Cloud Computing for Building Effective Information Systems for Banking

Literature Review

1) Introduction

1.1 Introduction and Scope

The topic of this literature review is ‘Cloud Computing for building effective information systems for the Banking Sector’. Cloud computing is an important topic. In 2019 more than a third of organisations saw the cloud as one of their top three priorities, and the public cloud market is estimated to be worth 266 billion USD in 2020 (Stein et al, 2020).

A number of papers found during this review, used the National Institute of Standards and Technology (NIST) for the definition of cloud computing (Zhao et al, 2022) and (Stewart, 2021). NIST defines cloud computing as providing on-demand computing services over the internet, which results in rapid innovation, agile resources and economies of scale (Stewart, 2021).

The banking sector has been selected, within the context of cloud computing, because of the challenges which banks face, which can impact migration to the cloud. These challenges include security and privacy issues. Banking is highly regulated and different regulatory requirements have to be taken into consideration, such as the general data protection regulation (GDPR) (Cheng et al, 2022).

When analysing cloud computing for building effective banking information systems, challenges and potential issues need to be considered, which can impact the effectiveness of a cloud deployment.

1.2 Literature Search Methodology

The literature review used a variety of tools to search for the relevant literature, due to search engine biases. The sources used were Google Scholar, Science Direct, IEEE, Springer Link and the Wiley Library. For Google Scholar, all the results were reviewed until the keywords no longer matched, so that the analysis wasn't influenced by the order in which searchers were returned. Only articles from journals and books were included in the literature review.

The following keywords were used for the search criteria 'bank' and 'cloud'. A manual search approach was used. Because of the fast pace at which the cloud is being adopted and is maturing, literature from 2020 to 2023 only was included, to ensure that it was up to date and relevant. The articles excluded were specific to developing countries, as defined by the International Monetary Fund, as these were thought to be less relevant. Two articles were excluded which focused on Iran and Ethiopia.

1.3 Definition of Cloud Computing

The cloud has three service models, which are SaaS, PaaS and IaaS, and four deployment models, the Private cloud, Public cloud, Community cloud and Hybrid cloud (Zhao et al, 2022). The IaaS service model is a model where the customer has access to the infrastructure services of the cloud, so processing power, storage and networking (Stewart, 2021). PaaS is where the customer uses the cloud to run applications, and the cloud provides development tools. In the SaaS model a customer uses software applications that run and are maintained in the cloud (Stewart, 2021).

The private cloud provides a customer with exclusive use of the cloud infrastructure (Zhao et al, 2022). The public cloud is available to the general public. The Community cloud is a multi-tenant system where different companies can collaborate on the same platform (Zhao et al, 2022). The hybrid cloud is made up of three or more cloud infrastructures which are linked together to facilitate data transfer (Zhao et al, 2022).

2. Literature Review Main Findings

The below papers were selected by searching for the keywords ‘bank’ and ‘cloud’ using the resources listed previously. The year range selected was 2020 to 2023. This returned 52 relevant papers, of which 7 were selected.

All of the relevant reviews described the benefits of cloud computing for banking and also the challenges. This was the framework which was used. Below is the list of the 7 most relevant papers selected:

Reference	Title
Vinoth et al, 2021	Application of cloud computing in banking and e-commerce and related security threats
Rana et al, 2023	The Role and Potential Applications of Cloud Computing in the Banking Industry
Cheng et al, 2022	Is cloud computing the digital solution to the future of banking?

Reference	Title
Mahalle et al, 2021	Challenges and Mitigation for Application Deployment over SaaS platform in Banking and Financial Services Industry
Kaya et al, 2020	The Banking Industry Underestimates Costs of Cloud Migrations
Oberoi et al, 2021	Cloud Computing in Banking Sector – A Case Study
Karmakar et al, 2022	Cloud Computing Application: Research challenges and opportunity

2.1 Cloud Benefits for Banking

In terms of the benefits of the cloud, the literature was consistent. Vinoth et al, 2021 mentioned on-demand self-service, broad network access, resource pooling, elasticity, usage based billing, cost savings, business continuity support, business agility and energy saving (Vinoth et al, 2021). Rana et al, 2023, also stated that costs are saved because banks do not need to buy data centres, storage devices and servers, also maintenance costs are limited, and there is a high degree of automation, and the cloud caters for demand spikes. Cheng et al, 2022, analysed cloud adoption from the perspective of Chinese banks and found that cloud adoption leads to lower costs and higher profit, because the 'pay as you go' model is more cost efficient and the cost of capital expenditure is saved. Cheng et al, 2022, also claim that cloud infrastructure is more reliable and can reduce the risk of privacy and security issues. An important point raised by Cheng et al, 2022, is that cloud adoption makes it easier to leverage emerging technologies, such as artificial intelligence and blockchain. Oberoi et al, 2021, also agreed that the cloud is cost

effective because capital expense is reduced, and productivity is greater because of the reduction in infrastructure management. Karmakar et al, 2022, also acknowledge that cloud adoption increases efficiency in the banking sector.

