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Chapter 2: Integrating advanced artificial intelligence into financial products, services, and operations

2.1. Introduction

Advanced Artificial Intelligence (AI) e.g., Large Language and Vision Models (LLMs), has become the latest tool of technology firms seeking to drastically advance technology and its applications via Software 2.0 products that allow easy access by employees and consumers. The application of AI to financial services should now go beyond robotic process automation, and more fully exploit the task breakdown that financial products and their construction and administration require. The advent of more capable AI presents both challenges and opportunities to the financial services business model. LLMs and other forms of Machine Learning/Deep Learning can enhance the creation and maintenance of financial products, product range, product distribution, product sale, customer service, risk management, and finance function (Brynjolfsson & McAfee, 2017; Agrawal et al., 2019; Alzubaidi, 2020).

These AI could add value to financial products via their immediate accessibility/availability, personalization, imaginative use of data, continuous optimization from data, speech/natural language use, and incorporation of predictive modeling. The wide-ranging use of these technologies could produce large cost savings in product development, product support and the operation of customer management systems. First-mover advantage could accrue to firms that build strong internal proficiencies around these new technologies. Given the importance of best practice in the management of client relationships in financial services, it is not surprising that LLMs have generated great interest among finance functions in areas such as regulatory compliance, management reporting, internal audits, taxation, and cash flow forecasting (Chakraborty et al., 2018; Dugan & Wang, 2021).

2.2. Overview of Artificial Intelligence in Finance

Artificial intelligence (AI) is already being extensively utilized in finance, both in terms of the variety of implemented functionalities as well as the deployment of financial products.

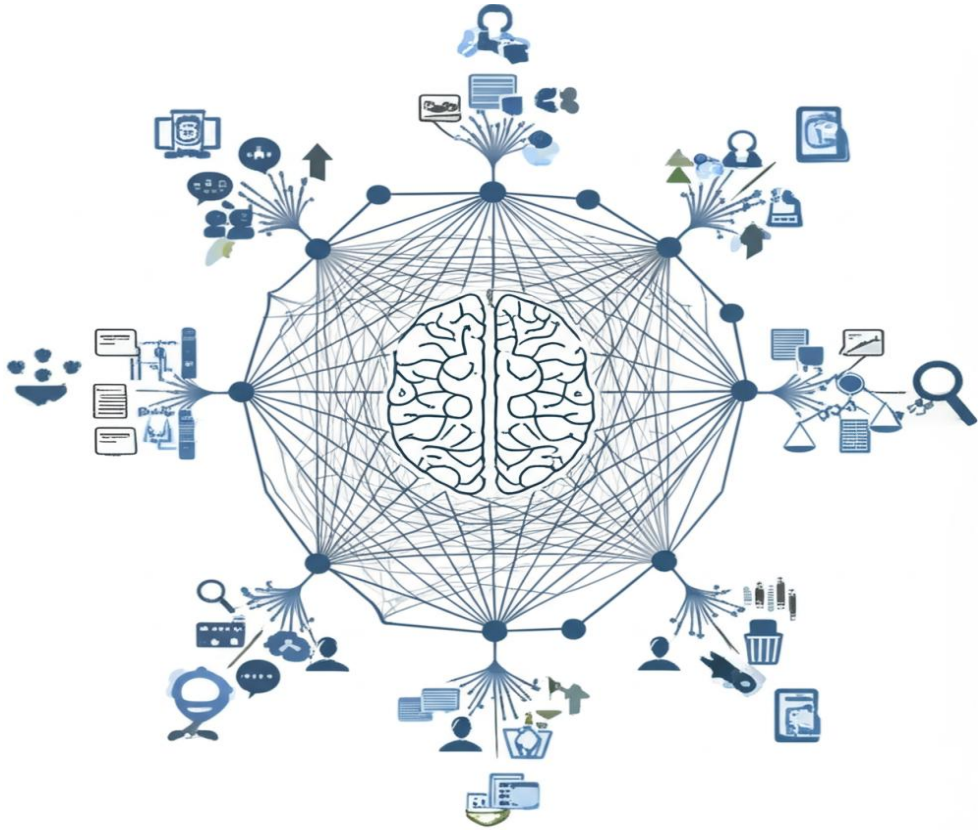

Fig 1 : This image showcases a modern and dynamic representation of Artificial Intelligence (AI) in Finance

However, the concept of AI—and even the narrower concept of machine learning, which is often treated as a synonym of AI—has become particularly popularized only recently. Indeed, some of the currently most popular types of AI implementations in finance and elsewhere, such as deep learning, have been introduced quite some time ago in the AI research community, but pre-AI financial products and services based on a broader and earlier concept of machine learning have been around for quite some time. Current AI research can be broadly categorized into those areas that use simulated machines to design better algorithms for human produced code or data and those that design tools that allow machines to be more autonomous in terms of learning and understanding the physical world by drawing from smaller and more abstract data

samples any human would be capable of providing—especially natural language—that correspond and relate to images, sounds, or physical stimuli. The AI boom has been catalyzed by three main recent technological trends. The first trend concerns the emergence of large-scale machine learning, in which problems once feasible only on a very small scale can now be solved at a massively larger scale, thanks to the availability of very large datasets, the possibility of parallelizing computations over an ever-increasing number of cores, and the emergence of specialized architectures for such processing tasks. The second trend is that many companies and organizations have made available very useful, easy-to-use, and even generalizable packages for machine learning, which allow data scientists to rapidly prototype machine learning solutions to data science tasks. The third trend is the emergence of specialized packages, particularly in the area of natural language processing, developed and open-sourced by research groups at large tech companies.

2.3. Historical Context of AI in Financial Services

What we think of as AI was not invented in our era. Computer chips do not think; they have no emotional or moral compass. No level of algorithms ever made products function as human charismatically did. But computer technology is moving fast now. What interests AI researchers and software developers now is simulating human thinking faster and with higher accuracy than human intelligence, memorizing more data more veraciously than humans, and acting more appropriately than humans, seemingly whether consciously or emotionally or not. Everyday people may be quite impressed when they find computer products doing the ordinary things more efficiently and at times at less cost than humans. Where will computers cease imitating humans? The answer to this question has implications for nearly all aspects of human endeavor, but mainly and necessarily for sheer human recruitment and participation in business, financial investing the entire process.

