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BIG DATA APPLICATIONS
IN THE BANKING INDUSTRY

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Abstract

This report examines the role of big data in the banking and securities industry, focusing on its application across various banking functions, including risk management, customer personalisation, operation optimisation and regulatory compliance. It analyses how banks leverage big data to gain insights, streamline operations, and enhance customer engagement. The report also discusses the challenges faced by banks, such as data integration into legacy systems, privacy concerns, and the need for sophisticated data governance mechanisms. Through various case studies of both regional and global banks, the report demonstrates the effectiveness of big data solutions in real-world scenarios, highlighting significant cost savings and operational improvements. Additionally, it explores the strategic considerations necessary for successful big data implementations and the potential return on investment that banks can achieve by adopting these technologies.

Part A: Big Data Applications in the Banking Industry

1. Project Landscape

The banking and securities sector relies heavily on big data to capitalise on opportunities and tackle challenges. As Li et al. (2015) state, the sector is not only driven by data but thrives on it. Since the 2008 financial crisis, tightened regulations have prompted banks to enhance risk management and reporting practices, with big data becoming indispensable for risk assessment, fraud detection, and credit risk management (Munar et al., 2014).

The rise of digital banks and alternative financial services providers has intensified competition, pushing traditional banks towards precision marketing. Big data helps banks to understand and predict customer behaviours to tailor marketing strategies and enhance customer experiences, thereby staying competitive and innovative (He et al., 2023). Moreover, technologies like AI and machine learning have revolutionised business operations, streamlining processes from anti-money laundering efforts to robo-advisory, high-frequency trading and customer support.

Big Data is also crucial for effectively navigating the complex, ever-changing landscape for regulatory compliance, with the rising adoption of Supervisory Technology (SupTech), a subset of RegTech. Innovations like Digital Regulatory Reporting simplify compliance by automating report generation and facilitating data sharing, thus easing the regulatory burden on financial institutions (Kourabas and Tsang, 2023).

Figure 1: Applications of Big Data Analysis

BANKING AND SECURITIES			
Risk Prevention	Precision Marketing	Business Operations	Regulatory Compliance
Risk Assessment/Control	Customer Behaviour	Operational Optimisation	Reporting
Supply Chain Finance (SCF) Risk	Marketing Analytics	Anti-money laundering Optimisation	Data Governance
Financial Fraud Detection	Innovation and Product Development	Robo Advisors	
Management of customer credit risk			

Source: Self-summarised from content

Li et al. (2015) describes the financial big data ecosystem as a complex network where data sources, infrastructure, and analytics interact to drive data-centric operations, as indicated in Figure 2. Core drivers include the growing volume, variety, velocity, and veracity, coupled with the need for dynamic data protection and fraud prevention. Influences on these drivers include

evolving customer preferences, business optimisation goals, and technological advancements in computing and storage. Data sources are split into intrinsic (enterprise applications, legacy systems, logs) and extrinsic (news feeds, blogs, social media) categories, ingested and integrated into a structured infrastructure for efficient data analysis. Finally, Analytics transforms collected and processed data into actionable insights for decision-making.

Figure 2: Big Data Drivers

Source: (Li et al., 2015)
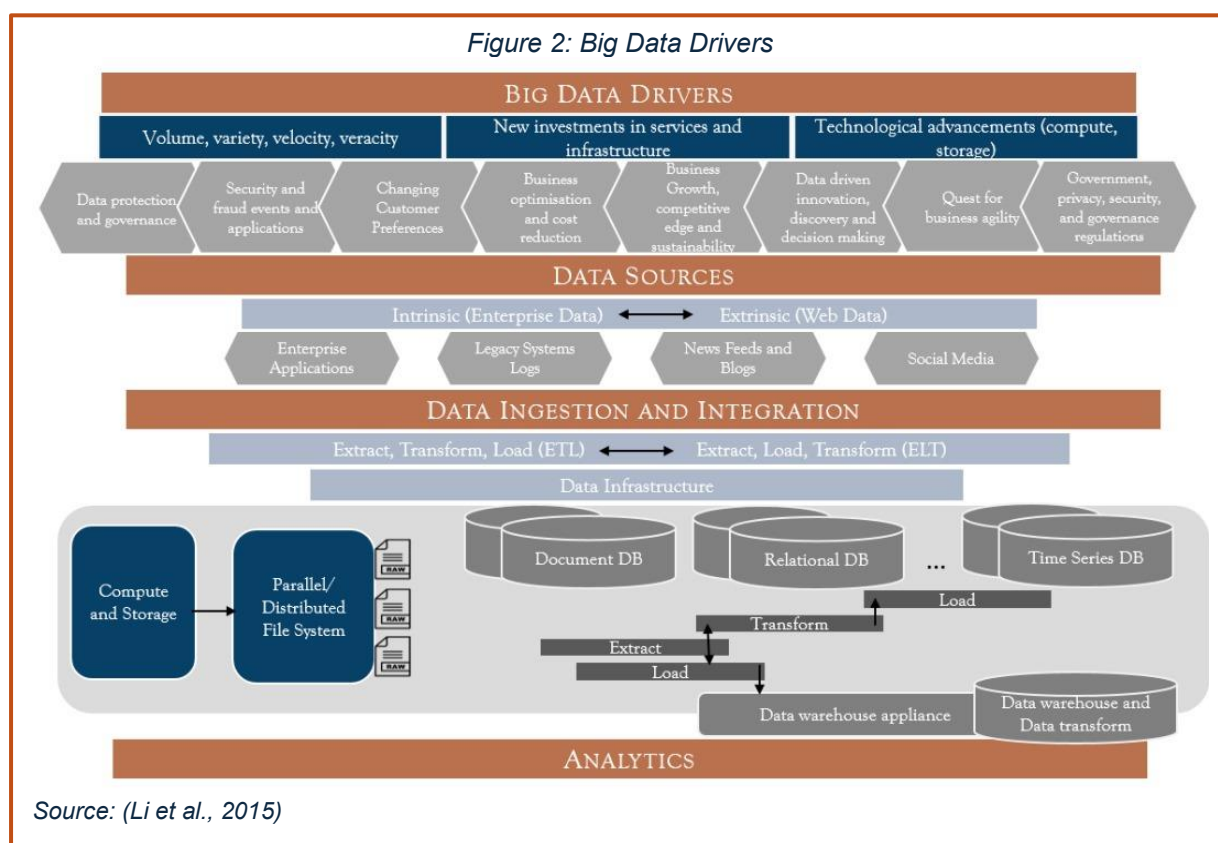
The digitisation of financial services, driven by electronic transactions and regulatory transparency, offers potential for innovative business models and enhanced customer engagement (Cavanillas et al., 2016:13). However, legacy systems, skill gaps, and data privacy concerns constrain capitalisation on these opportunities.

