

**The challenges of implementing cloud computing in
the South African financial sector**

Applied Research Project

submitted by

Kudzayi Dume

Student number: 2356447

Tel: 084 312 9468

Email: 2356447@students.wits.ac.za

Proposed Supervisor:

Ayanda Magida

Wits Business School

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ABSTRACT

This study aimed to explore the implementing challenges of cloud computing in the South African financial services sector, the interrelationships of the challenges and additional challenges.

The study sought to address three questions which are as follows, (1) What are the challenges of implementing cloud computing in the financial services sector? (2) What are the interrelationships between cloud computing challenges? (3) What are the other ranked challenges of implementing cloud computing in the financial services sector?

To answer these questions, the study explored Scaled Agile Framework (SAFe), an agile and lean methodology. The framework is for scaling large organisations, including the financial services sector. According to the conceptual model, the six identified cloud computing implementation challenges were assumed to be affecting SAFe.

The conceptual model was tested based on an online survey using Qualtrics. The collected responses were analysed using Statistical Package for the Social Sciences (SPSS) software. The data analysed was from seventy-six cloud computing users from South Africa financial services sector. The research findings showed that the challenges of implementing cloud computing had an impact on the South African financial services sector. Although the research questions were answered, the identified challenges of implementing cloud computing in the financial services sector were not all aligned with the opinions of the literature review. The details of the study can be used as a guide in implementing cloud computing solution in the financial services sector to reduce failure rate.

DEDICATION

I dedicate this to study to God for blessing me and providing me with strength and perseverance.

In addition, I dedicate this study to my son, Anesu for his love and support.

ACKNOWLEDGEMENTS

Firstly, I would like to acknowledge my supervisor Ms Ayanda Magida for the academic support and guidance during this project.

In addition, I would like to acknowledge my colleagues at University of Witwatersrand Business School for the encouragement and academic support through the tough days.

To my son Anesu, I would like to thank you for your support and understanding during this academic journey.

DECLARATION

I, Kudzayi Dume, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

KUDZAYI DUME

(Type your name in full here, and sign in the space above)

Signed atK.D.....

On the day of ...31/03/2022.....

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Chapter 1: Introduction

1.1 Background and context of the study

It was predicted that 49% of the world's stored data can have existence in the cloud environment by 2025 (Rydning, 2018). Cloud computing has become a major part of emerging technologies making it important to the future of financial services sector (Rydning, 2018). The financial services sector is faced with changing customer expectations and new business models demanding the migration to cloud computing from traditional systems (Rydning, 2018). In addition, different cloud computing products such as Amazon and Microsoft Azure have been compared to guide the cost and application performance limitations for different cloud computing implementation scenarios (Svantesson & Clarke, 2010). Organisations in India noted that financial support, data competency, organisation structure, change management, and management commitment to data analytics and cloud computing are fundamental (Lamba & Singh, 2018). Furthermore, the Bangladeshi manufacturing sector faced challenges of poor infrastructure, high cost of investments, data integration, and privacy (Moktadir, Ali, Paul, & Shukla, 2019). The challenges and benefits of the cloud to analyse data are highlighted for analysis systems such as planet analysis systems and related fields of science (Yang, Huang, Li, Liu, & Hu, 2017). The benefits and issues of cloud computing were outlined in mass production and service industries (Zhong, Newman, Huang, & Lan, 2016).

The use of cloud computing increased the degree of agile mass production activities, and the slow implementation of cloud computing contributed to not achieving better performance objectives, leading to market instability that has a bad effect (Gunasekaran, 2017). Organisation agility is required to achieve performance, and cloud computing helped address the changing customers' needs (Kitchens, Dobolyi, Li, & Abbasi, 2018). It was found that information technology capabilities increase organisation agility (Lu & Ramamurthy, 2011; Tallon, 2008).

1.2 Purpose of the study

This research analysed the challenges of implementing cloud computing in the financial services sector in South Africa. The list of challenges analysed were collected from articles available in the cloud computing environment. The study pursued to collect a list of additional challenges in implementing cloud computing in the financial services sector that had not been identified in the sources of this study. The challenges were ranked in order of relevance. The study also aimed to identify the interrelationship of the identified challenges analysed in this research. To better analyse the challenges of cloud computing in the financial services sector, an agile or lean methodology was utilised as financial services sector was having to act like technology organisations. Scaled agile framework (SAFe) was the methodology used to analyse the organisation agility of the financial service sector. The study results can guide implementing cloud computing in the financial services sector, which was essential to stakeholders.

1.3 Research Problem

No specific study was found that has been carried out in the South African financial services sector on the challenges of implementing cloud computing. Cloud computing development has been a fast-growing technology; despite having many benefits, many challenges have also been faced in organisations (Zhang, Cheng, & Boutaba, 2010). Many organisations have implemented cloud computing, however, not much academic research has been done to understand the challenges in cloud computing (Hashem et al., 2015). This study investigated the challenges of implementing cloud computing within the South African financial services sector.

1.4 Research Questions

- What are the challenges of implementing cloud computing in the South African financial services sector?
- What are the interrelationships between cloud computing challenges?

- What are the other ranked challenges of implementing cloud computing in the South African financial services sector?

1.5 Significance of the study

Cloud computing usage in organisations has been increasing, and its value has limited decision-makers and organisation employees who cannot understand the technology (Labrinidis, 2012). Cloud datacentres are becoming the new enterprise data repository as organisations pursue the cloud (Rydning, 2018).

The significance of this study was to contribute to the knowledge on the challenges of implementing cloud computing in the South African financial services sector. It also included interrelationships of challenges and additional challenges. The study also informed stakeholders of the challenges that lie ahead of cloud computing.

1.6 Delimitations of the study

- The online survey focused on organisations in the financial services sector in South Africa.
- The survey was limited to the respondents' population of cloud computing professionals and users of the cloud systems.
- The respondents were sampled from a various range of backgrounds and experiences.

1.7 Assumptions of the study

The following assumptions were made:

- The respondents reside in South Africa.
- The respondents provided truthful views based on their actual situations.

- The respondents agreed to respond honestly and accurately to the survey.
- The respondents had deep knowledge about the topic.

1.8 Chapter outline

The chapters and data covered in each chapter is outlined below:

1.8.1 Chapter 1: Introduction

This chapter introduced the background and context of the research. It outlined the purpose of the research. This was followed by the research problem that was, the challenges of implementing cloud computing in the financial services sector. Then the research problem and research questions. The chapter also included the study's significance, delimitations and assumptions and concluded with the outline of chapters.

1.8.2 Chapter 2: Literature Review

This chapter explains the literature review from previous research directing the source of this research: the challenges of cloud computing implementation in the financial service sector. The chapter was detailed into five sections. Section 2.1 discussed the literature on scaled agile framework (SAFe), which included portfolio, team, values stream and program, and section 2.2 outlined the literature on cloud computing, such as its characteristics, service models and deploying models. Section 2.3 highlighted challenges in cloud computing and hypothesis in this research, such as lack of skills and data quality, to highlight a few. Section 2.4 identified the conceptual model directing the study.

1.8.3 Chapter 3: Research Methodology

This chapter discussed the research approach in 3.1 and the research design in 3.2. this was followed by section 3.3 on population and sampling, followed by data

collection in section 3.4. Section 3.5, 3.6, 3.7, and 3.8 discussed data instrument, data analysis and interpretation, validity and reliability, and ethical considerations.