This chapter's purpose is to provide a brief overview of AI implementation in finance and corporate structures over the past sixty-five or so years. After all, this was there through much of that history. Classical AI was first introduced in the mid-1950s, when lent much of its breakthrough impetus from the cognitive revolution in psychology, the development of computer chips, and the funding of projects. Narrow and intelligent programs made their breakthroughs in fields such as games and arithmetic. Then came growth in intelligent pattern recognition, somewhat slower breakthrough time-transforming natural-language communication, and on to other advanced AI breakthroughs such as multi-agent systems, intelligent decision management, computer vision, and robotics, also partly engendered through the inner-funding of the Information Age. Since the mid-1950s, AI has made remarkable advances in important technology.

There exists a continuous demand for some of its technology, particularly innovations in speech, vision, machine learning, expert systems, natural language processing, and robotics.

2.4. Current Trends in AI Technologies

The fast pace of technology change enables the emergence and acceleration of new, revolutionary developments in AI technologies. These technologies are quickly redefining what types of functionality and capabilities can be integrated into products and solutions across industries. Certain AI technologies in particular, like deep neural networks, generative AI, and reinforcement learning, have made significant recent advances at a rapid enough pace that their new developments are drastically changing the technological landscape, enabling capabilities and applications that were infeasible or impractical even just a few years ago. It is critical that financial services organizations incorporate this technological evolution into their research and development roadmap to maintain relevance, competitive advantage, and leadership in the integration of AI into their products, services, and operations.

Deep learning, the technology behind much recent excitement in AI capabilities, is based upon deep neural networks. While deep neural networks are inspired by the biological neural networks that comprise the brain, they are primarily mathematical models rather than computational models and approximated in the form of mathematical functions that are part of larger systems that deliver inputs and receive different types of outputs, such as classifications. Deep learning works for supervised learning, self-supervised learning, unsupervised learning, and reinforcement learning tasks and is used for structured input scenarios, such as image, video, and text input. While these are not new concepts, recent developments have focused on scaling deep learning to the combined liberation of both available data and computing power. Specifically, increasing amounts of training data has been enabled by sensors, as well as by the increased ability of companies to crawl and scrape content to provide training data.

2.5. AI Applications in Financial Products

There is a rapid rise in the demand for smart financial products that satisfy customer needs as the sophistication of customers' financial needs increases with the expansion of the financial market. The advancement of expertise in finance leads to an increase in the important support provided by various financial products. Artificial intelligence can be used in products that provide the bulk of the functions of financial professionals, such as designing and implementing a plan to achieve customer-defined financial goals and developing and managing an optimal portfolio that generates a client-specified

investment return while minimizing the risk of loss. The product allows customers to select one or more companies that provide customized solutions that meet their investment objectives. These products employ the use of an artificial intelligence program to generate investment decisions. Financial products employing the use of an artificial intelligence program allow customers to specify investment objectives as input to the system and receive a document containing the output of the system composed.

Automated Investment Platforms

The roles of financial professionals include helping clients determine or clarify their life goals and offering solutions to realize those goals by effectively identifying and managing the various short- and long-term risks and implementing, and managing, the appropriate measures. Recently, people have actively used the services of wealth management companies for automated investment strategies. Programs that automate the wealth management process are called automated investment platforms or robo-advisor services. The major difference between these and customized products is that these platforms are typically not personalized, broad-based, or do-it-yourself investment strategies managing unknown investors' funds.

2.5.1. Automated Investment Platforms

In the past, analysts and financial professionals manually assessed clients' financial situations, objectives, and attitudes toward risk before offering investment advice. In the last ten years, automated investment platforms have made this investment process less labor-intensive and have improved clients' experiences. Robo-advisors take the investment processes one step further by using algorithms to offer services with little to no human oversight. Because of the current complexity of assigning a single industry term to the increasing saturation of automated advice in the investment and banking service sectors, the terms "automated investment platforms" and "robo-advisors" can be used interchangeably. These solutions utilize the latest technology to optimize investors' portfolios, recommending stock and bond tracking indices for tax-efficient investments across various asset classes.

Just as websites allow consumers to trade stocks on their own, automated investment platforms and robo-advisors also promise to upset the traditional model of personal financial advice. Robo-advisory platforms analyze users' financial profiles, risk appetites, and objectives before constructing and monitoring investment portfolios. In a niche market that started with a few products focused on low asset bases and individual investors looking for lower fees, there are currently several automated investment platform products that layer on various value propositions for consumers. Automated investment platforms and robo-advisors allow consumers to invest small amounts of

money in highly diversified portfolios across various equity and bond markets. These portfolios are constructed based on proprietary algorithms that recommend allocations based on users' financial profiles, objectives, and risk appetites.

2.5.2. Robo-Advisors

Advisory services for wealth management are expected to experience a substantial transformation in the near future due to the use of machine learning and AI on a wider scale. Robo advisors are the first Financial Advisors to combine the three distinct segments of asset management, technology, and regulation into one integrated product service and to offer it to previously untapped segments of the mass affluent and mass market. Digital-only financial advisors charge lower fees than traditional firms and are designed to provide several investment strategies to shorter-term, cost-sensitive clients with few assets. Robo-advisory firms were instrumental in the introduction of the passive-investment concept using low-cost ETFs.

The most significant difference between pure robo-advisory firms and hybrid robo-advisors is that pure-play firms do not provide physical contact with clients, who do not have direct access to knowledgeable financial advisors. The presence of a trained financial advisor is critical when it comes to transferring wealth across generations. Human advisors remain the primary source of advice on complex financial matters. Robo-advice essentially provides a more efficient delivery mechanism for the execution of certain services. Between 2015 and 2017, no actual regulatory lawsuits were filed against either robo-advisor firms or their investors. Consumer trust in robo-advisory firms is assuming the form of a deeply emotional bond between the client and brand.

2.5.3. Personalized Banking Solutions

With an evolving and relentless competitive environment, an ever-fluctuating market, growing digitally enabled customers, and increasing operational pressures, banks are compelled to create a redesigned banking experience that is both personalized and customer-centric. Out-of-the-box, standardized financial solutions and products are becoming a thing of the past; customers increasingly expect banks to recognize their unique financial situations and experiences. To this end, banks are leaning entirely on advanced AI, data analytics, and cutting-edge technologies to rewrite the rules of banking engagement and create bespoke, individualized banking products and solutions.

