CHAPTER 14

I-FinTech and Its Value Proposition for Islamic Asset and Wealth Management

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Abstract Artificial Intelligence (AI) is a highly evolved area of computer science that strives to create intelligent machines that can replicate certain human behaviour without its irrationalities for better predictability and consistency. Advanced AI that utilizes machine learning makes it possible for machines to learn from previous data (experience), adjust to new inputs (instructions) and perform tasks through updated algorithms. Through sophisticated algorithms, modern AI systems can be trained to accomplish specific tasks by processing large amounts of data, obtaining insights and recognizable patterns in the data to act upon. As such AI has become a hot topic, with much interest on its advantages to the highly regulated financial services industry.

Similarly, blockchain technology also has the potential to both enrich and improve financial processes and asset management systems, and progressive corporations have invested and devoted resources to utilize and incorporate blockchain into their businesses. The use of distributed ledgers or blockchain has been explored in areas such as compliance and

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securities settlement, and these technologies could also be used to improve efficiencies in asset management.

In this chapter, we provide a short discussion of AI and blockchain applications in asset management and understand the benefits and the shift in processes, as well as the challenges that need to be overcome for practical applications for AI and blockchain and how to approach such innovations.

Keywords Islamic • FinTech • Value • Asset • Wealth • Management

Introduction: Explosive Artificial Intelligence (AI) Growth Around the World

In the last 60 years the AI field has experienced curious interest, but in the last five years, it has turned into explosive growth where governments around the world are competing to create superior AI facilities and research with a view to AI being a lever for greater economic power and influence. According to the Wuzhen Institute Report (2017), 5154 AI start-ups have been established globally during the past five years, representing a 175% increase relative to the previous 12 years. There are two explanations for this impressive growth. First, exponential advances in computing power have led to declining processing and data storage costs, and secondly, the immense data availability has increased, creating more possibilities in the AI field.

Historically, the USA has dominated the AI industry, with 3033 AI start-up between 2000 and 2016, accounting for 37.41% of the worldwide total (Buchanan, 2019). Between 2012 and 2016 the USA invested $18.2 billion into AI compared with $2.6 billion in China and $850 million in the UK.[1] However, the proportion has been decreasing and in 2016 dropped to under 30% for the first time. During the same period, the USA received $20.7 billion in funding, accounting for 71.78% of the world's total funding (Wuzhen Institute Report, 2017). In 2017, China surpassed the USA for the first time in terms of AI start-up funding. In

[1] "Britain Urged to Take Ethical Advantage in Artificial Intelligence," John Thornhill, Financial Times. 16 April 2018. Available at: https://www.ft.com/content/b21d1fb8-3f3e-11e8-b9f9-de94fa33a81e

2012, China accounted for 48% of global AI start-up funding, and in 2017 the total global AI funding was $15.2 billion. AI equity deals increased 141% relative to the previous year, and since 2016 more than 1100 new AI companies have raised their first round of equity financing. However, the US global AI equity deal share has fallen significantly, from 77% to 50% during the last five years. China leads the Asian market in terms of AI growth. During the past five years China accounted for 68.67% of Asian AI start-ups, dominating with 60.22% of corresponding the total Asian AI funding.

With the help of AI, blockchain not only benefits wealth managers but also works on making returns for their clients. AI in return gets more information and that helps the system's evolutionary process. Furthermore, the more sophisticated the AI becomes efficient. The innovation of technology and the susceptibility to work in harmony with AI will also improve machine to machine interactions. These machines were made to facilitate human actions; thus, clustering computer systems together will make processes quicker and simplify complex processes. In fact, the Japanese Government Pension Investment Fund (the world's biggest manager of retirement savings) is considering AI to ultimately replace human fund managers.

