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AI-Assisted Change Impact Analysis for Legacy-to-Cloud Migration in Banking Systems

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Abstract | **Original Research Article**

The migration to cloud within banking systems is complicated by the closely linked architectures, rules and regulations, and the significant operational risk. This study explores how AI-assisted Change Impact Analysis (CIA) can help make the process of migration safer and more efficient. The proposed solution is beneficial as it is based on AI methods like predictive analytics and dependency models. The AI-assisted processes are more likely to show accuracy in detecting the effects of changes, ease manual work, and be better prepared to comply. The results of the numerical analysis and case studies in the industry show that AI-enhanced CIA can greatly enhance the processing speed, prediction accuracy, and risk mitigation. Hence, it can be used to modernise banking IT infrastructures. There are critical recommended actions for the banks, including the upskilling of employees, ensuring quality data inputs and stakeholders' interactions.

Keywords: Artificial Intelligence, Change Impact Analysis, Legacy Systems, Cloud Migration, Banking Systems, Regulatory Compliance.

I. INTRODUCTION

A. Background

Traditional banking institutions used to use the legacy systems built over the decades that enabled the bank to support major functions like processing transactions, customer relationship management, and reporting regulatory processes. These systems have been found to be strong and dependable, but with low scalability due to the monolithic architecture [1]. The advent of cloud computing has created a scope for banks to modernise their IT infrastructure by increasing agility and lowering the cost of operating their business.

The legacy-to-cloud migration in the banking industry is, by nature, a complex one. The banking systems are integrated, overly regulated, and mission-critical. Change Impact Analysis (CIA) is thus necessary to know the impact of changes on system behaviour, identifying the ripple effects [2]. The old models used at CIA are relying on the manual analysis, which tends to be outdated or even unfinished.

In recent years, Artificial Intelligence (AI) with graph-based modelling have been developed, significantly improving the efficiency and speed of the systems [3]. The option of AI-assisted CIA can provide the opportunity to analyse the dependencies of systems, predict the impact of changes, and assist in making decisions during the migration process. Such capabilities are specifically useful in the banking context based on the scale, complexity and sensitivity of migration projects to regulations.

B. Overview of the Study

This study is about analysing AI-driven change impact analysis systems to change the banking system's legacy to a cloud architecture. The failure tolerance and scalability are improved by using AI across the digital transformation [4]. The study is discussing the ways to use AI methods to identify, forecast, and deal with the effects of change in interdependent legacy and cloud-native systems. The study examines the current research on migration issues and AI-as-analytics, and analyses how they can be applied to the banking contexts.

In addition, the study proposes a research design that may be applicable to evaluate AI-assisted CIA models in the banking industry. The AI is having a significant advantage due to the runtime decisions, leading to increased adoption in changing circumstances [5]. The findings of the research will be used to further the knowledge on identifying methods of using AI to

facilitate safer and more effective migration policies, enabling CIA.

C. Problem Statement

The banking system migration of legacy to the cloud has high complexity, rigid regulations, and high operational risks. The unintended consequences of changes brought about in the process of migration, including financial frauds, information breaches, or even non-compliance leading to penalties [6]. This may be due to conversion of the data or reconfiguration of platform during the migration. Currently used change impact analysis techniques may not be adequate as they are based on manual procedures, lack scalability, and do not enable dynamic system behaviour.

The AI-assisted frameworks seem to promise many benefits in automating and improving the migration to modernised systems [7]. However, they are not widespread and under-researched in the banking sector. As to AI-supported CIA models, there is a gap in the systematic knowledge on the effectiveness, issues, and design focus when it comes to the legacy-to-cloud migration. It is essential to address this gap, to minimise the risks of migration and facilitate the successful transformation of banking systems to the cloud.

D. Aims and Objectives

The aim of the study is to examine the AI-assisted framework enabling change impacts during the transition of legacy banking systems towards cloud-based architectures. The study is focusing on the following objectives: 1) To identify the challenges faced regarding change impacts analysis across legacy banking systems migrating to cloud-based architecture 2) To critically examine the viability of AI-assisted frameworks in detecting, predicting and managing the impacts of changes during the migration 3) To evaluate the measures essential for designing an effective AI-assisted framework for legacy-to-cloud migration across banking systems

E. Scope and Significance

This research will be restricted to the application of AI-assisted change impact analysis to the banking industry, specifically, migrations to the cloud on a legacy basis. The study focuses more on software systems, architectural dependencies and operational risks being minimised through the application of AI.