Leveraging AI, banks can develop deeper insights into their customers separated by distance, speed, and modes of contact. Monitoring a huge catchment area, using AI to crunch data from several different sources to identify trends and patterns, and constantly

reworking algorithms to capitalize on anomalies enables banks open a 24/7/365 business. Customers can select from unique, relevant solutions within seconds of expressing a need - be it an overdraft, low credit on a credit card, location-based access to funds, finding suitable travel insurance, recommending unique products, providing promotions that match spending habits, offering a bundled family policy, or offering cash-back rewards for life. These recommendations are backed by intelligent forecasting and prediction models using machine learning to build predictive capability for risks such as credit, balance, and fraud; grow consumer journeys; maintain secure mobile, web, contact, and social services; and execute insights-driven agency workforce management. Armed with in-depth information about competitors' responses and available pricing strategies, banks are able to create promotional offers that spur purchases by the right customer at the right time.

2.6. AI in Financial Services Operations

Advanced AI applications are steadily evolving enterprise operations; deploying tailored AI for Financial Services operations can be a huge step forward, leading to increased efficiencies, reduced costs, straight-through processing without human intervention, and improved risk and compliance procedures. Financial Services are particularly well-suited to be redefined through advanced AI because most processes are rule-based, and much of the work involves vast data analytics and risk management, tasks demanding speed, accuracy, consistency, and reliability. AI has powered self-service across Financial Services enterprise operations with their 24 x 7 capabilities. Enabled also by Low Code/No Code and RPA tools, AI helps employees – and customers directly – find answers to FAQs, simplifying procedures, and filling forms. Knowledge management, one of the more important operational processes relying on human experts, can be simplified and standardized through trained AI, allowing technically complex customer or employee requests to be automated, reducing time, freeing experts to tackle the more complex issues.

Advancing from self-service to intelligent self-service, AI-enabled FinTechs are automating key enterprise operation functions: Financial crime compliance, credit decisioning, KYC, data management, and reconciliations to name a few. With the right data, AI offers Financial Institutions the opportunity to drive efficiency into their enterprise operation functions, but the Data Quality challenges in these processes – much of it in unstructured documents – must be met before the speed and efficiency expected from AI can be reliably achieved. External third-party data providers can fill the unstructured data gaps as Financial Institutions surmount their internal challenges. Balancing the AI cost advantages and the data management, regulatory compliance, and cyber security costs and risks of these domestic labor-sensitive tasks will drive success

to the team that can best achieve the right balance. The potential cost savings across Financial Institutions can range from hundreds of billions to trillions of dollars annually, and as in most automated tasks, the long-term solution favors deploying AI-Automated processing soonest.

2.6.1. Risk Management

One of the greatest concerns in AI development today is safety, to be sure. If the goal of AI is to create a kinder, gentler world, are we doing enough? There are steps being taken by stakeholders throughout the industry and at every level of government to ensure that the development of AI is completed safely and is utilized for the common good. But as the new technology enters our lives more and more, a new concept is emerging to protect both individuals and industry through the creation of risk centers, research institutions designed to mitigate the risks that AI may pose in the short- and long-term future. These centers will proactively assess key risks posed by the new technology and provide recommendations for industry and government, while focusing on engagement. However, the product risk centers are creating is recommendations rather than products that on-market would sort criticism and provide funds for upkeep.

The Financial Stability Oversight Council is requesting AI risk advisory reports from various financial institutions. The new centers will also provide protection, such as regulation against discrimination and product mismatches in AI-generated lending products. Additionally, these risk centers shall increase collaboration, identifying interesting synergies from their various activities as they work on the common cause of protecting the future, while developing talent both within their institutions and in the next generation. For their part, the President and the National Security Council are already formulating fall-back First Principles for addressing risks in the new technology and are focusing on keeping workforce pipeline needs fulfilled while developing new security collaboration.

2.6.2. Fraud Detection

There are multiple areas of benefit from using AI-Financial products, including fraud detection by monitoring behavioral changes amongst customers in highly unpredictable and sensitive areas such as financial behavior. Several organizations are now implementing a combination of AI models to better predict at-risk customers. Model optimization with event changes or seasonality detection is also helping organizations further reduce false negatives and improve effectiveness of models. In addition to managing the volume of false positives, especially in areas such as credit scoring, utilization of add-on models to limit the volume of applications going to the main risk

decision models and use of a lower-threshold non-AI based decision support may also be considered by organizations. Improving efficiency and manageability through lowering false positives may allow organizations to even revert back to their legacy models for secondary decisioning in a worst-case scenario. Unfortunately, proper utilization of AI to detect bad actors and categorize individuals' propensity to harm the financial systems or commit frauds is easier said than a task to be executed towards success. Building a meaningful output out from complex AI models will pose implementation challenges to organizations. A consolidated framework of checks and balances with adequate bias detection and validation measure designed into the model strategy will work better for protection from the bad actors and fulfillment of regulatory expectations. Add-on burst models for specific tenures, geographies and other such factors should be validated and their effectiveness evaluated against the main models, either during model building or during model valuation exercises. The priority of using these models can be made on the basis of the business objectives to minimize negative impact.

2.6.3. Customer Service Automation

Artificial Intelligence (AI), and its advancements in Machine Learning (ML), is a rapidly developing set of data processing capabilities that will go far beyond what we currently have available. AI Commercial Applications Companies that specialize in text and language analysis, including voice level emotion detection and surveying sentiment from phrases and conversations, Churn Risk Monitoring, Personalization, and Clustering. Some of these companies help with the creation of automated natural-language-based Financial Products and Services, create Origination Automation using natural language to pre-screen prospects, Review and improve Product or Service Offering using persona clustering based on sentiment and loyalty data as well as user feedback, build Product and Service Recommendation Engines, and perform Prospect Channel Selection and Automated Prospect Follow-Up.

