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Chapter 1: Understanding the structural shifts in financial services brought by the integration of artificial intelligence and digital infrastructure

1.1. Introduction to Financial Services Transformation

The financial services industry is in the midst of a historic transformation right now, and what it looks like once this transformation is complete will be very different from the financial services industry of a decade, or even a year, ago. As if the aftershocks of the pandemic had not already revolutionized so many life and business practices across the globe, the subsequent war has prompted businesses to re-think long-held policies about outsourcing and near-shoring. Customers demand ever-improving speed in their interactions with financial services providers, as well as new and innovative products and features tailored to meet their needs. Disruptors are nipping at the heels of traditional banks and capital markets firms, stealing customers and revenue along the way. The Great Resignation, followed by the Great Regret, has compounded the longstanding issues of talent acquisition and retention that have plagued the industry. Regulatory requirements, embracing both compliance and risk management, are at an all-time high. As all of this is happening, we also witness the emergence of tools that can improve employee productivity, and the accelerated race to the cloud (Arner et al., 2016; Brynjolfsson & McAfee, 2017; Bruckner, 2022).

When faced with these challenges, it can be tempting for organizations to take a reactive and piecemeal approach to address them. However, applied strategically, AI and the digital infrastructure that underpins it can empower financial services organizations to proactively meet these challenges and seize the moment to rethink how they operate and pivot toward their future. By embracing AI-enabled solutions and digital infrastructure as key enablers of business transformation, organizations can fundamentally change ways of working; improve resilience, analysis, decision-making and risk management; and ultimately improve profitability (Chen et al., 2019; Bussmann, 2020).

1.1.1. Background and Significance

The field of Financial Services has been undergoing rapid transformation for the past 25 years. The introduction of new digital capabilities – mobile technologies, electronic data interchange, cloud computing, big data, blockchain technologies, machine learning, and artificial intelligence – and new ways of meeting customer needs – remote services, convertible currencies, peer-to-peer lending and digital wallets – has seen formidable new entrants entering the payments, remittance, lending, foreign exchange, and banking businesses. As market share and profitability has been siphoned away from established institutions in securities, payments, lending, and banking by these new entrants, concerned regulators have looked to establish a "level playing field" to ensure capital adequacy, protect customer deposits, reduce the potential for cybercrimes, and augment institutional capacity to roll back abusive and predatory lending practices. Yet the industry continues to transform.

Fig 1.1: Understanding the Structural Shifts in Financial Services Brought by the Integration of AI and Digital Infrastructure.

What is causing such structural change in an industry that is a pillar of traditional economy, and how profound is the disruption? Why have such global giants entered the space with their wallets and lending ambitions? Although it is tempting to posit that this

structural transformation is simply an outgrowth of technological change, such a perspective robs the study of Financial Services of its idiosyncratic character. The challenge for the field is to distill the impact of technology flow on service flow in Financial Services and the greater economy, charting the patterns of coevolution. Economic modernization is, at its heart, the study of the structural and organizational change emanating from the interplay of the emergence of new capabilities that can be exploited to afford better, cheaper, faster products to consumers and meet their ever-evolving needs.

1.2. Historical Context of Financial Services

Before analyzing the structural shifts brought by the combination of generative AI and cloud and digital infrastructure, we explore how these technologies overlap with the evolution of financial services. To provide helpful principles for our subsequent analyses, we start with the historical context of the development of financial infrastructure and its intersection with radical technologies.

Financial services have a long history of providing value to society by enabling the exchange of risks ranging from liquidity to credit and market risk. These services have evolved slowly, adapting and aggregating underlying consumer and business use cases, from transferring payment via barter or currency-based transactions to formalizing debt, trading term structure, hedging and managing expectations of variables perceived to pose risk, and laying the foundation of trust in an economy. But unlike most essential services, those related to finance have been and remain costly compared to their use, and are weakly penetrating in emerging economies, or the large segments of the economy neglected by banks. Such shortcomings stem from the peculiarities of economic risk as an unobservable, ultimately political concept, and the issues of externalities, cross-network effects, asymmetric information, and the problems created by incumbent technology-based barriers to market entry.

To alleviate these problems, fundamental technologies like printing, electricity, telecommunications, and information processing helped reduce transaction costs, while political pressures demanded wider access and transparency in partnerships with governments. The result were periods of institutional change led by creation of the central banking model, floating of government debts, establishment of securities exchanges and clearinghouses, democratization of stock ownership and broader use of debit and credit cards, and more recently, privatization and globalization-driven deregulation of capital markets and the rise of global banking relationships.