Subsequent sections of this report will discuss technological advancements and their practical applications in the sector, examining their impact and solutions to associated challenges. Data governance issues, complexities of assessing ROI, and the future outlook of big data applications in the sector will also be explored, along with acknowledging the collaborative effort of the GPF-1 Team and individual insights.

2. Technology Adoption

Banks collect and manage a lot of sensitive data, from individual names and addresses to social security numbers, transactions and purchasing patterns, requiring in-depth analysis to understand

client behaviour and industry trends. Financial data is classified into structured, semi-structured, and unstructured forms. Structured data, comprising transaction and market data, is highly organised and easily searchable. Conversely, unstructured data, such as social media and customer feedback, lacks a predefined model and poses processing challenges. Semi-structured data, like Financial products Markup Language (FpML), includes tags for the semantic organisation (Cavanillas et al., 2016). Each data type plays a vital role in the financial service sector's big data ecosystem, offering valuable insights for analytics and decision-making.

However, conventional databases struggle to handle and analyse big data effectively, prompting the emergence of Big Data analytics technologies, which uncover hidden patterns, correlations, and market trends, enabling customisation of goods, services, and advertising to diverse customer needs. They also aid in fraud detection, risk management, and predicting consumer behaviour. The FinTech ecosystem, emphasised by (Vovchenko *et al.*, 2019), promotes steady economic growth through digitalisation, providing a structural framework for long-term financial innovations. The following are some frequently utilised big data technologies and tools in the banking industry that rapidly and effectively handle massive data for stated common purposes.

Consumer Analytics:

Sophisticated analytics enable financial firms to forecast consumer behaviour, using tools such as Hadoop to store and examine vast volumes of client data, Apache Spark for real-time analytics, and machine learning algorithms for trend spotting and fraud prevention.

Risk Analysis:

Risk management is crucial in preserving financial stability, evaluated through tools like NoSQL databases for handling risk-related data, Hadoop for data organisation, and predictive analytics for proactive risk control. Additionally, blockchain technology and robotic process automation streamline procedures, reducing operational risk.

Fraud Detection:

Technologies like machine learning algorithms and stream processing engines identify fraudulent activity by analysing transaction patterns in real-time, supported by data visualisation tools for investigative purposes.

Data Governance and Management:

Banks utilise data integration solutions like data lakes, metadata management tools, and data governance policies to oversee and control their information assets efficiently, ensuring correct data lineage, security, and compliance.

A growing number of banks are taking advantage of real-time business intelligence through various big data technologies to aid their decision management processes. Understanding the business

drivers and objectives should be the first step for a Big Data analytics plan. However, the implementation and technology selection decisions are influenced not only by organisational objectives but also by external factors like environmental, cultural, and social pressures (Baig, et al., 2019). Factors such as relative advantage, complexity, compatibility, perceived cost, and management support play significant roles in the big data adoption-decision process and affect the rationale for choosing a big data application over another.

3. Impact and Solution Analysis

3.1. Impact Analysis

Big data applications profoundly impact the banking and securities industry, redefining operations from customer experience to regulatory compliance. An example of a direct impact of the application of big data solutions is Revolut's Sherlock, a machine learning-based system that detects fraud by monitoring card transactions in real-time. By utilising Couchbase Server's NoSQL solutions for its database needs, Sherlock identifies 96% of fraudulent transactions and processing checks in under 50 milliseconds. This efficiency has saved Revolut over USD 3 million and improved fraud detection by 75% compared to industry standards (Couchbase, 2020 and T_HQ, 2019). Nikolay Storonsky, Revolut's co-founder (Medium, 2019), highlights the scalability of this application, as it processes a high volume of transactions efficiently, using a scalable NoSQL database and Google cloud services for data management, and retrains machine learning models nightly with new data to adapt to emerging fraud patterns. Apache Beam aids in feature engineering, ensuring scalable architecture that adapts to increasing user numbers and transaction volumes.

Furthermore, Revolut aims to monetise customer's data for targeted advertising while awaiting its UK banking license (Financial Times, 2024). This plan includes sharing user data with advertising partners and potentially transforming FinTech into a media platform where audience data is leveraged for profit. While this move could diversify revenue and spur growth, concerns about privacy, customer trust, and regulatory challenges persist. Ludloff and Craig (2011) argue that targeted advertising, when based on customer behaviour tracking, is morally acceptable if the consumer has provided consent, emphasising broader ethical considerations. Identifying entities using customer data, their purposes, and measures implemented to protect against privacy violations is crucial.

A critical use case of big data in banking is Anti-Money Laundering (AML) optimisation, exemplified by HSBC's response to the 2012 Money Laundering scandal. According to the court case documents "USA vs. HSBC Bank USA, N.A. and HSBC Holdings PLC" (The United States Department of Justice, 2012), HSBC failed to maintain an effective AML program and conducted due diligence on correspondent bank accounts belonging to foreign entities. The bank violated the

International Emergency Economic Powers Act and the Trading with the Enemy Act, which resulted in a $1.9 billion fine. HSBC has since implemented advanced AML systems, partnering with Google Cloud to develop an AI solution, named Dynamic Risk Assessment (DRA) system. This AI solution reduces processing time, enhances risk detection, and reduces false alerts by 60%. Recognised as 'Solution of the Year' by Celent (a research and advisory firm focused on technology for financial institutions), it identifies two to four times as much suspicious activity, revolutionising HSBC's AML approach (May, 2023).