Automated advisor services that help consumers manage money without interacting with a person, Automated Deal Execution for Financial Products with lots of opaque pricing information, Automated Personalized Money-Management Alerts, Portfolio Account Management Automation, Account Management Chatbots to answer questions instead of a human being. ChatBots and Virtual Assistants are going to be key to driving more efficient customer service experiences; however, to be truly powerful tools that push the envelope of legacy tier-one customer service capabilities, they'll have to be integrated into how a business operates on all levels, not just as a layer slapped on top. A company might have some of the smartest AI systems in the business for handling customer interactions, but if its backend processes aren't up to the same level, customers are going

to have a frustrating experience regardless. With that said, chatbots and virtual assistants can, and are already, becoming a powerful tool, and one that is continuously getting smarter.

2.7. Regulatory Considerations

Financial companies are already heavily regulated and will have to navigate a thicket of regulatory laws regarding certain aspects of the use-cases that their AI systems perform. Failure to do so could jeopardize product launches or important company operations, especially when it comes to large language models and associated technologies like generative AI. An LLM and associated technologies may be used by financial service firms to create value or generate revenue in innovative yet risky ways. Other creative uses are coming up quickly, including traditional palindrome analysis from very large datasets. Similar innovations exist along the whole spectrum of financial products or services using LLM and generative AI-like technologies.

The growing reliance of financial firms on an automation heavyweight like LLM AI brings many concerns for regulators. Failures using such complex models for some product or service could be catastrophic in growing contexts, especially finance, where trust is paramount. LLMs and generative AI systems come along with the problem of transparency and explainability concerns. If they make an error, it is hard to identify a culprit or to provide remedies to affected individuals or organizations. These types of challenges are already the result of technology entering such products in somewhat simple ways. And LLMs and other advanced AI technologies are one step further along the power-potential-risk continuum. These systems cannot simply represent reliable building blocks or serve as inputs or drivers in the background for products and operations. Because of their very nature, there are challenges around their situations in the foreground that complicate matters across the board for many financial products, services, and operations.

2.7.1. Compliance with Financial Regulations

A challenge for any new financial technology is to comply with existing regulations in an appropriate manner. With advanced artificial intelligence, the situation is further complicated because decisions made by complex models such as deep neural networks are actually quite difficult to explain – in a human-understandable form.

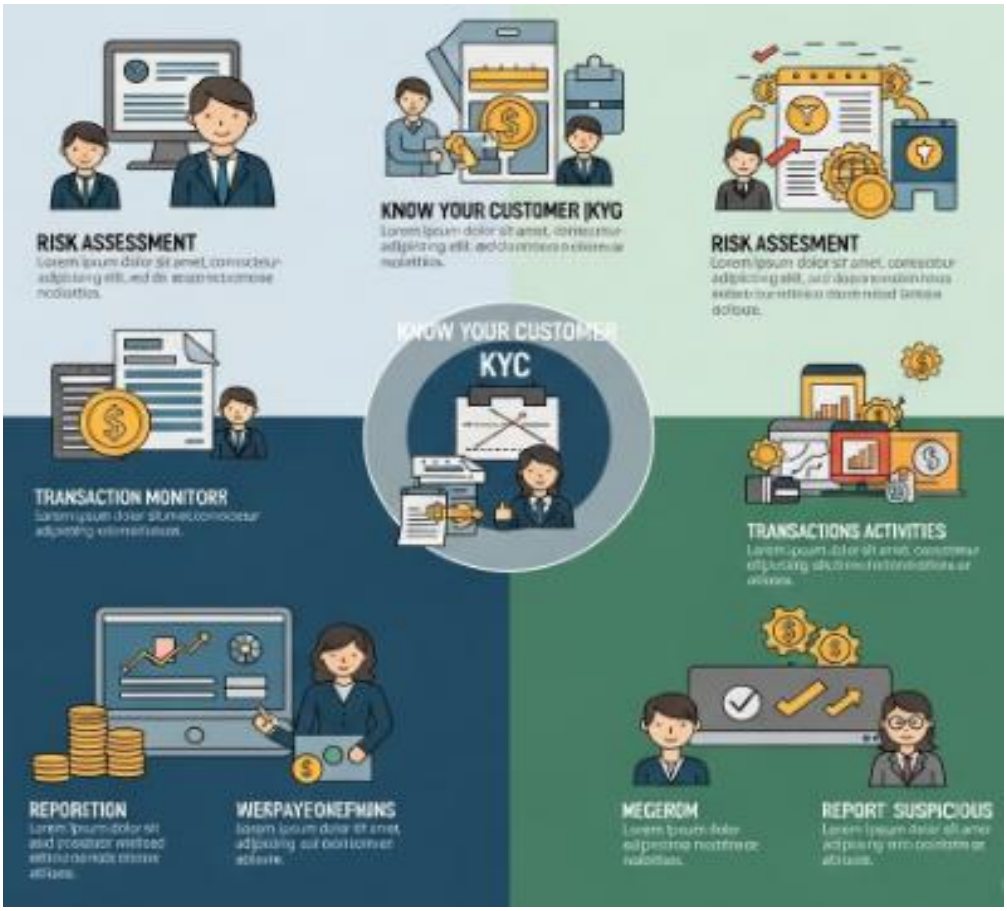

Fig 2 : This image is a detailed infographic illustrating the key aspects of compliance with financial regulations, with a focus on anti-money laundering (AML) and know your customer (KYC) procedures

However, if a text is totally impossible to read and understand, the regulator may be unable to confirm that it is complying with regulations regarding operations such as determining an appropriate interest rate for a requested loan, or determining whether to approve a mortgage application. This is known as the “black box” problem, and it may be one of the major challenges for the commercial operation of advanced AI models with regard to financial products, services, and operations.

In different financial operations, there are different requirements for compliance. For example, in the “know your customer” process for anti-money laundering compliance, many parties to the transaction must complete complicated processes to validate that they are legitimate clients. Though a model may be successful with optimizing this process for efficiency and speed, it may run afoul of regulations regarding the decision-making process by which the AI model explained the model’s decision in layman’s terms with regard to getting or letting the transaction go through. The decision is that

transactions that exceed or fall under a certain monetary threshold can be explained in probabilistic or deterministic terms; however, what happens in between those two thresholds requires clear explanation and documentation by the models to regulators to maintain compliance because failure to comply with the regulations may lead to serious liabilities and large fines. Hence, companies need to consider how to utilize advanced AI both for automation and possibly for making the process decision faster and clear enough so as to maintain compliance.