1.2.1. Research Design

The empirical-based analysis of this work is supported by an abundant body of literature in FinTech research, whose fast development has motivated us to classify the multitude of digitized financial services. This and the broad use of AI in the economy moved us to characterize the evolving financial services. The established framework provides empirical findings to identify possible evolving financial services, as well as mapping their physical and human structure. The methodology followed in this work is to use qualitative and comparative tools to categorize the technology-based products and services offered in the marketplace, to identify the key enabling AI and digital technologies, the market participants, and their relationships to construct the supporting ecosystem, and the mission critical processes to analyze the physical structure of the financial services. Together with the technology and physical infrastructures, we look at the people dimension associated with managing and executing the core business of financial services to understand how the incremented use of digitized processes and the supported AI-powered activities is affecting the way finance specialists do their work. Additionally, we examine if distinct characteristics from the regulated nature of the financial services are shifting, given that they are highly regulated, in homage to creating trust on the part of society, companies, and governments, and how such shifts might configure a change to the broad application of all sorts of technological solutions without the disruptive consequences we witnessed along the last century. Lastly, a section is dedicated to review literature contributions related to the financial services, conducted mostly by the Business Administration scholars' community. The aim is to provide a complementary contribution in understanding how those business services are affected by the deep integration of AI and the supporting digital technologies.

1.3. The Role of Artificial Intelligence in Financial Services

Artificial Intelligence (AI) is currently transforming many sectors. The financial services sector is an important user of data, it is also in the forefront of adopting digital technologies, so the use of AI is widespread. The adoption of AI can create value by enhancing existing products or creating new innovative services or products. It can also improve the efficiency of existing processes to lower costs and increase market share. In addition to industry level efficiency gains coming from lower prices, AI adoption can create significant value for individual institutions. The landscape of AI supported products and services is wide ranging and is increasing rapidly. The excitement around the potential productivity enhancing effects of AI is likely to spur additional demand as applications increase. The pandemic had already accelerated the development of digital solutions and hastened the replacement of human labor by digital technology. The use of AI, however, is not limited to areas where human labor has been displaced. AI can be

used to enhance or complement human decision-making. In these settings, having an AI solution can increase the quality of data-driven decisions. These improvements in decision making can come from faster decision making, better final decisions or a combination of the two. High-frequency trading is a prime example where AI has completely transformed an industry with speed being the important advantage. The area where AI is expected to have impact is relatively large. The unique ability of large language models to produce text that has high coherence and captures aspects of human conversation has created substantial interest in developing additional applications, enhancing customer service via chatbots, creating quality translations, aiding in product descriptions, customer analysis and market research.

1.3.1. AI Technologies in Finance

Artificial intelligence has enabled significant advances in a number of areas of human interest. In finance, its impact has been felt in areas such as trading, wealth management, banking, risk management, credit ratings, loans and transactions, insurance, and regulations and compliance. The technological advances fueling this revolution include data collection technologies, computing power, data connectivity, and AI software and algorithms. Data collection technologies refer to information technology devices and applications capable of capturing and transmitting interactional data in the daily lives of individuals and firms. Such devices include mobile phones, the web, and increasingly ubiquitous sensors in buildings, goods, machines, and other devices. This dataset of ephemerality is capable of revealing sensitive signals of future behavior about consumers and firms, thus unlocking an important advantage in financial decision-making requiring a short time horizon. Coupled with the growth in the size of the data utilized in AI, its evolution has been made possible via significant increases over the past decade in computing power, and programming and algorithmic advances in the area of AI and in particular deep learning.

1.3.2. Impact of AI on Decision Making

Intelligent systems have great potential to augment human decision-making by improving its accuracy, speed, or both. However, for AI to augment decision-making successfully, it has to influence the decision logic with the right level of autonomy, understanding of the task, and presentation of the decision. It is often easy to spot when a machine succeeded at a task that previously required substantial cognitive effort by a human, and these systems do provide valuable insights when applied to more complex tasks, as they are increasingly being used to in a self-driving capacity. For domains involving complex decisions where emotions play a central role, providing decision

support could occasionally yield better results than attempting to replace humans entirely. A specific but promising application of intelligent decision support is Affecting Computing, which attempts to impart emotional intelligence to machines, by detecting and factoring in users' emotions in order to improve the interaction and validate conclusions.Having been initially cast as "decision support" tools, intelligent systems have advanced rapidly, to the point where some areas such as specialized image and voice recognition function independently of human intervention. In addition, enabled with certain levels of emotional intelligence, AI can take on decision-making functions in areas with a significant behavioral component. Moreover, as the pace of implementation picks up further, the interface between humans and machines will evolve in both directions, with machines taking on more advanced tasks where they outperform humans but that also provide support to humans when additional cognitive effort is required.

