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Report for the Digital Industry Policy Association (DIPA)

Economic impact and dynamics of cloud services in South Korea

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March 2023

Ref: 8865878839-21

Contents

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0 Executive summary

This report has been prepared by Analysys Mason for the Digital Industry Policy Association (DIPA) and performs a review of the dynamics in South Korea's cloud services sector from both a demand and supply perspective, assesses the economic impact of cloud services in South Korea, and discusses regulatory considerations in light of the key findings. The analysis contained in this Report, including all future projections, is the sole responsibility of Analysys Mason and does not necessarily constitute an endorsement on the part of DIPA. The research that underpins this report was conducted between December 2022 and February 2023.

Demand for cloud services is growing rapidly and this supports the next phase of digital transformation for both companies and governments globally

'Cloud services' is a generic term that covers a wide range of IT-related activities provided over networks. The concept is not new – enterprise computing started with a 'mainframe-client' architecture where the IT infrastructure was removed from the user, in a 'mainframe,' and accessed through a lighter 'client' terminal. Today, the term 'cloud services' tends to refer to functions including storage, compute and networking, but also software platforms and applications provided by third-party cloud service providers (CSPs) over a combination of private networks and the internet. Traditionally, cloud services were segmented between infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). This classification was always an over simplification, and it is becoming increasingly outmoded as customer demands do not align to these classifications, as acknowledged by leading regulators (see Section 2.2).

Cloud services allow organisations to avoid the costs of directly owning and managing IT infrastructure, platforms and software, and benefits from economies of scale and scope where cloud resources can be shared between different uses, customers and end-users. Cloud services also play a critical role by enabling customers to redeploy their capital to other uses.

CSPs also have critical interdependent relationships with other stakeholders within the cloud services sector, including real-estate companies who build the data centres, hardware vendors who provide the equipment that goes in these data centres, and professional services companies who support cloud users in understanding and making the most of cloud services (see Section 3.1).

Cloud services support the emergence of entirely new business models: 'cloud-native' organisations, including start-ups and established companies with strong digital expertise, depend on access to a highly scalable and agile infrastructure with strong security and resiliency to offer services at scale to their own customers. In this way, cloud services contribute to driving economic growth through increased hiring of labour and increased spend on suppliers (see Section 2.3).

Governments and public-sector organisations, including schools and universities, are also increasingly understanding and unlocking the benefits that cloud adoption brings to their economies.

Many governments, including in South Korea, have started to introduce enabling policies to ensure the local workforce is equipped with the right skillsets and that commercial enterprises and government agencies are incentivised to migrate to cloud services (see Section 6.2.1).

Spending on cloud services in South Korea reached an estimated KRW5.2 trillion in 2022 contributing to GDP of KRW9.7 trillion across the economy; however, South Korea lags compared to other advanced economies and retains much scope for growth

South Korea is well placed to derive strong benefit from cloud services. It is one of the most digitally advanced economies in the world, with high-quality internet access widely available to consumers and enterprises. It has also consistently demonstrated relatively high capacity to adopt and explore digital technologies, having achieved consistent improvements in digital rankings over the years. South Korea ranked second globally in the Future Readiness factor within the International Institute for Management Development (IMD) Digital Competitiveness Ranking, which measures a country's "preparedness to exploit digital transformation".[1]

We estimate that enterprises and government agencies in South Korea spent KRW5.2 trillion overall on cloud services in 2022. Based on a conservative interpretation of available economic studies, we estimate that this spend supports about KRW9.7 trillion in economic output, driven by productivity gains and new business models enabled by cloud services (see Section 5.3). In other words, every 1000 won spent on cloud services contributed nearly 2000 won to South Korea's GDP in 2022.

Nevertheless, South Korea still lags behind many other advanced economies in cloud adoption based on OECD data for 2020.[2] This may be in part because of certain cultural and structural aspects of South Korea's economy (e.g. local conglomerates[3]) but is also due to regulatory factors that have acted to constrain the externalisation of IT functions and the adoption of cloud services. Regulation in the financial sector imposed by the Financial Services Commission (FSC)'s Regulation on Supervision on Electronic Financial Transactions (RSEFT) governs what IT functions may be served through cloud services. Recent revisions to the regulation in November 2022 reduced the number of criteria that financial institutions must assess to use cloud services. While these changes will reduce the burden to cloud adoption for financial institutions,[4] they remain more burdensome than in advanced cloud jurisdictions such as Singapore, where financial institutions are only recommended to perform a self-assessment based on guidelines.[5] Parts of the manufacturing sector, in particular semiconductors and batteries, are designated as national core technologies (NCTs). As such, they must comply with specific rules which require government pre-approval to use cloud services, which may hinder cloud adoption. Finally, government agencies and other public bodies, such as schools and hospitals, can currently only procure cloud services from a small shortlist of CSPs based on the

1 IMD World Competitiveness Center, 2022. "IMD World Digital Competitiveness Ranking 2022"

2 OECD, 2021. "Share of businesses purchasing cloud services"

3 Chaebols are large family-owned industrial conglomerates in South Korea

4 Financial Services Commission, 2022. "FSC Introduces Improvements to Cloud Computing and Network Separation Rules in Financial Sector"

5 Monetary Authority of Singapore, 2018. "Guidelines on Outsourcing"

Cloud Security Assurance Program (CSAP), which limits the ability of these agencies to select solutions and providers adapted to their needs, and constrains the benefits they can reap from cloud services (see Section 6.2.2).

Finally, some barriers to adoption have also been faced in economies that are further along the cloud adoption curve. Two key examples of this are workforce skills and cyber security.[6] South Korean organisations need to ensure employees are trained in cloud-related skills. At the same time, surveys show that South Korean enterprises still list security as the main obstacle to cloud adoption, despite mounting evidence of the strong security benefits of using best-in-class, professionally managed cloud services rather than relying on fragmented self-managed IT infrastructure.

With no major changes to the supply landscape or regulatory environment, cloud spend in South Korea could grow to KRW10.9 trillion in 2027, contributing KRW14.7 trillion to GDP of that year, driven by growing demand and vibrant supply

South Korea's cloud services sector is remarkably diverse, with a large number of CSPs offering a broad range of innovative services to organisations of all sizes (see Section 3.2).

Korean CSPs such as Naver Cloud, KT Cloud, NHN, Douzone Bizon and Kakao offer a range of services, including cloud-based compute and storage, 'big data' and AI platforms, as well as communication and collaboration platforms, and cloud-based game product suites. Naver Cloud stands out as a successful homegrown CSP in South Korea, having launched in 2017 with 22 cloud products and grown to over 200 product offerings across 18 categories by 2022. Naver Cloud has also publicly stated its ambition to expand strongly outside South Korea, to become one of the three largest CSPs in the Asia–Pacific region.[7]

In parallel, international CSPs including AWS, Google Cloud, Microsoft Azure and Alibaba Cloud, as well as smaller players such as Cloudflare and Snowflake, are also actively servicing commercial enterprises in South Korea. In particular, regional enterprises could make use of international CSPs' strong global presence supported by extensive infrastructure worldwide as well as support personnel that span across regions.

The vibrancy of the cloud services sector in South Korea can also be seen from the sustained growth in the number of CSPs operating in South Korea – the Korea Association of Cloud Industry indicated that there were 1764 CSPs in 2021, compared to 804 in 2017.[8] South Korea is also experiencing a high degree of multi-cloud take-up with an adoption rate of 2.5 public clouds per enterprise,[9] versus

6 KDI Economic Information Center Data Research Team, 2021. "Cloud Survey"

7 Korea Economic Daily, 2022. "Naver Cloud seeks win-win strategy with K-startups in overseas market"

8 Korea Association of Cloud Industry, 2022. "2021 Cloud Industry Survey Results Report"

9 VMware, 2022. "VMware Releases Multi-Cloud Maturity Study Report – South Korea's Multi-Cloud Ranks World's Highest"

the global average.[10] These factors reflect that cloud customers have a wide range of needs that requires different services and solutions from different CSPs. We also observe increased levels of collaboration between CSPs, with KT and AWS announcing a partnership in 2021 to conduct joint research in AI and cloud technologies, as well as the launch of a hybrid cloud service (see Section 3.2.1).

Despite the barriers to adoption mentioned earlier, the continued investments and education efforts of the diverse group of CSPs operating in the country is expected to drive sustained growth in cloud adoption in South Korea. Our central projection, where the supply landscape continues to be robust with demand increasing at a similar trajectory to past growth and the current regulatory environment remaining largely unchanged, expects overall cloud spend to grow to KRW10.9 trillion in 2027, with an estimated contribution to South Korea's GDP of KRW62.2 trillion cumulatively for the period of 2023 to 2027 (see Section 5.3).

A more supportive regulatory and policy environment in South Korea, could unlock faster adoption and greater economic impact

CSPs are investing and innovating at a rapid pace, reflecting the growing demand from customers (noting that cloud adoption is at an early stage, even in the most developed economies). Governments also appear keen to support such investment, innovation and growth: in South Korea, the government recently launched the third basic plan for cloud computing that provides multiple initiatives to nurture cloud-trained talent in the country. It adopted legislation as early as 2015 to promote the use of cloud services by government agencies. The government is also supporting cloud services by investing in cloud-based research and development which includes cloud-based high-performance computing (see Section 4.4).

Further actions, such as funding for training and subsidy programmes for digital initiatives, as well as ensuring that laws and regulatory measures are reviewed periodically to reflect and support government policy developments are needed. In particular, reviews of the CSAP regulation and NCT regulation to ensure cloud customers have access to the widest possible range of solutions, including within clearly defined security and resilience standards, could lower barriers to adoption, and further support digital investment and growth in South Korea (see Section 4.3.4).

Conversely, imposing regulatory measures that target specific CSPs or certain cloud services have the potential to adversely impact technological and digital developments in the cloud services sector. For example, regulation that imposes new onerous obligations on CSPs could reduce the IT choices available for businesses and government agencies and/or innovation and investment in new services in this sector. These risks indicate that in a fast-evolving sector, interventions must be carefully tested and calibrated to avoid poor outcomes that would ultimately reduce the economic potential of cloud services for South Korea overall (see Section 6.1.2).

10 The global average number of public clouds per cloud customer is at 2.2 in 2022. VMware, 2022. "The Multi-cloud Maturity Index"; based on a survey of organisations spread across 19 countries

In most cases, good policy and regulation is a matter of balance – with measured considerations on the level of obligations imposed which increases costs of doing businesses vs. the expected benefits to facilitate or level of risks to mitigate (see Section 6.2.2). For example, cloud security standards and certification programmes may increase costs to cloud users, but they also foster trust in the security and resilience of cloud services when well calibrated and defined. This can be particularly beneficial for organisations that have elevated security or operational needs, including the government sector and some of the commercial sectors that have more sensitive requirements, and ultimately it benefits cloud adoption and reduces the risks associated with security issues. Ensuring that the benefits of regulation outweigh its costs requires standards to be set carefully and fairly across all CSPs. Further, noting that new policies and regulations can be incorrectly calibrated (e.g. by being overly stringent) or even become outdated in view of industry developments, mechanisms are needed to revisit and revise such regulations. The anticipated relaxation of CSAP constraints is a good example of policy makers adapting regulation to reflect changing market conditions.

We note that ex-ante digital interventions,[11] encompassing cloud services, are currently being considered in other economies, with a lot of debate both within those countries and globally. From the perspective of South Korea, it is important to consider how the economic, political and legal considerations in those countries differ from South Korea's. For example, the implementation of the Digital Markets Act (DMA) was designed for the European Union (EU) and its unique characteristics and may not be suitable for single-country economies outside the EU. Notwithstanding the EU's decision to implement ex-ante digital regulation, that EU regime is subject to criticism from both regulators and industry associations.[12] Given the ongoing uncertainties surrounding how new and untested digital specific regulation will be implemented (e.g. DMA will only fully take effect in 2024) and its impact on the digital sectors, South Korean policy makers should exercise caution in considering whether this type of digital specific regulatory intervention is appropriate. Any proposed digital regulation should include a rigorous economic assessment on the expected trade-offs (see Section 6.4). This is especially critical given South Korea's lagging cloud adoption. Existing competition and antitrust laws in South Korea will also continue to provide effective tools for regulators to intervene when necessary.

In the context of the rapid pace of change in demand and supply in dynamic sectors like cloud services, it is challenging to clearly quantify the trade-offs involved in any individual policy decision. However, it is important for South Korean policy makers and regulators to have in mind the link between promoting the digital economy – including via facilitating increased cloud adoption – and the economic growth of South Korea.

11 The Digital Markets Act (DMA) introduced by the European Commission as an example

12 See Section 6.4 of the report for several examples of criticism of prescriptive digital platform regulation raised by leading industry bodies / regulators.

Illustratively, if cloud adoption accelerated over the next five years to KRW13.9 trillion in 2027, instead of our base case of KRW10.9 trillion, the corresponding multiplier effect could potentially result in a cumulative GDP increase of KRW8.3 trillion from 2023 to 2027. Conversely, constrained cloud adoption growth (for example due to restrictive policies or regulatory frameworks) could result in lower cloud adoption and spend leading to the opposite effect: a lower spend of KRW8.5 trillion in 2027 would lead to a decrease in GDP contribution by KRW7.9 trillion cumulatively from 2023 to 2027 (see Section 6.3).

Understanding that the benefits that cloud adoption can bring to commercial enterprises and government agencies positively impact the overall South Korean economy is crucial because only a policy and regulatory environment that facilitates the growth of cloud services in South Korea will achieve the cumulative GDP increase observed above.

This suggests the South Korea government needs to carefully consider, assess and determine the impact of policies that may increase or restrict cloud adoption (including restrictions on specific CSPs and ex ante regulation), through a careful analysis of their costs and benefits.

1 Introduction

This report was commissioned by the Digital Industry Policy Association (DIPA) and performs a review of the dynamics in South Korea's cloud services sector from both a demand and supply perspective, assesses the economic impact of the cloud services in South Korea, and discusses regulatory considerations in light of the key findings. The analysis contained in this report, including all future projections, is the sole responsibility of Analysys Mason and does not necessarily constitute an endorsement on the part of DIPA. The research that underpins this report was conducted between December 2022 and February 2023.

The expansion of broadband infrastructure globally, particularly since the turn of the twenty-first century, has spurred increasing internet penetration, allowed companies that span a range of industries to deploy advanced IT infrastructure for their own and others operational requirements and facilitated the emergence of cloud computing. Cloud computing allows resources and services to be delivered through the internet.

Strong growth in cloud adoption by commercial enterprises and government agencies alike has provided significant benefits – including enabling digital transformation and facilitating access to advanced digital applications that are commonly used today.

While South Korea is a highly developed market that is amongst the largest economies globally, cloud adoption lags behind those of peer countries. This has hindered the country from fully capturing the benefits of cloud adoption, including improving productivity and enabling the growth of the digital economy. Understanding barriers to cloud adoption in South Korea and identifying policy tools that may reduce these barriers can thus facilitate stronger cloud adoption and enable a stronger positive impact for the economy.

The remainder of this document is laid out as follows:

- Section 2 introduces cloud services, including main cloud architecture models, examples of cloud products, and key benefits.
- Section 3 provides an overview of the supply landscape for cloud services, starting with a general global view and then looking at the specific South Korean context.
- Section 4 assesses the growth potential of cloud services in South Korea.
- Section 5 reviews the economic impact of cloud services in South Korea based on the expected growth potential of cloud services.
- Section 6 considers how government policy can be used to maximise the benefits of the cloud services sector to the economy.

2 Overview of cloud services

The advent of cloud computing has played a key role in the digital transformation of organisations – by allowing them to outsource computing resources and access them via a third party through the internet. Cloud services have delivered significant benefits to organisations in both commercial and government sectors, including improving productivity, supporting tech start-ups and the overall digital economy, as well as facilitating more sustainable use of IT resources to support net-zero goals. For example, cloud services reduce the need for significant upfront costs for capital expenditure on IT hardware, thus freeing up capital that can be used for other purposes while also enabling greater flexibility by providing access to computing resources on-demand.

In this section, the Report:

- provides an overview of cloud computing and the main cloud architectures (Section 2.1);
- discusses the broad range of products enabled via cloud services – including new products that cut across traditional definitions within the cloud services sector (Section 2.2); and
- introduces the key benefits enabled via the use of cloud services (Section 2.3).

2.1 Cloud computing involves the on-demand delivery of computing services through the internet via architectures including public, private or hybrid clouds

The emergence of personal computers in the 1970s saw growth in computer literacy globally leading to increasing digitisation by organisations, and the twenty-first century saw the advent of broadband internet, which enabled digital transformation via cloud computing. By the early 2000s, copper-based digital subscriber line (DSL) broadband was starting to become available in most markets, and by the early 2010s, fibre-based broadband was starting to be introduced – enabling significant improvements in the performance of broadband networks. Increasing broadband network quality and availability allowed the emergence of companies to provide internet-based services and applications to consumers, businesses, and governments. These services have grown in popularity and today include web search, social media and other digital content services.

These developments enabled the rise of cloud computing, where computing resources are delivered through the internet, allowing organisations to access resources even if the underlying infrastructure is owned and/or managed by a third party. Today, cloud services are an alternative to self-managed information technology (IT) systems that operate on-premises in the organisation's own data centre, with the organisations generally purchasing, owning and managing the underlying IT equipment. That said, many organisations have adopted models that involve both cloud and on-premises solutions.

Computing resources refer to underlying compute, storage and networking resources that enable the delivery of software applications and workloads. With the advent of cloud computing, such computing resources can be outsourced to third parties to varying extents depending on the

requirements of the organisations using these resources. In addition, cloud computing facilitates virtualisation, which separates hardware resources from applications that utilise the resources. This separation allows multiple operating systems and applications to be run on common hardware (and potentially even allows for these to be shared across multiple different organisations) while improving the efficient use of resources. There are several key cloud computing architectures as described below, with their differences providing organisations with options to meet their unique and varying IT needs:

Public cloud Public cloud refers to an architecture where on-demand computing resources are managed by third-party providers that offer these resources to organisations; computing resources are also shared across multiple customers. This delivers efficiencies by sharing resources with other organisations and provides benefits to customers – such as reducing upfront costs and minimising underutilised resources.

Private cloud Private cloud refers to an architecture where computing resources are dedicated to a single organisation; resources can be managed by the organisation itself or outsourced to a third-party provider. The virtualisation of resources in a private cloud fundamentally differs from on-premises IT.

Hybrid cloud A hybrid cloud architecture allows organisations to combine private and public cloud environments. The organisation can continue using existing on-premises infrastructure for some workloads and applications while also utilising resources via the public cloud.

Multi-cloud With the emergence of numerous cloud service providers (CSPs) that offer various services, a further option is multi-cloud adoption where an organisation utilises services from multiple CSPs.

The differences between public cloud and private cloud as compared to on-premises IT are summarised in Figure 2.1. Public cloud offers the most significant "transformation to the way that businesses buy computing resources" as highlighted by Ofcom and will form the primary focus of this report, though we will also discuss other service models.[13]

Figure 2.1: Characteristics of on-premises IT versus public / private cloud [Source: Analysys Mason, 2023]

Characteristics	On-premises IT	Private cloud	Public cloud
Hardware ownership	Owned and managed by end user	Owned and managed by end user or outsourced to third party	Outsourced to third party

13 Ofcom, 2022. "Cloud services market study"

Characteristics	On-premises IT	Private cloud	Public cloud
Location of hardware	On-premises	Either on-premises of off-premises	Off-premises
Shared versus dedicated computing resources	Dedicated	Dedicated	Shared
Virtualisation (i.e. decoupled software and hardware)	✘	✓	✓

Cloud computing remains part of the overall IT services market – serving as an option against alternatives that includes on-premises IT or a hybrid approach. This is supported by a survey of IT decision makers which showed that 74% of respondents "had moved an application into the cloud and then moved it back into their own infrastructure" – highlighting how on-premises solutions remain viable alternatives to cloud services.[14] Cloud services thus remain a relatively nascent component of the broader IT services market.

2.2 Cloud services entail an extensive range of services to meet different customer needs, with products constantly evolving and blurring boundaries between different cloud services

2.2.1 The traditional IT stack has evolved amidst cloud-driven innovations to now comprise additional layers that enable the execution of software applications

Traditionally, an organisation's IT stack can be represented by the layers shown in Figure 2.2 – the various layers interact with each other to enable an application to be delivered to an end user. A simple illustration of how these layers interact with each other is shown in Figure 2.3, hardware such as servers and storage equipment can have an operating system installed that then enables applications to be run and used by end users. Cloud computing allows for varying levels of this IT stack to be outsourced to a third-party and delivered through the internet.