2.7.2. Data Privacy and Security

The development and implementation of revolutionary technologies, such as sophisticated AI applications in financial services, requires special emphasis on laws and regulations governing data privacy and security. These laws vary by region and are often vastly different, in many cases contradictory, as between different jurisdictions. Adhering to data privacy and security laws is necessary for every aspect of the utilization of data in financial services. These include the acquisition of data for input into advanced AI tools; the analysis and insights extracted from the tools; the use of such insights for purposes such as the origination of a loan, or the performance of a particular transaction; and the ongoing use and storage of data for operational purposes.

Various jurisdictions impose requirements (and at times, prohibitions) on the types of data that financial services companies can use for model construction and for model inputs, the use of which is often very precise for particular model purposes. Not only must a financial services company be knowledgeable about such prohibitions and/or requirements, but it is often required to disclose the factual basis for its selection of a particular model and its data sources and inputs. Because different types of data are subject to different oft-strict conditions for use, companies need to be knowledgeable about the risk of using prohibited or "unpermissible" data in models developed and employed for financial products and services. The financial services industry has faced enforcement actions, investigations, and scrutiny from regulators concerning the use of third party data in underwriting, marketing, and influencing pricing and consumer choices. Understanding and complying with these laws is essential to the incorporation of modern technological solutions and data assets within the financial services ecosystem.

2.8. Challenges of Integrating AI

Despite the above-mentioned advantages of AI, integrating AI in any operations comes with its share of complexities. Broadly, the companies looking to integrate AI face technical limitations, cultural resistance, scalability issues, and finally the concern

regarding investing in a future-proofed AI solution. Other issues revolve around the vertical-specific trade-offs between explainability, accuracy, performance, and ease of use while integrating AI. There are other sets of data technicalities such as trade-offs on the requirement of high-quality data in case of supervised learning, coupled with data volume and diversity in case of deep learning. Other minor technical complications can include overfitting, unbalanced data sets, and the security environment while developing AI models. Moreover, AI requires constant attention to stay updated with changing patterns and algorithms, large data stores, and the infrastructure development cost and maintenance.

Technical Limitations

Adoption of AI in fintech involves dealing with the limiting factors of traditional industries including but not limited to rigid regulatory framework that controls the viability of AI-fueled solutions, security implications regarding data sharing and pooling across multiple systems and players, limited shared data accessibility in domains such as anti-money laundering and getting the 'right talent to augment the existing workforce' in order to properly develop, pilot and deploy AI solutions. Most importantly, the challenges target systems face around explainability and interpretability issues relating designed models for critical classification and simulation tasks. Although, explainable AI is on the verge of technological breakthroughs, the fact still remains that black-box algorithms when applied in sensitive areas like credit scoring and loan approval are extremely difficult to explain.

Cultural Resistance

Adoption of AI proceeds best from the foundation of a robust existing culture – however, many organizations are not technologically equipped to design, develop and maintain a specialized solution that applies AI accurately in other functions. Majority of financial firms have large and complex internal infrastructures and have existed for decades. Taking such environments out-of-depth using advanced technology alone may just create further impediments to seamless finance integration or even stifle the overall advantages of AI. The financial services market has experienced little technological disruption and cometh the hour, company leaders must convince stakeholders and employees on the benefits of AI – while developing a practical plan to help employees transition away from functions SMEs have performed since decades.

Scalability Issues

Economies of scale seldom impose themselves equally across domains considering the mathematical and financial diversity of sub-verticals and verticals. Additionally, as cutting-edge solutions with short run-economies usually face quality constraints in the

beginning. Therefore, companies wanting to invest in scalable solutions must first gauge the possibility of runtime to inform them of talent requirements further down the line.

2.8.1. Technical Limitations

The integration of advanced artificial intelligence in finance has been limited by the technology's immaturity and inexperience. The excitement surrounding the emergence of artificial intelligent tools tends to mask the number of important limitations of these tools that the developer of projects building upon them or using them must face on a daily basis. The general issues include failures that lead to errors of fact, variation over time in quality and reliability, inability to produce shared source code, and lack of advanced AI tools capable of digesting the massive amounts of information typically produced in the financial industry. There are also issues that are specific to financial applications, including poor performance during stressed market conditions, exploitation by sophisticated users seeking to take advantage of vulnerable algorithms, background reliance on traditional data-processing algorithms for support tasks, challenges related to explainability, lack of coverage of certain data elements by AI algorithms, limited capabilities in certain specific applications such as improving weather forecasts or producing researched news articles, inability to draw from customer experiences, sheer volume of data produced during research processes, proliferation of erroneous data, and the cost and processes related to the maintenance of background data.

Dealing with both general and specific limitations of AI tools requires clear strategic guidance stemming from the corporate culture of the financial institution seeking to implement advanced AI technology. This is especially the case since a focused strategy, specialized staff, and dedicated resources to guide decisions about the application of the technology must also be in place for AI projects to succeed. Financial firms developing products and services that rely heavily upon advanced AI capabilities will need to work closely with specialized industry partners in both the financial and technology sectors to reach the productivity levels that established traditional tools allow today. AI technology is expected to accomplish the same thing researchers have strived to do for a long time, making efficient products that create a demand for financial expertise. However, industry veterans expect this type of success to require years before feasible services emerge.

2.8.2. Cultural Resistance

Organizational cultures are hostile to the introduction of advanced AI in many ways. Employees at every skill level express resistance to the replacement of their jobs through automation. Executive management is rife with fears that the use of advanced AI will

expose critical risks of instant failure, particularly reputational damage, if or when decisions go very wrong. Financial institutions have long told their customers that they are responsible and can be trusted with their customers' money. Advanced AI capabilities in many instances promise to move decision-making into a black box and to remove agency from executives and employees in high stakes decisions. Customers too may be uncomfortable having their transactions and interactions with a financial institution evaluated by a machine that operates on data and models that are not understood by anyone.

In addition, financial institutions and advanced AI teams also seem predisposed against each other. Financial institutions oppose the use of external production data to develop and validate better predictive models as a violation of the trust that customers place in the protection and confidentiality of their data. They are also concerned that the large language models from which advanced AI is developed are proprietary and not transparent to outsiders. Advanced AI teams may be responsive to customer concerns, but they work in firms whose business models depend on creating digital tools which do not focus for example, on the complexities of yelling over the phone or long online chats about fraud with customers who are confused or upset. This business focus puts AI digital teams at odds with the industry-specific concerns of responsible executives and employees.