The integration of blockchain and AI into a decentralized intelligence system has profound possibilities to employ data in innovative ways. An effective amalgamation of both technologies will enable faster and seamless data management, validation of transactions, detection of illegal documents, amongst others. For the asset and wealth management industry, blockchain will simplify transaction-tracking and reduce costs, as well as produce novel asset structures that can possibly maximize returns to the investor. AI has the ability to update and optimize investment strategies by diligently digesting new market data and consequently using them as inputs to project returns and risks for much attuned advisory and customer-centric service.

AI Applications in Asset Management

The term AI was coined in 1955 by the American computer scientist John McCarthy, based on the idea that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" (McCarthy, Minsky, Rochester, & Shannon, 1955). Other terms—like machine learning (ML), smart

automation, cognitive computing, self-service analytics—are all closely related to AI. Within the financial services industry, AI applications include algorithmic trading, portfolio composition and optimization, model validation, back testing, Robo-advising, virtual customer assistants, market impact analysis, regulatory compliance and stress testing.

Much of AI in the 1950s and 1960s did not focus on finance applications. In the 1960s, a substantial body of work on Bayesian statistics was being developed that would later be used in ML (Buchanan, 2019). Neural networks (which would become a cornerstone of deep learning) were developed in the 1960s and grew rapidly. However, due to a lack of sufficiently available electronic data and computing power, it did not progress much further (FSB, 2017). During the 1980s, however, AI made a revival when Japan, the UK and the USA competed heavily in AI funding. Japan invested $400 million through the Japanese Fifth Generation Computer Project (Kaplan, 2016). The UK invested £350 million in the Alvey Program and DARPA spent over $1 billion on its Strategic Computing Initiative. In 1982, AI made inroads into the financial services industry when James Simons founded quantitative investment firm Renaissance Technologies. Chase Lincoln First Bank and Arthur D. Little Inc. developed AI systems to carry out investment planning, debt planning, retirement planning, education planning, life-insurance planning, budget recommendations and income tax planning. And institutional investors used programme trading to capitalize on pricing disparities in the market.

The late 1980s witnessed the rise of IBM and Apple desktop computers, but specialized expert systems became more expensive to maintain. While probabilistic reasoning models dominated the 1960s and 1970s, Bayesian networks gained more acceptance by combining classical AI and neural nets which allowed for learning from experience (Buchanan, 2019). In the 2000s and 2010s, the development of machine learning, deep learning technology, bots and intelligent agents on a powerful cloud computing platform has ushered in a new era of computing. Although there are initial fears of AI taking over human activities, more awareness will shift these perceptions that AI harnesses humanity's collective knowledge and experiences to make better decisions and enrich communications across institutional or consumer omni-channels. For example, large firms like BlackRock, Deutsche Bank, UBS and Wells Fargo are already using AI

engines to analyse consumer digital footprints[2] via their online behaviours, to understand and subsequently predict the products and services most likely to be embraced and used.

Personalization of Services

With increasingly high levels of client expectations, the need for quick, secure and highly personalized solutions is vital. High-net-worth individuals (HNWIs) and wealth management clients have become accustomed to highly personalized services by their wealth managers, who do so through a support network of connected channels and integrated systems. Contextual insights from massive data analytics can be distributed to wealth managers to help them schedule their daily activities—engage clients in a timely manner and identify opportunities for them whilst all the time remaining compliant to regulations. Peers (2018) believes that this enables them to keep up with the "increasing speed, complexity and scale of the financial services industry". As such, they are still able to make every interaction personal and relevant, while being able to "build long-term rapport and trust by confidently helping clients solve their most important financial challenges".