The study is significant as it will improve the practice of legacy to cloud migration in the industry. In terms of academic quality, the study is contributing by analysing the value of AI-assisted CIA. In practice, it offers an insight that can help banks, system architects, and decision-makers adopt AI-assisted strategies to overcome the migration risk more efficiently, which will improve the reliability of the systems, their compliance, and sustainability over time.

II. LITERATURE REVIEW

A. Problems Faced in the Process of the Legacy-to-Cloud Migration

The old banking systems are usually monolithic, strongly coupled, and developed and maintained using dated technologies [8]. The complex interconnection of applications, databases, and external interfaces are among the key problems of migration. The documentation is not complete or up to date, which makes the identification of change impacts even more difficult.

The other challenging issue is regulatory compliance. The banking systems need to be compliant with highly challenging data privacy, security, and resilience regulations [9]. The relation to the migration of data and services to the cloud raises the issues of data residency, access control, and auditability. A false assessment of change implications may result in regulatory fines and penalties.

There is also the fact that the size of banking systems makes the process of migration more complicated. The high volumes of transactions, necessities of real-time processing, and high availability demands can be constraining during the migration [11]. The previous CIA techniques are not effective at addressing this level of complexity, and thus, more and more reason is given to expert intuition and manual verification.

B. Power of AI-Assisted Frameworks in the Change Impact Analysis.

AI-aided models have a number of pros compared to traditional approaches to change impact analysis. All of the historical change records, repositories of source code and system logs can be analysed by AI to determine the underlying dependencies and recurring impact patterns. Further, AI can clearly predict the resources needed during the migration [12]. The intricate interrelations among the system parts may be represented in dependency graphs.

A major advantage of artificial intelligence is its predictive capabilities, that is helping to understand the issues that can occur during migration. Using the lessons of past migration processes, AI models could also approximate the probability and extent of effects of changing the process. The use of AI has been able to increase the interactions between various functions by 25% in terms of accuracy during migration [8]. This predictive understanding enables the decision-makers to give greater focus to the high-risk changes and also offers better management of mitigation resources.

The AI models have the potential to support the changing system architecture and automatically revise impact measurements as the system changes. This flexibility is especially useful in banking settings in which systems constantly undergo changes.

C. Steps for using AI-Assisted frameworks across cloud migrations

The effective introduction of AI-based CIA designs needs a number of supporting actions. High-quality data is required. The banks have to preprocess the information in the source code and database schema for categorising the data [13].

Further, there is a strong transparency, particularly of importance in regulated banking [6]. The models of AI-assisted impact analysis should ensure that the results are interpretable and aligned with compliance. This is critical in the creation of trust and guaranteeing acceptance by the regulation.

The AI capabilities will require human interactions and solutions to bolster them. Although AI could automate massive analysis, it needs expert control to verify its results, address the exceptional cases, and domain expertise [15]. It is important to integrate AI-assisted tools in the current change management processes to make them easier to adopt and more relevant.

III. RESEARCH METHODOLOGY

A. Research Design

The current study is using an explanatory research design to examine AI-assisted change impact analysis to the legacy-to-cloud migration. This design is applicable in learning complicated technical phenomena and analysing emerging frameworks in real-life situations. The AI is aiding in optimising the overall process of migration in banks [16]. The explanatory design is effective in connecting the AI capabilities with the challenges faced by banks while migrating to the cloud-based architecture.

B. Data Collection

The research data is gathered through secondary sources in terms of journal articles, industry reports, and official websites of banking institutions. The practical implementations of AI-assisted analysis in banking cloud migration projects are learned using technical documentation, migration reports and publicly available case descriptions. The qualitative data is aiding in providing insights into the AI-assisted CIA that can empower the migration for banks. The quantitative data is being gathered from graphs and statistics to identify the viability of AI frameworks in the CIA. The quantitative data is being able to lend the numeric and precise knowledge on the advantages offered by AI-assisted frameworks. The study is able to reach an enriched understanding by gathering and analysing both quantitative and qualitative data for the study.