2.8.3. Scalability Issues

Though many commercial AI tools are available today, most are not tailored for the specific financial use case and setting. Tool developers usually focus their efforts on those data reps given the greatest commonality among all companies — such as sentiment analysis of tweets, documents, and quadratic functions modeled using support vector regression — but in finance, such functions represent only a tiny fraction of the delta; it is causing concern among experts. The task necessitates the application of specialist knowledge about financial risks, complex dynamics, and specific technical limitations of the assets or entities occupying the scope of exploration. Truly specialized models would be fundamental components in enabling FIs to analyze and act in most data types of immense quantity and variety that they hold.

Another aspect of scalability is the model-refreshing process. For many AI projects constructing models and using them for the first time is just the beginning. Ask how often the model will need to be refreshed and in effect rebuilt with new data and old data replaced with new data. Will model maintenance and updates be regular and tedious? If so, does it allow savings and efficiencies to be created, particularly if the model has been used to create additional savings or efficiencies on a regular basis since it was first set into operation? If that is true, then will substantial time-savings be created by allowing

the model to continuously monitor for the areas of the business that exhibit recurring costs that could be reduced or analyzed through trigger points either because they appear excessively as red flags or otherwise present the opportunity to generate continuing savings? If that is true then are those savings large enough to justify the time and cost of monitoring and conducting model refreshes?

2.9. Case Studies

Successful AI Implementations During the last two decades, artificial intelligence has made significant strides in its capability. Large companies have successfully implemented AI in their core products. These companies have afforded to invest heavily in talent and infrastructure, and they have also had access to massive amounts of data. Smaller companies have also successfully employed commercial off-the-shelf AI products to enhance their business.

Companies have increasingly adopted AI methods for internal use. In particular, optimizing operations with machine learning has garnered attention. One company has implemented AI to predict demand in different geographic regions, with a stated goal of maximizing rental unit occupancy rates. Similar techniques have been used by another company to predict demand in real time and derive pricing recommendations for drivers. One company uses big data for warehouse operations, employing AI to optimize inventory allocation, transportation scheduling, and the routes for picking orders. Another company uses machine learning to inform the styling decisions made by its human stylists. Banks often build machine learning systems to block fraudulent transactions and to estimate the severity of lender defaults before the fact.

Although well aware of the downsides of AI, large Internet services are fully embracing the technology. One company has deployed AI to help curtail objectionable content on its platforms and to make ad recommendations to users without accessing personally identifiable information. Another has equipped its AI with the ability to analyze copyrighted code to determine whether or not it would be appropriate to use similar code when searching for solutions to customers' queries. One company has used AI to discard harassing comments from its platform. This multitude of commercial ventures signals that AI may finally be ready for enterprise use, and that building business capabilities around AI can indeed create significant value.

This optimistic outlook should be taken with grains of salt, as not all AI developments have been successful. Many companies invested in AI hype, attempting to integrate it into products several years ago, when the technology was still limited. They created too many unfeasible projects, did not staff them carefully with the requisite skillsets, struggled with data integration and quality, and lacked a clear understanding of AI's

current strengths and weaknesses. Support for previous AI commercialization hesitated when the products were rushed to market and generated negative press.

2.9.1. Successful AI Implementations

There are many instances in which organizations have successfully integrated advanced artificial intelligence technologies into their products, services, and operations. A few examples are provided below.

A common AI implementation in financial services is AI-enabled chatbots. These chat bots enable consumers to easily access services over the internet, easing the burden of call centers and other live customer service functions. Traditionally, banks would have clerks staff service desks to provide their customers with specific information and help them execute required tasks. Consumers would visit their banks primarily for such things as backup services, payment execution, account verification, and information related to loans. Now, consumers can access most of these services – and many others – by visiting their bank's website. This ability has greatly reduced the volume of work that requires bank teller assistance. In addition to these competitive advantages, chatbots operating within the bank's website can provide instant responses to basic questions, such as what time the bank opens or how to enroll in online banking. A 24/7 service for clients is quite valuable and is efficient for the bank as well. Not only do chatbots answer such questions, they can also guide consumers through processes, like enrolling for banking services or applying for loans. Importantly, building and improving on these bots and other email functions can be simple, routine, and low-cost projects for technology staff in banks. Such AI implementations can involve simple AI technologies, and a financial institution doesn't have to be a world-class leader in generative AI to stand up chatbots. Such bots can enhance virtually anyone's website and will become the standard of the industry.

2.9.2. Lessons from Failed Integrations

Failing to favorably integrate artificial intelligence (AI) into set products, services, and operations can have undesirable consequences. The issues of achieving economic value while reducing operating losses and bottom-line losses are higher for those who have unsuccessfully integrated AI into their offerings. The lessons learned from past failed implementations can assist organizations in overcoming the challenges for types of integrations.

Learners must understand how and why the previous unsuccessful attempts have failed. If not, the same mistakes or lack of thinking/analysis prior to the implementation can

happen again. Bottom-line losses can lead to severe repercussions for financial services companies, such as committed exit from specific markets, costly reductions in their labor force, consolidation with additional mergers and acquisitions, avoidable bankruptcies, and potential taxpayer bailouts. They may also hurt customers who experience service reductions during those difficulties.

One of the most detrimental failures for financial services organizations is being unable to ensure the safety and security of their client's sensitive information. Even worse, the loss of customer trust, satisfaction, and loyalty resulting from AI solution debacles related to innovative offerings like marginal deposit, payment, and insurance safety and investment security cannot be regained quickly under prior product introduction circumstances. Such reasons compel financial services companies to consider how risks can be avoided or mitigated. Previous management mistakes should encourage and compel the financial services sector to more effectively reconsider such implementations and the soft and hard potential outcomes of doing so.