Some possible situations where Peers suggests that AI can help achieve these are:

- Attaining a holistic evaluation of the client's portfolio and using automated recommendations to advance engagement for further improvements. What can make this possible is through leveraging advanced machine learning algorithms that utilizes client's actions and behaviours from customer relationship management (CRM) systems to better understand unspoken client sentiment whilst generating targeted engagements and relevant conversations across all the channels with full orchestration from these customer insights.
- Retrieving instantaneous client relationships status, preferences and needs through tools such as sentiments, market analyses and sector alerts will enable real-time solutions, and they can produce insights that help to assess timely opportunities for a wealth manager to give

[2] FinTech—How Exponential Technological Progress will affect Asset & Wealth Management https://finlantern.com/fundforum/wp-content/uploads/2017/12/FACTSET_FinTech-how-exponential-technological-progress-will-affect-Wealth-Mana…pdf

their clients a call or visit. Customized engagements delight clients with pertinent information that are relevant to them.
- AI-driven services for wealth management have the capacity to craft new business models, provide incredible insights and spin off value-added products and services through massive data that can inform decisions better and quickly. This generates quality advice at a much lower cost through an optimal combination of intelligence from data analytics from technology and human assessment.

Certain facets of client engagement within financial services that can increase client relations and meaningful exchange without escalating fees are:

- Chatbots are programmed to answer clients' FAQs (frequently asked questions) or direct them to appropriate channels like appointment bookings, or lead clients to the best resources for further assistance—be it to check portfolio status, or find updates on order status or submissions, new financial reports and market events.
- Secure authentication bots that handle automated verification through reliable channels to conclude financial transactions.
- Transactional bots that answer simple queries and flag events to trigger alerts, such as when a transaction exceeds trigger limits, a deduction is due or when trading authorizations close.

Portfolio Management

Asset and wealth management firms are studying and testing prospective AI solutions to better their investment decisions through insights gleaned from mammon of historical data.[3] Digital asset management (like an investment portfolio) is ripe for automation through AI where copious amounts of data about the assets (like the historical performance of a particular fund and market movements) are already being monitored.

> More and more investors are turning to advisory services augmented with Robo-advisors for essential investment needs because of their convenience, ease of use, affordability and transparency. They can provide a range of advi-

[3] https://emerj.com/ai-sector-overviews/machine-learning-in-investment-management-and-asset-management/

> sory services, from personalized, automated, algorithm-based portfolio management to sophisticated tax strategies and risk management, all at a markedly lower cost than the traditional advisory model. (Peers, 2018)

Applying cognitive technologies and AI to various advisory utilities across the industry value chain[4] can be done by analyzing historical data, market patterns and market dependencies. While there have been debates like fundamental vs. macro, and passive vs. active investing in the past, it may be about AI enhancing (or replacing?) modern portfolio theory with drastically better projections.

Chatbots and Robo-Advisory

Robo-advisors and chatbots are "emerging across the financial services sector, helping consumers choose investments, banking products and insurance policies" (Buchanan, 2019). A "bot" is a software application created to automate certain tasks using AI technology (Future Today Institute, 2017). A Robo-advisor is an algorithm-based digital platform that offers automated financial advice or investment management services. Robo-advisors have the potential to lower costs and increase the quality and transparency of financial advice for consumers. Rohner and Uhl (2017) see Robo-advisory services in three ways: "(1) access to and rebalancing of passive and rule-based investment strategies, (2) cost-efficient implementation of a diversified asset allocation and (3) overcoming behavioural biases". They find that compared to traditional investment advice, Robo-advisors can save costs of up to 4.4% per year.

Banks are also engaging chatbots to improve their self-service interfaces. The Bank of America has launched its AI chatbot *Erica*, and it is available through voice or message chat on the bank's mobile app. *Erica*'s AI engine also leverages analytics to assist in managing personal finance. JP Morgan has invested in *COiN*, which is an AI technology that reviews documents and extracts data in far less time than a human. *COiN* can review approximately 12,000 documents in a matter of seconds, whereas a human would spend more than 360,000 hours of work on the same documents (Brummer & Yadav, 2019).

[4] "Artificial intelligence: The Next Frontier for Investment Management Firms," Deloitte, 2019.

Chatbots and conversational interfaces are a rapidly expanding area of venture investment and customer service budget. Such chatbots have had to be built with robust natural language processing engines as well as reams of finance-specific customer interactions. Natural language processing is making it increasingly difficult for bank customers to tell whether they are talking to an AI interface or a human. Japan's three megabanks are using AI and robotics to streamline customer questions.[5] For example, the Mizuho Group has a robot that helps answer asset management questions and compiles documents.

