Key Factors and Barriers Affecting the Adoption of Cloud Computing in the Irish Government

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Declaration

'I declare that this dissertation that I have submitted to Dublin Business School for the award of Keith Scanlon is the result of my own investigations, except where otherwise stated, where it is clearly acknowledged by references. Furthermore, this work has not been submitted for any other degree.'

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ABSTRACT

In 2019 the Irish Government issued a cloud computing advice note informing all government agencies to adopt a cloud-first strategy. Research has highlighted many issues and challenges in adopting a cloud-first strategy, particularly for government agencies. However, there is an enormous desire to adopt cloud computing if specific barriers are removed. This study aimed to identify the key factors and barriers that affect cloud computing adoption in the Irish Government. This study employs a quantitative approach using an online questionnaire survey collecting data from fifty-three senior ICT staff working across various government sectors. Descriptive statistics were used to answer the primary aims, and the central tendency was measured using median and mode. The study identified data protection, procurement, vendor and government support as barriers and key factors. Additionally cost, compatibility, technology readiness, and cybersecurity were identified as key factors. This research can support the Irish Government in expanding its cloud-first approach, establishing strategies and policies to support future cloud adoption.

Contents

List of Figures

List of Tables

1. Introduction

1.1 Digital Transformation

The Fourth Industrial Revolution is underway globally, characterised by the fusion of the digital, biological, and physical worlds and driven by new digital technologies, such as high-speed mobile internet capabilities, artificial intelligence, and machine learning. At the forefront of this fusion is cloud computing, resulting in organisations worldwide from all sectors and sizes having significantly and rapidly increased cloud computing adoption (Stein, Campitelli and Mezzio, 2020).

Indeed, digital technology has the ability to transform how governments operate and provides services to their citizens. Benefits of digital government include improving efficiency, productivity, and empowering citizens by allowing access to government services anytime, anywhere (Katsonis and Botros, 2015). A study by Gartner, Inc., a leading research and advisory firm, highlighted that historically governments are viewed as institutions resistant to change. However, today's governments are confronted with a confluence of forces that demand fundamental changes in policymaking and strategies. Likewise, in how it operates, serves citizens, and manages its workforce. Thus, modern society necessitates that governments take new actions in novel ways. As a result, governments worldwide have already recognised the importance of digital transformation, consequently recognising the adoption of cloud computing as a critical enabler (Gartner 2018).

1.2 Cloud Computing

Traditional IT infrastructure environments, usually delivered onsite, require enormous investments in physical servers, networks, and buildings (Han, 2011). As a result, this delivery method, commonly referred to as on-premises, has become expensive and challenging to manage. Conversely, governments with data protection concerns have complete control over

their sensitive and confidential data by continuing to use this delivery method. However, it has become evident that the traditional on-premises method cannot handle the modern and connected world (Tabrizchi and Kuchaki Rafsanjani, 2020).

In contrast to the on-premises delivery method, cloud computing is a new computing paradigm for delivering resources and services through a network that is usually the internet, commonly referred to as the cloud and allows organisations to deviate from the enormous capital investments in IT hardware toward a pay-as-you-go subscription model. However, by migrating to the cloud, organisations potentially lose control of their sensitive and confidential data, now stored outside their premises or country (Sallehudin *et al.*, 2020).

The US National Institute of Standard and Technology defines cloud computing as "enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." NIST further describes the five essential characteristics of cloud computing: on-demand self-service, board network access, resource pooling, rapid elasticity, and measured services (Mell and Grance, 2011). There are four cloud deployment models public, private, community and hybrid. Public cloud services can be delivered based on the following three service models, Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Ali *et al.*, 2016).

As well as providing the foundations for digital government, cloud computing also offers tremendous benefits to organisations in both the private and public sectors. For instance, it provides efficient ICT services and infrastructures without acquiring IT hardware. Additional reported benefits presented include lower IT costs, streamlined services, scalability on-

demand and accessibility with access to cloud services available from any connected internet device (Jones *et al.*, 2019). Consequently, organisations of all sizes, geographies, and sectors are provisioning various cloud services, from developing private cloud environments or purchasing public cloud services such as Amazon Web Services, Google Apps and Microsoft Azure (Stein, Campitelli and Mezzio, 2020). However, despite the benefits of cloud computing, this also comes with challenges and risks that are more prevalent in cloud computing than in traditional IT environments, including loss of governance, vendor lock-in, data protection concerns, and poor IT infrastructure (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014).

1.3 Cloud Computing Government Adoption

Government agencies have traditionally deployed and delivered IT systems on-premise (Jones *et al.*, 2019). The adoption of cloud computing is also recognised at the European level, confirming cloud computing as a critical enabler for the European Commission Digital Strategy 2018, which sets out a vision for a digitally transformed and user-focused administration (Michlmayr, 2019).

Cloud adoption by governments is gradually increasing. For example, the Buenos Aires council implemented a cloud-based system to manage new street lighting systems resulting in 50% operational savings and a significant reduction in CO2 emissions. Additionally, the government of Catalonia migrated their email system to a public cloud environment benefiting from high availability and 24/7 uptime guaranteed by service level agreements with their cloud service provider (Michlmayr, 2019). Equally, in 2021 the Australian government, under the remit of its cloud-first strategy, successfully delivered its second census through digital channels with a cloud computing solution provided by Amazon Web Services and was praised as a giant leap for digital government. The digital census solution set

a new standard for government content and has improved data quality. In contrast, the Office of Cybersecurity for Australia reported on the first digital census in 2016, delivered through the traditional on-premises method, and was deemed a failure. The website was taken offline for 40 hours due to hardware failures, with the Australian Prime Minister describing the failure as a humiliating debacle for a government promoting innovation, agility, and the promise of the digital era (Taylor, 2021). Likewise, in recent years the UK government placed digital government at the centre of its strategy by establishing the Government Digital Service in 2011 to save money, centralise information and improve user experience. Consequently, in 2013 the UK government adopted a cloud-first strategy resulting in the establishment of G-cloud to streamline the procurement of cloud services resulting in savings of £3.56billion between 2013 and 2015 (Digital Government Report, 2020).

1.4 Cloud Computing Irish Government

In comparison to the maturity of other government cloud strategies, despite all the realised and anticipated advantages of cloud computing, only recently has the Irish Government begun to recognise the importance of cloud computing. The Irish Government recently set out an approach to delivering digital government for all its citizens in its Connecting Government 2030: A Digital and ICT Strategy. Moreover, the strategy states that the Irish government must harness digitisation to drive a step-change in how people, businesses and policymakers interact to ensure interoperability across all government and public services. Additionally, the strategy emphasises cloud computing as a critical enabling factor for successfully delivering the strategy's action areas (*Connecting Government 2030: A Digital and ICT Strategy for Ireland's Public Service*, 2022). Furthermore, in 2019 the Irish Government issued a cloud computing advice note instructing all government agencies to adopt a cloud-first approach for all new IT systems and to review existing systems to develop

a roadmap to cloud migration. Additionally, the note highlights the adoption of cloud computing as underpinning several critical strategies at the government level, including the Climate Action Plan 2019, Our Public Service 2020 and The Public Service Data Strategy 2019-2023 (*Cloud Computing Advice Note*, 2019).

1.5 Problem Statement

Despite highlighting the benefits and significant importance of a cloud-first approach in government, research by this author has highlighted that there exist many issues and challenges in the adoption of a cloud-first approach. For example, the United Kingdom Government, which adopted a cloud-first approach in 2013, recently completed a survey of 300 government agencies to review the current status of cloud adoption. The survey found cloud adoption very low, with 40% ruling out cloud adoption for IT systems. However, there is an enormous desire to migrate IT systems to cloud computing if specific barriers, including procurement, cybersecurity, skills and budgeting, are removed (*The State of Cloud Adoption Report*, 2020). Similarly, the United States Federal Government, which issued a cloud-first approach in 2010 to implement cloud-first strategies, share a common infrastructure and reduce technology and support costs. However, a survey of Chief Information Officers from 49 states in the US in 2019 reported that only 34% had a cloud computing strategy in place, down from 41% in 2018. Of great concern, US states with cloud computing strategies have reported the implementation to be more costly, complicated and time-consuming than initially expected (The 2019 State CIO Survey, 2019).

Several studies have been carried out on cloud adoption in the government, primarily in countries that have already implemented cloud-first policies. For instance, Ali 2018 study researched the factors likely to influence the adoption of cloud computing for the Australian Regional Government. This study reported several factors that affected cloud computing

adoption, including reliable and fast internet connections, data protection concerns, costs, integration, vendor support, and employee's knowledge. Risks that influence barriers to cloud adoption are lack of trust, compatibility issues and cybersecurity challenges (Ali, Soar and Shrestha, 2018). Similarly, Sallehudin's study researched cloud adoption for the Malaysian Government, which adopted a cloud-first approach in 2013. The study found senior management support and organisational readiness to be significant factors in cloud adoption. Environmental factors, including government regulations, were found to be not significant. Also highlighted was cybersecurity, a significant barrier to cloud adoption (Sallehudin *et al.*, 2020). Furthermore, a recent study by Jones 2019 highlighted the factors and barriers to cloud computing in the UK government. Organisations that participated in this study highlighted that they implemented cloud computing technologies solely to meet a political mandate to reduce costs and become more efficient. This study found the organisational benefits of cloud computing adoption included improved collaboration and productivity and enabling a more modern approach to business processes. Additionally, improved data quality and reduced IT server space which lowered carbon footprint, were identified as critical factors in cloud computing adoption. Barriers to further cloud adoption include data protection concerns, reliance on vendor support and compatibility with legacy systems (Jones *et al.*, 2019).

As can be seen, there is evidence of research on the adoption of cloud computing within various governments across the world. Furthermore, compared to countries like the United Kingdom and the US, the adoption of cloud computing technology in Ireland is still in its infancy. Many organisations have yet to fully understand cloud computing technology, which is one reason why its adoption is resisted by many governments worldwide (Clifton, Díaz Fuentes and Llamosas García, 2020). The key factors and barriers that influence cloud computing adoption must be known before the Irish Government can realise the full potential

of cloud computing. This author's investigation shows to his knowledge that no research currently exists in this area for the Irish Government. This gap in research has led to this research question: What are the key factors and barriers affecting cloud adoption for the Irish Government.

1.6 Significance of the Study

Investigations by this author show a lack of exploratory studies that provide an in-depth and holistic investigation of the key factors and barriers that impact or influence the adoption of cloud computing in this area for the Irish government, and this study aims to fill this research gap. In his 2022 study, Abied critically analysed peer-reviewed articles from 2010 to 2020 on the adoption of cloud computing in governments, including the benefits, models, methodologies, and analysis techniques. This study noted that few studies highlighted the barriers to cloud adoption, with the majority of studies focused solely on the factors (Abied, Ibrahim and Kamal, 2022). Therefore, this study is one of few that combines both the key factors and barriers that influence cloud computing adoption in Government.

There are several factors and barriers that may affect government agencies' decision to migrate to the cloud. By developing an understanding of these factors and barriers, this research can support the government and individual government agencies to expand on the cloud-first policy, establish strategies and policies to support cloud adoption projects in the future and ensure the realisation of the many government strategies that the adoption of cloud computing underpins. The intended audience for this research will be stakeholders relevant to the decision making and implementation of cloud-first policies in government.

1.7 Research Aims, Objectives and Question

This study aims to fill the aforementioned gap in knowledge by investigating the key factors affecting cloud computing adoption in Irish Government. As a result, the study's primary aim is:

- To identify the key factors and barriers that affect cloud computing adoption in the Irish Government.

The primary objective of the current study is to develop an understanding of key factors and barriers that affect cloud computing adoption in the Irish Government. A quantitative approach will be taken to achieve this objective, using a 5-point Likert scale questionnaire distributed nationwide to senior IT Management across different government departments.

Thus, this leads to the following research question this project would like to answer:

- What are the key factors and barriers to cloud computing adoption in the Irish Government?

1.8 Scope of the Study

The study assesses the barriers and factors influencing the adoption of cloud computing across Irish government agencies. The research will cover all delivery and deployment models of cloud computing. Likewise, all various government departments, e.g. Civil Service, Public Service, Health Services and Local Authority, will be in scope.

1.9 Thesis Structure

Having introduced the research background, justification, problem statement, scope, aims and objectives in the opening chapter, the second chapter presents a structured review of the existing literature relevant to the research topic. In chapter three, the theoretical and conceptual models will be presented. Chapter four presents the research methodology that

will be used for this study. Chapter five will analyse the data and present the significant findings and emergent themes therein. Chapter six will discuss the research results in detail, and the implications of the significant findings will be reviewed. Chapter seven will draw conclusions and summarise the findings.

2. Literature Review

2.1 Introduction

This chapter will summarise the prevailing literature on cloud computing currently available, besides giving an overview of the adoption of the technology in various governments worldwide. Furthermore, the review was essential in improving this researcher's knowledge of the topic, mainly concerning cloud computing in governments worldwide. The literature review will be broken down thematically into the following interconnected topics, with the first theme comprising a summary of cloud computing, including definitions, history and the various deployment and service models. The second theme will discuss the general context, benefits and obstacles of cloud computing adoption. The third theme, narrowing the topic to cloud adoption at the government level, providing empirical support in this area at the European Union and United Kingdom level and then critically for this research topic, cloud adoption in the Irish Government, also highlighting the gap in knowledge referenced chapter one.

2.2 Cloud Computing

Figure 1.1 Cloud Computing

Source (Zienkiewicz, 2022)

A picture of the cloud, seen in figure 1.1 on the previous page, depicting a symbol of the Internet or any other network, is often used as a metaphor for cloud computing and is nevertheless insufficient to explain the principal ideas of cloud computing (Vladimir O. Safonov, 2017). This section will help understand these ideas, the motivation and the essence of cloud computing.

Cloud computing is viewed as a new computing paradigm that revolutionises how we access and use computer infrastructure and services and is considered the latest evolution in the history of technology (Sabi et al., 2018). Cloud computing affects most areas of our daily lives, from online shopping on amazon to video and music streaming services like Netflix and Spotify to social media platforms like Facebook, Twitter, and Instagram, all delivered using cloud-based technology (Shaar and Efe, 2018). The move toward cloud computing is comparable to the evolution of electricity supply in the early 20th century. Before this evolution took place, farms and businesses used power generators local to each site. Then, the invention of the central electric grid allowed farms and businesses to have this service now delivered by utility companies, who used vast economies of scale to supply cheaper electricity, removing the need to have onsite generators. Thus began the second industrial revolution. Consequently, the transformation to cloud computing is often compared to and promises to be as dramatic as that in electricity supply. As a result, cloud computing is frequently referred to as utility computing (Kale, 2014).

2.2.1 History & Current Status

Fundamentally, the concept of cloud computing can be traced back to the 1960s when computer scientist John McCarthy suggested that computing might be delivered and sold as a utility. Additionally, International Business Machines (IBM) began virtualising operating systems, which allowed multiple distinct computing environments to reside on one physical

environment. Later, advancements in virtualisation technology continued into the 1970s and 1980s with the networking of computers to allow them to talk to each other. Significantly, in the 1990s, the foundational technologies for cloud computing matured with the launch of the World Wide Web in 1991, leading to the dotcom and e-commerce revolution. Then the early 2000s marked the beginning of cloud services such as Salesforce, which provided customer relationship management software from its website (Varghese, 2019). Notably, Amazon Web Services (AWS) began providing customers with the capabilities to store data and run their applications on rented computers. Cloud computing evolved into the late 2000s with more services available like databases and applications, service level agreements, and quality of service began to be guaranteed to customers. Microsoft entered the cloud services marketplace, launching Azure services (Molo *et al.*, 2021). Finally, led by Microsoft, Amazon AWS and Google, the 2010 decade saw a marked enhancement in the catalogue of cloud services available to customers and vendors. Additionally, this period saw the development of serverless computing, backup, Software-as-a-Service and disaster recovery options. Due to these developments, a new deployment model became available, where private and public clouds could be combined to deliver hybrid clouds (Varghese, 2019).

Since the Covid-19 pandemic, the adoption of cloud computing has accelerated, drawing on its rapid provisioning capability to respond to the business needs in areas like remote working, communication and collaboration solutions like Zoom and Microsoft Teams (Alhomdy *et al.*, 2021). As a result, the cloud computing market is rapidly expanding, and more traditional IT companies are beginning to offer cloud computing services, such as Microsoft Azure, Google Apps and Amazon Web Services. A recent report highlighted that the global cloud computing market in 2019 was valued at $321 billion and is estimated to reach $1025 billion by 2026 (Ge Zhang, Lu Liu, and Hao Guo, 2021).

2.2.2 Definition

Cloud Computing has been defined from various perspectives, including the academic and business worlds. Gartner defined cloud computing as “a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service to external customers using Internet technologies”. Additionally, Forrester Research used the definition of “a standardized IT capability (services, software, or infrastructure) delivered via Internet technologies in a pay-per-use, self-service way” (Erl, Puttini and Mahmood, 2013). Another definition most commonly and widely accepted in the research domain is from the US National Institute of Standard and Technology, which defines cloud computing as "Enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”. Cloud computing has five essential characteristics, three service models, and four deployment models depicted in figure 1.2. Each of these is discussed in more detail in the following sections.

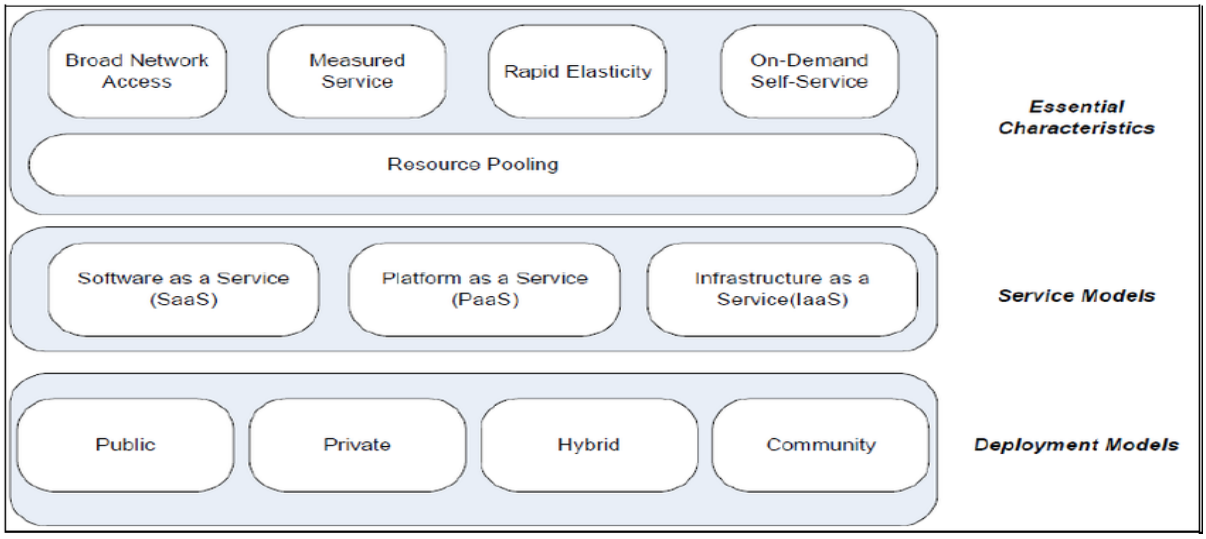

Figure 1.2 Cloud Computing Characteristics, Service and Deployment Models

Source (Al-Jabri, 2014)

2.2.3 Characteristics

Understanding the fundamental characteristics of cloud computing technology is imperative because of its growing need by various organisations. The fundamental characteristics as defined by NIST that differentiate cloud computing from other computing models are broad network access, measured service, resource pooling, rapid elasticity and on-demand self-service. These characteristics are discussed in more detail as follows. First, on-demand self-service is defined by consumers' ability to provision any computing capabilities such as applications, servers and storage as required automatically without further integration between the consumer and the service provider. A consumer usually requests a service when needed. As a result, this enables the usage-drive and service-based features found in cloud environments (Erl, Puttini and Mahmood, 2013). The second characteristic, broad network access, relates to accessing cloud resources anytime from anywhere through the Internet. Thus, consumers can use network-enabled devices via heterogeneous platforms like tablets, smartphones, laptops, or PCs to access cloud resources (Rountree and Castrillo, 2013). The third characteristic is resource pooling, which is the concept that multiple consumers can share the underlying physical cloud infrastructure in a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. Generally, consumers do not know the exact physical location of the resources, and they have no control over the location provided resources but may be able to specify location at a higher level of abstraction (Valacich and Schneider, 2017). Next is rapid elasticity, this characteristic is the rapid capability of provisioning cloud services, in some cases automatically for quick scaling out and scaling in capabilities according to the consumer demand. For the consumer, the rapid elasticity appears to be unlimited and can be provisioned as demanded and is the most common

justification for using cloud computing services (Barry and Dick, 2013). The final characteristic is metered service. Cloud resources automatically control and optimise resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service used, e.g. servers, storage, bandwidth and databases. Although different consumers share computing resources in the cloud, the resources are monitored, controlled, and reported for proper optimisation using metering, load balancing, and automated resource allocation (Erl, Puttini and Mahmood, 2013).

2.2.4 Deployment Models

Cloud computing presents four different deployment models of cloud computing to organisations. The four cloud deployment models are private, public, community, and hybrid (Badamas, 2012). Also, recent advancements and the increased adoption of cloud solutions for organisations have resulted in the rise of a fifth deployment model, multi-cloud. Organisations may decide to use one or a combination of these models based on their needs (Agbaegbu et al., 2021). Each of these deployments' models is discussed in more detail as follows. Private cloud, in this deployment model, the cloud infrastructure is deployed exclusively for a company that can be owned and managed internally or outsourced to a third party. Unlike the public cloud, the infrastructure location is known to the organisation, usually located on-premises or off-premises. Therefore organisations have control and private access to their systems and data (Pise, 2019). In the public cloud, the cloud services are accessible to the general public and shared in a pay-as-you-go payment model. The cloud service provider is responsible for the economies of scale and management of the shared infrastructure. The location of the underlying hardware and solution is not known to the customer and can be anywhere in the world (Barry and Dick, 2013). A community cloud model deploys a shared infrastructure by multiple organisations with a shared concern or interest, such as command

operational and regulatory requirements. This type of cloud may be managed by the organisation or by a third party and may be located on-premises or off-premises (Lebeda, Zalatoris and Scheerer, 2018). Next is the hybrid cloud, which comprises two or more clouds mentioned above, resulting in a single, unified, and agile computing infrastructure (Ren *et al.*, 2017). Finally, the exponential growth of cloud computing has given rise to a new deployment model defined as multi-cloud. This deployment is when an organisation uses multiple public clouds from different cloud service providers for services, including servers, storage, and applications, rather than just one vendor (Agbaegbu et al., 2021).

2.2.5 Service Models

Cloud computing has different service models, also known as delivery models, that describe the services and capabilities that cloud service providers can deliver to organisations. The three popular models of cloud service are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) (Mohamed ElSayed, 2020). Each of these delivery models is discussed in more detail. First, Infrastructure as a Service, in this delivery model, several types of resources such as servers, operating systems, storage, and networking are provided for consumers to provision and manage. Consumers can control the resources they deploy but have no control over the underlying cloud infrastructure (Kale, 2014). Second, Platform as a Service (PaaS) provides specific resources to build and deploy applications specifically for the consumer's requirements. The consumer can control these applications they deploy but cannot control the underlying cloud infrastructure such as servers, storage, and networking (Mell and Grance, 2011). Finally, Software as a Service (SaaS), this delivery model allows consumers to obtain applications on-demand over the network without purchasing or providing resources such as servers and operating systems. The consumer has limited control of the solution with just basic changes to settings allowed. This model is usually

delivered via a web browser and based on the pay-per-use model offerings built upon each other (Barry and Dick, 2013).

Microsoft Windows Azure, Amazon AWS platforms, and Google AppEngine are IaaS, PaaS, and SaaS providers that offer extensive computer resources (Han, 2011). In the case of SaaS, Salesforce is considered the market leader. IaaS is the foundation on which the other two build. PaaS is built on top of IaaS, while SaaS is built on top of PaaS. More important, due to this structure, the implications are that each layer builds upon the layer below. Thus, it inherits the strengths and weaknesses and defines the level of control that the cloud services provider and consumer share as per figure 1.3 (Cullum, 2020). As a result, there is a shared responsibility security model behind all delivery models provided by cloud computing. Both the provider and cloud consumer have a role in the security of cloud-resident infrastructure and cloud-delivered applications. The responsibility for security is different in each delivery model. In some services, the customer is responsible for data security like user access and identity management (Tabrizchi and Kuchaki Rafsanjani, 2020).

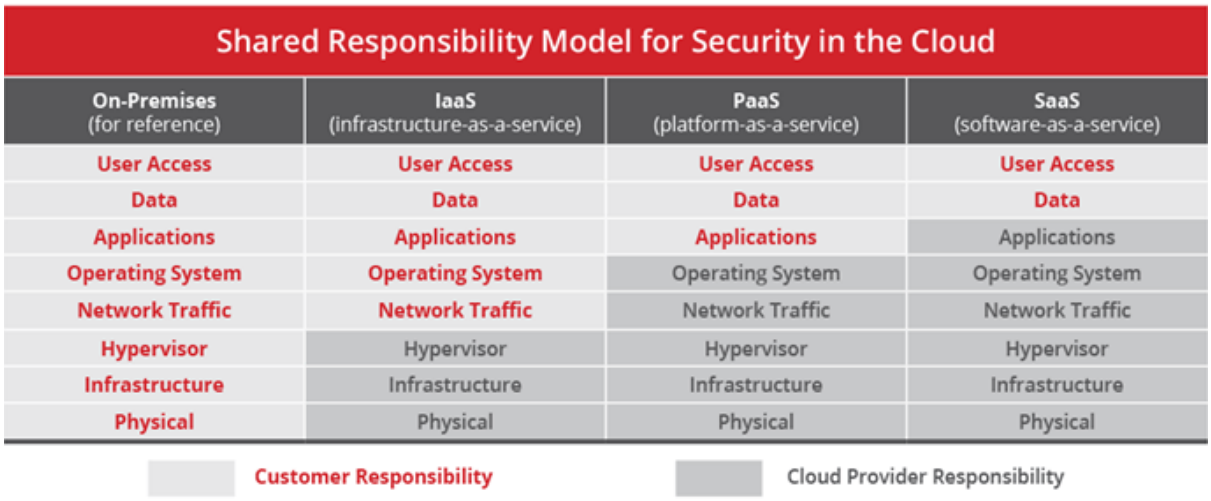

Figure: 1.3 Shared Responsibility Model for Security in the Cloud

Source (McAfee, 2022)

2.2.6 Benefits and Challenges

The recent emergence of cloud computing has had an enormous impact on the IT Industry bringing substantial benefits to organisations, including reduced capital investment resulting in a lower total cost of ownership. Furthermore, cloud computing brings scalability on demand, provisions IT services quickly and easily and allows critical staff to focus on innovative workloads (Kale, 2014). A study by (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014) highlights several benefits government agencies can gain from adopting cloud computing. For governments, cloud computing can remove the requirements to build and maintain expensive on-premises IT Infrastructure with the cost of repairing or replacing hardware passed to the cloud service providers. Moreover, cloud providers can save governments money through economies of scale because they purchase computing resources in massive quantities at lower costs, thus improving disaster recovery and business continuity for government agencies (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014).

Additionally, cloud computing capabilities are effectively unlimited and can be quickly scaled up or down in response to an organisation's changing needs (Nikolova, 2012). Unlike a traditional on-premise infrastructure, where scaling up or down in storage and computing capacity is slow and expensive, cloud computing enables government agencies to quickly scale up and down in real-time to respond to citizens' needs (Zaharia-Rădulescu Adrian-Mihai and Radu Ioan, 2017). Also, cloud computing enables organisations to develop a collaborative working environment, allowing employees the ability for multiple users to work together on the same projects or documents in the cloud simultaneously (Malak, 2016). Cloud computing allows citizens to access government services accessible anywhere, anytime, on any internet-connected device. Thus, allowing government agencies to deliver effectively and efficiently, making them more productive, leading to improved services and overall citizens' satisfaction.

On the other hand, with cloud computing emerging as a computing service paradigm and given its scale, complexity and novelty, this comes with challenges and risks for all organisations, particularly government agencies that store citizen's personal data (OECD, 2014). These risks include loss of governance, vendor lock-in, data protection, poor infrastructure, availability and compatibility, explored in the paragraphs below.

1. Loss of governance. By adopting cloud services, organisations cede control of several areas, including data protection, insecure or incomplete data deletion, and compliance risks concerning the use and location of data, potentially leaving gaps in security (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014).
2. Lock-in. Most cloud services lack clarity or standards in the approach to data, application and service portability, making this problematic for the customer to move to other cloud vendors when required (Ali *et al.*, 2016).
3. Data protection. Cloud computing can provide risks as the customer is handing overall responsibility for data protection to a cloud provider who will need to ensure they have all the correct certifications in place (Ali *et al.*, 2016).
4. Poor infrastructure. With resources now being accessed over the internet, broadband access is essential in accessing cloud services in rural areas, and some countries still have poor internet connections (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014).
5. Availability. Regarded as a significant issue that affects cloud adoption. Despite the vast investments to ensure high availability of services made by the large cloud service provider like Microsoft, Amazon and Google have been prone to large-scale outages that have impacted businesses and governments worldwide (Valacich and Schneider, 2017).
6. Compatibility. Despite cloud computing evolving rapidly with innovative technologies and features available to customers, many of these technologies do not meet industry

standards, leading to compatibility issues. For example, authentication standards and protocols are yet to be incorporated into cloud computing. Furthermore, this is particularly relevant to government agencies whose essential requirement is protecting citizens' data (Rountree and Castrillo, 2013).

2.3 Cloud Computing Adoption in Governments Worldwide

The following sections explore the current state of cloud computing strategies for governments worldwide, with the Irish government a primary area of focus. Also, this section presents examples of cloud computing projects and the benefits gained.

2.3.1 United States of America

The US federal government invests more than $90 billion annually in developing, implementing, and maintaining IT infrastructure (Giannetti, 2020). In 2019 the US Government launched their national cloud computing strategy, Cloud Smart. The strategy is designed to support government agencies across the US to achieve additional savings, improve security and deliver faster services. Further goals of the strategy are supporting agencies with the tools, knowledge, and flexibility to move to the cloud. The new strategy will update the "Cloud First" policy, established in 2010, to reflect where agencies and technology are today (O'Brien, 2019). As a result, examples of cloud computing adoption exist in the US, illustrated by the National Institute on Aging. Using the Google Cloud Platform, the Institute on Aging can now securely store, process, explore, and share large biological datasets, thus powering future studies into the underpinnings of Parkinson's disease, resulting in discoveries in weeks versus months (Marwaha, Knowles and Ashley, 2022). Besides, the state of Arizona deployed Google's Software-as-a-Service email, calendar and collaboration solution with over 40,000 mailboxes and over ninety different local government agencies, allowing them to discontinue thirty different disconnected email solutions saving over €750,000 annually.

Finally, In Pennsylvania, the Department of Revenue recently provisioned a modern cloud-based solution to replace its legacy tax administration solution, resulting in a 90% reduction in error rates in tax submissions (Digital States Survey 2020: Cloud Is More Critical Than Ever, 2020). Despite these benefits and successes, a 2019 survey of federal government technology decision-makers points out that several impediments remain despite an increasing readiness to provide cloud services at scale. With cybersecurity concerns seen as both a barrier and a rationale for moving to the cloud, 55% of IT executives say their agency's procurement ability is inadequate to support cloud adoption (*CIO Survey*, 2019).

2.3.2 United Kingdom

Likewise, in recent years the UK government placed digital government at the centre of its strategy by establishing the Government Digital Service in 2011 to save money, centralise information and improve user experience. Consequently, in 2013 the UK government adopted a cloud-first strategy resulting in the establishment of G-cloud to streamline the procurement of cloud services (Digital Government Report, 2020). In 2020, in alignment with the UK cloud-first strategy, the Welsh Government implemented a technology modernisation strategy with a critical target to move away from traditional working patterns and practices, consequently enabling a more flexible working environment. Using Microsoft's public cloud solution, this strategy delivered considerable cost savings and a more innovative working force, allowing for a greater focus on productivity and well-being (*UK Government*, 2020). Furthermore, UK local authorities are migrating their existing on-premises email system to a Software as a Service solution supplied by Google to improve collaboration and productivity with cost savings estimated at £3million. Additional benefits included reduced licensing costs, increased flexibility and mobile working (Jones et al., 2019).

2.3.3 Australia

To eliminate duplication and fragmentation, reduce costs, lift productivity and develop better services, the Australian government followed in the US and UK's footsteps with its own cloud-first strategy in 2014 (‘Australian Government’, 2020). Despite the expected benefits, in 2021, the Australian government acknowledged that several factors have blocked agencies from realising their cloud aspirations. These factors include a shortage of knowledge and experience, decades-old stubborn operating models, data protection concerns and a struggle to sell the business case for cloud adoption across the business. In response, the government launched The Secure Cloud Strategy to guide agencies past these barriers to ensure government agencies have the opportunity to maximise the benefits of cloud computing. The key strategic aims are the development of practical guidance to help agencies develop their knowledge, skills and the ability for government bodies to choose, secure, adopt and manage cloud-based services. Significantly, the creation of frameworks that enable a better understanding of, and ability to apply, appropriate risk and information management practices to services in a cloud environment (Agency, 2022). Despite the barriers, there are examples of cloud computing within the Australian Government. In the case of the Australian Bureau of Statistics, which in 2017 successfully delivered services for the Australian Marriage Law Postal Survey, using a public cloud solution, including an online return form and interactive voice (IVR) recognition, and a platform for publishing the results providing a resilient and contemporary experience for those participating in the Marriage Law Survey. Additionally, the Australian tax office migrated mission-critical applications from its traditional on-premises into the public cloud, including its primary website and the digital identity service. The benefits of moving its website to the public cloud have been significant, providing the opportunity to design new public-facing systems, deliver citizen-centric

services, and make the most of emerging technologies, including artificial intelligence, the internet of things and more innovative data analytics (*Deloitte Australia*, 2021).

2.3.4 European Union

The adoption of cloud computing is also recognised at European level, confirming cloud computing as a critical enabler for the Digital Agenda for Europe 2020 which sets out a vision for a digitally transformed and user-focused administration (Zaharia-Rădulescu Adrian-Mihai and Radu Ioan, 2017). Thus, in line with European cloud policies, the European Commission launched an updated cloud-first strategy in 2019. Likewise, The United Nations Department for Economic and Social Affairs reports that governments now realise the necessity of adopting cloud computing environments (United Nations Department for Economic and Social Affairs. Desa, 2020).

2.4 Cloud Computing Adoption Irish Government

In March 2022, the Irish Government launched its new Digital and ICT strategy for Ireland's Public Service called Connecting Government 2030, which sets out a step-change in how government services will be presented and used, see figure 1.4. The strategy identified six priority actions areas for successful implementation of the strategy:

1. A Human-Driven Digital Experience – Use digital solutions to provide a seamless, accessible and user-friendly experience to citizens and businesses.
2. Harnessing Data Effectively – Recognise data as a key strategic asset that can improve public services.
3. Government as a Platform – It will act as a platform when it delivers an integrated, proactive, seamless cross-sectoral service to its citizens.
4. Evolving Through Innovation – The development of new products, services, and processes methods to improve efficiencies, effectiveness, or quality outcomes.

5. Strengthening Digital Skills – The strengthening and development of new skills to support a digital government culture.
6. Focusing on Governance and Leadership – Establish governance structures that will drive digital transformation across government.

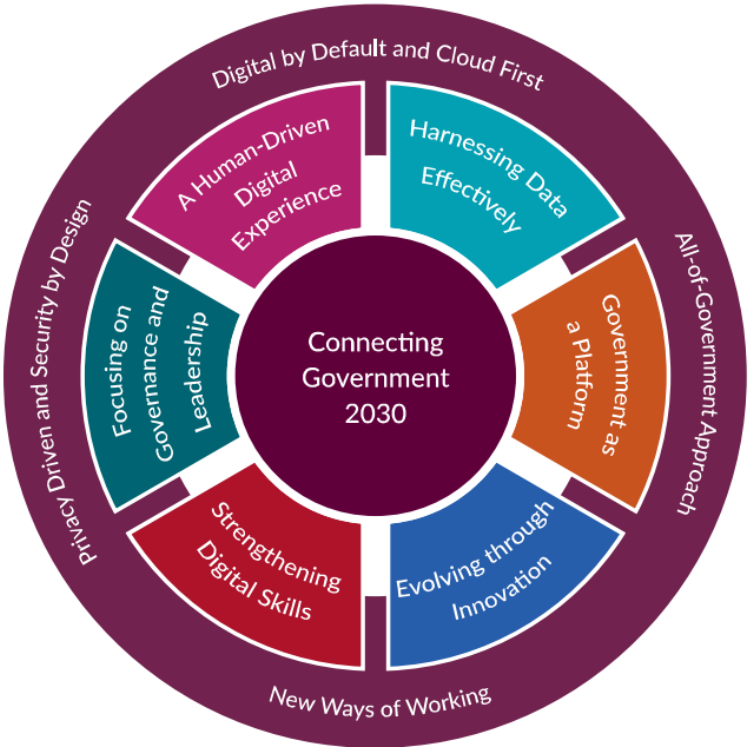

Figure 1.4 Ireland's Public Service Connecting Government 2030 Strategy

Source (Irish Government, 2022)

The strategy defines cloud computing as a critical enabling factor for successful digital government transformation. As a result, the Irish Government will take a proactive and progressive approach in embracing the cloud in line with public services advice note from 2019 (Irish Government, 2022). Significantly, the 2019 cloud computing advice note issued by the Irish Government instructed all government agencies to adopt a cloud-first approach for all new IT systems and to review existing systems to develop a roadmap to cloud

migration. Notably, the advice note emphasises that in the long term, the traditional technology delivery model, on-premises solution, will no longer be sufficient to respond to the pace and demands of digital transformation in government with technologies like blockchain, artificial intelligence and the internet of things. Critically, the note states that government agencies that the decision to move the cloud is not a matter of why. Hence the decision is what, how and when to move to the cloud. Additionally, the note highlights the adoption of cloud computing as underpinning several critical strategies at the government level (Cloud Computing Advice Note, 2019).

2.4.1 Cloud Computing Response to Covid-19

The impact of the Coronavirus (COVID-19) outbreak resulted in a global lockdown, putting governments in emergency mode. Consequently, governments worldwide needed to respond to this crisis, particularly in healthcare, remote working and education, which resulted in many government agencies accelerating the adoption of cloud computing (Alhomdy et al., 2021). Suddenly, for the Irish government, cloud computing was not just viewed as a critical enabler but essential to keep services running, and thus it became the salvation in the country's response to the healthcare-specific challenges of the Covid-19 pandemic.

For example, the Irish Healthcare Executive (HSE), responsible for the provision of health and personal social service, using cloud technology, launched the SamplePath App. The app managed the testing and laboratory logistics management for Covid-19, providing traceability, enabling logistics and real-time information on national swabbing activity with over several million samples processed since its launch in 2021 (*Deloitte*, 2021). Also, prior to the Covid-19 outbreak, the HSE had several segmented regional vaccine systems for more concentrated outbreaks like flu, Hepatitis C and children's vaccines. Paul Reid, CEO of the HSE

stated, "we suddenly found ourselves being called into action overnight. Our reform plans jumped off of PowerPoints and Excel sheets, and were put into action immediately, turning what easily could have been a traditional, reactive response into a transformative, strategic approach," As a result, partnering with IBM and Salesforce, the HSE delivered a national digital programme called COVAX (COVID-19 Vaccination Information System), on the Salesforce cloud platform. The rapid deployment, enabled using cloud technologies, only took three weeks to build, which generally would take months to deliver (Salesforce, 2021). Consequently, this system gave HSE the tools to manage the communications, intake, and personalise case management work at the scale demanded by Covid-19, therefore freeing frontline workers to focus on progressing the vaccine roll-out program. Additionally, the HSE launched a new system called HSE Live, a contact centre system deployed rapidly by IBM cloud technology in three weeks which deals with an average of 20,000 queries for the public on Covid-19 via email, phone and chat, providing an omnichannel experience to customers (*HSE*, 2022).

2.4.2 Irish Health Service Executive Cyber-Attack

In May 2021, The HSE, Ireland's largest government agency, consisting of approximately 4,000 locations, 70,000 devices, 54 acute hospitals, and over 100,000 staff, was hit by a severe cyber-attack. As part of its critical incident response plan and in the middle of the Covid, all HSE IT systems were shut down, resulting in healthcare professionals no longer having access to clinical systems like laboratory systems, patient information systems and clinical care systems. Also, access to non-clinical systems like finance, payroll and procurement systems was removed, resulting in healthcare professionals reverting to pen and paper for a considerable time causing significant risks to patient care. As a result, the cost

of the response and recovery from the cyber-attack has reached €43 million and could rise to €100 million (*HSE Cybersecurity Attack Report*, 2021).

Conversely and notably in the context of cloud systems, in the minutes of an HSE meeting in 2021, it has been noted by the Chief Information Officer of the HSE Fran Thompson that its cloud-based systems were not impacted by the cyberattack, solely impacting the on-premise solutions and suggested that IT systems will subsequently move to cloud-based solutions (*HSE*, 2021). Additionally, Martin Curley, director of Digital Transformation and Open Innovation at the HSE, opinions that the cyberattack will accelerate the transition to cloud-based solutions (Irish times).

2.4.3 Summary

This chapter summarises the prevailing literature on cloud computing. Also, the history and current role of cloud computing were discussed. Furthermore, the characteristics of cloud computing were described. Also, a summary of cloud computing benefits and challenges was presented, and finally, the status of cloud computing adoption worldwide was reviewed. The next chapter will discuss the theoretical and conceptual models used for this study.

3. Theoretical & Conceptual Framework

3.1 Introduction

The degree to which a technology is selected for usage by a person or an organisation is referred to as technology adoption (Tripathi, 2017). Over the last two decades, intensive research has been undertaken utilising various models to investigate how to adopt various types of technology into organisations (Al Mudawi, Beloff and White, 2019). This section analyses the relevant empirical studies and theoretical literature, ultimately leading toward a conceptual model of the adoption of cloud computing by government organisations. The proposed conceptual model will subsequently be used as the basis for a general understanding of the adoption of cloud computing in the Irish Government context and the data collection and analysis conducted in this study.

3.2 Theoretical Models

Several models and theories exist to measure the intention to adopt different technologies, such as The diffusion of innovation (DOI) model, resource-based View (RBV), technology acceptance model (TAM), technology-organisation-environment (TOE), and the theory of reasoned action (TRA). The model's TAM and TRA deal with adoption issues at the individual level. Alternatively, TOE, DOI and RBV address the issues related to technology adoption at the organisation level (Tripathi, 2017).

3.3 Technology-Organisation-Environment (TOE) Framework

The TOE framework, unlike many other adoption theories, for instance, the technology acceptance model (TAM), theory of planned behaviour (TPB), and unified theory of acceptance and use of technology (UTAUT) emphasises not only the critical influences of organisational characteristics and environmental factors but also provides a technological perspective. Hence, TOE theory can be viewed as a good fit for cloud computing since using cloud computing services necessitates a comprehensive holistic analysis (Hsu and Lin, 2016).

Moreover, a literature review was conducted by this author to establish the most commonly used model in cloud computing adoption, and this review appears to confirm the TOE Framework as the dominant theoretical approach to cloud computing adoption research (Refer to appendix 9.1). Thus it can be concluded that this model is most suitable and comprehensive for the specific research requirements of this topic.

Tornatzky and Fleischer (1990) created the technology-organisation-environment (TOE) framework to characterise the aspects that may influence organisations' adoption of technological advancements. According to this concept, three settings or factors influence organisational decision-making when it comes to adopting new technologies: technological, organisational, and environmental (Ng Picoto, Fernandes Crespo and Kahn Carvalho, 2021). The technological context describes the internal and external technologies such as IT Infrastructure, hardware, software and IT systems relevant to the organisation, including current practices. The organisational context refers to the organisational characteristics including size, scope, management structure, human resources and level of centralising. The environment context describes the area in which the organisation conducts its business, such as market competition, policies and regulations.

3.4 Conceptual Model

This research conceptualises cloud adoption through the TOE framework. First, in the domain of latent constructs, the TOE framework identifies three multi-dimensional constructs: technology, organisational, and environmental factors. Cloud computing adoption is observed as a dependent variable. Second, an operational model is proposed for the objectives of this study which focuses on a set of ten independent variables. The variables, seen in figure 1.5, divided across the technological, organizational and environmental domains, will be operationally defined and measured as (1) data protection, (2) cybersecurity,

(3) cost, (4) compatibility, (5) senior management support, (6) organisation readiness, (7) technology readiness, (8) government support, (9) vendor support and (10) procurement support. These variables have been selected based on the most commonly used from existing research (Refer to appendix 9.1). Likewise, based on the literature review, slight amendments that separate cybersecurity and data protection have occurred to make these variables compatible with the objectives of this study and the contextual aspects of cloud adoption in the Irish Government. Each variable, grouped by its respective domains, is described in the following sections.

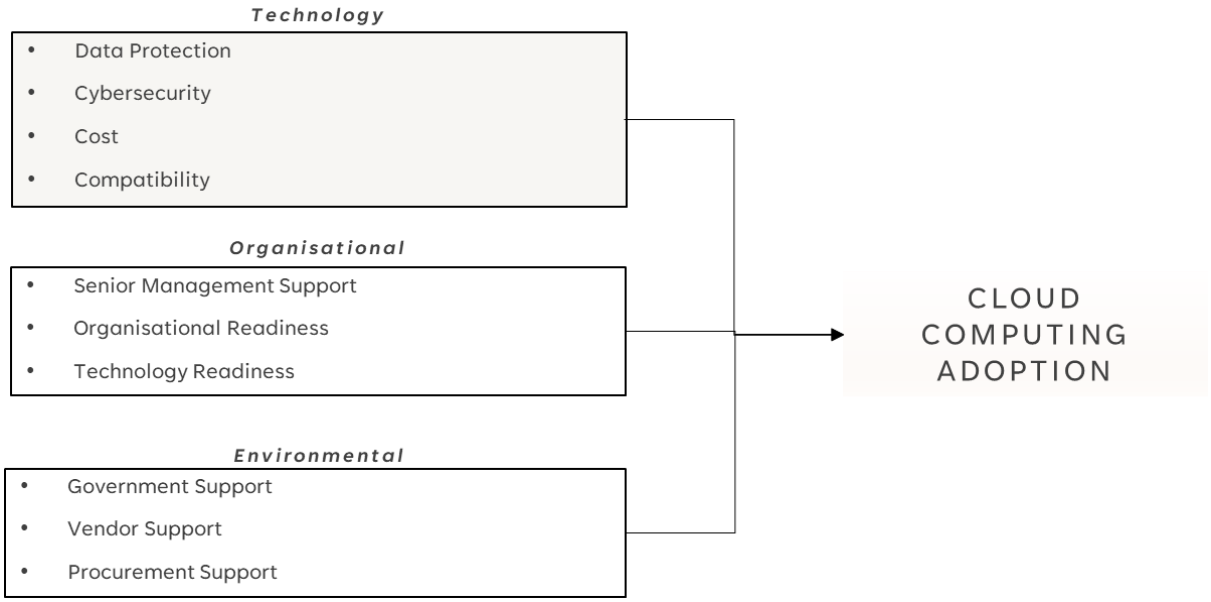

Figure 1.5 The Proposed Conceptual Model for this Study

3.5 Technological Factors

This section describes the characteristics of cloud technology and identifies the technological factors that might affect an organisation's decision to adopt this technology. Data Protection refers to the practice of safeguarding important data from corruption, compromise or loss and providing the capability to restore the data to a functional state in a cloud environment (Hsu and Lin, 2016). Cybersecurity refers to securing environments against both external and insider cybersecurity threats (Hsu and Lin, 2016). Cost is defined as

the investment required to adopt cloud technologies (Bryan and Zuva, 2021). Finally, compatibility is cloud computing compatibility with existing IT environments, including IT infrastructure and systems (Bryan and Zuva, 2021).

3.6 Organisational Factors

These factors relate to the characteristics of an organisation that might have a significant impact on its decision to adopt cloud computing. First is senior management support, which describes the support provided by the organisations' senior management that enables organisations to adopt cloud computing (Ng Picoto, Fernandes Crespo and Kahn Carvalho, 2021). The second is organisational readiness which refers to the organisation's management, financial management, resources, required skills and knowledge in cloud computing (Kumar Bhardwaj, Garg and Gajpal, 2021). Finally, technology readiness is defined as organisations having the required technical infrastructure and expertise to support cloud computing adoption (Kumar Bhardwaj, Garg and Gajpal, 2021).

3.7 Environmental Factors

The environmental factors determine the environmental elements that might affect an organisation's intent to use cloud technology. Government support refers to the Irish Government policies and strategies in place to support cloud computing adoption (Jere and Ngidi, 2020). Also, vendor support is the availability of experienced and certified suppliers of cloud computing services to organisations (Jere and Ngidi, 2020). Finally, procurement support is the guidelines, policies, procedures and frameworks available to organisations to support the adoption of cloud computing.

3.8 Existing Studies

Several studies have been carried out on cloud adoption, drawing on the TOE framework. For instance, Isma'ili's study on A Multi-Perspective Framework for Modelling and Analysing the

determinants of cloud computing adoption among SMEs in Australia found that under environmental factors, external vendor support is one of the essential factors in cloud computing adoption. In the area of organisational factors, all four factors, which included senior management support, innovation of the organisation, prior IT experience and firm size, are positively related to cloud computing adoption. Notably, relative advantage was a significant factor in the technology context, with cybersecurity and data protection concerns highlighted as a barrier to cloud computing adoption (Isma'ili, no date). Additionally, Ayman Mohamed's study examining the effect of the TOE model on cloud computing adoption in Egypt found organisational factors, including technology readiness, senior management support, and maturity and performance directly affecting factors of cloud computing adoption. In contrast, due to the poor services supplied by antiquated communications infrastructure, technology readiness is a barrier to cloud computing adoption (Mohamed ElSayed, 2020).

Several studies have been carried out on cloud adoption in the government domain. For instance, Ali's study researched the factors likely to influence the adoption of cloud computing for the Australian regional governments. The study concluded several factors, including reliable and fast internet connections, costs, integration, provider dependability, employee knowledge and data protection concerns, including backup and sovereignty issues. Risks that influence barriers to cloud adoption are lack of trust, compatibility issues and cyber security challenges (Ali *et al.*, 2016). Similarly, Sallehudin's study researched cloud adoption for the Malaysian government, which adopted a cloud-first approach in 2013. The study found senior management support and organisational readiness to be significant factors in cloud adoption. Also, cyber security was highlighted as the dominant factor in the barriers to cloud adoption (Sallehudin *et al.*, 2020). Alsanea, in his research on the Factors Affecting the

Adoption of Cloud Computing in Saudi Arabia's Government Sector, observes that organisational and technological factors will have a massive influence on the adoption of cloud computing by Saudi government organisations, significantly with the complexity of the cloud services viewed as a barrier to the adoption of cloud computing. Furthermore, the case study findings revealed that government support is a critical issue and that Saudi government help is required to facilitate the adoption process (Alsanea, 2015). In his study, Mubarkoot investigated the factors that influence cloud adoption in government organisations in Yemen. He proposes that compatibility, cybersecurity concerns, and government support as the key factors directly influence the adoption of cloud technology (Mubarkoot Mohammed Salem and 황기현, 2016). Finally, a study by Samuel Tweneboah-Koduah, focusing solely on the barriers to cloud adoption in the Ghana government, found cyber security and data protection to be the most prominent barriers. Additionally, the study found that most government agencies lacked a complete understanding of the complexity of cloud computing (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014).

3.9 Summary

This chapter presented the research model of this study. The proposed model incorporates the factors and barriers from the literature review and other factors that have not been investigated in previous studies to identify the key factors and barriers on the adoption decision of cloud services in the Irish Government. The chapter also provided empirical evidence of cloud computing adoption in governments worldwide. The next chapter will provide an overview of the research methodology for this study.

4. Research Methodology

4.1 Introduction

Saunders defines research as a process undertaken systematically with a clear purpose of finding things out (Saunders, Lewis and Thornhill, 2019). Research methodology refers to the general logic of an investigation, including philosophical assumptions, research design, the selection and adoption of research methodologies and techniques, and arguments for knowledge construction and verification (Williamson and Johanson, 2017). This chapter outlines the research methodology used to collect and analyse data to answer the research problem that this research topic addresses to identify the key factors and barriers affecting the adoption of cloud computing in the Irish Government. This chapter is divided into four sections, the first section aims to explain the research philosophy, the second section discusses the selected research design, and the following sections outline the research strategy, which includes the details of data collection methods, sampling techniques and instruments used are discussed, and justifications are provided for specific research methods used. The methods employed to analyse the outcome of the data are also put forward. Finally, the last section presents the ethical issues relating to conducting the research.

4.2 Research Philosophy

Before discussing positivism and interpretivism, we must examine different research styles, one being ‘deductive’ and the other ‘inductive’. Inductive research is usually associated with the interpretivism approach, with deductive usually linked with the positivist approach and adopted in scientific research (Greetham, 2019). Deductive research can be defined as the progression from general ideas to specific conclusions, also called top-down reasoning or deductive logic. In this approach, the conceptual framework is tested in quantitative and operational terms to produce facts that can be generalised. In contrast, inductive begins with specific conclusions and ends with general ideas or principles, such as the data is collected

and then the theory is created. Qualitative methods are usually associated with the inductive approach to establish different views of the problem under study (Williamson and Johanson, 2017). Thus, the selection between these two approaches depends on whether the research is built based on existing theory or theories built on the results of the research.

According to (Saunders 2019), in sociology, positivism and interpretivism paradigms are the two most well-known approaches to research methods. In interpretivism research, the primary focus of research undertaken within this paradigm is how we as humans attempt to make sense of the world around us. Interpretivism is an ontology position which is concerned with existence and reality. Also, an interpretivist approach to social research usually applies qualitative methods, using unstructured interviews or participant observation and is associated with inductive reasoning (Saunders, Lewis and Thornhill, 2019). Alternatively, positivists, also referred to as realists or rationalists, believe that there is a reality or truth to be discovered. Positivism is an epistemological position. Epistemology is the study of knowledge or the theory of knowledge (Howitt and Cramer, 2016). The positivist research philosophy usually applies quantitative data to explain the causalities, causes and effects of the problem being studied and is associated with deductive reasoning (Williamson and Johanson, 2017). Thus, the study reviewed the existing literature on cloud computing adoption to propose a theoretical model and identify factors that influence cloud adoption through the process described in Chapter two. Therefore, this research takes a scientific theme and adopts a positivist philosophy. Thus, the quantitative deductive approach was deemed the most appropriate for the current study.

4.3 Research Design

Research design is the framework of methods covering decisions from broad assumptions to detailed data collection and analysis methods. Choosing an appropriate

research design method is vital as it determines how the research data will be collected and analysed. Each method has its own merits and demerits, but the researcher selects a suitable method based on the intersection of philosophical worldview, the strategy of inquiry and specific methods (Creswell, 2009). Strategies of inquiry or otherwise called research methodologies, are the choice between quantitative, qualitative or mixed methods to conduct the study. With the scientific method, quantitative research gathers empirical data and bases conclusions on statistical findings. In contrast, qualitative is based on non-empirical data and is expressed in words that describe opinions, customs, beliefs, and attitudes. The mixed methodology combines both qualitative and quantitative research and is typically suitable for both requiring both inductive and deductive analysis studies (Greetham, 2019).

This study adopts a quantitative approach in line with this research's positivist worldview. This approach provides a quantitative description of trends, attitudes, or opinions from a sample population required to answer the research question for this study. Creswell's view is that particular types of social research problems are factors in the approach required. For example, if the problem calls for identifying factors that influence an outcome or testing a theory or explanation, then a quantitative approach is best. Additionally, the quantitative approach helps gather information from large groups of people and is considered more cost and time-efficient (Creswell, 2009). Finally, existing research in cloud and technology adoption appears to highlight a quantitative approach as the leading method to gather data (See Appendix 9.1). On the other hand, given the short timeframe allocated for this research, the mixed methodology was not appropriate for this study because it would add another layer of complexity to the research by expanding its scope and applicability.

4.4 Research Strategy

4.4.1 Data Collection Method

Data collection for this study is centred on collecting primary data. Primary data are those collected by the researcher for the first time and are specifically intended for the study (Daniel, 2012). Different data collection techniques include survey questionnaires, interviews, focus groups, and observation (Saunders, Lewis and Thornhill, 2009). The chosen data collection method for this study will be a questionnaire, as this was one of the most commonly used scales in studies that use the TOE Framework (See Appendix 9.1). Questionnaires today are common, with many participants frustrated with poorly designed questionnaires. Therefore the fundamentals of questionnaire design are essential to a successful study, including appearance, question selection, instructions crystal clear, organising questions into groups and being clearly and simply worded and conducting a pilot (Williamson and Johanson, 2017). Consequently, this researcher has taken these fundamentals into account when formulating data collection methods.

4.4.2 Questionnaire Design

This section explains the structure of the survey by providing details of the overall structure of the survey. To achieve the research aims proposed in this study, all data will be collected through a survey questionnaire via Microsoft Forms, comprising of two parts. Part one contains sections one to three. Section one introduces the study to the participant and provides data protection information, risks and benefits of taking part and consent information. Section two provided a breakdown of the structure of the remaining sections of the questionnaire and a consent form in which participants must confirm they are willing to complete the questionnaire before proceeding. Then using forced multiple-choice questions, section three of the questionnaire will gather demographic information, including job title, level of ICT and cloud computing experience, number of employees in their

organisation, and use and type of government agency. In addition, this section will gather data on the participant's organisation's plan for cloud computing adoption and the type of cloud deployment their organisations may have already adopted.

Part two of the questionnaire, containing sections four to seven, aims to identify the key factors and barriers in cloud computing adoption and contains four sections. Eleven constructs were measured based on the proposed TOE conceptual model detailed in the previous chapter. Section four contains three questions each on data protection, cybersecurity, cost, and compatibility variables in the technological domain. Next, section five contains three questions each in the organisational domain on the variable's senior management support, organisation and technology readiness. Then, section six contains three questions on each variable in the environmental domain, government support, vendor support, and procurement support. At the end of sections four to six, participants were invited to add any additional information using an open-ended question. These key factors and barriers are measured using a five-point Likert scale, ranging from 1 "Strongly Disagree" to 5 "Strongly Agree". Finally, section seven provided an open-ended question that allows the participants to identify any other factors or barriers that affect the adoption of cloud computing or any additional information that is not covered that would be useful to this study, enabling the researcher to explore and discover other factors not covered in the proposed model. The questionnaire and consent form can be found in appendix 9.2.

4.4.3 Questionnaire Validity

On analysis of the literature, no validated scales exist that fit this research topic's context. Consequently, the questionnaire proposed to measure the factors and barriers affecting cloud computing adoption was adapted from existing studies. Therefore further assessment will be required to test the instrument's validity to assess its accuracy. As a

result, the questionnaire was evaluated and reviewed by experts from government agencies experienced in both technology adoption and research, with feedback incorporated into the final version prior to distribution to participants. Given the time constraints with this study, a small pilot survey to initially test the scales was conducted, with the feedback incorporated into the questionnaire released to participants.

4.4.4 Nature of Inquiry

According to Saunders (2019), the four research purposes include exploratory, descriptive, explanatory, evaluative, or some combination of these. Exploratory studies are likely to begin with "what" or "how" and ask open questions to find out about a topic of interest. Explanatory studies are likely to begin with "why" or "how" and wish to establish causal relationships between variables. Evaluative studies are to find out how well a product or concept works. Descriptive studies are likely to begin with "who, "what", "where" and to gain an accurate profile of events, persons or situations, and the researcher already has a clear picture of the phenomenon they wish to collect data (Saunders, Lewis and Thornhill, 2019). Therefore this research is categorised as descriptive as it aims to accurately describe characteristics and trends associated with a pre-defined phenomenon: cloud computing adoption.

4.4.5 Sample Size

In general, a researcher cannot include the whole research population. As a result, the researcher needs to select a sample of the population. There are two types of sampling available to a researcher, probability and non-probability, with the type of sampling chosen directly related to the purpose of the research, the methodology and the type of research question (Daniel, 2012). In probability sampling, chance is used. The theory is that if random selections are made, an extensive sample will naturally contain a representative cross-section

of the population. In contrast, in non-probability sampling, the researcher selects a sample based on the researcher's reasons, including the subjective judgement of a representative cross-section of the population (Blair and Blair, 2015). In non-probability sampling, there are four different types: availability sampling, purposive sampling, quota sampling, and respondent-assisted sampling. Purposive sampling is a technique in which researchers rely on their judgment when choosing population members to participate in their survey (Daniel, 2012). This study's target population is ICT staff who work in the Irish Government across the various government sectors, e.g. Civil Service, Public Services, Health Services and Local Authority. The research study aims to collect the data from a sample of fifty plus ICT senior staff. The characteristics of the population will be ICT staff who have experience, direct responsibility for, or involvement in ICT implementation and decision-making processes and have an excellent knowledge of ICT and cloud computing strategy in the Irish Government. Thereby, ICT Staff will be required to be of a particular seniority level or higher. Significantly, this will ensure respondents will have the ability to understand the current situation of their organisation and the factors influencing cloud adoption. This researcher used well-established contacts in the government IT industry to access forums and distribution groups. In conclusion, given this topic purpose and methodology approach referenced in this chapter, a non-probability sampling technique with a purposive sampling type will be used for this study.

4.4.6 Time Horizon

The time horizon, which defines the timeframe for the research study, is a vital aspect of the research process. There are two primary types of time horizons, namely cross-sectional and longitudinal. The latter, longitudinal studies are conducted for a long time, focusing primarily on a particular case, change or trend over time. On the other hand, cross-sectional

studies are of a particular phenomenon at one specific point of time on a case or multiple cases (Imhanwa, 2016). The time horizon for this study is cross-sectional as the data collected is at one given point in time across a sample population.

4.4.7 Data Analysis

The aim of conducting statistical analysis is to identify the key factors and barriers to cloud adoption in the government. This section explains the process used for the data analysis of this study. After collecting the data, the first process will be to conduct a preliminary analysis of the data, which will involve tabulating the data and eliminating any errors or incomplete questionnaires using Microsoft Excel. All validated data received will be analysed using the widely recognised SPSS v.26 software. Second, once data quality has been verified, the data analysis process begins.

Given that the type of data collected will be quantitative, the analysis will use descriptive statistical techniques to answer the research aims and question. Also, the central tendency will be measured by using median and mode, along with the standard deviation. The data will be categorised based on an ordinal level of measurement derived from the data supplied via the 5-point Likert-scale questionnaires for each variable.

4.5 Ethics

In ethics, researchers should adopt a self-reflective attitude. Hence, placing themselves in the shoes of a person being researched quickly clarifies how many ethical questions arise. From an entirely pragmatic point of view, widely accepted values lie behind ethical research behaviour. Williamson (Williamson and Johanson, 2017) highlight several phases in research where ethics are relevant, including planning and design, collecting data, management and storage of data, publication, ownership and authorship.

First, in the area of planning and design, research should never contain vulnerable participants. The focus of this study will exclusively target senior IT management staff working across agencies for the Irish Government. Therefore, this sample can be characterised as the adult working population in Irish Government departments, and it follows that the questionnaire will be circulated to adults only. However, the questionnaire may be answered by adults 65+ in senior management roles. Thereby, it follows that the participants would not belong to a vulnerable group. Additionally, consent is essential concerning data collection. Therefore the first part of the questionnaire will act as a cover letter that includes a welcome note and provides a brief explanation of the purpose of this study and consent information. Consequently, the cover letter will be apparent that no personal information is required or collected in this survey, and it is a voluntary process. Therefore, participants can opt-out and stop at any time. Finally, participants will be required to click a button confirming that they have reviewed and understood this information, thus giving their express consent to participate in the study (Refer to Appendix 9.2). For management and storage of data, first and critically, anonymity is maintained during the research since no personal details will be required. Hence individuals will be non-identifiable. The questions within the questionnaire have been carefully considered to avoid collecting personal information and will be limited to the scope of this study.

Secondly, in the context of data collection and management, once the data is collected through Microsoft Forms, the data will be exported, stored, and analysed within the password-protected Microsoft solution, an encrypted and GDPR compliant platform. Significantly, only this researcher will have access this the data. For publication, the research results will be published only in academic publications without providing any confidential information with participants informed of this. This questionnaire has been designed with

risk in mind. Examples of potential risks such as physical, psychological, social, economic, legal, and dignitary do not apply to this study. As a result, no steps are required to minimise risks (Labott and Johnson, 2004). On the other hand, by taking part in this research project, participants will provide data that could support the increased adoption of cloud computing, thus improving the opportunities for a digital government that provides greater efficiency, productivity and empowers citizens by allowing access to government services anytime, anywhere.

4.6 Summary

This chapter outlined the philosophies, approaches and strategies adopted and disregarded for this study. This research adopted a positivist philosophical position, also a deductive approach was taken, aligning with the positivist philosophy. It outlined the data collection methods and data analysis approach. A quantitative method using the questionnaire strategy was considered appropriate for this study. The appropriate sample size of fifty participants and the target population of senior IT management in the Irish government was discussed. This chapter also explains designing and developing the questionnaire in detail. Ethical issues for this study were detailed. The next chapter will present the results and details of the data analysis process on the data collected and during the research process.

5. Results

5.1 Introduction

The study aims to identify the key factors and barriers that will affect cloud computing adoption in the Irish Government. This chapter is presented in three sections. The first section describes the preliminary analysis undertaken. Next, the respondent's demographic characteristics and their organisation's current and future cloud adoption status are analysed. Finally, presenting the findings and analysis from the quantitative data collected via a survey questionnaire using descriptive statistics for each variable.

5.2 Preliminary Analysis

The preliminary analysis of the data obtained from the survey involved three fundamental processes. First, the process involved exporting the data from Microsoft Forms into Microsoft Excel. The second is tabulating and reviewing the quantitative survey data using Microsoft Excel. As a result of the review, all fifty-three responses were accepted for further analysis. Third, all collected data was converted to Statistical Package for the Social Sciences (SPSS) format for analysis. Also, within SPSS software, the questionnaire was coded from 1 – 5, with 1 representing 'Strongly Disagree' and 5 representing 'Strongly Agree'.

5.3 Demographic Data

The respondent's demographic data in this research included: job title, level of professional ICT experience, level of professional experience with cloud computing, number of employees in their current organisation and the type of government agency. The data collected was treated as ordinal non-parametric data since the responses are measured as ranks and categories. Each of these respondents' demographic data will be addressed next.

This item represents the role of the respondents inside their government agencies. Figure 1.6 below shows that 35.8% of respondents identified as CIO/Head of IT, followed by 24.5% as ICT Manager, and 15.1% came under the category of other. Of the other participants, 11.3% reported as Senior ICT Project/Programme manager, followed by 9.4% as ICT Infrastructure Manager and finally 3.8% of respondents as ICT Cloud Architect/Manager.

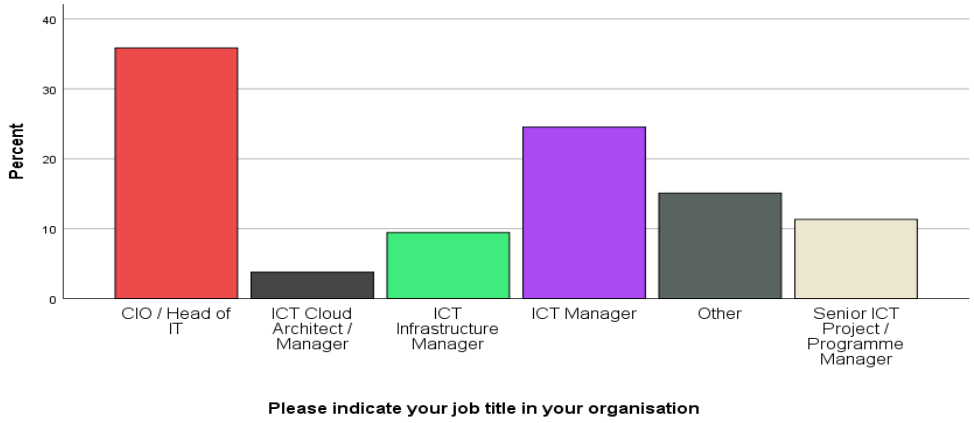

Figure 1.6 Survey Responses on Job Title

For the level of professional ICT Experience, as seen from figure 1.7, the largest group of respondents, 50.9%, were those with more than twenty years of working ICT experience, followed by 26.4% of participants who have experience of between six and ten years. While those with five to ten years represent 5.7%, respondents with less than five years of experience were the least represented, with 3.8%.

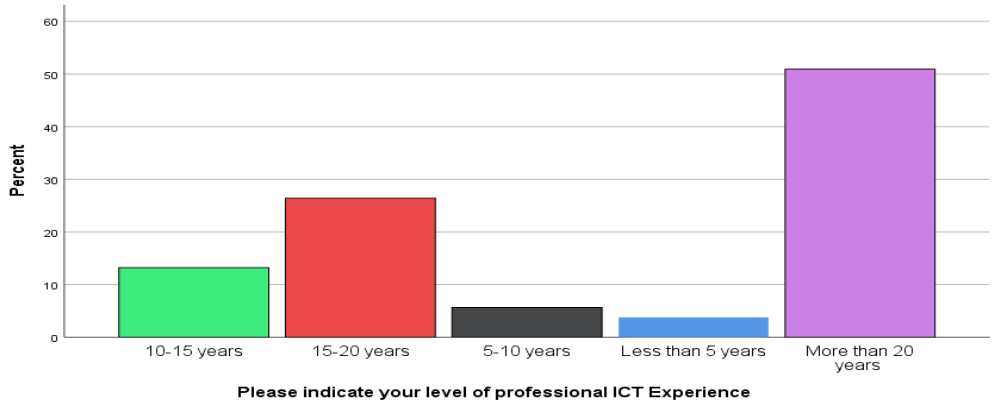

Figure 1.7 Survey Responses on Level of Professional ICT Experience

Illustrated in Figure 1.8 is the type of government agency data. The data revealed that the majority of respondents, 41.5% worked in the public service. Civil Service and Health Service Excutive also had significant representation, consisting of 30.2% and 13.2% of the respondents, respectively. In contrast, the lowest identified organisation type was Local Authority with 11.3%. Finally, some respondents identified their government agency as other had the lowest representation, forming 3.8 % of the responses.

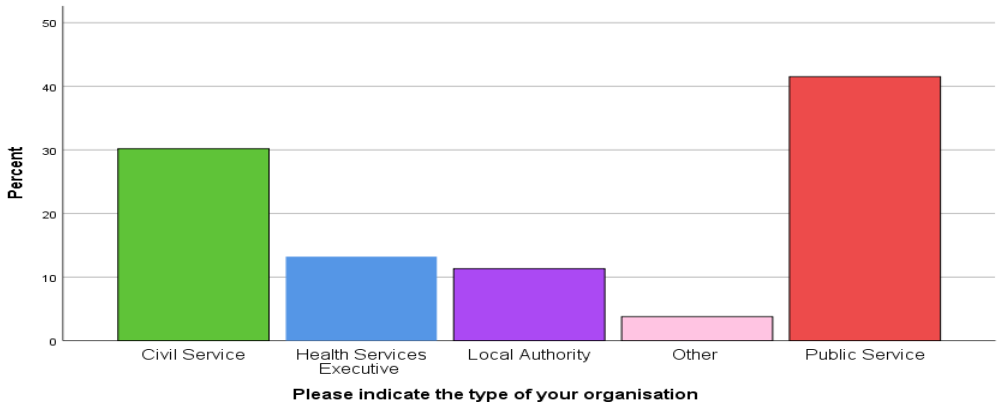

Figure 1.8 Survey Responses on Type of Government Agency

The below item represents the participants' level of professional experience with cloud computing. Figure 1.9 indicates that 56.6% of respondents have less than five years of experience with cloud computing, and 39.6% have five to 10 years of experience. Also, there was only 3.8% with ten to fifteen years of cloud computing experience.

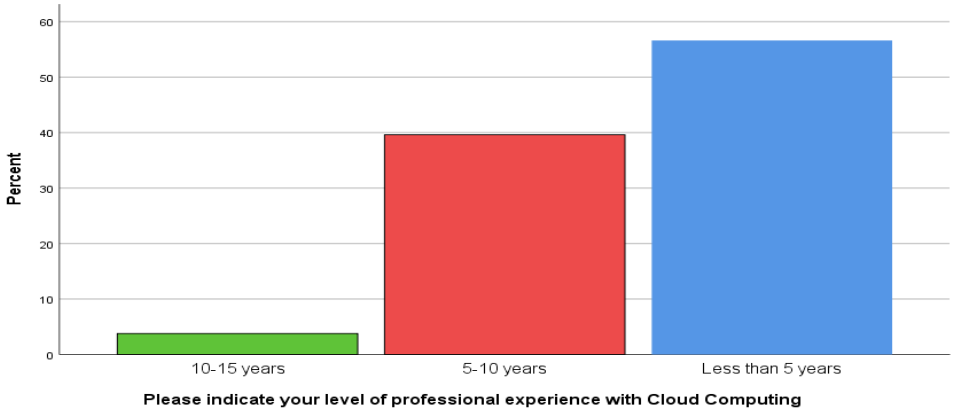

Figure 1.9 Survey Responses on the level of Cloud Computing Experience

Figure 2.0 below represents the size of organisations in the study. The chart indicates that respondents working in organisations with 100-500 employees represent 45.3%. 22.6% were from organisations with 1000-5000 employees, followed by organisations of less than 100 with 17.0%. Organisations with 500-1000 and more than 5000 employees comprised 11.3% and 3.8%, respectively.

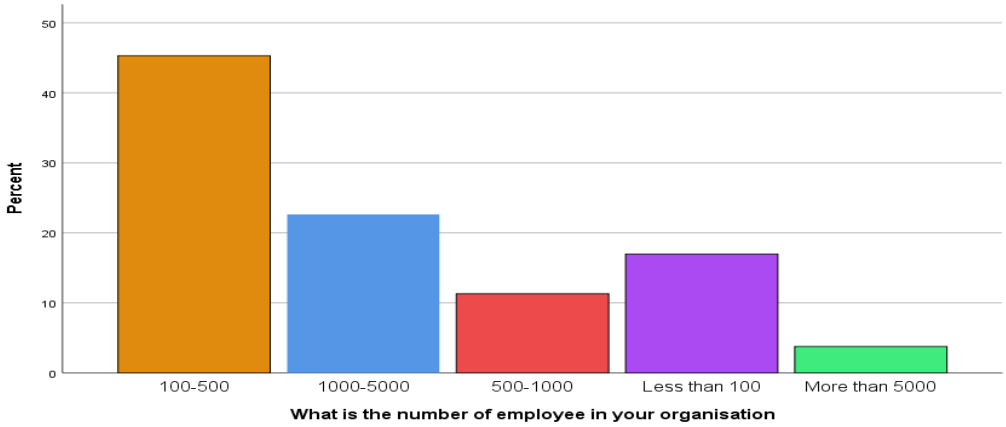

Figure: 2.0 Survey Responses on the Number of Employees

Table 1.1 represents the current level of cloud adoption within the organisation in the study. The results indicate that a significant number of respondents, 81.1% have already adopted some cloud computing services. In contrast, 13.2% intend to adopt cloud computing in the next two years. Notably, 1.9% of respondents do not intend to adopt cloud computing for the foreseeable future. Finally, 3.8% are unsure of their organisation's plans.

Table 1.1 *Organisations Current Cloud Adoption State*

What is your organisation's plan for cloud computing adoption	Frequency	Percentage
We have already adopted some Cloud Computing services	43	81.1%
We intend to adopt Cloud Computing services in the next 2 years	7	13.2%

We do not intend to adopt any Cloud Computing services for the foreseeable future	1	1.9%
I do not know	2	3.8%

Table 1.2 represents the current cloud computing deployment model currently in use for government agencies. The table indicates that both private and hybrid deployments models are in use by 32.1% of respondents. In addition, 35.8% of the respondents use public cloud services.

Table 1.2 *Organisation's Current Deployment Model*

What type of cloud deployment model does your organisation use?	Frequency	Percentage
Private Cloud	17	32.1%
Public Cloud	19	35.8%
Hybrid Cloud	17	32.1%

5.4 Key Factors and Barriers

In this section, research findings related to the key factors and barriers that influence cloud computing adoption of cloud computing in the Irish Government are analysed. This section will be divided into three domains, each based on the context of the TOE model: technological, organisational and environmental. Each variable is described in more detail by performing descriptive analysis from the data gathered via the closed-ended question. More importantly, each variable's mean, mode, and standard deviation are stated. Furthermore, at the end of each domain, respondents were provided with an open-ended question to supply any additional information. Finally, an open-ended question was provided at the end of the questionnaire to establish any other factors or barriers that affect the adoption of cloud computing applications in their organisation not covered in this study or any additional information they felt would be helpful in this study.

5.5 Technological Domain

5.5.1 Data Protection

As can be seen in Table 1.3, the results of the data protection variable show the results for key factors provide a mean of 4.38, mode of 5 and standard deviation of 0.84, thus showing data protection to be an influential key factor in the adoption of cloud computing. Additionally, the results provide a mean of 3.57, mode of 4 and standard deviation of 0.91, thus showing data protection is also a barrier to cloud adoption. Notably, compared to all other variables in the technological domain, data protection was the only variable that is both a key factor and barrier in adopting cloud computing. Furthermore, highlighting the issues with data protection, the participants were asked about their confidence in storing their organisation's sensitive data in the cloud, with the results showing that organisations are not confident on this topic.

Table 1.3 *Descriptive Statistics of Data Protection*

Data Protection	Mean	Mode	Standard Deviation
Data protection is a key factor that affects your decision to use cloud services.	4.38	5	0.84
Data protection concerns are viewed as a barrier to your organisation's cloud computing adoption.	3.57	4	0.91
You are confident storing your organisation's sensitive data in the cloud	2.53	1	1.28

5.5.2 Cybersecurity

The results from the survey, as seen in table 1.4 below, revealed that cybersecurity is a key factor in the adoption of cloud computing. Results show a mean of 3.83, mode of 4 and a standard deviation of 0.75. Alternately, with results of a mean of 2.75, mode of 2 and standard deviation of 0.91, thus showing cybersecurity as not a barrier to cloud computing adoption. Moreover, respondents were unsure if cloud services provide better cyber-security than traditional on-premises solutions.

Table 1.4 *Descriptive Statistics of Cybersecurity*

Cybersecurity	Mean	Mode	Standard Deviation
Cybersecurity is a key factor that affects your decision to use cloud services.	3.83	4	0.75
Cybersecurity concerns are viewed as a barrier to cloud computing adoption in your organisation.	2.75	2	0.91
Cloud computing provides better cybersecurity than on-premises solutions	3.43	3	1.04

5.5.3 Cost

As seen in table 1.5, participants see cost as a key factor. However, it is not viewed as a barrier to cloud computing adoption. The results of the key factor question provide a mean of 3.45, mode of 4 and standard deviation of 0.99. In contrast, for the barrier question, the results provide a mean of 2.75, mode of 2 and standard deviation of 0.91. Also, results show that the majority of the participants agree that cloud computing reduces the investment cost in new IT Infrastructure.

Table 1.5 *Descriptive Statistics of Cost*

Cost	Mean	Mode	Standard Deviation
The cost of cloud computing is a key factor that affects your decision to use cloud services.	3.45	4	0.99
The cost of cloud computing is seen as a barrier to cloud computing adoption in your organisation.	2.75	2	0.91
Cloud computing reduces the investment cost in new IT Infrastructure.	3.53	4	0.82

5.5.4 Compatibility

As seen in table 1.6, the survey results revealed that compatibility is a key factor in adopting cloud computing. Results from the table below show a mean of 3.62, a mode of 4 and a standard deviation of 1.00. Alternately, with results of a mean of 2.57, mode of 2 and standard deviation of 0.93, thus showing compatibility as not a barrier to cloud computing adoption. Moreover, most respondents agree that cloud technology is compatible with their organisation's current IT environment.

Table 1.6 *Descriptive Statistics of Compatibility*

Compatibility	Mean	Mode	Standard Deviation
The compatibility of cloud computing with your current IT environment is a key factor that affects your decision to use cloud services.	3.62	4	1.00
The compatibility of cloud technology with your current IT environment is a barrier to cloud computing adoption in your organisation.	2.57	2	0.93
Cloud technology is compatible with your organisation's current IT environment.	3.83	4	0.96

5.5.5 Technological Open-Ended Responses

The below data reflects some of the vital commentary provided by participants from the open-ended questions asked at the end of the technological domain; In the area of data protection, cybersecurity, cost and compatibility, is there anything you wish to add that you think would be helpful to this study: One respondent stated: "In the area of data protection, cybersecurity, cost and compatibility, is there anything you wish to add that you think would be helpful to this study". Another one stated, “we have a cloud computing policy that precludes storage of sensitive content in the Cloud so you always need to consider what use cases Cloud can be suitable for and when not", and another one stated, "Data protection concerns are viewed as a barrier to your organisation's cloud computing adoption only for sensitive data, cloud is fine for the likes of telephony, website hosting etc that has no data" and finally ”The greatest challenge for Cloud Services adoption in government is public perception. Research is needed to determine whether citizens are concerned or content in using Cloud Services."

To summarise the technological domain factors, data protection concerns are barriers and key factors. Additionally, cybersecurity, cost and compatibility were identified as key factors but not as a barrier to cloud computing adoption, as shown in Table 1.7 below.

Table 1.7 *Summary of Technological Domain*

Technological Domain	Barrier	Key Factor
Data Protection	√	√
Cybersecurity	X	√
Cost	X	√
Compatibility	X	√

5.6 Organisational Domain

5.6.1 Senior Management Support

As can be seen from table 1.8 below, participants see senior management support as a key factor. However, it is not viewed as a barrier to cloud computing adoption. The results of the key factor question provide a mean of 3.98, mode of 4 and standard deviation of 0.84. In contrast, for the barrier question, the results provide a mean of 3.15, mode of 2 and standard deviation of 0.88. Also, results show that the majority of the participants agree that senior management must be involved in decision-making around cloud computing adoption.

Table 1.8 *Descriptive Statistics of Senior Management Support*

Senior Management Support	Mean	Mode	Standard Deviation
The support of senior management in your organisation is a key factor that affects your decision to use cloud services	3.98	4	0.84
Lack of senior management support is seen as a barrier to cloud computing adoption in your organisation	3.15	2	0.88
Senior management must be involved in decision-making around cloud computing adoption	4.00	4	1.02

5.6.2 Organisational Readiness

The results seen in table 1.9 reveal that organisational readiness is neither a key factor nor a barrier to adopting cloud computing. Results from the table below show key factors with a mean of 2.85, mode of 2 and standard deviation of 1.18. Also, the results show for the barrier question with a mean of 2.62, mode of 2 and standard deviation of

1.26. Moreover, most respondents agree that their current organisation, including budgets, is ready to adopt cloud computing technology.

Table 1.9 *Descriptive Statistics of Organisational Readiness*

Organisational Readiness	Mean	Mode	Standard Deviation
Organisational Readiness is a key factor that affects your decision to use cloud services.	2.85	2	1.18
A lack of organisational readiness is a barrier to cloud computing adoption.	2.62	2	1.26
Your current organisation is ready to adopt cloud computing technology.	3.66	4	1.01
Your organisation's budget e.g. CapEx/OpEx are ready to support cloud computing adoption.	3.17	4	1.25

5.6.3 Technology Readiness

As can be viewed in table 2.0, participants see technology readiness as a key factor. However, it is not viewed as a barrier to cloud computing adoption. The results of the key factor question provide a mean of 3.92, mode of 4 and standard deviation of 0.68. In contrast, for the barrier question, the results provide a mean of 3.24, mode of 3 and standard deviation of 1.05. Also, results show that the majority of the participants agree that their organisation is equipped from a technology readiness viewpoint to adopt cloud technology.

Table 2.0 *Descriptive Statistics of Technology Readiness*

Technology Readiness	Mean	Mode	Standard Deviation
Having technology ready is a key factor that affects your decision to use cloud services.	3.92	4	0.68
A lack of technology readiness is a barrier to cloud computing adoption.	3.24	3	1.05
Your current organisation is equipped to adopt cloud technology.	3.75	4	0.85

5.6.4 Organisational Open-Ended Responses

The below results reflect the vital elements of the commentary provided by participants from the open-ended questions asked at the end of the organisational domain section of the questionnaire: In the area of senior management, organisational and technology readiness, is there anything you wish to add that you think would be helpful to this study. One participant stated: "senior management should be involved in the objectives and outputs not the method so much". Another stated, "Bringing everyone along with you is a key factor, especially Board and Business". And finally, "Support of Senior Management, the Audit Committee, and of the Board were key to implementing our cloud journey"

To summarise the organisational domain factors, the results in table 2.1 reported no barriers to organisations adopting cloud computing. In contrast, two key factors were identified in senior management support and technology readiness. Significantly, across the entire study, organisational readiness is the only factor reported as neither a barrier nor a key factor.

Table 2.1: Summary of Organisational Domain

Organisational Domain	Barrier	Key Factor
Senior Management Support	X	√
Organisational Readiness	X	X
Technology Readiness	X	√

5.7 Environmental Domain

5.7.1 Government Support

As per the results generated from the questionnaire and viewable in table 2.2, government support is both a key factor and barrier to cloud computing adoption. Indeed, the barrier questions returned a mean of 3.70, mode of 4 and standard deviation of 1.10. Likewise, the key factor question returned a mean of 3.79, mode of 4 and standard deviation of 1.08. Significantly, results show that the majority of respondents agree that the Irish Government has provided insufficient support to promote cloud computing for government agencies.

Table 2.2 *Descriptive Statistics of Government Support*

Government Support	Mean	Mode	Standard Deviation
Having strong government support is a key factor in adopting cloud computing.	3.79	4	1.08
A lack of government support in place is a barrier to cloud computing adoption.	3.70	4	1.10
The Irish Government has provided sufficient support to promote cloud computing for government agencies.	2.30	2	1.03

5.7.2 Vendor Support

The results of the vendor support variable, seen in table 2.3, show that the results for key factors provide a mean of 3.57, mode of 4 and standard deviation of 0.99, thus showing vendor support to be a key factor in the adoption of cloud computing. Additionally, with a mean of 3.62, mode of 4 and standard deviation of 1.00, respondents consider not having vendor support a barrier to adopting cloud computing. Also, results show that organisations require vendor support to adopt cloud computing technology.

Table 2.3 *Descriptive Statistics of Vendor Support*

Vendor Support	Mean	Mode	Standard Deviation
The ability to source vendor support is a key factor in adopting cloud computing.	3.57	4	0.99
Not having vendor support in place is a barrier to cloud computing adoption.	3.62	4	1.00
Your organisation requires vendor support to adopt cloud computing technology	3.87	4	0.83

5.7.3 Procurement Support

As seen in table 2.4, the results from the survey revealed that procurement support is a key factor in the adoption of cloud computing. Results from the table below show a mean of 4.23, a mode of 4 and a standard deviation of 0.91. Following this, with results of a mean of 4.21, mode of 4 and standard deviation of 0.96, thus showing procurement is also viewed as a barrier to the adoption of cloud computing. Additionally, most respondents identified their organisations as not having sufficient cloud-based procurement experience to support cloud computing adoption.

Table 2.4 *Descriptive Statistics of Procurement Support*

Procurement Support	Mean	Mode	Standard Deviation
Having government procurement support in place is a key factor in adopting cloud computing.	4.23	4	0.91
Not having flexible government procurement support in place is a barrier to cloud computing adoption.	4.21	4	0.96

Your organisation has sufficient cloud-based procurement experience to support cloud computing adoption.	3.87	4	0.83

5.7.4 Environmental Open-Ended Responses

The below information reflects the vital elements of the commentary provided by participants from the open-ended questions asked at the end of the environmental domain section of the questionnaire: In the areas of government, vendor and procurement support, is there anything you wish to add that you think would be helpful to this study?. One participant stated, “vendor support is something that can be purchased if the right government framework and support is in place, currently they are not, these 3 are interlinked”, another one stated, “Public sector procurement processes are not aligned with most cloud providers selling processes, which are often on a 'take it or leave it' basis, here's our pricelist now off you go.” Furthermore, “As a public sector organisation I believe the government has a very important role in supporting any moves to cloud computing and Three year contracts are no use for cloud computing as so much effort is required to migrate providers.”

To summarise, as seen in table 2.5, all three variables, procurement, government and vendor support, are identified as key factors and barriers within the environmental domain. Significantly, this is the only domain where all factors are reported as key factors and barriers.

Table 2.5 Summary of Environmental Domain

Environmental Domain	Barrier	Key Factor
Government Support	√	√
Vendor Support	√	√
Procurement Support	√	√

5.8 Additional Key Factors or Barriers

Finally, participants were provided with the opportunity via an open-ended question to identify any additional key factors or barriers not covered in this study or any additional valuable information to the study. Thus, the more significant responses were: “One barrier that is now slowing this process is the public sectors ability to hold on to qualified cloud computing engineers and staff as the salary within the public sector is lower than that offered in the private sector”, also “Providing a sufficient budget to buy these resources as the Private sector can offer more benefits.” And “One barrier that is now slowing this process is the public sectors ability to hold on to qualified cloud computing engineers and staff as the salary within the public sector is lower than that offered in the private sector”.

5.9 Summary

This chapter has presented the analysis of the quantitative data collected from the questionnaire. It shows the key factors and barriers that face government organisations when adopting cloud computing in the present and future. The findings show that they were four barriers to cloud computing adoption. These barriers were data protection,

government support, vendor support and procurement. Furthermore, the study has shown that all but one variable identifies as a key factor. In the next chapter, conclusions will be drawn from the findings.

6. Discussion

6.1. Introduction

This chapter will contextualise the primary research findings within the existing literature to purposively address the research aims. Thus, this chapter aims to provide a sharp and clear discussion of the findings presented in chapter five. This study aims to identify the key factors and barriers that affect the adoption of cloud computing in the Irish Government. The following discussion of the findings will thus be framed using the TOE model and therefore discusses in detail the effect of technological, organisational and environmental domains on government agencies decision to adopt cloud services. Table 2.6 summarises the results from the analysis chapter.

Table 2.6 *Summary of Quantitative Analysis*

Domain	Summary	Barrier	Key Factor
Technological	Data Protection	√	√
Technological	Cybersecurity	X	√
Technological	Cost	X	√
Technological	Compatibility	X	√
Organisational	Senior Management Support	X	√
Organisational	Organisational Readiness	X	X
Organisational	Technology Readiness	X	√
Environmental	Government Support	√	√
Environmental	Vendor Support	√	√
Environmental	Procurement Support	√	√

6.2. Technological Domain

This section discusses the technological key factors and barriers related to cloud computing adoption in the Irish government. These are data protection, cybersecurity, cost, and compatibility.

6.2.1 Data Protection

Significantly, within the technological domain, data protection is the only variable that is a barrier and a key factor. Equally important, the quantitative data analysis showed that data protection is statistically the most significant that will affect the adoption of cloud computing. Essentially, the leading data protection challenge in cloud computing is preserving the integrity and privacy of data. In contrast to the traditional on-premises solution, by using cloud services, governments could be storing data located in different locations across the globe. Therefore potentially increasing the risk of uncontrolled distribution of the information to third parties or the risk of the data being hacked. Privacy and data protection laws like General Data Protection Regulation (GDPR) and US Safe Harbour Program require organisations know the exact location of their data stored, the ramifications of which are of great concern for government bodies, especially those who hold citizen data. These findings reflect those of some previous studies, such as the research of (Jones *et al.*, 2019) and (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014). However, the participants in the study who responded to the open-ended question highlighted that adopting cloud services for solutions that do not hold sensitive data is suitable for government agencies, for example, telephony or video conferencing solutions. Thus, based on this study, the data protection of sensitive citizens' data is considered the most significant challenge to government agencies in adopting or expanding on existing cloud computing adoption.

6.2.2 Cybersecurity

The staff of government organisations identified security concerns as not being a barrier to cloud computing adoption. By comparison, it is considered a key factor. While many cybersecurity challenges still exist, the results from this study indicate that they can be overcome by a solid investment in security controls. It is now accepted that cloud computing now provides a more improved solution than traditional on-premises solutions. The results do not fit the majority of existing literature, which can be divided into two timeframes. Mainly, pre covid studies by (Ali *et al.*, 2016) and (Jones *et al.*, 2019) showed that cybersecurity and data protection were considered the most significant barrier and were also key factors for government organisations hesitating about moving to cloud technology. However, as seen in the literature review chapter, there is no question that Covid-19 has accelerated cloud adoption, with technology playing a crucial role in fighting the epidemic. The most current literature studies, explicitly those carried out during the Covid-19 period in government cloud computing adoption, reflect this study and reinforce the revised role of cyber-security. For example, the findings by (Alhomdy et al., 2021) mirror that cybersecurity is a significant factor but no longer a barrier. Consequently, as seen from Lenz (2021) study, cybersecurity is now deemed a driver toward cloud adoption due to the ability to leverage the cloud service providers' economies of scale, particularly in specialised security staff and other robust security systems and infrastructure (Lenz, 2021).

6.2.3 Cost

The quantitative data analysis showed that cost is statistically significant and will positively affect the adoption of cloud computing. It is considered a key factor that will motivate government organisations to adopt cloud computing. Adopting cloud computing reduces the costs organisations incur as they no longer purchase, maintain, resource and

secure their own IT infrastructure. However, these costs are shifted to the cloud service provider and are realised quickly due to immediate savings on legacy licensing and hardware costs. Equally critical, respondents did not find the cost of cloud computing, one of the advantages of using cloud computing, as a barrier to cloud adoption. According to the literature reviewed for this study, there may be a dearth of studies related to cost and cloud adoption. Results from this study reflect those of some previous studies (Stefan IOVAN and Gheorghe Iulian DAIAN, 2013), (Lebeda, Zalatoris and Scheerer, 2018), (Zaharia-Rădulescu Adrian-Mihai and Radu Ioan, 2017). Furthermore, this study's participants strongly agree that cloud computing will reduce the costs of and investment in IT infrastructure compared to traditional on-premises solutions. This study also provided new insights into costs not seen in previous studies, specifically costs related to adopting cloud computing, as in migrating existing systems to the cloud. These additional migration costs include building new technology and secure cloud infrastructure, training existing staff, policy and standards formulations. Furthermore, the unknown cost and lack of understanding of cloud costing are identified as concerns to government agencies.

6.2.4 Compatibility

In this study, compatibility was a key factor but not a barrier to an organisation's decision to adopt cloud services. As cloud computing matures, its compatibility with existing on-premises solutions will be no more complex than common IT management challenges. Thus, compatibility is a factor that will reduce in importance or disappear over time. This relationship was also confirmed as the majority of participants in this study reported that cloud technology is already compatible with their organisation's current IT environment. Furthermore, these results from this study show that 82% of respondents have already adopted some Cloud computing services. Accordingly, compatibility is not a current issue.

These findings reflect those of some previous studies, such as the research of (Jones *et al.*, 2019) and (Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014).

6.3. Organisational Domain

This section discusses the organisational key factors and barriers related to cloud computing adoption in the Irish government. These are senior management support, organisational readiness and technology readiness.

6.3.1 Senior Management Support

Senior management support, which is the participation and interest of decision-makers when it comes to technology implementation and adoption, is a key factor. Given its disruptive and complex nature, cloud adoption is a significant decision for government agencies. It requires substantial input from senior management and the organisation's board, but the fear of getting it wrong often leads to no decision or delays in cloud adoption. Senior management must be involved in decision-making around cloud computing adoption. On the other hand, the finding of this research indicated that a lack of senior management support is not a barrier to government agencies. Compared to previous studies, this study brings new data as no evidence can be found that analysed barriers within the senior management context. Alternatively, the finding within key factors is consistent with research in previous IT adoption studies by (Ng Picoto, Fernandes Crespo and Kahn Carvalho, 2021) and (Abied, Ibrahim and Kamal, 2022). Equally important, the participants in the study who responded to the open-ended question highlighted that senior management, the decision-makers to adopt cloud computing, have limited knowledge of cloud computing concepts, and many management executives did not come from an IT background or have little or no experience or knowledge in relation to cloud computing adoption. Thus, based on this study and existing research, educating senior management on

cloud computing is vital in creating a supportive climate and providing adequate resources and funding. Consequently, where IT Management fails to conceive the benefits of cloud computing to the business, senior management may oppose its adoption.

6.3.2 Organisational Readiness

Significantly, across all three domains: technology, organisational and environmental, organisational readiness is the only variable that is neither a barrier nor a key factor. The majority of respondents of government organisations for the study agree that they are ready to adopt cloud computing technology from an organisational readiness perspective, and the financial processes are in place to support adoption. Therefore, it is considered the least critical element government organisations face in adopting cloud computing. A case in point is data provided from an open-ended question that organisational readiness can be addressed quickly, therefore it is neither a factor nor a barrier. These findings do not reflect some previous studies, such as the research of (El-Haddadeh, 2020), that identified organisational readiness as a barrier, also (Sallehudin *et al.*, 2020) study found that organisational readiness was a significant factor for IT innovation adoption. In the same way, the cybersecurity variable does not reflect the existing literature, following the results from the current cloud adoption status, with 81.1% already using cloud services, it can be opined that Irish Government agencies have overcome the organisational challenges like financial management and resources that previously would have been a factor and barrier to cloud computing adoption.

6.3.3 Technology Readiness

The findings from the analysis of quantitative data in chapter five revealed that technology readiness is a key factor yet is not viewed as a barrier to the adoption of cloud computing. These findings do not reflect some previous studies, such as the research of

(Mubarkoot Mohammed Salem and 황기현, 2016) and (Hsu and Lin, 2016), whose research identified technology readiness as a substantial barrier to cloud adoption in government. Given the results from the demographic analysis of this study, combined with the literature review, one potential explanation of this finding is again the consequence of Covid-19 accelerating cloud computing adoption. Thus, Irish Government agencies had to accelerate their technology readiness. Overall, this factor plays an essential role in an organisation's decision to utilise cloud services. Equally important, the participants in the study who responded to the open-ended question highlighted a more current challenge, which is the recruitment, upskilling and the retention of staff with cloud computing skills, explaining why technology readiness remains a key factor.

6.4. Environmental Domain

This section discusses the environmental key factors and barriers related to cloud computing adoption in the Irish government. These are government support, vendor support and procurement support.

6.4.1 Government Support

Government support is a critical environmental factor and a fundamental issue that tends to affect cloud computing adoption, as the findings from the quantitative data in chapter five identified this variable as both a barrier and a key factor. Additionally, 61.9% of participants agree that the Irish Government has provided insufficient support to promote cloud computing for government agencies. As seen from the literature review, in their 2019 cloud-first advice note, the central Irish Government stated that all government agencies should adopt a cloud-first strategy. Since this advice note was published, this study confirmed that government agencies have received no further support or advice. Furthermore, analysis of the open-ended questions results strongly referenced that a lack of

centralised government support, particularly in policies, guidance and frameworks, will hinder further cloud adoption until this topic is resolved. As a result, having solid and proactive central government support is critical and would have a considerably positive effect on the adoption of cloud computing if this was in place. A case in point is Australia, the United States and the United Kingdom governments, highlighted in the literature review chapter, with each country now providing additional support by expanding on the initial advice notes and strategies to encourage further adoption. These findings reflect those in the previous literature, such as the study by (Sallehudin *et al.*, 2020) on cloud computing adoption in the Malaysian Government and (Al Mudawi, Beloff and White, 2019) study on cloud computing adoption in the Saudi Arabia Government.

6.4.2 Vendor Support

Similar to government support, vendor support was also viewed as a critical environmental factor, as the quantitative data shows this as a key factor and barrier. The importance of vendor support is coherent with the findings of (Jere and Ngidi, 2020), whose results show that vendor support is significant and thus is also seen as a key factor in adopting cloud computing. Additionally, research by (Ali *et al.*, 2016) identified the lack of vendor support as a barrier. Furthermore, respondents in this research firmly believed in the importance of external vendor support, mainly because their advanced capabilities are essential to supporting government agencies in adopting cloud computing. A case in point was the responses to the open-ended question where participants referenced that having certified suppliers of cloud computing services available to their organisation is essential due to the lack of in-house cloud IT skills and the challenges of recruiting resources with these skills. Furthermore, the positive perception of the role of vendors indicated by

respondents in this research is supported, with 80% agreeing that government agencies require vendor support to adopt cloud computing technology.

6.4.3 Procurement Support

Highlighting the importance of procurement support, for government agencies to acquire the vendor support detailed in the previous section, the government's procurement strategy must align with the requirements of individual agencies. Thus providing centrally negotiated framework contracts for cloud services is essential to provide the flexibility and ease to purchase cloud services. However, this study highlights that the current lack of procurement support is identified as a barrier to cloud computing adoption in the Irish Government, also signalling its importance as a key factor. Furthermore, underling the importance of centralised procurement support to government agencies, only 25.5% of organisations have sufficient in-house cloud-based procurement experience. Therefore, the Office of Government Procurement, responsible for sourcing standard products and services for the public service, must develop frameworks similar to the UK G-cloud solution highlighted in chapter two to make it clearer, simpler and faster for individual government bodies to purchase cloud-based services. Given that procurement was added to the conceptual framework to understand the cloud computing adoption within the Irish government's context, no existing research was found by this researcher that analysed procurement.

6.5. Summary

This chapter has discussed the key findings of this research. There were nine key factors identified in this study. These factors are data protection, cybersecurity, cost, compatibility, senior management support, technology readiness, government support, vendor support and procurement. Additionally, there were four barriers identified. These barriers are data

protection, government support, vendor support and procurement support. In the next chapter, conclusions will be drawn from this study, research contributions and limitations of the study discussed, and future research directions will be suggested.

7. Conclusion

7.1 Introduction

This chapter starts by providing an overview of the study. Then, the research is evaluated against the aims and objectives described in chapter one to demonstrate that this research has fulfilled them. In addition, this chapter highlights the limitations of this study and makes recommendations for further research. Finally, it presents a discussion of the practical and theoretical research contributions that the study has made.

7.2 Overview of the Study

This study started with an introduction that provided the research rationale, aims, background of the research topic and the problem statement. This research sought to identify the key factors and barriers to cloud computing adoption by government agencies in Ireland. This study can help government organisations realise the reasons for not adopting cloud computing and guide them towards a better and more efficient adoption. The next chapter provided a literature review of cloud computing, including previous research on this topic and the current status of cloud adoption in various governments worldwide and in Ireland. Furthermore, the literature review showed that no research was conducted to examine the factors and barriers affecting government agencies' intentions in Ireland. Also, the theoretical and conceptual model was constructed. Then, the research methodology was discussed and presented, using a quantitative survey methodology. Finally, the quantitative data was analysed using descriptive statistics collected from the questionnaires, identifying the key factors and barriers. These findings were then discussed whilst taking into account previous theory and research.

7.3 Fulfilling the Aims and Objectives of this Study

As detailed in chapter one, this research aimed to identify the key factors and barriers to cloud computing adoption in the Irish Government. This aim was accomplished as follows:

Nine key factors were identified in this study. These factors are data protection, cybersecurity, cost, compatibility, senior management support, technology readiness, government support, vendor support and procurement support. Additionally, there were four barriers identified. These barriers are data protection, government support, vendor support and procurement support. Thus, as seen in the discussion chapter, also achieving the objectives of this study, which was to develop an understanding of key factors and barriers that affect cloud computing adoption in the Irish Government.

7.4 Research Limitations

Even though the present study achieved its aims and objectives, it still has some limitations. The researcher faced time, word count and resource limitations. Consequently, this study used a small sample size. Future research can consider increasing the sample size to enhance the research quality further. Additionally, this study was conducted using a quantitative method through an online questionnaire. However, researchers of future studies could use a qualitative or mixed-method approach, possibly case studies or interviews, to achieve a more comprehensive and in-depth knowledge of the factors and barriers that impact the adoption of cloud computing.

7.5 Future Research

Given the recent acceleration of cloud computing and the drive towards government digitalisation highlighted in this study, future research should focus on adopting cloud computing in a post-COVID-19 pandemic world, specifically to identify if new factors or barriers exist in government organisations that have already adopted cloud computing. Also, by using the TOE model, this study measured cloud computing adoption on a broad level. Consequently, this study opens possibilities for further research to analyse cloud adoption at the individual level through other models and theories referenced in the literature

review, such as the Technology Acceptance Model, Unified Theory of Acceptance or Use of Technology Model, or combining these theories with the TOE framework. Furthermore, stemming from the findings of this study, researchers could develop a robust and exhaustive national framework to support the Irish Government in overcoming the remaining barriers identified in this study.

7.6 Research Contribution

7.6.1 Theoretical Contribution

The main contribution of this research is the proposed model. For example, the model used in this research was constructed from the literature review and other factors not investigated in previous studies, particularly the integration of procurement support into a modified TOE model. Additionally, this study also identified the lack of availability of staff with cloud experience, including the challenges of retaining these staff, as a potential new barrier to cloud adoption. Future researchers could incorporate this new variable, recruitment, into their theoretical framework. Also, given its scope and importance, this study separated data protection from cyber-security. Thus, future researchers can also adopt this approach.

Furthermore, to the best of the author's knowledge, this is the first study to examine the impact of key factors and barriers to the adoption of cloud computing in the Irish Government. A further contribution of this research is the new instrument developed. The questions in the survey used to identify the key factors and barriers in the cloud adoption model were adapted from former studies. However, some questions were modified to fit the research context, while other items were added by the researcher based on feedback from several senior ICT managers across various government agencies. Finally, previous studies using the TOE model for cloud computing adoption focused on either the factors or,

in some cases, solely barriers. Alternatively, to provide a more holistic study of cloud computing adoption, this study chose a more integrated solution to examine both the factors and barriers. Moreover, the modified research model, integrated solution and the corresponding instrument can also be used or adapted for adoption studies in Governments or other technologies and organisational settings.

7.6.2 Practical Contribution

The general outcomes of this study have contributed to and extended knowledge in the field of cloud computing adoption in the Irish Government. The findings of this study provided a comprehensive and deep understanding of the key factors and barriers to cloud computing adoption in the Irish Government. Therefore, the main practical contribution in the government context is that the results of this study can be used as a guideline for the decision-makers in government bodies to support the successful adoption of cloud computing. Compared to other government-based cloud adoption studies, this research highlighted that the majority of Irish Government agencies have already adopted some form of cloud computing to meet the business needs in response to the challenges of Covid-19. Therefore, another practical implication of this study is that it can support the Irish Government in expanding its current adoption levels.

There is no question that this research found the environmental domain the most critical aspect of the study. Namely, government support, vendor support, and procurement were identified as key factors and barriers. Consequently, further support is required from the central government to individual agencies to support adopting or expanding on existing cloud-first strategies. For example, the Irish Government could take guidance from more cloud mature countries like the UK and the US, as detailed in chapter two of this study. For instance, introducing flexible procurement frameworks like the UK's G-Cloud would allow

individual government agencies to purchase cloud computing services clearer, simpler, and faster. This type of framework, if introduced in Ireland, would encourage the purchase of vendor support, highlighted by this research as a barrier, in turn enabling and encouraging further cloud computing adoption. Also, this research has shown that the Irish Government's cloud strategy is vague, with very little support provided to individual bodies. Thus the Irish government could follow the US, which has progressed from the cloud-first strategy to a cloud smart strategy, equipping agencies with more robust support, information and recommendations. In summary, this study shows that whilst some Irish government agencies have adopted cloud computing, there are still large-scale environmental barriers that cannot be removed by agencies alone. Hence, the central Irish Government and individual agencies must collaborate to focus on the solutions to the barriers and increase the adoption rate of cloud computing, which will result in improved government services to all citizens. Additionally, robust support and guidelines are essential for government agencies reluctant to move sensitive data to the cloud within the data protection context, similar to Australia's approach seen in the literature review. As a result of these data protection concerns, the existing footprint of cloud computing may not increase for government agencies until this issue is resolved.

7.7 Summary

In conclusion, to understand the adoption of cloud computing in the Irish Government, it is essential to identify the key factors and barriers, that this study has achieved. All three domains, technological, organisational and environmental, are identified in this research as having an impact in determining the decision to adopt cloud computing. Equally important, the research presented the environmental domain as the most representative of key factors and barriers. By identifying the key factors and barriers, his research can support the

government and individual government agencies in the successful implementation of the 2019 cloud-first policy, establish strategies and policies to support cloud adoption projects in the future and ensure the realisation of the many government strategies that the adoption of cloud computing underpins. Most of all, the adoption of cloud computing will support the Irish Government with the necessary platform to respond to the fundamental challenges of the Fourth Industrial Revolution.

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9 Appendix

9.1 Theoretical Framework/Method/Instrument Table

Study	Reference	Theoretical Framework	Method	Instrument
Barriers to government cloud adoption	(Tweneboah-Koduah, Endicott-Popovsky and Tsetse, 2014)	TOE	Qualitative	Semi-Structured Interview
Cloud computing in government organizations: towards a new comprehensive model	(Al Mudawi, Beloff and White, 2019)	TOE & DOI	Mixed	Survey, 7-point Likert Scale Semi-Structured Interview
Cloud Computing: TOE Adoption Factors By Service Model In Manufacturing	(McKinnie, 2016)	TOE	Quantitative	Survey, 7-point Likert Scale
Critical Factors Influencing Adoption of Cloud Computing for Government Organizations in Yemen*	(Mubarkoot Mohammed Salem and 황기현, 2016)	TOE & DOI	Quantitative	Survey, 7-point Likert Scale
Digital Innovation Dynamics Influence on Organisational Adoption: The Case of Cloud Computing Services	(El-Haddadeh, 2020)	TOE	Quantitative	Survey, 7-point Likert Scale
Perceived potential for value creation from cloud computing: a study of the Australian regional government sector	(Ali, Soar and Shrestha, 2018)	TOE, DOI & Desires Framework	Qualitative	Semi-Structured Interview
Performance and key factors of cloud Computing implementation in the public Sector	(Sallehudin *et al.*, 2020)	TOE	Quantitative	Survey, 5-point Likert Scale
Success of Small and Medium Enterprises in Myanmar: Role of Technological, Organizational, and Environmental Factors	(Bala and Feng, 2019)	TOE	Quantitative	Survey, 5-point Likert Scale
Understanding the Determinants and Future Challenges of Cloud Computing Adoption for	(Lynn *et al.*, 2020)	DOI & HOT-fit	Quantitative	Survey, 5-point Likert Scale

High Performance Computing				
A TOE Approach to Establish a Green Supply Chain Adoption Decision Model in the Semiconductor Industry	(Hwang, Huang and Wu, 2016)	TOE	Quantitative	Survey, 5-point Likert Scale
A technology, organisation and environment framework analysis of information and communication technology adoption by small and medium enterprises in Pietermaritzburg	(Jere and Ngidi, 2020)	TOE	Quantitative	Survey, 5-point Likert Scale
A Multi-Perspective Framework for Modelling and Analysing the Determinants of Cloud Computing Adoption among SMEs in Australia	(Isma'ili, 2017)	TOE&DOI	Mixed	Survey, 7-point Likert Scale Semi-Structured Interview
Understanding the Determinants Affecting the Continuance Intention to Use Cloud Computing	(Tripathi, 2017)	TAM	Quantitative	Survey, 5-point Likert Scale
Factors affecting the adoption of cloud services in enterprises	(Hsu and Lin, 2016)	TOE	Quantitative	Survey, 5-point Likert Scale
A model of a Private Sector Organisation's Intention to Adopt Cloud Computing in the Kingdom of Saudi Arabia	(Nouf Rashed, 2017)	TOE	Mixed methods	Survey, 5-point Likert Scale Semi-Structured Interview
Factors Affecting the Adoption of Cloud Computing in Saudi Arabia's Government Sector	(Alsanea, 2016)	TOE	Mixed Method	Survey, 5-point Likert Scale Case Study
An Analysis of the Technological, Organizational, and Environmental Factors Influencing Cloud Adoption	(Malak, 2016)	TOE&DOI	Quantitative	Survey, 7-point Likert Scale
Technology organization environment framework in cloud computing	(Ahmed, 2020)	TOE		
The influence of the technology organization-environment framework	(Ng Picoto, Fernandes Crespo	TOE	Quantitative	Survey, 7-point Likert Scale

and strategic orientation on cloud computing use, enterprise, mobility, and performance	and Kahn Carvalho, 2021)			
The perceived benefits of cloud computing technology for regional municipal governments and barriers to adoption	Ali 2016	TOE	Mixed	Survey, 5-point Likert Scale Interview - Semi-Structured

9.2 Questionnaire and Consent Form

Factors and barriers affecting cloud computing adoption in the Irish Government.

I am a master's student at Dublin Business School and I am carrying out my thesis project under the direct supervision of Paul McEvoy on the subject of cloud computing adoption in the Irish Government. The project aims to identify the key factors and barriers in cloud computing adoption in the Irish Government.
I would like to invite you to take part in a short questionnaire. As a participant in the study you would be required to answer questions about cloud computing within the context of technology, organisational and environmental factors.

Data Protection
The data you provide as part of this questionnaire will be fully anonymous. I will not gather any direct personally identifying information about you or anyone close to you. You will be asked to provide demographic information of a broad nature about yourself and the organisation you work for. Your data will be collated into a larger dataset and analysed at the group rather than the individual level. Your data will only be used for academic purposes and will not be shared with anyone for commercial purposes.

What are the risks and benefits of taking part in this study?
In addition to providing much appreciated assistance to the student researcher, the main benefit of taking part in this study will be your contribution to academic research, which aims to expand knowledge and generate new insights. There will be no risks posed to you as a participant in this study, either physical or psychological, beyond that which is normally expected of day-to-day activities.

If you are interested in taking part...
If you are interested in taking part please review the information provided in the consent form and if you are happy to proceed with the study then please indicate your willingness to take part by ticking the appropriate box.

You are under no obligation to take part in this study or to provide a reason if you decide not to take part. You may choose not to take part without fear of penalty. If you agree to take part you have the right to cease participation and withdraw your data at any time for any reason without fear of penalty. The data will not be used by this student researcher for commercial purposes.

* Required

5/18/2022

Consent Form

I voluntarily agree to take part in this research study.

I understand that I am not obliged to take part in this study and that my participation in the study is entirely voluntary.

I understand that I am free to withdraw from the study at any time or refuse to answer any question without the need to provide reason and without fear of negative consequences.

I understand that my responses will be anonymous.

I understand that in the case of completing an anonymous questionnaire, it will not be possible to subsequently withdraw my data due to the fact that there will be no personally identifying information attached to my responses.

I understand that I will not benefit directly from participating in this research.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

I understand that signed consent forms will be retained for some time until the exam board confirms the results of their dissertation.

I confirm that I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study with satisfactory answers provided.

By ticking this box, I confirm that I have read and fully understood the information provided and statements above.

Introduction

Part A of the questionnaire contains multiple-choice questions on job title, organisation type, IT experience, and your organisation's current or future cloud computing plans.

Part B of the questionnaire contains four sections, three of these each containing compulsory multiple-choice questions based on predefined topics, and at the end of each section, there is an option to provide any additional information if required.

- Section 4 contains questions on data protection, cybersecurity, cost and compatibility.
- Section 5 contains questions on seniors management and organisational & technology readiness.
- Section 6 contains questions on government, external vendors and procurement support.

In Section 7, you will be provided with an opportunity to add any additional information that you think would be useful to this study.

Below, once you confirm to participate, the questionnaire will begin.

1. Please confirm if you are willing to complete the questionnaire by ticking the box to continue *

   ◯ I can confirm I am willing to complete the questionnaire.

Part A

2. Please indicate your job title in your organisation *

- ◯ CIO / Head of IT
- ◯ ICT Manager
- ◯ ICT Infrastructure Manager
- ◯ Senior ICT Project / Programme Manager
- ◯ ICT Cloud Architect / Manager
- ◯ Other

3. Please indicate your level of professional ICT Experience *

- ◯ Less than 5 years
- ◯ 5-10 years
- ◯ 10-15 years
- ◯ 15-20 years
- ◯ More than 20 years

4. Please indicate your level of professional experience with Cloud Computing *

- ◯ Less than 5 years
- ◯ 5-10 years
- ◯ 10-15 years

5. What is the number of employee in your organisation *

- ◯ Less than 100
- ◯ 100-500
- ◯ 500-1000
- ◯ 1000-5000
- ◯ More than 5000

6. Please indicate the type of your organisation *

- ◯ Public Service
- ◯ Civil Service
- ◯ Health Services Executive
- ◯ Local Authority
- ◯ Other

7. What is your organisation's plan for Cloud Computing adoption *

- ◯ We have already adopted some Cloud Computing services
- ◯ We intend to adopt Cloud Computing services in the next 2 years
- ◯ We do not intend to adopt any Cloud Computing services for the foreseeable future
- ◯ I do not know

8. What type of cloud deployment model does your organisation use? *

- ◯ Private Cloud
- ◯ Public Cloud
- ◯ Hybrid Cloud
- ◯ Not sure
- ◯ None of the above

9. What type of cloud service/delivery model does your organisation use? (Tick all items that are applicable) *

- ☐ Software-as-a-Service
- ☐ Platform-as-a Service
- ☐ Infrastructure-as-a-Service
- ☐ Not sure
- ☐ None of the Above

Part B - Key Factors and Barriers

Section 4

10. Data Protection - Refers to the practice of safeguarding important data from corruption, compromise or loss and providing the capability to restore the data to a functional state in a cloud environment. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
You are confident storing your organisation's sensitive data in the cloud.	◯	◯	◯	◯	◯
Data protection is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
Data protection concerns are viewed as a barrier to your organisation's cloud computing adoption.	◯	◯	◯	◯	◯

11. Cybersecurity - Refers to securing environments against both external and insider cybersecurity threats. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Cloud computing provides better cybersecurity than on-premises solutions.	◯	◯	◯	◯	◯
Cybersecurity is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
Cybersecurity concerns are viewed as a barrier to cloud computing adoption in your organisation.	◯	◯	◯	◯	◯

12. Cost - Refers to the investment required to adopt cloud technologies. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Cloud computing reduces the investment cost in new IT Infrastructure.	◯	◯	◯	◯	◯
The cost of cloud computing is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
The cost of cloud computing is seen as a barrier to cloud computing adoption in your organisation.	◯	◯	◯	◯	◯

13. Compatibility - Refers to the compatibility of cloud computing with your existing IT environment, including IT infrastructure and systems. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Cloud technology is compatible with your organisation's current IT environment.	◯	◯	◯	◯	◯
The compatibility of cloud computing with your current IT environment is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
The compatibility of cloud technology with your current IT environment is a barrier to cloud computing adoption in your organisation.	◯	◯	◯	◯	◯

14. In the area of data protection, cybersecurity, cost and compatibility, is there anything you wish to add that you think would be helpful to this study.

15. Senior Management - Refers to non ICT senior management support that enables your organisation to adopt cloud computing. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Senior management must be involved in decision-making around cloud computing adoption.	◯	◯	◯	◯	◯
The support of senior management in your organisation is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
Lack of senior management support is seen as a barrier to cloud computing adoption in your organisation.	◯	◯	◯	◯	◯

16. Organisational Readiness - Refers to your organisation's management, financial management, resources, required skills and knowledge in cloud computing. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Your current organisation is ready to adopt cloud computing technology.	◯	◯	◯	◯	◯
Your organisation's budget e.g. CapEx/OpEx are ready to support cloud computing adoption.	◯	◯	◯	◯	◯
Organisational Readiness is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
A lack of organisational readiness is a barrier to cloud computing adoption.	◯	◯	◯	◯	◯

17. Technology Readiness - Refers to your IT department having the required technical infrastructure and expertise to support cloud computing adoption. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Your IT department is equipped to adopt cloud computing technology.	◯	◯	◯	◯	◯
Having technology ready is a key factor that affects your decision to use cloud services.	◯	◯	◯	◯	◯
A lack of technology readiness is a barrier to cloud computing adoption.	◯	◯	◯	◯	◯

18. In the area of senior management, organisational and technology readiness, is there anything you wish to add that you think would be helpful to this study.

Section 6

19. Government Support - Refers to the Irish Government policies and strategies in place to support cloud computing adoption. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The Irish Government has provided sufficient support to promote cloud computing for government agencies.	◯	◯	◯	◯	◯
Having strong government support is a key factor in adopting cloud computing.	◯	◯	◯	◯	◯
A lack of government support in place is a barrier to cloud computing adoption.	◯	◯	◯	◯	◯

20. Vendor Support - Refers to the support from experienced and certified suppliers of cloud computing services to your organisation. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Your organisation requires vendor support to adopt cloud computing technology.	◯	◯	◯	◯	◯
The ability to source vendor support is a key factor in adopting cloud computing.	◯	◯	◯	◯	◯
Not having vendor support in place is a barrier to cloud computing adoption.	◯	◯	◯	◯	◯

21. Procurement Support - Refers to the guidelines, policies, procedures and frameworks available to organisations to support the adoption of cloud computing. *

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Your organisation has sufficient cloud-based procurement experience to support cloud computing adoption.	◯	◯	◯	◯	◯
Having government procurement support in place is a key factor in adopting cloud computing.	◯	◯	◯	◯	◯
Not having flexible government procurement support in place is a barrier to cloud computing adoption.	◯	◯	◯	◯	◯

22. In the areas of government, vendor and procurement support, is there anything you wish to add that you think would be helpful to this study?

Section 7

23. In your opinion, are there any other factors or barriers that affect the adoption of cloud computing applications in your organisation which are not covered in this study, or any additional information which you think would be useful to this study?

Thank you for taking the time to complete my questionnaire.