1.8.4 Chapter 4: Presentation of Results

In this chapter section 4.1 discussed introduction and section 4.2 profile of respondents. Section 4.3 showed results pertaining to hypothesis 1 and 2 and section 4.4 results pertaining to hypothesis 3. This was followed by section 4.5 which highlights factor analysis and section 4.6 structural equation modelling. Section 4.7 was the conclusion.

1.8.5 Chapter 5: Discussion of Results

This chapter discussed the results presented in Chapter 4 of the hypotheses of the study. Section 5.1, 5.2 and 5.3 are discussions pertaining to hypothesis 1, 2 and 3 respectively. Section 5.4 was the conclusion of the results discussion.

1.8.6 Chapter 6: Conclusion and Recommendation

This chapter highlighted the conclusion and recommendation of the study. Section 6.1 that highlighted the conclusion of the study. Section 6.2 explained the limitation of the study and section 6.3 explained the recommendation. Section 6.4 described the suggestions of future research.

Chapter 2: Literature Review

2.1 Scaled Agile Framework (SAFe)

Scaled Agile Framework (SAFe) enables and supports growth in large organisations through agile methods (Alqudah & Razali, 2016). The framework has become popular in large organisations and the South African financial services sector has adopted SAFe (Putta, Paasivaara, & Lassenius, 2018). Dean Leffingwell and his associates created Scaled Agile Framework (SAFe) which combines Agile and Lean methodologies across four levels: portfolio, program, value stream or solution and team (Alqudah & Razali, 2016). The four levels and some activities and roles are shown in Figure 1 below.

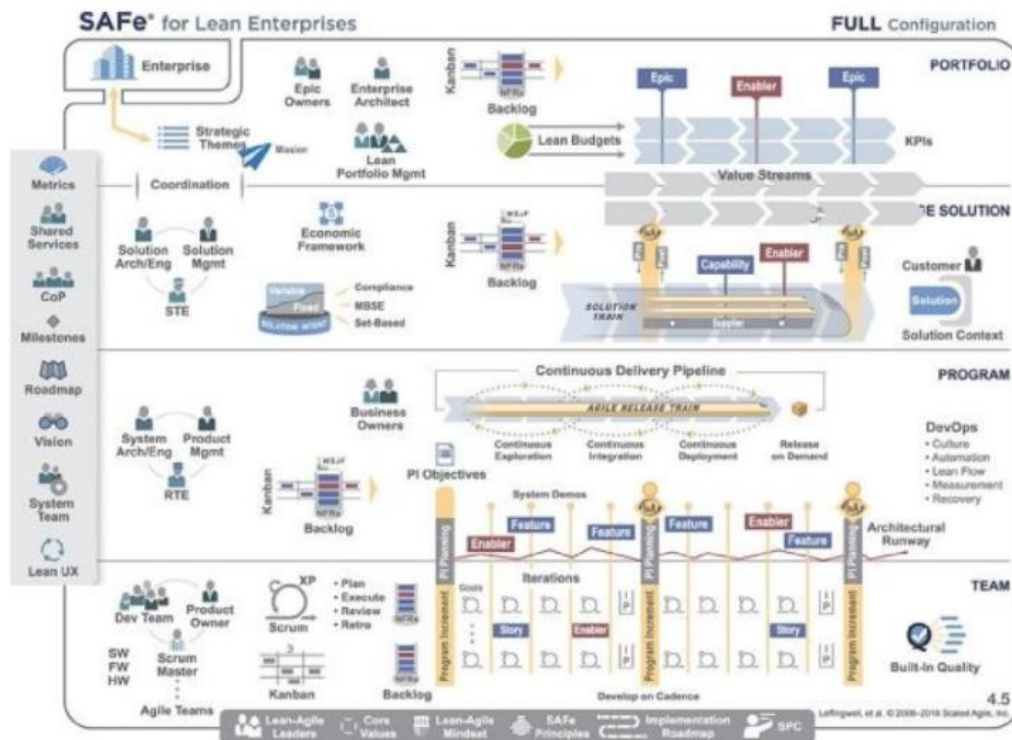


Figure 2-1: SAFe Framework (Knaster & Leffingwell, 2018).

Portfolio

At the portfolio level, the teams have a focus on new ideas (Alqudah & Razali, 2016). There are epics which are initiatives that go beyond all levels of the

organisation, such as the visions of the higher levels to ascertain development projects in the lower levels are used at this level (Alqudah & Razali, 2016). The Portfolio level is used to align the value streams to meet the portfolio's business objectives and financial targets and the organisation through program portfolio management (Alqudah & Razali, 2016).

Program

A program consists of five to twelve teams or fifty to one hundred and twenty-five individuals that are assigned to the program (Alqudah & Razali, 2016). Programs are aimed at developing items such as a vision, roadmaps, and features which provide business value (Alqudah & Razali, 2016). An Agile Release Train (ART) organises the agile teams (Alqudah & Razali, 2016).

Value Stream

The Value stream level is used by organisations that need additional roles to combine the work of complex systems that are reliant on each other (Alqudah & Razali, 2016). Release management and economic frameworks work together to align multiple ARTs and value streams (Alqudah & Razali, 2016). Value Stream levels are used to ensure that multiple teams remain aligned (Alqudah & Razali, 2016).

Team

The team are comprised of five to nine individuals, including a scrum master and product owner who work to deliver functional systems every two weeks (Alqudah & Razali, 2016). User stories are applied to the development work (Alqudah & Razali, 2016).

2.1.1 Benefits of SAFe

SAFe has enabled organisations to increase quality, employee engagement, productivity and time-to-market (Knaster & Leffingwell, 2018). Quality increased the capability to innovate and increased customer satisfaction (Knaster & Leffingwell,

2018). Organisations that used SAFe experienced fast, compelling increased solution quality and faster more certain value delivery (Knaster & Leffingwell, 2018). Productivity was essential for teams within organisations as individuals thrive when contributing more to work than when doing less inefficient work (Knaster & Leffingwell, 2018). SAFe improved employee engagement, thereby increasing organisational performance (Knaster & Leffingwell, 2018). First-mover advantages and high margins have been achieved through SAFe enabling the organisation to rapidly provide value to the market (Knaster & Leffingwell, 2018).

2.2 Cloud Computing

The concept of cloud computing was not new, as suggested in previous virtualisation research, despite unique characteristics separating cloud computing from virtualisation (Gong, Liu, Zhang, Chen, & Gong, 2010). Cloud computing was a model that enables omnipresent, convenient, and on-demand network access for resource pooling of configurable computer resources, which can be provisioned and decommissioned quickly with minimal administrative effort or service provider interaction (Mell & Grance, 2011). It was a new paradigm provided through the internet as an on-demand web service that expanded computing resources (Goscinski & Brock, 2010). In addition, cloud computing was both hardware and software systems in datacentres that provided services for applications delivered as services over the internet (Armbrust et al., 2009).

The advent of Service Oriented Architecture (SOA) allowed organisations to share the physical and non-physical aspects of their information technology (IT) infrastructure (Bello et al., 2020). Examples of SOA include Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), extensible Markup Language (XML) and Universal Description, Discovery and Integration (UDDI) (Endrei et al., 2004). Cloud services were delivered through a cloud client that consisted of computer software and hardware and relied on cloud computing (Mathur & Nishchal, 2010).