Financial Prediction

Advances in technology have been the vanguard of financial services, especially if these solutions can provide strong and viable economic advantages to them. In portfolio management, AI and machine learning tools are being used to recognize new signals on price movements and to generate effective use of vast available data to improve market assessment and decision acumen than with current models. "The key task is to identify signals from data on which predictions relating to price level or volatility can be made, over various time horizons, to generate higher and uncorrelated returns" (FSB, 2017). Portfolio construction with probabilistic (risk) calculations, stochastic modelling and scenario testing are some of the mathematical models (including option-related calculations) that are computationally intensive. Technology again will provide that leap forward with

> cloud computing streamlining existing infrastructure and at the same time enabling many new, previously unimaginable or un-implementable, applications. In addition to the currently available near-unlimited, on-demand cloud computing, recent progress in quantum computers could soon provide the next disruptive chapter in humanity's unbounded appetite for computational processing. (Buchanan, 2019)

Black swans or extreme events in financial markets have been impossible to predict or time, but historically most of the profits have been made

[5] "Megabanks in Japan Embrace Artificial Intelligence", Robot Technology. 30 October 2017. Available at: https://business.inquirer.net/239571/megabanks-japan-embrace-artificial-intelligence-robot-technology

or lost during these extreme events.[6] It is now possible to not depend on predictive analytics based on existing models and past events. Newer technologies, for example, those that use forward-looking directional market risk forecasting instead of being limited to historical data, are beginning to be adopted by asset managers and other financial institutions globally. Concepts like the efficient market hypothesis (EMH) and portfolio diversification may still applicable, but these concepts will give birth to new ones as the financial data gets increasingly processed by the improved algorithm types in the enhanced AI systems for better projections and predictions.

Algorithm Trading

Algorithmic trading (AT) has become a dominant force in global financial markets. Also called "Automated Trading Systems", AT's origins date back to the 1970s. Kirilenko and Lo (2013) provide a brief survey of the evolution of the AT field. Chakravorty (2016) defines AT as: "Algorithmic trading is about implementing trading rules into a program and using the program to trade, [and AI trading] can be defined as an approach to machine learning that learns the structure of the data, and then tries to predict what will happen". Algorithmic trading now involves the use of complex AI systems to make extremely fast trading decisions. Computers generate 50–70% of equity market trades, 60% of futures trades and 50% of treasuries (Brummer & Yadav, 2019). Aldridge and Krawciw (2017) estimate the share of market AT to be between 10 and 40%. The benefits of AT include (1) the ability of trades to be executed at the best possible prices, (2) increased accuracy and a reduced likelihood of mistakes, (3) the ability to automatically and simultaneously check multiple market conditions and (4) human errors caused by psychological or emotional conditions are likely to be reduced.

Algorithmic trading's target clientele is hedge funds, proprietary trading houses, bank proprietary trading desks, corporates and the next-generation market makers. AT includes making certain trading decisions, submitting orders and managing those orders after submission. Martinez and Rosu (2013) argue that algorithmic speed should have a positive effect on the informativeness of prices. Hendershott and Riordan (2013)

[6] http://mebfaber.com/2011/08/12/where-the-black-swans-hide-andthe-ten-best-days-myth

find that AT improves liquidity and enhances the informational content of quotes. On the other hand, AT may also impose higher adverse selection costs on slower trades.