Additionally, while automation in big data analytics can streamline data provenance – the origin of data, it poses challenges, as exemplified by a European insurance firm fined 1.75 million euros for retaining personal data for an excessive time (Siddiqi & Khader, 2022). Therefore, banks must prioritise privacy and security throughout the life cycle of big data attributes, as emphasised by the European Banking Authority's 2020 report, "Elements of trust in big data and advanced analytics", covering interpretability, traceability, and data quality.

3.2. Solution Analysis

Hu et al. (2014) discuss adaptable, scalable, and proficient big data solutions characterised by the capacity of efficient data collection, advanced processing models, energy-conscious designs, and robust privacy and security protocols. These solutions are equipped with innovative processing models, including real-time processing for swift analysis of incremental updates. Below are examples of banking institutions that have implemented such solutions.

3.2.1. Big Data Use Cases in Banking Industry

Technological Solutions and Security Enhancements:

The Malaysian bank implemented tailored Big Data Solutions to ensure robust data security across its extensive network of over 200 branches in multiple countries. These solutions, including cognitive computing for customer analysis and updated cybersecurity protocols, risk assessments, and employee training programs, were tailored to comply with Malaysia's Personal Data Protection Act 2010 (Salleh & Janczewski, 2019).

Investment in Technology Infrastructure:

Palestinian banks effectively leverage Big Data investments to enhance financial analysis capabilities and improve customer service and strategic decision-making, resulting in reported improvements in operational efficiencies and customer satisfaction (Rjoub, 2024).

Utilisation of Predictive Analytics and Data Mining:

In Taiwan, the combination of predictive analytics and data mining led to customer segmentation and product affinity prediction, significantly enhancing marketing strategies and customer

relationship management. Response rates to targeted campaigns notably improved from 3.1% to 6.5% in subsequent phases (He, Hung and Liu, 2022).

Improving Business Operations and Customer Service:

The Bank of China's extensive big data strategy, incorporating Hadoop, MapReduce, NoSQL databases, machine learning, and real-time data processing, facilitates in-depth analysis of both structured and unstructured data. This enables the bank to develop detailed client profiles, evaluate risks, detect fraud, optimise marketing efforts, and streamline operations, leading to enhanced customer service, operational efficiency, and overall performance (Cheng and Feng, 2021).

3.2.2.   Adaptability, Scalability, and Proficiency of These Solutions

The scalability of Big Data Solutions is demonstrated through the analysis of structured and unstructured data, along with facilitating widespread employee training. For example, Indian banks utilise Big Data frameworks like Hadoop (YARN, Hive) to handle vast data volumes. This scalability has proven crucial for managing increased data complexity and enhancing capabilities in fraud detection and risk management (Singh et al., 2022).

Effective customer analysis, analytics visualisation, and rigorous security assessments highlight proficiency. The real-time processing capabilities provided by Big Data technologies enable banks to perform immediate risk assessments and customer service enhancements. This proficiency is critical for maintaining competitive advantage and adapting to rapidly changing market conditions. However, challenges such as regulatory compliance and environmental uncertainties persist, compelling continuous improvement in the evolving big data landscape.

4. Data Governance

According to Plotkin (2014), effective data governance depends on three key elements: policies, which set strategic goals and actions; processes, which outline tasks and assign responsibilities; and procedures, which provide detailed instructions for task execution, ensuring accuracy and adherence to policies.

Data governance in banking is a framework and continuous process that ensures the responsible management of sensitive data while maintaining privacy, accountability, and integrity. It treats personal and transactional information as valuable assets, safeguarding them from misuse. The framework aims to enable banks to utilise data effectively while complying with regulations and reducing risks. Key practice includes defining data ownership, data definitions, and implementing data accuracy and confidentiality controls. Regulatory frameworks, such as GDPR, Basel III, and Dodd-Frank, necessitate banks to have comprehensive data governance practices for compliance. This is evident in the risk data aggregation and reporting (RDAR) principles issued by the Basel

Committee for Banking Supervision (BCBS), which mandate banks be subject to strong governance and data quality for mitigating financial risks (Deloitte, 2013).

Data governance in financial services requires a tailored approach to address diverse regulatory nuances across regions. For instance, the "Information Technology Governance, Risk, Controls and Assurance Practices Directions, 2023" issued by the Reserve Bank of India outlines guidelines for managing IT-related risks and ensuring compliance within financial institutions (Tsaaro Consulting, 2024). Furthermore, India's Digital Personal Data Protection Act of 2023 regulates the collection and usage of personal data to enhance transparency, consent, and security measures (The Legal 500, 2024).