2.2 Banking Challenges for Cloud Adoption

The literature also covered the challenges of migrating to the cloud, three common themes were security and privacy, cyber risk and loss of control. Rana et al (2023), Cheng et al (2022), Karmakar et al (2022) all described the increased risk from a security and privacy perspective. Rana et al (2023) states that data security is of critical importance to banking, as well as describing the issues related to where data is physically located and its importance from a regulatory perspective. The physical location of data as a regulatory requirement is also part of the paper by Cheng et al (2022).

Vinoth et al (2021), Cheng et al (2022), Mahalle et al (2021) and Karmakar et al (2022) all mention the challenge of cyber risk in a cloud environment, and refer to data breaches, fraud, insider threats, malware and human mistakes. However all of these cyber threats could also apply to non-cloud applications, there was no evidence that cloud adoption increased the risk. The third theme was loss of control, which is referred to by Vinoth et al (2021) and Mahalle et al (2021).

A critical point covered by two studies was the significant cost involved in migrating to the cloud, it was surprising that this issue had not been covered by the other studies (Cheng et al, 2022), (Kaya et al, 2020). The study by Kaya et al (2020) involved the analysis of ten international corporate banks, and the methodology used was to interview key individuals who had been involved in cloud adoption projects.

3. Critical Literature Review

Across the studies there was a lack of analysis of specific cloud migrations. As an example on the Oracle website it lists 59 banks which are using Oracle Cloud, and some of these will be leveraging a SaaS model (Oracle, 2023). Only one study involved interviewing key staff within a broad range of banks.

Rana et al (2023) state that cloud service can be purchased without the need for up front investment. However, this is too simplistic, up-front investment will be required to migrate data, and for cutting over to the cloud the normal testing phases will be required. A data migration will involve user acceptance testing, and often testing with downstream consumers of the data.

4. Limitations of the existing Literature Frameworks

The first step in the literature review was to search for previous up to date literature reviews by using the following keywords ‘banking’, ‘cloud’ and ‘literature review’ and the date range 2020 to 2023, using google scholar. This returned a total of 6 matches. The objective was to analyse the literature categorisation or framework.

The most comprehensive literature review out of the six was by Adwan et al, 2022. Other literature reviews were not considered to be broad enough. The Adnan et al (2022) review covers the period from 2011 to 2021, which resulted in 27 directly relevant papers, with 14 frameworks or models, the models were based on geographical location (Adwan et al, 2022). Country isn’t an appropriate framework, larger banks are global, and may centralise systems in one country or distribute them globally.

There were no papers found during the literature review which used the categorisation of different types of banking systems, which would be more relevant

as a categorization. A framework for banking needs to be based on different system types, each category of system will have different requirements in terms of privacy, availability, performance, security, regulatory requirements and the degree to which a system provides competitive advantage to the bank. A large bank will have thousands of systems, some more suitable than others to migrate to the cloud, and the cloud will be more effective for some system types than others. And so I would propose a framework based on banking applications system category, with the system requirements of privacy, availability, performance, security, regulatory requirements, system competitive advantage, business continuity and disaster recovery as part of the framework. These factors will drive cloud adoption. As an example within banking migrating Microsoft office to the cloud is going to be less costly than other applications, because of the standard format. Human resources systems will contain sensitive data under GDPR, and so privacy and security will be key. Within trading there will be applications which provide competitive advantage, such as algorithmic trading applications, performance here will be key, and these will probably not be candidates for moving to the cloud, because of the risks involved.

5. Conclusion

Adwan et al, 2022, state that there is a lack of research on practical frameworks for cloud adoption in the banking industry, which is evident from this analysis.

A literature review framework based on location for banking isn't relevant, because the majority of banks are global, and have a presence in multiple countries. This literature review has proposed a framework for banking based on specific system types, and also the system requirements of privacy, availability, performance,

security, regulatory requirements, system competitive advantage, business continuity and disaster recovery. This literature review found that all system types for banks were categorised together.

With the current literature it is not feasible to demonstrate how effective cloud computing has been within banking. The literature reviews point to the fact that one of the advantages of cloud adoption is cost saving and an increase in efficiency or effectiveness, but there are no specific banking examples provided as evidence.

In terms of future research topics, a specific cloud banking framework based on system and key cloud requirements would provide transparency into how effective cloud adoption has been. Another future research topic is what defines effectiveness within banking, as an example is it based on profit or the reduction of regulatory risk? A number of the literature reviews referred to the benefit of the cloud in terms of emerging technologies, and this is another research gap, in terms of banking.

The literature reviews also mentioned the benefits to banking of cloud adoption and emerging technologies, such as AI and blockchain. One way that AI could help the cloud adoption process for banks is to analyse and then convert the data from legacy systems, this is another future research area.

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