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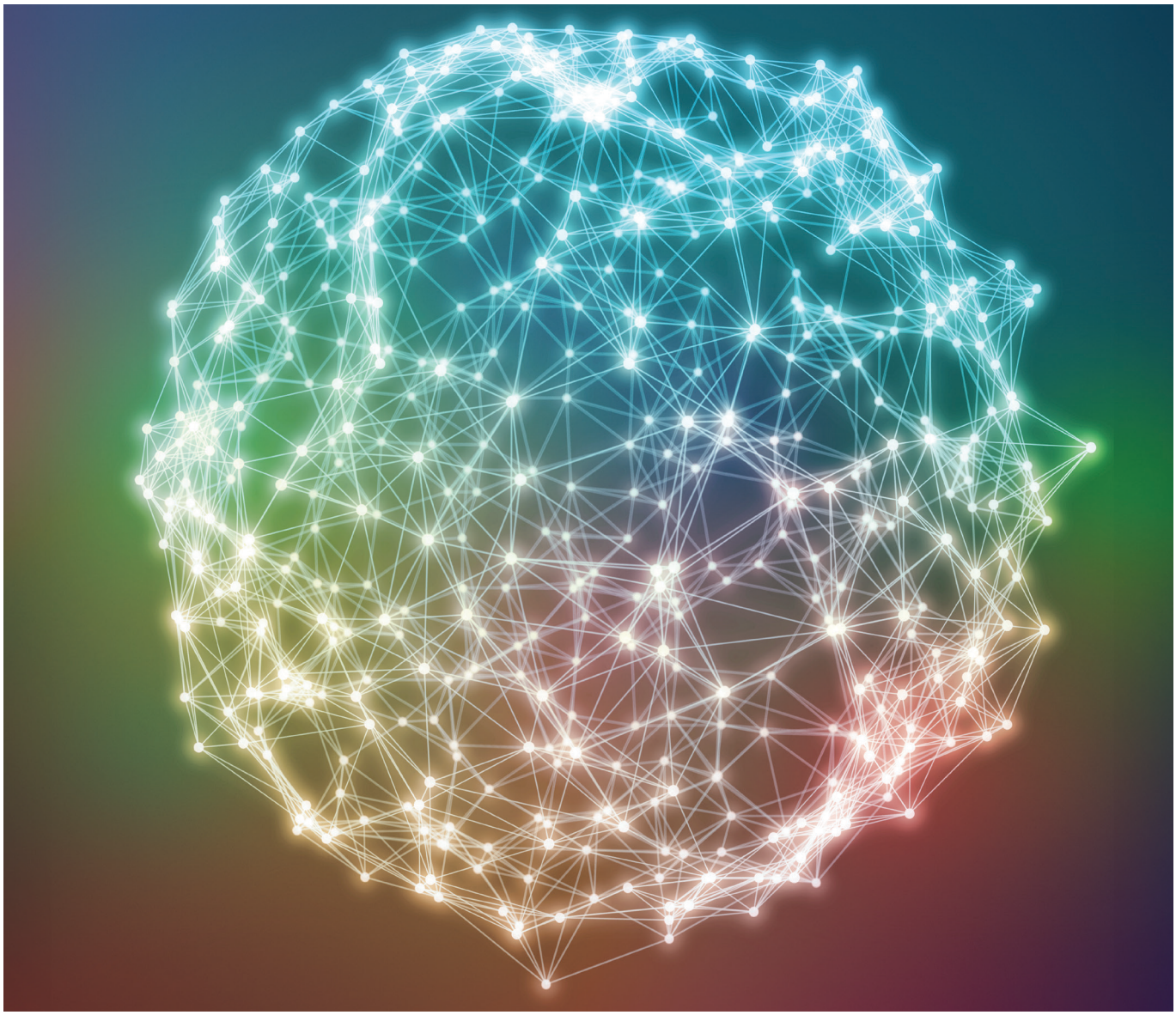
Technology and Innovation in Global Capital Markets

Current trends in technology and innovation and their impact on the 'Investment Bank of the Future'

March 2019



Global Financial Markets Association
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Foreword

The Global Financial Markets Association (GFMA) and PwC are pleased to publish "*Technology and Innovation in Global Capital Markets*." This report comes at a time when the industry continues to face a challenging economic environment, is adapting to post-crisis regulatory parameters, and client expectations continue to rise. Trends in new technologies and innovation not only offer an opportunity to address these challenges but also raise a threat of disruption.

In producing this report, GFMA, working with its members and supported by PwC, has set out to examine the key global trends in innovation and new technologies for investment banks over the next five years, as well as the opportunities for the future.

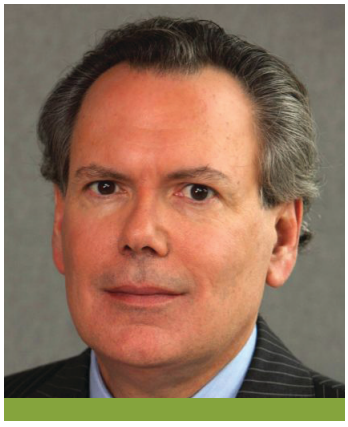
This report builds on the Association for Financial Markets in Europe (AFME) report published in 2018, to now include perspectives from the US Securities Industry and Financial Markets Association (SIFMA), and from the Asia Securities Industry and Financial Markets Association (ASIFMA). The global findings are provided throughout the report.

New technologies will drive changes across bank functions, the workforce, and industry partnerships. Success will depend on the ability to achieve the long-term benefits from new technologies by prioritising investment, collaborating where possible, building a culture of innovation and developing the skills needed; all while managing the potential risks these may introduce for resilience and cybersecurity.

Policymakers and regulators will have a key role to play in building awareness and supporting the adoption of new technologies, for example through regulatory sandboxes. This role and approach will be important for ensuring that future regulatory frameworks maintain a balance between innovation, competition, fair and consistent regulation, and financial stability.

We hope that this report can support the industry – investment banks, investors, market infrastructures, policymakers, regulators, and third-party providers – in realising the future potential from new technologies.

We wish to thank the subject matter experts from the GFMA's working groups as well as the AFME Technology and Operations Committee for their efforts in contributing to this report.



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Technology and Innovation in Global Capital Markets

Current trends in technology and innovation and their impact on the 'Investment Bank of the Future'

Executive Summary

This report examines key trends in capital markets investment bank technology and innovation over the next five years, along with the opportunities and implications that these present.

Investment banks ('banks') continue to face significant challenges in the current operating environment. These challenges are becoming increasingly pronounced as the wider industry becomes more interconnected and digital. Banks must invest in new ways to mitigate these challenges and take advantage of opportunities in this developing environment.

These challenges include:

- increasing regulatory requirements;
- ongoing pressure on returns;
- the cost of maintaining complex and legacy technology platforms;
- the emergence of new technologies and offerings;
- evolving client expectations; and
- intensifying competition for talent.

Through our survey and in-person interviews with representative AFME, ASIFMA and SIFMA member banks, coupled with subject matter expertise from PwC, four key findings have been identified which we believe will be of vital consideration. These are:

- **Technology is one of the most powerful levers banks have to address current industry challenges and deliver future opportunities**
  - 90% of respondents in our survey rated the potential for new technologies to reduce current operating costs and inefficiency as the primary business driver for their adoption.
  - Beyond this, new technologies will enable banks to: enhance client service and offerings; drive productivity, increase collaboration and partnerships; and open-up new ways of operating.
  - While there is a clear appetite to develop new technologies, only 26% of respondents felt that the current investment allocated to this strategic change was sufficient.
  - The potential for disruption in capital markets from new technologies and market entrants is anticipated to be less than in other sectors, such as retail banking or insurance. This is primarily due to high barriers to entry, such as capital and regulatory requirements.
  - Nevertheless, new technologies may enable third-party providers to pose a challenge to banks' core offerings if banks do not keep pace with innovation.
  - Banks which place new technologies and innovation at the centre of their long-term strategy, and embed it across all functional areas, will be best placed to realise maximum benefit.

- **Four technologies have the potential to transform banks and the industry: Data & Analytics, Cloud Computing, Artificial Intelligence (AI) and Distributed Ledger Technology (DLT)**

  - The survey identified areas of the bank value-chain which are expected to be positively impacted by the technologies identified, with a high impact expected from Data & Analytics and AI on Sales and Trading, and DLT on Post Trade.

  - 84% of survey respondents expected banks to have significantly advanced Data & Analytics capabilities embedded in five years' time. These capabilities, alongside increased Cloud Computing adoption, were highlighted as the enabler for further technologies and operations developments.

  - Banks are currently at varying levels of maturity for each of the four technologies identified, ranging from a general awareness through to mature and embedded 'business as usual' solutions.

  - Data & Analytics (the control, management and generation of insights from data) is a priority, given the increasing regulatory oversight of data usage, and its central role in delivering the technologies we have identified.

  - Significant implementation of DLT is a longer-term priority (5 years+) for banks. This reflects the complexity of moving from current use cases to larger, industry-wide interoperable platforms based on common standards, and remaining uncertainty on the longer-term adoption of DLT solutions in capital markets.

  - Robotic Process Automation (RPA), while not considered a new development, was identified as an additional technology that is expected to receive significant investment in the short to medium-term.

- **New technologies and a focus on innovation will require the banks of the future to be increasingly automated, data-led, open and agile. Business models are expected to be relationship-based, with banks connected into a wider pool of technology and service providers**

  - 96% of survey respondents agreed that successful banks of the future will be those that are more flexible and agile to change and innovation.

  - Banks are increasingly expected to become product and service 'aggregators', retaining the interface with clients, but combining their own products and services with those of other market participants.

  - 82% of survey respondents believed that business and IT roles and expertise will continue to merge, and key skills required by banks in the future will be relationship-based (focused on clients, third-party management and internal collaboration) and technology enabled.

  - The investment banking industry is expected to be more interconnected, with some banks playing a greater 'service provider' role than others. Banks are likely to partner with FinTech firms to optimise discrete parts of their existing functions as they focus on service aggregation.

  - Regulatory-focused technologies (focused on monitoring, reporting and compliance, and often called 'RegTech') will become a key element of industry change, with close collaboration between banks, providers and regulators acting as a catalyst for change.