Algorithmic systems often make thousands or millions of trades per day. The term given to this is HFT. HFT is the most recognizable form of AT and uses high-speed communications and algorithms in financial market transactions. HFT has both its supporters and detractors. Since 2013, two-thirds of the top 30 cited papers on HFTs show positive market effects from HFTs (Das, 2017). There are supporting arguments that HFT helps with price discovery and efficiency by trading in the direction of permanent price changes and in the opposite direction of transitory pricing errors (Brogaard, Hendershott, & Riordan, 2014). These types of trading improve market liquidity. Hendershott and Riordan (2013) find that HFT can provide market stability, and Menkveld (2016) finds that HFT reduces trading costs. Hasbrouck and Saar (2013) provide evidence that HFT improves market quality and reduces bid-ask spreads. In fact, HFT is changing the traditional field of market microstructure and will continue to be reinvented through new AI and DL techniques.

Most hedge funds and financial institutions do not openly disclose their AI approaches to trading (for proprietary reasons), but it is believed that ML and DL play an important role in calibrating real-time trading decisions. It also involves neural networks, fuzzy logic and pattern recognition.

Blockchain Applications in Asset Management

Many blockchain experts believe that "distributed ledgers are highly flexible; once implemented, they can be used to remove friction from the client onboarding process, streamline management of model portfolios, speed the clearing and settlement of trades, and ease compliance burdens associated with anti-money laundering (AML) and KYC" (EY, 2017). Blockchain applications bring efficiencies in eliminating redundant functions, reducing operational expenses and increasing client ease-of-use experience. It may be used to reconcile information across current legacy systems and subsequently enable new infrastructure for potentially new markets and novel products.

Blockchain experts are sure that it can be used to develop client profiles more efficiently and reliably. "Storing client profile data on a blockchain allows for data points—profile data, behavioural preferences, wealth net

worth, personal account information, social media profiles—to be shared as needed, with each individual block of data being stored securely, but permissioned for access by the individual (read, write, edit) as needed" (EY, 2017).

Client Onboarding Process

In the current system, prospective patrons are required to show identification and residency documents and prove marital status, sources of wealth, pronounced business interests and official occupation (and even declare political ties in order to set up certain accounts) for financial transactions. Going through this process, financial institutions may take days or weeks to verify information and conduct due diligence with reliable accuracy. In such cases, the blockchain presents a strong use case for client onboarding in wealth management.

Utilizing the blockchain, it would enable profiles of customers to be stored on a blockchain/distributed ledger where assigned groups can be granted access to selected information or entire profile based on issuing cryptographic access keys. The system intrinsically embeds an audit trail for tracking any change along the chain of information blocks (hence the blockchain). As a result, processes requiring information-verification and fact-checking, such as those employed in AML or KYC, can be very much streamlined. In addition, blockchain technologies can be integrated into onboarding and "automated clearinghouse (ACH) and automated customer account transfer (ACAT) systems that traditionally takes multiple days and involve manual processes using multiple systems and databases" (EY, 2017). The blockchain can also enhance transfers of assets between financial institutions with verified derivation of tracked changes.

Management of Model Portfolios

The propagation of open architecture investment offerings and the availability of third-party investment vehicles have presented significant hurdles for wealth managers. "Distributed ledger technology would allow portfolio managers to instantly communicate portfolio changes to all clients 'subscribed' to the model, as well as enable real-time views of individual account performance, drift outside of tolerances and cash flows" (EY, 2017). Also, smart contracts built on the blockchain would execute trade terms and conditions, including management of fees to be paid by

the sponsors, if programmed to take proprietary fees every time the model is used.

Currently, asset managers use legacy platforms operating on archaic data architectures which inhibit ease of distribution, interfacing and updating newer third-party models. In some cases, corporations may end up supporting redundant model management systems and remain stuck in time-consuming processes and frustrating users. However, with the blockchain, investment EY notes that managers can create and maintain a model which "could be transmitted through a blockchain to various subscribed brokers where individual accounts can be invested according to the model". Other account-level constraints or restriction customizations can be implemented conveniently.

