities and Exchange Board of India (SEBI) has developed

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167   Draft - Information Technology (Security of Prepaid Payment Instruments) Rules 2017. (2017, March 8). Retrieved from http://meity.gov.in/writereaddata/files/draft-rules-security%20of%20PPI-for%20public%20comments.pdf

168   Medium Term Recommendations to Strengthen Digital Payments Ecosystem. *Ministry of Finance.* (2016, December). Retrieved from http://finance.du.ac.in/du-finance/uploads/pdf/Reports/watal_report271216.pdf

169   Master Directions - Non-Banking Financial Company – Peer to Peer Lending Platform (Reserve Bank) Directions. (2017, October 4). Retrieved from 2017https://rbidocs.rbi.org.in/rdocs/notification/PDFs/MDP2PB9A1F7F3BDAC463EAF1EEE48A43F2F6C.PDF

170   The Information Technology (The Indian Computer Emergency Response Team and Manner of Performing Function and Duties) Rules, 2013. Retrieved from http://meity.gov.in/writereaddata/files/G_S_R%2020%20%28E%292_0.pdf

171   Guidelines for Protection of Critical Information Infrastructure. *National Critical Information Infrastructure Protection Centre.* Retrieved from http://nciipc.gov.in/documents/NCIIPC_Guidelines_V2.pdf

172   Datta, S. The NCIIPC & Its Evolving Framework. (2016, October 27). Retrieved from http://www.digitalpolicy.org/nciipc-evolving-framework/

guidelines concerned with processes that work with predefined algorithms and analytics, mainly automated trading systems and robo advisors -- automated support for financial advisory services devoid of human intervention[173] -- in their model bye-laws, planning to introduce rules for retail investors participating in algorithmic trading and wealth management.[174] The move to regulate algorithmic trading is also part of an attempt to prevent and minimize the flash crashes that have occured in the country.[175] These guidelines work in creating a liability framework where "the creator or employer of automated decision making tool is liable".[176]

Additionally, with the increasing use of AI in decision making with regards to investment strategies and portfolio management, SEBI will be required to carve out suitable provisions in its regulations on intermediaries operating in the securities markets such as stock brokers, investment advisers, research analysts and underwriters.

Currently, specific rules pertaining to robo-advisers have not been formulated by the Sebi; however there is a consultation paper out in this regard.[177]

The proposals in the consultation paper, while mentioning the US approach are a departure from it - the proposals do not envision a framework where robo-advisers will have to separately registered as investment advisers. Instead, they seem to have only taken into account scenarios where robo-advisers assists human advisers in dispensing investment advice. Indeed, they regard the robo-advisers as 'tools'. This approach could possibly have been developed to fit robo-advisers within the extant regime. It could also be looked at as acknowledgement of the tricky nature of regulating algorithms within a framework created to regulate human behavior.

However, the consultation paper proposes a regime where there will be several compliance requirements on the part of the investment adviser using the robo-adviser and goes on to suggest that the "investment adviser using the tool shall be held responsible for the advice." Additionally, this ties into the existing position of law on the fiduciary obligation of investment advisers towards their clients.[178].

- **Liability**
  - **Consumer Protection Act:** RBI put out a Report for their Working Group on Fintech and Digital Banking and stated that in regards to data protection, the onus of consumer data protection lies with such fintech companies, "ranging from data

173   Zorz, Z. (2018, February 21). Afraid of AI? We should be. *Help Net Security.* Retrieved from https://www.helpnetsecurity.com/2018/02/21/afraid-of-ai-we-should-be/; Consultation Paper on Amendments/Clarifications to the SEBI (Investment Advisers) Regulations, 2013. (2016, October 07). *Securities and Exchange Board of India.* Retrieved from www.sebi.gov.in/sebi_data/attachdocs/1475839876350.pdf

174   Vasudevan N. & Zachariah R. (2017, November 29). Sebi framing algo trading rules for retail investors. Economic Times. Retrieved from https://economictimes.indiatimes.com/markets/stocks/news/sebi-framing-algo-trading-rules-for-retail-investors/articleshow/61841163.cms

175   SEBI to tighten algo trading rules. (2017, February 27). The Hindu. Retrieved from http://www.thehindu.com/business/sebi-to-tighten-algo-trading-rules/article17378415.ece

176   Mohandas, S. (2018, February 7). AI in Banking and Finance: Looking Forward. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/draft-roundtable-report-on-ai-and-banking/view

177   Consultation Paper on Amendments/Clarifications to the SEBI (Investment Advisers) Regulations, 2013. (2016, October 07). *Securities and Exchange Board of India.* Retrieved from www.sebi.gov.in/sebi_data/attachdocs/1475839876350.pdf.

178   Regulation 15(1) of the Securities and Exchange Board of India (Investment Advisers) Regulations, 2013.

Preservation, Confidentiality, Integrity, and Availability" irrespective of the ways in which data is stored or moved.[179] The working group recognized the risk to personal data that comes with innovations in Fintech the report also emphasizes the potential need for an "exhaustive stand-alone legislation on data protection". However, these recommendations have not be codified in any regulation.

While consumer protection is a part of the mandate of financial and banking regulators, the question of liability is also separately raised under the Consumer Protection Act, 1986. This legislation offers redressal mechanisms and legal damage caused must be demonstrated. When services are provided by an entity separate from the one involved in creating the AI system, the issue of liability may be significantly more complicated.