AI can help speed up the decision-making process and make it less prone to error in a variety of areas in finance. Investment banks, for instance, are rapidly adopting machine-learning language-processing tools to identify and extract relevant information from the millions of news items, research reports, earnings releases, and corporate filings issued daily.

1.4. Digital Infrastructure in Financial Services

Digital infrastructure, vital to the economic growth fostered by the Internet, represents a series of technological advancements that have enabled the delivery of products and services -- banking, insurance, asset management -- and a wide range of services to both consumers and corporates more efficiently and at lower cost, while at the same time enhancing accessibility, transparency, and user experience. Digital infrastructure can be understood as a technical ecosystem composed of the distributed storage, network, computing, development, connectivity, and processing layers that technological services delivered in the digital economy rely upon.

At the core, digital services to access digital infrastructure are made available on-demand, automatically managed and optimized, and of variable cost, accessible for both incumbent and new players, busy building and rolling-out digital services, which can then have associated with them third-party digital services lacking technology infrastructures of their own. Third-party technology providers allow for ease of on-boarding and diverse - often region and service dependent - transactional and post-transactions services: Know-Your-Customer, Payment Processing, Compliance, and Loan Management tools are outsourced offerings available to digital banks, neobanks, online lenders, and marketplaces. Technology advancements have enabled the re-thinking of technology architecture and lowered the cost of technology services at every

layer, allowing for established banks and tech-driven players to build core and transactional banking, lending and investment services at scale with lower costs.

Digital financial services have lower marginal development costs than traditional financial services. Transactional financial services are served by embedded finance, and have become a product or feature of platforms, where payment processing, credit underwriting, insurance and investment services are made available, and bundling and strategic partnerships are the aims. Digital services are immersed in the overall customer experience or journey, in activities like travel, e-commerce, entertainment, or marketplaces, removing reliance on direct interactions. Traditional banking services are migrating to the background, allowing banks and tech driven players to reduce contact, thus enhancing cost control. And the players most capable of absorbing the costs presented by digitalization are the same large integrated technology platforms.

1.4.1. Overview of Digital Infrastructure

In recent years, there has been explosive growth in public access to IT tools, digital infrastructure, and data. At the same time, massive amounts of data are flowing over the internet from an increasing number of devices that harvest an array of real world signals, including images and videos, sound, location, and environmental factors. Digital infrastructure is the underlying technology stack that makes it easy, quick, and economical for individuals and organizations to deliver products and services online. For financial services, digital infrastructure allows firms and innovators to partner and collaborate much more effectively; to leverage innovative APIs, software, and application architectures; and to scale solutions quickly and cheaply. It helps both established firms and new entrants ensure that they are not replicating centrally what could be done, or even should be done, by externalized partners.

In addition to enabling and accelerating financial services innovation, activity, and investment, digital infrastructure will also transform the way financial services operate more generally. Firms will maintain digital infrastructure relationships with a multitude of external partners—specializing in AI and data solutions and other components— around the world. A diverse range of digital, technology, and other partners will plug in their innovative solutions via APIs to help financial services firms, grandmothers, and the entrepreneurs of the future for whom digital infrastructure eases technology burdens, more easily connect and create evermore innovative, useful, and efficient offerings. The firms, wherever located, that provide the best combination of products and services around the world for customers and clients will survive. Digital infrastructure will change the shape of financial services, with its core value drivers shifting increasingly from proprietary, in-house legacy tech stacks to a large and diverse range of innovative, creative external partners.

1.4.2. Key Technologies Supporting Digital Infrastructure

In the context of the financial services industry, digital infrastructure refers to the foundational technological elements that enable data, processes, systems, and the overall digital economy to connect, interact, and exchange value. The tools, technologies, products, and platforms that underpin the digital economy are critical for not only traditional companies but also those labeled New Tech players, generating a highly compressed and distributed digital economy performing commerce with no physical or geographic barriers. In this sense, although the building blocks of digital infrastructure are similar to those of traditional infrastructure, aspects like virtualization, cloud capacity and capabilities, and other elements of digital infrastructure enable a very different economic principle: the on-demand economy.