Trade Clearing and Settlement

The last few decades have seen the asset management industry grow remarkably in both size and complexity. The range of fund structures and coverage of underlying asset classes has expanded to meet the investor's demands for a distinct set of products. To service this global set of products, "the industry makes significant use of service companies that act as intermediaries between them and the clearing and settlement infrastructure, currently a complex network of brokers, custodian banks, stock transfer agents, regulators, and depositories" (BIS, 1997). A single transfer can require multiple liaising transactions and usually takes three days to settle, of which about 20% generate errors, which has to be corrected manually (Mohamed & Ali, 2019).

With a blockchain, two trading parties can read and write to a shared, trusted and error-free platform.[7] "The transaction could be written in legal language as well as in computer code, so that the data exchange itself is the settlement" (BCG, 2016), which can be made to be visible to regulators where necessary. "The brokers (as agents of the buyer and seller) could trade on a larger blockchain to remove custodians as intermediaries, thereby reducing total transaction costs. Institutions issuing securities, such as corporations, cities and municipalities, could issue them directly onto the blockchain", thereby removing the need for share registry agents.

[7] https://www.bcg.com/en-sea/publications/2016/blockchain-thinking-outside-the-blocks.aspx

The "ability of blockchain distributed ledgers to replace intermediary centralised systems of record has attracted real interest in investment firms given the potential to cut cost, reduce delays, provide more timely and accurate data and enhance reporting accuracy".[8] The blockchain can have a deep bearing on the settlement of securities transactions and offer massive reduction in transactional costs leading to reduced charges for investors.

Regulatory Compliance to Shariah Observance

Blockchainized platforms can be used to address the administration and coordination of identity, privacy and security across millions of devices by making them autonomous. These decentralized platforms give integrated systems an identity, make and receive payments, enter into complex agreements and transact without an intermediary (Mohamed & Ali, 2019).

One way to help ease compliance burdens is to build and deploy identity management solutions using blockchain. A blockchain consists of a node and any transaction comprises a chain of blocks that have been accepted by the participating node through a consensus mechanism. One of the most important elements in the blockchain is the identity of a node, and once the node has been identified flawlessly, the entire transaction becomes trustworthy.

An identity management system based on verification cryptography can be built using AML, CTF and KYC[9] requirements according to the country-specific regulations. The same is stored virtually, and a part of this information is released to the counterparty at the time of transaction to suffice the counterparty's requirement. The entire solution is built on the distributed ledger where an enterprise is a node and the platforms developed by asset management companies provide a cryptographic code for each node based on AML, CTF and KYC requirements.

Islamic asset and wealth investment funds are similar to conventional funds in terms of the common objectives that they share, such as pooled investment, capital preservation and returns optimization. The distinguishing feature between the two types of funds is that Islamic funds must

[8] https://sokodirectory.com/2018/01/blockchain-and-its-impact-to-the-investment-industry/

[9] AML refers to anti-money laundering, CTF is counter-terrorism funding and KYC is know-your-client.

always comply with Shariah rules and laws in terms of their operations, activities and investments. Islamic fund management is therefore about the professional management of investors' money in Shariah-compliant securities and assets, in line with Shariah principles to achieve set financial goals. Elements such as the contractual relationship between fund managers and investors, Shariah screening of investments, the role of Shariah boards, Shariah governance mechanisms involving Shariah reviews and audits, purification of impure income and alms-giving (zakat) calculation are important in the adherence of Islamic funds' activities to Shariah requirements.

Automated reporting, automated audits and process streamlining are other benefits offered by such blockchainized platforms to address regulatory compliance, where technology is bridging the gap between regulators and the asset management industry.

Openness to Adoption and Regulations

While many technologists are able to grasp the decentralized ledger concept and the complex Bayesian algorithms, many business leaders are still fuzzy on how it can benefit their business in a profound way, or where it can disrupt current models for competitive advantage. Because blockchain applications may be complicated to understand, determining a good business strategy for using it becomes even more difficult.