2.2.1 Characteristic of Cloud Computing

According to the literature on cloud computing, there are five characteristics of cloud computing, and these are discussed in detail below:

On-demand self-service, the individual provision computing features that do not require face to face intervention with the service provider for server time and network storage (Mell & Grance, 2011). It provided computing capabilities automatically to users through the web service portal (Bello et al., 2020)

Broad network access, the computing infrastructure has multiple locations, and cloud services can be accessed using any device via the internet or local area network (LAN) (Bello et al., 2020). It utilised standard protocols and mechanisms (Grobauer, Walloschek, & Stocker, 2010). Varied thin or thick client platforms are promoted by broad network access (Mell & Grance, 2011).

Resource pooling can respond to many users and applications through a multi-tenant infrastructure that allows for sharing of the same computing infrastructure, thereby ensuring individual privacy and security (Bello et al., 2020). This allowed cloud service providers to invest in the best technologies and provide focused expertise (Grobauer et al., 2010). Resource pooling s customers to specify the location with a higher level of abstraction as its position is independent; therefore, they generally do not have control of the precise location of the resources provided (Mell & Grance, 2011).

Rapid elasticity allows users to increase or decrease their demand for computing resources at the time of demand by using services such as the Just-in-time (JIT) service. (Bello et al., 2020). The features available to customers are often seemingly unlimited, allowing them to allocate an amount at any time (Mell & Grance, 2011). To meet the expanding system performance needs, cloud users have been extending the services they receive from their providers (Sabharwal & Wali, 2013).

Measured service is measured usage of cloud resources at month-end to ensure accurate usage. It has the same use as users of electricity and water that pay bills for service received (Bello et al., 2020). It monitors and reports on resource usage,

providing transparency to both providers and customers of service (Mell & Grance, 2011).

2.2.2 Service Models

Cloud computing has three layers: software as a service, platform as a service, and infrastructure as a service (Hwang, Dongarra, & Fox, 2013).

Software as a Service (SaaS) eliminates the need to install and run the application on users system as it has delivery over the internet (Mathur & Nishchal, 2010). Centralised locations manage the network-based access and management of commercially available software, enabling customers remote access through the internet (Mathur & Nishchal, 2010). Applications are made available on a range of client devices through one of the thin client interfaces such as the web browser (Mell & Grance, 2011). Salesforce.com, Microsoft, IBM and Oracle are examples of key providers of SaaS (Rimal, Choi, & Lumb, 2009).

Platform as a Service (PaaS) uses cloud infrastructure to deploy a computing platform and all the applications that a customer would typically require (Rimal et al., 2009). Service developers such as GAE and Microsoft Azure access software life cycle such as developing, testing, and deploying (Rimal et al., 2009). In addition, the functionality provided to the customer to deploy cloud infrastructure is created using programming languages, libraries, services and tools (Mell & Grance, 2011).

Infrastructure as a Service (IaaS) provides the infrastructure required by the customer as a service, and the customer does not need to purchase servers, data centres and network resources (Rimal et al., 2009). The functionality provided to customers has provision for processing, storage, networks, and other basic computing resources that customers distribute and perform, such as software for operating systems and applications (Mell & Grance, 2011). The customers pay for only the time duration they use the service, with examples of IaaS such as GoGrid and Flexiscale (Rimal et al., 2009).

2.2.3 Deployment Models

Cloud architecture comprises four deployment models: private, community, public, and hybrid (Zissis & Lekkas, 2012).

Private cloud is an outsourced third party or the organisation is provided with the cloud infrastructure which it may own, manage and operate on or off premises for its many customers (Mell & Grance, 2011).

Public cloud is also hosted, owned and operated by a third party or the organisations providing unlimited memory storage and increased data transmission through the internet (Grossman, 2009). The infrastructure is provisioned for public use and can be owned, managed, and operated by businesses, academia, governmental organisations or a combination (Mell & Grance, 2011).

Hybrid Cloud is a cloud infrastructure of two or more disparate cloud infrastructures joined by patented technologies that remain distinct entities but enable portability for data and applications (Mell & Grance, 2011).

Community Cloud is provisioned for private use by a specific consumer community that shares concerns (Mell & Grance, 2011). It has managed, owned and operated by multiple organisations in the community or third parties (Mell & Grance, 2011).

2.3 Challenges of Implementing Cloud Computing

The cloud computing implementing challenges identified are as follows

2.3.1 Lack of Skills

The potential difficulties of using the cloud are inexperienced employees (Schoenherr & Speier-Pero, 2015). The capability of which cloud centres are enabled is determined by employees' skills in inputting and analysing the data (Richey, Morgan, Lindsey-Hall, & Adams, 2016). Most organisations have not built their skills on cloud computing and their skill sets are not the same as on legacy

systems (Russom, 2011). Lack of experience in cloud computing are a significant issue (Richey et al., 2016). Due to the lack in skills there are issues in end user usability and difficulty in system architecting (Russom, 2011). For example, a data scientist would need to have expertise in analytical and domain skills, which are difficult to find as a good analyst cannot have interest in domain knowledge (Waller & Fawcett, 2013).

Hypothesis 1: H₁

There is a positive relationship between lack of skills and SAFe.

2.3.2 Cost Management

Obtaining financial benefits has been difficult as it relies primarily on the downstream users who perform the task (Davenport, Harris, De Long, & Jacobson, 2001). Returns of investment (ROI) made are difficult to establish when implementation fails, which results in loss of confidence in the technology (Richey et al., 2016). An example is that a market segment can be based on data analytics; however, to make a significant change, a marketing team must believe in data-driven insights and treat customers based on the market segment (Davenport et al., 2001). This leaves stakeholders uneasy about the implementation because of unclear advantages and ambiguities in ROI (Richey et al., 2016).

Hypothesis 2: H₂

There is a positive relationship between cost management and SAFe

2.3.3 Data Scalability

The varied data sets that have been collected will need to be stored and managed and provide function and performance assurance in terms of scalability (Hu, Wen, Chua, & Li, 2014). Due to the diversity and vast amount of varied data sources, it has been difficult to collect and integrate extensible data in distributed locations (Hu et al., 2014). Old data needs to be archived, and the new data generated requires using cloud computing capabilities (Richey et al., 2016). Cloud computing

capabilities has tackled scalability problems to accommodate the increase in data size (Richey et al., 2016). However, the cost increases when cloud computing storage increases, eventually increasing the financial burden on organisations (ur Rehman, Chang, Batool, & Wah, 2016).

Hypothesis 3: H₃

There is a positive relationship between data scalability and SAFe.

2.3.4 Security

The risks of security infrastructure are on the three major domains of visualisation, network and physical (Vaquero, Rodero-Merino, & Morán, 2011). The security risks are related to cloud service models (Subashini & Kavitha, 2011). The risk was analysed as part of the underlying technology and user-specific security requirements (Grobauer et al., 2010; Zissis & Lekkas, 2012).

Hypothesis 4: H₄

There is a positive relationship between security and privacy and SAFe

2.3.5 Privacy

The cloud's distinctive privacy challenges are data and application outsourcing (Takabi, Joshi, & Ahn, 2010). Privacy and unethical use of data are an issue that is associated with implementation (Hashem et al., 2015).