- **We have identified eight principles that banks should adopt into the future to keep pace with technology and innovation, and balance potential new risks and cybersecurity concerns**

  - The eight principles are: maintain a long-term focus; embed data as an enabler; embrace open technologies; adopt a collaborative approach; identify industry priorities; use agile work practices; develop a relationship-based workforce; and enable secure and resilient operations.

  - Given the rate of change, and the need to maintain pace with evolving client expectations and regulatory obligations, banks must maintain a long-term focus and take strategic decisions based on these principles to benefit fully from the opportunities new technologies afford.

  - Banks should continue to adapt their engagement model with FinTech firms to increase collaboration and the ease with which this partnership model can be achieved, with benefits for both sides.

  - To do this, banks should embed an enterprise-wide approach towards innovation that includes attracting and retaining new talent and capabilities and focus on maintaining resilience and effective cybersecurity.

  - The industry as a whole, including supervisors and regulators, will increasingly need to share information and collaborate for the full benefits of new technologies to be realised.

  - Any future regulatory frameworks applicable to new technologies should be applied using a proportionate and principles-based approach. Promoting a level-playing field across the industry will create an open, competitive and sustainable market for technology and innovation, and ensure that potential risks from new technologies or industry participants are managed appropriately.

1. Technology and Innovation in Capital Markets

Introduction

The last ten years have seen new technologies and innovation impact most industries, introducing varying levels of disruption (impacting established technologies, products and services, and business models) and changing the competitive landscape. For example, online media and music streaming services have had a significant and disruptive effect on the entertainment industry, and within financial services there has been an increase in digital, or online-only, retail banking propositions. To a large extent, this evolution of technology has been driven by a huge expansion in the availability of computing power, combined with lower costs. On the one hand, this has allowed existing firms to improve efficiency and reduce overheads, helpful for maintaining a competitive advantage. But at the same time, it has also encouraged new entrants into these industries, who are able to leverage these technologies in new ways.

In terms of technology and innovation disruption within the capital markets industry, the relatively high barriers to entry, such as capital requirements and significant levels of regulatory scrutiny, have to date resulted in a less pronounced impact. Nonetheless, banks are increasingly confronted with the need to engage with new technologies to address long-term industry challenges such as evolving regulatory requirements, persistently low interest rates and ongoing pressure on their returns. In addition, banks face challenges in meeting the evolution of their clients' expectations, and in using technologies to innovate with new products and services.

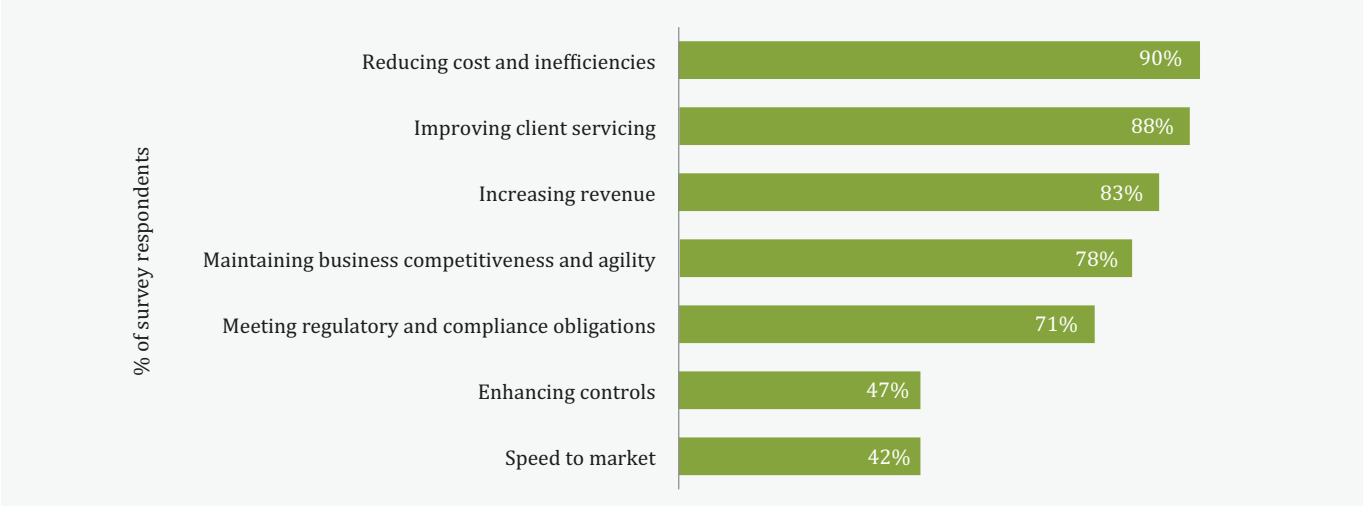
This report examines the key trends in technology and innovation for investment banking which are expected to impact the industry over the next five years, providing a vision for the investment bank of the future and identifying the implications for the industry and for future policy. The report has been developed through a survey of, and interviews with, representative AFME, ASIFMA and SIFMA member banks, coupled with subject matter expertise from PwC.

This first section looks at the drivers for adopting new technologies, the key technologies anticipated in the future and the priorities for investment. While the importance and opportunities of new technologies are recognised, the appetite and ability of banks to lead and invest in the strategic change required is constrained. This in turn creates a level of uncertainty in the overall outcomes and successes that may be realised in the longer-term.

What are the drivers for adopting new technologies?

We asked respondents to our survey to identify the five most important factors driving their bank's adoption of new technologies. 90% of survey respondents selected cost reduction and improving client service as their joint top factor.; however, the overall results and interviews also showed that increasing revenue was an important consideration, as illustrated in Figure 1 below.

Figure 1: **Which factors, in order of importance, are driving the adoption of technology?**



However, one challenge that many banks face is that a large percentage of today's cost is focused on developing and maintaining legacy technology to meet regulatory requirements. This, in turn, impacts the ability to invest in new technology and innovation; a very real conundrum as it is these same new technologies that are believed to offer alternative solutions which could address some of those increased costs. Alongside this, new technologies could also present opportunities for genuine innovation, creating the potential for new revenue streams needed to offset lower returns in traditional products and services.

What are the key technologies for the future?

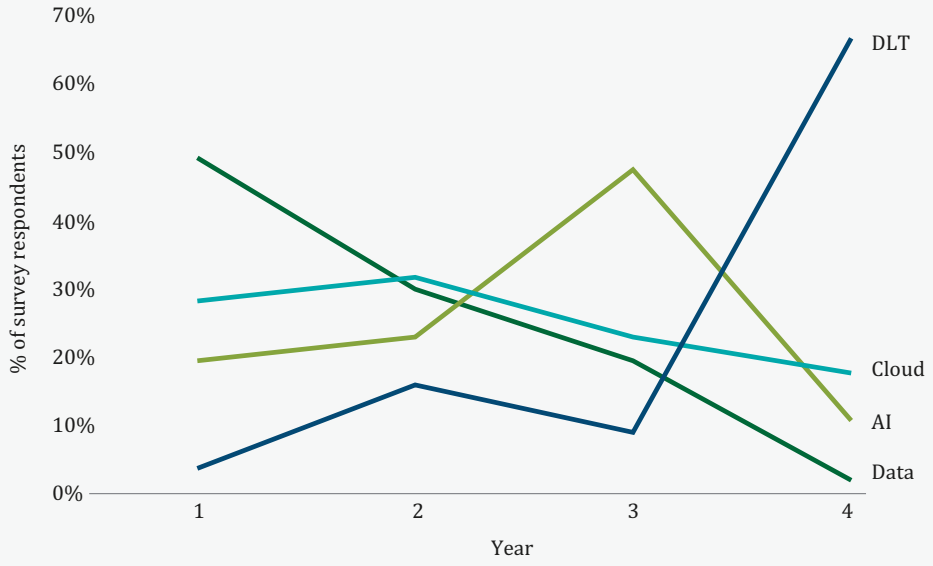
Our survey and interviews identified four technologies that are believed to offer the highest potential in transforming how banks operate. These are:

- **Data & Analytics;**
- **Cloud Computing;**
- **Artificial Intelligence (AI), and;**
- **Distributed Ledger Technologies (DLT).**[1]

Of the four technologies identified, Data & Analytics and Cloud Computing were seen as critical and required to underpin and enable the other identified technology developments of AI and DLT. We therefore consider these two technologies (Data & Analytics and Cloud Computing) as instrumental in enabling future change.

Responses to our survey support this position as illustrated in Figure 2, which shows the relative priority levels of the implementation of each technology. There is a particular short-term focus on Data & Analytics, with Cloud Computing platforms and the use of AI as a medium-term focus. Implementation of DLT is expected to remain a lower priority than the other three technologies in the near-term.

Figure 2: **What are the relative implementation priorities for each technology?**



1 The definition for each technology is provided in Section 2

Exploring the detailed responses on each of these four technologies provided further insights on the above timeline, and each of these is further discussed in this report:

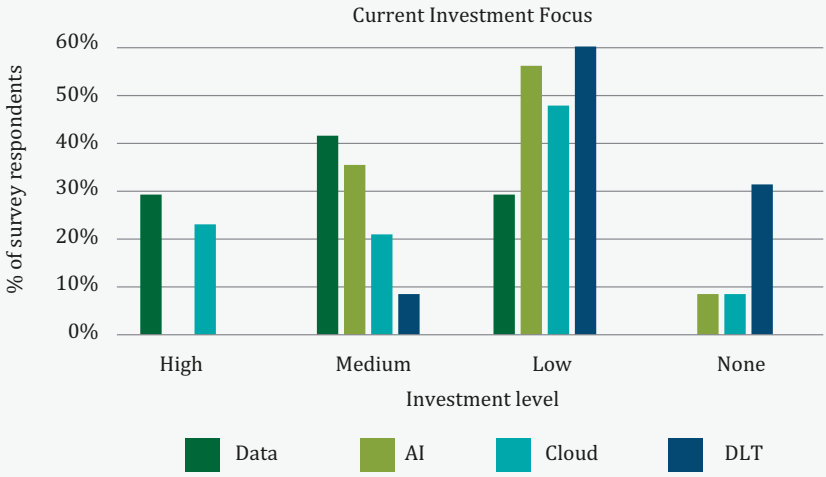
- **Data Management** remains an immediate and short-term priority, due to the ongoing regulatory focus on this topic (for example, the EU General Data Protection Regulation, or 'GDPR', and India's draft Personal Data Protection Bill), and the need to improve existing data capabilities that can support future technology change and innovation;
- **Implementation of AI** will increase over one to three years. However, the benefits will be dependent on the investment and improvements in data management (notably the access and quality of data). By year four, AI is expected to be relatively well embedded, so it will become less of a priority item compared to other technologies;
- **Implementation of Cloud Computing platforms** are expected to remain a priority in the medium and near-term; and
- **Significant implementation of DLT** remains a longer-term priority based on the current complexity of bringing large-scale enterprise and industry solutions to market, as well as integration with legacy systems, and remaining uncertainty on the longer-term adoption of DLT solutions in capital markets.