The conflict between data protection regulations, such as the General Data Protection Regulation (GDPR), and anti-money laundering (AML) regulations presents significant challenges for law enforcement agencies like Europol and the banking sector. According to Arthur and Owen (2019), while the GDPR aims to protect individuals' privacy and grant them control over their personal data, the AML regulations mandate the collection and analysis of financial data to detect and prevent money laundering and other illicit activities. Balancing compliance with these two spectrums remains an ongoing challenge.
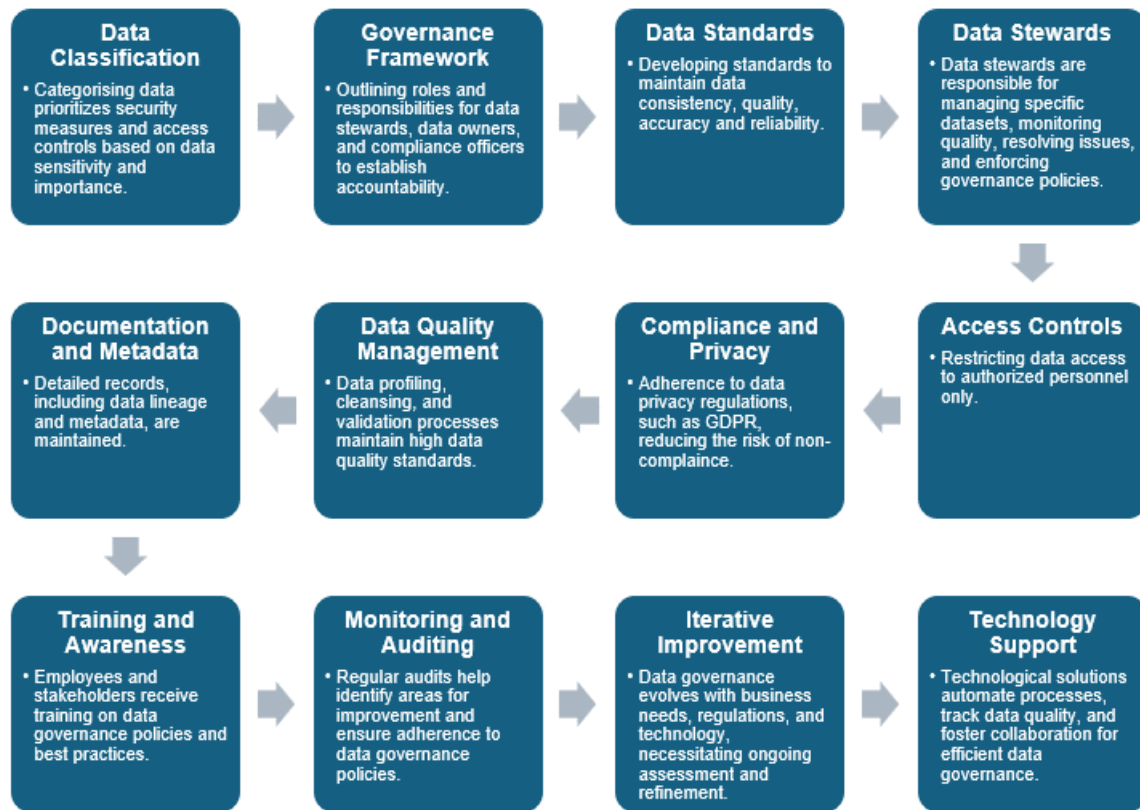
As such, it can be inferred that data governance is an iterative process with many sub-projects and milestones that serve as checkpoints to ensure practical and effective processes. It requires clear guidance on data management, ownership, access, quality, origin, encryption, access controls, and audits.

The absence of the three Ps in data governance can lead to data pollution and inconsistency in insights, resulting in poor data quality, lack of data standardisation, unintegrated systems, incorrect data, and huge data management costs. (Al Wahshi, et al., 2022) investigated data governance in the Omani banking sector, surveying 51 data stakeholders of 9 banks. Investigation revealed that the robust data governance mechanisms, including performance measurement, compliance monitoring and continuous training, significantly mitigate data quality issues.

Effective data governance in banking and securities requires continuous monitoring, adaptation, and scalability to ensure alignment with the latest regulatory changes. It requires teamwork, strategic investment, and planning. By aligning governance with business goals, the banks can identify their strategic data assets and deploy suitable big data management governance models. It requires significant effort but enables better decision-making, operational efficiency, data security, and a competitive edge (Meijer and Majumdar, 2015).

Figure 3: Data Governance Framework in Banking

Governance Framework to ensure data is accurately managed, secure, and utilise effectively to support banking operations and regulatory compliance.

Data Classification
- Categorising data prioritizes security measures and access controls based on data sensitivity and importance.

Governance Framework
- Outlining roles and responsibilities for data stewards, data owners, and compliance officers to establish accountability.

Data Standards
- Developing standards to maintain data consistency, quality, accuracy and reliability.

Data Stewards
- Data stewards are responsible for managing specific datasets, monitoring quality, resolving issues, and enforcing governance policies.

Access Controls
- Restricting data access to authorized personnel only.

Compliance and Privacy
- Adherence to data privacy regulations, such as GDPR, reducing the risk of non-compliance.

Data Quality Management
- Data profiling, cleansing, and validation processes maintain high data quality standards.

Documentation and Metadata
- Detailed records, including data lineage and metadata, are maintained.

Training and Awareness
- Employees and stakeholders receive training on data governance policies and best practices.

Monitoring and Auditing
- Regular audits help identify areas for improvement and ensure adherence to data governance policies.

Iterative Improvement
- Data governance evolves with business needs, regulations, and technology, necessitating ongoing assessment and refinement.

Technology Support
- Technological solutions automate processes, track data quality, and foster collaboration for efficient data governance.

Source: (Turner, 2021)

5. Return on Investment (ROI)

Despite its potential benefits, calculating the ROI for a big data governance project is challenging, often causing delays in management buy-in and approval. This raises the need to assess and validate ROI for technology and talent investments while managing setup and maintenance costs against expected benefits. When selecting a data governance framework, banks must assess their needs, goals, and factors, defining KPIs and metrics to measure governance success before initiating a project. For example, sales and marketing comprise about 15% of financial services costs and are crucial for customer acquisition. Leveraging big data allows banks to integrate consumer data for targeted advertising, potentially reducing marketing expenses (Ogochukwu, n.d.). Also, analysing massive data in real-time enables financial institutions to instantly detect fraud, unusual transaction patterns, and market anomalies. This proactive approach helps mitigate financial losses and safeguard clients' interests (Zaineh, 2024), thereby enhancing productivity and profitability and directly contributing to higher ROI.

Figure 4: Big Data Return on Investment
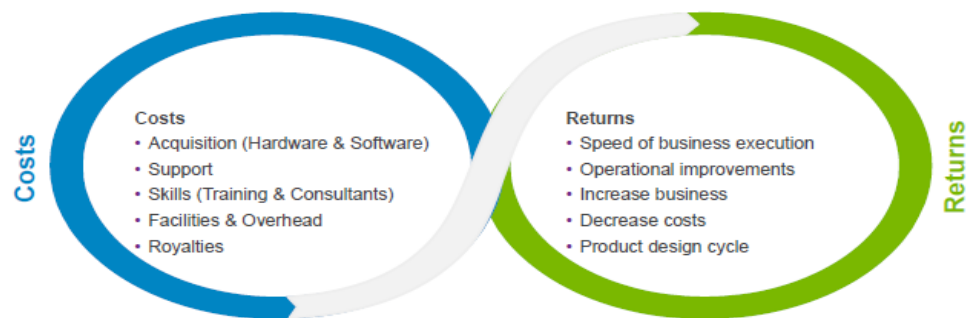
Source: (Shim, et al., 2015)

Additionally, PwC research indicates that return on experience (ROX) surpasses ROI as a key success metric, with data analytics enabling banks to craft marketing personas and proactive solutions for optimal customer experience investment outcomes (Marous, 2021).