Establishing an effective framework to identify real business value is critical especially when there are many potential blockchain opportunities. "Firms should focus on those use cases that have the greatest opportunity with minimal risk, and use a framework to properly allocate time and resources" (EY, 2017). In the short-term, there are use cases that can be developed quickly to drive results to win support for long-term solutions that may be slow to show returns. In addition to creating blockchain-specific business solutions, blockchain should be seen as an enabling technology to improve business operations in the areas of data management through transparency and revenue-generating opportunities captured through ease of use.

AI and ML are moving faster than policy-makers can understand to the extent it is almost outstripping the current legal and regulatory framework. Technology is opaque and fast moving, and regulators find it hard to keep pace, for both the cumulative impact and risks of contagion. Athey and Imbens (2017) and Mullainathan and Spiess (2017) argue that ML

methods hold great promise for improving the credibility of policy evaluation. The technology underpinning Fintech is also fuelling a spinoff field known as RegTech which aims to make compliance and regulatory activities easier, faster and more efficient. RegTech utilizes Big Data and ML. RegTech is an emerging field to reduce costs and increase effectiveness. Alarie, Niblett and Yoon (2016) explore how ML technology can improve regulation of human behaviour. They argue that ML techniques can provide fast, accurate and consistent judgements and streamline operations with reduced error.

Financial regulators are also exploring the use of AI for better monitoring of financial institutions. The UK Financial Conduct Authority (FCA) is examining "the possibility of making its handbook machine-readable and then fully machine-executable. This would mean that machines can interpret and implement the rules directly" (Citi, 2018). "The Division of Economic and Risk Analysis (DERA) at the SEC is exploring ML to extract actionable insights from massive datasets, helping examiners find cases of potential fraud or misconduct" (Bauguess, 2017). "As institutions find algorithms that create uncorrelated profits or returns, there are concerns that these will be manipulated on a suitably wide scale that correlations actually increase, which will only become clear as such advanced technologies are actually adopted". More generally, "greater interconnectedness in the financial system may help to share risks and act as a safety net to potential shocks or contagion effects" (FSB, 2017).

International regulators utilize "AI-supported analytical methods to recognise vulnerability patterns, scan lengthy reports or analyse incoming data" (Buchanan, 2019). In 2017, the Bank of England (BoE) joined forces with MindBridge to use an AI auditor to help detect anomalies in transactions and reports. In 2018, Chancellor Angela Merkel announced that the German government would spend €3 billion to boost AI capabilities. The Deutsche Bundesbank is already using AI in its risk management area and uses neural networks (NN) to assess financial market soundness.

The European MIFID II50 (which also came into effect in 2018) requires that "firms applying algorithmic models based on AI and ML should have a robust development plan in place. Firms need to ensure that potential risks are included at every stage of the process" (Wuermaling, 2018). In February 2018, the FCA and Prudential Regulatory Authority released consultation papers on algorithmic trading which lists key areas of supervisory focus in relation to MIFID II.

Conclusion

Along with Big Data, AI is viewed in the financial services sector as a technique that has the potential to deliver huge analytical power. Yet many risks still need to be addressed. Many AI + blockchain techniques remain untested in financial crisis scenarios. There have been several instances in which the algorithms implemented by financial firms appeared to act in ways quite unforeseen by their developers, leading to errors and flash crashes (notably the pound's flash crash following the Brexit referendum in 2016). Technology needs to be more robust to be capable of adapting to human idiosyncrasies so that users can employ these tools safely, effectively and effortlessly.

In the asset management industry, advanced AI technology supported by blockchain applications will help us automate existing processes and realize new revenue streams and business models. In the distributions space, we use AI + blockchain technology to help us predict customer journeys throughout the life cycle of their engagement with the company—from onboarding to redemption—and explore ways consumers can be better served by offering products better suited to their investment style at certain stages in their customer journey. On the product management front, AI + blockchain technology help our portfolio managers make the smartest possible investment decisions at a given point in time using sophisticated analytics. Other emerging technologies and approaches to be adopted in the financial space—such as virtual reality (VR) and integrating the Internet of Things (IoT) to create holistic solutions.

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