Robotic Process Automation (RPA)[2], while not considered a new development, was also identified in our research as a technology that is expected to continue to receive significant investment in the short to medium-term. As such we also cover this in our report.

Where is investment being prioritised?

We asked our survey respondents what proportion of their current technology investment was focused on these technologies, shown in Figure 3 below. The results show that most are focused on investing in Data & Analytics, Cloud Computing and AI, which further supports the implementation priorities identified above.

Figure 3: **What proportion of your technology investment is focused on these technologies?**



We also asked how banks would prioritise investment in the next five years to provide more detail on their response show in Figure 3 opposite.

We identified that, whilst Data & Analytics and AI will be less of an implementation focus longer-term (as shown in Figure 2), investment will remain high and is expected to increase due to their importance as enablers for further change and future innovation.

2 The definition for RPA is provided in Section 2

DLT investment is also likely to increase into the longer-term, particularly based on the views of banks in Europe. However, it is seen as less certain due to the viability of future industry-wide use cases and considerations for data privacy and cybersecurity

Cloud Computing, despite its implementation priority remaining relatively consistent over the next four years onwards, is expected to have less uniform investment over this period. While the importance of this technology for building a foundation for future technology change is clear, uncertainty remains on the long-term ease of adoption related to regulatory and security concerns.

Appetite for adoption

However, despite the importance and investment being attributed to these technologies, our survey also identified a mixed view from banks on the approach being taken towards their adoption and likely overall outcome.

As shown in Figure 4, only 14% of survey respondents identified their bank as having an advanced approach towards new technologies adoption. It was found that most banks are adopting a more cautious long-term approach towards innovation, with a view to being 'fast followers' rather than originators or 'early adopters'.

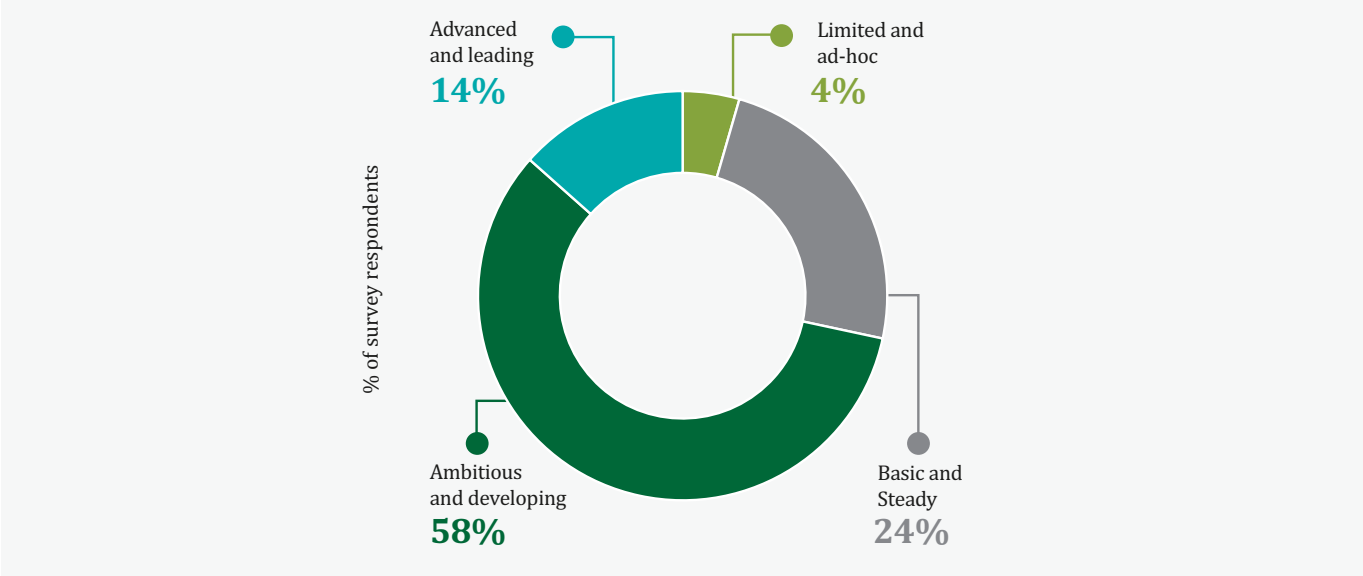
A key reason for this was identified in a follow-up poll to survey participants, where only 26% of respondents believed that their banks current budget for strategic change, such as for new technologies, was sufficient for capitalising on future opportunities. Even for investment banks seen as industry leaders, with large investment budget and senior executive and Board support, a self-funding business case for technology innovation opportunities was still required in most cases.

Therefore, our conclusion would seem to be that there is a recognition of the importance of adopting new technologies which has not yet fully manifested itself into an appetite for wider budgetary prioritisation.

Interviews also helped to identify further key reasons for this mixed view on the long-term strategy and expected success of these new technologies, including: current immaturity and risks associated with some of the technologies; the need for current investment to be directed to remediate or maintain legacy technology platforms; and ongoing regulatory requirements creating a focus on shorter-term mandatory priorities.

In this first section, we have summarised the drivers and prioritisation trends identified in our survey for Data & Analytics, Cloud Computing, Artificial Intelligence and Distributed Ledger Technology. In Section 2 we will discuss each of these four technologies, as well as Robotic Process Automation, providing comment on the current and future state of each, and identifying more detailed opportunities and challenges.

Figure 4: **How would you assess your bank's overall approach to the adoption of these technologies over the next 5+ years?**



2. Four Key Technologies

Through our survey and interviews, we identified the four technologies which are expected to impact how banks operate in the future. In Section 1, we introduced these four technologies (namely Data & Analytics, Cloud Computing, Artificial Intelligence and Distributed Ledger Technology) and how banks are currently prioritising investment.

In this section, we look to provide more insight into each of these four technologies. Specifically, we discuss both the current and future state of each and develop the opportunities and challenges that each brings.

Whilst not a new technology in itself, Robotic Process Automation (RPA) has also been included, as research for this report showed that this technology continues to receive significant investment in the short to medium-term.

Data & Analytics

Data is seen as a key enabler for all future technology change and innovation; however, there are varying levels amongst respondents as to how data is currently being managed and in the approaches being applied to realise its future value.

Data & Analytics encompasses the control and management of data assets, and the generation of insights from those data assets to improve decision making. Core data assets include client data, product data, account data, employee data, transaction data, and position data.[3]

Data & Analytics: Current State

The focus on data in capital markets has increased dramatically in the past ten years, primarily because of new regulations in the wake of the financial crisis, such as the Basel Committee on Banking Supervisions Principles for Effective Risk Data Aggregation and Reporting (BCBS 239), the second Markets in Financial Instruments Directive (MiFID II) and the Market Abuse Regulation (MAR), which require firms to generate, sort and analyse increased quantities of data. Additional example drivers include the General Data Protection Regulation (GDPR) and India's draft Personal Data Protection Bill, which have resulted in increased focus on control and protection of the data held by firms. Compliance with these regulations has required firms to generate, store, monitor and report significantly increased quantities of data on trading, risk and financial activity. This, in turn, has prompted banks to look for opportunities to use the data to enhance client service. The level of investment in data initiatives has grown in line with this, with many banks appointing Chief Data Officers (CDOs) and establishing new data functions to institutionalise management of data.

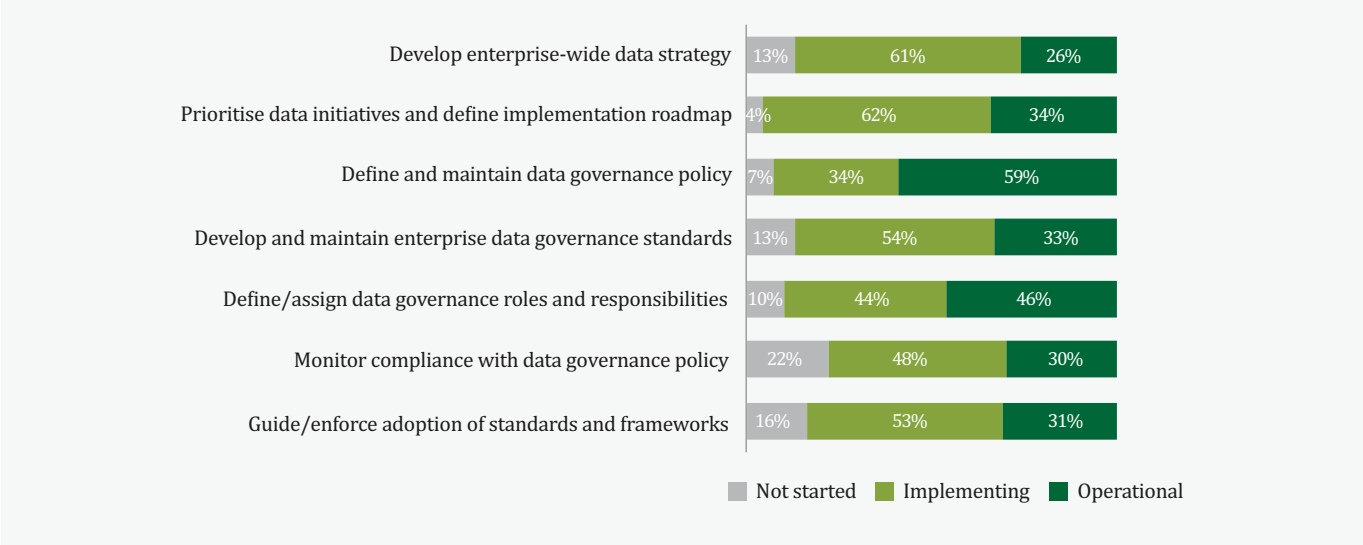
However, the need to establish foundational data capabilities (such as governance, access, and quality) and meet minimum standards to achieve regulatory compliance has forced the industry to prioritise data governance and control ahead of innovation and analytics. While most banks today have defined data policies, governance models, standards and procedures, these have typically been in non-trading functions such as Risk, Finance and Operations.