Al-Dmour et al. (2021) highlighted that banks face customer retention challenges amid rising competition from Fintech startups and non-bank payment service providers. To address this, banks must invest in customer analytics for effective customer segmentation, which aids in tailoring their marketing strategies and customer approaches.

In this context, in 2010, Amex shifted from conventional database technology to a Hadoop infrastructure, enhancing their machine learning integration for large-scale data processing and analysis. Further adoption of various data platforms and NoSQL database further enhanced their ability to utilise extensive transaction records for various applications, including fraud detection. Notably, Amex developed a machine learning model to predict customer attrition, successfully identifying 24% of accounts at risk of closure, which facilitated targeted retention efforts and improved customer loyalty, thus maximising ROI.

A McKinsey study found that organisations effectively using big data are 5% more productive and 6% more profitable than competitors (Zaineh, 2024). Another study in Kenya on 42 banks and 38 FinTech companies revealed that although 23.1% effectively utilised big data, its adoption significantly enhanced competitive advantages, spurred new product development, and facilitated entry to new markets (Mugane, 2018). Such organisation often attracts investor interest and achieve higher stock prices and ROI.

6. Challenges in Implementing Big Data Solutions within the Banking Industry

While implementing Big Data Applications offers significant benefits for banks, it also comes with considerable challenges. Banks must contend with the daily management of complex and voluminous datasets, including customer information, financial transactions, and market data. Ensuring data quality and manageability is extremely difficult. Compounding this issue are data silos with bank's disparate systems and databases, which hinder data visibility and access. Furthermore, data security remains a critical concern as banks are prime targets for cyberattacks, necessitating a careful balance between implementing effective security measures and maintaining authorised access (Turner, 2021).

Additionally, creating a governance framework that aligns with organisational goals and regulatory compliance is challenging for banks using big data. Ethical considerations, such as the extent of personal profiling, must be balanced with privacy rights under GDPR principles like data minimisation and purpose limitation, which can restrict essential data access for AML efforts. Compliance with these often conflicting regulations can significantly increase operational costs, including system upgrades, staff training, and penalties for non-compliance.

Moreover, the substantial investments required for hardware, software, and skilled personnel and the need for scalable solutions to support growth present further challenges in measuring the effectiveness and managing the costs of big data implementations (Zubenko, 2023).

7. Solutions to Overcome Big Data Challenges

To overcome the challenges of implementing big data solutions, the banks should start by clearly articulating the vision and goals of the big data project. Developing a comprehensive data governance framework outlining roles, responsibilities, policies, and procedures aligned with regulatory requirements is crucial. Effective data governance ensures data consistency, reliability, and proper usage, clarifying data ownership and access rights, thus supporting the achievement of the institution's KPIs (DataGalaxy, 2023).

To mitigate security risks in big data, banks can implement data anonymisation, encryption, and consent management. Karasek-Wojciechowicz (2021) suggests permissionless DLT-based networks to ensure GDPR compliance and manage risks associated with money laundering and terrorist financing. Additionally, privacy-enhancing technologies like confidential computing, homomorphic encryption, and pseudonymisation provide confidentiality safeguards during data processing (Siddiqi and Khader, 2022).

Big Data analysis in financial institutions necessitates scalable infrastructure, like reliable servers and cloud computing platforms, to manage data growth effectively. Establishing KPIs and metrics

is essential to measure the success of Big Data initiatives, along with employing skilled IT analysts and data scientists for insightful data extraction. Furthermore, Effective change management, including clear communication of benefits, thorough training, and adherence to data governance best practices, is crucial for promoting data-driven decision-making across financial institutions and ensuring successful Big Data implementation.

Notably, adopting standardised semantic models like the Financial Industry Business Ontology (FIBO) is also essential for successful bid data implementation. FIBO provides a common vocabulary or ontology that enables data standardisation, quality assurance, and seamless big data integration across sources for banks. It supports data governance through its metadata framework for policies, controls, and lineage tracking. Adopting FIBO fosters interoperability, regulatory compliance, and unlocking value from big data analytics for the banks (Bennett, 2016).

8. Conclusion

Big data technologies continue to revolutionise the banking and securities sector by enhancing business strategies, customer experiences, and operational efficiency. The effectiveness of Big Data technologies in banking hinges on the alignment between technological capabilities and organisational readiness, as challenges like legacy system integration, data governance, and ethical concerns regarding privacy and data security can impede the implementation. Scalability presents both opportunities and challenges, as banks must navigate data management complexities and address potential security vulnerabilities associated with handling large volumes of data. Overcoming these challenges requires robust data governance frameworks and a culture of ethical data usage and transparency within banking institutions.

In our opinion, Big Data tools bridge the gap between raw data analysis and business decision-making, allowing banks to synthesise unstructured data from various sources into actionable insights, not possible with traditional technologies. These tools support advanced analytics, data mining, and predictive modelling, enabling real-time insights and strategic growth. By modelling risk scenarios, banks can identify vulnerabilities and implement mitigation strategies to prevent losses (Zaineh, 2024). Thus, adopting Big Data is crucial for banks to stay competitive, respond swiftly to market changes, and achieve sustainable growth while also considering the ethical implications of data usage.