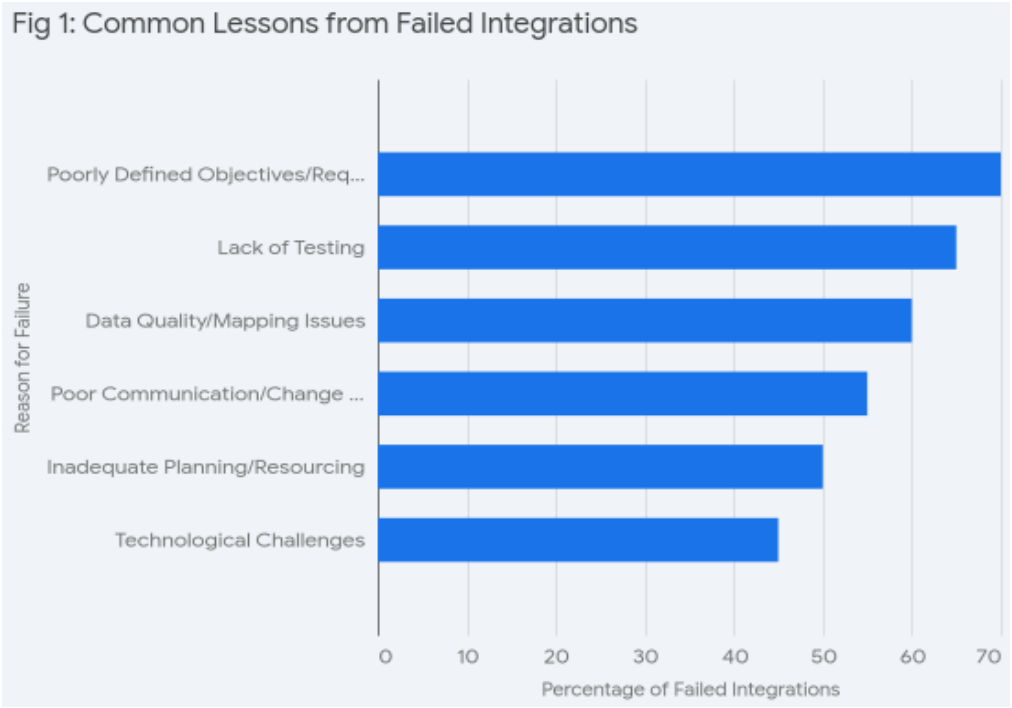

Fig 1: Common Lessons from Failed Integrations

2.10. Future Directions for AI in Finance

AI technology is continuously evolving and is expected to facilitate developments that will significantly shape and possibly transform the entire financial ecosystem. There are

several emerging trends. Data processing via more sophisticated natural language and image processing and even quantum computing will lead to more advanced algorithms. Such algorithms will be able to better analyze and more accurately assess soft information, such as personal characteristics and psychological features, and to identify motives and intentions of other actors, including those of individual investors, business clients, and developers. Moreover, the use of algorithmic trading will become even more dynamic and will play a major role in almost all financial markets. Algorithms and non-fundamentalist investors will increasingly determine short-term price fluctuations, while seasonality and fundamentals will in most instances determine long-term price development. The role of bots in finance is expected to grow and bots will manage a considerable share of savings as well as be the service interface of many financial institutions. Moreover, the currently evolving intersection of decentralized finance with AI technology is expected to bring private finance to a new quality level. By enabling a much more efficient matching of supply and demand, allowing financial transactions to take place for a fraction of the cost associated with traditional channels, and eliminating counterparty risks associated with both custodians and intermediaries, AI and decentralized finance solutions promise to make reliable financial services more widely available to individuals and small and medium-sized enterprises, especially those currently underserved by traditional financial institutions.

2.10.1. Emerging Technologies

Just as previous generations were responsible for looking to the sky and creating the playbook of aerospace activities that have resulted in today's space economy, leaders today need to quickly acknowledge and embrace the emerging technologies that are responsible for defining the beginning of tomorrow's AI economy and its subsequent trajectory. High-performance computing stored in the Cloud at low unit costs has finally made possible the generation of unparalleled datasets. These datasets, along with the increased speed and size that can now be deployed to analyze them, together with the shift from rule-driven expert systems to deep learning neural networks that can learn from their training datasets without explicit direction, make it possible to create sophisticated AI systems that can improve both on the execution and decision making components at a large but focused scale. In finance, the creation of risk-sensitive AI systems that can advise and execute on trades and corporate strategies at digital speed is nearing reality. Financial leaders must make the investments needed to deploy the technology components underlying this risk-sensitive AI, experimenting with using it for both traditional financial products and for creating new products solutions. They will need to identify the best partners to collaborate with and the areas of financial activities that should be led by the financial institution versus those that should be led by the technology partner. They will need to best ascertain the economics of the partnership

over the entire lifecycle of the corporate relationship. Meanwhile the developing technologies include the ever-richer datasets enabled by the movement to data lakes backed by the ever increasing digitalization of the process flows of products and services, the use of advanced data analytics, automation and more recently Large Language Models to support both the top and bottom lines of the business. Financial Institutions, like everyone else, must be pursuing the incorporation of LLMs as AI assistants into their Signature products and services. So far the range of currently approved LLM applications for major applications inside savvy financial institutions have been limited to tasks capable of delivering incremental improvements with a high confidence in the productivity gains.

2.10.2. Predictions for Market Evolution

This section presents the views of experienced people who are active in the financial industry regarding their expectations for how the industry will change. It may take a few years or decades for the vision that they put forth to fully manifest, as will become apparent. They specialize in wealthy individuals, family offices, fund of funds, hedge funds, institutional investors, private equity, venture capital, investment managers, investors, banks, and other corporations. These experts say that AIs will be adding much value in the next 5 years, helping to better manage more than marketable assets and liabilities that total about $350 trillion. In the next 15 years they expect a large-scale transfer of control of money from the big universal banks with their thousands of branches and hundreds of thousands of people to investment fiduciaries with few or no employees who are clients of managed investment advisors. They see an enormous opportunity, between now and 2023, for specialized financial institutions to dominate intimate relations with truly wealthy individuals and their family offices. Family office outsourcers will help these clients protect their wealth by helping them survey, monitor, and manage more than $25 trillion that is more than their liabilities, which consist essentially of taxes, liability insurance premiums, and costs of sailing through life. In addition, demand for forensics, appraisal, and matchmaking advisory services to help identify and hire good specialists to smartly assess, acquire, and build, protect and transfer wealth through a large number of investments in private businesses will expand rapidly as the demand for better investment returns grows.

2.11. Ethical Considerations

The implementation of AI into financial products, services, and operations raises various ethical questions that FIs must address. These ethical dilemmas can greatly impact the efficacy of their business models. Undeniably, the impact of racism or sexism in

decision-making areas such as hiring and lending is a key area of concern. This section elucidates on the role bias plays in financial decision-making and examines whether humans could be removed from the decision-making processes altogether.