Fig 1.2 : Technologies Supporting Digital Infrastructure.

The digital infrastructure of the financial services industry is similar to the digital infrastructure described. Financial markets, instruments, and services perform commerce like any sector of the digital economy, from mining through ecommerce.

Consequently, support for the secure movement and coordination of data, processes, systems, and services of the financial markets and the products and services built around them is the primary and foundational layer of digital infrastructure within financial services. Unlike other vertical markets, a key differentiator of financial services digital infrastructure is that it is not only available to support the internal processes and functions but also available to, and actually serve as the foundation for, supporting the secure processing and coordination of the services and products offered to customers. Data security and privacy concerns arise within the transactions that involve the ecosystems of traditional and alternative or New Tech players.

1.5. Integration of AI and Digital Infrastructure

Artificial Intelligence is radically changing the landscape of financial services, but it may be said that the developments of the last ten years in Cloud, APIs, Low-Code/No-Code, and Open Standards are, if anything, more disruptive. What is most significant is the convergence of both. Dominant large Tech firms have used existing AI solutions for Finance and increasingly adjacent real economy markets as the focal point for the development of their Cloud Infrastructure. General impact on future Financial Services is, and will be, more shaped by the intersection of both categories of applied technology than AI itself, as cutting AI Solutions and Tech from the Digital Infrastructure would limit all future development.

The value of AI lies in it being embedded into Digital Infrastructure, Applications and Capabilities. Digital Infrastructure is the new architecture of Financial Services, that will allow all established as well as new entrants to build on top Digital Financial Services using a design capable of integrating many new or advanced Tech Solutions such as AI. The work of Industry players and Fintechs of the last years have created a new Digital Infrastructure that is at the very center of Financial Services capability. This Infrastructure consists of Digital Platforms, Cloud, APIs, Open Data, Advanced Security, Composability, Architectures, No/Low Code, Outside In/Inside Out, and thus starts with either existing or new Infrastructure Providers.Such integration of AI and Digital Infrastructure may afford new immense advantages for existing as well as new banks that actually implement it. Not only are banks subject to production of services where costs are extremely opened to optimization by AI Powered Efficiency Economies of Scale. They are also able to massively improve Core Capabilities Critical Services that have offered traditional banks their only distinctive advantage in the Search for Value Matrix.

1.5.1. Synergies between AI and Digital Platforms

In contrast to an AI system in isolation, an integrated system that combines digital architecture and AI creates synergies. Digital architecture enables the easy transport of vast amounts of data that link the many modules that comprise the integrated system, and AI enables the modules to convey more intelligent, value-enhancing higher-level service tasks. We see this synergy between digital architecture and AI as a process of stepwise enhancements. Digital architecture continually harvests data associated with service outcomes, user preferences, and transaction flows that allow the algorithmic logic of AI to refine and improve more and more of the service outcome tasks that comprise the customer value proposition.

The ability to build AI-enhanced solutions around the fundamental customer service journeys is at the heart of how AI can augment or even replace human judgement and error. Retail banks primarily offer their customers low-cost access to three key services: manage current account deposit and withdrawal; transfer funds to and from other accounts; take out and repay loans. More demanding customers embrace ancillary services: such as managing health savings accounts and flexible savings accounts; wire transfer funds to foreign accounts; apply for home mortgages, bank credit card and personal loans; and order deposit account checks. Currently 70% of the deposit account service tasks are fully automated; home mortgages are primarily processed by AI, while credit cards and other personal loans are increasingly being handled by AI. It is fully expected that loan delinquencies and defaults will increasingly be predicted, monitored, and managed by AI as well.

1.5.2. Case Studies of Successful Integration

While the integration of AI and digital infrastructure is an emerging area of work, there are examples in the broad space of finance and adjacent industries where such synergies are apparent. Investments have begun to move toward a comparison of digital infrastructure approaches, creating the possibility for competitive advantage. By drawing on decades of experience, a small number of companies with a heavy capital base plan to centralize "the cloud" — an abstraction layer for data management and processing — and integrate the power of AI using accelerator chips. These participants are providing accelerator hardware which can be combined with software for specialty AI functions, commercial services across the major AI functions such as large language models which have been quickly made commercially available by various companies.

Integrating AI and digital infrastructure seems more advanced in the major Internet companies who in many respects operate at the same scale and business model of traditional financial services. These "Big Tech" companies — with an infrastructure

layer that has combined major platform services such as search and online shopping recommendations, social networks, cloud services for data storage and remote processing of local applications with an also complex portfolio of adjacent services — are diving deeper into the mass market of small micro-lending businesses and portfolio services for individual retail investors. Often funded via short term borrowings through traditional financial institutions making a spread such as a local loan association, these "Big Tech" companies have an enhanced advantage in quick approval and processing via their existing digital infrastructure of cloud services, payment processing, a user's social network data used to observe likely repayment patterns, loan assembly for sale to investors with the technology of securitization using their cost advantages in needed tech as in all financial services business models.

1.6. Regulatory Challenges and Opportunities

Financial services are often told that they will face a race to the bottom in some aspect of their business. And once this competition is underway, regulators will find it more and more difficult to continue to mandate that they have more capital, use better credit technology, or provide services to a wider constituency. In other words, some elements of financial services will be completely deregulated. In their place will be new regulations that will play a different function, but may be much less parametric than the current rules.
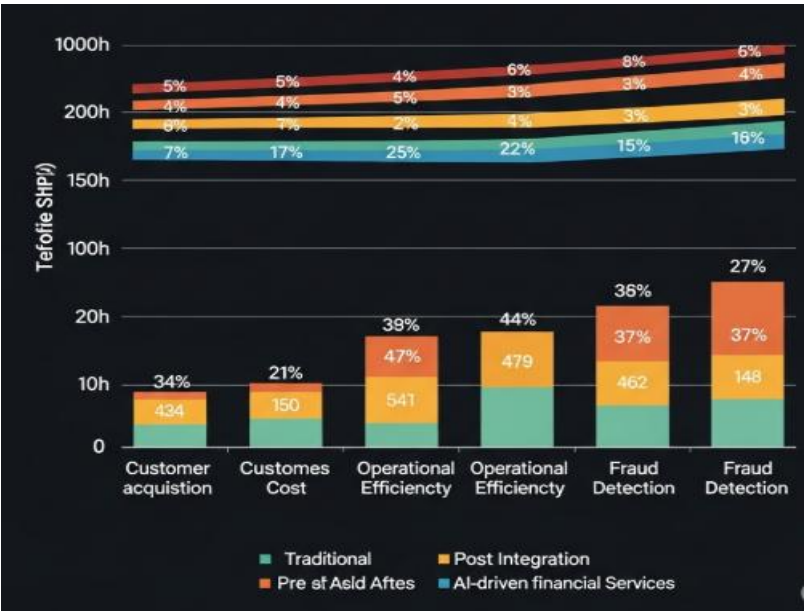

Fig : Understanding the Structural Shifts in Financial Services Brought by the Integration of AI and Digital Infrastructure.

It is, in theory, possible that unregulated entities create a systemically regulated banking system that pushes down everyone's profits. The newly created banking system will choose to compete only on price. Because these institutions do not have a deposit franchise that protects them. They will therefore abandon assets that are otherwise integral to the business strategy of traditional banks. For this reason, they will manage their liabilities more heavily and decide to set up strict liquidity constraints on certain assets. Especially given the large deposit base that banks usually provide for systematic players. In this context, it is crucial to think of the design of collateral in a way that protects the system at large.

1.6.1. Current Regulatory Landscape

The financial services industry has long been one of the most heavily regulated sectors of the economy, as it plays a fundamental role in the effective operation of the economy. In addition to the myriad effects that its services have on demand, money supply determination, investment, and economic growth, the financial services sector is also critical in affecting systemic risk. In tutoring these effects, the financial services sector is also considered to have a negative externality associated with its operation. This negative externality is simply the cost incurred in providing a financial safety net for the industry. Years of excessive risk-taking in the financial sector resulted in the systemic risk incurred by the industry having precipitated perhaps the deepest and longest-lasting depression in the history of finance, The Great Recession. In addressing the need to protect against systemic risk in the industry, regulators adopted a variety of policies and formal rules that were intended to reduce the downside risk incurred in ensuring availability of a financial safety net.

In well-ordered free economies, rules and guidelines are enacted to define compliance for firms and individuals engaged in behaviours that are amenable to regulation because of the public good nature of the effects incurred in their operations. The financial services industry is disciplined by long-standing government behaviours designed to protect consumers and ensure stability, thus minimizing the likelihood of a financial crisis. Traditionally, federal and state agencies oversee and monitor risk taken by financial institutions, seeking to reduce the likelihood of an adverse outcome that would harm the economy. In addition to mitigating occurrences of systemic risk, regulators often determine the structure of the industry by stipulating which entities or branches are permitted or encouraged to provide services that complement or substitute for one another.