Looking ahead, the future of Big Data in banking will likely be characterised by further integration of artificial intelligence (AI) and machine learning (ML) technologies to automate decision-making processes and enhance predictive analytics capabilities. To capitalise on these trends, banks should prioritise investments in AI and ML training programs to build internal expertise and stay abreast of technological advancements. Additionally, adopting Data-as-a-Service (DaaS) models can streamline data management processes, enabling banks to focus on deriving actionable

insights from their data. Phased implementation strategies and a commitment to fostering a culture of data-driven decision-making will be essential for banks to successfully harness the full potential of Big Data technologies and maintain their competitive edge in the evolving digital landscape.

Part B: Reflections

1. Group Work Evaluation

Strategic Organisation:

Our group was strategically formed to facilitate optimal collaboration and efficiency. One of the key advantages of our team organisation was the alignment of our class schedules, which facilitated seamless coordination and planning of tasks around everyone's availability and convenience, as we could efficiently schedule meetings and allocate tasks without significant conflicts or scheduling constraints.

We established a WhatsApp group for frequent communications, quick queries, and informal discussions. Additionally, we utilised Microsoft Teams to share files and documents related to the project. Informal discussions during classes and on WhatsApp provided additional opportunities for brainstorming ideas and clarifying any doubts.

Besides, formal meetings were held, with seven meetings throughout the project duration, including sessions with Module and Seminar leaders, for structured forums for discussing progress, addressing challenges, and making key decisions. Detailed minutes were recorded during each meeting, summarising discussion points, decisions made, and action items for follow-up (Appendix 1).

Task Allocation:

Our task allocation strategy was initially preceded by individual research efforts across various industries, with each member creating industry proposals. However, given our background in FinTech, we decided to focus on the banking industry for our project.

In distributing tasks among members, our strategy revolved around leveraging individual expertise and interests while ensuring consensus where necessary. We facilitated open discussions during meetings to allow members to express preferences for task assignments.

Subsequently, following the outline of project requirements, we conducted a WhatsApp poll to ensure fair and equitable task distribution aligned with members' interests and capabilities. Harshit

took on the Technology Adoption section, utilising his SQL experience. Federica and Wubedel focused on Impact Analysis, showcasing their adept research skills. Zeinab and Adityan explored Solution Analysis, identifying pertinent case studies. Laura and I focused on Governance and ROI, drawing upon our backgrounds in finance to elucidate metrics for measuring big data solutions.

Quality Assurance:

We prioritised quality assurance through conducting extensive research from academic journals and industry reports, along with continuous peer review and feedback. This comprehensive approach enabled us to develop a nuanced understanding of the subject matter and produce high-quality content.

Initially we encountered some challenges, struggling to find relevant case studies. Guidance from our Module and Seminar leaders, Dr Oliver and Mr Gall, helped us overcome this hurdle. Additionally, managing time effectively, particularly in balancing project work with other academic and personal commitments, was also challenging.

However, these challenges offered valuable learning opportunities. We learned the importance of effective time management, prioritisation, and clear communication. We believe we have delivered quality work meeting the project's requirements through collaborative efforts and adherence to course guidelines.

Claims and Meeting Minutes:

All the minutes of meetings and the snapshot of our Teams folders have been included in Appendix 1 and 2, respectively, for clarity and easy reference.

2. Individual Contribution Assessment

Strengths:

Each team member brought unique strengths and contributions to the project, which significantly enriched our collective efforts:

- Harshit provided insights into various big data technologies and their applications in the banking industry, as detailed in Part A: Section 2. He also contributed to the conclusion of the report.
- Federica sourced compelling case studies of HSBC and Revolut for the Impact Analysis section, offering a clear overview of big data analytics' triumphs and setbacks (Part A: Section 3.1).
- Wubedel made significant contributions to multiple aspects of the project. Alongside Federica, she worked on the Impact Analysis section, contributed additional literature across all sections, co-compiled the project with me, and facilitated communication within

the team. She also proactively designed presentation templates, created the course outline and ensured overall project quality. The reflections of her efforts are integrated throughout the project.

- Zeinab identified a case study of a Malaysian bank exemplifying big data use cases for the Solution Analysis section. Her detailed research covered the adaptability, scalability, and proficiency of solutions implemented by the bank (Section 3.2).

- Adityan conducted extensive research, providing multiple use cases for the Solution Analysis section. His work included valuable insights into scalability, proficiency, and the future outlook of big data applications. He also provided information on future trends in big data applications that contributed to the report's conclusion.

- Laura presented a valuable case study of Amex, highlighting the ROI of big data implementation (Part A: Section 5). She also contributed content to address challenges related to Data Governance (Section 6).

- I, Versha, worked on the rest of the content related to Governance and ROI (Sections 4 and 5, respectively). I also worked on Challenges and Solutions for Big Data implementations (Sections 6 and 7). I wrote the conclusion (Section 8) by summarising the findings of the whole team and presented the group's opinion on the topic. With extensive help from Wubedel, I compiled the entire report in a consistent and logical format by adding relevant information to all sections and eliminating redundant information, contributing to the project's overall depth and credibility.

Areas for Improvement:

While each team member excelled in their respective roles, there are areas where all members could improve, such as ensuring timely completion of tasks to minimise last-minute rushes. Also, we need to further deepen our understanding in the field by researching and learning how to practically work on the Big Data Technologies being used in the Banking Industry.

Impact Assessment:

Each member's contribution significantly impacted the group's performance and improved the overall quality and credibility of our work. This project enriched our understanding of real-world applications and implications of big data, offering valuable insights for consideration in our future career path. Each member played an important role in achieving the project's outcomes, highlighting the value of collaboration and diversity in achieving shared objectives.

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Appendix

1. Minutes of Meeting

Meeting Number: 01

Dated: 22 February 2024

Meeting Details – Project Initiation I

MEETING TITLE	Group Coursework Planning and Strategic Organization	MEETING CALLED BY	Wubedel Shuba
DATE	22 February 2024	MEETING FACILITATOR	Wubedel Shuba
LOCATION	Marylebone Campus (IT Lab 4)	MINUTE TAKER	Versha Sandesh
TIME	13:30 – 14:30	TIMEKEEPER	Federica Migliaro

Attendees

Adityan	Federica	Harshit	Laura	Versha	Wubedel	Zeinab
✓	✓	✓	✓	✓	✓	✓

Agenda

AGENDA ITEM	PRESENTER
BDTP Assessment Guidelines	Wubedel Shuba

Discussion Points:

Point 1: Critical discussion and interpretation of the project objectives of the assigned Course-work.