Figure 5 shows additional supporting PwC research of 74 international financial services firms, which highlights that while 59% have a defined data governance policy in place, only 26% have operationalised an enterprise-wide strategy that covers all aspects of how data capabilities and management need to be considered.

Banks are at differing levels of maturity in terms of their data capabilities, but many still have work to do on fundamental building blocks, such as implementing sources of common reference data. Consequently, it is difficult for banks to realise the significant benefits data management may bring (such as reduced need for reconciliation) as many of the same historical constraints, legacy complexity and IT cost issues, still exist. However, banks recognise that they will become increasingly data and technology driven, and that better data and analytics capabilities will be key enablers to unlocking other technology opportunities, such as artificial intelligence.

3 Definition: PwC

Figure 5: **At what level of maturity are banks data governance and strategy capabilities?**



Source: PwC research

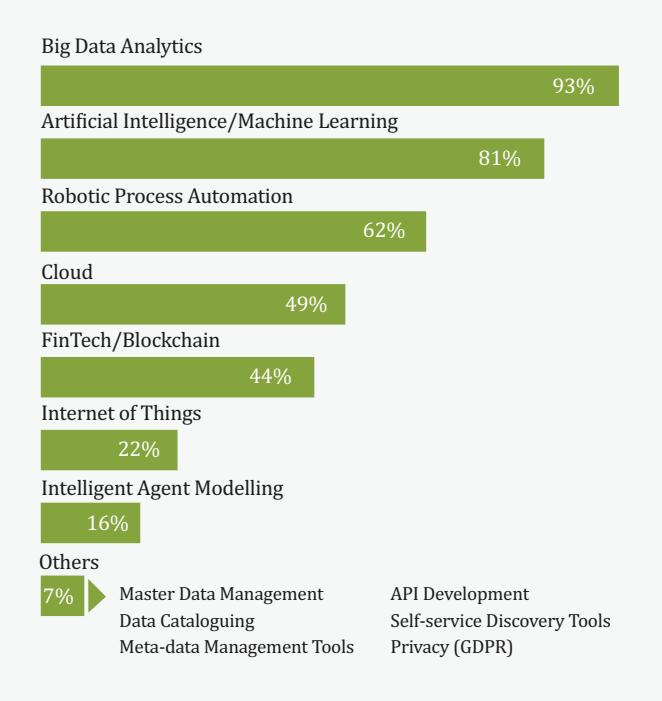
Data & Analytics: Future State, Opportunities and Challenges

As a fundamental building block for a number of other technologies, data is a key part of a bank's future innovation strategy, and it is expected to drive benefits across all functions. Advanced technologies, such as Cloud Computing and AI, will allow banks to process vast quantities of data in real time (or very near real time) and to integrate external and internal structured and unstructured data.

Additional PwC research, shown in Figure 6, also shows how Data & Analytics (and the other technologies discussed in this report) will be critical in helping banks monetise their data in the future.

One of the challenges for banks is how they will both manage and monetise the value of data, and who will be responsible for this within the organisation. Whilst some banks' Chief Digital Officers (CDOs) are responsible for the management of the control and innovation agenda, others have appointed a Chief Information, Data and/or Digital Officer(s), specifically responsible for monetising data assets. Whilst these types of roles will continue to evolve, they will be key to a bank's ability to manage both innovation through data and any associated risks.

Figure 6: **Which technologies will be significantly transformative to how FS firms govern and monetise data?**



Source: PwC research

Cloud Computing

Cloud Computing underpins the ability to implement new technologies and to quickly process large amounts of data; however, there are challenges in moving existing infrastructure to both Public and Private Cloud platforms.

Cloud Computing is considered in three models:[4]

- **Private Cloud:** Applications are run on virtual infrastructure at the bank's designated facilities, or those hosted and managed by a third-party provider. Physical infrastructure costs remain with the bank.
- **Public Cloud:** Applications are hosted on a Cloud provider's infrastructure in their data centres, typically via a pay-as-you-go model.
- **Hybrid Cloud:** A mix of both private and public Cloud approaches are adopted.

Each Cloud model – Private, Public and Hybrid - can provide one or more of the following services:

- **IaaS (Infrastructure-as-a-Service):** Servers and network equipment are provided as an on-demand service to develop and run applications. This allows banks to purchase resources as-needed instead of having to buy hardware outright.
- **PaaS (Platform-as-a-Service):** Software components, such as an operating system or database, are provided on-demand, upon which the banks can deploy their own applications.
- **SaaS (Software-as-a-Service):** Standardised applications are hosted, managed and provided on a subscription basis by a Cloud vendor. These are typically run directly through a web browser and do not require any downloads or installations.

Cloud Computing: Current State

As with Data & Analytics, our survey identified Cloud Computing as an enabler for other innovations and new technologies, increasing a bank's ability to process huge quantities of data quickly. Cloud Computing can generate significant benefits for banks, including reducing fixed costs, simplifying application portfolios, providing technology cost transparency, and allowing quicker time to market for new solutions. These benefits are even more pronounced for public Cloud Computing offerings which have minimal to zero fixed costs and significantly larger scale and flexibility.

Most banks surveyed currently have a private Cloud Computing environment running critical applications, although the number of deployed applications varied considerably. It is seen to be simpler to move from an existing on-premise datacentre to a private Cloud, than to a public Cloud. Private Cloud Computing environments are more easily configured to support most types of application that banks' datacentres currently host, including legacy applications, which may not easily migrate to modern IT infrastructures.

Cloud Computing: Future state, Opportunities and Challenges

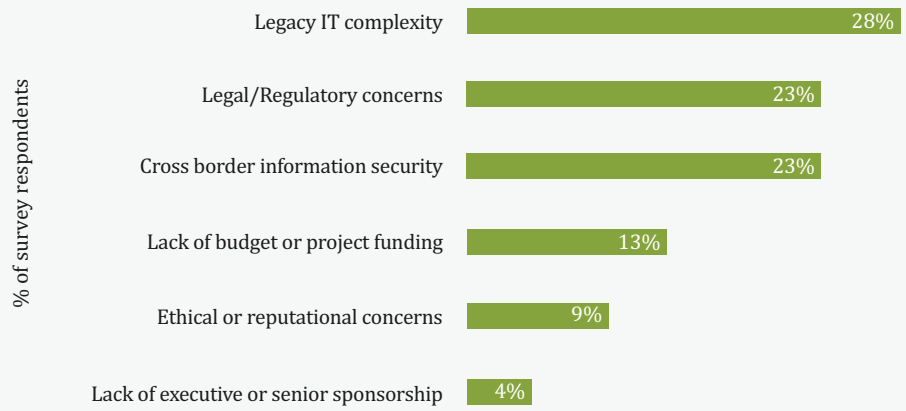
Given the prominent role Cloud Computing could play in delivering other technologies, some banks are looking to evolve to a future state where more critical or core systems are migrated to public Cloud Computing infrastructure. The technology will allow banks to deploy IT infrastructure more quickly (such as computing power and storage) and bring new solutions to market.

Our survey found adoption of Cloud Computing, particularly public Cloud, to be one of the areas of highest divergence for banks; only 24% of survey respondents believed there will be rapid adoption of public Cloud in the next five years. A significant reason for this response was security concerns associated with public Cloud from internal bank stakeholders, and the impact on existing cybersecurity models in place.

4 Definitions: PwC

This is shown in Figure 7, where survey respondents identified several constraints on widespread adoption, including cross-border information security, legacy IT complexity, and legal and regulatory concerns. Interviews also identified further material concerns related to reduced overall control, third party risk management requirements and vendor lock-in and ownership of data and infrastructure.

Figure 7: **What are the main constraints your bank is facing in the adoption of public Cloud solutions?**



There are also specific jurisdictional requirements and limitations on the storage of data in public Cloud Computing infrastructure. One example is data localisation restrictions by public authorities on the geographical location of non-personal data due to security concerns as well as concerns around data access.

A further challenge for migration to Cloud Computing comes from regulatory requirements and policy developments for outsourcing arrangements, such as the US FFIEC TSP guidelines[5], which may inhibit the adoption of Cloud solutions. However, the European Banking Authority (EBA) Guidelines on Outsourcing Arrangements[6], and the MAS outsourcing guidelines[7], are examples of regulation that could help promote the use of Cloud Computing in a secure and controlled manner. The Free Flow of Non-Personal Data (FFNPD) framework for Europe, coming into force in 2019, (complementing personal data managed under the GDPR), is another initiative that aims to increase Cloud Computing adoption and reduce EU jurisdictional constraints.

5 https://ithandbook.ffiec.gov/media/274876/ffiec_itbooklet_supervisionoftechnologyserviceproviders.pdf

6 https://eba.europa.eu/documents/10180/2551996/EBA+revised+Guidelines+on+outsourcing+arrangements

7 http://www.mas.gov.sg/~/media/MAS/Regulations%20and%20Financial%20Stability/Regulatory%20and%20Supervisory%20Framework/Risk%20Management/Outsourcing%20Guidelines_Jul%202016%20revised%20on%205%20Oct%202018.pdf

Artificial Intelligence (AI)

Artificial Intelligence (AI) is expected to develop rapidly across multiple functions performed by banks. Its success will be dependent on the quality of data and the ability to understand, or explain, how outcomes are realised.

AI is an umbrella term for a number of algorithms and technologies that allow machines to simulate human intelligence by learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions) and self-correction.[8]

AI: Current State

Artificial intelligence (AI) is considered a cutting-edge technology within financial services but is based on techniques that have been developed over many decades and are already widely used in other, non-financial industries. It is the availability of increased computing power to run intensive AI algorithms, in addition to the greater breadth and depth of data now available to banks, which has increased the potential of these technologies.