C. Evaluation Metrics

The efficacy of AI-aided change impact analysis frameworks is determined by a number of metrics. These consist of precision in determining the affected elements, inclusion of system dependencies, lessening of manual analysis work, and the capability to make informed choices in risk. The effect of AI on the change process in legacy-to-cloud migration is concerned with both the technical efficiency and operational advantages. The improvement of migration efficiency, system reliability, and capability to mitigate risks in terms of accuracy are being studied to understand the value of AI-assisted frameworks. The metrics are used for evaluating the information available [17]. Thus, the precision and accuracy in terms of improvements are the evaluation metrics being used to examine AI's usage in migration. The study is making important derivations based on the metrics assessing the accuracy and precision of outcomes, using AI in the CIA.

D. Examples of the case studies

Case Study 1: HSBC applying AI in its cloud infrastructure.

HSBC has made use of AI in the cloud-based capabilities, leading to improved results [18]. The accuracy of results and detection capability have been tangibly improved with the integration of AI. There is a significant reduction in the batch processing time as well. Thus, it can be derived how AI is enabling the cloud-based systems with greater transparency, leading HSBC to overcome anti-financial incidents. Further, the efficiency of processes at HSBC is being improved as well.

Case Study 2: JP Morgan applying AI in its legacy systems

JP Morgan is using AI applications for modernising its applications across the cloud-based environment [19]. The use of AI in JP Morgan spans the aspects of prospecting, risks and fraud prevention. The AI is hence being impactful in improving the applications at JP Morgan to create processes that can run on public and private cloud infrastructure. A more resilient system is being constructed on account of the AI and Machine Learning applications. The overall analysis is pointing out the relevance of AI in being able to improve the legacy processes for JP Morgan, increasing operational efficiency.

IV. FINDINGS

A. Numerical Analysis

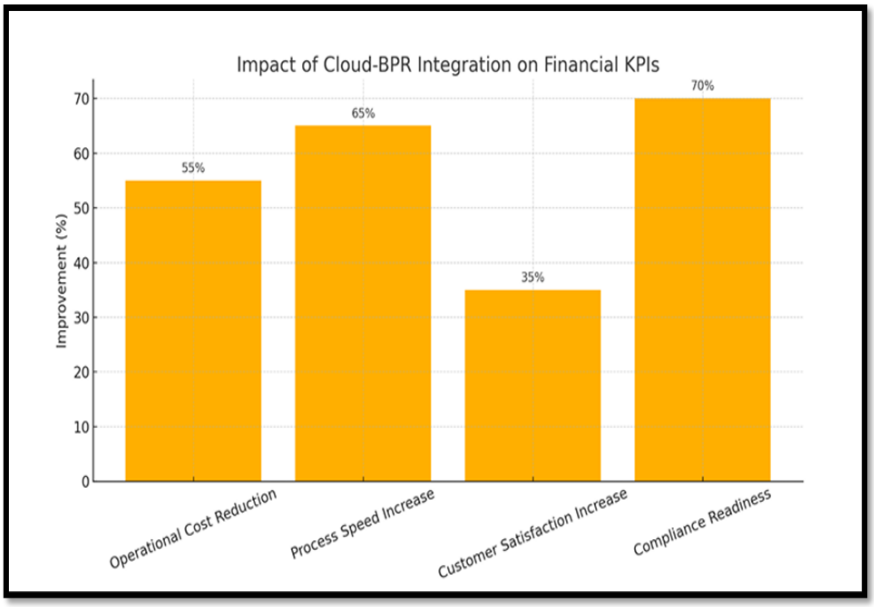

Figure 1: Improvements in financial systems using cloud
(Source: [9])

The above figure is depicting how cloud technologies are paving the way for scalable and on-demand infrastructure for banks looking to modernise their systems. The migration from legacy systems to clouds is having a strong set of advantages with the effective business process re-engineering (BPR) [9]. There is a 55% increase in the reduction of operational costs and 65% increase in process speeds. There is a 35% increase in customer satisfaction and 70% in compliance readiness indicating the relevance of such applications. There is effective elimination of bottlenecks and scalable systems achieved.