- **Ownership of data and algorithms**: As has been outlined above, huge swaths of personal data belonging to the consumers form the ingredients for the effective operation of AI systems. With more complex datasets being harnessed, sometimes even cross-border jurisdictional issues will arise. In fact, the need for carving out a policy framework that encapsulates such challenges whilst apportioning liability to the consumer of such data whilst also granting ownership rights to the owners of data is being thought of. For instance, a project entitled the "Rethinking Personal Data"[180] under the aegis of the World Economic Forum, is being developed to better understand what they term as the 'personal data ecosystem'. In India too, policy measures are in the pipeline to regulate this burgeoning personal data ecosystem. This is imperative as leveraging personal data has become crucial to players in the banking and finance sector in gaining competitive edges.

With such data protection norms gradually becoming entrenched globally, corporate entities will need to factor in risks associated with personal data in potential mergers and acquisitions they seek to undertake; these risks could take the shape of potential monetisation of the data as well as the risks of privacy and cybersecurity that are presented. Due diligence exercises undertaken prior to acquisitions will need to value the data as well as the concomitant risks. With the large datasets that are being harnessed by AI systems, these risks are only further exacerbated.

- **Bias and discrimination**: Even in the existing human-based system, banks in India are heavily biased in making decisions like granting/rejecting loans. An AI developed on historical data would simply internalise the existing bias and perpetuate the problem. India currently does not have non-discrimination provisions that pertain to the financial sector - such as in credit scoring.[181]

The definition of credit information currently is limited to the amounts and nature of loans, the nature of securities taken, the guarantee furnished or any other non-funding based facility granted by a credit institution to establish the creditworthiness of any borrower.

For more apparent bias, there could be safeguards within the model of the AI to prevent biased results. To avoid the perpetuation of historical bias due to reliance on historical data, it was stated that the regulator would need to bring the treatment of data already held by banks under its ambit, as well as data newly collected through AI solutions.

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179   Report of the Working Group on FinTech and Digital Banking. (2017, November). Retrieved from https://rbidocs.rbi.org.in/rdocs/PublicationReport/Pdfs/WGFR68AA1890D7334D8F8F72CC2399A27F4A.pdf.

180   Rethinking Personal Data: A New Lens for Strengthening Trust. (2014, May). World Economic Forum. Retrieved from http://reports.weforum.org/rethinking-personal-data/.

181   Sinha A., Rakesh v. & Marda V. (2017, February 19). Big Data in Governance in India: Case Studies. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/big-data-compilation.pdf.

- **Profiling**: Data mining techniques coupled with algorithms underlying AI systems are being increasingly used for profiling in spheres such as the criminal justice system.[182] In the sphere of finance, there are several potential use-cases such as grant of credit, determination of insurance premiums etc - more generally speaking, their use to enterprises lies in the realm of addressing the task of knowledge discovery[183]. Profiling of any kind, and especially that which is done at the instance of a black-box neural network has some deeply troubling and obvious consequences. For one, it has the potential to further alienate marginalised communities from getting access to the financial system owing to the deeply personal insights AI systems are capable of generating. It is an even more concerning problem that AI systems can replicate and further entrench discrimination from past data without intending it.

- **Nudging**: The use of financial data commingled with other data sets has led to the onset of what is popularly called 'predictive analytics'. Inferences from such an exercise can be used to manipulate future behaviour and *nudge* consumers into taking certain decisions that they otherwise may not have taken. The ability of AI systems to exploit systemic behavioural biases inherent in consumers needs to be looked at.[184] This has the effect of severely prejudicing autonomous agency in financial transactions.

- **Workforce transformation:** The use of AI systems in conjunction with other upcoming technologies - widely referred to as Industry 4.0 - holds the potential to result in job displacement, at least in the short to medium term. It becomes imperative to pre-empt such a scenario so as to develop adequate policy measures to mitigate the impact that might be felt on the workforce. It might become necessary to explore policy tools such as robot taxes[185]. This transformation has already started with traditional jobs like updating the passbook and cash deposits being automated. Workers in these areas run the highest risk of losing their jobs to automation.[186]This change can be seen in numbers too, HDFC saw the employee count fall by 6,096, or 7 per cent, from 90,421 in December 2016 to 84,325 in the quarter ended March 2017.[187] However the EY Report states that the use of AI will lead to the creation of jobs such as cyber security specialist, robot programmer, credit analyst to name a few.[188]

- **Data localization**: Recently, in a notification[189] issued by the RBI, it has mandated data localisation from all payments systems providers. In other words, payment systems

182   Angwin J., Larson J., Mattu S. & Kirchner L. (2016, May 23). Machine Bias. Propublica. Retrieved from https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing.

183   Anrig, B., Browne, W., & Gasson, M. (2008). The role of algorithms in profiling. In *Profiling the European Citizen* (pp. 65-87). Springer Netherlands.

184   Lowe J. (2017, 6 March). Consumers and competition: Delivering more effective consumer power in retail financial markets. The Open University. Retrieved from https://fs-cp.org.uk/sites/default/files/fscp_consumers_and_competition_thinkpiece_finalpp_jtl_20170306.pdf

185   How a "Robot Tax" Could Reduce Income Inequality. (2017, December 01). Kellogg Insight. Retrieved from https://insight.kellogg.northwestern.edu/article/how-a-robot-tax-could-reduce-income-inequality

186   Future of jobs in India: A 2022 perspective. (2018, January 4). Retrieved from http://www.ey.com/Publication/vwLUAssets/ey-future-of-jobs-in-india/$FILE/ey-future-of-jobs-in-india.pdf

187   Shukla S., & Rebello J. (2017, May 03). Threat of automation: Robotics and artificial intelligence to reduce job opportunities at top banks. Economic Times. Retrieved at https://economictimes.indiatimes.com/industry/banking/finance/threat-of-automation-robotics-and-artificial-intelligence-to-reduce-job-opportunities-at-top-banks/articleshow/58485250.cms