Hypothesis 5: H₅

There is a positive relationship between security and privacy and SAFe

2.3.6 Data quality

Poor data quality has been a serious problem for cloud service providers as data is frequently collected from other sources (Hashem et al., 2015). There was a dependence on data-driven insights for reasons such as optimisation, process

control and monitoring to obtain a competitive advantage (Davenport et al., 2001). The quality and accuracy of data was less controllable; therefore, obtaining the trustworthiness of data was a significant issue in organisations to obtain great value of cloud computing (Tan, Zhan, Ji, Ye, & Chang, 2015). Furthermore decision-making was affected by the good quality of data as it comprised data analysis (Hashem et al., 2015).

Hypothesis 6: H₆

There is a positive relationship between data quality and SAFe.

2.4 Conceptual Model

Below figure 2 shows the conceptual model of the challenges of cloud computing on SAFe. The arrows from the six challenges to SAFe show the relationship examined in the study. The arrow from SAFe to other challenges shows a relationship with additional challenges. The dashed line around the six challenges shows the interrelationship of the challenges.

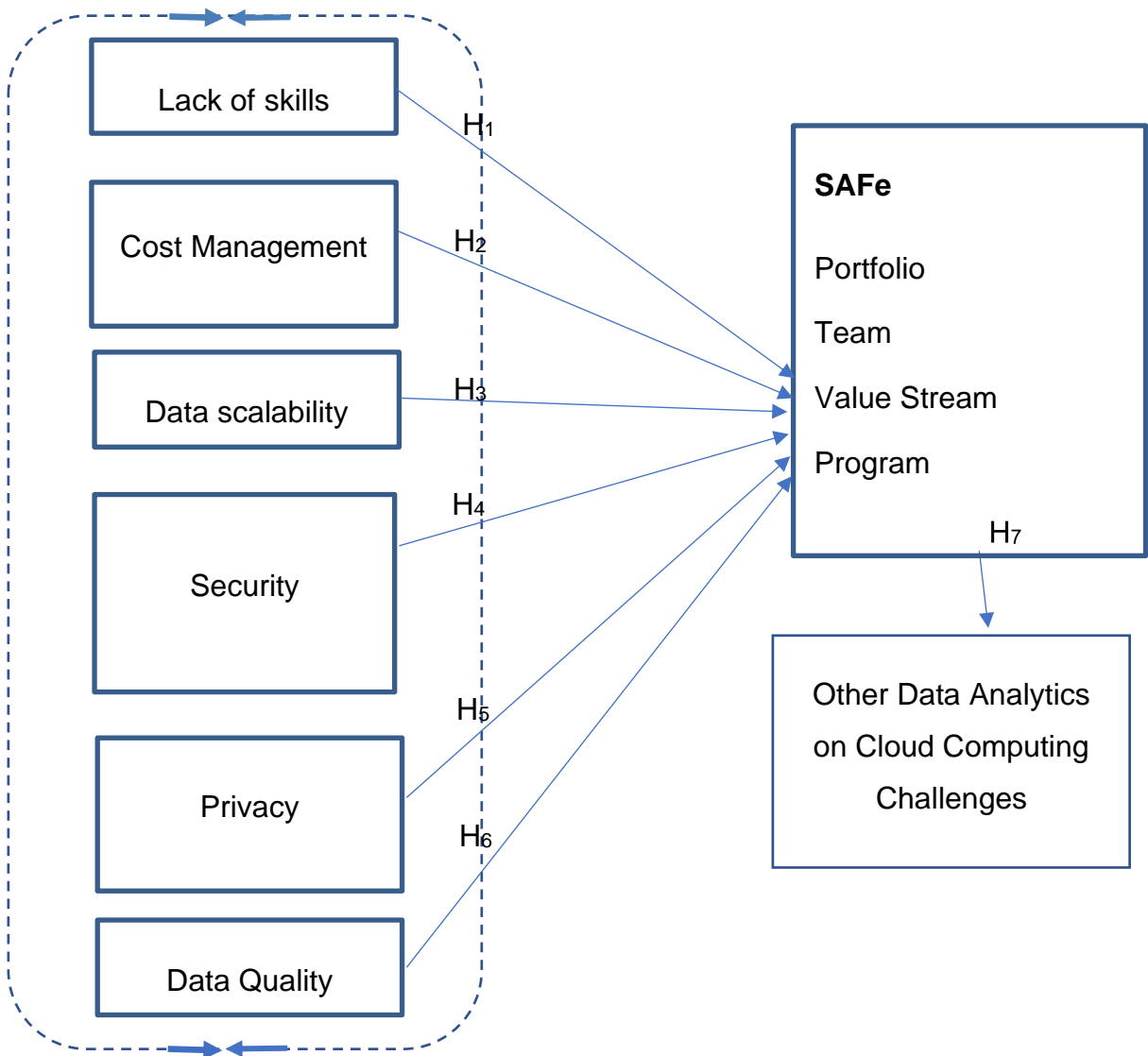


Figure 2.2 Conceptual model

Chapter 3: Research Methodology

3.1 Research Approach

The research approach selected for this study was quantitative because it allowed for deductive reasoning. Several researchers have followed a deductive perceptive or rational analysis to research problems in information technology (Campbell & Stanley, 2015). A meta-analysis, replication research and evaluations studies contribute to empirical generalisation of the findings that involve quantitative modes of discovery (Counsell & Harlow, 2017). Quantitative methods are used to test hypotheses, determine relationships between variables, and measure observations' frequency and percentages (Bowling, 2014). The quantitative approach allows for the generalisation of the sample population to a bigger population.

3.2 Research design

This research used an online survey research design, as it was effective and useful for non-experimental research (Blundell & Costa Dias, 2000). In addition, online survey research technology was new and advancing (Nayak, 2019). It was much easier and faster due to the use of software packages and services (Nayak, 2019). There are advantages and disadvantages of online survey data collection.

Advantages comprise of individuals not been exposed during surveys giving it an ethical advantage (Mathers, Fox, & Hunn, 2009). Respondents may respond without feeling unnecessary influence or pressure in surveys (Mathers et al., 2009). A survey can reach a wide selection of respondents in far places and results of the sample can represent the whole population (Wright, 2005). Using an online survey was convenient and reduced time and effort by having automated data collection (Wright, 2005). Another of the advantage was questions used are internal and external validated (Mathers et al., 2009). Disadvantages include indecision of the validity of the data and sampling problems (Wright, 2005). There are concerns of the online survey design, execution, and evaluation (Wright, 2005).

3.3 Population and Sampling

3.3.1 Population

The survey respondents were members of cloud computing knowledge-sharing communities and employees working with cloud computing and knowledgeable of cloud computing technologies in the financial services sector. These included managers, solutions architecture, business users, data analyst, business intelligence developers, and other solutions implementations.

3.3.2 Sampling

Sampling has been classified into probability sampling and non-probability sampling (van den Bergh et al., 2012). Probability sampling are simple, systematic, or random, cluster, and multi-stage (Rajkoomar, 2013). Whilst non-probability sampling or qualitative sampling includes snowball, purposive, self, convenient and quota sampling (Rajkoomar, 2013)

The number of respondents was seventy-six respondents. The participants were project managers, technical leads, data analysts, business users and CIOs in the financial services sector.

3.4 Data Collection

The data collection was depended on an online web survey tool to distribute the questions. The questions were available through a survey platform called Qualtrics. After accepting to be part of the study, the respondents had access to the survey. The survey link was distributed to respondents on social media platforms such as LinkedIn or via email.