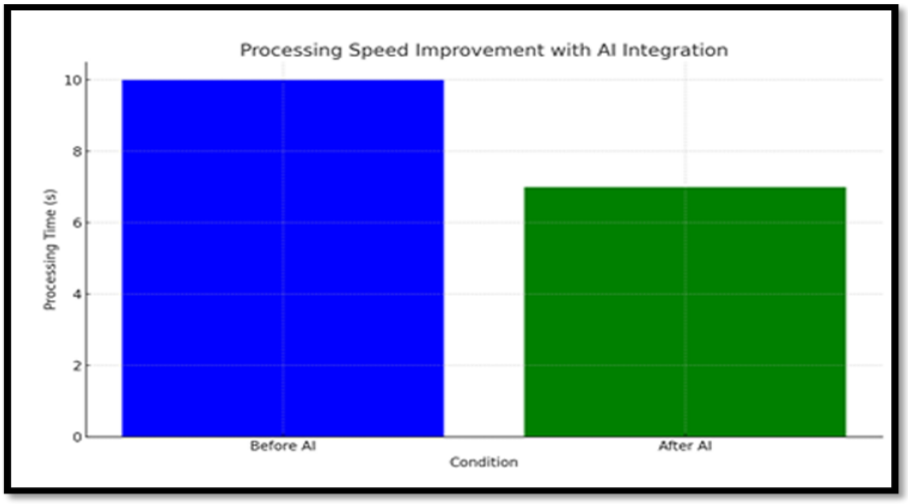

Figure 2: Processing speed system improvements with AI
(Source: [8])

The above figure points out how AI is crucial in improving the processing speed of legacy systems migration. The processing speed has reduced by 30% on account of using AI during the migration process [8].

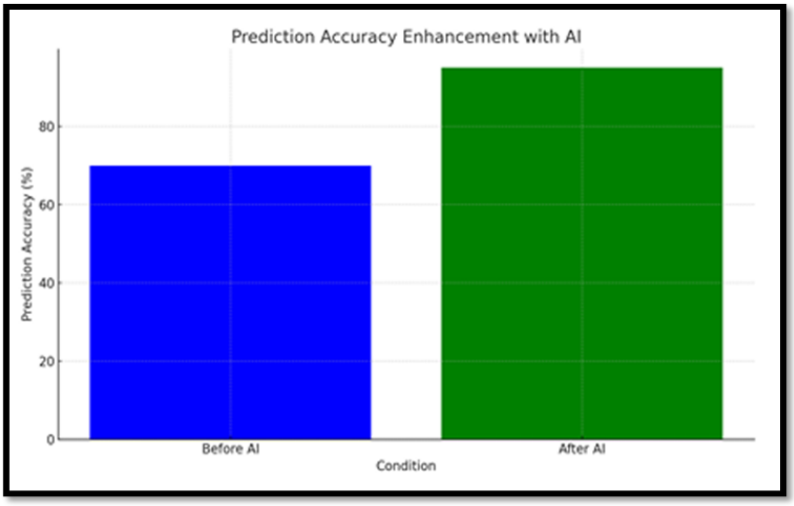

Figure 3: Prediction Accuracy increasing with AI
(Source: [8])

The figure above is once again depicting the impacts of AI in being able to increase prediction accuracy. The prediction accuracy is increasing by 25% on account of using AI during the migration of legacy systems [8]. The transition is enabled through AI, which provides critical insights regarding the changes in the systems and predicts any failures. The problems and functional situations could be identified beforehand on using AI for the processes.

B. Findings

The three bar graphs are indicating the necessity of cloud-based infrastructure across the banks and the salience of AI. The cloud-based application is leading to a 65% improvement in processing speed that is benefitting the transactions [9]. The vital improvements of using AI are being derived from the following two bar graphs, whereby the response times are improved through its application. The use of AI is decreasing processing time by 30% and increasing the accuracy of prediction by 25% [8]. Thus, the results are establishing how the migration process is deeply enhanced by AI identifying the issues and increasing the speed of execution.

C. Case Study Outcomes

Table 1: Results of the case study

Case Study	***Outcomes***	***Relevance***
Case Study 1: HSBC applying AI in its cloud infrastructure.	AI in cloud-based capabilities, improved transparency, reduced batch processing time [18]	Increasing the efficiency of the systems and scalability
Case Study 2: JP Morgan applying AI in its legacy systems.	Using AI in risks, prospecting and fraud prevention [19]	Increasing the security of systems and leading to improved operational efficiency

(Source: self-developed)

The table states how HSBC and JP Morgan have benefited from using AI across their legacy systems. The cloud-based infrastructure is being strongly supported on account of AI. HSBC is able to accomplish increased efficiency across its systems [18]. JP Morgan is similarly using AI when transitioning to the cloud-based system. The AI is leading to increased management of risks and fraud prevention, leading to enhanced outcomes.