Figure 2.2: Key layers of the traditional IT stack [Source: IBM, 2020][15]

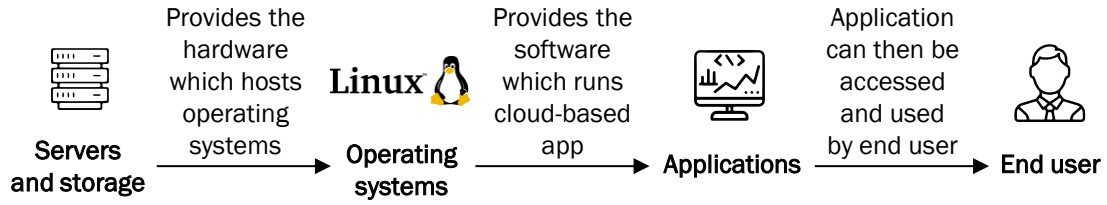
Layers	Description
Application	Program or software that performs a specific task or set of tasks
Data	Data refers to information that is stored and managed by a computer or system
Runtime environment	The environment in which an application executes; this includes the operating system, libraries and dependencies

14 IHS Markit, 2019. "The Bi-Directional Cloud Highway: User Attitudes about Securing Hybrid- and Multi-Cloud Environments"

15 IBM Cloud Learn Hub, 2020. "Cloud Computing"

Layers	Description
Middleware	Software that acts as a bridge between different applications or systems, enabling them to communicate and exchange data
Operating system	Software that manages a computer's resources and provides a platform on which to run applications
Virtualisation	Use of software to create virtual versions of computer hardware, such as servers, storage and networking resources
Servers	Servers are powerful computers that host applications and services, and provide resources and capabilities to other devices on a network
Storage	Storage is a general term that refers to devices and technologies used to store and manage data, such as hard drives, solid-state drives and storage area networks
Networking	Infrastructure and devices that enable communication and connection between computers and other devices, such as routers, switches and hubs

Figure 2.3: Illustration of how IT layers interact with each other



Innovations in cloud computing have added new layers to the IT stack. For example:

Containers — Containers are executable units of software in which application code is packaged, along with its libraries and dependencies, so that it can run consistently across any supported environment.[16] Containers can be considered as a form of operating system virtualisation and they thus sit above the operating system layer in the IT stack.[17]

Functions — Functions can be thought of as the individual components that make up an application.[18] They are blocks of code that perform a specific task in applications and can be called upon to execute that task when needed. They can be represented as sitting above the application layer in the IT stack.

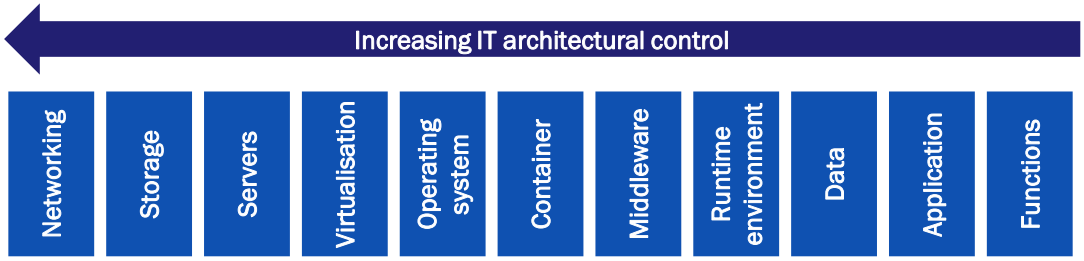
Today's IT stack can be represented with the layers shown in Figure 2.4. The layers towards the left of the figure provide increasing control of the computing resources as they represent the building blocks that the subsequent layers (e.g. operating system and applications) build upon.

16 IBM. "What are containers?"

17 NetApp. "What are containers?"

18 YouTube, 2022. "Cloud Fundamentals – What is FaaS (Functions as a Service)?"

Figure 2.4: Modern IT stack with cloud-driven innovations [Source: Analysys Mason]



2.2.2 Cloud services enable parts of the IT stack to be outsourced to third-party CSPs, relieving organisations of the burden of directly owning and managing all layers

With cloud computing enabling access to IT resources via the internet, organisations can choose to own and manage all layers of the IT stack or they can selectively outsource parts of the IT stack to CSPs. With IT needs varying significantly across different industries and organisation sizes, a wide array of cloud services have emerged. The wide range of cloud services has led to the coinage of the term 'anything as a service' (XaaS) to describe various cloud services that are delivered to end users via the internet. Some examples of cloud services are shown in Figure 2.5 which highlights the layers of the IT stack provided by the CSP as part of the cloud service. This non-exhaustive list already shows how the IT stack provides for a multitude of cloud services that vary by the extent of outsourcing to the CSP.

Figure 2.5: Cloud services and the extent to which they are outsourced to CSPs [Source: Analysys Mason, 2023]

Cloud services	Networking	Storage	Servers	Virtualisation	Operating system	Container	Middleware	Runtime	Data	Application	Functions
Desktop as a service (DaaS)	✓	✓	✓	✓							
Containers as a service (CaaS)	✓	✓	✓	✓	✓	✓					
Database as a service (DBaaS)	✓	✓	✓	✓	✓	✓	✓	✓			
Functions as a service (FaaS)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Cloud-based enterprise resource planning (ERP)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cloud-based communication platforms	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Cloud services	Networking	Storage	Servers	Virtualisation	Operating system	Container	Middleware	Runtime	Data	Application	Functions

Legend: ✓ Controlled by CSP in delivery of cloud service

The diversity of cloud services underscores how a broad array of differentiated cloud services can meet varying organisational needs

Cloud product differentiation goes beyond differences in the layers of the IT stack that are controlled by the CSP in the delivery of the product. For example, while both cloud-based enterprise resource planning (ERP) and cloud-based communication platforms involve the CSP controlling the full IT stack to enable the product (see Figure 2.5 above), the functionality of these two product types differs significantly.[19] These differences illustrate the significant diversity of cloud services – with a broad array of services differentiated not only by the layers of the IT stack that are outsourced but also by the actual functionality and features of the service. This flexibility allows organisations to customise cloud solutions appropriately to meet their unique needs.

2.2.3 Newer cloud services with features that blur the boundaries of the IT stack are reducing the relevance of traditional cloud categorisations

Traditionally, cloud services have often been classified simplistically across three main categories: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS), with the key difference being the extent of outsourcing across the IT stack. However, as described above, cloud services span a broad range of functions and features across the IT stack.

In addition, continued innovation within the cloud industry has seen the introduction of new products which do not directly fit into the traditional categorisation of IaaS / PaaS / SaaS. For example, CaaS refers to a cloud service that manages containers and organises containerised workloads – the CSP is responsible for the networking-to-container functions described in Figure 2.5 above. This differs from the traditional classification of IaaS products, where only the network to virtualisation layers are managed by the CSP, and also differs from the traditional classification of PaaS products where additionally the CSP would be responsible for runtime and middleware functions (which are generally not part of CaaS products). The UK regulator, Ofcom, has noted that the boundaries between the "IaaS, PaaS and SaaS designations" can blur, and that "customers typically focus on buying capabilities rather than by reference to these terms".[20]

19 Cloud-based ERP involves the management of business functions such as accounting and supply-chain management; cloud-based communication platforms enable functionalities that include instant messaging, conference calls and document sharing.

20 Ofcom, 2022. "Cloud services market study: Call for inputs"

The traditional classifications of cloud services into IaaS / PaaS / SaaS is thus seen as increasingly outmoded given that it does not reflect:

- **how customers typically purchase cloud services** – where customers generally first define their objectives and then consider how a broad set of IT service options that can help meet them – which can include cloud-based and non cloud-based solutions. Customers typically do not evaluate services based on the traditional IaaS / PaaS / SaaS categorisations;
- **the complexity of cloud services** – there are a large number of cloud services offered by numerous CSPs that can fulfil customer's IT needs, with cloud services often able to be used in combination with others realise different use cases. Such combining of cloud services can thus make it difficult to allocate individual cloud services to traditional IaaS / PaaS / SaaS categorisations;
- **the introduction of newer cloud services where definitions are blurred** – innovation continues to introduce new types of cloud services where traditional IaaS / PaaS / SaaS classifications are blurred.

2.3 Cloud services enable improved economic efficiency, promote the emergence of start-ups and support improved IT energy efficiency

2.3.1 Cloud services enable improved economic efficiency for organisations

Cloud services can bring many benefits to organisations, which serve as the main reasons why customers choose to use cloud services, these benefits include:

- productivity gains;
- cost savings;
- increased agility;
- higher resilience;
- scalability.

These benefits are explained further below.

Productivity gains

By removing reliance on on-premises IT systems, where hardware and software are directly intertwined, cloud services enable organisations to easily access advanced technology and tools, enabling them to increase their productivity. Examples include:

- enabling the development of customised cloud-based tools that bring about the automation of tasks and facilitate the creation of a next-generation, built-to-suit workspace with streamlined operations
- using cloud-based communication and collaboration tools that facilitate more efficient working in teams – such as via concurrent work on live cloud-based documents

- facilitating aggregation of data across sources to create a comprehensive view of operations, enabling end users to better identify areas for improvement.

The European Commission has stated that cloud services have enabled "productivity improvements generated at the company level" which "accelerate macroeconomic growth".[21]

Cost savings

In on-premises IT systems, organisations typically own and manage the underlying hardware used to run their applications. Significant capital expenditure is required to invest in the initial deployment of the hardware as well as to support ongoing maintenance and replacement.

Cloud services can enable further cost savings for organisations compared to on-premises IT systems, as they provide:

- the ability to access advanced computing resources without needing to commit to significant capital expenditure
- usage-based pricing models for cloud services, with varied payments based on organisational requirements (compared to on-premises systems where capital expenditure is spent upfront, with no savings even if the hardware is underutilised).

A study commissioned by the European Commission notes the cost savings and financial flexibility that cloud services enable: "[Cloud services] allow firms to reduce IT costs ranging from a 20% to 50% reduction and to shift IT costs from capital expenditure (CAPEX) to operating expenses".[22]

Increased agility

Cloud computing and virtualisation technology decouple software applications from the underlying hardware that provides the computing resources, thus helping organisations to tailor their products/services to different environments, geographies and channels. New applications can be quickly developed, tested and launched without the need for an organisation to deploy its own hardware.

21 European Commission, 2020. "Advanced Technologies for Industry – AT WATCH – Technology Focus on Cloud Computing"

22 Study prepared for the European Commission DG Communications Networks, Content & Technology by Deloitte, 2016. "Measuring the economic impact of cloud computing in Europe"

Netflix has highlighted the increased agility enabled by cloud services, stating that the use of cloud services was critical in enabling it to introduce new features, and that this would not have been otherwise possible. The convenience of quick access to servers has enabled Netflix to offer "many new resource-hungry features" and played a key role in supporting its expansion and growth as a leading over-the-top (OTT) video provider globally.[23] Regulators such as the Infocomm Media Development Authority (IMDA) in Singapore have also noted that access to cloud services "increases business agility to market changes".[24]

Higher resilience

The increased digitalisation of consumer activities has resulted in a broad range of applications being used daily; these span a variety of use cases such as social media, content, enterprise collaboration and finance. The frequency of use of such applications and their significant contribution to our daily lives has made it critical to ensure resiliency and prevent or minimise downtime.

Cloud services can facilitate the higher resilience of applications – many CSPs utilise redundant and geographically distributed architectures that minimise or eliminate the existence of a single point of failure. Major CSPs have established cloud regions where the hardware resources used to provide cloud services are located at (typically key cities). Each cloud region can comprise multiple availability zones – these availability zones involve hardware deployed in geographically isolated locations and are interconnected via high-performance links. This provides for redundancy as a breach or outage at one availability zone does not impact the other availability zones which can still provide computing resources to end users and minimise downtime. For example, a CSP may offer a cloud region in Seoul, with the underlying hardware spread across multiple locations (i.e. availability zones) in the city.

According to Ofcom, the resilience and security benefits of cloud services is noteworthy – it states that cloud services not only helps end users to "increase their innovation potential" and "increase their quality of service" but also helps organisations to "achieve baseline security and resilience".[25]

Scalability

A key issue related to on-premises IT systems is the ability of an organisation to increase computing resources quickly and affordably. A lack of ability to do this can hamper the organisation's ability to meet growing computing requirements effectively. For example, an organisation that is looking to procure additional hardware to increase computing resources may face difficulties on a financial level (e.g. due to the need to incur upfront capital expenditure) as well as on an operational level (e.g. due to the need to follow a procurement process and ensure sufficient IT headcount to manage the process). In comparison, cloud services can allow organisations to rapidly alter and increase their access to computing resources as their requirements evolve. By providing a more flexible on-

23 Netflix, 2016. "Completing the Netflix Cloud Migration"

24 Infocomm Media Development Authority. "Cloud Computing"

25 Ofcom, 2022. "Cloud services market study: Call for inputs"

demand model, cloud services reduce financial (e.g. upfront capital expenditure to procure hardware) and operational challenges (e.g. need for procurement process) when needing to scale up computing resources in an on-premises IT approach.

The Organisation for Economic Co-operation and Development (OECD) recognises scalability as one of the key features of cloud services, mentioning that cloud services help to provision computing resources "in a rapid and elastic way". It adds that users can buy computing services at "various granularities" and can "up- and downscale those services according to their needs".[26]

2.3.2 Cloud services benefit both commercial- and government-sector organisations

Government agencies and commercial organisations alike can benefit from migrating to the cloud – Figure 2.6 provides examples of how both types of organisations have leveraged cloud services in their digital innovation journey.

Figure 2.6: Examples of government- and commercial-sector organisations leveraging cloud services

Type	Organisation (country)	Description
Government sector	GovTech (Singapore)	• The Singpass app was launched by GovTech in 2018, and offers an array of functions including a digital identity card (IC), access to commonly used government digital services and the digital signature of documents • While Singpass initially ran on infrastructure that was entirely on premises, the majority of the back-end components today run on the Government on Commercial Cloud (GCC), which includes multiple public cloud providers[27] • Singpass has service availability of "close to 100%" via cloud services[28] • By February 2022, the Singpass app had 3.5 million users, representing more than 75% of citizens and permanent residents aged 15 and above[29]
Commercial sector	Netflix (global)	• After facing a severe outage in its own data centre in 2008, Netflix decided to move to the public cloud, fully completing its migration in 2016

26 OECD iLibrary, OECD Digital Economy Papers, 2014. "Cloud Computing: The Concept, Impacts and the Role of Government Policy"

27 The World Bank, ID4D, GovTech Singapore, 2022. "National Digital Identity and Government Data Sharing in Singapore"

28 Computer Weekly, 2022. "Inside Singapore's national digital identity journey"

29 Smart Nation, 2022. "Singpass Singapore's National Digital Identity (Factsheet)"

Type	Organisation (country)	Description
		• It has cited multiple benefits from moving to the cloud, including improved service availability, rapid global expansion and cost savings[30]

2.3.3 Cloud adoption drives an increased number of firms via start-ups and thus enables growth in the digital economy

The rise of the internet has fuelled the emergence of the digital economy, with firms looking to leverage the internet and related internet-based services to meet consumer and enterprise needs. One feature of the digital economy is tech start-ups, with their typically lean organisational structure and capital constraints. This allows them to particularly benefit from cloud services to scale quickly and cost effectively. Cloud services and providers are thus key enablers in the growth of the digital economy.

The benefits of cloud services for tech start-ups and thus the digital economy are discussed in further detail below.

Reducing set-up costs for start-ups

One of the biggest challenges faced by start-ups is the finite funding available, particularly because their profit-generation capabilities are likely to be limited initially. Given such financial constraints, start-ups face difficulties in investing in their own computing resources by committing to upfront capital expenditure for hardware.

Cloud services provide a cost-effective IT solution for start-ups by enabling access to advanced computing resources without this upfront capital expenditure. Cloud services can also provide computing resources on demand to facilitate entry into a new sector or launch of a new service.

The Asian Development Bank notes how cloud services can benefit "cost-conscious start-ups" by reducing "large upfront spending on on-premises ICT infrastructure" which can "bog down their ability to focus on their core products and services".[31]

Enabling corporate flexibility through cloud-based business services

Start-ups tend to begin with a lean structure, and initial employees are often focused on driving revenue growth via functions such as product or business development. However, start-ups still require critical functions like human resources and accounting – these may not be revenue

30 Netflix, 2016. "Completing the Netflix Cloud Migration"

31 Asian Development Bank, 2021. "Cloud computing as a key enabler for tech start-ups across Asia and the Pacific"

generating, but do ensure smooth ongoing operations. Cloud services support the outsourcing of such critical functions, allowing the start-up to be run effectively even with a lean structure.

According to the Asian Development Bank, cloud services play a key role in the success of start-ups due to the provision of such "cloud-based business services" (e.g. accounting, human resources) which allow them to "build support systems according to their needs" and "reduce the burden of having to build a new system from scratch".[32]

2.3.4 Cloud services also improve the IT energy efficiency of organisations

Sustainability and IT efficiency are becoming increasingly critical priorities for commercial enterprises and government agencies globally. A major source of carbon emissions / electricity usage in organisations is self-owned data centres and IT equipment, and while organisations would like to improve their energy efficiency and lower their carbon emissions most do not have the resources to make substantial improvements.[33] The adoption of cloud services can facilitate these improvements due to following drivers:

- the utilisation of servers are maximised due to the availability of on-demand models (as opposed to on-premises IT systems where servers are underutilised during off-peak periods but still use energy for operating and cooling)
- CSPs generally operate in more energy-efficient data-centre facilities with lower power usage effectiveness (PUE) that minimise excess energy for non-computing needs (e.g. cooling)
- CSPs typically use state-of-the-art server chips and components that can provide better computing power per unit of energy.

Cloud migration is estimated to reduce carbon emissions globally by over 59 million tonnes per annum – this is equivalent to taking 22 million cars off the road.[34] The potential of cloud services to improve energy efficiency has also been acknowledged by governments and regulatory bodies globally. For example, Ofcom has noted that "cloud services could also help businesses become more sustainable by lowering their IT energy consumption".[35]

32 Ibid.

33 S&P Global Market Intelligence, 2021. "The Carbon Reduction Opportunity of Moving to the Cloud for APAC"

34 Accenture, 2020. "The green behind the cloud"

35 Ofcom, 2022. "Cloud services market study: Call for inputs"

3 The supply landscape for cloud services

In Section 2, the Report provided an overview of cloud services, including how CSPs provide these services to customers, enabling the benefits described in Section 2.3. In this section, the focus moves to the complex underlying cloud service value chain, which features multiple types of players brought together by CSPs. South Korea has seen the development of a diverse cloud services supply landscape supported by different types of CSPs that offer a wide range of cloud services (Section 2.2) that are able to meet varying customer needs. The cloud services sector continues to see strong innovation in terms of new types of cloud services; in addition, new CSPs provide new options for customers, thus increasing the potential benefits to customers.

In this section, the Report:

- introduces the cloud services value chain (Section 3.1);
- provides an overview of South Korea's diverse cloud services supply landscape (Section 3.2);
- discusses innovations and successful challenger CSPs that continue to emerge in the cloud services sector (Section 3.3).

3.1 The cloud services value chain is complex and involves stakeholders ranging from real-estate providers to application providers

The cloud services value chain involves multiple types of players that provide critical products and services to each other. Their interactions and relationships allow customers to use, and benefit from, cloud services. For example:

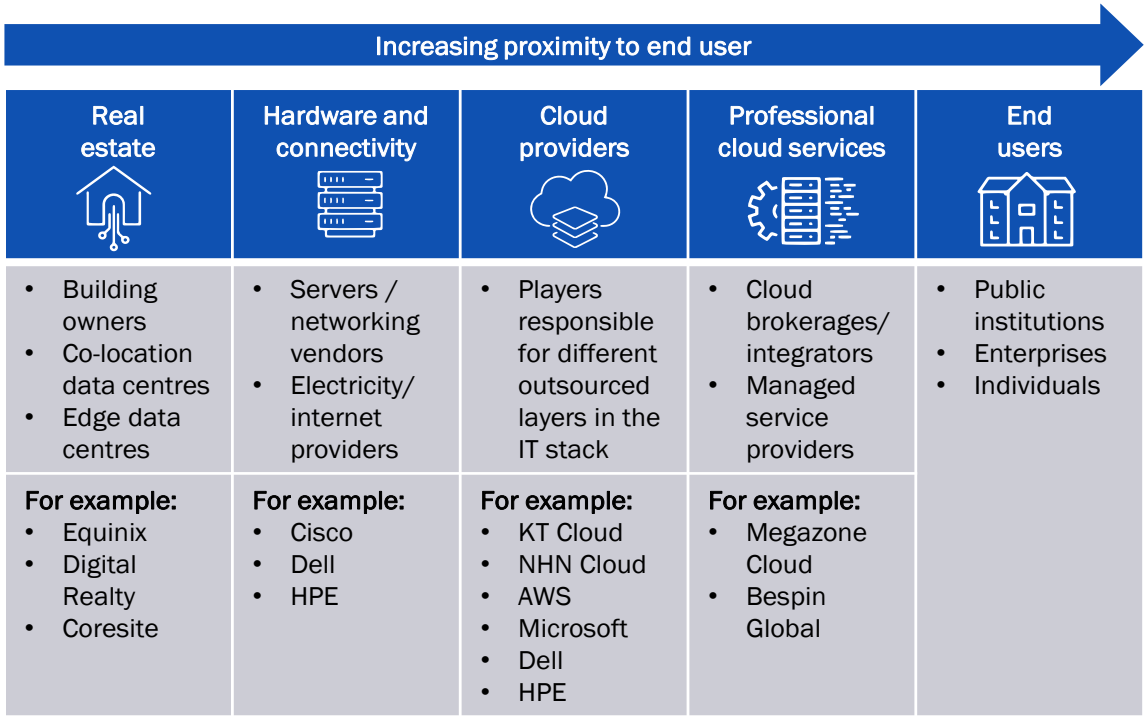
- CSPs are reliant on hardware that provides the underlying computing resources and connectivity that allows these resources to be delivered through the internet – these are typically provided by third parties to the CSP.

- Hardware that provides computing resources for cloud services are typically located at data centres which are effectively a type of industrial real estate. CSPs often lease space from data-centre co-location providers and are reliant on these players for critical infrastructure to enable cloud services.

- Organisations considering IT services, including cloud services, often rely on professional service providers to evaluate vendors and provide recommendations. These professional service providers can also be involved further support efforts, for example by managing the cloud migration process.

Figure 3.1 below provides an illustration of the cloud services value chain, including the major types of players that interact with each other as well as examples of companies in each category.

Figure 3.1: Cloud services value chain [Source: Analysys Mason, 2023]



The categorisation of players into different aspects of the cloud services value chain is not rigid, as players can choose to offer services in multiple areas. For example, Dell Technologies (Dell) and Hewlett Packard Enterprise (HPE) are both recognised market leaders in the provision of server hardware, and together hold approximately one-third of the global server market.[36] Both players also offer cloud services, as seen with Dell's APEX Cloud Services[37] and HPE's GreenLake suite.[38]

The interactions between players along the value chain is not fixed as they are ultimately dependent on the unique deployment requirements of each customer. For example, organisations that opt for a hybrid IT services solution that combines cloud services and on-premises IT will see the hardware provider being located next to the end user. Similarly, the need for professional cloud services is dependent on the characteristics of the organisation – larger organisations that have more developed IT teams internally may not require such services and may instead go direct to the CSP.

3.2 South Korea has a vibrant supply landscape supported by a diverse and increasing range of CSPs

The supplier landscape of the cloud services sector is important as it determines the range of services available to number of vendors competing to provide services to potential customers. South Korea's cloud services sector has a diverse supply landscape with a wide mixture of renowned and credible

36 Ofcom. 2022. "Cloud services market study: Call for inputs"

37 Dell Technologies. 2021. "Dell Technologies APEX Transforms How the World Consumes Technology"

38 HPE. "HPE GreenLake"

CSPs. In addition, the steady rise in the number of CSPs present in South Korea provides wider breadth of options available to customers and increases the level of competition in the sector.

3.2.1 South Korea has a diverse mixture of CSPs that offer unique strengths, with collaboration between industry players to promote cloud services

South Korea has a large range of CSPs present, with each presenting unique strengths and propositions that appeal to different organisations. As discussed in Section 2.2, the cloud services sector involves an extensive range of services across the entire IT stack. This can similarly be seen in South Korea, where different CSPs offer varying cloud services across the IT stack.

Figure 3.2 below provides examples of CSPs that are currently active in South Korea and a selection of the key cloud services that they offer. The key cloud service examples illustrate the broad range of services provided by these CSPs.

Figure 3.2: Examples of CSPs operating in South Korea [Source: CSP websites, 2023]

CSPs	Examples of key cloud services
Alibaba Cloud	• Alibaba Cloud ECS (elastic compute service) • Alibaba Cloud CDN (content delivery network) • PolarDB (cloud-native relational database)
AWS	• AWS EC2 (virtual servers) • AWS SageMaker (machine learning platform) • AWS Lamda (serverless computing)
Douzone Bizon	• Douzone Cloud Server (virtual servers) • Amaranth 10 (cloud-based ERP) • WEHAGO Platform (cloud-based business platform)
Google Cloud	• Google Anthos (container platform) • Google Workspace (cloud-based productivity) • BigQuery (data warehouse)
Kakao	• Mobile platform (cloud-based social media, messaging, payments, shopping etc) • Kakao i Cloud (enterprise cloud services) • KakaoWork (cloud-based communication and collaboration platform)
KT Cloud	• CloudFarm (hybrid cloud service) • KCI (KT Cloud container instances) • Data Lake (big data platform)
Microsoft	• Office 365 (cloud-based productivity suite) • Microsoft Teams (cloud-based communication) • Azure Virtual Desktop (DaaS)
Naver Cloud	• Compute and storage • Clova suite (AI services) • Workplace (cloud-based business applications)
NHN Cloud	• Compute and storage • NKS (managed Kubernetes clusters) • NHN Cloud GamePlatform (cloud-based game product suite)

CSPs	Examples of key cloud services
Salesforce	• Customer 360 (cloud-based CRM) • Tableau (visual analytics platform) • Slack (cloud-based communication)
Samsung SDS	• Compute and storage • DB Service (database creation/management) • Kubeflow (machine learning platform)
SAP	• SAP S/4HANA Cloud (cloud-based ERP) • SAP SCM software (cloud-based supply-chain management software) • Cloud-based financial management software
Tencent Cloud	• Lighthouse (lightweight cloud server service) • TDSQL-C (cloud native database) • Tencent CVM (cloud virtual machines)
Workday	• Workday HCM (cloud-based human capital management software) • Workday Adaptive Planning (cloud-based enterprise planning software) • Workday Peakon (cloud-based employee engagement software)
Yanolja	• Global travel platform (cloud-based travel booking platform) • Y Flux (cloud-based automated hotel solution) • eZee (cloud-based global hotel management solutions)

The diversity of South Korea's supply landscape is further supported by the success and growth of players focused primarily on the South Korean market over global counterparts. For example, Douzone Bizon offers cloud-based ERP software and has become the market leader in South Korea, reaching a domestic ERP market share of 19% in 2019. In 2021, it was described as "eating away at the market share of the world's dominant ERP software developer SAP".[39] Its success saw it receive investment of USD360 million from Bain Capital in the same year. Similarly, Naver Cloud was launched in 2017, initially offering 22 cloud products, which grew to over 200 products across 18 categories by 2022.[40] In Q3 2022, Naver reported that its Cloud & Other (B2B) revenue had reached KRW112.9 billion, compared to its Q3 2021 revenue of KRW100.9 billion, implying a 12% year-on-year growth in revenue.[41] Another example can be seen via KT Cloud which achieved revenue of KRW144.1 billion in Q3 2022, with a quarter-on-quarter increase of 11%.[42]

In addition, there is on-going collaboration between CSPs to promote cloud adoption in South Korea. In July 2021, KT Corporation announced that it had entered into a strategic partnership with AWS to pursue joint research in AI and cloud technologies. The two players also announced the launch of a hybrid cloud service which would provide added flexibility for customers. In the context of this partnership, a newspaper article stated that "if a company utilising KT Cloud services expands overseas, it will be able to use AWS's services and cloud infrastructure, which are better suited to local market conditions, and vice versa for AWS clients that enter the Korean market, where they

39 Korea Economic Daily, 2021. "Bain Capital to invest $360 mn in Korea's top ERP developer"

40 Korea Economic Daily, 2022. "Naver Cloud seeks win-win strategy with K-startups in overseas market"

41 Naver, 2022. "3Q22 Earnings Results"

42 KT, 2022. "KT 3Q22 Earning Release"

will be able to connect to KT's Cloud services."[43] This active collaboration illustrates the complexity and dynamism (and ongoing evolution) of South Korea's cloud services sector – with CSPs able to collaborate and compete, all at the same time.

> "We have a cooperative and competitive relationship with AWS in the cloud market. We will bring the optimum services to our B2B clients, which will be able to have more choices through the partnership… We will combine the know-how and capabilities of KT with AWS's diverse cloud services and technologies, including machine learning, Amazon Connect and the Internet of Things, while helping to enhance companies' competitiveness and innovativeness."
>
> **KT official**

3.2.2 South Korea's healthy supplier landscape is underscored by the continued rise in the number of CSPs

Figure 3.3 illustrates that the total number of companies providing cloud services in South Korea has been growing steadily in recent years. This growth can be attributed to the dynamic nature of the industry, with new suppliers constantly entering the sector. CSPs have been attracted by South Korea's immature cloud services sector and the strong growth potential offered (this is discussed in further detail in Section 4).

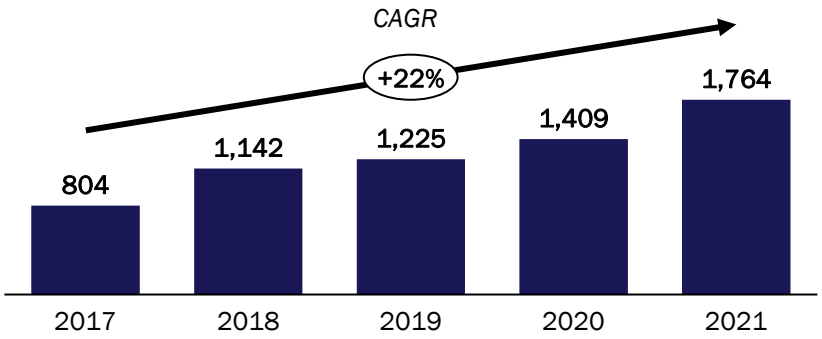


Figure 3.3: Number of cloud providers in South Korea [Source: National IT Industry Promotion Agency & Ministry of Science and ICT, 2023][44]

The increasing number of CSPs in South Korea includes the emergence of successful South Korean start-ups who have attracted significant funding to support continued growth. For example, flex is a South Korean cloud-based human resource management platform which enables organisations to automate human resource processes. It was able to grow revenues ~10× year-on-year which led to it successfully raising USD32 million at a valuation of USD287 million in early 2022 despite only being two years old.[45] Another example of this is 'DeepBrain AI' which offers cloud-based AI-powered customer service products, with a focus on human-like avatars that respond to natural

43 Korea Times, 2021. "KT partners with Amazon to collaborate in digital platform, media biz"

44 Korea Association of Cloud Industry, 2023. "2022 Cloud Industry Survey Results Report"

45 TechCrunch, 2022. "South Korean HR automation platform flex raises $32M Series B at a $287M valuation"

language questions. Its customers include major South Korean enterprises such as MBN, LG HelloVision, and KB Kookmin Bank and it successfully raised USD44 million in 2021 a valuation of USD180 million.[46]

The growing number of CSPs also includes the entry of international CSPs into South Korea and their increasing investments that will provide greater options available to potential customers. These CSPs entering and investing in South Korea include:

Alibaba Cloud	Alibaba Cloud launched its first local data centre in South Korea in 2022.[47] It further announced a partnership with the Korea Indie Game Association to "boost the digital transformation of small and medium-sized game companies in Korea", including providing them with "free cloud-related training and professional consultation".[48]
Cloudflare	Cloudflare, a publicly listed content delivery network (CDN) and security solutions provider, launched its office in Seoul in December 2022. It stated that it was already serving many local customers, including bemyfriens, EJN Corp, Hyperconnect, Neowiz, Radish Media Inc and TeamBlackbird Inc.[49]
Snowflake	In November 2021, Snowflake, a sizable big-data cloud provider from the USA, opened an office in Seoul. It described its expansion as showcasing "[its] ongoing commitment to empowering Korean customers with data".[50]

46 VentureBeat, 2021. "Deepbrain boosts AI-powered virtual avatars with $44M raise"

47 Alibaba Cloud, 2022. "Alibaba Cloud Launches Data Center in South Korea"

48 Alibaba Cloud, 2022. "Alibaba Cloud Partners with Korea Indie Game Association to Support Game Developer"

49 Cloudflare, 2022. "Cloudflare Announces New Seoul Office and Appoints Head of Korea"

50 Snowflake, 2021. "Snowflake Continues Global Data Cloud Expansion With Entry Into the Korean Market, Names Hyoungjun Kang as Country Manager"

"We are launching the data center in Korea to meet the strong needs for digital transformation from our Korean customers. Through the launch of the data center, we will continue to enable Korean customers with the latest cloud-based technologies and solutions to succeed in their digital journey."

Unique Song, Regional General Manager
Alibaba Cloud Intelligence

"Korea is an innovation and technological hub and is one of the most Internet-connected countries in the world. As such, Korea was a clear choice when considering expansion locations for our next office in Asia."

Jonathan Dixon, Vice-President and Managing Director
Cloudflare

"Snowflake considers the growth potential of the Korean market very high. There is a high demand for Snowflake's services in Korea."

Kang Hyoung-jun, Country Manager (South Korea)
Snowflake

South Korea's diverse supplier landscape with a broad mix of CSPs that each offer unique strengths, coupled with the steady increase in the number of CSPs, promotes a healthy level of options available to customers. In addition, collaboration across players to promote cloud services will further spur greater levels of innovation and drive higher cloud adoption in South Korea.

3.3 Key global trends in the cloud supplier landscape indicate that customers benefit from continued innovation, fuelled by the competitive, tech-driven nature of the sector

The competitive cloud services sector has driven innovation amongst CSPs and the continuous emergence of challengers that provide increasing options available to customers – with growing multi-cloud adoption both globally and in South Korea providing evidence of this. In addition, innovations introduced by CSPs and spurred by the competitive cloud services sector have reshaped how customers are able to use and benefit from cloud adoption.

3.3.1 Growing multi-cloud adoption globally emphasises the abundance of credible cloud providers –this is particularly apparent in South Korea

Multi-cloud use refers to an organisation utilising services from multiple third-party CSPs. Multi-cloud adoption is driven by various factors, including the fact that it:

- allows end users to leverage a broader range of innovative and best-in-class products, due to the abundance of CSPs that all have unique strengths and offer different products;
- supports cost optimisation by considering unique pricing by CSP when allocating various outsourced functions to different CSPs;

- can strengthen resilience by reducing dependency on a single CSP and its infrastructure;
- improves the negotiating power of customers and can lower their barriers to switching CSP in the future.

Multi-cloud adoption has been growing globally, and studies show that the average number of public clouds used by organisations has increased from 1.3 clouds in 2020 to 2.2 clouds in 2022.[51] One recent landmark example is the award by the United States Department of Defense (DoD) of cloud services contracts worth up to USD9 billion to Google, Oracle, Amazon and Microsoft.[52] This represented a shift from a previous decision to award a single cloud services contract to Microsoft. The Pentagon stated that "the evolution of the cloud ecosystem […] and changes in user requirements to leverage multiple cloud environments" contributed to its decision to move to a multi-cloud approach.[53]

South Korea has a relatively high multi-cloud adoption rate of 2.5[54] public clouds per enterprise in 2022, which shows that South Korean cloud customers are sophisticated and also indicates that multiple credible CSPs are readily available to serve cloud customers in the country.

3.3.2 The competitive nature of the sector is demonstrated by successful CSP challengers globally

Numerous new and innovative CSP challengers have demonstrated their ability to successfully compete against larger or more established CSPs. Many of these challengers have obtained large amounts of funding at high valuations, which demonstrates investor confidence in these players. Some examples of successful CSP challengers are detailed below:

DigitalOcean DigitalOcean was founded in 2011 and its cloud offerings cater mostly to start-ups and small businesses. It provides a range of cloud products that span compute, storage, networking and database categories.[55] Its unique selling proposition to customers includes: a simple cloud platform that is easy to learn and manage; consistent pricing across all data centres to provide greater price certainty; and offering significantly lower prices than the large CSPs.[56] DigitalOcean went public in 2021, raising USD775 million, with a valuation of ~USD5 billion.[57]

51 VMware, 2022. "The Multi-cloud Maturity Index"

52 CNBC, 2022. "Google, Oracle, Amazon and Microsoft awarded Pentagon cloud deal of up to $9 billion combined"

53 U.S. Department of Defense, 2021. "Future of the Joint Enterprise Defense Infrastructure Cloud Contract"

54 VMware, 2022. "VMware Releases Multi-Cloud Maturity Study Report – South Korea's Multi-Cloud Ranks World's Highest"

55 DigitalOcean. "Products"

56 DigitalOcean, 2022. "AWS or DigitalOcean – Which cloud platform is the best fit for you?"

57 Bloomberg, 2021. "Blavatnik-Backed DigitalOcean Raises About $775 Million in IPO"

Wasabi Technologies

Wasabi Technologies (Wasabi) was founded in 2015. It provides cloud storage and claims that its pricing is 80% lower than large CSPs; it offers faster performance by optimising "the way data is stored on disk and designing a system that reads and writes to large arrays of drives at enormous speeds".[58] Wasabi raised USD250 million in 2022 at a valuation of over USD1.1 billion and has been expanding globally. This includes adding storage regions in Asia–Pacific via Osaka, Singapore and Sydney.[59]

Backblaze

In 2016, Backblaze launched its B2 cloud storage product, which is now its primary product offering. Its main selling point is its "astonishingly affordable" storage which it claims is ~20% that of comparable products offered by larger CSPs.[60] Backblaze's strategy focuses on mid-market businesses via its "straightforward cloud storage offerings" where it sees "unmet market needs" in contrast to large cloud vendors who it claims may be more "focused on the largest enterprises" with more complex offerings.[61] Backblaze went public in 2021, raising ~USD100 million at a valuation of ~USD470 million.[62]

Snowflake

Snowflake was founded in 2012 and offers a fully managed cloud data platform to facilitate workloads that include data warehousing, data lakes and data application development. For example, Snowflake's platform can be used to "consolidate data into a single source of truth" to "get the complete picture of individual customer behavior".[63] Snowflake's platform can be hosted on the public clouds of major CSPs.[64] Snowflake raised ~USD3.4 billion in its 2020 initial public offering (IPO) with a valuation of ~USD33 billion.[65] It opened a South Korean office in November 2021.

3.3.3 Innovations are continuing to emerge in the cloud services sector

CSPs are constantly looking to innovate and improve their cloud services to maintain competitiveness. As CSPs strive to differentiate themselves from competitors, significant cloud

58 Wasabi Technologies. "About Wasabi"

59 TechCrunch, 2022. "Cloud storage startup Wasabi raises $250M to reach unicorn status"

60 Backblaze. "Cloud storage pricing"

61 Backblaze, 2021. "Preliminary prospectus"

62 Crunchbase. "Backblaze financials"

63 Snowflake. "Leverage ecommerce analytics to boost online sales"

64 Snowflake. "Supported Cloud Platforms"

65 CNBC, 2020. "Snowflake prices IPO above increased range, implying initial market cap of $33.3 billion"

service innovations have emerged which have enabled end users to enjoy new products – some of which have significantly reshaped how cloud services are used.

One such example of innovation in cloud services is Kubernetes, a container orchestration platform that enables the deployment and management of containerised applications. Containers function as packages of software that can be run quickly and reliably in different computing environments – regardless of the hardware, operating system or who the infrastructure provider is. Kubernetes was first introduced by Google Cloud in 2014 as an open-source standard in an "attempt to shift the industry to vendor-agnostic containers" and enable it to gain share in the emerging cloud services sector.[66]

Kubernetes played a key role as a catalyst for driving container usage within cloud services, and today it has become the de-facto container orchestration standard – a 2021 survey found that 96% of cloud-native organisations are either using or evaluating Kubernetes.[67] The use of Kubernetes enables end users to reap multiple benefits including: facilitating portability of applications across different types of infrastructure, facilitating multi-cloud environments, supporting high availability, and enabling cost savings via more efficient use of resources. Kubernetes' open-source standard has also enabled the rise of new infrastructure providers within the cloud services sector. For example, Kasten was founded in 2017 as a data management and recovery platform; it was purpose built for Kubernetes and was subsequently acquired for USD150 million by Veeam in 2020.[68]

Serverless computing is another example of innovation in cloud services, allowing applications to be managed and run without the end user having to worry about the underlying infrastructure needed. In serverless computing architectures, CSPs help to manage and scale the servers that are required. This allows developers to focus on coding while reducing the effort required to maintain and scale the servers, which are now outsourced. Serverless computing further benefits end users by charging based on the resources used, which eliminates idle capacity and improves cost efficiency.

AWS was the pioneer of serverless computing when it launched AWS Lambda in late 2014. Since its launch, other major CSPs have released their own serverless computing offerings: in 2016, Microsoft Azure launched Azure Functions and in 2017, Google Cloud launched Google Cloud Functions. Many other CSPs have since developed their own serverless computing offerings, including CSPs that focus primarily in South Korea (e.g. the Naver Cloud Functions and KT Cloud Serverless Code Run/App Run cloud services).

These innovations developed by CSPs have played a significant role in the evolution of cloud solutions, allowing end users to solve more complex problems through cloud services and reap greater benefits. In addition, they have created opportunities for the challenger CSPs to capture niche segments of the cloud services sector.

66 Stratechery, 2016. "How Google is challenging AWS"

67 Cloud Native Computing Foundation, 2022. "CNCF Annual Survey 2021"

68 SDxCentral, 2020. "Veeam Puts $150M Ring on Kubernetes Startup Kasten"

4 The growth potential of cloud services in South Korea

In Section 3, the Report discussed the vibrant supply landscape for cloud services in South Korea, supported by a diverse mixture of CSPs that compete and collaborate with each other. We now look more into the demand for cloud services in South Korea and understand both drivers and barriers to cloud adoption.

While South Korea is a digitally advanced economy supported by high-quality broadband infrastructure, its cloud adoption rate lags behind those of other developed markets, partly due to barriers that are present. Initiatives that have been announced by the government to develop the cloud services sector and promote adoption can lower these barriers and thus enable growth.

In this section, the Report:

- explains why South Korea's digitally advanced economy makes it a favourable environment for cloud adoption (Section 4.1);
- notes that South Korea's cloud adoption is underdeveloped compared to peer markets and that this reveals key opportunities to grow cloud adoption (Section 4.2);
- examines the barriers to cloud adoption in South Korea (Section 4.3);
- identifies examples of supportive government policies that can address these barriers to cloud adoption (Section 4.4);
- discusses the expected growth of South Korea's cloud services (Section 4.5).

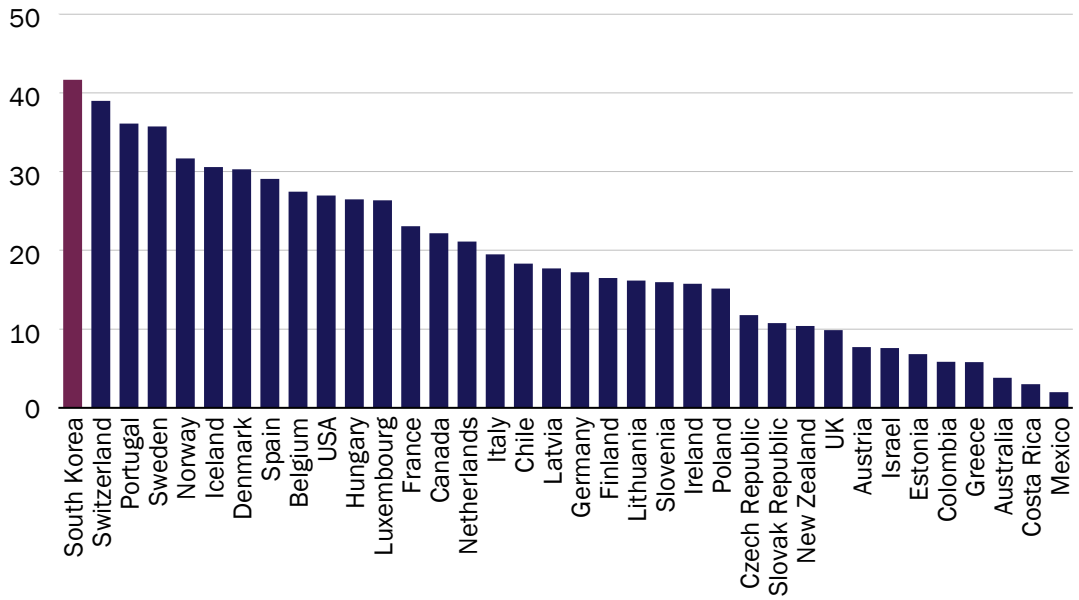
4.1 South Korea is one of the most digitally advanced economies globally with favourable conditions to support cloud adoption

South Korea's high-quality broadband infrastructure coupled with its high and improving position in global digital rankings provides evidence of a favourable environment for cloud adoption – these factors are discussed further below.

4.1.1 Broadband infrastructure investments have enabled South Korea's high fixed broadband penetration which facilitates digitalisation of consumers and enterprises

High-quality internet access is a fundamental pillar for the adoption of advanced digital technologies and a critical enabler for cloud services, which rely on the internet for the delivery of computing resources from servers to end users. South Korea ranks first across OECD countries when considering access to high-quality fixed broadband, as ~42 out of 100 inhabitants have fixed broadband subscriptions with speeds of at least 100Mbit/s (see Figure 4.1). Investments in broadband infrastructure in South Korea, particularly via fibre deployments, have enabled the availability of high-quality broadband that can facilitate adoption of advanced digital technologies, including cloud services.

Figure 4.1: Fixed broadband subscriptions (≥ 100Mbit/s) per 100 inhabitants [Source: OECD, December 2021][69]



4.1.2 South Korea has also demonstrated relatively high capacity to adopt and explore digital technologies, having improved consistently in global digital rankings

The International Institute for Management Development (IMD) Digital Competitiveness Ranking assesses a country's capacity and readiness to adopt and explore digital technologies (including cloud services) for economic and social transformation. South Korea's ranking increased from twelfth in 2021 to eighth out of 63 countries globally in 2022, indicating its strong readiness to adopt advanced digital technologies.[70] In particular, when considering larger markets with populations above 20 million, South Korea ranked second globally, behind only the USA.

In the same study, South Korea ranked second globally in the Future Readiness factor, which measures a country's "preparedness to exploit digital transformation", further emphasising the strong potential South Korea has to benefit greatly from the digital transformation afforded by cloud adoption.

4.2 However, South Korea's cloud adoption is underdeveloped compared to peer countries, emphasising the strong potential for growth across all CSPs

Despite having favourable conditions for cloud adoption, South Korea lags behind peer countries – highlighting the significant opportunity for growth in cloud services by closing this gap. In particular, lagging cloud adoption in small businesses and critical industries (e.g. manufacturing;

69 OECD, 2021. "Fixed broadband subscriptions per 100 inhabitants, per speed tiers (Dec. 2021)"

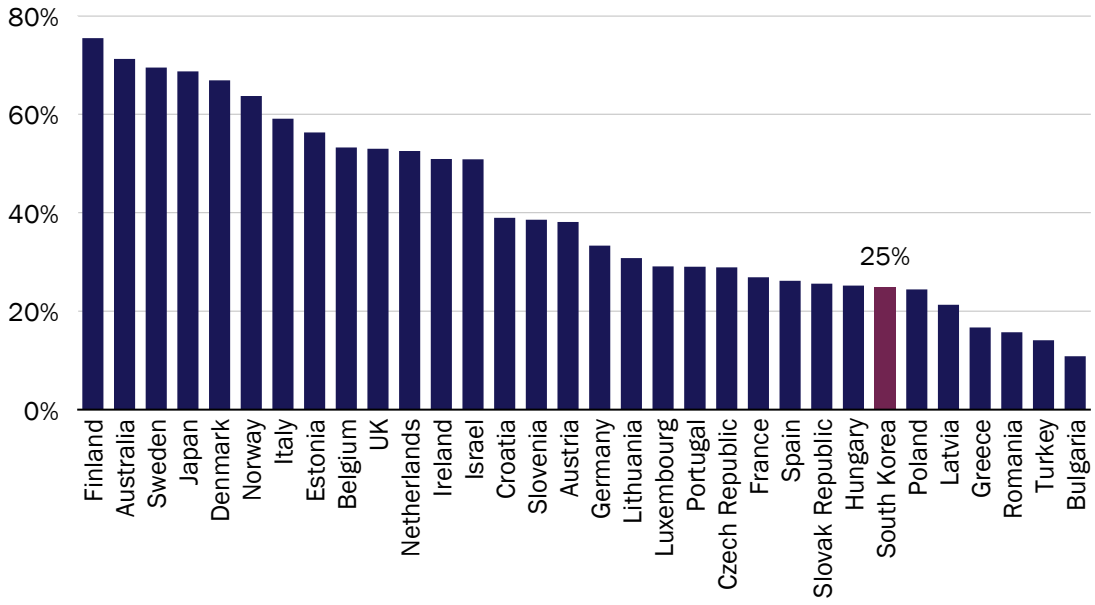
70 IMD World Competitiveness Center, 2022. "IMD World Digital Competitiveness Ranking 2022"

finance and insurance) suggest key areas for potential growth to enable South Korea to close its gap in cloud adoption.

4.2.1 Enterprise cloud take-up in South Korea lags behind many markets

South Korean enterprises lag behind many OECD markets and trails multiple less-developed markets in cloud adoption (see Figure 4.2), despite the country's high-quality broadband infrastructure and high capacity to adopt and explore digital technologies. This reduces the extent to which South Korea is able to reap the benefits of cloud services (as discussed in Section 2.3).

Figure 4.2: Percentage of businesses (≥10 employees) purchasing cloud services in 2020 [Source: OECD, 2022][71]



4.2.2 The state of current cloud take-up in South Korea reveals key focus areas to grow cloud adoption

Cloud services can involve the use of cloud-based software products with lower technical complexity. This means the services can be used even by smaller organisations that may not have advanced or dedicated IT teams. However, data indicates that within the different sizes of enterprises in South Korea, small businesses are the biggest stragglers relative to the OECD average when considering purchasing cloud services (see Figure 4.3).

71 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

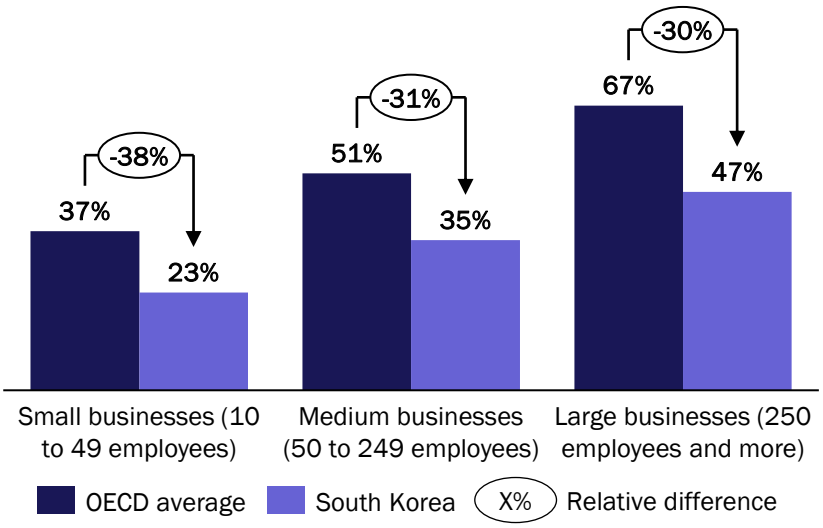


Figure 4.3: Percentage of businesses purchasing cloud services by business size in 2020 [Source: OECD, 2022][72]

In addition, while the manufacturing and finance and insurance sectors contribute over a third of South Korea's GDP, cloud adoption is lagging considerably in these critical sectors in South Korea compared to selected OECD markets (see Figure 4.4).

Sector	Percentage contribution to GDP [73]	Percentage of businesses purchasing cloud services – OECD average	Percentage of businesses purchasing cloud services – South Korea
Manufacturing	29%	40%	23%
Finance and insurance	7%	66%	40%

Figure 4.4: Percentage of businesses purchasing cloud services by sector in 2020 [Source: OECD, 2022][74]

Low cloud adoption in these sectors prevents the realisation of the benefits and use cases that cloud services can enable, such as:

Manufacturing Cloud services can support improved productivity management using cloud-based applications to monitor and manage production. It can also improve supply-chain management by leveraging cloud-based digital twin technologies to help enterprises make better use of their data.

72 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

73 KOSTAT, 2023. "GDP by industry at current prices"

74 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

Finance and insurance	Cloud services can facilitate the digital transformation of financial institutions, including building cloud-native digital banking apps that reduce reliance on manual processes and increasing resiliency of banking services by having a higher level of disaster recovery via cloud services.

There remains significant untapped opportunity across organisations that have yet to take up cloud services and these organisations could reap significant benefits when they begin their cloud migration journey.

4.3 Barriers to cloud adoption in South Korea include technology skill gaps, security, cost concerns and restrictive regulation

Understanding the key barriers to cloud adoption in South Korea can help to identify potential measures to bolster cloud adoption. These barriers are discussed in more detail in the following sub-sections.

4.3.1 South Korean organisations face a gap in digital and cloud-related training and skills

Digital and, more importantly, cloud-specific skills are critical for cloud adoption given the inherent complexity associated with cloud deployments. Examples of cloud-specific skills include:

- Containerisation: trained employees who are able to use container technologies (e.g. Kubernetes) can facilitate numerous benefits including portability, greater efficiency, and faster delivery of feature enhancements
- Development and operations (DevOps): organisations with employees trained in DevOps principles can allow the integration of software development with IT operations – thus allowing faster launch of products and enhanced agility in launching new features
- Cloud architecture: cloud architects translate the technical requirements of a project into cloud computing components required to enable it – including front-end platforms, back-end platforms, cloud-based delivery, and the network.

Organisations first require cloud experts who are able to assess the benefits of cloud services and justify them internally within the organisation to obtain management support for the adoption of these services. For the organisations to benefit from cloud adoption, IT functions must be equipped with the specialised skills to architect/develop cloud-based applications and other employees will also need to learn how to utilise these applications.

However, there is currently a digital skills gap in South Korea seen across multiple studies:

OECD[75]	A report published by OECD states that 72% of South Korean workers in micro-firms have low digital problem-solving skills. In addition, less than

75 Bianchini, M. and I. Kwon (2021), "Enhancing SMEs' resilience through digitalisation: The case of Korea"

	15% of small and medium-sized enterprises (SMEs) in South Korea provide general ICT education to employees.
IMD Digital Competitiveness Ranking[76]	While South Korea was ranked 8th in IMD's overall digital competitiveness ranking, it ranked 46th globally in terms of "digital/technological skills", which assesses if these skills are readily available across a workforce.

The importance of addressing South Korea's digital skills gap to support cloud adoption is highlighted by a survey of enterprises conducted by the KDI Economic Information Center in 2021. Enterprises surveyed cited the "nurturing of manpower – such as field talent" to be the most required factor to improve the competitiveness of South Korea's cloud industry.[77] In comparison, Denmark was ranked first globally in terms of digital competitiveness, and was cited as being "among the world's leading economies in digital talent and training and education", which underscores the connection between improving the availability of skilled digital experts and an increase in cloud adoption.[78]

4.3.2 Security concerns remain a key barrier for cloud adoption among South Korean enterprises

It is vital that all organisations ensure that their IT systems are secure and resilient against threats, as any breach can compromise operations and data. Cloud adoption can involve significant changes to an organisation's existing IT architecture, thus organisations must be reassured that their security requirements will still be met.

In a survey conducted by the KDI Economic Information Center, South Korean enterprises indicated that security concerns were the biggest obstacle to cloud adoption (see Figure 4.5). Education programmes that improve digital skills will play an important role in addressing such concerns. For example, trained cloud experts will have a better understanding of the security implications when migrating to cloud services and will be able to select CSPs that can meet the organisation's specific security requirements. Trained cloud experts can also educate their organisations on how cloud services allow them to access best-in-class security features (see Section 2.3.1) and can enable them to enhance security levels – thus addressing security concerns.

76 IMD World Competitiveness Center, 2022. "IMD World Digital Competitiveness Ranking 2022"

77 KDI Economic Information Center Data Research Team, 2021. "Cloud Survey"

78 IMD World Competitiveness Center, 2022. "IMD World Digital Competitiveness Ranking 2022"

Factors hindering growth in cloud services	% of respondents
Security concerns	32%
Burden of introduction and conversion	25%
Lack of information about cloud services	12%
Ownership preference vs. resource sharing	11%
Uncertainty about performance	8%
Lack of response to market changes	7%
Lack of conversion incentives	5%

Figure 4.5: Survey responses on the main obstacle to cloud adoption [Source: KDI Economic Information Center Data Research Team, 2021][79]

4.3.3 Funding to support initial cloud deployments can also help ease the transition and reduce initial upfront costs which can be a barrier for some organisations

As discussed in Section 2.3.1, cloud services can provide significant cost savings relative to the use of on-premises IT systems. This is due to the more efficient use of computing resources in cloud services, with organisations only paying for the actual resources they consume. Organisations can also minimise the need for upfront capital expenditure on IT hardware which can now be outsourced through CSPs.

However, the cost savings may not be fully realised immediately. Enterprises migrating to cloud services may incur costs due to a range of activities that can include decommissioning existing hardware, terminating contracts for on-premises IT systems, and increasing personnel to manage cloud migration. These costs can serve as a deterrent to initial cloud adoption and is evident in South Korea, where cost burdens were cited as the second-largest obstacle to cloud adoption (see Figure 4.5). In addition, respondents to the same survey highlighted that cloud conversion support and support for cloud usage fees (e.g. provision of vouchers) were some of the most effective support mechanisms to accelerate the growth of cloud services in South Korea.[80]

4.3.4 Regulatory barriers that hinder fair access by all CSPs or impose restrictions on potential end users can hamper growth of cloud adoption

Regulation imposed on CSPs as well as potential cloud customers can lead to barriers to cloud adoption. While South Korea is the 10th largest economy in the world,[81] it ranks 19th in MIT Technology Review Insights' Global Cloud Ecosystem Index which is determined based on "how well technology, regulations, and talent promote the availability of cloud services".[82] In particular, South Korea was ranked only 33rd out of 76 countries in the security and assurance pillar, which "measures the maturity of regulatory environments that promote progressive, cloud-forward data

79 Ibid.

80 Ibid.

81 The World Bank, data for 2021. "GDP (current US$)", extracted 20 January 2023

82 MIT Technology Review Insights 2022, "The Global Cloud Ecosystem Index 2022"

security and sovereignty environment".[83] This suggests that the regulatory landscape in South Korea may be hampering its cloud adoption.

Examples of existing regulatory policies that may hinder cloud adoption in South Korea include:

CSAP	CSAP was introduced in 2016 and required CSPs to receive CSAP certification to serve government agencies. Requirements to receive CSAP certification included (i) physical separation of servers for private enterprises from government agencies; (ii) localisation of cloud service management and operation personnel within South Korea; and (iii) the use of government-certified encryption technology.[84] These measures have constrained supplier choice for government agencies.
Act on Prevention of Leakage and Protection of Industrial Technology	The Act was introduced in 2006 and includes designating several national core technologies (NCT) – this includes certain semiconductor technologies. Companies operating as NCTs have obligations such as requiring government approval for the export of the technology to foreign enterprises.[85] Such requirements have created a barrier to cloud adoption, as there is uncertainty on whether accessing cloud services would be deemed as an export of an NCT and thus require government approval.

Such regulations are likely to have negatively impacted cloud adoption, effectively reducing the number of eligible CSP suppliers available to government agencies and hindering the ability of enterprises in major industries to adopt cloud services. The Computer & Communications Industry Association (CCIA) published comments to the United States Trade Representative (USTR), highlighting that CSAP "effectively serves as a technical barrier to trade and prohibits global cloud service providers from accessing the Korean public sector market" and "undermines the economies of scale of cloud computing".[86]

83 Ibid.

84 U.S. Chamber of Commerce, 2023. "Public Consultation on Amendments to Korea's Cloud Security Assurance Program (CSAP)"

85 Korea Legislation Research Institute, 2019. "Act On Prevention Of Divulgence And Protection Of Industrial Technology"

86 Computer & Communications Industry Association, 2021. "Comments of the Computer & Communications Industry Association Regarding Foreign Trade Barriers To U.S. Exports For 2022 Reporting"

4.4 Supportive government policies that have been introduced can reduce these barriers and serve as a catalyst for cloud adoption growth in South Korea

The benefits of an advanced digital economy supported by cloud services are widely accepted by governments globally. In South Korea, for example, the introduction of the Cloud Computing Act in 2015 included measures to promote the use of cloud services by public institutions.[87]

Since then, the South Korean government has continued to introduce further plans and policies intended to support the development of cloud services and the digital economy. Recent plans include:

Third Basic Plan for Cloud Computing[88]	The Third Basic Plan for Cloud Computing was announced by the Ministry of Science and ICT (MSIT) in 2021. The MSIT stated that the objective of this plan was to boost digital innovation in the public sector through cloud computing and also to strengthen the cloud services sector.
Digital Strategy of Korea[89]	The Digital Strategy was announced by the MSIT in 2022. This strategy was developed to implement the 'New York Initiative' which was announced by the President of South Korea in New York. The strategy aims to make Korea a best-practice country in digital innovation

Selected measures introduced by the government that can address the barriers to cloud adoption identified in Section 4.3, or that can encourage cloud adoption, are discussed in the sub-sections that follow.

4.4.1 Bridging the cloud skills gap through nurturing cloud talents

The government has recognised the gap between the current level of cloud talent in South Korea and the desired level of cloud talent. Under the Third Basic Plan for Cloud Computing, the government plans to aid the collaboration of the public sector, private sector and academia to create a curriculum at the university level which will help to produce talents in the cloud field. The government's aim, under this initiative, is to nurture 10 000 cloud talents by 2024.

4.4.2 Initiatives to drive the development of cyber-security experts can address or alleviate security concerns when adopting cloud services

The Korean government has emphasised the importance of cyber security in the Digital Strategy for Korea, where it plans to develop 100 000 talents in this field and aims to develop cyber security as

87 Korea Legislation Research Institute, 2015. "Act on the Development of Cloud Computing and Protection of its Users"

88 Ministry of Science and ICT, 2021. "MSIT hosts the 14th Information and Communication Strategy Committee"

89 Ministry of Science and ICT, 2022. "Korea to Come up with the Roadmap of Digital ROK, Realizing the New York Initiative"

a strategic industry. It has further earmarked cyber security as one of the six major digital innovative technologies on which it will focus its R&D investment from 2023.

Having a greater pool of trained cyber-security experts, coupled with potential advances in cyber security supported by R&D, can help to improve the cyber-security maturity of organisations and better enable them to select cloud services that are appropriate for their security needs – thus reducing security concerns which are a significant barrier to cloud adoption in South Korea

4.4.3 Additional measures are being introduced which can drive cloud adoption

The South Korean government has also introduced other measures that promote the development and adoption of cloud services. For example, the Third Basic Plan for Cloud Computing acknowledged a shortage of cloud-based software solutions in serving government agencies. The government thus intends to launch 300 cloud-based software services used by government agencies by 2024, a significant increase from the 15 that were in use in 2020. This was echoed in the Digital Strategy of Korea, where the government stated its intent to reshape the software industry to focus on cloud-based software and has established the goal of fostering 2000 software-focused CSPs by 2027.

In addition, the government aims to develop advanced cloud use cases, stating that it plans to invest in cloud-based research and development which includes cloud-based high-performance computing. It has also stated its vision of enabling the sharing of AI semiconductors over the internet via cloud services – effectively providing 'AI as a service' – and intends to launch a project to develop this strategy. These initiatives also reinforce the view that the cloud services sector is continuously evolving with the boundaries of the IT stack increasingly blurred as discussed in Section 2.2.

4.5 South Korea's cloud services sector is expected to grow from KRW5.2 trillion in 2022 to reach KRW10.9 trillion by 2027

While South Korea is currently lagging in cloud adoption (see Section 4.2.1), the vibrant supply landscape with diverse CSPs offering a wide range of services, supported by the high quality digital infrastructure available in the country – as well as the presence of supportive policies that the government has recently introduced, will facilitate growth in adoption. Cloud adoption rate by enterprises with ≥10 employees is thus estimated to grow steadily over the next five years from 31% in 2022 to reach 48% by 2027. This compares to the average adoption rate amongst OECD countries of 43% in 2021.[90] The projected cloud adoption implies a ~30% relative increase in the current adoption rate of 31% over the next 3 years to reach 41% by 2025. This ~30% relative increase is in line with an internal survey conducted by Analysys Mason – where current cloud adoption levels

90 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

are expected to increase by ~30% on a relative basis based on enterprises' response on their expected use of cloud services within 3 years.[91]

We also expect existing cloud customers to shift an increasing proportion of workloads to cloud services given that they are familiar with the benefits of cloud adoption and have existing cloud-trained employees – thus increasing their cloud spend as they use more advanced cloud services. This is consistent with our internal survey data which shows that South Korean enterprises that are already using cloud services expect to increase the proportion of software that is cloud-based from ~30% in 2022 to ~50% within three years.[92]

However, this growth in average cloud spending from existing cloud customers will be balanced by the growth in cloud adoption from new cloud customers with a lower average cloud spend as they will be smaller enterprises adopting cloud services for the first time and have IT requirements that are smaller in scale. These customers are also likely use less complex cloud-based applications such as cloud-based productivity and collaboration tools, where the average spend required will be relatively low. Given these blended effects, the average spend on cloud services is expected to grow moderately at a compound annual growth rate (CAGR) of 4% over the 5-year forecast period from KRW62 million / year in 2022 to KRW76 million / year in 2027.

Considering the expected increase in cloud adoption coupled with the moderate growth in average cloud spend, the South Korean cloud services sector is thus expected to grow from ~KRW5.2 trillion in 2022 to ~KRW10.9 trillion in 2027 (see Figure 4.6) with a CAGR of 16% across the next 5 years.[93] This growth rate is broadly in line with consensus estimates from other analyst reports that project South Korea's cloud spend to grow between 15% to 17% CAGR.[94] [95] [96]

91 Based on a survey conducted by Analysys Mason covering enterprises with more than USD75 million in annual revenue

92 Based on a survey conducted by Analysys Mason covering enterprises with more than USD75 million in annual revenue

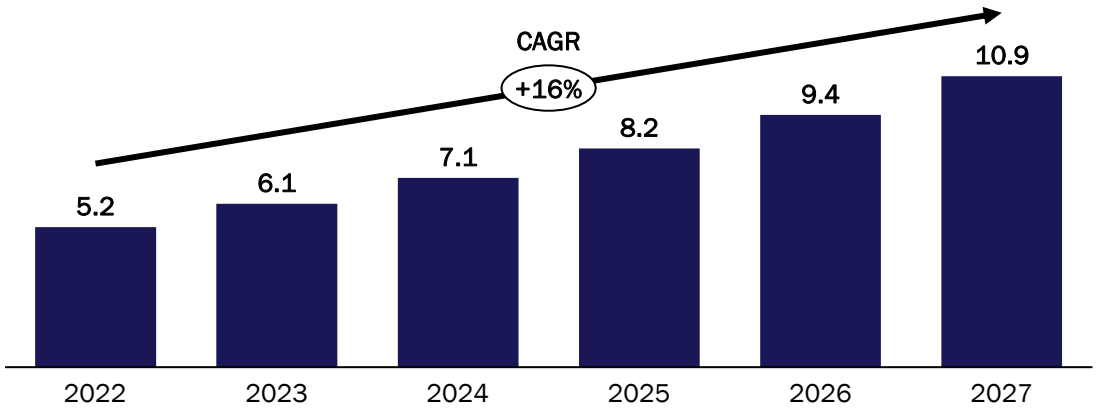
93 The cloud spend includes spend on public, private and hybrid cloud by both commercial and government sector customers.

94 BCG, 2019. "Ascent to the Cloud: How Six Key APAC Economies Can Lift-off"; BCG projected public cloud spend in South Korea to grow at a CAGR of 15% from 2018 to 2023

95 Deloitte, 2021. "The cloud imperative – Asia Pacific's unmissable opportunity"; Deloitte projected public cloud spend in South Korea to grow at a CAGR of 17% from 2020 to 2024.

96 IDC Korea, 2022. "2H21 Cloud Services Country Report – South Korea"; IDC projected South Korea's public cloud spend to grow at a CAGR of 15% from 2021 to 2026.

Figure 4.6: Cloud services sector spend forecast (KRW trillion) [Source: Analysys Mason, 2023]



Details of the methodology used to estimate the projected growth of South Korea's cloud services sector can be found in Annex A.2

5 The economic impact of cloud services in South Korea

In Section 4, the Report discussed the growth potential of cloud services in South Korea in consideration of both favourable conditions in the form of its vibrant supply landscape and high-quality broadband networks as well as barriers to cloud adoption that are still present in the market. Sustained growth in South Korea's cloud adoption enables the country to gain a range of benefits (as discussed in Section 2.3) and various South Korean organisations that have adopted cloud services have also highlighted the benefits gained from doing so, including cost reduction and greater business agility. Benefits from cloud adoption at the organisational level can spread across South Korea – facilitating digital transformation and driving overall economic growth. This multiplier effect on the economy has been discussed across multiple recent studies.[97] In addition, the greater IT energy efficiency that cloud services enable can support South Korea to achieve its sustainability goals.

In this section, the Report:

- provides examples of how cloud adoption has benefited the South Korean economy (Section 5.1);
- discusses how cloud adoption can enable South Korea to fulfil its digital economy potential (Section 5.2);
- examines how cloud spending can thus have a multiplier effect on South Korea's overall economy (Section 5.3);
- notes how cloud service can also support South Korea's sustainability objectives (Section 5.4).

5.1 Cloud adoption has enabled South Korean organisations to reap the benefits of improved efficiency and supported economy-wide productivity improvements

Cloud adoption drives improved economic efficiency for organisations through the numerous benefits it affords, including productivity gains, cost savings, increased agility, higher resilience and scalability (as discussed in Section 2.3.1).

South Korean organisations across various industries have adopted cloud services and have highlighted the benefits that they have experienced. Some examples of such South Korean organisations are discussed in the case studies below.

► *Case study: Kmong*[98]

Context Kmong is a business services marketplace in South Korea which connects the buyers and sellers of freelance services. The company was looking to optimise

97 Based on studies conducted by BCG, Deloitte and the Economic Strategy Institute which assess the economic impact of cloud spending. Full citations for the studies are provided in Section 5.3

98 AWS. "Kmong achieves 30% higher conversion with AWS

its use of data for decision making, and was considering the use of cloud services to implement a data pipeline. It successfully launched its data pipeline in 2018.

Benefits from using cloud services

Cloud services allowed Kmong to scale in a rapid yet stable manner, and by 2019, its website housed 170 000 freelance experts and the company was processing over 1 million transactions. Kmong experienced a 30% increase in conversion and 40% decrease in churn by leveraging insights that it was now able to generate by means of the cloud-based data pipeline.

- *Case study: Neowiz*[99]

Context

Neowiz is an online game company that offers gaming portal services, and also develops and publishes games. The company was looking for new technologies to advance the speed, quality and stability of its services.

Benefits from using cloud services

By 2020, Neowiz had shut down its own data centres and completely migrated to the use of cloud services. It estimated that cloud migration would reduce costs by 30% while allowing for a much faster launch of products, as its "old data centers were not scalable enough to support [its] growing mobile game business and expansion to the global market". Cloud services also enabled Neowiz to deal with sudden traffic spikes without requiring significant investments in on-premises infrastructure.

- *Case study: Shinhan Bank*[100]

Context

Shinhan Bank is South Korea's longest-operating bank and, outside of South Korea, its global network covers 20 countries. It was looking for a way to address local demands and offer support and security without having to build unique platforms for individual overseas locations.

Benefits from using cloud services

By 2020, Shinhan Bank had replaced its existing infrastructure and development processes with cloud-native solutions to centralise its global workload management – this removed the need to operate independent dedicated systems in each country. This transformation reduced the time-to-market for new services by 50% and allowed for a 60% reduction in operating costs.

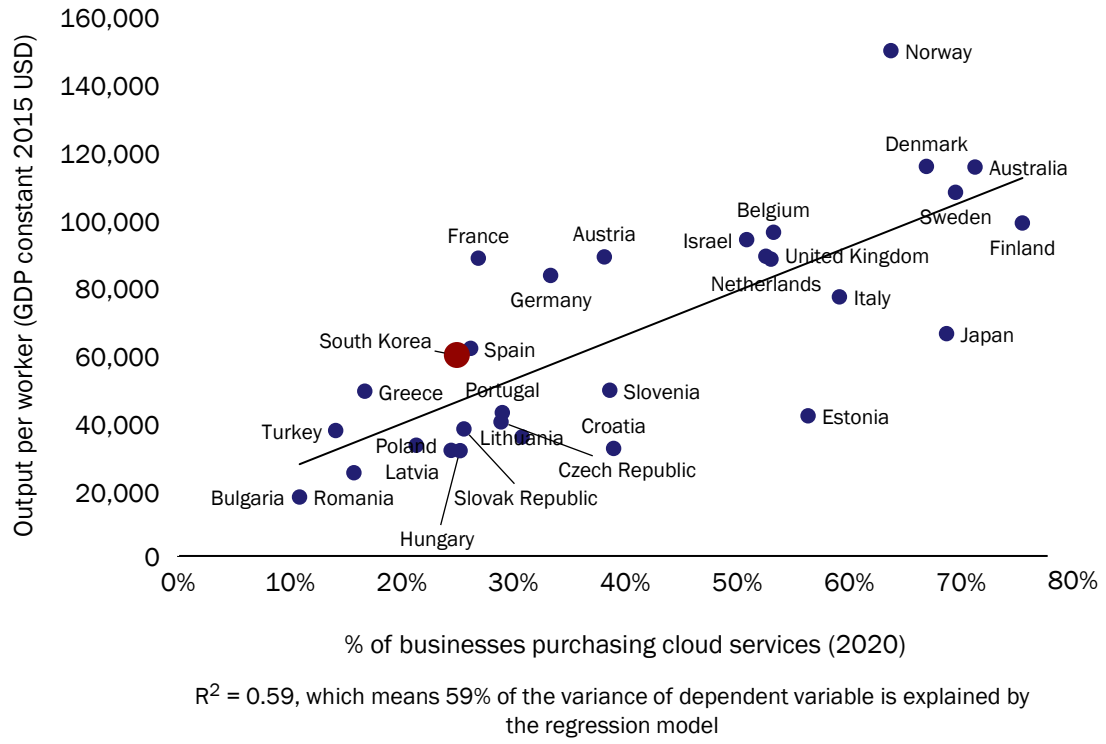
Significant cloud adoption in a country can therefore have an impact on the overall productivity of the economy, as organisations become more efficient in their operations. Figure 5.1 shows the cloud adoption of various markets globally and their labour productivity, which is measured based on GDP per worker. The data suggests a positive relationship between the two factors, where countries with higher cloud adoption experience higher labour productivity. The figure shows South Korea's

99 AWS, 2020. "AWS Case Study: NEOWIZ"

100 Red Hat, 2020. "Shinhan Bank uses cloud to reduce operating costs"

relatively low labour productivity – while it is the 10th largest economy in the world,[101] its labour productivity is only ranked 35th in the world.[102] Based on the best fit regression line, 10 percent point increase of cloud adoption rate in South Korea, from 25% to 35%, will yield 22% increase of GDP per worker.[103]

Figure 5.1: Cloud adoption versus labour productivity[104] [Source: OECD (2022)[105] and International Labour Organization (2022)[106]]



R^2 = 0.59, which means 59% of the variance of dependent variable is explained by the regression model

5.2 Cloud adoption can enable South Korea to achieve its full digital economy potential by fostering digital transformation and the growth of digital native start-ups

Cloud adoption is a critical enabler for digital transformation and growth of the digital economy. This is highlighted in a study by Access Partnership which states that "access to cloud services in particular, is critical to businesses digitalization and the ability to innovate using cutting edge

101 The World Bank, data for 2021. "GDP (current US$)", extracted 20 January 2023

102 ILOSTAT, 2022. "ILO Modelled Estimates and Projections (ILOEST) Database, Nov. 2022 edition"

103 GDP per worker in South Korea is estimated to increase from USD59 184 / worker to USD72 243 / worker with a 10 percentage point increase in cloud adoption rate.

104 Measured in "GDP constant 2015 US $" in 2020

105 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

106 ILOSTAT, 2022. "ILO Modelled Estimates and Projections (ILOEST) Database, Nov. 2022 edition"

computing and technologies".[107] This is especially important for South Korea as its digital economy remains relatively underdeveloped. Figure 5.2 indicates that South Korea's digital economy contributes only 1.16% of GDP as compared to other developed Asia–Pacific markets that have reached 3–4% of GDP. Figure 5.3 further shows that South Korea has only realised 23% of its potential digital economy value as compared to the ~60% seen in other developed Asia–Pacific markets. This underscores the importance of increasing cloud adoption to enable South Korea to fully realise its digital economy potential.

Figure 5.2: Digital economy as a percentage of GDP [Source: Analysys Mason analysis; World Bank and Access Partnership, 2022] [108,109]

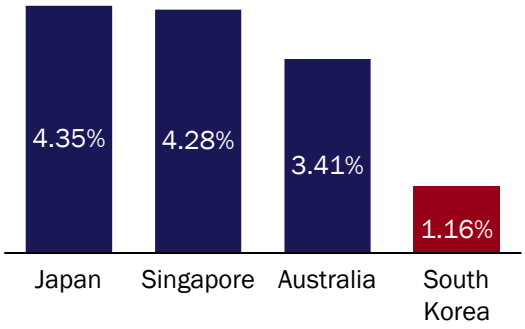
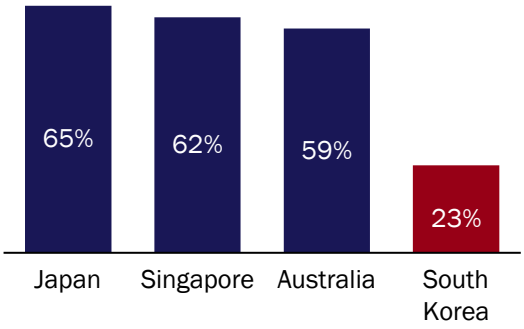


Figure 5.3: Percentage realisation of potential digital economy value [Source: Access Partnership, 2023][110]



As discussed in Section 2.3.3, cloud services are especially beneficial for start-ups, who have to grapple with a lean organisational structure and capital constraints. These start-ups utilise cloud services to build new and innovative digital applications. Various South Korean start-ups have successfully leveraged cloud services. Urbanbase, a South Korean spatial data platform start-up, was able to use cloud computing technologies such as containerisation and serverless computing to launch its services 20 times faster than if it were to build the infrastructure on its own.[111] In 2021, it successfully raised an additional USD11 million in funding to facilitate its expansion.[112]

5.3 Studies show that cloud spend can have a multiplier effect on GDP – South Korea's cloud services sector is expected to drive a KRW 62.2 trillion GDP contribution over the next five years

In the context of the economic benefits described in Section 2.3, various studies have attributed material impact on the overall economy to the adoption of cloud services. Examples of these studies include:

107 Access Partnership, 2022. "Prosperous APAC – Digital Economy Enablers"

108 World Bank, 2022. "GDP per capita (current US$)", data as of 22 December 2022

109 Access Partnership, 2022. "Prosperous APAC – Digital Economy Enablers"

110 Ibid.

111 ADB, 2021. "Cloud Computing as a Key Enabler for Tech Start-Ups across Asia and the Pacific"

112 TechCrunch, 2021. "Korean 3D spatial data tool startup Urbanbase closes $11.1M Series B+ round"

BCG – Ascent to the cloud[113]	This study covered six Asia–Pacific markets (including South Korea) and found that "the overall economies of the six markets will receive a far greater share of the economic benefit than the cloud service providers themselves will, with user industries emerging as the economic engines in their economies".
Deloitte – The cloud imperative[114]	This study stated that the cloud services sector enables "benefits in the broader economy", including "helping to drive productivity growth" which can "translate into economy-wide gains by improving the overall efficiency of firms, resulting in a flow-on benefit for consumers and improving living standard."
Deloitte – Measuring the impact of cloud computing in Europe[115]	This study was prepared for the European Commission and identified cloud computing as "a crucial driver of growth in the EU" that generates quantifiable benefits that include "GDP and macro-economic performance, through both increased revenue and business creation."
Economic Strategy Institute (ESI) – Cloud Services will Expand US GDP, Jobs and Tech Spending[116]	This study stated that the economy would "obtain dramatic benefits from enterprise spending on cloud services" and that this could accelerate "economic growth to a much faster-paced expansion than some forecasters are predicting."

The studies mentioned above created models that estimate the economic impact of cloud spend on the overall GDP of an economy. From these studies, we are able to derive the implied 'multiplier effect' of cloud spend on GDP, where a dollar of cloud spend leads to more than a dollar increase of GDP.

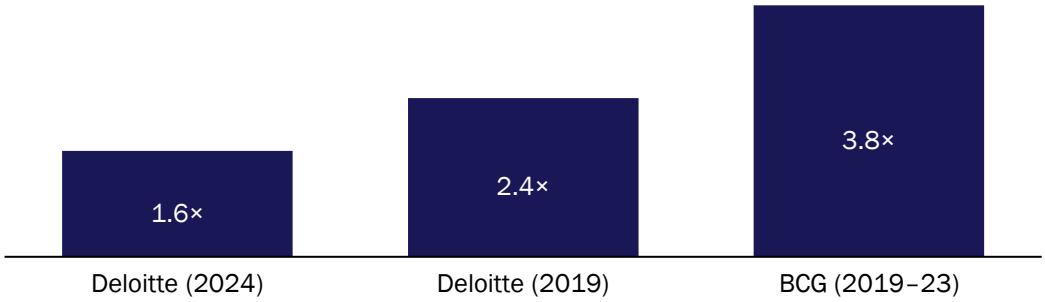
113 BCG, 2019. "Ascent to the Cloud: How Six Key APAC Economies Can Lift-off"

114 Deloitte, 2021. "The cloud imperative – Asia Pacific's unmissable opportunity"

115 Study prepared for the European Commission DG Communications Networks, Content & Technology by Deloitte, 2016. "Measuring the economic impact of cloud computing in Europe"

116 Economic Strategy Institute, 2016. "Enterprise Spending on Cloud Services will Expand US GDP, Jobs and Tech Spending"

Figure 5.4: Summary of GDP multipliers from cloud spend for South Korea [Source: Analysys Mason analysis; BCG, Deloitte]



The GDP multipliers ranging from 1.60× to 3.80× for South Korea (see Figure 5.4) provide us with an indication of the broader economic impact that cloud spend can have within the country. Based on the expected growth of South Korea's cloud services sector reaching KRW10.9 trillion by 2027, we estimate the cloud services sector to conservatively contribute KRW62.2 trillion to South Korea's GDP cumulatively from 2023 to 2027. This includes the benefits received by cloud adopters and their suppliers as well as the indirect effect driven by increases in the personal incomes of employees in both cloud adopters and suppliers due to increased wages and increased employment. These effects would stimulate further spending in other areas for the economy (e.g. food and leisure activities).[117]

The economic impact is based on a more conservative average multiplier of 1.49x over the 2023 – 2027 period and considers a gradual reduction in the multiplier as cloud adoption matures and the productivity impact through new cloud adopters slowly wanes – as organisations with the greatest potential productivity benefits via cloud adoption would be amongst the earlier adopters.

Figure 5.5: Economic impact from cloud spend in South Korea [Source: Analysys Mason, 2023] [118]

Metric	2022	2023	2024	2025	2026	2027	2023–27
Cloud spend (A)	KRW5.2 trillion	KRW6.1 trillion	KRW7.1 trillion	KRW8.2 trillion	KRW9.4 trillion	KRW10.9 trillion	KRW41.7 trillion
GDP multiplier (B)	1.85×	1.71×	1.60×	1.50×	1.42×	1.35×	1.49×
Economic impact (A) × (B)	KRW 9.7 trillion	KRW10.5 trillion	KRW11.3 trillion	KRW12.3 trillion	KRW13.4 trillion	KRW14.7 trillion	KRW62.2 trillion

Details of the methodology used to estimate the economic impact can be found in Annex A.2.

117 BCG, 2019. "Ascent to the Cloud: How Six Key APAC Economies Can Lift-off"

118 Figures for cloud spend and economic impact are based on nominal KRW

5.4 Adoption of cloud services can also facilitate South Korea's achievement of its sustainability/net-zero goals

As described in in Section 2.3.4, cloud services can enable not only economic benefits but can also improve the IT energy efficiency of organisations. This is becoming pertinent as commercial enterprises and government agencies globally are increasing their sustainability efforts.

The sustainability benefits of cloud services are particularly important for South Korea given its aims and commitments in this area. South Korea is member of the Paris Agreement that was adopted at COP 21 in 2015. The legally binding agreement has a long-term goal of limiting global warming, and involves commitments from all involved countries to reduce their greenhouse gas emissions substantially.[119] In 2020, the South Korean government further stated that South Korea would become carbon neutral by 2050.[120] In addition, the government announced in October 2021 that it would accelerate its carbon emission reduction timeframe – it now aims to achieve a 40% reduction in greenhouse gas emissions by 2030 as compared to the original target of 26.3%.[121]

Cloud adoption can serve as an important tool for South Korea to achieve these sustainability goals. A study by S&P Global Market Intelligence found that South Korean organisations could see workload energy savings of up to 80% and a significant reduction in carbons emissions if businesses were to migrate to hyperscale cloud services. The study also estimated that if just 25% of businesses in South Korea with more than 250 employees migrated 1MW of IT load to cloud services, the resultant savings in carbon emissions over a year would be equivalent to the emissions (from electricity use) of ~53 000 Korean households.[122]

Given the ability of cloud services to improve energy efficiency, it can play an important role in supporting the achievement of South Korea's sustainability goals and may potentially further accelerate the timeframe in which those goals are reached.

119 United Nations. "The Paris Agreement"

120 Reuters. 2020. "South Korea's Moon targets carbon neutrality by 2050"

121 Reuters. 2021. "S.Korea to raise emissions reduction goal to 40% by 2030"

122 S&P Global Market Intelligence, 2021. "The Carbon Reduction Opportunity of Moving to the Cloud for APAC"

6 Providing a supportive policy and regulatory environment is critical to facilitate growth of cloud services in South Korea

As discussed in this report, cloud services deliver benefits to organisations, governments and end users – these benefits then drive a multiplier effect that impacts the overall South Korean economy, as discussed in more detail in Section 5..

The government's policy and regulatory settings have a material impact on the supply of cloud services and demand drivers, which have flow-on effects for the overall economy. For example, policies enhancing customer confidence when selecting CSPs will help customers to realise the benefits of cloud adoption (as outlined in Section 2.3). Accordingly, South Korea's regulatory settings can materially shape the overall IT landscape, including cloud services, and this has a significant flow on effect across the economy as supported by the numerous examples of Korean organisations benefitting from the use of cloud services (as discussed in Section 5.1).

In this section, the Report:

- discusses the broad regulatory approach towards cloud services observed globally in advanced markets (Section 6.1);
- considers how regulatory and policy tools have implications for cloud services and their ability to drive the digital economy and encourage the government's digital policies and goals (Section 6.2);
- identifies three scenarios (base case, accelerated case, restricted case) driven by differences in the regulatory and policy environment for cloud services and evaluates their implications for cloud services growth as well as the resulting economic impact for South Korea (Section 6.3);
- discusses broader digital market regulation in South Korea and the implications for the cloud services sector (Section 6.4).

In summary, imposing new regulations only on specific CSPs or only in the cloud sector may reduce the potential multiplier effect that cloud services have on South Korea's economy discussed in Section 5.3.

6.1 Regulators around the world have been focusing on reducing barriers to cloud adoption, rather than imposing new cloud-specific regulations to a still immature sector

Cloud services remains a relatively new sector that has not yet fully matured. Given its early stage of growth coupled with its dynamic nature and constant innovation, regulation globally focus mainly on supporting cloud adoption to deliver the benefits described in Section 2.3.

6.1.1 Policy and regulatory measures in digitally advanced markets mainly focus on promoting adoption and industry development

> "Cloud computing can contribute to economic growth by reducing the costs of procuring and operating IT systems. Furthermore, both customers and suppliers can scale IT products up or down as required"
>
> **The Danish Government**

Digitally advanced markets have recognised the role of cloud services in their digital transformation agendas and have put in place policies to enable accelerated cloud adoption.

For example, in Denmark, Singapore and the USA, policy makers recognise the benefits of cloud services and have introduced various policies conducive to fostering adoption, rather than focusing on cloud-specific regulation.

Selected examples of the policies introduced in each market are described below. Further details and examples of such measures are discussed in Section 6.2.

Denmark The Danish government has developed a guide on the use of cloud services for government agencies to encourage cloud adoption and address key concerns that may be a barrier to cloud use.[123] The Danish Data Protection Agency has also published its own guidance on the use of cloud services for both government-sector and commercial-sector organisations to support their "assessment of cloud services and CSPs in relation to data protection law".[124]

Singapore The Singapore government has established a target of migrating 70% of less sensitive government systems to commercial cloud systems by 2023.[125] In addition, the establishment of minimum standards for cloud services has been recognised as supporting greater levels of trust in these services. This has led to the creation of the Multi-Tier Cloud Security (MTCS) standard and certification scheme to "encourage adoption of sound risk management and security practices by CSPs".[126]

USA In 2011, the US government introduced its Federal Cloud Computing Strategy which involves a cloud-first policy that required federal agencies to consider cloud services where viable. The Federal Risk and Authorization Management Program (FedRAMP) was then introduced to complement this. FedRAMP includes standardised security requirements and a third-party assessment programme to provide a "cost-effective, risk-based approach" for cloud adoption by federal agencies.[127]

123 Digitaliseringsstyrelsen. "Vejledning til anvendelse af cloudservices"

124 Datatilsynet, 2022. "Guidance on the use of cloud"

125 Digital Government Blueprint, 2020. "A Singapore Government that is digital to the core, and serves with heart, v2"

126 Infocomm Media Development Authority. "Cloud Computing and Services"

127 Executive Office of the President, 2011. "Security Authorization of Information Systems in Cloud Computing Environments"

6.1.2 Given the state of evolution of South Korea's cloud services sector, imposing intrusive cloud-specific regulatory measures may be premature and could hinder economic benefits

In many countries including South Korea, education and development programmes remain active to improve awareness of cloud services and the potential benefits. In addition, there continues to be significant innovation in cloud services – including the introduction of new technologies that have shaped how cloud services are used (e.g. Kubernetes and serverless computing, as discussed in Section 3.3.3). Furthermore, there is continual entry of CSP start-ups and challengers, including those targeting South Korea (e.g. Snowflake's 2021 entry into South Korea, as discussed in Section 3.2.2). These factors show how the cloud services supply landscape continues to evolve – any regulation considered for this sector must carefully weigh the benefits against the costs implications it could have.

In particular, the cost implications of cloud or CSP specific regulatory measures could include:

- increased operating costs for CSPs, leading to increasing prices for end users
- a slowdown in adoption of cloud services due to an increase in cloud pricing
- CSPs discouraged from investment in R&D and customer education due to reduced profits
- lower levels of product innovation and scaling back of developer programmes.

Regulators can address and resolve potential harms by using measures available from their existing regulatory toolkit

Adopting balanced regulatory approaches requires careful assessment of any new regulatory burden, but does not mean that governments and regulators are unable to implement necessary reforms or new regulations. However, it is important that such regulations are focused on clear risks or harms that are not adequately addressed with existing regulatory frameworks. For example, in most cases, existing consumer protection and competition tools may be sufficient to deal with most concerns. First, cloud services are not unique or special such that 'new' regulatory measures are needed. Second, existing regulatory tools, such as competition laws tend to take a principle-based approach and operate on an economy-wide basis, which provides flexibility and predictability to market participants.

This has been observed in other markets. For example, the case study below discusses how Microsoft's cloud business, when it raised competition concerns, was dealt with under existing EU competition rules, and how Microsoft responded by putting corrective measures in place (albeit at EU level).

Case study: Microsoft cloud licensing terms (Europe, 2022)

In April 2022, it was reported that Microsoft was facing scrutiny from the European Commission for "using its potentially dominant position in certain software markets to foreclose competition regarding certain cloud computing services".[128] This scrutiny was based on complaints filed by industry players to the European Commission's Directorate-General (DG) for Competition that Microsoft had breached EU competition rules which are not specific to cloud services.

By October 2022, Microsoft had reacted prior to the explicit imposition of remedies by revising the terms of its licensing deals – this revision would facilitate customers' ability to use their Microsoft software licences on selected third-party cloud providers' cloud infrastructure.[129]

This demonstrates that the threat of intervention based on European Union (EU) competition rules was effective, in that it made Microsoft react quickly (in approximately half a year). This change in the status quo did not require or involve the presence of cloud-specific regulation as it was based on the EU's competition rules.

Competition and antitrust laws are present in all developed markets. They play a key role in supporting fair markets across industries by empowering regulators to take corrective action when there is evidence of anti-competitive behaviour. These tools apply equally to the market for cloud services, as illustrated in the case study above, where the threat of intervention based on EU competition law was sufficient to drive Microsoft to change its behaviour. Existing competition law allows governments and regulatory bodies to monitor the cloud services sector and maintain fair competition without the need for the imposition of cloud or CSP specific regulation.

Imposing additional cloud-specific or CSP-specific regulation in an immature and dynamic sector will increase the regulatory burden for CSPs, leading to reduced incentives to innovate and invest – reducing the economic benefits of cloud services. For this reason, new regulatory and policy tools must be considered carefully to ensure South Korea can develop a vibrant digital economy supported by a cloud services sector that delivers efficiencies rather than stifling growth and innovation.

6.2 Regulatory or policy tools directed at cloud services must be considered carefully

The importance carefully considering regulatory settings is highlighted in the International Institute for Management Development (IMD) Digital Competitiveness Ranking, which states that "secured networks and solid regulation […] constitute the fundamental building blocks for technology adoption in society".[130] The cloud-related regulatory and policy tools considered globally can be grouped into three broad categories, as shown in Figure 6.1.

128 Reuters, 2022. "Microsoft's cloud business targeted by EU antitrust regulators"

129 Microsoft, 2022. "Easily bring your licenses to the cloud"

130 IMD World Competitiveness Center, 2022. "IMD World Digital Competitiveness Ranking 2022"

Figure 6.1: Classifying impact of regulation/policy measures for cloud growth [Source: Analysys Mason, 2023]

Category 1: Clear enabling policies for cloud growth	Category 2: Potential enabling policies for cloud growth with appropriate caution	Category 3: Policies with unclear impact on cloud adoption
• Skills development • Funding support for cloud adoption • Cloud-first policies	• Data privacy standards • Security standards • Resilience standards	• Vendor switching measures

We explore each category of measures in turn in the remainder of this section.

6.2.1 Clear enabling policies for cloud growth

Category 1 measures relate to enabling policies that have been put in place by governments to ensure the workforce is equipped with the right skillsets and that commercial enterprises and government agencies are incentivised to migrate to the cloud. As discussed in Section 6.1.1, such policies have been the focus of governments and regulators in many markets as they look to spur cloud adoption.

Figure 6.2: Enabling policies towards cloud adoption [Source: Analysys Mason, 2023]

Category 1: Clear enabling policies for cloud growth	Category 2: Potential enabling policies for cloud growth with appropriate caution	Category 3: Policies with unclear impact on cloud adoption
• Skills development • Funding support for cloud adoption • Cloud-first policies	• Data privacy standards • Security standards • Resilience standards	• Vendor switching measures

Skills development

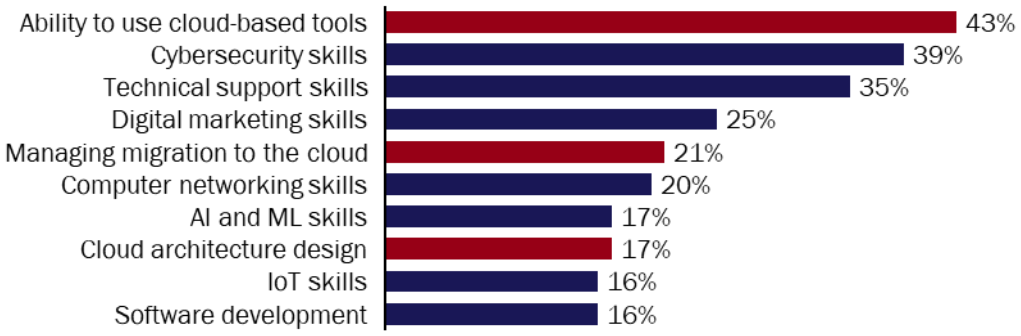
Cloud services are technologically complex and are continuously evolving due to innovation. It is thus vital that organisations' employees are well trained in cloud-related skills to support cloud adoption. For example, organisations must have cloud-trained personnel able to do the following to support cloud adoption:

- identify cloud-based options for various IT tools used by the organisation
- evaluate different cloud-based options, including their cost and security implications and their key benefits and risks
- handle the procurement and execution of cloud solutions (if these processes are not outsourced to a managed service provider)
- develop an IT migration plan to facilitate cloud migration

- utilise cloud-based services by end users (e.g. sales personnel using a cloud-based customer relationship management product).

The importance of such skills is highlighted by a survey undertaken in seven Asia–Pacific markets (including South Korea). The survey shows that cloud-related skills are among the most in-demand digital skills that employers will look for by 2025 and that the ability to use cloud-based tools is seen as the most in-demand digital skill (see Figure 6.3). This is especially relevant for South Korea where there is a cloud skills gap (see Section 4.3) hindering cloud adoption. IT teams that are sufficiently trained in cloud technologies can play a critical role in educating decision makers within organisations. Increasing the number of skilled cloud experts includes cloud security professionals (who ensure the security of data and applications when using cloud services). Access to a wider pool of trained cloud security professionals can mitigate security concerns when migrating to cloud services, which is another key barrier to cloud adoption in South Korea.

Figure 6.3: Share of employers who rank specific skills within the top-ten digital skills demanded by 2025 [Source: AlphaBeta][131]



The South Korean government has recognised the importance of trained cloud experts as highlighted by its plan to nurture 10 000 cloud-trained talents by 2024 (stated in the Third Basic Plan for Cloud Computing).[132] The provision of funding to educational institutions that offer cloud-related training programmes can support the achievement of the South Korean government's goals – this has been seen in other markets globally as governments recognise the importance of equipping employees with cloud-related skills. For example, the Digital Europe Programme was introduced to support the development of a "skilled talent pool of digital experts" that are equipped to respond to "developments in key and emerging technologies" in Europe, with a budget of EUR580 million to promote digital skills in the period 2021–27.[133] This budget includes providing educational institutions with funding for Master and Bachelor degree courses in digital technologies, and cloud computing is identified as one of the areas to be prioritised.[134]

131 AlphaBeta, 2022. "Building Digital Skills for the Changing Workforce in Asia Pacific and Japan"

132 Ministry of Science and ICT, 2021. "The third basic plan for cloud computing (2022–2024)"

133 Digital Skills & Jobs Platform. "Digital Europe Programme"

134 Digital Europe Programme (DIGITAL), 2022. "Call for Proposals: Advanced Digital Skills"

Funding support for cloud adoption

While cloud adoption provides multiple benefits, including productivity gains and cost savings (see Section 2.3.1), some enterprises in South Korea are concerned by the potential costs incurred when adopting cloud services, which can hinder take-up (see Section 4.3). Government funding provided to South Korean enterprises for the adoption of cloud services can play a key role in lowering these barriers – thus accelerating cloud adoption and increasing the resulting economic benefits. South Korea's Korea Small Business Innovation Research (KOSBIR) programme provides SMEs with funding to support adoption of innovative technologies.[135] Utilising such a programme to provide enterprises with funding support focused on the adoption of advanced cloud services can accelerate cloud take-up.

This is similar to other governments globally who recognise the benefits of cloud adoption. For example, the IMDA in Singapore introduced the Advanced Digital Solutions (ADS) scheme, which helps enterprises address common challenges at scale by providing funding support, with an emphasis on cloud-based solutions. Under the ADS scheme, up to 70% of funding support can be provided for the qualifying costs of the digital solutions to encourage adoption.[136] Examples of ADS-supported solutions include a cloud-based enterprise-grade property management platform and a cloud-based integrated digital solution platform for food and beverage merchants.[137]

Cloud-first policies

Cloud-first policies involve a concerted effort by governments to migrate to the cloud and includes encouraging or requiring government agencies to utilise cloud services to derive the technical and cost efficiencies discussed above. South Korea introduced the Cloud Computing Act in 2015, which included measures to promote the use of cloud services by public institutions.[138] This has been expanded upon via subsequent government initiatives as seen in the Third Basic Plan for Cloud Computing, which includes:

- establishing the principle of first using cloud services by public-sector organisations;
- converting the information system of public institutions to be cloud-based;
- supporting the costs of public institutions that are adopting cloud services.

Such cloud-first policies are in line with other advanced markets. For example:

UK In 2013, the UK government introduced its 'Cloud First' policy, which states that when procuring new or existing services, government-sector organisations should prioritise the full evaluation and consideration of cloud solutions – this was made

135 Korea Economic Institute of America. 2021. "Digitalization In Korea: A Path To Better Shared Prosperity?"

136 Qualifying costs include: the costs for hardware, software, infrastructure, connectivity, cyber security, integration, development, enhancement and project management. The programme will also cover the cost of deploying these solutions (e.g. acquisition, subscription, lease, transaction, training and professional services like programmers and project managers).

137 Infocomm Media Development Authority. "Advanced Digital Solutions"

138 Korea Legislation Research Institute. 2015. "Act on the Development of Cloud Computing and Protection of its Users"

mandatory for the central government (e.g. ministries). The government has highlighted that "the primary benefits for government come when we embrace the public cloud".[139]

Singapore In 2018, the Singapore government introduced its five-year plan with a "target of migrating 70% of less sensitive government systems by 2023" to commercial clouds. This would allow the government to benefit via "cheaper hosting, higher availability and greater ease of continually improving services".[140]

In January 2023, the South Korean government announced an ~80% cut in budgets for cloud transformation projects for government and administrative institutions, which will likely delay the government's transition to the cloud.[141] This is in contrast with Singapore, where the government spent SGD200 million from 2018 to 2021 to build up cloud infrastructure and capabilities, before increasing the budget to SGD1 billion for 2022.[142] Ensuring that cloud-first policies are supported with sufficient funding is important to enable government agencies to utilise cloud services effectively to be more efficient with subsequent positive multiplier effects for the economy overall.

Summary and conclusion

Despite the various benefits that can be enabled by cloud adoption, some organisations remain hesitant to migrate to the cloud. This can be due to various barriers,[143] including:

- lack of employees trained in cloud-related skills
- concerns over security implications when migrating to cloud services
- concerns over costs that may be incurred when migrating to cloud services.

Enabling cloud-first policies, as well as policies that support the funding of training programmes and subsidise cloud adoption, can play a key role in cloud services adoption and driving accelerated growth across the economy overall.

6.2.2 Potential enabling policies for cloud growth with appropriate caution

Category 2 relates to policies that have the potential to foster growth in cloud adoption but need careful design and implementation to mitigate potential constraining effects.

139 GOV.UK, 2017. "Guidance: Government Cloud First policy"

140 Digital Government Blueprint, 2020. "A Singapore Government that is digital to the core, and serves with heart, v2"

141 Korea IT News, 2023. "Public Cloud Budget 'Cut in Half'"

142 GovTech Singapore, 2022. "Government's FY22 ICT spending to hold steady at $3.8 billion"

143 As discussed in Section 4.3

In particular, introducing standards in line with international best practice and applying them uniformly across CSPs can facilitate cloud adoption by enabling greater trust and certainty in cloud services, while maintaining fair market competition. It is critical to set standards at appropriate levels to avoid constraining cloud adoption – for example, unnecessarily stringent standards may reduce the number of eligible CSPs in the market and thus reduce the number of options available to customers.

Figure 6.4: Potential enabling policies via standards [Source: Analysys Mason, 2023]

Category 1: Clear enabling policies for cloud growth	Category 2: Potential enabling policies for cloud growth with appropriate caution	Category 3: Policies with unclear impact on cloud adoption
• Skills development • Funding support for cloud adoption • Cloud-first policies	• Data privacy standards • Security standards • Resilience standards	• Vendor switching measures

Data privacy standards

Rapid growth in internet and smartphone adoption globally has given rise to internet-centric consumers who use internet-based platforms daily, for example by browsing websites, using internet search engines, shopping online and accessing social media applications. These platforms may have access to identifiable users' personal data, including their location and gender and the cultural or social identifiers of the end user. Governments have recognised the importance of providing individuals with the right to protect the extent to which they share such data, which has resulted in data privacy laws being enacted in most countries. In South Korea, data privacy is governed by the Personal Information Protection Act (PIPA) that was introduced in 2011.[144]

Given the need for organisations to comply with data privacy regulation, standards which show CSPs' compliance to such regulation can provide comfort to cloud customers and facilitate their selection process. For example, the EU Cloud Code of Conduct aims to "enable CSPs to demonstrate their capability to comply with GDPR", and the European Commission, together with CSP members, was involved in the drafting process of the Code.[145] The European Data Protection Board has since accepted that the EU Cloud Code of Conduct complies with the GDPR; this facilitates CSPs using the Code to formally demonstrate compliance with the GDPR (as permitted for within the GDPR's own stipulations).[146] Cloud customers have noted the benefits of using the Code in this manner to support their use of cloud services. For example, Volkswagen's Chief Data Privacy Officer has stated that

144 Korea Legislation Research Institute, 2020. "Personal Information Protection Act"

145 EU Cloud CoC. "About EU Cloud Code of Conduct"

146 European Data Protection Board, 2021. "EDPB adopts opinions on first transnational codes of conduct, Statement on Data Governance Act, Recommendations on the legal basis for the storage of credit card data"

"customers enjoy great protection by this trustmark approach" and that the Code allows them to "reduce monitoring efforts in this important technology".[147]

Security standards

Concerns that moving to cloud services may lead to security risks impacting cloud adoption worldwide, including in South Korea, as discussed in Section 4.3. The development of standards that allow CSPs to demonstrate their compliance to certain levels of security can serve as a key enabler to cloud adoption by providing comfort to cloud customers on minimum security standards adhered to by the cloud service. For example, the German government has acknowledged the benefit of security standards in supporting cloud adoption, stating that "trusted cloud offerings based on certified secure solutions can be a promising option in many cases for small and medium-sized businesses, which can then reduce their own IT and become flexible".[148]

In South Korea, security standards have been introduced for the provision of cloud services to government agencies through the CSAP certification system (see Section 4.3). The CSAP certification system in South Korea effectively prevents international CSPs from serving the public sector by applying technical barriers that international CSPs are unable to meet (e.g. requiring physical separation and manpower localisation i.e. physically restricting the location of cloud service management and operation personnel within the territory of South Korea). This has reduced the number of CSP suppliers available to government agencies, lowered the level of competition for this segment, and disincentivised investments into South Korea by international CSPs.

In comparison, Germany introduced the Cloud Computing Compliance Controls Catalogue (C5) in 2016. This is a verification framework that establishes a minimum baseline for cloud security, initially intended for use by government-sector organisations looking to adopt cloud services. Unlike in South Korea where international CSPs are prevented from serving government agencies due to the CSAP requirements, Germany has seen "many national and international Cloud Service Providers, both small and large" receiving C5 audit certification.[149] It is critical that the criteria within such cloud security standards are set at appropriate levels that do not unnecessarily or artificially hinder CSPs from obtaining certification as this can have further implications for private enterprise cloud adoption. For example, while the C5 framework in Germany was initially intended for use by government-sector organisations looking to adopt cloud services, C5 audit certificates obtained by CSPs are increasingly used by commercial-sector organisations to assess the security of cloud services and are also "accepted as verification in regulated industries such as banking and insurance".[150] Unnecessarily stringent security standards can thus reduce the number of options available to cloud customers – including private enterprises.

147 Diginomica, 2021. "Volkswagen and Euroclear give thumbs up to Europe's new Cloud Code of Conduct"

148 Federal Ministry for Economic Affairs and Energy, 2016. "Digital Strategy 2025"

149 Federal Office for Information Security, 2020. "Cloud Computing Compliance Criteria Catalogue – C5:2020"

150 Federal Office for Information Security, 2020. "Cloud Computing Compliance Criteria Catalogue – C5:2020"

Resilience standards

Resilient IT architecture can enable continued operations of key functions even in the event of IT-related disruptions or threats. This is especially important for critical industries such as the financial sector, where failure to maintain operations can have significant implications for the overall financial market, affecting both consumers and enterprises. Governments and other institutions have acknowledged the important of resilience standards in the financial market; for example, the European Commission has stated that "making the financial sector more cyber resilient is of paramount importance" to ensure that "financial services are delivered effectively and smoothly across the EU, and that consumer and market trust and confidence are preserved".[151]

In South Korea, the use of cloud services by financial institutions is governed by the Financial Services Commission (FSC)'s Regulation on Supervision on Electronic Financial Transactions (RSEFT). Regulatory measures include the requirement that financial institutions "conduct a soundness and stability assessment" on the CSP before using the cloud service. In 2022, the FSC announced that it will be simplifying the assessment process by reducing the assessment criteria from 141 to 54 to reduce the burden on financial institutions.[152] Such periodic reviews of cloud-related regulation for critical industries are important to ensure they remain appropriate. While the recent changes in South Korea will reduce the burden to cloud adoption for financial institutions, they remain more burdensome than advanced cloud jurisdictions such as Singapore, where financial institutions are only recommended to perform a self-assessment based on guidelines.[153]

Summary and conclusion

Standards or certification programmes can provide cloud customers with an independent means to verify a CSP's minimum quality of service across aspects that are critical to the customer. Such programmes can therefore provide cloud customers with increased trust and comfort when migrating to that CSP. This can be particularly beneficial for organisations that have elevated security or operational needs, including the government sector and some of the commercial sectors that have more sensitive requirements (e.g. financial services).

Enabling these benefits requires standards to be set appropriately with careful consideration, and avoiding:

- standards that are overly stringent, which may restrict the CSP options available to customers or lead to increased costs for CSPs, which are then passed on to customers;
- measures which may unfairly restrict some CSPs from obtaining the certification; this may in turn limit the CSP options available to customers and thus hinder cloud adoption.

151 EUR-Lex, 2018. "FinTech Action plan: For a more competitive and innovative European financial sector"

152 Financial Services Commission, 2022. "FSC Introduces Improvements to Cloud Computing and Network Separation Rules in Financial Sector"

153 Monetary Authority of Singapore, 2018. "Guidelines on Outsourcing"

Given the technology-driven nature of cloud services, and the fact these services continue to evolve due to industry innovation, it is important for standards to be reviewed every few years to consider the need for revisions amidst ongoing developments. This is in line with approaches in other markets – for example, Germany's C5 security standard, first introduced in 2016, was "completely revised in 2019 to consider the latest developments in detail".[154]

6.2.3 Policies that risk negatively impacting the growth potential of cloud adoption

Category 3 relates to policies that risk negatively impacting the growth potential of cloud adoption. Policies of this nature must be considered carefully given their potential to reduce entry of new CSPs, impact the provision of cloud services or the expansion of CSPs thereby the resulting in a reduction of the benefits of cloud services across the overall economy.

Figure 6.5: Potential constraining policies [Source: Analysys Mason, 2023]

Category 1: Clear enabling policies for cloud growth	Category 2: Potential enabling policies for cloud growth with appropriate caution	Category 3: Policies with unclear impact on cloud adoption
• Skills development • Funding support for cloud adoption • Cloud-first policies	• Data privacy standards • Security standards • Resilience standards	• Vendor switching measures

Cloud vendor switching measures

Governments and regulators in some markets are investigating whether cloud customers face challenges in switching from their current CSP to another provider or an alternative model – such as an on-premises IT approach.

A survey conducted in 2022 by the Japan Fair Trade Commission (JFTC) on cloud services examined responses from cloud customers on factors that may make it challenging to switch providers. The results are summarised in Figure 6.6 below.

Figure 6.6: Factors that make it difficult to switch from the current cloud service in Japan [Source: JFTC, 2022][155]

Factor	% of cloud customer respondents
A new service that has similar functions to those of the existing system will incur costs (expenses, time, labour) to build and operate a system	77
Unfamiliar technologies or knowledge must be learned for a new service	37

154 Federal Office for Information Security, 2020. "Cloud computing C5 criteria catalogue"

155 Japan Fair Trade Commission, 2022. "Report on Trade Practices in Cloud Services Sector"

Factor	% of cloud customer respondents
Although the current contract permits us to transfer data to another service, we will need to pay the cost of data transfer fees	16
As the data format in the existing system is different from a new service, data transfer is technically impossible or requires some processing	13
New services do not support certain important software/application functions used in the existing system	11
Nothing in particular (switching is not difficult)	11
The existing contract commits to use for a certain time period or a certain volume. Cost of any unused portion or a cancellation fee must be paid	7
The current contract prohibits/restrains us to transfer our data from the existing system to another service	4
Others	4

The survey reveals that the two biggest factors relevant to switching are due to: (i) the costs associated with building a new system (77% of respondents); and (ii) the need for training to equip personnel with appropriate knowledge to facilitate migration (37% of respondents). This suggests that potential challenges in switching are not due to CSPs exit fees, but are rather a function of a cloud services sector that is still growing and evolving. Similar findings can be seen in the U.S. Department of the Treasury's study on the adoption of cloud services by financial institutions which found that switching to another CSP is operationally complex which can even take years for the customer to execute successfully – highlighting that operational and practical challenges are the key barrier to switching vendors.[156]

For example, many organisations have yet to migrate to cloud services and will typically start their migration by selecting a primary CSP. As the organisation progresses with its migration and digital transformation, it may adopt a multi-cloud approach where it engages additional CSPs to support resiliency, reduce reliance on a single primary CSP, or access a unique cloud product/feature offered by the additional CSP. A multi-cloud approach can lead to: (i) higher competition, which places price pressures on CSPs; and (ii) greater exposure of employees to different CSPs, which reduces barriers related to training employees when switching.

In comparison, costs involved in transferring data from an existing CSP to another via egress fees charged by the existing CSP are a much less significant factor cited by cloud customers (16%). A separate study conducted for the European Commission estimated that for a mid-sized enterprise in Europe, one-off data egress costs reach 0.30–0.38% of annual cloud running costs.[157] Like the JFTC survey, the European Commission study suggests that egress fees are not a major factor that hinders a cloud customer from switching to another CSP. Accordingly, designing a policy specific to switching in the absence of a clearly characterised competition issue (e.g. banning exit fees) could

156 U.S. Department of the Treasury, 2023. "The Financial Services Sector's Adoption of Cloud Services"

157 Publications Office of the European Union, 2018. "Switching of Cloud Services Providers"

lead to inefficient pricing that may ultimately reduce the attractiveness of taking up cloud services compared to on-premises solutions, and therefore limiting cloud adoption and benefits to the overall economy.

The discussion above, demonstrates the importance of examining the evidence to determine whether there are indeed cloud specific concerns before determining whether new policies or changes to existing regulatory frameworks are needed. Even where regulators in other countries are reviewing their regulatory setting to ensure customers can freely switch suppliers, they have generally not led to new regulatory measures being introduced. In fact, some regulators have determined no new regulation is needed, instead opting to continue to rely on existing tools that can be imposed if market distortions or failures are identified. For example, JFTC states that it will "continue to closely monitor the conditions of the competitors in the cloud services sector […] and will continue to take strict and appropriate measures on specific cases that raise issues under the AMA (Anti-monopoly Act)".[158] In South Korea, CSPs face competitive pressures in terms of price and quality as they attempt to attract and acquire new customers. This is supported by JFTC, which notes that prices for cloud services have been declining, and that there is currently a "certain level of competition regarding prices and quality" in the sector.[159] In the context of natural competitive pressures in growing markets, coupled with the availability of existing tools to address potential market distortion, new regulatory interventions do not appear to be warranted. In addition, the Korean Fair Trade Commission's (KFTC) recent cloud study revealed that while almost 80% of organisations surveyed pay over 60% of their total cloud spend to their primary CSP, the main reasons for this high dependency on their primary CSP are: the quality of the CSP's offerings (43% of respondents), breadth of solutions and service options offered (40% of respondents), and reputation (39% of respondents). This highlights that the relatively high dependency towards a primary CSP by South Korean organisations are due to the merits of the CSP and its offerings rather than the lack of viable alternative CSPs available – with less than 7% of respondents citing no alternative CSP available as the reason for choosing their primary CSP.[160]

Summary and conclusion

There are two key conclusions.

First, imposing new policies or regulatory frameworks to facilitate switching of cloud vendors by customers risk negatively impacting the growth potential of cloud adoption and/or have unclear implications for the cloud services sector. For example, imposing limits on CSPs' egress fees may result in CSPs increasing the prices of other cloud services to ensure continued recovery of their infrastructure costs – thus negatively affecting affordability and demand from customers. Where regulators are evaluating such measures, most are still in the proposal and assessment stage. As such, we have yet to see markets where switching policies have been introduced for a sufficient period

158 Japan Fair Trade Commission, 2022. "Report on Trade Practices in Cloud Services Sector"

159 Ibid.

160 Korea Fair Trade Commission, 2022. "KFTC Announces Results of Cloud Service Market Study"

that allow us to observe how these policies impact the benefits cloud services deliver across the economy.

Second, evidence from multiple studies by regulatory bodies further highlight that barriers to switching vendors are generally not due to contractual or commercial factors, but due to operational challenges faced by the customer when switching. Introducing new policies or regulatory measures that target certain CSPs to promote vendor switching are unlikely to be effective as they do not address the actual problems to switching.

While this section has focussed on switching, the same conclusions apply in respect of other suggestions for cloud-specific regulations. For any cloud-specific policy, the government and regulators should ask: (1) what is the evidence that a specific policy addresses a real and identifiable (as opposed to a perceived) concern?; and (2) what is the evidence that a specific new policy or obligation will deliver an outcome that enhances economic welfare overall

6.3 Selecting appropriate regulation/policy regarding cloud services is key, given implications for the growth of cloud adoption and its associated economic impact

The underlying regulatory landscape plays a critical role in establishing the environment for cloud adoption. We have considered how different regulatory and policy approaches may either increase or decrease the growth rate of cloud adoption relative to the base-case projections (see Section 4.5) as summarised below.

The scenarios considered are summarised in Figure 6.7 below.

Figure 6.7: Scenarios considered for cloud service sector size forecasts [Source: Analysys Mason, 2023]

Scenarios	Demand drivers	Supply drivers
Base case	= Current levels of funding for cloud policies are maintained	= Current regulation remains unchanged
Accelerated case	+ Increased funding for skills training + Increased funding to drive adoption via subsidies + Revision of regulation to lower barriers to adoption by critical industries	+ Revision of regulation to allow broader supply of CSPs to serve government agencies
Restricted case	– Reduction in funding for pro-cloud policies	– New cloud-specific regulation that constrains supply

In the accelerated case, increased efforts and funding to spur cloud adoption will play a key role in increasing demand from South Korean organisations – particularly as these policies will help to reduce the major current barriers to adoption. Revising current regulation that may prohibit cloud adoption – particularly by critical industries – can also boost cloud adoption. In addition, revising

regulation to expand the range of CSPs that are qualified to serve government agencies can also increase cloud adoption as the increase in the number of suppliers for the segment will drive greater innovation and competition. Cloud adoption in the accelerated case is thus expected to increase further while average cloud spend will also grow as organisations move a greater number of advanced workloads to cloud services.

In contrast:

1. The restricted case involves a reduction of funding for pro-cloud policies which can worsen existing barriers to adoption.
2. The introduction of new cloud-specific regulation (whether switching policies or other CSP specific policies) is likely to increase regulatory burdens on CSPs, leading to increased costs passed on to customers coupled with decreased levels of innovation and investment by CSPs. Cloud adoption in the restricted case is thus expected to increase at a more moderate rate, while average cloud spend will be largely flat as the rate of shifting increasing workloads to cloud services slows down significantly.

Based on the policy environments around these scenarios, cloud spend in South Korea will be affected relative to the base case as shown in Figure 6.8 – leading to the economic impact increasing by 13% in the accelerated case and decreasing by 13% in the restricted case as shown in Figure 6.9. The estimated economic impact for each scenario considers the different maturity levels of cloud adoption – with the multiplier typically reducing as adoption grows. This is in line with studies that cover the economic impact of cloud spend as discussed in Section 5.3, where countries with more mature cloud adoption see a lower economic impact.

The varying economic impact from cloud services due to different rates of growth in cloud spend underscores the importance of: (1) establishing a conducive regulatory environment for cloud services in South Korea; and (2) carefully examining the evidence of whether CSP or cloud specific policies or regulatory frameworks are needed, given the implications for the broader economy.

Figure 6.8: Cumulative cloud services sector spend from 2023 to 2027 (KRW trillion) [Source: Analysys Mason, 2023]

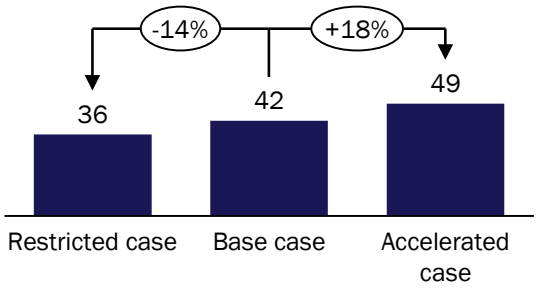
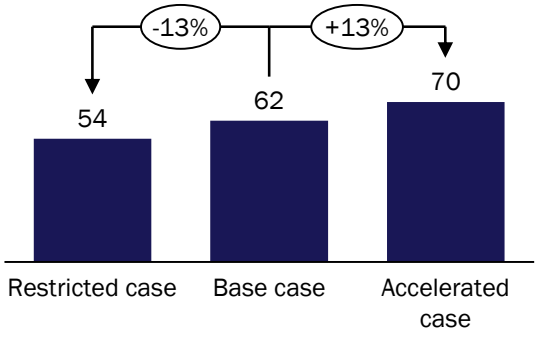


Figure 6.9: Cumulative GDP impact from cloud services sector from 2023 to 2027 (KRW trillion) [Source: Analysys Mason, 2023]



6.4 Policy makers in South Korea should approach ex-ante regulatory intervention in digital markets with caution to avoid unintendedly hindering the economic benefits from cloud services

Beyond cloud-specific regulation, broader digital market regulation covers various services within the digital space, including cloud services. The European Commission has introduced ex-ante regulation for large digital platforms, which can include CSPs. Specifically, the EU's introduction of the Digital Markets Act (DMA) and Digital Services Act (DSA) in 2022 includes rules for selected digital platforms. An overview of the DMA and DSA is provided in Figure 6.10.

Figure 6.10: Overview of DMA and DSA [Source: Analysys Mason, 2023]

Act	Description
DMA	• The DMA covers digital services that are identified as core platform services, including cloud computing services • It establishes criteria to designate companies as 'gatekeepers'; the criteria includes their turnover and number of end users in the EU[161] • Gatekeepers have to comply with several 'dos and don'ts' that are intended to support fair and open digital markets[162]
DSA	• The DSA covers online intermediary services, including cloud computing services • Obligations applicable under the DSA depend on the role, size and impact of an online intermediary service[163]

161 European Commission, 2022. "Digital Markets Act: rules for digital gatekeepers to ensure open markets enter into force"

162 European Commission. "The Digital Markets Act: ensuring fair and open digital markets"

163 European Commission. "The Digital Services Act: ensuring a safe and accountable online environment"

Act	Description
	• The DSA includes measures to counter illegal content; measures to empower users of online platforms; measures to strengthen oversight of online platforms[164]

The challenge and difficulties inherent with this model of regulation are illustrated by the following comments about the DMA:

- The EU's Commissioner for Competition acknowledged that the term 'gatekeeper', as used in the DMA, would be "tricky to define".[165]
- The EU's Regulatory Scrutiny Board, in its final opinion of the DMA, highlighted its "significant shortcomings", including its inability to "fully justify the selection of the core platform services to be covered".[166]
- The Chief Economist of the European Commission's Directorate-General (DG) for Competition has suggested that the European Commission will be "shorthanded" for the "first few years" with regards to implementation of the DMA.[167]
- An Economics Director at Ofcom stated that a rules-based regulatory approach such as the DMA "carries a greater risk of unintended consequences. Market dynamics can make it more challenging to predict the impact of rules, especially if such impacts are not immediate". For example, if a large platform is uniquely well-suited to enter a market with a powerful incumbent, then blanket rules that limit the ability of the platform to enter new markets may weaken competition faced by that incumbent".[168]
- A former deputy director of the Federal Trade Commission Bureau of Competition highlighted the significant uncertainty regarding the impact of the DMA, stating "the DMA aims to bring seismic change to digital markets. But it's going to take years, maybe decades, for courts and businesses to figure out, one case at a time, what that change will look like".[169]

It is important for policy makers in South Korea to exercise caution when assessing the introduction of this form of ex-ante digital regulation, particularly as the context in South Korea will differ significantly from the European context. Examples of aspects to consider include:

164 Ibid.

165 Lexology, 2020. "European Commission Consultation on Ex Ante Regulation of Online Platforms: Is Change Coming?"

166 European Commission, 2020. "Regulatory Scrutiny Board opinion"

167 Matt Stoller, 2022. "Big Tech and the Beautiful Losers in Europe"

168 Ofcom, 2021. "Rules-based versus principles-based regulation – is there a clear front-runner?"

169 Axios, 2022. "Europe's new digital rules are giving tech leaders nightmares"

- Digital market regulation has been introduced in the EU as part of the overarching goal of achieving "open strategic autonomy" that supports the "EU's ability to make its own choices and improve resilience and competitiveness of the region".[170] This consideration is unique to the EU and may not resonate with South Korea's own ambitions/objectives.

- The DMA/DSA imposes common regulation of cloud services across the EU's internal market, which operates as a multi-country single market that benefits from intra-EU trade among its member countries. This differs from South Korea, which is more reliant on external trade.

- Digital market regulation is broad, covering a range of cloud and non-cloud services. Taking a common approach to regulating across different digital services risks unintended consequences that may negatively impact cloud services.

- The impact of the DMA/DSA on cloud services in the EU will not be known in the short term as it has not yet taken effect.

Summary and conclusion

Given South Korea remains at a stage where the cloud services sector is immature and dynamic, the introduction of new cloud or CSP-specific ex-ante regulation does not appear warranted.

- South Korea's cloud services sector is immature, featuring the continued entry of new players and growth of local CSPs, and cloud adoption by both commercial enterprises and government agencies is expected to grow for some time. South Korea has a healthy cloud supply landscape supported by a diverse range of CSPs (see Section 3.2.1) and also has innovative players entering the cloud services sector (see Section 3.2.2).
- There is evidence of healthy competition to capture new cloud end users as cloud adoption has strong room for growth (see Section 4.2). Furthermore, introducing specific regulation can have unforeseen consequences. For example, measures which mandate a change in current supplier-customer contractual arrangements may unknowingly force CSPs to change the pricing of cloud services, which can be to the detriment of customers and cloud adoption.
- There is no evidence of significant market failures in South Korea's cloud services sector that warrant digital platform regulation.
- The presence of competition and antitrust laws in South Korea will continue to provide effective tools for regulators to maintain fair competition without the introduction of cloud-specific regulation which may hinder cloud adoption and reduce the economic impact from cloud services (see Section 6.1.2),

Noting the ongoing uncertainties surrounding how the DMA/DSA will be implemented and its impact on digital sectors, South Korean policy makers should assess any such measures carefully taking into account the following:

170 European Commission, 2021. "Trade Policy Review – An Open, Sustainable and Assertive Trade Policy"

- Unilateral regulatory intervention of the cloud services sector may hinder South Korea's access to international CSPs and hamper its ability to benefit from global trends and innovation in cloud services – this is especially critical given South Korea's less developed cloud services sector and its lagging cloud adoption rate (see Section 4.2).
- Whether the South Korean government has sufficient regulatory capacity and is able to fully and accurately assess and understand the impact of DMA-/DSA-type regulation on the cloud services sector and the broader economy.

Before considering similar cloud or CSP-specific ex-ante regulation, it will be crucial for South Korea to observe the impact of this type of regulation when the DMA/DSA come fully into effect in 2024. South Korea's relatively low ranking in terms of regulatory quality and government effectiveness related to cloud services (see Section 4.3) suggests any similar regulatory proposals will require careful and detailed assessment. Introducing regulation without careful assessment will risk unintended consequences – including hampering cloud adoption and reducing the economic benefits of cloud services (see Section 6.3).

Annex A Methodology

A.1 Projected growth of South Korea's cloud services sector

As discussed in Section 4.5, South Korea's spend on cloud services in our base case scenario is projected to grow from KRW5.2 trillion in 2022 to KRW10.9 trillion by 2027. This includes spend on public, private and hybrid cloud services by both commercial enterprises as well as government agencies.

The forecast is driven by both the expected growth in cloud services adoption and average spend on cloud services which will be discussed in turn below, focusing on adoption and spend by commercial enterprises. Spend by government agencies currently represents ~10% of the overall cloud services sector and we expect this proportion to remain relatively stable over the forecast period.

Projected cloud adoption in base case

Cloud adoption amongst South Korean enterprises with more than 10 employees is estimated to be ~31% in 2022, with OECD's latest available data for South Korea placing it at 25% adoption as of 2020.[171] South Korea's cloud adoption is higher for larger enterprises as they are more technologically advanced and better able to attract cloud-trained talent. This is supported by OECD's latest available data for South Korea, with cloud adoption as of 2020 at 47% for large enterprises with >250 employees vs. 35% and 23% for medium enterprises (50 - 250 employees) and small enterprises (10 – 49 employees) respectively.[172]

In the base case, we expect cloud adoption amongst larger enterprises to grow steadily to reach 80% by 2027 as cloud-skills training initiatives that have been introduced by the government (see Section 4.4) continue to lower existing barriers. 80% adoption amongst large enterprises will bring South Korea in line with the top-10 OECD markets in terms of cloud adoption by large enterprises in 2021.[173] The rate of growth in cloud adoption by small and medium enterprises is expected to be slightly faster given their larger pool of non-cloud users currently, reaching 45% and 62% respectively by 2027. South Korea's overall cloud adoption by enterprises with more than 10 employees is thus projected to reach 48% by 2027. This will see South Korea catching up and surpassing the average adoption rates currently seen across OECD countries in 2021 of 43%.[174] A breakdown of our estimates are provided in Figure A.1.

171 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

172 Ibid.

173 Ibid.

174 Ibid.

Enterprise category	Cloud services adoption (2022)	Cloud services adoption (2027)
Small: 10 to 49 employees	29%	45%
Medium: 50 to 250 employees	43%	62%
Large: 250 employees and above	56%	80%
All enterprises	31%	48%

Figure A.1: Cloud adoption rates by enterprise size [Source: Analysys Mason, 2023]

Projected average spend on cloud services in base case

Average annual cloud spend by enterprises that use cloud services in South Korea is estimated to be KRW62 million. Large enterprises are estimated to currently spend ~KRW1.4 billion / year on average on cloud services, with this figure supported by an internal survey conducted by Analysys Mason covering enterprises with at least USD75 million (~KRW90 billion) in annual revenue. The average spend by small and medium enterprises is estimated to be significantly lower at ~KRW13 million / year on average currently given that they have less sophisticated business needs which require less complex cloud-based applications.

We expect large enterprises to shift an increasing proportion of their workloads to cloud services given their existing familiarity, access to cloud-trained personnel, and better understanding of the associated benefits – thus driving a gradual increase in spend on cloud services. This is consistent with Analysys Mason's internal survey data which shows that South Korean enterprises that are already using cloud services expect to increase the proportion of software that is cloud-based from ~30% in 2022 to ~50% within three years.[175] We thus expect the average spend on cloud services by large enterprises to grow at 6% CAGR to reach KRW1.9 billion / year by 2027.

The average spend on cloud services by small and medium enterprises is expected to grow more moderately. While existing cloud users may shift more workloads to cloud services and thus increase spend, this will be tempered by new adopters of cloud services who are expected to start with simpler and lower cost cloud services. We thus expect the average spend on cloud services by small and medium to grow at 2% CAGR to reach KRW14 million / year by 2027.

We thus expect the overall average spend on cloud services to reach KRW76 million / year by 2027. A summary of our estimates for the average cloud spend in the base case is provided in Figure A.2

Enterprise category	Average spend on cloud services (2022)	Average spend on cloud services (2027)
Small and Medium	KRW13 million / year	KRW14 million / year

Figure A.2: Average spend on cloud services by enterprise

175 Based on a survey conducted by Analysys Mason covering enterprises with more than USD75 million in annual revenue

Large	KRW1428 million / year	KRW1920 million / year
Overall	KRW62 million / year	KRW76 million / year

size [Source: Analysys Mason, 2023]

Projected restricted and accelerated cases

As discussed in Section 6.3, we have developed two other scenarios – a restricted case and accelerated case – and estimated their expected cloud spend as well as resulting economic multipliers.

In the restricted case, funding for of pro-cloud policies will be reduced and new cloud-specific regulations that constrain the number of CSPs available to customers are expected to be introduced. In this scenario, cloud adoption rates are expected to show significantly slower growth to only reach 40% in 2027 vs. 48% in the base case. This slower growth will be in line with the historical growth reported for South Korea between 2018 – 2020, where cloud adoption increased by less than 2% a year.[176] We also expect average spend on cloud services to lag the base case, reaching KRW69 million / year by 2027 vs. KRW76 million / year in the base case. This is due to the introduction of new cloud-specific regulations constraining supply which then hinder the rate of customers moving increasing workloads to cloud services. Lower funding for pro-cloud policies will also reduce the adoption of more advanced cloud services – further slowing the increase in average spend.

In the accelerated case, funding for pro-cloud policies will be increased along with the revision of current regulations that may prohibit cloud adoption – particularly by critical industries – thus boosting cloud adoption. In addition, revising regulations to expand the range of CSPs that are qualified to serve government agencies will increase in the number of suppliers for the segment. Cloud adoption in the accelerated case is thus expected to reach 60% in 2027 vs 48% in the base case as barriers to adoption are lowered. Similarly, the average spend on cloud services is expected to increase faster to reach KRW78 million / year as the lowering of barriers to adoption coupled with greater innovation due to higher competition leads to the use of more advanced cloud services.

The projected cloud adoption and average spend for these scenarios compared with the base case are shown in Figure A.3

Figure A.3: Cloud service adoption and average spend on cloud services by scenario [Source: Analysys Mason, 2023]

Scenario	Cloud services adoption (2022)	Cloud services adoption (2027)	Average spend on cloud services (2022)	Average spend on cloud services (2027)
Restricted case	31%	40%	KRW62 million / year	KRW69 million / year

176 OECD, 2022. "The OECD Going Digital Toolkit, based on the OECD ICT Access and Usage by Businesses Database"

Scenario	Cloud services adoption (2022)	Cloud services adoption (2027)	Average spend on cloud services (2022)	Average spend on cloud services (2027)
Base case		48%		KRW76 million / year
Accelerated case		60%		KRW78 million / year

A.2 Economic impact multiplier for South Korea

We performed a literature review of studies that assess the economic impact of cloud spend on the broader economy for South Korea as well as for other markets. The studies evaluate the economic impact driven by cloud spend, which we have used to derive the implied economic multipliers for each study, include the following:

Figure A.4: Studies that assess the economic impact of cloud spend [Source: Analysys Mason, 2023]

Studies	Year of publication	Countries covered	Summary of methodology
BCG – Ascent to the cloud[177]	2019	Australia, India, Indonesia, Japan, Singapore, South Korea	• GDP impact of cloud services broken down into direct, indirect and induced impact • Direct impact: identification and calculation of variables are added up to form estimate • Indirect/induced impact: used input/output tables from OECD and national statistics authorities to learn the relation between the different industries; • Used increase in cloud spend by CSPs and end users to derive indirect impact on other industries and derived multipliers for indirect and induced impact
Deloitte – The cloud imperative[178]	2021	Australia, China, Hong Kong, Japan, New Zealand, Singapore, South Korea	• Formed an econometric equation with GDP per capita as the dependent variable with other variables including a digital variable index, part of which comprises cloud expenditure • Ran two scenarios – one with all variables and one with cloud expenditure removed, with the difference in both scenarios being the economic impact of cloud spend
Deloitte – Measuring the impact of cloud	2016	France, Germany, Italy, Spain, UK	• Modelled the benefits of cloud services to businesses in 4 aspects: business development opportunities, business creation, net IT cost savings, and the indirect impact of cost savings or incremental revenue leading to increased spend other sectors

177 BCG, 2019. "Ascent to the Cloud: How Six Key APAC Economies Can Lift-off"

178 Deloitte, 2021. "The cloud imperative – Asia Pacific's unmissable opportunity"

Studies	Year of publication	Countries covered	Summary of methodology
computing in Europe[179]			• Modelling was done for each aggregated industry sector – comprising nine in total
Economic Strategy Institute (ESI) – Cloud Services will Expand US GDP, Jobs and Tech Spending[180]	2016	USA	• Used a Keynesian multiplier to calculate the effect of an increase in cloud spending on the GDP of the country • The Keynesian multiplier is 1/(1-MPC); where MPC refers to the marginal propensity to consume – with the authors estimating it to be 0.4 for the USA

Based on the cloud spend and GDP impact stated in each paper, we were able to derive the implied multipliers as shown in values in Figure A.5.

Figure A.5: Methodology used to derive multipliers [Source: Analysys Mason, 2023]

Studies	Country/region	Cloud spend (A)[181]	GDP impact (B)	Multiplier (B)/(A)
BCG – Ascent to the cloud[182]	Australia (2019–2023)	USD39.1 billion	USD108.0 billion	2.8×
	Japan (2019–2023)	USD66.8 billion	USD129 billion	1.9×
	Singapore (2019–2023)	USD13.1 billion	USD31.0 billion	2.4×
	South Korea (2019–2023)	USD11.8 billion	USD45 billion	3.8×
Deloitte – The cloud imperative[183]	South Korea (2019)	USD1.2 billion	USD2.8 billion	2.4×
	South Korea (2024)	USD2.7 billion	USD4.2 billion	1.6×
Deloitte – Measuring the impact of cloud	Five countries in Western Europe (2016)	EUR144.1 billion	EUR763.3 billion	5.3×

179 Study prepared for the European Commission DG Communications Networks, Content & Technology by Deloitte, 2016. "Measuring the economic impact of cloud computing in Europe"

180 Economic Strategy Institute, 2016. "Enterprise Spending on Cloud Services will Expand US GDP, Jobs and Tech Spending"

181 Note that authors of the "BCG – Ascent to the cloud" and "Deloitte – The cloud imperative" studies have indicated that cloud spend refers to public cloud

182 BCG, 2019. "Ascent to the Cloud: How Six Key APAC Economies Can Lift-off"

183 Deloitte, 2021. "The cloud imperative – Asia Pacific's unmissable opportunity"

Studies	Country/region	Cloud spend (A)[181]	GDP impact (B)	Multiplier (B)/(A)
computing in Europe[184]				
Economic Strategy Institute (ESI) – Cloud Services will Expand US GDP, Jobs and Tech Spending[185]	USA	Not applicable		1.7× Multiplier derives by taking 1/(1-MPC) where MPC =0.4)

As discussed in Section 5.3, we then used the implied economic multiplier from the studies to estimate the expected economic impact for South Korea based on our projected growth in cloud spend. In assessing the appropriate economic multiplier to use, we have focused on the BCG and Deloitte studies as they provide implied multipliers for South Korea which reflect South Korea's unique stage of cloud services maturity.

184 Study prepared for the European Commission DG Communications Networks, Content & Technology by Deloitte. 2016. "Measuring the economic impact of cloud computing in Europe"

185 Economic Strategy Institute. 2016. "Enterprise Spending on Cloud Services will Expand US GDP, Jobs and Tech Spending"