There have also been major supporting developments in AI over recent years. For example, programming capabilities and tools for machine learning[9] have become more openly available, and there has also been a rapid acceleration of advanced techniques (such as complex mathematical methods termed "deep learning") through the release of new open-source software.

As the development of AI applications allows banks to perform tasks that would otherwise be too complex, slow or labour-intensive (including existing activities), there has been increased momentum in applying AI in new ways. For example, banks' Trading & Sales functions are developing AI applications for trading, moving away from predictive analysis (i.e. what is likely to happen) to prescriptive analysis (i.e. recommending one or more courses of action and showing the likely outcome of each decision). This is improving banks' ability to anticipate and respond to emerging trends in the market. There is also increasing use of AI in some control functions, e.g. Compliance, to spot patterns of abnormal behaviour to detect market abuse. Beyond these areas, most AI investment is currently focused on pilots and prototypes in localised functions.

AI: Future State, Opportunities and Challenges

There are increasing opportunities for banks and technology providers to use AI to reduce costs, mitigate risks and optimise decision making. Our survey identified that AI will come to be considered 'business as usual', through the increased deployment of AI in production environments across multiple functions, predominantly in trading and risk. Almost two-thirds of survey respondents believed that AI will be increasingly embedded in banks within five years' time, targeting capabilities such as:

- Natural language processing (NLP), such as speech recognition, along with Natural language generation (NLG);
- Optical character recognition (OCR), such as the ability to read unstructured (e.g. handwritten) documents; and
- Trading risk analytics, and social networks analysis.

In addition, it is likely that the supervisory arms of regulators will begin to use AI technology to monitor and process data from market participants, allowing greater oversight and assessment of market trends and risks. This has the potential to allow regulators to react more quickly to market developments, and design regulation based on highly accurate market assessments.

8 Definitions: PwC

9 Definition: PwC: Machine Learning (ML) as an application of AI that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed and is typically sub-divided into three categories: supervised, unsupervised, and reinforcement learning.

However, it is important to ensure that the development of AI applications fits within current regulatory and control frameworks. Banks' AI applications are still largely comprised of algorithms and processing continues to require significant human configuration and oversight. As AI solutions continue to evolve, banks will need to ensure that their AI applications maintain levels of transparency and 'explainability' of decisions in order to evidence that they are continuing to fulfil regulatory obligations such as suitability and appropriateness or treating clients fairly. AI applications are reliant on good quality data, so banks must also continue to review and update internal data policies to address inaccuracies or bias in input data and to review the output of applications, with human intervention where necessary.

The increased adoption of AI will also necessitate further discussion and evaluation of the responsible and ethical deployment of the technology, and of the use and ownership of data for firms and individuals. Policymakers will play an important role in supporting this debate, noting that the European Commission appointed a High-Level Expert Group on AI[10] in Q2 2018, and have released draft ethics guidelines for AI as part of its mandate[11]. Another example is the Monetary Authority of Singapore FEAT principles[12], which are aimed at promoting fairness, ethics, accountability and transparency (FEAT) in the use of Artificial Intelligence and Data Analytics in Financial Services.

Distributed Ledger Technology (DLT)

There is widespread research and specific live proofs of concept of DLT being used in banking, and extensive future use cases. However large scale or industry-wide use is still seen as a long-term (5 year+) and ambitious objective.

Distributed Ledger Technology (DLT) combines database technology and cryptography where multiple participants each keep their own (distributed) copy of, and can update, records in a shared dataset. All copies remain consistent through computerised consensus mechanisms rather than through a trusted third party. Some of the most well-known DLTs are blockchains.[13]

DLT: Current State

Our report identified that all surveyed banks have some form of research, experimentation or live proof of concept underway into Distributed Ledger Technology (DLT)[14]. However, most respondents believed the current investment into DLT research and initiatives was limited, and largely allocated to specific proofs of concept rather than larger firm or industry-wide uses. 72% of surveyed banks were seen to be in a 'wait and see' phase (building awareness and understanding the business case), while 17% have implemented small-scale live solutions, such as in the areas of trade finance and exchange settlement.

While nearly half of banks surveyed believed that this technology will have the largest beneficial impact in trade processing and client support activities, the list of potential uses given was extensive, for example from processing corporate actions to automating contractual agreements.

10 https://ec.europa.eu/digital-single-market/en/high-level-group-artificial-intelligence

11 Artificial intelligence: Commission outlines a European approach to boost investment and set ethical guidelines, European Commission, (https://ec.europa.eu/digital-single-market/en/news/draft-ethics-guidelines-trustworthy-ai)

12 http://www.mas.gov.sg/News-and-Publications/Media-Releases/2018/MAS-introduces-new-FEAT-Principles-to-promote-responsible-use-of-AI-and-data-analytics.aspx

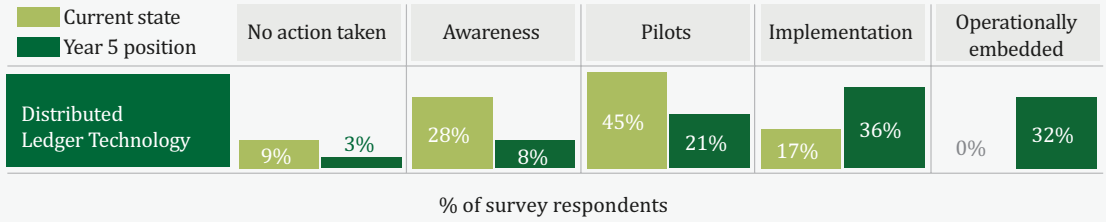
13 Definitions: PwC

14 https://www.coindesk.com/ubs-backed-blockchain-platform-completes-live-trade-transactions

DLT: Future State, Opportunities and Challenges

DLT has the potential to become an integral part of all banks' technology and operational infrastructure, as illustrated in Figure 8 below. Survey participants considered an evolution in DLT awareness through to implementation across the five-year horizon. However, a quarter of banks surveyed believe that DLT will become a lower priority for investment in 5 years' time.

Figure 8: **What is your current and 5-year target maturity level for DLT?**



Both individual banks and consortiums will continue to collaborate and enhance DLT and our survey identified that, in the next 5 years, open source projects will make significant traction in both the sophistication and future readiness of DLT. For example, projects such as the Enterprise Ethereum Alliance and Hyperledger have significant support from hundreds of major firms including banks included in our survey, as well as major technology and advisory firms. Another key example is the R3 consortium which includes over 100 banks working to develop the Corda DLT platform.

Where Distributed Ledger systems can be deployed across the industry, rather than just internal to a specific bank, they offer an opportunity to further automate processes between industry participants and deliver cost savings across the value-chain. For example, DLT may be used to transfer common trade data between all participants so that Straight-Through Processing (i.e. requiring no human intervention) can be fully achieved between firms end-to-end. Another potential benefit could be in regulatory reporting, where the representation of trades using harmonised data and definitions would be a significant step forward to reduce the mapping and interpretation that is required today.

However, challenges exist in the wider network adoption of DLT, notably current limitations in the latency and scalability of the underlying technology to deliver industry-wide solutions. There is also a need for wider industry collaboration and agreement on common standards, for example, a common trade representation and harmonised definitions. The lack of traction in developing industry standards has led many banks to focus on smaller partnerships, focused on specific issues. This is unlikely to be beneficial for the industry in the long term if many different standards emerge.

Further challenges arise in integrating the technology with existing processes and systems. There is a risk that the approach to how DLT is developed may reinforce existing systems and complexity, rather than create greater simplification. Similarly, a large number of bank-specific DLT solutions could further increase technology and operational fragmentation within the industry, illustrating the need for interoperable solutions. Cybersecurity concerns for DLT, such as potential vulnerabilities in key management and access to systems, are also cited as a challenge.

As with Cloud Computing, there is also the need for DLT to overcome security concerns as the technology matures. Current security concerns include the risks associated with attempts to manipulate a ledger, and to introduce fraudulent data, and with cyber-attacks threatening the integrity and availability of a platform.

A small number of banks are expected to lead the combined DLT and crypto-asset related change across the industry in the next five years. This may bring new business opportunities for these banks in the fields of trading, market-making, and underwriting; however, this may also be impacted by any future regulation. Long term however, survey respondents were cautious regarding the expectations and level of adoption of crypto-assets over the next five years, with 32% believing there will be no viable use in the long-term.

Robotic Process Automation (RPA)

RPA continues to be used extensively for tactical remediation and remains relatively cost-effective. It has potential as a future technology to extend into more strategic process efficiency improvement initiatives.

Robotic Process Automation (RPA) refers to software that can be programmed to replicate human operational tasks. RPA is primarily used to minimise repetitive and repeatable tasks. [15]

RPA: Current State

There has been significant investment in the use of RPA as a solution to remediate existing fragmentation in banks' technology architectures and operations processes. This fragmentation and resulting complexity has developed in banks over many years, as new systems were bolted on to existing architecture, or due to processes developing without standards. This has created today's significant requirement for manual processing, copying and reconciling of data between systems and firms. Replacing repetitive forms of manual intervention through RPA helps to reduce operational risk and costs, identified in our survey as a key driver for the continued adoption of the technology.

Most banks are using RPA to address the symptoms of existing constraints, but not the root causes or underlying fragmentation.[16] This requires the perception of RPA initiatives to move beyond being seen as "sticking plaster" solutions to a broader foundational technology capability for the bank. However, our survey also identified that a small number of banks are also developing RPA as an opportunity for broader process optimisation and improvement.

RPA is relatively quick to deploy, even in to production environments, meaning benefits can be realised in the short term. Our survey identified that most banks have mature RPA solutions in place to remediate manual processing, particularly across post-trade functions. RPA can also provide oversight features, such as the ability to monitor for potential bottlenecks in banks' systems and generate real-time data on how processes are handled which allows for more effective supervision and control.