3.5 Research instrument

The research instrument used was an online survey with questions focused on collecting data to answer the research questions. The survey consisted of five

sections. The first section was the participation information sheet that informed participant benefits and information of the study followed by the consent form in the second section. Demographic data was outlined in the third section, it requested respondents to provide demographic information such as gender, education qualification, type of financial services sector and work experience. The fourth section covered cloud computing challenges on SAFe. The fifth section outlined SAFe. All the items were measured on a 5-point Likert scale ranging from strongly agree (1) to strongly disagree (5).

The finale section allowed to list additional cloud computing challenges that were not the main challenges analysed in the research and asked participants to rank them according to relevance.

3.6 Data Analysis and Interpretation

The analysis was done using the statistical software SPSS. Descriptive statistics such as standard deviations and means and inferential statistics such as ANOVA test and t-test was used. Linear regression analysis estimated the linear equation involving the independent variables that was the six challenges of cloud computing. The independent variables could best predict the dependent variable, which was scaled agile framework (SAFe). Missing responses verification and clean-up was done through SPSS.

3.7 Validity and Reliability

The research instruments and survey questions were tested through pilot study (Polit, 2015). To ensure data collection's validity and reliability, the survey was pilot tested. During the pilot test, 10 members of the cloud computing community were surveyed. The group represented members of the sample population mentioned earlier. The ten members did not participate in the final survey.

3.8 Ethical Consideration

Participants' rights and integrity in the research were protected (Gilbert & Stoneman, 2015). The participants' rights of the respondents were respected, as ethical consideration was critical for the research. The respondents were given a choice to either respond or not to respond to the survey. The University of Witwatersrand ethics committee also authorised the study to provide ethical clearance.

Chapter 4: Presentation of Results

4.1 Introduction

The presentation of the results follows the design of the online survey. The data presented was using analysis tools such as graphs, charts, tables, measures of correlations and reliability. Analysis tools presentation displayed the patterns form the collected data.

4.2 Profile of Respondents

4.2.1 Respondents highest level of education

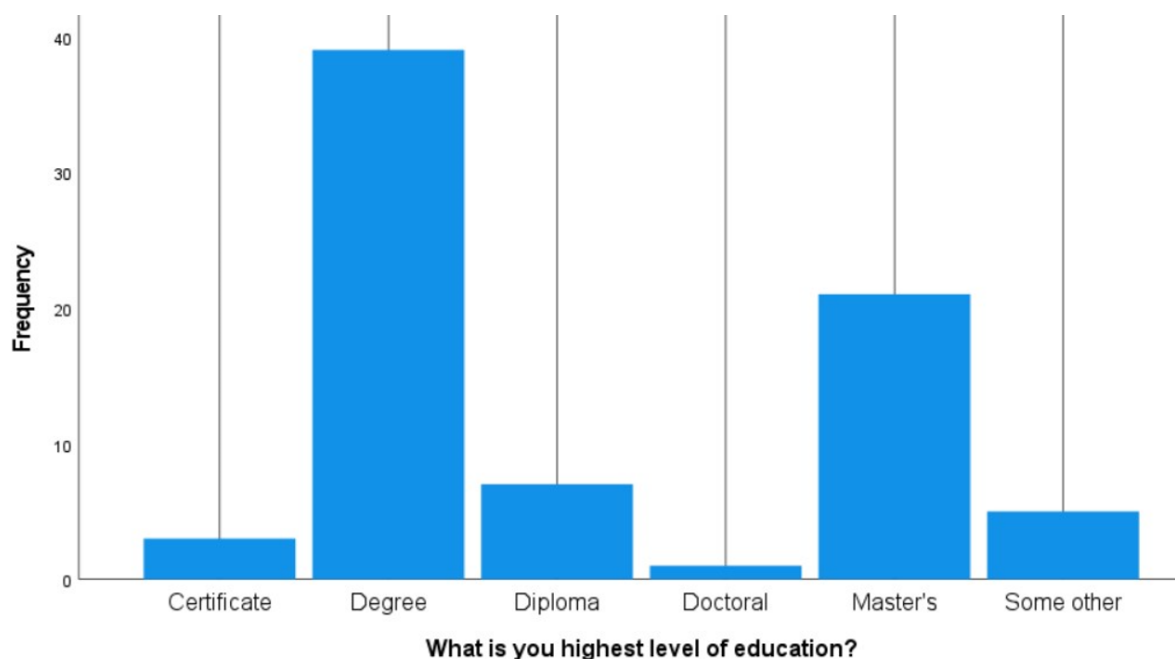


Figure 4-1: Level of education

From graph 4-1 above, most of the respondents had obtained a degree, followed by respondents that had obtained a master's degree. The least number of respondents had obtained a doctorate. The remaining respondent had a certificate, diploma, or other qualifications.

4.2.2 Gender of respondents

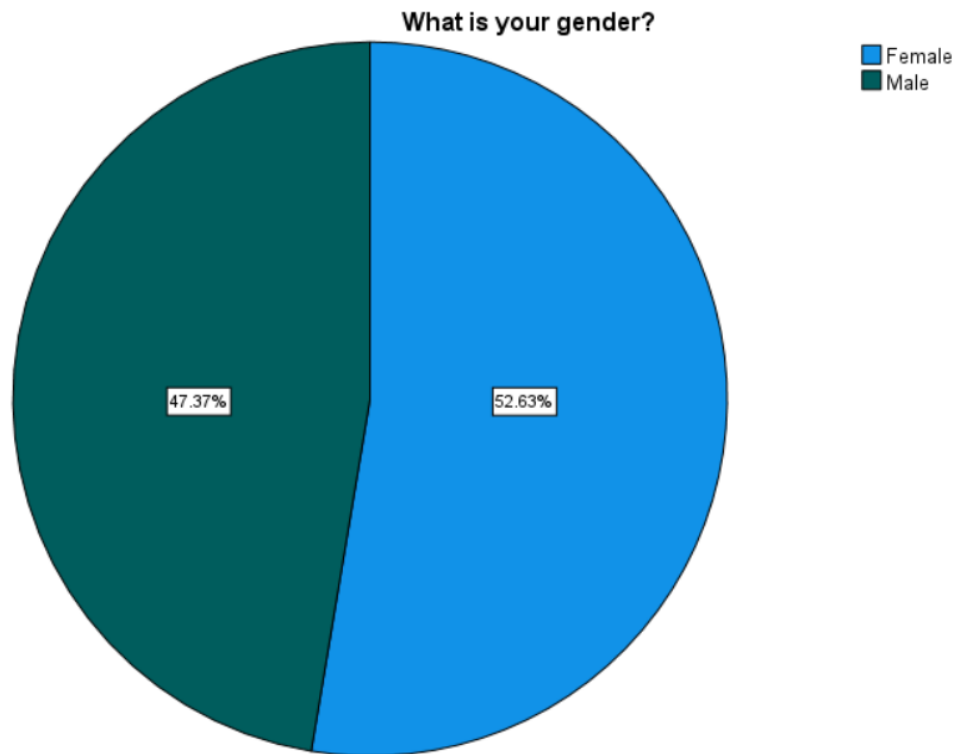


Figure 4-2: Gender

From figures 4-2 above, females were the bigger proportion of the population sample with 52,6% of the respondents been female and 47,4 % been male.

4.2.3 Experience of Respondents to Cloud Computing

How long have you been using cloud computing in the financial sector

	<1 year	1-3 years	10+ years	3-5 years	5-10 years	Total
Frequency	16	19	11	20	10	76
Percent	21.1	25.0	14.5	26.3	13.2	100.0

Table 4-1: Experience

From table 4-1 above 21,1% of respondents had less than 1 year of experience using cloud computing in the financial sector, 25% had between 1 to 3 years' experience, and 14% had 10 years and above. The highest number of respondents with cloud computing in the financial sector was between 3 to 5 years. The least number of respondents was 5 to 10 years' experience.

4.2.4 Financial Sector when using Cloud

What is your primary industry when working with cloud computing							
	Advisory	Banking	Insurance	Mutual Funds	Other Financial Service	Wealth Management	Total
Frequency	2	26	14	1	29	4	76
Percent	2.6	34.2	18.4	1.3	38.2	5.3	100.0

Table 4-2: Industry

From table 4-2 above, respondents of the financial service sectors were mainly banking with 34,2%, insurance 18,4% respondents and 38,2% respondents of other financial services. Mutual funds and wealth management had the lowest respondents of 1.3% and 5,3%, respectively.

4.3 Results Pertaining to Hypothesis 1 and Hypothesis 2

Lack of skills

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I received adequate	14,5	35,5	18,4	22,4	9,2

cloud computing training					
I am unable to see the benefits of cloud computing implementation	9,2	14,5	14,5	32,9	36,8
I have skills in cloud computing	26,3	35,5	14,5	14,5	9,2
I have no confidence in the investment made for cloud computing	3,9	7,9	13,2	35,5	39,5

Table 4-3: Lack of skills

Table 4-3 above shows that 35,5% agreed and 14,5% strongly agreed that they received adequate cloud computing training. A large percentage of 32,9% of the respondents disagree with not been able to see the benefits of cloud computing implementation and 36,8 strongly disagree. 35.5% agreed to have skills in cloud computing and 26, 3 strongly agreed. A larger percentage of respondents disagreed to not having confidence in the investment made for cloud computing with 35.5 disagreeing and 39,5 strongly disagreeing.

Data Scalability and Quality

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
All the necessary data can be captured, managed and stored in the cloud	47,4	44,7	2,6	3,9	1,3
I find it difficult to collect and integrate data in the cloud	1,3	11,8	21,1	42,1	23,7
The data that is collected in the cloud is not of good quality		3,9	10,5	55,3	30,3
Cloud computing data in my organisation is not trustworthy		9,2	10,5	51,3	28,9

Table 4-4: Data scalability and quality

The table 4-4 shows that a larger percentage of respondents of 44,7% agreed to all the necessary data been captured, managed, and stored in the cloud with 47,4 strongly agreeing. 42,1% disagreed and 23,7 strongly disagreed to finding it difficult to collect and integrate data in the cloud. The respondents disagreed that cloud computing data in their organisation was not trustworthy, with 51,3% disagreeing and 28,9% strongly disagreeing.

Security and Privacy

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I feel my organisation personal data is not protected on the cloud network	9,2	13,2	7,9	48,7	21,1
I feel data was more protected on traditional systems	10,5	21,1	11,8	43,4	10,5
I feel my organisation manages control access	19,7	60,5	6,6	11,8	1,3

and identity on the cloud					
The visibility of cloud data in my organisation is centralised and prevents attacks	19,7	48,7	21,1	6,6	2,6

Table 4-5: Security and Privacy

Table 4-5 illustrates that 48,7% of respondents disagreed with the data not been protected on the cloud network with 21,1% strongly disagreeing. 43,4% disagreed to data been more protected on traditional systems with 13,2% strongly disagreeing. 60,5% of the respondents agreed, and 19,7% strongly agreed that their organisation managed control access and identification on the cloud. The visibility of cloud data in the organisation was agreed by 48,7% to be centralised and prevented attacks with 19,7% strongly agreeing.

Scaled Agile Framework (SAFe) – Portfolio, Team, Value Stream, and Program

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
My organisation has greater data availability because of	22,4	56,6	10,5	6,6	3,9

cloud computing					
Employees in my organisation can easily work remotely through cloud increasing flexibility and productivity	48,7	48,7	1,3	1,3	
Our organisation focuses on maintainance of cloud applications and not infrastructure thereby reducing costs	1,3	43,4	25,0	6,6	1,3
Cloud computing allows for simplification of internal operations and resources in	32,9	56,6	9,2	3,9	

my organisation					
Cloud automation has reduced the time to market, as employees can focus on developing applications	23,7	44,7	25,0	6,6	
My organisation cloud has reduced complexity of employees ways of work and collaboration and improved ability to share analyse and act on data	34,2	52,6	9,2	3,9	
My organisation has improved its uptime with	35,5	43,4	19,7	1,3	

cloud computing					
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Table 4-6: SAFe

Table 4-6 illustrates that 56,6% agreed that their organisation has better data availability because of cloud computing, with 22,4% strongly agreeing. There was a balance of 48,7% agreeing and 48,7 strongly agreeing that the employees in their organisation can easily work remotely through cloud, increasing flexibility and productivity. 43,4% of the respondents agreed that their organisation been focused on maintenance of cloud application and not infrastructure thereby reducing costs with 24,4% strongly agreeing. The respondents agreed that cloud computing simplifies internal operations and resources in their organisation, with 56,6% agreeing and 32,9% strongly agreeing. 44,7% agreed that the time to market had reduced as employees only focused on developing applications, with 23,7% strongly agreeing. A larger percentage of 52,6% agreed that to cloud having reduced the complexity of employees' ways of work and collaboration and improved ability to share, analyse and act on data with 34,2 strongly agreeing. 43,4% agreed to having improved uptime with cloud computing with 35,5 strongly agreeing.

4.4 Results Pertaining to Hypothesis 3

	Extremely relevant	Relevant	Extremely irrelevant
Additional cloud computing challenge - Migration	73,7	21,1	5,3

Additional cloud computing challenge - Performance	68,4	26,3	5,3
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Table 4-7: Additional challenges

Table 4-7 shows that 68,4% considered performance an additional challenge of cloud computing, with 26,3% considering it as relevant. 73,7% considered migration to be extremely relevant, and 21,1% considered it as relevant.

4.5 Factor Analysis

	Minimum	Maximum	Mean	Std. Deviation
I received adequate cloud computing training	1	5	2.76	1.221
I have skills in cloud computing	1	5	2.45	1.280
I am unable to see the benefits of cloud computing implementation?	1	5	3.74	1.340
I have no confidence in the investment made for cloud computing	1	5	3.99	1.101
All the necessary data can be captured, managed, and stored in the cloud	1	5	1.67	.823
I find it difficult to collect and integrate data in the cloud	1	5	3.75	.995
I feel my organisation personal data is not protected on the cloud network.	1	5	3.59	1.224
I feel data was more protected on traditional systems	1	5	3.28	1.239
I feel my organisation's manages control access and identity on the cloud	1	5	2.14	.919
The visibility of cloud data in my organisation is scentralised and prevent attacks	1	5	2.21	.943
The data that is collected in the cloud is not of good quality	2	5	4.12	.748
Cloud computing data in my organisation is not trustworthy	2	5	4.00	.879
My organisation has greater data availability because of cloud computing	1	5	2.13	.971

Employees in my organisation can easily work remotely through cloud increasing flexibility and productivity	1	4	1.55	.598
Our organisation focuses on maintenance of cloud applications and not infrastructure thereby reducing cost	1	5	2.18	.920
Cloud computing allows for simplification of internal operations and resources in my organisation	1	4	1.79	.660
Cloud automation has reduced the time to market, as employees can only focus on developing applications	1	4	2.14	.860
My organisation cloud has reduced complexity of employees' ways of work and collaboration and improved ability to share, analyse and act on data.	1	4	1.83	.755
My organisation has improved its up time with cloud computing	1	4	1.87	.772

Table 4-8: Descriptive Statistics

The descriptive statistics of the items was provided in Table 4-8. The measured item: the data collected in the cloud is not of good quality had the highest mean of 4,12. The second highest mean was the item related to cloud computing data in my organisation is not trustworthy with a mean of 4,00. The lowest mean of 1,55 related to employees in my organisation can easily work remotely through cloud increasing flexibility and productivity.

4.5.2 Pearson's Correlations

The individual measures for each construct were developed by summing up the scores from responses that related to the six identified cloud computing challenges in chapter 2.3 and SAFe in chapter 2.1.

		Lack of Skill	Cost Management	Data scalability	Security	Privacy	data quality	SAFe
Lack of Skill	Pearson Correlation	1	-.249*	-.397**	-.157	.150	-.251*	.457**
	Sig. (2-tailed)		.030	.000	.176	.195	.029	.000
Cost Management	Pearson Correlation	-.249*	1	.249*	.311**	-.345**	.513**	-.352**
	Sig. (2-tailed)	.030		.030	.006	.002	.000	.002
Data scalability	Pearson Correlation	-.397**	.249*	1	.259*	.066	.305**	-.297**
	Sig. (2-tailed)	.000	.030		.024	.570	.007	.009
Security	Pearson Correlation	-.157	.311**	.259*	1	-.361**	.582**	-.287*
	Sig. (2-tailed)	.176	.006	.024		.001	.000	.012
Privacy	Pearson Correlation	.150	-.345**	.066	-.361**	1	-.539**	.500**
	Sig. (2-tailed)	.195	.002	.570	.001		.000	.000
Data quality	Pearson Correlation	-.251*	.513**	.305**	.582**	-.539**	1	-.530**
	Sig. (2-tailed)	.029	.000	.007	.000	.000		.000
SAFe	Pearson Correlation	.457**	-.352**	-.297**	-.287*	.500**	-.530**	1
	Sig. (2-tailed)	.000	.002	.009	.012	.000	.000	
*. Correlation is significant at the 0.05 level (2-tailed).								
**. Correlation is significant at the 0.01 level (2-tailed).								

Table 4-9: Pearson's correlations

Pearson's correlation matrix was used to determine the linearity in data. The matrix was used to check for correlations in constructs. There was a positive correlation between cost management and data quality of 0,513. The highest correlation was between security and data quality of 0,582. There was a lower correlation between data scalability and privacy of 0,066. The significant value used to determine the correlation was $p < 0,05$.

4.6 Structural Equation Modelling

4.6.1 Reliability Measurement

	Cronbach Alpha
Lack of Skills	0,835
Cost management	0,743
Data scalability	-0,762
Security	0,702
Privacy	0,612
Data Quality	0,718
SAFe (Portfolio, Team, Value Stream, and Program)	0,846

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Table 4-10: Cronbach Alpha

Cronbach Alpha was used to test the reliability of the online survey. Table 4-10 shows the results of the analysis. SAFe had the highest Cronbach Alpha of 0,846 and privacy with the least of 0,612. The Cronbach Alpha value of 0.7 was considered to be an acceptable value, although a value of above 0,6 can also be acceptable (Bland & Altman, 1997) The reliability measures of constructs are above 0,7, and one close to 0,7 thus representing a good internal consistency reliability.

4.6.2 Regression Analysis

Construct	Hypotheses	Anova (F)	P-Value	Coefficient
Lack of Skills SAFe	H1	19,5	0,000	0,292
Cost management → SAFe	H2	10,2	0,002	-0,13
Data scalability → SAFe	H3	7,17	0,009	-0,141
Security →	H4	6,63	0,012	0,079

SAFe				
Privacy → SAFe	H5	24,64	0,000	0,346
Data Quality → SAFe	H6	28,85	0,000	-0,267

Table 4-11: Regression Testing

Data quality and SAFe had the highest significant positive relationship of $F = 28,85$ and $p = 0,000$. The coefficient of the Beta value between data quality and SAFe was $-0,267$. The relationship between privacy and SAFe had the second highest significant positive relationship of $F = 24,64$ and $p = 0,000$ and a coefficient of $0,346$. Security and SAFe had the lowest positive relationship of $F = 6,63$ and $p = 0,012$.

4.7 Conclusion

The presentation of the results showed respondents information and details of survey responses and patterns. It showed frequency distribution, correlations, and reliability of data.

Chapter 5 Discussion of Results

The discussion of the results for each of the constructs is structured to present findings.

5.1 Discussion pertaining to Research question 1

For this construct, six cloud computing challenges were identified from the literature review as the challenges impacting the financial service sector using SAFe. SAFe a framework largely used in the financial service sector to enable organisation agility. The cloud computing challenges were lack of skills, cost management, data scalability, security, privacy, and data quality. Fourteen items measured these challenges. SAFe, categorised as portfolio, value stream, program and team, was measured by seven items.

Hypothesis H₁ Lack of skills and SAFe

The mean values for lack of skills measured items were 2,76 and 2,45 (Table 4-8). This indicated the respondents agreed to having skills in cloud computing hence there was 44,8% and 51 % chance of lack of skill causing cloud computing implementation failure in the financial service sector. This related lack of skills in cloud computing is a serious problem (Richey et al., 2016) There was a positive relationship between lack of skills and SAFe of $F = 19,5$ and $p = 0,000$. Lack of skills is a significant indicator of SAFe with a coefficient value of 0,292 (Table 4-11). Therefore, for every increase in lack of skills in cloud computing implementation, SAFe will increase by 0,292. It was noted that the ability to enable cloud centers was determined by employee skills in analysing the data (Richey et al., 2016) In the financial services sector increase in cloud computing skills would increase organisation ability to grow.

Hypothesis H₂ Cost management and SAFe

The mean values for cost management measured items were 3,74 and 3,99 (Table 4-8). This indicated that respondents agreed to not having confidence with cost management for cloud computing. There was 74% and 79% chance of cost

management causing cloud computing implementation failure in the financial service sector. There was a positive relationship between cost management and SAFe of $F = 10.2$ and $p = 0,002$. Cost management is a significant indicator of SAFe with a coefficient value of $-0,13$ (Table 4-11). Therefore, for every increase in cost management related to cloud computing implementation there is a decrease in SAFe by $0,13$. Implementing of cloud computing leaves stakeholders anxious as there unclear of advantages and ambiguities in the return of investment (Richey et al., 2016) The expansion of implementing cloud computing in the financial services sector reduces the organisation agility

Hypothesis H₃ Data scalability and SAFe

The mean values for data scalability measured items were $1,67$ and $3,75$ (Table 4-8). This indicated that the respondents' perception to data scalability in cloud computing was not consistent. There was 33% and 75% chance of data scalability causing cloud computing implementation failure in the financial services sector. There was a positive relationship between data scalability and SAFe of $F = 7,17$ and $p = 0,009$. Data scalability had a coefficient value of $-0,141$ (Table 4-11). Therefore for every increase in data scalability in cloud computing implementation there is a decrease in SAFe by $0,14$. The increase in cloud computing storage leads to increased costs, increasing the financial burden on an organisation (ur Rehman, Chang, Batool, & Wah, 2016). This meant that for the financial services sector, the decrease of organisation growth was impacted by cloud computing handling data.