D. Comparative Analysis

Table 2: Comparative Analysis

Author	***Focus***	***Key Learning***	***Limitation***
[9]	The migration processes and digital transformation in banks	AI is crucial in driving the transformation and overcoming complexities [9]	Lack of analysis on the challenges faced during migration
[11]	The contribution of AI across modern banking systems	The salience of AI in automating processes and recognising salient patterns [11]	Lack of exploring the steps for using AI in the CIA

Author	*Focus*	*Key Learning*	*Limitation*
[13]	The use of microservice architecture for migrating from monolithic systems [13]	The agility and faster development across the cloud is possible through scalable messaging	Lack of exploring relevant case studies using the application
[16]	The data migration was secured through the use of AI	The AI is being critical in overcoming possible breaches, adhering to regulations and improving efficiency	Lack of examination of the challenges encountered during data migration

(Source: self-developed)

The comparative analysis between various authors reveals how an AI-assisted framework is crucial for overcoming the challenges during the migration of banks. The banks face critical challenges operating in a highly regulated environment and consisting of vast volumes of data. The use of AI is improving the migration from legacy systems, overcoming such complexities.

V. DISCUSSIONS

A. Interpretation of Results

The results of this study indicate that AI-assisted change impact analysis (CIA) is very important in aiding the process of legacy-to-cloud migration in banks. The analysis shows that operation performance has been improved significantly and there is a decrease in processing time and an increase in accuracy of prediction [8]. The findings can be made in accordance with the study objectives, as they demonstrate that AI-driven models could help to establish the dependencies in a complex system. The rise in prediction accuracy and efficiency of the processing reminds the ability of AI to improve CIA. The case studies of HSBC and JP Morgan support the fact that AI-powered CIA allows making informed decisions during the process of migration. Further, banks need to ensure high-quality data and greater transparency for improving the AI-enabled processes [8].

B. Practical Implications

The AI-assisted CIA can provide significant value to banks in the process of migrating to the cloud. The dependency mapping and predictive analytics can help banks to avoid manual analysis, which enables reducing the time of migration. The enhanced transparency in the interaction of the systems helps in the better management of risk and also facilitates continuity of the services [4]. Further, AI-enhanced CIA helps promote the aspect of regulatory compliance facilitated by the AI-enabled aspects, which would be necessary in the highly regulated banking settings. The implications are that an AI-aided CIA could be a core facility of sustainable digitalisation in the banking sector.

C. Challenges and Limitations.

The use of AI as an assistant to the CIA has benefits, but there are various problems associated with it. The performance of AI models is depending on the quality of the input data [22]. The complexity of integration is another major weakness, where aligning the AI tools with the current banking systems would demand a lot of technical know-how and investment [10]. The use of AI should be overseen by the human factor to ensure AI-derived inferences are verified, and bias is reduced [8]. These shortcomings suggest that AI-assisted CIA is to be treated as a supplementary solution only.

D. Recommendations

The key element that banks need to focus on to make AI-assisted CIA most effective is in the areas of data standardisation and governance to provide quality inputs to AI models [10]. It is advisable to adopt open AI methods to address regulatory expectations and develop trust in the stakeholders. The banks must also invest in professional upskilling so that professionals can deal effectively with AI-driven insights by validating them [21]. In addition, the implementation of AI-assisted CIA into the current change management and compliance models will help to streamline the adoption process. The cooperation among banks, technology providers, and regulators is needed to create the best practice and support the AI-assisted migration [20].

VI. CONCLUSION AND FUTURE SCOPE

This study finds that AI-assisted change impact analysis plays an important role in improving the process of legacy-to-cloud migration in banking through the maximisation of its efficiency, prediction accuracy, and compliance management. The case studies and findings state that AI-powered methods overcome the weaknesses of the traditional CIA practices in the complex, regulated context. However, there are still difficulties concerning the quality of the data, the complexity of integration models, and the transparency of the models. Further investigations ought to be conducted toward creating more effective AI designs, industry conventions, and practical assessments of AI-aided CIA across various banking domains in a bid to enhance its relevance and usage.

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