1.6.2. Future Directions for Regulation

What we need is a regulatory framework that also helps signal our global leadership. The flow of people and ideas cannot be matched by data or money alone. We believe policymakers can play a key role in driving our international competitive position as a digital economy. To be at the forefront of the present convergence of finance and technology, governments will need to consider new, extend existing or remove some – and be bold about it.

The key question is how granular we should regulate firms – or entire business lines – that present systemic risk across all sectors of the economy. In traditional sectors, the government acts as the final arbiter of trust and allocates consumer protection as a monopoly administrative function. For new, disrupted sectors without a monopoly legal function, governments cannot be omniscient. By controlling and empowering autonomous data governance, encryption, identification and valuation solutions to the proof of trust in digital infrastructure, self-sovereign monetary and financial transactions, protection of personal sovereignty becomes a constitutional function of the digital economy. Any attempt by third parties to register, transfer or access unique identifiers of property – whether real or digital, tangible or intangible – without going through a trusted intermediary of the rightful owner in accordance with legally established rules, will be considered fraudulent activity. Public and private analogue and digital infrastructure will thus share the same principles of digital property. All transactions will therefore have legal recognition provided the rightful identifiable owner has issued his or her consent. This structured, decentralized process can be steered either continuously or on demand. It will only require the establishment of the rules of the shared digital economy on the one hand and the necessary market infrastructure on the other.

1.7. Conclusion

Challenges are opportunities in disguise and, in the age of AI, infrastructure, security, risk, compliance, services scaling, and knowledge transfer are the core problems that Financial Services need to overcome. The digital revolution aggregates diverse services and simplifies people's life in increasingly vertical and specific areas. The users of these digital services demand, abstractly, to have at hand an infrastructure that provides safety, knowledge, and transparency. The digital infrastructure is the heart of this aggregation, the motherboard on which financial services applications, essentially banking, insurance, and investments operating depending on the type of risk, are connected. The financial services smartly made available through the infrastructure, like free and paid apps on smartphones, are the final users' work tools: fungible and devastatingly influential on global savings, allocation of resources, stability of the economies. This report pointed out some critical areas of intervention that may help define the digital infrastructure that

Financial Services need to sustainably serve their customers. The costs for AML, KYC, fraud prevention, and customer engagement currently undertaken, in terms of money, energy, and time are unsustainable. The integration of AI systems to digitize knowledge and increase the ecosystem's learning ability will drop the related costs. Scale virtuous logics controlling frauds will allow the services to become unitary and variable-cost, not fixed, with many financial services operating at breakeven and a few that absorb the totality of the cumulative risk dismissing the cost of equity. The will to push towards the tokenization of reality and a shared registry of economic exchanges has in CBDC penned by Central Banks a promising point of coordination for favorable scaling. The clear rules on crypto – important for new developments in Fintech – sanctioned by regulation and implemented by supervision will allow the services to develop their full potential and allow economies to run better.

1.7.1. Future Trends

Continuing the AI Revolution in Financial Services: Overcoming Legacy Architecture: Many banks and financial institutions will soon find themselves hard-pressed to adapt to a modern information architecture that enables rapid decision-making, culturally embedded responsibility, agile responses to change, and conformance with consumer protection regulations. Digital-free DNA is impossible to remove, and these institutions will continue to struggle unless they are willing to change their data architecture and migrate to new cloud platforms that support microservices connected with containerized APIs. The Value of Partnership: For those institutions that are unable to remake the core of their businesses in an automated, flexible, and rapid fashion, it is quite possible that the best path forward will be to form partnerships with hyper-specialized fintechs to perform operations at increasingly specialized domains at lower cost and with fewer errors – as long as the banks are willing to make the necessary investments in data architecture and cloud computing that allows for rapid implementation of these niche services. Incremental adoption will not be sufficient; banks must be willing to realign major swathes of their businesses to specialize in selected capabilities and partner around the others. Revolutionizing the Middle and Back Office Too: As banks and financial institutions re-engineer the front office for a new customer-centric model, it is likely that the existing players will share the disruption with companies that specialize in the middle and back office. By providing specialized services that have been powered up with AI-dedicated capabilities, such as requiring fewer merchant bankers and back-office personnel to perform duplicated, rules-based processing, institutions will be able to lower the costs of service without opening up their client-facing businesses to competitors but still be able to reap most of the rewards from the newfound efficiencies.

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