Hypothesis H₄ Security and SAFe

The mean values for security measured items were $3,59$ and $3,28$ (Table 4-8). This indicated that the respondents agreed to security issues of cloud computing. There was $71,8\%$ and $65,6\%$ chance of security causing cloud computing implementation failure in the financial services sector. There was a positive relationship between security and SAFe of $F = 6,63$ and $p = 0,012$. Security and SAFe had a coefficient value of $0,079$ (Table 4-11). Therefore, for every increase security in cloud implementation there is an increase in SAFe by $0,012$.

Hypothesis H₅ Privacy and SAFe

The mean values for privacy measured items were 2,14 and 2,21 (Table 4-8). This indicated that the respondents agreed to privacy issues of cloud computing. There was 42,8% and 44,2 % chance of privacy causing cloud computing implementation failure in the financial services sector. There was a positive relationship between privacy and SAFe of $F = 24,64$ and $p = 0,000$. Privacy and SAFe had a coefficient value of 0,346 (Table 4-11). Therefore, for every increase in privacy in cloud implementation, SAFe by 0,346.

Hypothesis H₆ Data quality and SAFe

The mean values for data quality measured items were 4,12 and 4,00 (Table 4-8). This indicated that the respondents strongly agreed to data quality of cloud computing. There was 82,4% and 80% chance of data quality causing cloud computing implementation failure in the financial services sector. There was a positive relationship between data quality and SAFe of $F = 28,85$ and $p = 0,000$. Data quality and SAFe had a coefficient value of -0,267 (Table 4-11). Data credibility is a serious issue in organisations to obtain great value of cloud computing as data quality and accuracy are less controllable (Tan, Zhan, Ji, Ye, & Chang, 2015). Therefore, for every increase data quality in cloud implementation, there was a decrease in SAFe by 0,267.

5.2 Discussion pertaining to Research question 2

The analysis showed correlations of the six identified cloud computing challenges in the financial service sector. The measurement items for the six challenges were relatively consistent when analysed as percentages. The results were closely related, and this was confirmed by Pearson's correlation matrix from Table 4-9.

Results showed correlations for lack of skills with other challenges as follows cost management $r = -0,249$ and $p = 0,030$, data scalability $r = -0,397$ and $p = 0,000$, security $r = -0,157$ and $p = 0,176$, privacy $r = 0,150$ and $p = 0,195$, data quality $r = -0,251$ and $p = 0,029$. These results indicated a significant relationship between lack of skills and other challenges excluding security and privacy. The relationship between lack of skills and cost management, data scalability, data quality was

negative indicating that as the other challenges increase, lack of skill decreases. The training of employees on cloud and purchasing equipment are costs incurred by organisations during implementing cloud solutions (Richey et al., 2016)

Results showed correlations for cost management with other challenges as follows data scalability $r = 0,249$ and $p = 0,030$, security $r = 0,311$ and $p=0,006$, privacy $r = -0,345$ and $p = 0,002$, data quality $r = 0,513$ and $p = 0,000$. These results indicated a significant relationship between cost management and other challenges. The positive variables indicated that as the other variables increased cost management also increased.

Results showed correlations for data scalability with other challenges as follows security $r = 0,259$ and $p = 0,024$, privacy $r = 0,066$ and $p = 0,570$, data quality $r = 0,305$ and $p = 0,007$. These results indicated a significant relationship between data scalability and other challenges excluding privacy. The positive variables indicated that as the other variables increased data scalability also increased.

Results showed correlations for security with other challenges as follows privacy $r = -0,361$ and $p = 0,001$, data quality $r = 0,582$ and $p = 0,000$. These results indicated a significant relationship between security and the other challenges. The positive variable indicated that as the other variable increased security increased and the negative variable indicated as other variable increased security decreased.

5.3 Discussion pertaining to Research question 3

This construct sought to determine other cloud computing challenges impacting the financial services sector that were not identified in the literature review. The additional challenges were categorised according to relevance. The online survey requested respondents to mention other cloud computing challenges that were not already in the survey. Of the added challenges some were rephrases of the already identified and the rest of the added challenges were summarised up to migration and performance as additional challenges. The results show that migration and performance were extremely relevant 73,7% and 68,4%, respectively.

5.4 Conclusion

Overall, these results showed that the cloud computing challenges have an impact on the South African financial service sector. The study's purpose and significance were established from the results enabling the research questions to be answered.

Chapter 6 Conclusion and Recommendation

6.1 Conclusion of the Study

The study showed that cloud computing implementation challenges in the financial services sector are interrelated and ever-changing, emerging new challenges. The impact of the challenges identified was quantified.

6.1.1 Conclusion pertaining to research question 1

The results did not align with those from online cloud computing sources referenced in the literature review. The opinions listed in the literature review were of the perception that all the identified challenges for implementing cloud computing impacted the financial service sector. The reasons for the difference in results could be that this study was for the South African financial services sector and the others covered all the sectors and industries.

6.1.2 Conclusion pertaining to research question 2

The results did not align with those from online cloud computing sources referenced in the literature review. The challenges of implementing cloud computing were not all interrelated.

6.1.3 Conclusion pertaining to research question 3

The results did not align with those from online cloud computing sources referenced in the literature review. Performance and migration are new emerging challenges not mentioned in previous sources of cloud computing implementing challenges. These two main additional challenges in cloud computing were confirmed to be relevant to the financial services sector and therefore to the success or failure of implementing cloud computing in the financial service sector.

6.2 Limitations of the Study

The documents retrieved for literature review from online sources to identify the challenges of cloud computing implementations would have been valid if the authors of the documents had participated in validating the list of cloud computing challenges based on rapid changing cloud computing implementation scenarios. New cloud computing challenges keep developing from cloud applications. The opinions of the authors may have changed because of the continuous changes in cloud computing.

The number of respondents expected for the study after was one hundred respondents from the South African financial service sector, with each respondent having experience with cloud computing implementation. However only 76 respondents represented the financial service sector. The results could have been more reliable with more respondents, which would have improved the accuracy of the results.

6.3 Recommendations

The study can contribute to the existing online sources of the challenges of implementing cloud computing in the financial service sector and interrelationship of the cloud challenges. The findings showed that lack of skill and data quality are effective challenges to the financial service sector and have helped progress research on cloud computing challenges.

The study can guide managers or management that plan to implement cloud computing in the South African financial services sector. The results can have reduction in cloud computing implementation failures when used by organisations to plan. The adaption of the results to a wide range of implementations in organisations can have the failure rate lessened and the return of investment increased on cloud computing implementation.

6.4 Suggestions for Future Research

Future research can use this study to target other South African industries in analysing the challenges of implementing cloud computing in other sector. The interrelationships of the six challenges can also be analysed to provide statistical accuracies of sector. In addition, future research can analyse the challenges in combination or individually.

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