188   Future of jobs in India: A 2022 perspective. (2018, January 4). Retrieved from http://www.ey.com/Publication/vwLUAssets/ey-future-of-jobs-in-india/$FILE/ey-future-of-jobs-in-india.pdf

189   Storage of Payment System Data. (2018, April 6). Reserve Bank of India. Retrieved from https://rbi.org.in/Scripts/NotificationUser.aspx?Id=11244&Mode=0

providers are now required ensure that the entire data relating to payment systems is stored on a system situated in India, by October 15, 2018. The notification further clarifies that such data shall entail "the full end-to-end transaction details / information collected / carried / processed as part of the message / payment instruction." Moreover, the RBI seeks to arm itself with "unfettered supervisory access" to this data. While this may be the first such diktat in India in terms of data localisation, conversation around enforcing data localisation mesures has been ongoing both globally[190] and domestically. The White Paper published by the Srikrishna Committee[191] dedicated an entire chapter to discuss the impacts and utility of data localisation measures in order to better protect the privacy of Indian citizens. Data localisation frameworks have obvious implications for the 'data economy' at large, and by extension, for firms utilising AI systems which are heavily dependent on data. For instance, the impact of data localization requirements on the productivity and economic output in industries providing data-intensive services has been documented.[192] Additionally, data localisation could put foreign firms at a disadvantage and prop up the costs associated with operating within the country by compelling investment into IT infrastructure such as data centres.[193]

Challenges

While the Indian banking and finance industry have displayed the impetus for increased adoption of AI in their services, there are several challenges that stand in the way of this goal. These challenges make it difficult for the banking and finance industry to acquire the necessary components to effectively develop and/or implement AI tools. As discussed in the roundtable held by CIS on finance and AI[194] and as seen in news items -challenges include:

Development and Innovation: Challenges in the development and innovation of AI services in the finance sector in India can include:

- **Absence of Standards:** Presently, while independent banks and other financial organisations are already following, or in the process of developing internal practices, there exist no globally popular standards for digitisation of financial data. As AI development, and application becomes more mainstream in the financial sector, the lack of a fixed standard could create significant problems. On one hand, there are ethical issues with allowing each organisation to choose their own specific standards to operate under, while on the other hand, non-uniform digitisation of data will also cause several practical problems, most primarily to do with interoperability of the individual services, as well as their usability.

- **Education:** Universities in various countries including the US and UK are beginning to address and adapt to the changes that AI is bringing about in the finance sector by

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190   Cory, N. (2017, May). Cross-Border Data Flows:Where Are the Barriers, and What Do They Cost?. Information Technology and Innovation Foundation. Retrieved from http://www2.itif.org/2017-cross-border-data-flows.pdf

191   White Paper of the Committee of Experts on a Data Protection Framework for India. Ministry of Electronics and Information Technology. Retrieved from http://meity.gov.in/writereaddata/files/white_paper_on_data_protection_in_india_18122017_final_v2.1.pdf

192   Bauer, M. Ferracane, M. & Marel, E. (2016, May). Tracing the Economic Impact of Regulations on the Free Flow of Data and Data Localization. Global Commission on Internet Governance. Retieved from https://www.cigionline.org/sites/default/files/gcig_no30web_2.pdf

193   O'Connor, B. (2015, June 24). Quantifying the Cost of Forced Localization. Leviathan. https://www.leviathansecurity.com/blog/quantifying-the-cost-of-forced-localization

194   Mohandas, S. (2018, April 26). Draft Roundtable Report on AI and Banking. Retrieved from https://cis-india.org/internet-governance/files/draft-roundtable-report-on-ai-and-banking/view

offering undergraduate and masters programmes in fintech.[195] In India HDFC Bank has launched a programme in partnership with engineering and MBA colleges to provide knowledge to students on emerging banking technologies.[196] The SP Jain School of global management has also launched a 9 month long weekend program for Fintech in India.[197]

- **Adaptability:** As AI solutions will be trained on historic data, it is possible that the solutions will not be adaptable to new events and shifting circumstances resulting in mis-identification or inaccurate decisions and recommendations.[198]

- **Opacity of Algorithms**: Algorithms are often a black box - making the accuracy and security of the algorithm difficult to verify. How banks appear to be currently addressing this challenge is by requiring startups that they collaborated with to produce their algorithms for scrutiny.[199]

Adoption and Integration: Challenges in the adoption of AI in the finance sector in India can include:

- **Ensuring Regulatory Compliance:** Financial regulation in India is complex with multiple regulators and constantly evolving policy. As discussed in the legal and ethical considerations section with fintech, evolving technology and business models do not always clearly fit into the scope of existing legal frameworks. Navigating compliance requirements can take time and potentially slow down innovation and adoption of new technologies by actors in the sector.

- **Responsibility for biases**: The use of data for providing financial services runs the risk of biases creeping in and certain people being denied services on account of algorithmic decision making. In the case of some AI and Fintech startups in India it has been noted that the banks that use these AI solutions require them to produce their algorithms for scrutiny[200]. This is done by banks in order to safeguard themselves from any negative consequences as a result of the use of the AI.[201] Hence theses AI developers need to convince the banks that their system does not result in negative consequences, before a bank agrees to use the AI.

Implementation and Usability: Challenges associated to the implementation and usability of AI solutions in the finance sector in India include:

- **User Capacity**: A crucial element to ensuring the effectiveness of a financial/banking service that utilises an AI is the ability of the customer to provide useful data that can be understood by the AI. Specifically, this would require that the customer articulates their query in a form or manner that the AI can recognize and respond to for the resolution of the customer's queries or fulfillment of their requests. In India, it is the experience

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195 Alam, N. & Kendall, G. (2017, June 29) Are robots taking over the world's finance jobs?. The Conversation. Retrieved from http://theconversation.com/are-robots-taking-over-the-worlds-finance-jobs-77561

196 Industry Academia: About Program. Retrieved from https://www.hdfcbank.com/htdocs/common/Industry_Academia/about_program.html

197 Professional Program In Fintech. S P Jain School of Global Management. Retrieved from https://www.spjain.org/programs/professional-technology/financial-technology

198 Artificial intelligence and machine learning in financial services: Market developments and financial stability implications. (2017, November 01). Financial Stability Board. Retrieved from http://www.fsb.org/wp-content/uploads/P011117.pdf

199 Mohandas, S. (2018, February 7). AI in Banking and Finance: Looking Forward. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/draft-roundtable-report-on-ai-and-banking/view

200 Ibid.

201 Ibid.

of professionals in the banking and finance industries that users are usually incapable of articulating their queries/requests in a manner that is comprehensible to AI.[202] This is particularly true given the vast diversity in customers and levels of digital literacy that rely and use banking services. There is a need for transaction-oriented, rule-based menus driven by purpose-built expert systems to address such issues.

- **Language:** For an AI enabled service to cater to customers, being able to effectively communicate with customers is an unavoidable prerequisite. In India, this requirement becomes even more complex due to the number of spoken languages that exist. An effective AI-based communication platform intending to provide banking or financial services must be able to comprehend the consumer's spoken language, and ideally respond to the consumer in the same language. To create AI models that do this, developers will first require data on the spoken languages that the AI technologies can be trained on be fed to the AI. In India, limited machine-readable corpus of vernacular languages for training natural language processing and generation algorithms, even setting aside the problem of local dialects, makes it challenging to develop effective AI-enabled communication services to reach the majority of Indians in their first/preferred languages. Efforts to collect data on Indian languages have only begun recently, and there is a wide gap between AI that operates in English, or is bilingual, and AI that has begun to process and comprehend local languages.[203]

- **Trust**: Indians have historically displayed a proclivity towards human correspondence when dealing with financial matters.[204] This has translated into users being reluctant to utilise AI based financial/banking services, and instead prefer to talk to a human employee who can provide them the same service. This creates a disincentive for the development and utilisation of AI services in the industry, since it is unlikely that immediate returns will be seen.

AI in Finance Going Forward

- **Innovation**: Going forward, companies in the finance sector are realizing the importance of AI and are trying to proactively leverage the technology through hosting events and forming partnerships that spur innovation.[205] For example, ICICI Bank created the Technology and Digital Group that works towards building up the companies digital services in commercial, retail, and wholesale banking.[206] Similarly, Axis Bank launched the 'Thought Factory" - an AI innovation lab[207] that has partnered with OCBC Bank & Visa Innovation Lab, Singapore and AWS for co-innovating products and solutions.[208] In another example, RBL Bank partnered with IBM, PwC, Microsoft, and NPCI launched its maiden Hackathon. During the Hackathon the bank shared its API and participants

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202   Ibid.

203   Ibid.

204   Ibid.

205   Banking on the Future: Vision 2020. (2016, September 16). Deliotte. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

206   Salecha, M. (2016, July 11). ICICI Bank moves the digital way through Blockchain and Artificial Intelligence. Analytics India. Retrieved from https://analyticsindiamag.com/icici-bank-moves-digital-way-blockchain-artificial-intelligence/

207   Axis Bank launches 'Thought Factory', an Innovation Lab to drive FinTech innovation. (2016, June 29). Axis Bank. Retrieved from https://www.axisbank.com/docs/default-source/press-releases/axis-bank-launches-thought-factory-an-innovation-lab-to-drive-fintech-innovation.pdf?sfvrsn=4

208   Kannan, U. (2017, September 4). Artificial intelligence to power banking. Deccan Herald. Retrieved from http://www.deccanherald.com/content/631355/artificial-intelligence-power-banking.html

innovated around ideas such as AI based smart assistants, biometric authenticator, wealth management solutions, and plug - and play solutions for SMEs and financial inclusion solutions.[209] Kotak Mahindra Bank also opened an 'Innovation Lab" that partners with different start-ups in the AI and fintech space for testing concepts and developing them into products that can be launched in the commercial space.[210] The State Bank of India has launched InCube, a startup bank branch that provides business guidance to entrepreneurs. Similarly, HDFC launched a banking solution for startups known as SmartUp[211] It has been noted that these partnerships demonstrate an evolving relationship between banks and fintechs - from vendor/customer to mentorship/ investment. Such a relationship is beneficial for both types of companies and necessary to capitalize on emerging technologies and ensure innovation. [212]

- **Data and Infrastructure:** The Government of India and financial regulators are in the process of laying the foundations of an enabling data environment for the use of AI in the sector. This includes the growing availability of transaction data enabled through digital payment systems[213] and the linking of PAN cards to Aadhaar numbers to bank accounts to SIMs.[214] Infrastructure that can be leveraged by AI solutions include IndiaStack, UPI, IMPS, USSD, Aadhaar Pay.[215]

- **Regulatory Technology:** Regulatory technology refers to technologies that help companies comply with regulations that affect their business operations. These technologies monitor business processes, often utilising AI, to generate outputs that aid in decision making. In India, the rollout of GST and the requirement for all companies to do their filings online have turned the focus on Regulatory Technology. While this focus is slowly intensifying in the broader industry, regulatory technologies have been implemented only in the established, and top tier firms in India.[216]

Conclusions and Recommendations

Artificial intelligence is changing business processes and customer facing services in the finance sector in India. It is also being used to meet regulatory compliance, detect fraud,

209   RBL Bank launches RBL iLabs, and it's first-ever Hackathon. (2017, April 17). Economic Times. Retrieved from https://cio.economictimes.indiatimes.com/news/enterprise-services-and-applications/rbl-bank-launches-rbl-ilabs-and-its-first-ever-hackathon/58238872; Raval, A. (2017, September 21). RBL Bank's journey from a legacy to a new age bank. Express Computer. Retrieved from http://computer.expressbpd.com/magazine/rbl-banks-journey-from-a-legacy-to-a-new-age-bank/22419/

210   Kotak bank sets up innovation lab, could invest in startups. (2016, August 15). Your Story. Retrieved from https://yourstory.com/2016/08/kotak-sets-innovation-lab; Kotak Bank starts Innovation Lab, open to investing in start-ups. (2016, August 14). Live Mint. Retrieved from http://www.livemint.com/Companies/kTYHAZgmTKlTn3gn4MW36I/Kotak-Bank-starts-Innovation-Lab-open-to-investing-in-start.html

211   Mishra, A. (2016, January 14). SBI Launches First Dedicated Branch For Startups InCube. Inc42. Retrieved from https://inc42.com/flash-feed/sbi-launches-branch-for-startups-incube/

212   Banking on the Future: Vision 2020. (2016, September 16). Deliotte. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/financial-services/in-fs-deloitte-banking-colloquium-thoughtpaper-cii.pdf

213   Maiya, R. (2017, September 25). How AI and analytics will benefit digital payments. CIO. Retrieved from http://www.cio.in/opinion/how-ai-and-analytics-will-benefit-digital-payments

214   Golakonda, P. (2018, February 19). Artificial Intelligence for Financial Inclusion. Edge Verse. Retrieved from https://www.edgeverve.com/blog/artificial-intelligence-financial-inclusion/

215   Maiya, R. (2017, September 25). How AI and analytics will benefit digital payments. CIO. Retrieved from http://www.cio.in/opinion/how-ai-and-analytics-will-benefit-digital-payments

216   Dash, S. Regtech in India: The need of the hour? (2017, June 5). Entrepreneur India. Retrieved from https://www.entrepreneur.com/article/295334

and assess individual creditworthiness. The application of AI has the potential to create more efficient business processes, offer personalized services, and assist in larger goals such as financial inclusion. Despite these benefits a number of challenges still exist to the development of AI in the finance sector - a few being the diversity of languages hosted in India, consumer trust, data and capacity. One way financial institutions are overcoming challenges and pursuing innovation in the area of AI is through partnerships with startups and fintech companies. From a regulatory perspective though there are a number of security standards financial institutions must adhere to - a comprehensive privacy legislation is needed to address the potential misuse of personal data. Furthermore, existing security standards should be harmonized and revisited in the context of potential threats specific to systems employing AI solutions. Below are a set of recommendations for consideration towards enabling innovation, successfully implementing AI solutions, and mitigating harms resulting from the use of AI in the finance sector in India.

Development and Innovation:

- **Emphasize Speech Recognition:** Speech recognition is still a key hurdle that AI is overcoming as the AI's ability to understand and accurately respond not only depends on how a word is pronounced but also how a question or statement is phrased. Towards increasing the speed of development of AI in local languages in India, speech recognition technology can purposefully be integrated into solutions and processes in the finance sector and more generally. This will allow for the collecting of diverse data on different Indian languages.[217] This is an approach being deployed across sectors in China with relative success.[218] Although the technical landscape is different in India, the principles that guide the solution remain the same.

- **Continuing, deepening, and expanding partnerships:** Continued innovation will be key for actors in the finance sector to remain competitive. As noted in the report, partnerships between banks and fintechs has been one way companies have facilitated this innovation. The finance sector could also explore cross sector/business partnerships such as the sharing economy, e-commerce[219], and the telecom sector. While forging partnerships can increase innovation financial institutions should be aware of potential dependencies on third party vendors[220] - domestic and foreign.

- **Sector wide coordination:** AI systems and solutions have the potential for optimal functioning when interconnected and networked across the finance sector as opposed to functioning in a silo within one bank or company. The finance sector could begin to take steps to consider sector wide coordination in implemented AI. Potential stress and system wide vulnerabilities would need to be considered when undertaking this.

- **Open Data, Source, Platforms, and Standards:** Using open data, open source, open platforms, and open standards can enable further innovation and accountability.

- **Privacy and Security by design:** Privacy and security must be designed into an AI solution at the outset to ensure effectiveness. For example, systems can be designed to capture non-identifying information and ensure anonymization of sensitive data. Practices described in an interview with MasterCard give an illustrating example *"We don't capture*

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217   Mohandas, S. (2018, February 7). AI in Banking and Finance: Looking Forward. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/draft-roundtable-report-on-ai-and-banking/view

218   Sun, Y. (2017, September 14). Why 500 Million People in China Are Talking to This AI. MIT Technology Review. Retrieved from https://www.technologyreview.com/s/608841/why-500-million-people-in-china-are-talking-to-this-ai/

219   Artificial intelligence and machine learning in financial services: Market developments and financial stability implications. (2017, November 01). Financial Stability Board. Retrieved from http://www.fsb.org/wp-content/uploads/P011117.pdf

220   Ibid.

your password, we capture specific details around keystrokes and timing between them and other details such as how hard you press. These are the data which nobody can use to connect back to a user and say this is Paul. Importantly, even if that data ever get lost, there is no way that your privacy would be in danger". According to them, the private information such as email address, phone number, and biometrics like the fingerprint and iris scans are already anonymised before reaching MasterCard's servers."With biometrics, we don't even capture the actual biometrics. We capture few points and these go into the algorithm and it turns it into a value. We don't store the fingerprints, it is a hashed algorithm of some points within the fingerprint that we have"[221]

- **Offer courses in Finance and AI:** Educational institutes in India can begin ensuring that upcoming generations have the skills required to work in an AI environment. This would not necessarily entail courses on how to develop AI solutions for banking but instead courses on emerging business models, practices, and workflow that integrate and leverage AI.

- **Ensure robust development process:** MiFID II, Basel Committee on Banking Supervision, International Organization of Securities Commissions, Senior Supervisors Group

- **Develop a standard benchmark to assess quality of algorithms**: As noted by the NIFM in the context of algo trading "With brokers offering many algorithmic strategies, one concern is that buy-side institutions lack the tools to understand which algorithm to use for a particular stock. The lack of a standard benchmark has made it almost impossible to assess the quality of algorithms."[222]

Adoption and Integration:

- **Incentivising Consumer Choice**: A well planned shift of components of different services to an AI based model, in addition to creating incentives to users to choose to use AI services over human based equivalents could encourage the initial uptake of AI services that is needed to begin to build longer term consumer trust.

- **Accessibility and Usability:**

  - **Consumer Awareness:** High level awareness campaigns can be structured to raise awareness on the use of AI solutions and services amongst consumers in the finance sector.

  - **Templates to Guide Customer Input:** Chatbots and virtual agents are one of the predominant forms of AI seen in the finance sector in India. Yet, the success of these solutions are dependent on a number of factors including inputs from the customer that are standardized and processable. To facilitate this, banks could develop standard templates to guide customer interaction with these AI solutions.

- **Liability:**

  - **Remediation Models of liability**: In order to avoid stifling innovation liability frameworks should be structured so if developers recognise a flaw, or a bug in the AI model, and take steps to address it, the developers would not face liability. [223]

  - **Standards**: Towards the above, due diligence as a possible standard operating procedure could be another process for assessing and assigning liability. If a

221   Gupta, S. & Elias, J. (2017, November 20). How MasterCard is reinventing itself in the age of digital payments and artificial intelligence. PCMag. Retrieved from http://in.pcmag.com/digital-payment/117656/feature/how-mastercard-is-reinventing-itself-in-the-age-of-digital-p?p=3

222   A Study on Algorithm Trading/ High Frequency Trading in the Indian Capital Market.(2018, May 09) Retrieved from https://dea.gov.in/sites/default/files/NIFM%20Report%20on%20Algo%20trading.pdf

223   Mohandas, S. (2018, February 7). AI in Banking and Finance: Looking Forward. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/draft-roundtable-report-on-ai-and-banking/view

developer is able to demonstrate that pre-defined or reasonable measures were taken to ensure due diligence when developing the AI, they could be immune or be held only partially liable. There is a need for metrics or bands along the relevant dimensions and factors to be articulated as standards for the due diligence.

- **Define Responsibility:** Going forward Regulators should have clear understandings of how responsibility may be attributed when loss results from the use of AI - either loss to a consumer or loss to the financial system at large.

- **Transparency:**

  - **Audits**: As in the Payment Card Industry (PCI) tool, where transparency is achieved through frequent audits, the results of which are simultaneously and instantly transmitted to the regulator and the developer.

  - **Tiered Levels of Transparency**: There are different levels and forms of transparency as well as different ways of achieving the same. The type and form of transparency can be tiered and dependent on factors such as criticality of function, potential harm, sensitivity of data involved etc. The audience can also be tiered and could range from an individual user to senior level positions, to oversight bodies.

Bias and Discrimination:

- **Bring historic data under purview of regulator**: To avoid the perpetuation of historical bias due to reliance on historical data, the regulator could bring the treatment of data already held by banks under its ambit, as well as data newly collected through AI solutions.[224]

- **Discuss Data:** As solutions bring together and process vast amounts of granular data. This data can be from a variety of public and private sources - from third party sources or generated by the AI and its interaction with its environment. This means that very granular and non traditional data points are now going into decision making processes. Public discussion is needed to understand social and cultural norms and standards and how these might translate into acceptable use norms for data in the finance sector.[225]

- **Address Use of Publicly Available Data:** If the data is PI or SPDI it could fall under the protection of a data protection law, but if the data is publicly available, it would not receive the same treatment.. Techniques such as anonymization could become a norm to protect privacy when using publicly available data.[226]

  - **Consumer Group Norms**: Establishment of consumer group norms to identify deviations from it, and creation of judicial systems that are faster and more effective than existing machinery at dealing with AI specific cases.

- **Conduct Impact Assessment**: There is a need to evolve Algorithmic Impact Assessment frameworks for the financial sector in India, which should address issues of bias, unfairness and other harmful impacts of use of automated decision making.

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224   Mohandas, S. (2018, February 7). AI in Banking and Finance: Looking Forward. Centre for Internet and Society. Retrieved from https://cis-india.org/internet-governance/files/draft-roundtable-report-on-ai-and-banking/view

225   Artificial intelligence and machine learning in financial services: Market developments and financial stability implications. (2017, November 01). Financial Stability Board. Retrieved from http://www.fsb.org/wp-content/uploads/P011117.pdf

226   Ibid.

Annex 1: AI in Banking and Finance Stakeholder Mapping

AI in Banking and Finance: Stakeholder Mapping

RBI

The RBI has set up an interegulatory working group on Fintech and Digital Banking. The working group while recognising the use of AI in banking states that companies need to adopt AI technologies into its system along with reskilling and upgrading workers.

Further Reading

SEBI

SEBI has constituted the 'Committee on Financial and Regulatory Technologies (CFRT). The CFTR is expected to examine, deliberate and advise the SEBI on the application of new technological solutions like applying distributed ledger technology, Big Data, data analytics, Artificial Intelligence, machine learning etc.

Further Reading

AI Task Force

Consists of members specialising in AI from different fields including industry and academia. Creation of policy and legal framework to accelerate deployment of AI technologies in sectors including fintech.

Ministry of Electronics and Information Technology

The Expert Committee set up by the Ministry is intended to inform the government's policy on AI. The government has reportedly also decided on a 7 point strategy when dealing with matters concerning AI. The strategy includes developing methods for human machine interactions; ensuring safety and security of AI systems; creating a competent workforce in line with AI and R&D needs, understanding and addressing the ethical, legal and societal implications of AI, measuring and evaluating AI technologies through standards and benchmarks, among others.

Further Reading

Government Authorities

Niti Ayog

Niti Aayog, the National Institute for Transforming India, is in the advanced stages of launching a National Data and Analytics Portal to facilitate training and dataset sharing between different organisations for AI-related applications.

Further Reading

Digital India

The Digital India initiative has allocated funds towards creating a favorable regulatory environment to increase the use of Artificial Intelligence.

Further Reading

Institute for Development and Research in Banking Technology

The IDRBT set up by the RBI has been continuously conducting research on the use and effect of AI technologies in banking and finance. The institute has produced multiple research papers of this topic as well as conducts seminars and conferences to increase the conversation about AI in the financial sector.

NASSCOM

The industry body NASSCOM is setting up Centers of Excellence on AI and Data Sciences in Bengaluru and Hyderabad. These could potentially contribute to the growing number of start-ups and also help shape the vacuum that currently exists with regard to AI regulation.

Ministry of Corporate Affairs

Plans to use AI for fraud detection. And detecting shell companies.

Further Reading

ZestMoney
Credit Scoring

Signzy
Automation of Backend Process

Fluid AI
Fraud Detection

Active AI
Customer Interface

Capital Quant
Personalised Services

Quantx Technology
Risk Management

Senseforth AI Research
Customer Interface

Payjo
Customer Interface

Google
Personalised Services

niki.ai
Customer Interface

ThirdWatch
Fraud Detection

HDFC Bank
Customer Interface

PNB Metlife
Customer Interface

Jubi.ai
Customer Interface

DBS Bank Ltd
Customer Interface

NextAngles
Risk Management

Quadratyx
Personalised Services

Invento Robotics
Customer Interface

Accenture
Customer Interface

Monsoon CreditTech
Credit Scoring

Infosys Finacle
Across Focus Areas

Capital Float
Credit Scoring

Loan Frame
Credit Scoring

Developers

Slicepay
Automation of Backend Process

G-square
Business Strategy Insights

Yana AI
Across Focus Areas

3LOQ
Customer Interface

CropIn
Customer Interface

Heckyl
Credit Scoring

Creditwatch
Business Strategy Insights

Easygoals
Customer Interface

Fintech Labs
Automation of Backend Process

Fundexpert
Across Focus Areas

Paymatrix
Personalised Services

Pally
Customer Interface

D.E Shaw India
Across Focus Areas

AccuraCap
Risk Management

Larsen & Toubro Infotech
Automation of Backend Process

PolicyBazaar
Customer Interface

Wipro Holmes
Automation of Backend Process

Haida Technologies Pvt. Ltd
Customer Interface

Razorthink
Across Focus Areas

Mypoolin
Automation of Backend Process

Paytm
Customer Interface

Cashe
Automation of Backend Process

Rupeelend
Personalised Services

Indialends
Business Strategy Insights

EarlySalary
Personalised Services

Instamojo
Fraud Detection

IBM
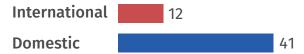Across Focus Areas

Easypolicy
Customer Interface

Perfios
Automation of Backend process

Fundstiger
Customer Interface

Distribution of Developers Based on Type and Focus Area

TYPE OF COMPANY

International   12

Domestic   41

FOCUS AREA

Credit Scoring   5

Fraud Detection   3

Customer Interface   19

Personalised Services   6

Risk Management   3

Across Focus Areas   6

Business Strategy Insights   3

Automation of Backend Process   8

State Bank of India
Beta-testing **SIA — SBI Intelligent Assistant**

Using an **AI-based solution developed by Chapdex**

City Union Bank
Uses **India's first Robot Response Service in a bank**

YES Bank
Uses **YES TAG**

Uses **AI solution by Quadratyx**

ICICI Bank
Uses **iPal, an AI-based chatbot**

ICICI Lombard
Uses **a chatbot platform called MyRA**

HDFC Life
Uses an **AI based email bot, named SPOK**

DBS Bank
Uses an **AI enabled platform**

TATA Capital Ltd
Uses an **AI based online Chatbot**

Motilal Oswal
Launched **Target Investment Plan (TIP)**

Paytm
Uses **Staqu's mobile-based platform**

Microsec Finance
Uses **Staqu's mobile-based platform**

Users

Axis Bank
Launched an **AI & NLP enabled app developed by Active Ai**

JPMorgan Chase
Uses **COIN**

Royal Bank of Scotland
Uses a **Virtual chatbot, Luvo, powered by IBM Watson**

Bank of Baroda
Uses **AI solution by Quadratyx**

Kotak Mahindra Bank
Uses **AI solution by Quadratyx**

Bombay Stock Exchange
Uses a **data analytics based systemic solution**

Oxigen Wallet
Uses a **Chat and pay interface using NikiAi**

Instamojo
Uses **AI for fraud detection**

PNB Metlife
Uses a **bot called Dr. Jeevan**

Canara Bank
Uses a **humanoid robot Mitra**

Motilal Oswal Securities
Introduced **MO-Genie**

Academic Consultancies and Industry Agencies

Infosys
Banking on AI to Differentiate

Reserve Bank of India
Neural networks and early warning indicators of currency crisis