RPA: Future State, Opportunities and Challenges

In the next five years, our survey suggests that RPA will further extend beyond implementations for the short-term remediation of existing fragmented technology architecture or operational processes, and instead drive more efficient processes. This will see the deployment of the technology in more intelligent and innovative ways (for example using RPA and AI in the same application), creating further opportunity to automate and reengineer much larger processes and workflows with increased operational efficiency.

However, similar to the introduction of other technologies which change processes and therefore behaviour, increased use of RPA means that institutional knowledge of existing processes is likely to decrease over time. Banks must continue to have contingency plans in place and maintain a knowledge base of those processes that have been subject to automation, as part of their operational resilience planning.

Shaping the Investment Bank of the Future

Within this Section, we have described the current state and potential future deployment of four key technological developments: Data & Analytics, Cloud Computing, Artificial Intelligence and Distributed Ledger Technology, as well as Robotic Process Automation. Having considered the opportunities and challenges these technologies present, we will now consider new barriers impacting on this change.

15 Definition: PwC

16 https://www.sifma.org/resources/research/sifma-insights-rpa-not-your-science-fiction-movie-robots/

3. New Barriers to Change

The implementation of the new technologies we have discussed (Data & Analytics, Cloud Computing, Artificial Intelligence and Distributed Ledger Technology) will be dependent on the industry's ability to address several emerging barriers to change.

Traditional impediments to business transformation, such as budgetary conflicts and decommissioning legacy IT systems, have existed over many years and will remain important to address. However, banks must now consider new barriers, such as how to create a culture for innovation and how to maintain resilience against increasing cyber threats. These will be critical in determining the successful implementation of these four technologies. We also believe that the supervisory community has a role to play, promoting and encouraging innovation and collaboration.

We provide further insight into some of these new barriers within this section, namely the promotion of an innovation culture, cyber and resiliency as well as policy and regulatory collaboration.

Promoting innovation

As noted in Section 1, banks are under increasing pressure to leverage technology to address cost challenges and inefficiencies and to improve client servicing. Even where technological solutions are bought in, rather than developed in-house, banks are still required to innovate to work differently. 97% of our survey respondents agreed that successful banks of the future will need to be flexible and agile to change and innovation.

Our survey identified that banks have applied a range of approaches in promoting, managing and governing innovation. These are on a range between two distinct approaches:

- **A centralised approach**: Innovation is managed from the centre with limited responsibility held within functions or lines of business. This approach pushes the management of innovation higher up within the bank, increasing the chance of ongoing sponsorship and funding.

- **A decentralised approach**: Innovation is managed by individual functions or lines of business, with a less pronounced overall bank-wide strategy or governance structure. This bottom-up approach keeps innovation more closely aligned to day-to-day business needs.

While the exact approach varies by bank, our research found that applying a combination of both approaches (aspects of both a centralised and decentralised approach) appears more successful. This allows for oversight and control from the centre (centralised approach), with freedom for individual functions to determine where to invest to realise the greatest value from new technologies (decentralised approach).

Summarising findings from interviews for this report, three complementary aspects applicable to all innovation approaches were highlighted which may increase the success rate of technology innovation within banks. These were:

- **Establish innovation pathways and funding:**

  - A central innovation fund is used to encourage new ideas and ways of thinking, through 6-12-month pilots. The fund, supported by a dedicated resource group, reports directly to the Board to embed a long-term mandate to innovation, outside of existing technology functions and delivery frameworks.

  - Clear pathways and guidelines for individuals to drive innovative ideas are established. This creates a culture that gives 'permission to innovate' and allocates appropriate time to generating new ideas.

- **Support training and information sharing:**

  - Educating the wider bank on the technology available to help functions develop tools, which they can implement locally. For example, setting up a Centre of Excellence (CoE) for training trading and sales functions to replace traditional spreadsheets with advanced analytics solutions.

  - This can also help to share knowledge and build engagement across different functions on the opportunities and recent developments in new technologies (both internal to the bank and external in the industry).

- **Focus on specific and practical use-cases:**

  - Innovation should focus on specific uses, where an expected business value and return on investment can be determined, and where returns can be realised in relatively short timescales (noting that both short and long-term opportunities must be prioritised accordingly).

  - Banks should also focus on ensuring a clear pathway from the pilot stage to production at scale and associated realisation of benefits.

  - Given that banks will continue to rely on existing core and legacy platforms for the foreseeable future, new technologies need to complement and work alongside these systems. Making sure that existing platforms can connect to new technologies and systems through common Application Programming Interfaces (API) is preferable. This will help banks avoid building tomorrow's legacy systems and ensure investment in technology innovation is sustainable and future-proofed.

Prioritising security and resilience

New technology, innovation and the shift towards greater connectivity potentially introduces new sources of risk such as cyber-crime and the need to further protect a bank's digital assets. Balancing new technology, security and operational resilience will be a key priority in demonstrating the suitability of future technology change to both internal and external stakeholders.

In particular, we expect that there will be a continued expansion of regulation concerning operational resilience; consequently, this will become an even greater priority for Boards and senior management of banks. Wider adoption of new technologies will need to be supported by operational resilience teams, working closely with stakeholders to enable a safe and proactive response to future business needs and to meet regulatory requirements.

While it is inevitable that future incidents will occur, they can be avoided by a continued development of frameworks for managing resilience risks and cybersecurity. Comprehensive risk assessments will be required to inform decisions on innovation and investments in the context of critical economic functions and potential client impact.

The growing Cyber threat and its impact

The annual cost to the global economy of cyber-crime for all industries continues to increase. In 2014, it was estimated at approximately $400 billion[17] (including direct losses such as the theft of financial assets and indirect costs such as reputational damage). Gross written premiums for cyber insurance, which totalled $2.5 billion in 2014, are expected to exceed $7.5 billion by 2020[18]. The heightened threat to banks of cyber-crime, given the adoption of new technologies and the increasing interconnectedness of firms, has further contributed to the focus on operational resilience.

From interviews for this report it was highlighted that cybersecurity is a primary concern for banks when adopting new technologies. Key areas identified include: the adoption of public Cloud; the development of DLT; and increased reliance on third parties (e.g. via outsourcing), such as technology providers or FinTech firms.

17 Net losses: Estimating the Global Cost of Cybercrime, CSIS (https://www.csis.org/events/2014-mcafee-report-global-cost-cybercrime)

18 Net losses: Estimating the Global Cost of Cybercrime, CSIS (https://www.csis.org/events/2014-mcafee-report-global-cost-cybercrime)

Growing cyber threats and levels of scrutiny on resilience create two challenges for bank-led innovation:

- **Internal stakeholders:** Functions such as Risk, Legal, Compliance and Audit may place overly restrictive constraints on technology development efforts due to perceived risks and concerns in areas such as information security and cybersecurity risk; and

- **External authorities**: Regulators may restrict how new technologies may be designed and implemented due to more circumspect approaches to innovation or shortages in technical expertise. They may also develop frameworks which could constrain innovation or are not harmonised across jurisdictions.

Banks have complex legacy IT infrastructures that can exacerbate cybersecurity risks and are increasingly costly to maintain and secure. However, rather than increasing the risk, innovative technologies could help solve some of these challenges, by enabling organisations to re-configure their technology with security and resilience in mind.

Balancing security and innovation

There is increasing recognition in the industry that emerging resilience risks, such as cybersecurity, require a more robust approach to controls that go beyond demonstrating that they are simply 'good enough'. The future technological and operational choices made by firms will need to be designed with resilience in mind and will need to consider cases where risks could increase and create significant disruption. This includes how firms would manage recovery from such situations.

Large third-party providers and technology firms have already invested significantly in data security and privacy and will continue to do so. This is at the forefront of their investment due to the scale and risks of cybersecurity, and to demonstrate resilience and compatibility to their clients, such as banks. Where banks are using third-party providers, they must ensure robust governance, such as additional contractual and data security requirements.

Banks also need to continue to design and implement technology solutions that ensure they can retain adequate control of their processes and information. However, this must not place unnecessary constraints on the adoption and expansion of new technologies or inhibit banks' ability to make strategic decisions about where to apply new technology and focus on innovation.

Regulation that is outcome-based, rather than prescriptive, will support this aim of balancing security and innovation. For example, regulation for protecting personal data could specify an individual's right to their personal information as the key outcome required from a firm's data policy and define the parameters in which the personal data can be used with data owners' consent. The 2017 EU Cybersecurity Legislative package, placing cybersecurity at the centre of an EU Digital Single Market, combined with the General Data Protection Regulation, which addresses the export of personal data outside the EU and EEA areas, is a positive example of how this is being addressed.

Technology Focused Policy and Regulatory Collaboration

Like banks, regulators in the financial markets are trying to keep pace with technical developments and at the same time increase their own adoption of innovative solutions. Our survey highlighted that, over the next five years, banks and regulators will benefit from working more closely together to assess where new technologies may present challenges for compliance, supervision, and market stability, and to identify how to overcome them. This can be achieved by providing a controlled environment for the development of new technologies, by maintaining a consistent and fair regulatory environment and by supporting the industry's focus on resilience.

Regulatory sandboxes

Global regulators[19] have been vocal in their support of innovation, and their desire not to introduce short-term regulatory and supervisory frameworks, which may prevent new technologies from developing and delivering the expected benefits to firms. Notably, in China, banks have a larger remit for innovation and technology deployment and therefore, supported by their regulatory environment, they have benefitted from a faster rate of progress.

19 For instance, in the US, https://www.cftc.gov/LabCFTC/Overview/index.htm

While regulators cannot endorse new technology and innovation, we believe they can play an important role in building awareness and educating on the impact and opportunities of new technologies for industry participants. A regulatory sandbox approach, where regulators, firms and third-party providers can collaborate on new technologies in a controlled environment, is one way this has been achieved successfully. Examples include: the sandbox recently proposed by the US Monetary Authority of Singapore; UK Financial Conduct Authority Project Innovate; and the Korean Financial Services Commission (FSC) financial regulatory sandbox (to be launched in April 2019) as well as similar initiatives by the Securities and Futures Commission, , Hong Kong Monetary Authority and Monetary Authority of Singapore. Effective regulatory sandboxes look to consider all regulatory authorities relevant to the use case in question.