Bias in AI Algorithms

Despite the fact that many people trust the AI and machine learning models used to make financial decisions, there is evidence that biases in the data on which the ML models are trained would then result in biased ML models. Certain groups are usually less creditworthy to lenders, difficult to insure due to being perceived as higher risk, etc. due to industrial and societal structures. This makes it difficult to determine what's the bias and what's an accurate correlation.

Yet we can't know which correlations are correct: if AI algorithms allow lenders to make credit decisions more in accordance with reality, this will harm certain groups. That would place some kind of moral or ethical blame for the disproportionate impact on the affected people, rather than society or the lenders. By using AI algorithms, the lenders or other decision-makers can argue that they bear no moral or ethical blame. Doing so enables them to avoid taking responsibility that would make society remedy the source of the problem. Instead, it shifts the responsibility to the individuals and thus the blame model of corporate ethics is not really effective here.

Impact on Employment

Employment is always a topic related to the Uncanny Valley, where the chain of value creation is shortened and, ideally, results in the loss of work. FIs are likely to be among the most affected areas as AI takes on ever-harder client-facing tasks. Consulting firms usually do the AI-driven segmentation. Then, the less "important" clients can be serviced through online alliances or chatbots, which leaves only the high-value consulting clients for face-to-face meetings.

2.11.1. Bias in AI Algorithms

AI, like every machine-generated process, carries the potential for bias, and it is of immense importance that such biases be dealt with actively and rapidly. AI will often be used to drive processes involving great economic and consequential impact, and it is essential that the data on which decision-making is based is as free of bias as humanly possible. Any AI-generated outcome or decision that is built on biased data is unlikely to be generically disseminated without the potential for harm for some, if not all. In a legal context, the AI industry also faces increased pressure, as the Product Liability Directive requires that Producers be responsible when AI systems produce faults damaging life and property. For investment products, the use of biased data, even if

unintentional, might result in measures taken against persons involved in the decision-making or product structuring, for example by national Regulatory Authorities in the context of detecting Market Abuse or Money Laundering. In our view, biases can be classified into three groups: Data Bias, Algorithm Bias and Analysis and Report Bias. The AI developer's classic industry sector responsibilities apply, particularly the requirement to be scrupulous, careful and transparent when using AI algorithms.

Data Bias generally results from the data used to train a neural network being itself biased and unbalanced. In the context of risk modeling to detect illegal behavior, for example, only sample historical bad data is available, which is certainly not a 100% representation of all past loans, since whilst a sizeable percentage of loans will have been fully repaid, this has no bearing on the AI empirical investigation.

2.11.2. Impact on Employment

The greatest impact of AI on employees has been on lower-skilled, lower-wage jobs, including those in manufacturing, transportation, and logistics. These sorts of jobs were declining before the introduction of AI due to offshoring and other factors, but the introduction of AI has accelerated that decline. The introduction of writing assistants may have a substantial effect on certain types of white-collar jobs that involve writing. For example, some aspects of jobs in various media-related and content generation sectors, as well as in employment-related services, could be impacted. In the white-collar sector, certain categories of employment were already declining, and AI may hasten the reduction of those jobs.

It seems plausible that, over time, there will be a gradual tendency toward the upgrading of most occupations through the increasing interaction of employees with AI, even in areas currently predicted to be significantly disrupted. For example, teachers might use AI-driven learning assistants to leverage their own efforts and deliver more personalized attention to their students. Nurses, in turn, could benefit from predictive algorithms that use AI to guide them in prioritizing their support across a patient load. As the wider introduction of more advanced types of AI occurs, the interaction between humans and AI could, it is hoped, contribute to upgrading the occupational mission of a variety of sorts of workers, in education, healthcare, as well as possibly in manufacturing and logistics. Achieving this hoped-for scenario, however, will take substantial investment on the part of both businesses and government. It is not a direction that simply occurs as a multiple of the adoption of AI technologies.

2.12. Conclusion

Those seeking to bring advanced artificial intelligence (AI) into banking and finance as a whole have many often neglected planning considerations to address. AI should be used only where it will materially enhance what providers and users do best in particular products, services, operations, and markets, but any affiliated provider or dealer will want the same. Where interactive systems are at play, it may be that unscripted conversational interactions that really test the limits of the systems are the only realistic test of different configurations and implementations of the systems. As matters currently stand, we are aware of only a small number of real uses of AI in active operation in the marketplace. This is a concern, as in this day and age without any extensive commercial use, it is doubtful whether anyone understands how best to use these systems or what the relative advantages or disadvantages are of different possible implementations. Reasonable parties will want to experience real successes and failures of substantial implementations to be confident before spending the time and expense to develop further packages of AI for the industry. It is also possible for parties to overly personalize the interactions with AI implementations. This is a tendency especially when the implementation is script-driven or otherwise limited and directly exercised one on one.

If providers are not willing to share their actual AI commercialization and usage experiences on an anonymous aggregated basis, then others will only be able to develop systems on a speculative basis and innovation may stagnate as party's interactions become largely scripted and driven by a limited set of applications. Business-oriented interfaces appear to have moved advanced AI from its roots in academic research to a new commercial milieu. Business strategy should determine what problems AI should solve for companies, rather than the odds of success being sufficiently high to justify a company's investment in attempting to use AI to address a current problem or opportunity. With a targeted approach, companies increase their chances for success by addressing problems with a track record for predetermined AI techniques.

References:

E. Brynjolfsson and A. McAfee, Machine, Platform, Crowd: Harnessing Our Digital Future, Norton & Co., 2017.

R. Agrawal et al., "The future of AI in financial services," AI Mag., vol. 40, no. 4, pp. 59–72, 2019.

F. S. M. Alzubaidi, "Application of AI in financial risk prediction," IEEE Access, vol. 8, pp. 165157–165166, 2020.

S. Chakraborty, R. A. Wilson, and A. Bhatia, "AI-based credit scoring using alternative data," Proc. IEEE Big Data, pp. 4421–4426, 2018.

J. B. Dugan and H. Wang, "Deep learning in algorithmic trading," IEEE Comput. Intell. Mag., vol. 16, no. 1, pp. 26–39, 2021.