Point 2: How to achieve the desired outcomes of the coursework.

Point 3: How to decide on an industry for group work.

Point 4: How to develop consistent findings among all group members.

Decisions Made:

Decision 1: All team members read the provided coursework guidelines thoroughly during the meeting and highlighted the required objectives of the project.

Decision 2: A tentative 7-week meeting schedule has been generated and shared among the group for assured progress towards individually assigned tasks.

Decision 3: Each member will individually research at least two of the industries of interest from the provided list and write a brief proposal on the reason behind selecting that industry.

Decision 4: The group produced a questionnaire framework that is to be followed by all members in the preliminary proposal of the industry under research.

Action Items

ACTION	RESPONSIBLE PERSON	DUE DATE
Industry Research	All team members	28 February 2024

Risk and Issues

RISKS AND ISSUES	IMPACT	MITIGATION
Compliance with the assignment brief	High	Read the assignment brief. Speak to the module leader for further clarification.
Technical challenges	Low	If there are issues with accessing information, reach out to the module leader for guidance.
Team member commitment	Medium	Team members have pledged to contribute fully. In unexpected personal circumstances, help the team member and inform the module leader.
Communication and Conflict	Medium	Communication lines are through in-person meetings, emails and WhatsApp group messages. In case of disagreements, a group discussion will be conducted, and a majority vote system will be put in place.

Additional Notes

Overall Participation: All members participated actively and constructively in the meeting discussion.

Highlights from Individual Contributions:

- Wubedel: Created and presented slides based on the coursework guidelines to easily understand project objectives. Created initial template for weekly Minutes of Meeting record.
- Wubedel and Versha: Shared opinions to make a proposal to justify the chosen industry for coursework.
- Federica and Zeinab: Proposed the idea of investigating two industries of interest before reaching a consensus on industry selection.
- Adityan: Shared examples of how industries like the Government and Hospitals employ big data resources prominently.
- Laura: Shared information on how 'Sports' industry can be a good source of Big Data.
- Harshit: Suggested to choose the industry, ensuring that the group can explain it well in terms of the 3 Vs of big data.

Meeting Number: 02

Dated: 01 March 2024

Meeting Details – Project Initiation II

MEETING TITLE	Group Coursework Planning and Strategic Organisation	MEETING CALLED BY	Team
DATE	01 March 2024	MEETING FACILITATOR	Zeinab
LOCATION	Teams	MINUTE TAKER	Adityan
TIME	09:00-09:40	TIMEKEEPER	Harshit

Attendees

Adityan	Federica	Harshit	Laura	Versha	Wubedel	Zeinab
✓	✓	✓	✓	✓	✓	✓

Discussion Points:

  Point 1: Each member briefly discussed their finding on both suggested industries and the availability of information on the given topics.

  Point 2: a quick read of the project samples to check how it is instructed and how the data is being presented so it can give a better insight on selecting the industry.

  Point 3: Harshit & Versha discussed on related articles that are useful. And Versha shared about insurance, which was great.

  Point 4: Federica talked about the obstacles in the banking industry and will take more data collection, which can lead to delays in the timeline; Zeinab agreed with her.

Decisions Made:

  Decision 1: a group decision was made to share all findings about the insurance and Banking industry and share it for a group vote.

  Decision 2: include a company or bank example in the findings so it can give a clearer understanding.

Action Items

ACTION	RESPONSIBLE PERSON	DUE DATE
Share findings on Banking & insurance for Monday's group vote on the project industry	All team members	03 March 2024

Additional Notes

- A link will be shared on Teams for Google Doc SharePoint. (title doc shared **Banking** or **Insurance**)

Meeting Number: 03

Dated: 07 March 2024

Meeting Details – Project Planning

MEETING TITLE	Group Coursework Planning and Strategic Organisation	MEETING CALLED BY	Team
DATE	07 March 2024	MEETING FACILITATOR	Harshit
LOCATION	Teams	MINUTE TAKER	Wubedel
TIME	12:50pm - 01:30pm	TIMEKEEPER	Versha

Attendees

Adityan	Federica	Harshit	Laura	Versha	Wubedel	Zeinab
✓	✓	✓	✓	✓	✓	✓

Discussion Points:

  Point 1: Laura gave brief update on the sector she conducted research on.

Point 2: Each member discussed their take on industry preference, and the team developed a framework to vote on the industry between Banking and Insurance. The framework included a) relevance to our studies (Fintech with Business Analytics), b) data/research availability and accessibility, c) complexity and impact of industry, and d) personal interest. Based on these points, banking was selected as the industry of focus.

Point 3: The team discussed approaches to consider while preparing for the presentation.

Point 3: Wubedel will share a draft outline for comments and adjustments to be made

Point 4: The team will do further investigation on the Banking industry to clarify how we approach the technical report.

Point 5: Book a meeting with Mr. Gall for the 20ᵗʰ of March.

Decisions Made:

Decision 1: Banking was selected as an industry for the group assignment.

Decision 2: The presentation preparation will incorporate and reflect group and individual elements.

Decision 3: A draft outline is to be shared amongst the group to divide the task accordingly.

Action Items

ACTION	RESPONSIBLE PERSON	DUE DATE
Share a draft outline for the report	Wubedel	08 March 2024
Further investigation of Banking industry	All Team Members	18 March 2024

Additional Notes

- Inform Dr Oliver and Mr Gall about selection of the industry.
- Book an appointment with Mr. Gall for March 20ᵗʰ for guidance.