A consistent and level-playing field for regulation

Maintaining a level-playing field in financial markets regulation will be important in creating an open, competitive and sustainable market where technology and innovation can evolve but where the potential risks (from new technologies or new industry participants) are managed consistently. This is important for not only large banks which may present more of a systemic risk, but also smaller or newer market entrants, which may also present a risk to clients if not properly managed or supervised. This can be best achieved through a proportionate and principles based regulatory framework geared towards technology innovation that applies equally to all participants.

Interviews highlighted that where banks, policymakers and regulators were already engaged in a collaborative dialogue on the impact of new technologies, there was increased pragmatism and optimism on the delivery of future benefits to the industry and its clients. Examples include the BCBS 431[20] and the Global Financial Innovation Network (GFIN) based on the FCA's 2018 proposal to create a "global sandbox".[21] On the other hand, where this dialogue was less prevalent, there was a greater sense that a lack of education and understanding of new technologies could lead to potential regulatory constraints being inadvertently introduced.

There also remain a number of jurisdictions where data localisation and cybersecurity laws include requirements for data to be stored onshore. This requirement can often act as a barrier to the development and adoption of certain new technologies.

20 https://www.bis.org/bcbs/publ/d431.htm

21 https://www.fca.org.uk/publications/consultation-papers/global-financial-innovation-network

4. The Investment Bank of the Future

This final section draws together the survey and interview findings to identify where the four technologies identified (Data & Analytics, Cloud Computing, Artificial Intelligence and Distributed Ledger Technology) may create opportunities for the 'Investment Bank of the Future'.

We have considered where these opportunities may exist for the future bank in three areas: the functional value-chain; the workforce and skills; and partnerships and collaboration.

A range of opportunities in these three areas have been identified that suggest the bank of the future to be more agile and automated, using sophisticated and efficient data analysis and decision-making, and supported by a workforce that is focused on increasingly high-value activities and client relationships. Banks may seek to combine a number of opportunities identified to underpin their long-term strategy.

However, achieving the opportunities in the functional value-chain, workforce and future partnerships will not be straightforward. Based on the technologies in this report it will require banks to identify where benefits can be delivered incrementally in the near term, while maintaining a long-term focus on investment, with priority given to innovation, security and resilience.

The Investment Bank Functional Value-Chain

Figure 9 illustrates where our survey respondents expect to see the greatest positive impact from the technologies identified across the bank functional value-chain. As discussed in Section 2, data is a fundamental building block for many other technologies, so will have a broad impact across the bank, whereas the benefits of other technologies may be more targeted to specific areas.

Figure 9: **Where do you expect to see a positive impact of new technologies across the bank functional value-chain?**

	Sales and Trading				Post Trade			Risk,Compliance and Finance			Information Technology
Technology	Sales & Relationship Management	Trading	Advisory	Research	Trade Support & Processing	Product Management	Client Support & Servicing	Risk Management	Finance & Treasury	Legal & Compliance	Technology & Infrastructure
Data Management and Analytics	Med	Med	Med	Med	Med	Med	Med	Med	Med	Med	Med
Artificial Intelligence	Med	High	Med	Med	Med	Low	Med	Med	Low	Med	Med
Cloud Computing	Low	Med	Low	Med	Med	Low	Med	Med	Low	Low	High
Distributed Ledger Technology	Low	Med	Low	Low	High	Low	Med	Med	Med	Med	High

Areas where additional PwC research and interviews indicate the opportunity may be greater than shown by survey responses. For example, whilst responses on Cloud computing tended to consider the potential benefits of infrastructure solutions, the opportunities would be significantly higher for platform (PaaS) and software (SaaS) cloud services.

We have grouped the key blocks of the value-chain and below discuss some of the opportunities of these technologies.

Sales and Trading: *Sales & Relationship Management, Trading, Advisory, Research*

- The trading and sales function is likely to change where new technology capabilities further enable the automation of traditional core front office activities, such as predictive modelling and trade execution.[22]

- Further automation in trading practices via algorithmic tools will support higher volume flow trading on electronic platforms, which can be expected to rely on minimal human decision inputs. The skills profile of some trading staff may therefore further shift towards quantitative and analytics disciplines. These roles will increasingly be supported by AI Cloud-based tools that can provide services such as news sentiment and market volatility analysis for financial forecasting and early warning signalling.

22 Future of Banking March 2018, Citi Digital Strategy Citi Research

- New data platforms supported by AI models may enable firms to be more targeted in how they sell products and services to clients and anticipate their needs (e.g. predicting liquidity requirements).

- Servicing may evolve to a more self-service and digital enabled approach to meet changing client expectations. Client interaction may therefore be more independent and rely on automated processes that could enhance the overall experience and the ability to process more data, more quickly.

Post Trade: *Trade Support & Processing, Product Management, Client Support & Servicing*

- Trade execution and processing will become increasingly electronic and automated, through innovations such as 'smart contracts' (enabled on DLT) that can automatically execute based on pre-agreed conditions.

- Straight-Through Processing (STP) will become increasingly predominant as early stage RPA solutions are replaced by automated and scalable infrastructure on Cloud Computing. This may lead to further opportunities to shorten existing settlement cycles.

- Services may become more concentrated in banks seeking to 'become the platform' (banks providing Post Trade services to industry peers), by viewing these services as a strategic, revenue-generating asset. These are likely to be larger universal banks that already operate at significant scale, and with the resources and depth to take on complex on-shore processing. Such banks will have invested heavily in these new technologies, and market infrastructure integration, and will therefore be more likely to bring on new business at lower marginal cost.

- New market entrants may make further incursions into specific areas of banks' operations. This may include both niche FinTechs and existing outsourcing providers or BigTech firms.

- Banks that opt to use more external service providers for operation functions may see internal operational roles shift more towards Vendor and Contract Management, as the interface with third parties increase in size and significance.

Risk, Compliance and Finance: *Risk Management, Finance & Treasury, Legal & Compliance*

- Processes will become more automated, employing Data Analytics and Cloud Computing technologies. More sophisticated tools, using AI, will support complex analysis of multiple financial and risk factors to drive optimal use of the balance sheet, regulatory capital, liquidity and funding.

- Sophisticated Data Analytics (such as understanding emerging risks) will increase data-driven decision making. AI and Cloud-enabled 'intelligent dashboards', available digitally, will help these functions better identify risk exposures to determine appropriate responses and monitoring procedures.

- Functions such as Legal and Compliance will be able to leverage AI to create predictive monitoring tools and derive analytical insights from structured data. For example, AI applications that can generate market compliance and fraud insights from large volumes of market data, digital contracts which can reduce the time required to execute transactions, or automated regulatory reporting.

Information Technology (IT): *Technology & Infrastructure*

- Value-add technology services (such as engineering) will move from cross-functional teams and into business lines. This may lead business and IT skills to further converge as roles become more technology-enabled. Individuals within the business may become more technologically literate, through easy to access, and open source tools.

- Internal IT shared service teams will increasingly need to compete with external third-party technology providers that can provide lower cost services at scale. As a result, if third-party providers become the norm, IT shared service groups within banks may evolve to become outsourcing and vendor management functions, focused primarily on control and governance of outsourced systems and processes.

- AI solutions for cybersecurity will improve IT cyber-attack detection rates and support all functions to better track security risks and respond in real time.

The Workforce of the Future

This section considers the opportunities identified in the investment bank functional value-chain above, such as the increase in automation, and how they may influence changes in the roles performed by individuals and teams.

In our survey, close to 90% of respondents agreed that the key skills required by the workforce of the future will be increasingly relationship-based and technology enabled, driven through a merging of business and IT roles and skills. This change in the profile of the workforce will be most pronounced where activities can be automated more quickly, for example in areas such as trade support & processing.

This change will also be driven by wider demographic and generational shifts impacting on banks' workforce and their client base, and the next generation of workers, more familiar with and reliant on new technologies in all aspects of their daily lives.

To take advantage of the future opportunities identified for the workforce, interviews for this report identified that banks will need both to foster new talent and to develop existing teams and skills. The impact of new technologies on the workforce, and, ways to address a potential future skills gap, are discussed in further detail below.

Considerations for the future

Given the opportunities identified in the value-chain, banks must carefully consider what roles will be predominant and how future business models will need to be resourced. Some of the key opportunities for the workforce include:

- The need for manual processing and repetitive activities by individuals will be further reduced. While existing roles may change, new positions will also be created, particularly within client-facing functions. New categories of employees will continue to emerge and evolve, just as with the current shift from traditional IT infrastructure specialists and developers to data scientists.

- Employee time will become more engaged in high-level thinking, creativity, and decision-making (such as selecting new trading strategies to target opportunities identified by AI analytics tools). Technology will support individuals and teams in processing, analysing, and evaluating increasingly complex datasets that that cannot currently be utilised.

- Through this increased automation, and the merging of business and IT roles and skills, it is expected that Sales & Trading roles will be more focused on client relationship management. However, this may create a career progression gap between junior data analysts and senior client relationship leads that will require new career pathways and development opportunities.

- Post Trade roles may increasingly move towards client servicing activities with the automation of data processing, payments, corporate actions and trade processing.

- Risk, Finance and Treasury functions are likely to work together more closely, using real-time analytics to support and enhance shared decision making, enabled by the ability to rapidly access and process greater quantities of data.

- Science, Technology, Engineering and Mathematics (STEM) disciplines and social sciences will increasingly converge. Taking AI as an example, banks will need more staff with knowledge across disciplines such as ethics, psychology and economics, in roles focused on identifying opportunities to use these new technologies responsibly and sustainably.

- Continuous learning and development will become a more standard working practice. As new technologies become prevalent, leading to agile ways of working, there will be a greater willingness to experiment, learn quickly from setbacks and enable more rapid development of solutions.

Addressing the future skills challenge

Based on the workforce opportunities above, follow-up interviews identified that a key challenge facing investment banks will be the availability of, and competition for, technical skills (i.e. data analytics, data science, and AI programming). In response, most banks have begun implementing new recruitment approaches, investing in re-skilling the existing workforce, and driving a cultural change to address this skill gap.

Traditional means of recruitment have become more competitive with other industries, especially with technology firms. Interviews identified that several banks are complementing traditional recruitment methods with newer models, identifying types of career paths and compensation structures that encourage new ways of working to be more appealing to future employees. Examples identified include:

- Implementing an '80-20 rule' giving technology teams back 20% of their time to focus on developing ideas for both cost reduction and revenue generation.
- Adopting a 'seed and grow' approach, bringing interested people across the organisation together in smaller teams outside their day to day reporting lines to support collaboration on innovation initiatives.
- Reviewing their location models to focus on where the future skills required are being developed and increasing partnerships with postgraduate programs in target specific skillsets, such as data science.
- Increasingly looking at new talent pools for the right type of individual, from partnering with FinTechs to creating an in-house technology fund to invest in technology companies and start-ups.

Partnerships and Collaboration

This section considers how the opportunities identified in the bank functional value-chain, and the workforce, may influence how banks partner and collaborate with other market participants and third-parties in the future.

Our findings are that the opportunities identified from new technologies will lead to the investment banking industry becoming more open and connected. Banks will be required to reimagine their existing engagement models with third-parties (such as market utilities, FinTechs and BigTech firms) in order to ensure maximum effectiveness of their future outsourcing, partnerships and collaboration. Banks will need to remain vigilant to greater disruption from larger technology firms that may seek to expand further into the capital markets value chain, in particular, firms that can benefit from a growing domestic market.

75% of respondents to our survey agreed that over the next five years, banks will increasingly become product and service 'aggregators'. This means they will retain the interface with their clients but will aggregate external products and services from new market participants, alongside internal products and services.

A further 55% of survey respondents agreed that there will be a reduction in the number of internal technology teams and services operating across multiple bank functions. Instead, internal IT teams will need to compete with external technology service providers who can provide innovative technology platforms, skills and scale.

Results from our survey in Figure 10 below supports this view by highlighting sizeable third-party opportunities in the Technology and Infrastructure function. Expanding the survey response provided further information on how these opportunities may impact this function:

- Banks' technology and infrastructure will be modified to allow easier access to on-demand services and integration of third-party solutions, keeping in-house only what is deemed 'core' for managing client relationships and regulatory interfaces.
- Banks will continue to build their own platforms, innovating within functions where a differentiation or competitive advantage relative to other banks or firms can be maintained (such as in research or advisory services).

Figure 10 also shows that sizeable third-party opportunities are expected in Trade Support and Processing. This finding is supported by the AFME paper on industry utilities published in March 2018, which found that third-party collaboration is a growing opportunity for banks to realise cost and efficiency savings in areas of mutual interest, such as trade settlement.[23]

The market for industry shared services will continue to mature. This will result in greater industry consolidation of these services to realise cost and efficiency savings, and potential new revenue channels, by packaging and white-labelling products and services in an open banking market environment.

Figure 10: **Which functions of the bank do you see as being positively impacted by third-parties?**

Source: AFME, Industry Utilities: A perspective for Capital Markets

23 https://www.afme.eu/globalassets/downloads/publications/afme-tao-industry-utilities.pdf

Conclusion

This report has examined key trends in technologies and innovation for banks over the next five years, centred on: Data & Analytics, Cloud Computing, Artificial Intelligence; and Distributed Ledger Technology. With additional considerations, such as the impact on the workforce, and new dependencies (including the need to balance innovation and resilience) we have set out to assess how this may influence the investment bank of the future.

The pace and impact of these technological changes suggest that industry participants, particularly banks, need to act now in order to realise the benefits and maintain their competitive position in the evolving landscape.

To reinforce this, we have identified the following eight principles from the findings of this report, which we believe will support banks in their evolution.

Eight Principles for the Investment Bank of the Future

Prioritise investment in key technologies:

1. **Maintain a Long-Term Focus:** Ensure long-term investment in new technologies is prioritised and applied to more sophisticated and intelligent use-cases, including revenue generation opportunities, rather than just automating existing processes. Establish central funding for innovation that is allocated to individual functions or lines of business.

2. **Embed Data as an Enabler:** Data management and quality are critical and must be tightly managed to enable other technology capabilities, such as analytics and AI. Data should increasingly be viewed as an asset and embedded into all functions, to enable enhanced ways of working and decision-making.

3. **Embrace Open Technology:** Collaboration on Open-APIs (Application Programming Interfaces) and shared platforms will allow banks, clients and approved third-parties, including regulators, to access data and information in a seamless manner. This will be enabled by further industry progress on common standards and data taxonomies across processes such as settlement, client identification (Know Your Customer) and AML (Anti-Money Laundering).

Enable a culture of innovation:

4. **Adopt a Collaborative Approach:** Banks will need to focus on core business and IT functions to differentiate themselves and maintain a competitive advantage. The use of third-party providers may be increased for activities that can be commoditised, with FinTech and third-party services used to access specialist resources, skills and technologies when required.

5. **Identify Industry Priorities:** Banks should support joint initiatives across the industry which can help to solve common problems, encourage shared knowledge and education, and promote open engagement models between supervisors and firms to shape future policy.

6. **Use Agile Work Practices:** Simplified technology and data architectures should allow banks to be more flexible, agile and modular. Unnecessary complexity and duplication of effort should be removed, allowing banks to adapt quickly to a rapidly changing future environment, and keep pace with changing client needs.

Develop the future workforce:

7. **Develop a Relationship-based Workforce:** Banks should prepare for a workforce that is centred on relationship-based and technology enabled roles, driven through a merging of business and IT skills. This will enable a cross-cutting and more collaborative mindset and culture across all functions. Banks must adapt how they acquire, retain and develop their future workforce in an increasingly competitive market for future talent and skills..

Focus on security and resilience:

8. **Enable Secure and Resilient Operations:** Cybersecurity detection and prevention must be at the core of all functions, activities and roles. All new technology and operational choices should be designed with resilience and recovery, and information security and privacy, in mind. Existing controls should continue to be reviewed to ensure a balance between innovation and potential new risks and cybersecurity concerns.

Notes

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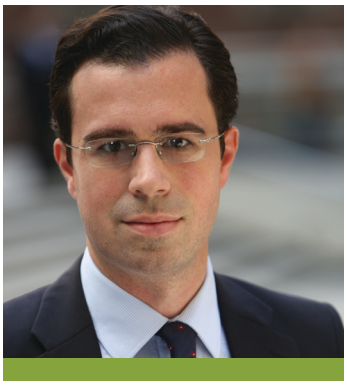

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The Global Financial Markets Association (GFMA) represents the common interests of the world's leading financial and capital market participants and speaks for the industry on the most important global market issues.

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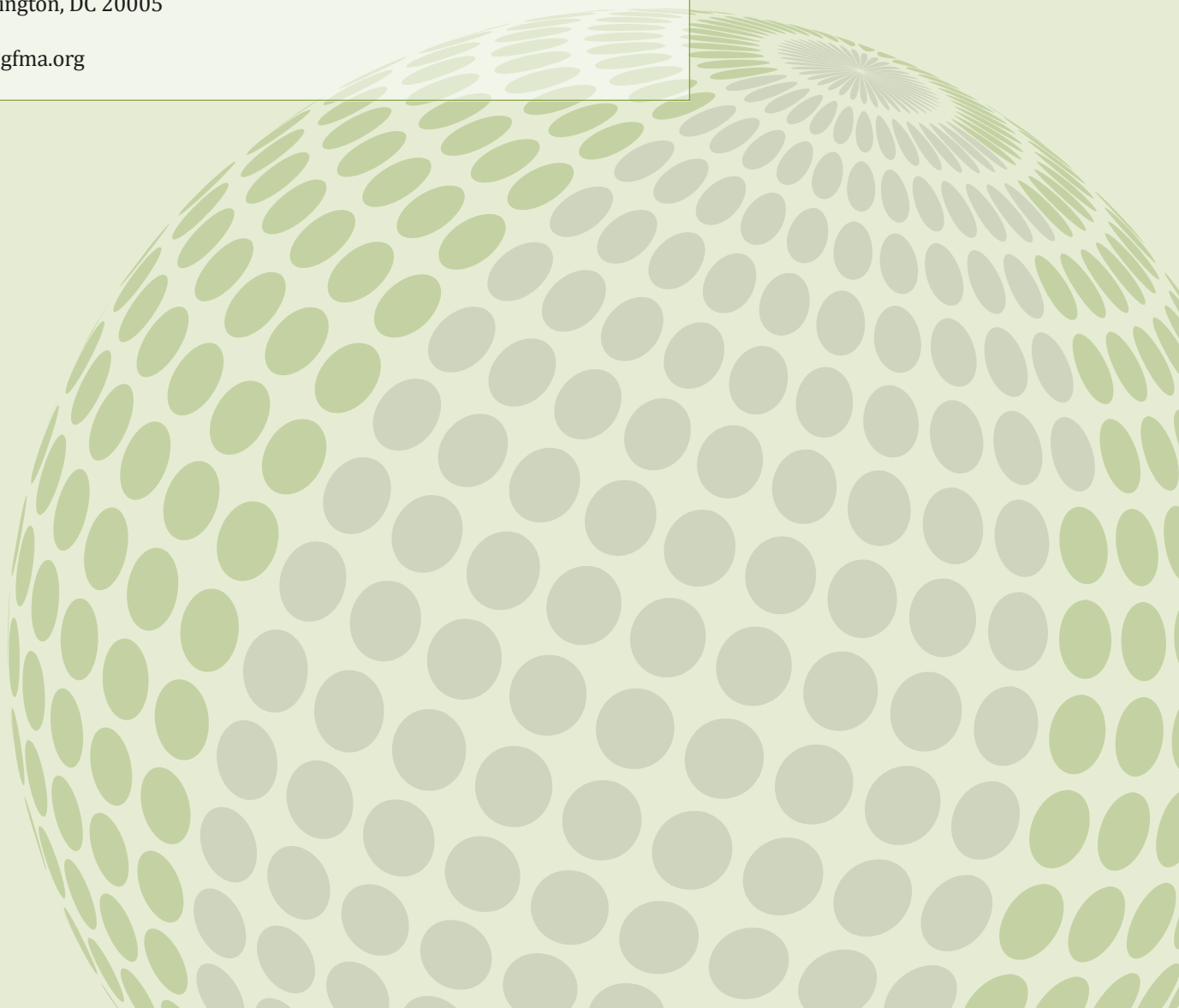

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