Forecasting daily foreign exchange rates using genetically optimized neural networks

Government Arts College, Melur, Madurai
Data mining techniques and its applications in banking sector

V.V. Vanniaperumal College for Women, Virudhunagar
Data mining techniques and its applications in banking sector

IIM Calcutta
Prediction of corporate financial health by artificial neural network

Wadhwani Foundation

Institute for Development and Research in Banking Technology
A hybrid under-sampling approach for mining unbalanced datasets: applications to banking and insurance

Machine Learning Techniques Applied to Profile Mobile Banking Users in India

Recurrent neural network and a hybrid model for prediction of stock returns

Aligarh Muslim University, Department of Computer Engineering
(Conference) Real-time credit-card fraud detection using artificial neural network tuned by simulated annealing algorithm

Sujata Gothoskar
Computerisation and women's employment in India's banking sector

D. E. Shaw India Private Limited ("DESIS")

PWC
Fintech Trends Report 2017

Chatbot: The intelligent banking assista

CII
Banking on the Future Vision 2020

Deloitte India
Banking on the Future Vision 2020

Microfinance Institutions Network
Microfinance in Asia A mosaic future outlook

Asian Development Bank
FINANCIAL INCLUSION IN THE DIGITAL ECONOMY

Institute of Public Enterprise, Hyderabad
Improving retail banking loans recovery via data mining techniques: a case study from Indian market

Rajendra Mane College of Engineering & Technology, Ambav, Devrukh. Mumbai University
Intelligent Chat Bot for Banking System

Swissnex India
Fintech in India

HDFC Bank
Industry Academia

Amrita Vishwa Vidyapeetham, Amrita Nagar
Artificial intelligence applications in financial forecasting–a survey and some empirical results

RCEW, Jaipur
Credit card fraud detection using neural network

Somaiya College of Engineering
Approaches towards Building a Banking Assistant

KITE Group of Institutions
The use of Artificial Intelligence (AI) based technological applications by Indian Banks

Khalsa Institute of Management and Technology for Women
An AI-Enabled Model for Risk Assessment of Trading in Indian Stock Market

Department of Computer Science and Engineering, Guru Nanak Dev University, Amritsar
An AI-Enabled Model for Risk Assessment of Trading in Indian Stock Market

IKG Punjab Technical University, Kapurthala, Punjab
An AI-Enabled Model for Risk Assessment of Trading in Indian Stock Market

Amrish Rau
Signzy

IDG Ventures
Active AI

Vikram Chachra
Signzy

SAP.iO
Niki

Aditya Singh
Monsoon CreditTech

Das Capital
Slicepay

Kalaari Capital
Active AI

Kstart Capital
Signzy

Unilazer Ventures
Niki

Rishi Srivastava
Monsoon CreditTech

Simile Ventures
Slicepay

Vertex Ventures
Active AI

Eight Innovate Partners
Signzy

Indian Angel Network
ThirdWatch Data Pvt. Ltd

Rajan Anandan
Monsoon CreditTech

Blume Ventures
Slicepay

Creditease
Active AI

SAIF Partners
Capital Float

Traxcn Labs
Slicepay

Dream Incubator
Active AI

Investors/ Funders

Bitkemy Ventures
3LOQ

Naspers (PayU)
ZestMoney

MasterCard Start Path
Fluid AI

VentureWorks India
ThirdWatch Data Pvt. Ltd

Sequoia
Capital Float

IIT-Hyderabad
Paymatrix

Ribbit Capital
ZestMoney
Capital Float

Microsoft Accelerator Bangalore
Fluid AI
Capital Quant

Creation Investments
Capital Float

PayPal Incubator
Paymatrix

Omidyar Network
ZestMoney

Batlivala and Karani Securities
ThirdWatch Data Pvt. Ltd

William Campbell
Loan Frame

Voyager-Nomura FinTech Accelerator
Senseforth AI Research

Sunil Kalra
Monsoon CreditTech

Parag Saxena
Loan Frame

Conferences and Exhibitions

Fintech Storm India Summit
Organiser: **Fintech Storm**
12th May, 2016
Mumbai

Finance in Digital Era: Navigating the knowns and unknowns
Organiser: **FICCI**
6th November, 2017
Mumbai

Fintech Summit
Organiser: **UNICOM**
31st August, 2017
Mumbai

RBS Fintech Meetup at Gurgaon
Organiser: **India Fintech Forum**
3rd July, 2017
Gurgaon

India Fintech Day
Organiser: **NASSCOM and KPMG**
13th December, 2017
Mumbai

Fintech Summit 2017
Organiser: **Mint**
23rd June, 2017
Mumbai

Fintech Summit India 2017
Organiser: **JMR**
8th December, 2017
Mumbai

Money Tech
Organiser: **Businessex.com**
10th April, 2017
New Delhi

BFSI CXO Summit
Organiser: **Businessworld**
16th June, 2017
Mumbai

BFSI Digital Enclave
Organiser: **ETCIO**
10th May, 2017
Mumbai

BFSI Innovation & Technology Summit
Organiser: **Exito Media Concepts Pvt Ltd**
9th August, 2017
Mumbai

Fintech Summit
Organiser: **Saltmarch Media India Private Limited**
7th December, 2018
Mumbai

India Payments Technology Summit
24th May, 2018
Bengaluru

BFSI Innovation & Technology Summit
Organiser: **Exito Media Concepts Pvt Ltd**
16th August, 2018
Mumbai

AI and Machine Learning and Sentiment Analysis Applied to Financial markets
Organiser: **IIM Calcutta**
13th March, 2018
Bangalore

BFSI Conference In India - Smart Tech BFSI Exchange 2018
Organiser: **Smartech**
9th May, 2018
Goa