Meeting Number: 04

Dated: 20 March 2024

Meeting Details – Project Planning

MEETING TITLE	Feedback and Direction from Seminar Leader	MEETING CALLED BY	Team
DATE	20 March 2024	MEETING FACILITATOR	Mr. Edmund Gall
LOCATION	Cavendish Campus	MINUTE TAKER	Versha
TIME	02:15pm - 02:50pm	TIMEKEEPER	-

Attendees

Adityan	Federica	Harshit	Laura	Versha	Wubedel	Zeinab
X	✓	X	✓	✓	✓	✓

Discussion Points:

Point 1: The team shared details with the Seminar Leader (Mr. Edmund) to seek opinions about approaching the assignment by focusing on a specific bank, e.g. Revolut.

Point 2: Another query was about whether to add a comparison of new digital banks to traditional big banks in the report.

Point 3: The team requested General guidance about the coursework.

Meeting Outcome:

Decision 1: Mr Gall provided useful advice that a case study of Revolut may be included in the coursework as an example; however, the emphasis should be on providing a bigger perspective of big data applications in our chosen industry (Banking).

Decision 2: It was suggested that the team research a comparison between digital banks and legacy banks and determine if such information is available in the context of coursework requirements.

Decision 3: Mr Gall shared techniques on how to research quality scholarly articles from Google Scholar and the University's library resources. He helped clarify all the teams' minor doubts, which helped us develop our research framework. Mr. Gall also provided some guidelines for presentation of coursework as below:

- What is Industry?
- Why did the team choose that industry?
- Key Findings.
- Feedback on the group / how it was organised.
- What each member is doing or is planning to do.

Action Items

ACTION	RESPONSIBLE PERSON	DUE DATE
Share the common presentation template for the group.	Wubedel Shuba	28 March 2024
Share the meeting details with the group	Versha / Wubedel	20 March 2024
Further investigation on divided tasks	All Team Members	01 April 2024

Meeting Number: 05

Dated: 27 March 2024

Meeting Details – Project Execution

MEETING TITLE	Feedback and Direction from Module Leader	MEETING CALLED BY	Team
DATE	27 March 2024	MEETING FACILITATOR	Dr Thomas Oliver
LOCATION	Cavendish Campus	MINUTE TAKER	Team
TIME	03:50pm - 04:10pm	TIMEKEEPER	-

Attendees

Adityan	Federica	Harshit	Laura	Versha	Wubedel	Zeinab
X	✓	X	✓	✓	✓	X

Discussion Points:

> **Point 1**: The team shared details with the Module Leader (Dr. Oliver) about how the tasks have been divided among the team members.

> **Point 2**: The team shared concerns about not being able to find good articles about Big Data technologies being used in the Banking industry.

> **Point 3**: Federica shared a viewpoint of identifying BD technologies in banks through an indirect technique, i.e. from various job adverts by banks and the listed technical skills requirements.

Meeting Outcome:

> **Decision 1**: Dr. Oliver asked each of the group members to provide some examples of impact, solution, governance, and ROI as per individually divided tasks.

> **Decision 2:** Dr. Oliver helped in searching for a few articles related to the banking industry. He advised us to look for articles in Neo4j as one source and showed one article, "Modern Banking Products Fueled by a User-Centric Approach," as a useful case of a bank that benefited from using Neo4j technology for analysing big data. Besides, researching MongoDB was also suggested, and he showed some articles available in Quanta magazine.

> **Decision 3:** The module leader appreciated Fede's idea of researching Big Data Technologies and mentioned that it is a way of 'Synthesis Research' technique. He encouraged us to use such creativity in research and offered to seek his assistance in case any further help was needed.

> **Decision 4:** The whole team was further reminded about the upcoming submission of the presentation. It was recommended to use 6 slides, 3 common for the team and 3 for individual work, and we were instructed to provide sources for images in the presentation as well as in the final report. It was advised to adhere to UOW generic grade descriptors and given rubric criteria for all the submissions.

Action Items

ACTION	RESPONSIBLE PERSON	DUE DATE
Share the meeting details for the group.	All Team Members	27 March 2024
Share the individual presentation slides among the group	All Team Members	02 April 2024

Meeting Number: 06

Dated: 26 April 2024

Meeting Details – Project Finalisation - I

MEETING TITLE	Sharing of individual contributions on Coursework and feedback	MEETING CALLED BY	Team
DATE	26 April 2024	MEETING FACILITATOR	-
LOCATION	Online	MINUTE TAKER	-
TIME	06:00pm - 08:00pm	TIMEKEEPER	-

Attendees

Adityan	Federica	Harshit	Laura	Versha	Wubedel	Zeinab
✓	✓	✓	✓	✓	✓	✓

Discussion Points:

Point 1: All team members shared the progress of individual content on coursework and shared examples of some good articles that they have referred to.

Point 2: The team shared feedback on each other's work and decided to include more use cases of Big Data Applications within the coursework.

Point 3: The team committed to submit the final version of their work by 28th April 2024, which is to be compiled by Wubedel and Versha for submission.

Meeting Outcome:

All team members provided samples of great work and good research on the given topic.

Action Items

ACTION	RESPONSIBLE PERSON	DUE DATE
Combine the whole report in a final submission format	Wubedel and Versha	29 April 2024

Meeting Number: 07

Dated: 29 April 2024

Meeting Details – Project Finalisation - II

MEETING TITLE	Report Compilation	MEETING CALLED BY	Versha and Wubedel
DATE	29 April 2024	MEETING FACILITATOR	-
LOCATION	Marylebone Campus	MINUTE TAKER	-
TIME	10:00am - 08:00pm	TIMEKEEPER	-

Meeting Outcome:

- Wubedel worked on combining contributions relevant to Impact Analysis and Solution Analysis from Federica, Zeinab and herself. She also wrote the Abstract, Project Landscape and part of the conclusion.

- Versha worked on combining Data Governance and ROI content from Laura's and her own contributions. She also worked on writing Challenges of implementing big data projects and solutions to overcome those challenges, along with summarising the group's opinion on big data usage and applications.

- Both Versha and Wubedel worked on compiling the report in structured form, along with ensuring consistency and logical sequence of information presented.

- The final version was then shared with the team for feedback and subsequent final submission.

2. Evidence for Group Communication

Below is the screenshot of the Microsoft Teams shared folder, which includes files from team members for their contributions towards the coursework: