Deloitte.

Economic and social impacts of Google Cloud

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Contents

Executive Summary

This study analyses the Economic and social impacts of Google Cloud across 14 different markets[1]. Key findings are based on *Deloitte's public Cloud business users survey,* conducted with 1488 IT decision makers using Cloud services from any provider, and a further Google Cloud business case studies survey, conducted with a further 80 IT decision makers among some of the most successful Google Cloud users. Both surveys include IT decision makers from SMEs and large businesses[2].

1. Benelux, France, Germany, Israel, Italy, Japan, Nordics, Saudi Arabia, South Africa, Spain, Turkey, United Arab Emirates, United Kingdom, United States.

2. The Cloud business users survey interviewed IT decision makers from 1185 SMEs and 303 large companies, and the Google Cloud business case study survey interviewed IT decision-makers from 47 SMEs and 33 large companies.

Economic and social impacts

Cloud technology is driving revenue growth and cost savings across both small and large organisations, providing on-demand access to powerful and flexible IT resources and tools.

Millions of businesses are now benefiting from Cloud technology, including some of the smallest businesses and start-ups. The business impacts of Cloud quantified in this study include[3] :

Average net return of up to $2.5 for every $1

Average Net Return on Investment of up to $2.5 for every $1 invested in Cloud services[4], with higher returns also possible, for both SMEs and large companies.

70%

70% of companies have used Cloud to develop new products, services or business models, to enter new markets, or to enable other product or service innovations.

More than 300,000

More than 300,000 businesses across the countries covered in this study could not operate at all without Cloud, including start-ups with new business models enabled by Cloud.

5%

Average 5% of users' revenue is Cloud enabled.

6-10%

Average increase in the customer base of 6% to 10%.

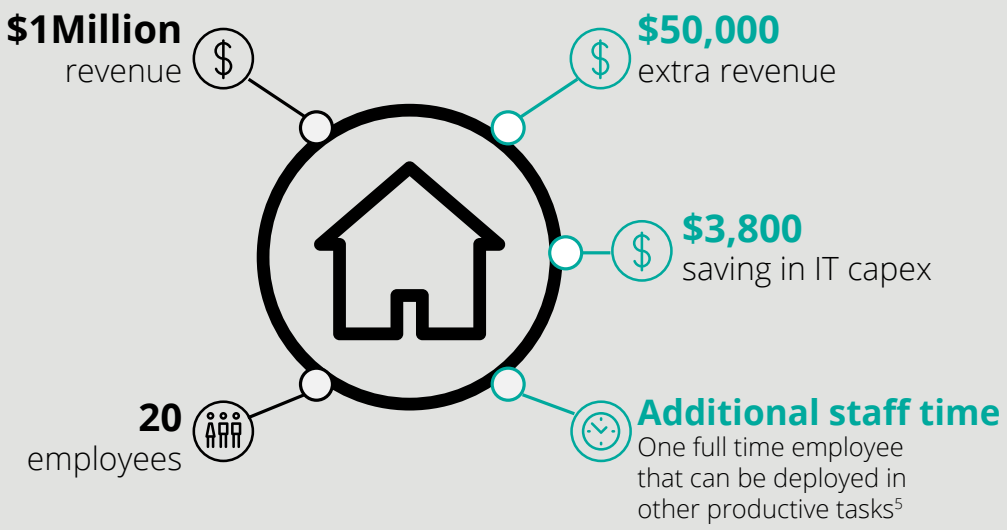
19%

Average 19% IT capital expenditure (CAPEX) reduction.

2 to 3 hours

Average staff time savings of 2 to 3 hours per employee per week.

An illustrative example in a small company:



3. Deloitte analysis based on the *public Cloud business users survey*
4. The sample consists of users of Cloud from various providers including Google among others
5. IT capex assumed to represent 2% of revenues. Figures are based on average responses and are for illustrative purposes.

Google Cloud in particular offers distinctive features supporting productivity and innovation, including its open source ethos and accessible machine learning and AI tools, helping to democratise access to these technologies across small and large organisations. The open source nature of tools such as Kubernetes also facilitates the use of multi-cloud solutions and portability of workloads between different Cloud platforms, increasing flexibility for customers who can benefit from using multiple Cloud platforms with complementary features.

The business impacts of Google Cloud quantified in this study include:[6]

- Net returns in the order of **$10 for every $1 spent on average are reported by some of the most successful Google Cloud users.**
- Aggregate productivity impacts including revenue expansion and cost savings across all Google Cloud users in the order of:[7]

The magnitude of business and productivity impacts from use of public Cloud and Google Cloud is estimated in this study relative to a scenario where only on-premise solutions are available. The study therefore does not measure the impact relative to other providers.

Businesses also use Google Cloud services in ways that have a variety of social impacts, such as helping to improve patient outcomes in healthcare and educational results for students. Healthcare applications range from pre-trained Artificial Intelligence/Machine Learning models for image and speech recognition to support patient care to Google Genomics, capable of quickly analysing petabytes of genomic information.

$3 billion to $9 billion

$3 billion to $9 billion in the US.

$300 million to $1.2 billion

$300 million to $1.2 billion per country in other large Cloud markets – UK, Japan and Germany.

$100 million to $600 million

$100 million to $600 million per country across the Nordics, France, Benelux, Italy, Israel and Spain.

$10 million to $70 million

$10 million to $70 million per country across relatively small Cloud markets – South Africa, Saudi Arabia, Turkey and UAE.

6. Results from the Google Cloud business case studies survey.
7. Based on the average estimated net return on investment of $1-$2.5, and total investment estimated to be associated to Google Cloud in each country.

Key challenges:

Despite Cloud's benefits, barriers to Cloud adoption still exist, including limited awareness of its benefits and its security features, and regulatory barriers related to the cross-border flow of data. In Deloitte's Cloud public businesses users survey, half of respondents mention security concerns as a barrier to Cloud adoption while one in three mentions skills and capabilities within the business.

The prominence of data security concerns as a barrier to Cloud adoption reflects the importance of online security in today's economy. While there is sometimes a perception that keeping data on premise or in a country is more secure, different features of Cloud can lead to enhanced security. Cloud providers can offer security capabilities that would not be available to most organisations individually, including more sophisticated data encryption, superior physical security of data centres, advanced authentication methods, access to cutting-edge solutions for novel threats and automatic processes such as security updates.

Though adoption is increasing, only 46% of large businesses and 22% of small and medium enterprises in OECD countries have made the leap to Cloud[8].

Policymakers can boost their economies by undertaking measures to address these barriers, working alongside industry.

Through the study of best practices in a number of jurisdictions, as well as interviews and surveys, this study proposes a list of actions for policymakers to foster Cloud adoption across five areas:

Develop a national strategy to prioritise Cloud ("Cloud First strategy").

Review existing requirements to store data in the country.

Develop guidance for businesses on the benefits of Cloud and best practices for adoption.

Provide resources and support for businesses to facilitate transition to Cloud.

Promote interoperability and data portability through open standards and industry codes of conduct.

8. Calculation based on data from OECD, see Organisation for Economic Co-operation and Development (OECD). 2017. "OECD Digital Economy Outlook 2017" http://www.oecd.org/internet/oecd-digital-economy-outlook-2017-9789264276284-en.htm

Develop a national strategy to prioritise Cloud ("Cloud First strategy")

- Define a classification for Public sector data to streamline decisions to use Cloud and implement it. For example, the simplified model defined in the UK with 3 levels of data (Official, Secret and Top Secret) with different protocols for storing the data depending on the level.
- Require public organisations to evaluate Cloud solutions first before considering other options when procuring IT services, and to justify the decision taken regarding use of Cloud.
- Develop framework agreements with suppliers to streamline public sector procurement.
- Nominate 'Cloud Ambassadors' in the public sector to act as leaders and promote Cloud. This may be done through Agencies tasked with promoting Cloud in the public sector or through training public sector employees to promote Cloud within their organisations.
- Create sandboxes to enable public entities to experiment with Cloud solutions, helping to identify priority use cases with the greatest potential benefits.
- Develop tools to set and monitor cost savings targets from Cloud adoption in the public sector.
- Publish energy consumption of public sector data centres to enhance accountability and illustrate improvements achieved over time through Cloud.

Review existing requirements to store data in the country

- Review the applicable requirements to store data in the country taking into account the security features of Cloud.
- Engage in regulatory cooperation internationally to define shared principles and rules to meet minimum acceptable levels of data protection so that countries are more readily willing to let data flow to other countries. These could be for example in relation to the rights of data subjects to be informed about the uses of personal data and transfer to third parties, or reasonable limits on data retention.
- Continue to foster international cooperation and bilateral agreements to streamline provision of information by the countries where data is stored to law enforcement agencies from the countries where the data originates, while respecting the objectives of the respective legal systems.

Develop guidance for businesses on the benefits of Cloud and best practices for adoption

- Develop an "online hub" containing information to "demystify the Cloud". For example information on the benefits of Cloud, practical steps on how to transition to Cloud, and best practice examples.
- Develop user-friendly guides for businesses on the security features of Cloud.
- Facilitate comparison of providers based on compliance with key quality criteria (e.g. security, compliance with industry specific regulatory requirements), for example through certification schemes.

Provide resources and support for businesses to facilitate transition to Cloud

- Invest in a Centre of Excellence hub for talent that can help tackle the challenges of Cloud adoption, bringing together experts from different sectors, and large and SME businesses. Make this hub provide training and information to IT decision makers in businesses about Cloud adoption.
- Provide SMEs with access to free expert advice on practical issues regarding Cloud adoption and transition, including how to minimise security risks resulting from human error.
- Consider making financial support available to SMEs in the IT sector to develop new tools that can help SMEs across all sectors migrate to the Cloud more easily.

Promote interoperability and data portability through open standards and industry codes of conduct

- Promote understanding and adoption of open standards working with industry bodies and SMEs.
- Actively support the development of relevant common technical standards and standardised Service Level Agreements through international organisations.
- Develop codes of conduct to ensure that Cloud providers do not unduly restrict portability of user data and applications, working with industry.

Introduction

This report explores how Google Cloud is having an impact through its role in making advanced Cloud-based services and resources accessible to a wide range of organisations

What is Cloud computing?

At its essence, Cloud computing allows users to access an extensive range of resources offered by third parties over the internet, without needing to build and operate their own IT infrastructure. It enables ubiquitous, on-demand network access to a shared pool of configurable computing resources that can be made available quickly and easily.[9]

There are different deployment models for such resources. At one extreme, Private Cloud infrastructure is used exclusively by a single organization; in contrast, Public Cloud resources are offered to the general public by providers such as Google, IBM, Amazon, Microsoft, Oracle, SAP, Alibaba, Fujitsu, Rackspace and others. Organisations may also adopt Hybrid Cloud models, using a combination of Private and Public Cloud resources.

Cloud-based resources are commonly classified into three categories:

- Infrastructure as a Service (IaaS): Allows users to access processing, storage, networks and other fundamental computing resources, to be used for any purpose.
- Platform as a Service (PaaS): Allows users to deploy onto the Cloud applications that they have developed or acquired.
- Software as a Service (SaaS): Allows users to use third-party software that runs on Cloud infrastructure.

Typically there are five core characteristics of Cloud computing, which may confer significant advantages to its users.

On-demand self-service	Broad network access	Resource pooling	Rapid elasticity	Measured service
Users can instantly access the computing capabilities they need.	***Capabilities are available over the internet and accessible from different devices, platforms and locations.***	***Shared computing resources serve many customers, with dynamic optimisation to support efficient use of these resources.***	***Capabilities provided to each user can be scaled rapidly and automatically in line with changes in demand.***	***The extent of usage of each service is monitored and measured, enabling pay-per-use pricing models.***

Source: US National Institute of Standards and Technology (NIST)

9. See for example US National Institute of Standards and Technology (NIST). 2011. "The NIST definition of Cloud computing" https://csrc.nist.gov/publications/detail/sp/800-145/final

Cloud trends

Organisations are increasingly opting to use Cloud-based resources and services for various purposes. Among large enterprises, Cloud adoption has become commonplace: 45% of large enterprises in the EU are estimated to have purchased at least one Cloud computing service in 2016, up from 35% in 2014.[10] Use of public Cloud services in particular is growing rapidly; Cisco forecasts that use of public Cloud[11] will grow at a compound annual growth rate (CAGR) of 28% from 2016 to 2021, while use of private Cloud will grow at a slower rate of 11% CAGR.

Cloud computing is intrinsically linked to other key technology trends, as an enabler of application deployment, advanced data processing and storage. In particular, the use of Cloud is accelerating because individuals, businesses and Internet of Things (IoT) devices are generating data at rapidly increasing rates and Cloud allows its analysis.[12] In this context, the European Commission has described Cloud computing as the major driver bringing together IoT, Big Data and mobile computing.[13] Businesses and other organisations are using Public Cloud services to process, store and analyse data, including through an expanding range of Artificial Intelligence (AI) and Machine Learning (ML) tools.

Businesses and policymakers are exploring the potential for these technologies to drive innovation and growth. For example, Cloud computing plays a key role within the European Commission's Digital Single Market Strategy[14] and countries such as the UK and France have recently launched national strategies to support investment in AI.

Experts expect that Cloud adoption will continue to expand. Use of Cloud remains markedly lower among smaller organisations. In 2016, Cloud adoption among small and medium businesses in the EU was estimated as 20%, which suggests potential for further uptake.[15] Moreover, although use of public Cloud services such as email and data storage has become relatively common, there is potential for greater use of more sophisticated tools incorporating technologies such AI, ML and Big Data analytics, which may unlock further benefits for businesses and society.

Artificial Intelligence, Machine Learning and Big Data

While there are alternative definitions of AI, it can be understood as getting computers to do tasks that would normally require human intelligence. Examples of AI applications include speech recognition, image recognition, robotics, automated vehicles and sophisticated statistical analysis.

AI is closely tied to the concepts of Big Data and Machine Learning. Google Cloud has focused particularly on developing tools that can help to make these technologies accessible to businesses.

Big Data describes very large volumes of data, potentially from different sources and in unstructured form, which traditional technologies may be unable to usefully capture and process. AI can create new opportunities to make this data manageable and useful.

Machine Learning refers to a class of AI applications whereby computer systems are able to improve their performance by exposure to data, without the need to follow explicit instructions. Applications in elude fraud screening, sales forecasting, inventory management, oil and gas exploration, or public health.

Source: Deloitte Insights. 2014. "Demystifying artificial intelligence"; Deloitte. 2017. "Part 1: Artificial intelligence defined".

10. Eurostat, based on enterprises with ten or more employees, excluding the financial sector.
11. Measured by installed workloads and compute instances
12. Cisco. 2018. "Cisco Global Cloud Index: Forecast and Methodology, 2016–2021" https://www.cisco.com/c/en/us/solutions/collateral/service-provider/global-cloud-index-gci/white-paper-c11-738085.html
13. EU-Korea Joint Call, EUK-01-2018: Cloud, IoT and AI technologies. See http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/Znanost/doc/Horizon_2020/doc/Razpisi/2018_ICT/EU-K01-WP2018_Coud-IoT-AI.pdf
14. European Commission, see https://ec.europa.eu/digital-single-market/en/policies/Cloud-computing
15. Eurostat, based on enterprises with ten or more employees, excluding the financial sector.

Overview of Google Cloud

Google Cloud provides a comprehensive set of Cloud services, as set out below. Research groups have reported Google Cloud's revenue share of the global market in 2017 to be in the region of 5%.[16]

Google Cloud places a particular focus on innovation, including in areas such as Big Data and AI. Products such as BigQuery and Dataflow bring advanced analytics capabilities to businesses, while the Cloud AI products offer an expanding range of ML services, enabling customers to train large-scale ML models at one extreme, or use ready-made ML-based Application Programming Interfaces[17] (APIs) at the other. These tools have enabled new services and business models to emerge, in areas from mobile games and virtual assistants to e-commerce platforms and IoT solutions.

Another key area of innovation has been in 'containerisation', a programming approach which involves different elements of code that make up an application existing in separate 'containers'. Google designed a system known as Kubernetes, where different elements of code that make up an application exist in separate 'containers' that can automatically be deployed, scaled and managed. Customers can use this through Google Cloud's Kubernetes Engine product, while the system has also been made available more widely as open source.

Other systems made available as open source by Google include TensorFlow – a software library commonly used for ML applications – and Apache Beam – a system for Big Data processing. With these systems being freely available, users can develop and test applications outside of the Cloud and then seamlessly move these to Google Cloud.

Cloud services and open source technology help to democratise access to specialised technologies such as machine learning or artificial intelligence. This is especially relevant for SMEs, where resources are more limited. Absence of fixed costs enables these companies to start using technologies it may be harder for them to access otherwise.

16. See for example Synergy Research Group. 2018. "Cloud growth rate increases; Amazon, Microsoft & Google all gain market share" https://www.srgresearch.com/articles/cloud-growth-rate-increases-amazon-microsoft-google-all-gain-market-share ,and Skyhigh Networks. "Overview of Cloud Market in 2017 and beyond" https://easycloudsolutions.com/2018/06/08/overview-of-cloud-market-in-2017-and-beyond/

17. An API is a set of definitions, protocols and tools that can be used to facilitate programming of new applications by providing the necessary building blocks

Google Cloud services

Google Cloud provides a comprehensive set of Cloud services, encompassing core IaaS functionalities such as virtual machines (e.g. Compute Engine), PaaS services for app development and hosting (e.g. App Engine), and SaaS applications such as email, storage and word processing services.

These services fall under two main categories: Google Cloud Platform and G Suite.

Google Cloud Platform (GCP) encompasses a range of IT infrastructure services as well as some PaaS and SaaS offerings across the following product suites.

- **Big data:** These services enable users to process and query very large datasets to generate results and insights from complex analysis, e.g. BigQuery, Cloud Dataflow, Data Studio Explorer and Cloud Composer.
- **Machine learning:** A variety of ML tools are available under the GCP Cloud AI platform, distinguished by the extent to which Google or the customer trains the algorithms:
  - Various APIs allow users to implement ML tools without creating or training their own algorithms. Applications include voice and text analysis, making videos and images searchable, facilitating job search processes and creating 'chatbots'.
  - Cloud AutoML represents a hybrid approach, where Google initially trains the algorithms and then the customer extends the training to reflect their specific needs.
  - Cloud ML Engine allows users to host and train bespoke TensorFlow ML models.
- **Computing and hosting:** This includes Cloud-based resources with different degrees of control over resource management:
  - Compute Engine is GCP's core IaaS service. It provides virtual machines and gives users control over configuration, administration and monitoring.
  - Kubernetes Engine is an environment for hosting containerized applications using the open source orchestration system Kubernetes.
  - App Engine is a PaaS environment for app building and hosting, where Google mainly handles resource management, providing automatic scalability as traffic increases.
  - Cloud Functions is a serverless environment fully managed by Google, suitable for single-purpose functions related to other Cloud infrastructure and services.
- **Storage:** This includes services for data to be stored and accessed from different locations, serving different user needs such as storing SQL databases (Cloud SQL), NoSQL databases (Cloud Bigtable), large unstructured datasets (Cloud Storage) and data related to mission-critical applications (Cloud Spanner).

To support those core services, Google Cloud offers additional services such as Networking, API Platforms and Ecosystems, Identity and Security tools, monitoring and management tools, data transfer services, developer tools and professional services offering expert support.

In addition, Google Cloud provides **Productivity** tools through **G Suite,** including various Cloud-based SaaS applications to support collaborative working and efficient communications.

G Suite includes a range of tools that can be used to:

- Connect through email, calendar and video-conferencing services;
- Create documents in a variety of formats;
- Access and share information using storage and search services; and
- Control user, device and security settings.

Scope of this study

This study examines the impacts of Cloud computing, with a focus on Google Cloud's contribution in the following areas:

- Productivity impacts on businesses using Google Cloud services.
- Social impacts on Education, Healthcare and the Environment.

The study's findings are based on interviews conducted by Deloitte, data collected through bespoke business surveys, as well Deloitte's analysis, existing literature and third-party data. The case studies have been developed through interviews and publiclly available information.

The two bespoke surveys comprised:

- A survey of 1488 IT decision makers in businesses using public Cloud from any provider (*the public Cloud business users survey*);
- A survey of 80 organisations using Google Cloud specifically selected from businesses listed as Google case studies (the Google Cloud business case studies survey)

As well as examining the impacts of Google Cloud, this study considers potential barriers to use of Cloud services and sets out a policymakers' playbook that can help to address these.

The geographic scope of the study is limited to the following 14 countries and regions: Benelux, France, Germany, Israel, Italy, Japan, Nordics, Saudi Arabia, South Africa, Spain, Turkey, United Arab Emirates, United Kingdom, and United States. For each of these, country chapters are included to provide an overview of the state of Cloud, the impact of Google Cloud and existing policy initiatives related to Cloud.

The remainder of this study covers:

- The productivity impacts of Cloud (Section 2)
- The social impacts of Cloud (Section 3)
- The existing barriers to Cloud adoption (Section 4)
- Potential policy actions to support an enabling environment for Cloud (Section 5)
- The state of Cloud, impact of Google Cloud and relevant Cloud-related policy, summarized for each of the 14 countries and regions included in the study (Appendix 1)
- Study methodology (Appendix 2)

Productivity impacts

Cloud services can change the way that businesses operate in a multitude of ways. This section explores how Cloud services affect business practice and how this may ultimately feed through to improved business performance.

Impacts of Google Cloud on business practice

The Information and Communications Technology (ICT) industry is transitioning from a model that heavily relied on on-premise infrastructure to a model based on Cloud. With on-premise infrastructure, companies owned their own servers and dedicated part of their teams and resources to maintaining them. Collaborative systems were traditionally based on private networks and local data storage, making businesses less efficient. These technologies required greater capital investments, which made it harder for SMEs to enter new markets and grow.

With Cloud, companies do not need to have proprietary infrastructure, and can enjoy transformative benefits relative to on-premise IT solutions. Cloud services offer opportunities to transform or enhance business practices, allowing businesses to perform the same activities more efficiently, reliably or flexibly, or even to engage in new activities that could not otherwise have been possible. While some of these opportunities reflect core characteristics of Cloud computing in general, including as a result of economies of scale that Cloud providers can achieve in providing Cloud services, in a number of areas the distinctive features of Google Cloud may give rise to specific benefits.

Organisations using Cloud effectively outsource aspects of IT infrastructure deployment and management to providers that, in many cases, have significant resources and expertise devoted to ensuring quality of service. Business practice may improve in areas such as efficiency, reliability and scalability. In these areas, Google Cloud's global scale, fibre backbone network and technical expertise may confer benefits to customers. For example, innovations such as a new congestion control algorithm developed for Google's own use, improving YouTube network throughput by 4% globally, have been made available to Google Cloud customers,[18] who also benefit from

Efficiency

Large public Cloud providers benefit from economies of scale in infrastructure deployment and management, to an extent that most organisations could not match individually.

Reliability

Large providers may also offer high degrees of redundancy (protection in any event of technical failure) and reliability for many use cases.

Scalability

If business needs change, Cloud services can scale rapidly, often automatically, without users having to invest in new fixed capital. This can support flexible business practices.

Velocity

Cloud services generally allow organisations to make faster changes to websites, applications and other IT services.

Google Cloud in particular, with its emphasis on 'containerisation' technology, can simplify the interactions between parts of an application and enable fast, seamless and frequent updates.

Data-driven insights

As organisations become increasingly data-driven, Cloud-based tools can provide ways to integrate data into applications, processes and decisions.

This is a key area of focus for Google Cloud, which offers different tools to cater for varying degrees of ability, potentially contributing to wider access to these technologies.

Ways of working

Cloud-based software for tasks such as email, data sharing or collaborative working can impact business practices at employee level and across organisations.

Previous studies indicate that Google's G Suite can help organisations modernize their ways of working, potentially enhancing collaboration through real-time access to shared resources, and supporting mobility, remote working and employee engagement

18. TechCrunch. 2017. "Google Cloud gets a new networking algorithm that boosts internet throughput" https://techcrunch.com/2017/07/20/google-cloud-gets-a-new-networking-algorithm-that-improves-internet-throughput/

Google's infrastructure investments such as the trans-Pacific undersea fibre cable.[19]

Organisations using PaaS services to build and host applications, or SaaS services for a variety of other business purposes, may experience additional enhancements to business practice across velocity, data-driven insights, and ways of working.

In combination, the above effects can create a working environment that supports business productivity and innovation, ultimately improving overall business performance.

Impacts of Cloud on business performance

Use of Cloud, including Google Cloud, may improve business performance by enabling:

Expanded revenue and profit

Including due to:

- **New or enhanced products and services enabled by Google Cloud; and/or**
- **Improvements in Customer Relationship Management (CRM).**

Reductions in costs

Including due to:

- **Lower capital expenditure from using Cloud rather than on-premise infrastructure; and/or**
- **Lower operating expenditure due to back office efficiencies.**

Businesses using Cloud incur costs in terms of expenditure on Cloud services and additional implementation costs, where these are required to support migration to the Cloud. Overall, analysis of data collected for this study indicates that Google Cloud typically contributes to improvements in productivity for the businesses that use it, by supporting revenue growth and cost reductions that exceed the costs associated with Google Cloud services. Specific areas of impact are explored below.

Product or service innovation

Cloud services are supporting the development of innovative products and services, whether this is by helping to launch new mobile or web applications, develop new types of Cloud-based software, or incorporate technology such as ML that is made more accessible by public Cloud services. The features of Cloud services have enabled an ecosystem of startups to develop around Cloud-centric business models, as well as helping larger organisations to develop new Cloud-based offerings for their customers, enabling innovations that range from mobile games and virtual assistants to e-commerce platforms and IoT solutions.

Cloud services have a number of characteristics that can support product or service innovation:

High-value work

Cloud can allow organisations to abstract away from issues such as managing data centres, servers, storage and networks. In this way, developers may be able to spend more time on creating value through new applications.

Latency and reliability

Cloud can help to democratize access to resources such as ML tools and advanced compute power, which can contribute to innovation.

Fostering experimentation

With pay-per-use pricing, Cloud provides ways for users to experiment with new ideas or apps at any scale, potentially reducing the need for upfront investments that may be prohibitively costly or risky for some businesses.

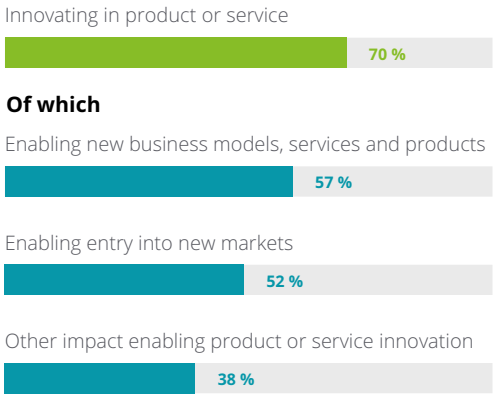
Scalability and velocity

The ability to instantly provision the resources required and to have these scale automatically in response to demand can accelerate the process of developing,

19. Blog Google Cloud Platform. 2016. "Google Cloud customers run at the speed of light with new FASTER undersea pipe" https://cloudplatform.googleblog.com/2016/06/Google-Cloud-customers-run-at-the-speed-of-light-with-new-FASTER-undersea-pipe.html

Through these effects, Cloud may enable new revenue streams for businesses, or even help new startups to emerge and grow with business models reliant on Cloud.

Figure 2: Percentage of public Cloud users using public Cloud to innovate in product or service



Source: the public Cloud business users survey; the green bar represents the proportion of the total survey sample that select at least one type of product or service innovation enabled by their use of Cloud. Respondents can select more than one type of product or service innovation. The blue bars illustrate the percentage of respondents selecting each sub-category, among those respondents who report at least one type of product or service innovation.

Google Cloud has specific characteristics that can support innovation. GCP's range of Big Data and ML tools contribute to expanding access to advanced technologies. Through products such as Kubernetes Engine, rolling updates to new apps can be made so innovations can continue to be rolled out while the service remains available to end-users.[20]

As a result of this range of capabilities, GCP as a whole was ranked as a "leader" in Public Cloud Development Platforms in a recent independent study.[21] Among the features noted by the study are Google Cloud's commitment to open source, its fully managed services, ML tools, transparent pay-as-you-go pricing and a wide partner ecosystem.

A variety of new services have been enabled by Google Cloud services in recent years; for example:

- A voice and text analysis service that organisations can use to optimize communications in contact centres.[22]
- A system for digitally tracking people and devices over large physical locations.[23]
- An AI virtual assistant that provides customers with marketing insights and advice.[24]
- A smart parking solution using more than 50,000 sensors to monitor parking in real time.[25]
- A mobile game featuring real-time translation of communications between up to 300,000 concurrent users per second.[26]
- A platform for retailers to build online grocery businesses.[27]

20. See for example https://cloud.google.com/kubernetes-engine/docs/tutorials/hello-app#step_8_deploy_a_new_version_of_your_app
21. Other 'leaders' identified by the study are AWS and Microsoft. Forrester. 2018. "The Forrester Wave: Full-Stack Public Development Platforms, North America, Q2 2018".
22. InteractiveTel, see: http://interactivetel.com/
23. Gennion Solutions, see http://www.gennion.com/en/
24. See iGenius case study
25. Smart Parking Limited, see https://www.smartparking.com/
26. Elex, see http://www.elex-tech.com/
27. See Ocado case study

Niantic (US) – Supporting innovation and growth in augmented reality games

Niantic is a California-based software development company, known for developing innovative Augmented Reality (AR) games which overlay digital images on real-world visuals. Its mobile game Pokemon Go, released in 2016, surpassed all expectations to exceed 500 million downloads worldwide by the end of the year, becoming by far the most popular AR app released to date. Pokemon Go relied on more than a dozen Google Cloud services to manage the newly launched product's rapid growth, while continuing to update and improve it for users.

Niantic used Cloud Datastore as the game's primary database, which quickly saw a rise in demand far exceeding expectations. Player traffic surged to levels 50 times higher than Niantic's target, and ten times higher than the anticipated 'worst case scenario'.

Not everything was smooth sailing at launch. When issues emerged around the game's stability, Niantic and Google engineers tackled each problem in sequence, working quickly to create and deploy solutions. Such rapid growth above expectations would have posed significant challenges with on-premise IT infrastructure and may have required major additional capital outlays, but Cloud Datastore allowed Niantics to automatically scale capacity and continue delivering the service to the growing user base.

Google Kubernetes in addition allowed Niantic to continue adapting as the game grew in popularity, enabling live changes being deployed to the game while minimising disruption to players.

iGenius (Italy) – Building new products with artificial intelligence technology

Headquartered in Italy and present also in the US, UK and Switzerland iGenius is an artificial intelligence company on a mission to simplify the relationship between people and business data. The company has used GCP tools to incorporate AI into innovative solutions for its customers.

In June 2016, iGenius developed 'crystal', described as the world's first virtual advisor for business data. At this stage registered users can ask crystal questions related to marketing activities, such as 'how is my website doing?' and crystal provides an immediate response based on the available data. The aim of crystal is to provide smart insights to businesses as quickly and intuitively as possible also in other data silos such as IoT, sales, CRM and operations, helping them to make more effective decisions. It now handles thousands of daily visitors worldwide.

To make business data literally talk with crystal, iGenius used Google Cloud's App Engine and its AI tools Translation API, Cloud Natural Language and Cloud Speech API. The decision to use Google Cloud was motivated by the fact that, as a startup, iGenius had limited IT resources and wished to maximize the amount of time its developers could work on creating products, rather than on tasks such as maintenance.

iGenius had previously used other Cloud services, but found them to be more expensive and time consuming. When they moved to GCP iGenius says it took them 30 days to develop a prototype and the Alpha version was then demonstrated and tested at an event in Cannes. According to the CEO and Founder of iGenius, Uljan Sharka, demonstrations of Crystal left people "speechless" and developing the service would not have been possible without GCP.

Among the specific advantages from using Google Cloud, iGenius has highlighted:

- Cost savings of around 50% with GCP relative to its previous Cloud solution.
- Ease of use of GCP services.
- Improved scalability of App Engine compared to some alternative platforms.

Enhanced Customer Relationship Management (CRM)

Digital technologies have become an important element of customer interactions in every sector and even for smaller businesses. For example, 77% of EU enterprises are now estimated to have a website.[28] At the same time, businesses generate increasing volumes of data through their customer-facing processes, but may lack the resources or expertise to use this data. Public Cloud services offer a range of ways to improve online marketing, customer interactions and user experience. Cloud-based tools may also be applied in offline contexts, for example to improve telephone customer service through automated processes or data-driven insights.

In these areas, organisations report they are most commonly using public Cloud services to improve customer communications, user experience and marketing effectiveness, as shown in Figure 3. This can lead to improved business performance in terms of increased revenues and profits from improvements in customer engagement, retention or satisfaction.

Google Cloud can support effective CRM by facilitating the storage, processing and analysis of marketing and customer-related data through tools such as BigQuery, Machine Learning Engine or Data Studio:[29]

Figure 3: Percentage of public Cloud users experiencing improvements in CRM

Source: the public Cloud business users survey; the green bar represents the proportion of the total survey sample that select at least one type of CRM improvement. Respondents can select more than one type of CRM improvements. The blue bars illustrate the percentage of respondents reporting each sub-category, among those respondents who report at least one type of CRM improvement

As a result of these capabilities, Google Cloud has been identified in an independent analysis as the leading provider of Insight PaaS.[30 - 31]

The range of opportunities for CRM improvements through Cloud-based tools is expanding over time. Services recently launched by Google Cloud include ML tools that allow Google users to:

- Develop conversational interfaces or 'chatbots' that can interact with end customers, potentially improving customer engagement and efficiency of customer services.
- Analyse communications with end customers through speech recognition or text analysis in order to prioritise urgent issues or identify areas for improvement in customer service.
- Personalise search results or recommendations provided to customers via online services, which has the potential to improve user experience and support sales.

Google BigQuery can ingest data automatically from va rious sources and provides a u ser interface for analyzing the data

Machine Learning Engine allows more advanced users to run predictive algorithms seeking further insights, such as identifying customer segments or clusters, predicting sales and using sentiment analysis to better understand customer response

Google Data Studio allows non-technical users to visualize data so that it can be shared and used throughout the business

28. Eurostat, based on enterprises with ten or more employees, excluding the financial sector.

29. For more details see Google Cloud. 2018. "Build a marketing data warehouse on Google Cloud Platform" https://cloud.google.com/solutions/marketing-data-warehouse-on-gcp

30. Forrester defines this as "An integrated set of data management, analytics, and insight application development and management components, offered as a platform the enterprise does not own or control".

31. The report highlights Google's comprehensive set of analytics and machine learning tools. It also suggests that Google Cloud's portfolio of services in this area and its billing process may be overly complex. Forrester. 2017. "The Forrester Wave™: Insight Platforms-As-A-Service, Q3 2017" https://cloud.google.com/forrester-wave-leader/

Manchester City Council – Delivering public services more efficiently

Manchester City Council is the local government authority for the city of Manchester in the North of England. Manchester City Council provides public services to 550,000 residents, including education, childcare, environmental and waste services. The Council employs over 7,000 staff.

Manchester is the UK's third largest city and Council staff are spread across 300 sites. Looking after over such a large community, MCC strive to support the whole city by delivering services and enhancing the experience their residents receive. Coordinating the delivery of public services and handling residents' queries, either responding to them or directing them to the correct part of the council, can be complex. Manchester City Council uses Google Cloud as part of its G Suite implementation to deliver operational efficiencies and financial savings with a more efficient ICT system that helps the Council be closer to residents and work more efficiently together with our partners.

The Council decided to transform the way that it worked and make the move to G Suite based on functionality, efficiency, flexibility and cost. As part of their initial strategy, Manchester City Council rolled out thousands of new smartphones, tablets and laptops to enable greater flexibility and mobile working. Their key focus was to provide their staff with the right tools that will allow them to work flexibly with cloud based apps; Gmail, Calendar, Sheets, Docs, Slides, Drive, Hangouts and Chat.

Moving to G Suite has delivered cost savings from lower software licence and hardware costs, as G Suite replaces the need for the Council's own servers.

Council staff now report working more efficiently and collaboratively thanks to G Suite features around document editing and sharing, mobile working, online meetings and videoconferencing. The migration to G Suite has also enabled staff time saving by reducing the need to travel, improving mobile working when this is necessary and reducing the time to deliver the work. Ultimately, this means that the Council is able to respond to the residents' queries quicker and deliver public services more efficiently. In addition, the change has reduced the amount of paper the Council uses for printing and the amount of space it needs for meetings.

Ingedata (France) – Improving client experience and productivity

Ingedata is a smart outsourcing agency that provides high value-added outsourcing services, predominantly to clients located in France. Since its launch in 2006, the company has grown to more than 500 employees and provides services in the fields of data management, machine learning, computer vision and technical design.

Ingedata has developed its own enterprise resource planning (ERP) solution, known as 'Rhymes', that includes activities such as processing clients tasks and client account management. By migrating its entire IT system to GCP, using a range of different GCP services, Ingedata has been able to implement a number of CRM improvements, including:

- Giving clients the option of directly placing orders via Ingedata's information system (200 requests every minute).
- Providing client dashboards and real-time progress updates on orders.
- Responding to client queries more quickly.

Ingedata believes these improvements would not have been possible without GCP. Key advantages include the velocity provided by Google Kubernetes Engine, allowing the company to react to client queries, prepare the solution to the client, and deliver in less than one day. More generally, using GCP has led to time savings for staff that have allowed them to focus on achieving improvements. Ingedata's IT teams have been able to release time away from maintenance tasks and dedicate it to developing Rhymes further.

Ingedata believes that these enhancements have improved the customer experience and ultimately contributed to overall business performance in terms of customer base and revenue growth.

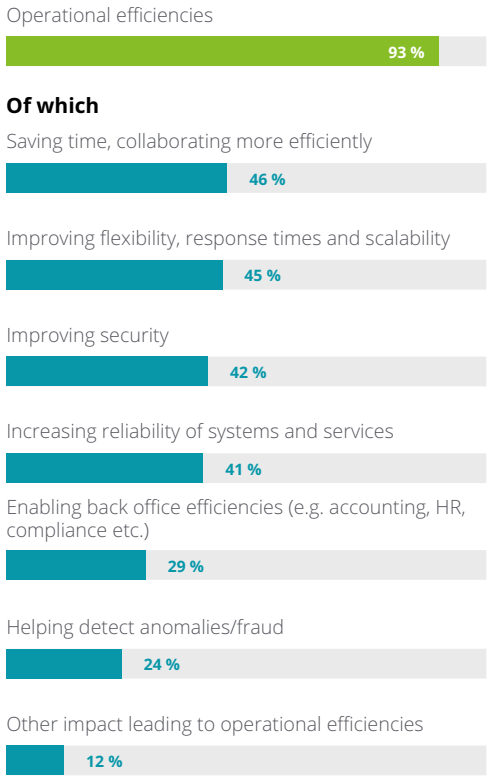
Operational efficiencies

Use of digital technologies has become integral to many companies' internal processes. Public Cloud services have the potential to generate operational efficiencies. Most commonly, business performance is improved through improved collaboration, flexibility, security and reliability, as shown in Figure 4.

Cloud services can directly impact businesses' IT operations. Previous research has indicated that each $1 spent on Cloud generates $0.52 in IT opex savings – for example through outsourcing of IT services and re-deployment of IT staff to more productive tasks – and $0.40 in power and cooling savings, in addition to other benefits.[32]

For example, independent research has found that Google Cloud's file sharing and storage application, Google Drive, offers features such as very large file handling, embedded OCR, automated sensitive data masking, and search/discovery.[33] Recent innovations include Team Drives for the management of departmental content and AI services including automated image tagging and an automatic Quick Access feature based on work patterns.

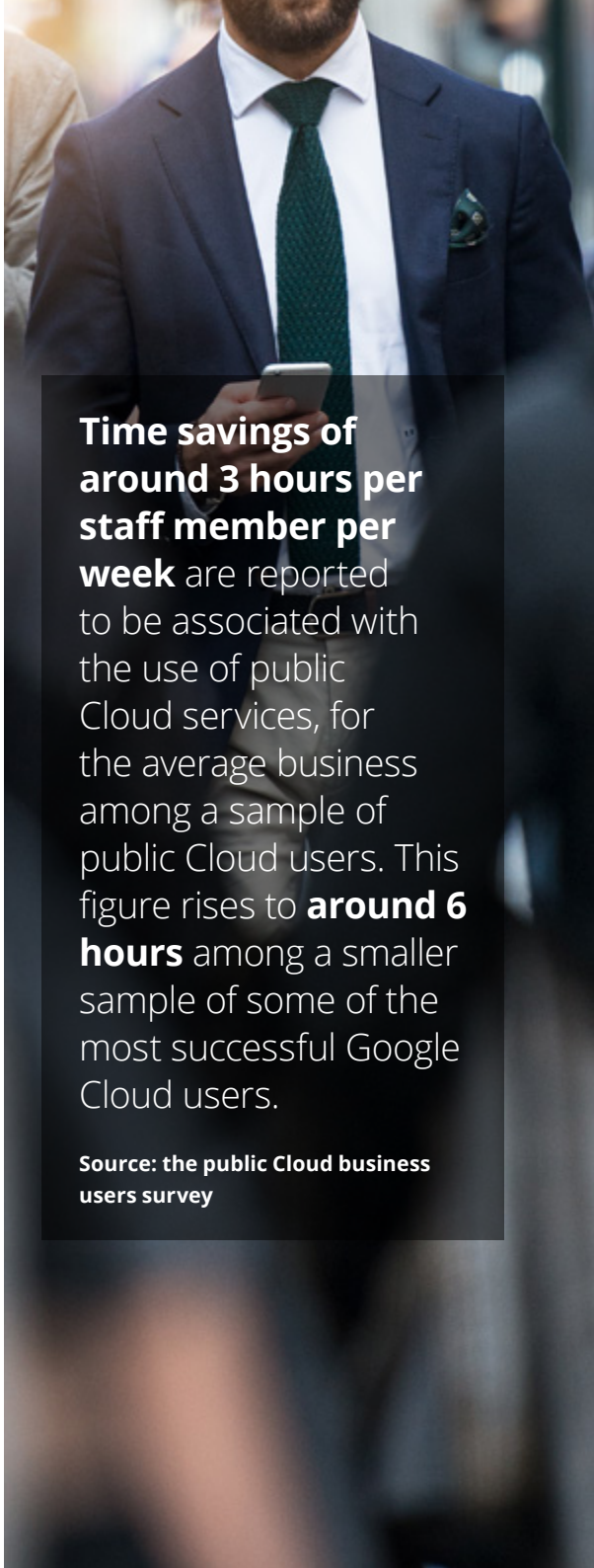
Figure 4: Percentage of public Cloud users experiencing operational efficiencies



Source: the public Cloud business users survey; the green bar represents the proportion of the total survey sample that select at least one type of operational efficiency. Respondents can select more than one type of operational efficiency. The blue bars illustrate the percentage of respondents selecting each sub-category, among those respondents who report at least one type of operational efficiency

Beyond IT operations, SaaS tools are increasingly enabling users to realise efficiency gains in other areas of the business. Google Cloud's productivity tools, branded as G Suite, can support a range of cost and time savings through mechanisms such as:

- Facilitating flexible and mobile working, so that workers in different sites are seamlessly able to work together.
- Enhancing communication and collaboration between employees, including through real-time access to shared documents and through video-conferencing.
- Reducing the need for travelling, making traditional telephone calls and printing documents, therefore reducing the costs associated with these activities.



Time savings of around 3 hours per staff member per week are reported to be associated with the use of public Cloud services, for the average business among a sample of public Cloud users. This figure rises to **around 6 hours** among a smaller sample of some of the most successful Google Cloud users.

Source: the public Cloud business users survey

32. Deloitte. 2016. "Measuring the economic impact of Cloud computing in Europe". Published by the European Commission. https://ec.europa.eu/digital-single-market/en/news/measuring-economic-impact-cloud-computing-europe .These figures are based on a 2010 study and may not capture the full scale of potential efficiencies that Cloud users can realise today, as Cloud services have evolved over time to create further opportunities for cost and time savings.

33. Forrester. 2017. "The Forrester Wave™: Enterprise File Sync And Share Platforms — Cloud Solutions, Q4 2017" https://www.forrester.com/report/The+Forrester+Wave+Enterprise+File+Sync+And+Share+Platforms+Cloud+Solutions+Q4+2017/-/E-RES140078

AVEVE Group (Belgium) – Improving business productivity across subsidiaries

AVEVE Group buys and sells farm products and materials. The Group employs more than 1,800 people across more than 50 businesses, from large factories to small enterprises. AVEVE has the largest chain of garden centres in Belgium, with more than 230 stores.

With so many companies operating independently under distinct administrative processes, AVEVE saw potential to improve communications between staff across its subsidiaries. It decided to roll out G Suite with the objective of improving productivity, as well as achieve savings on software licences and IT maintenance costs, with a platform where information and resources could be centralised and freely shared. The company estimated it could save €2 million every year with G Suite.

With the support of Google's partner, Fourcast, AVEVE was able to migrate 220 stores to G Suite over the course of two months, before rolling out G Suite tools to the rest of the group. By the end of 2018, AVEVE aims to have more than 90% of its employees solely based in the G Suite environment.

The benefits identified by AVEVE include:

- Staff access to shared resources from any location, at any time, through a web browser.
- Improved collaboration and connectivity between teams.
- Avoided travel between locations, with meetings and trainings taking place via video-conference using Google Hangouts.
- Outsourcing of IT maintenance, allowing the IT team to focus on business support.

Within six months, AVEVE reports it was able to observe an 8% gain in productivity across the group. AVEVE continues to work with its subsidiaries to identify additional G Suite cases that could contribute further gains, such as replacing extensive and time-consuming paperwork in its engagement with more than 60 grain warehouses.

ACDC Express (South Africa) – Supporting franchise growth

ACDC Express is South Africa's largest electrical retail franchise, with 29 stores nationwide. The company has seen rapid growth in the order of 28% per year, but this has increased the demands on ACDC Express's central IT administration and other support functions.

The company decided to implement G Suite in order to ensure that it could continue to support growth in the business, as well as reducing software licence overheads. Supported by a training programme over six months, all stores were migrated to Cloud.

The company saw improvements from using G Suite in the following areas:

- Email server downtime had become a frequent problem and was leading to lost revenue, with recovery times sometimes exceeding one or two days. With G Suite and the service level agreement of 99.9% uptime, the problem of email server downtime was addressed.
- Tools such as Google Hangouts and Google Drive have enabled rapid sharing of new ideas and improved procedures or systems across all stores. For example, individual businesses that do require help are contacted over Google Hangouts Meet to assess what they need, part of a culture of sharing expertise, which is key to help share knowledge rapidly.
- The central administration is estimated to have been able to achieve twice as much as it would have been able to without G Suite tools.

ACDC Express has also realised value from combining G Suite with use of other Google Cloud products. It has been able to obtain performance data from each franchise through Google Sheets and convert this to insightful visualizations using Data Studio, helping to identify any business performance issues that may need to be investigated.

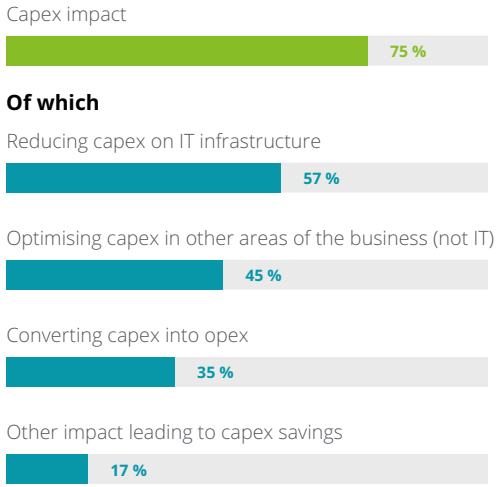
Capex savings

A fundamental characteristic of Cloud services is the ability of organisations to use computing tools and resources without owning and operating the underlying IT infrastructure. Specific pricing models differ by service and provider, but pay-as-you-go pricing without upfront fees is widespread for public Cloud services. Therefore, organisations using Cloud can pay for the exact volume of resources or services used on an ongoing basis, without needing to invest in sufficient IT infrastructure to cope with peak demand.

Previous research has indicated that, due to the elimination of server and storage costs, each $1 spent on Cloud may generate $1.08 in IT capex savings in addition to other benefits.[34]

As well as direct savings, there may be further impacts on business performance, including optimising capex in other areas of the business or converting capital expenditure into operational expenditure, reducing up front investments required particularly for small businesses.

Figure 4: Percentage of public Cloud users experiencing capex impacts



Source: the public Cloud business users survey; the green bar represents the proportion of the total survey sample that select at least one type CAPEX impact. Respondents can select more than one type of CAPEX impact. The blue bars illustrate the percentage of respondents selecting each sub-category, among those respondents who report at least one type of CAPEX impact

The reduction in capital expenditure requirements due to Cloud has been widely recognised as having wider benefits. The European Commission notes that it reduces barriers to entry, promoting business creation and competition.[35] The OECD notes that SMEs in particular can benefit from reduced capex requirements as they save on investment costs and have access to cutting edge technology.[36]

In this way, the capex savings from Cloud support and reinforce innovation impacts and the emergence of successful startups. Research for the European Commission estimates that 300,000 new businesses could be created in Europe from 2015 to 2020 through the development and deployment of Cloud computing.[37]

34. Deloitte. 2016. "Measuring the economic impact of Cloud computing in Europe". Published by the European Commission. https://ec.europa.eu/digital-single-market/en/news/measuring-economic-impact-cloud-computing-europe .These figures are based on a 2010 study and may not capture the full scale of potential efficiencies that Cloud users can realise today, as Cloud services have evolved over time to create further opportunities for cost and time savings.

35. European Commission. 2013. "Net-Cloud future" http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=4440.

36. OECD. 2014. "Cloud computing: the concept, impacts and the role of government policy" https://read.oecd-ilibrary.org/science-and-technology/cloud-computing-the-concept-impacts-and-the-role-of-government-policy_5jxzf4lcc7f5-en

37. Deloitte. 2016. "Measuring the economic impact of Cloud computing in Europe". Published by the European Commission https://ec.europa.eu/digital-single-market/en/news/measuring-economic-impact-cloud-computing-europe

The Cloud Gate (Spain) – Reducing start up costs

The Cloud Gate is a Spanish startup that develops internet and mobile applications. It has created 'nubbius', a software offering for lawyers to manage cases, contacts, appointments, documents and expenses.

From its inception, the company was conscious of the fact that IT infrastructure expenses and maintenance could interfere with their ability to focus on building high-quality, cost-effective services for lawyers. The team opted to use Google Cloud's App Engine to develop nubbius.

Ignacio Zafra, founder of The Cloud Gate, believes that without App Engine the company would have had to raise money for infrastructure. Dealing with infrastructure expenses and maintaining machines would have detracted from their goal, which was to offer a high-quality, cost-effective service for lawyers. He estimates that the platform has resulted in savings of more than $130,000 per year, consisting of avoided capital outlays on servers as well as associated maintenance costs.

The company was able to launch nubbius in 2011 and seamlessly integrate it with G Suite applications. Other benefits have been noted by the company in terms of a lack of downtime for users, as well as the ease of scaling the service as demand increases or making changes in response to user feedback.

HUDORA (Germany) – Enhancing productivity and lowering costs

HUDORA is a German manufacturer and wholesaler of sporting goods.

The company identified an opportunity to create a more flexible Enterprise Resource Planning (ERP) system, but wanted to avoid additional expenses and complexity as far as possible. HUDORA decided to use Google Cloud's App Engine to build and host the new ERP software. Maximillian Dornseif, co-owner of the company, states that this approach allowed the team to focus on quickly building, without devoting resources to infrastructure issues.

Since HUDORA began using App Engine, the number of on-premise servers has been reduced from 25 to six. Hardware and operating cost savings are estimated as $80,000 per year.

Other benefits have been noted by the company:

- HUDORA's developers are able to update the ERP software twice a week using App Engine, whereas on the previous system some updates took months to deploy.
- App Engine makes it easier to schedule shipments more efficiently, contributing to shipping cost reductions of up to 40% in some cases.
- Having a more flexible ERP system increased company's efficiency and helped lower costs. For example prior to using Google Cloud's App Engine employees couldn't change orders once they had been entered into the existing in-house system, which led to time-consuming workarounds that now are avoided.

Approach to ROI estimation

ROI calculations are based on data from a survey of 1488 businesses using public Cloud services, which includes reported expenditure on Cloud and impacts from Cloud during the most recent financial year.[38]

For each business, ROI from using pubic Cloud services is estimated as:

$$ROI = \frac{Return\text{-}Investment}{Investment}$$

- 'Return' captures productivity benefits arising from a combination of cost savings and revenue growth associated with public Cloud services, relative to a counterfactual where the business does not use any public Cloud services, but may use on-premise or private Cloud alternatives instead.

- 'Investment' captures spend on public Cloud services, plus additional implementation costs incurred in adopting Cloud (e.g. training, change management, professional service fees).

To quantify the ROI that is realised on average, the mean ROI across the sample is used and expressed as a range, based on sensitivities applied to the calculations.

For more details on the methodology used, see Appendix 2.

Quantifying impacts of Google Cloud on business performance

The different impacts outlined above result in improved productivity for businesses, through a combination of additional revenue and cost reductions associated with the use of Google Cloud. The magnitude of this impact is estimated through a Return On Investment (ROI) measure.

Based on the approach to ROI estimation, it is estimated that businesses on average experience a net return in the range of 100% to 250% on their investment in public Cloud services. This means that, **on average, businesses using public Cloud services report a net return in the order of $1 to $2.50 for every $1 invested in using public Cloud services** in the last financial year.

While this range captures the average values reported by businesses, ROIs appear to vary above and below this range for some businesses. This is likely to reflect a number of factors, including differences in the extent of Cloud use, the types of Cloud services used and the diversity of potential use cases. As the range of services used expands or implementation costs are amortised or depreciated, the returns experienced may change over time.

Among a smaller sample of some of the most successful Google Cloud users, average net returns are reported in the order of $10 for every $1 invested in using Google Cloud services.[39] This provides an indication of the magnitude of impact achievable by organisations that successfully incorporate Google Cloud services as a key enabler of core business processes, products, or business models.

38. The ROIs values are based on a subset of businesses from the total sample that were able to report sufficient financial information for an ROI value to be estimated.

39. This is based on the same approach described above, but applied to a smaller sample of 80 particularly successful businesses using Google Cloud, focusing specifically on the returns from investment in Google Cloud services.

Approach to estimation of aggregate productivity impacts

In each country or group of countries, aggregate productivity impacts are estimated as:

Total investment on Google Cloud services x Indicative ROI range

Total Google investment spend in each country is estimated based on multiple third-party estimates of total public Cloud spend, third-party estimates of Google Cloud's market share, and survey information on additional implementation costs, cross-referenced against previous studies.

The ROI range is based on survey data for businesses using public Cloud services.[40] In each country, the ROI is adjusted for differences in survey responses and profitability rates between countries.

For more details on the methodology used, see Appendix 2.

Quantifying aggregate productivity impacts of Google Cloud

The estimated returns realised by individual businesses can be used to estimate aggregate productivity impacts across all businesses that use Google Cloud.

Across the 14 markets studied in this report, the size of aggregate productivity impacts varies by country based on factors including the size of the country, the extent of digitalisation in the economy, the rate of Cloud adoption and the size of the overall Cloud market.

In the US – by far the largest Cloud market globally – Google Cloud is associated with the largest aggregate productivity impact in the United States, estimated in the order of **$3 billion to $9 billion** in 2017.

In other large Cloud markets – UK, Japan and Germany - Google Cloud is associated with an estimate aggregate productivity impact in the order of **$300 million to $1.2 billion** per country.

Across the Nordics, France, Benelux, Italy, Israel and Spain, Google Cloud is associated with an estimate aggregate productivity impact in the order of **$100 million to $600 million** per country or group of countries.

Finally, across relatively small Cloud markets – South Africa, Saudi Arabia, Turkey and UAE – Google Cloud is associated with an estimate aggregate productivity impact in the order of **$10 million to $70 million** per country.

Country	Estimated aggregate productivity impact (2017)	Estimated impact per $1m of Gross Domestic Product (2016 GDP data)
United States	$3,000m - $9,300m	$160 - $500
United Kingdom	$420m - $1,160m	$160 - $440
Japan	$380m - $1,220m	$80 - $250
Germany	$330m - $1,120m	$90 - $320
Nordics	$180m - $470m	$130 - $330
France	$170m - $610m	$70 - $250
Benelux	$140m - $470m	$110 - $360
Italy	$100m - $340m	$50 - $180
Israel	$70m - $220m	$220 - $690
Spain	$60m - $200m	$50 - $160
South Africa	$20m - $65m	$70 - $240
United Arab Emirates	$10m - $40m	$30 - $110
Saudi Arabia	$10m - $35m	$20 - $50
Turkey	$10m - $30m	$10 - $30

Source: Deloitte analysis, World Bank GDP data (Current US $). Figures are rounded. For details on the methodology see Appendix 2. For details on the Cloud adoption measure see Appendix 1 - country summaries.

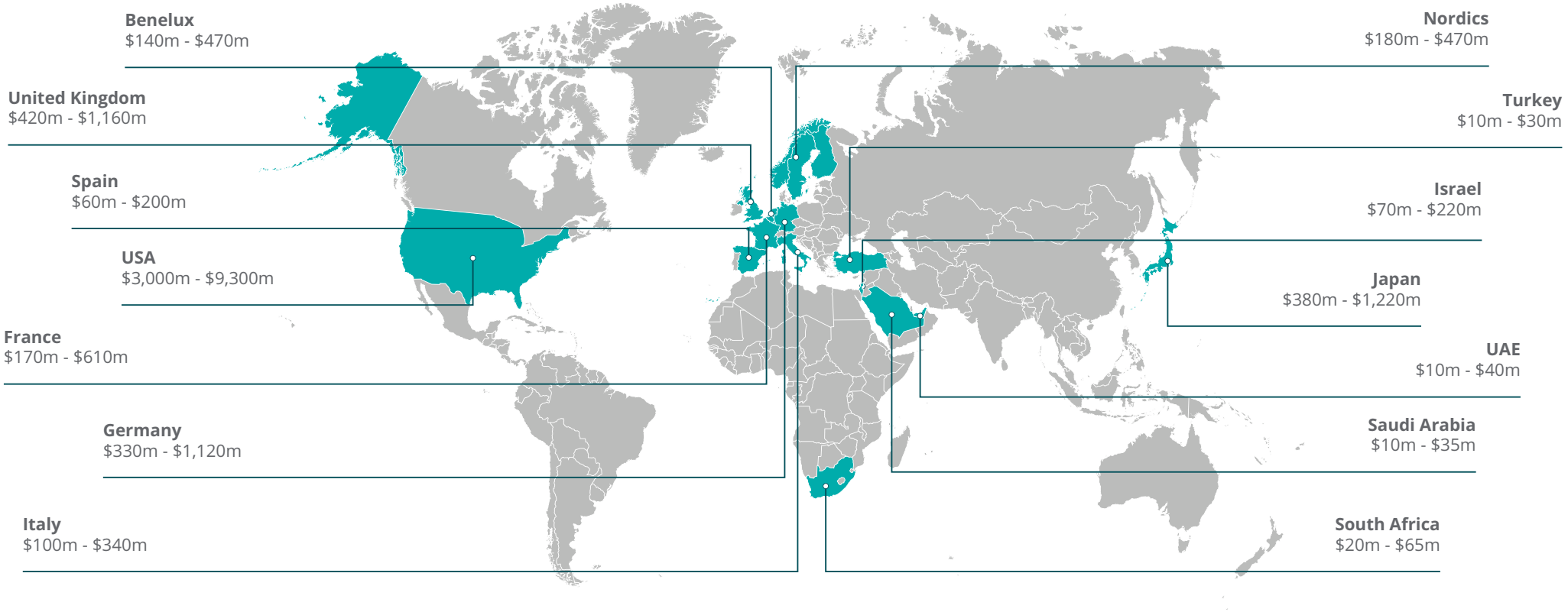
40. Analysis indicates that this is an appropriate proxy for the ROI associated with Google Cloud services specifically, as reported business-level productivity impacts from users of Google Cloud services are typically in line with impacts from other comparable providers, with no evidence to suggest that impacts from using Google Cloud are systematically lower. For more detail see Appendix 2.

The aggregate impacts being estimated can be described as 'gross impacts'. This means that:

- The impact being estimated is relative to a counterfactual where no public Cloud services are used, but where businesses may use on-premise or private Cloud solutions instead. The methodology does not consider as part of the quantitative estimation the impact that use of Google Cloud has relative to other providers of public Cloud services that could have been adopted in Google's absence, hence this approach considers the value that Google 'supports'.
- The methodology only considers impacts on Google Cloud users and therefore does not measure to what extent any advantage enjoyed by these users may divert activity away from non-users.

Equally, if Google Cloud contributes to lower barriers to entry and increased competition, this may lead to other economic benefits, such as consumer benefits from lower price levels or increased choice, which are not considered by the methodology.

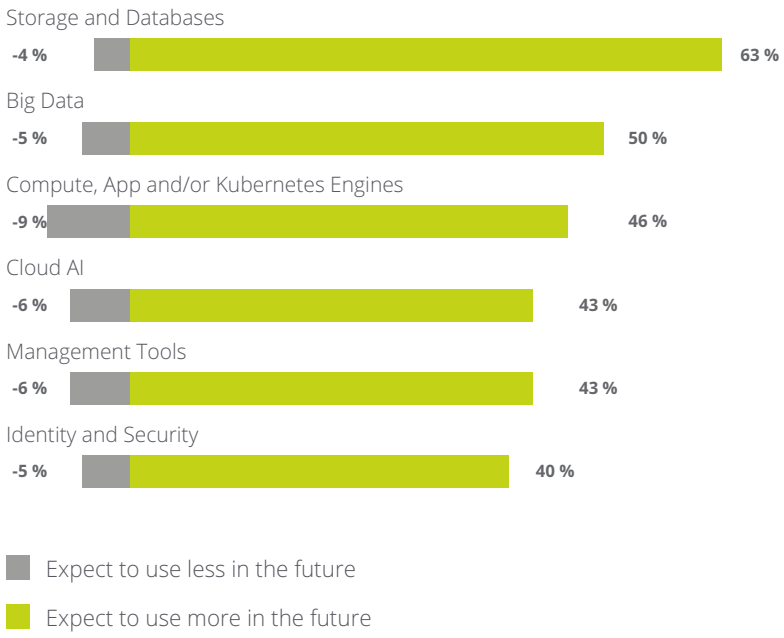
Figure 6: Estimated aggregate productivity impacts of Google Cloud



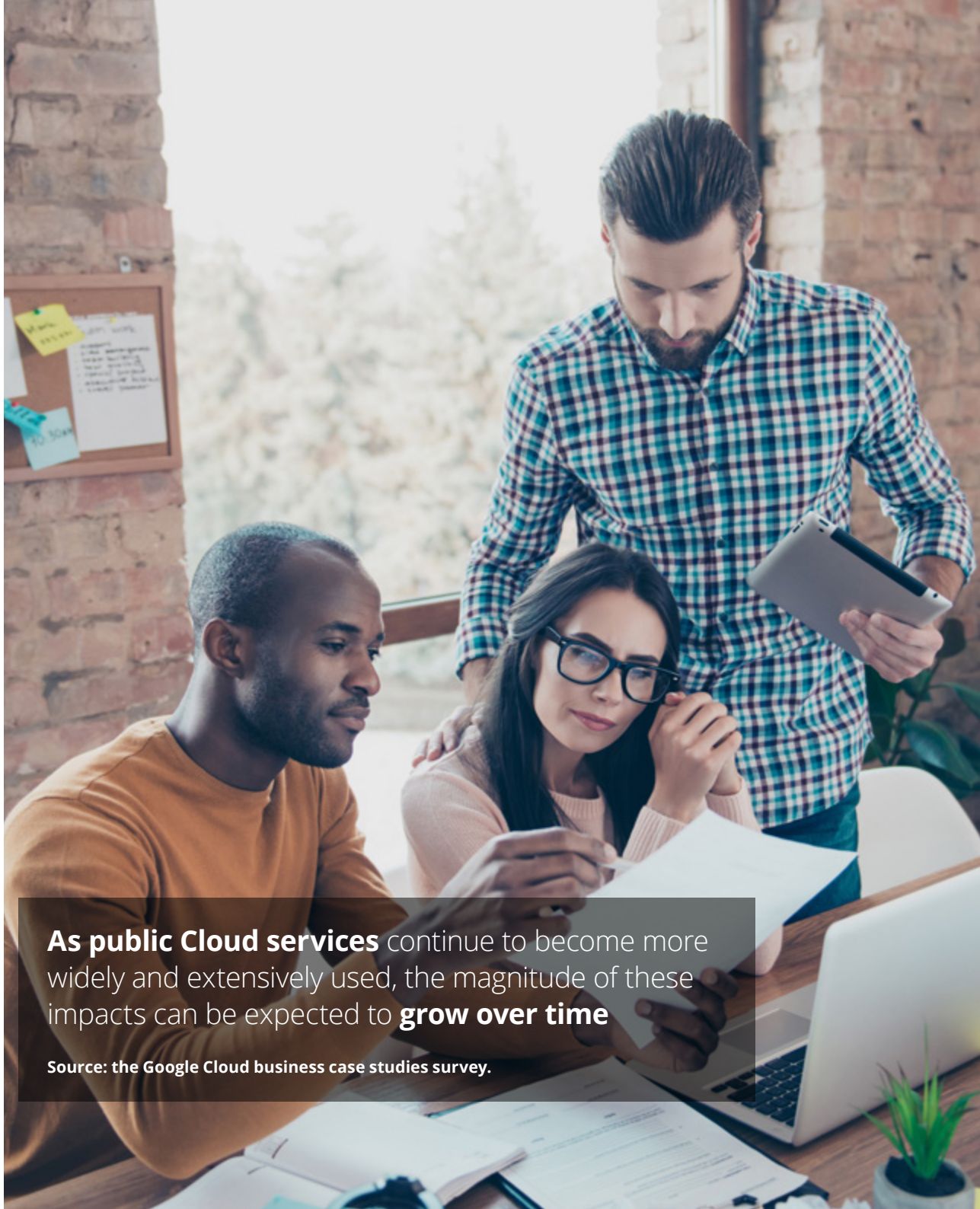
Source: Deloitte analysis. For details on the methodology see Appendix 2.

As public Cloud services continue to become more widely and extensively used, the magnitude of these impacts can be expected to grow over time. One industry forecast predicts that global public Cloud spend will grow at 22% CAGR to 2020. Consistent with this, survey data indicates a propensity for Google Cloud users to increase their use of Google Cloud services in future, particularly for innovative services such as Big Data and AI tools whose potential benefits are likely to not yet have been fully realised by many organisations.

Figure 7: Expectations of future use of Google Cloud services



Source: the Google Cloud business case studies survey.
The proportion of respondents answering "About the same as now" is excluded from this chart



Social and other impacts

Beyond business benefits, Cloud services are being used to support social impacts, helping to improve patient outcomes in healthcare and educational results for students. Cloud services may also support the reduction of carbon emissions when compared against on-premise solutions.

Healthcare

Digital technology has a variety of potentially transformative applications in the healthcare sector. From biosensors and robotics to 3D printing and AI, technology can create new opportunities throughout the value chain, from scientific research through to healthcare delivery.

Globally, healthcare currently appears to lag other industries in applying technology and data analytics to daily activities, but the focus on these areas is intensifying; for example, global hospital expenditures on analytics are anticipated to reach USD $18.7 billion by 2020, up from USD $5.8 billion in 2015, as hospitals focus on quality and cost reduction.[41]

The digitisation of health records, combined with new data sources such as biosensors, means that healthcare providers have access to very large datasets from which to attain valuable insights, but often face difficulties in doing so effectively and securely.

As healthcare data can be particularly sensitive, there are often heightened privacy and security concerns in the sector. A survey of healthcare stakeholders found that for almost 50% of organisations, digital health tools are not more widely embraced due to security and privacy concerns.[42] With the right safeguards in place, Cloud computing could play a role in facilitating data sharing between medical professionals and accelerating the analysis and use of data, while preserving the security of sensitive data.

Organisations such as the UK's National Health Service have published guidance stating that healthcare organisations "can safely locate health and care data, including confidential patient information, in the public Cloud". The guidance notes that the significant investments public Cloud providers make in their infrastructure "can mitigate many common risks NHS and social care organisations often face", but recommends that organisations take a risk-based approach when deciding whether to use public Cloud services, including by ensuring that the right skills, cultural understanding and behaviours are in place among staff.[43]

Google Cloud Initiatives

Google has developed specific products to address the needs of the healthcare community.

Google Genomics is a service based on Google Cloud Platform but tailored to the needs of bioinformatics scientists, programmers and researchers, allowing them easier access to relevant Cloud-based tools. The Google Genomics API uses open standards set by the Global Alliance for Genomics and Health – of which Google has been an active member – and allows secure collaboration between researchers.[44] Google has released further open source tools, such as Variant Transforms, for the analysis of genomics data.[45]

41. Deloitte. 2018. "https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-hc-outlook-2018.pdf"

42. Change Healthcare. 2018. "https://www.changehealthcare.com/blog/wp-content/uploads/change_healthcare_industry_pulse_report_2018.pdf".

43. NHS Digital. "https://digital.nhs.uk/binaries/content/assets/legacy/pdf/3/q/guidance_on_nhs_and_social_care_use_of_public_cloud_services1.pdf"

44. Google Cloud Platform. "https://cloud.google.com/genomics/resources/google-genomics-whitepaper.pdf"

45. Blog Google Cloud Big data and machine learning. 2018. https://cloud.google.com/blog/products/gcp/how-color-uses-the-new-variant-transforms-tool-for-breakthrough-clinical-data-science-with-bigquery "

More recently, Google Cloud's **Healthcare API** is being rolled out to address interoperability issues in the sector and allow healthcare providers to bring together different data types, such as clinical and administrative data, electronic health data and imaging data[46], on a single platform[47].

Aside from tailored products for the healthcare community, Google has been working to make its products **compliant with the Health Insurance Portability and Accountability Act** (HIPAA), helping US customers to meet security and compliance requirements related to sensitive healthcare data while taking advantage of the capabilities and features offered by Google Cloud. As well as G Suite, there are now 27 Google Cloud Platform services that are HIPAA-compliant.

The impact of Google Cloud

Some of the impacts from using Cloud products in the healthcare sector are analogous to the impacts seen elsewhere, such as cost and time savings, and more productive and flexible ways of working. In other cases, Cloud drives enhancements and innovations in healthcare delivery that show some potential to feed through to patient outcomes in terms of better diagnosis and treatment, though many of these initiatives are still at a nascent stage.

Cost and time savings

The scalability offered by Google Cloud Platform has brought savings to some users, including by significantly reducing the cost and time required to carry out complex tasks.

The Broad Institute of MIT and Harvard

One of the largest genomic sequencing centres, reports it has reduced its processing and analysis costs from around $45 per genome to around $5 since adopting Google Cloud Platform.[48]

DNAstack

A genomics technology company, uses BigQuery for complex searches of large genomics datasets, achieving 4-second turnaround times compared to tens of seconds or even minutes previously.[49]

Alacris

A German company involved in cancer drug development, adopted Google Cloud in order to run its highly complex modelling system, which simulates the potential impacts of different drugs on cancer patients. Using Google Cloud enabled Alacris "to rapidly refine and improve our modeling system, which has become about 10x faster than using the Alacris' computer cluster".[50]

More productive and flexible ways of working

Cloud offers opportunities for a variety of medical professionals and support staff to work together using shared information and common systems. The importance of interoperability of digital systems for healthcare providers is recognised in the literature.[51] Productivity tools can help healthcare professionals to collaborate, while moving patient data to the Cloud may help ensure relevant professionals in different locations can access key information.

The Ministry of Health

In Chile created a national API-based architecture built on Google Cloud's Apigee, addressing interoperability challenges to help professionals across the national healthcare ecosystem access patient information throughout the care cycle. According to the Ministry, the platform also delivered reductions in costs, delays and duplication, as well as providing patients themselves better access to their own data.[52]

The Roche Group

A multinational healthcare company, adopted G Suite to address interoperability issues with multiple email and calendaring platforms, moving to a single common platform for all employees. It reports that this has enabled better collaboration and facilitated home or mobile working. In combination, these benefits help employees focus their time on patient outcomes, according to the company.

46. Including HL7, FHIR and DICOM
47. Google Cloud. 2018. "https://www.blog.google/products/google-cloud/google-cloud-healthcare-new-apis-customers-partners-and-security-updates/"
48. Google Cloud. 2018. "In our genes: How Google Cloud helps the Broad Institute slash the cost of research" https://www.blog.google/products/google-cloud/our-genes-how-google-cloud-helps-broad-institute-slash-cost-research/
49. Google Cloud Platform. "Genomic data is going Google. Ask bigger biological questions" https://cloud.google.com/genomics/resources/google-genomics-whitepaper.pdf
50. Blog Google Cloud Platform. 2015. "Alacris helps better match cancer patients with drug therapies using Google Cloud Platform" https://cloudplatform.googleblog.com/2015/01/alacris-helps-better-match-cancer-patients-with-drug-therapies-using-Google-Cloud-Platform.html
51. Monitor Deloitte. 2015. "Digital Health in the UK. An industry study for the Office of the Life Science" Deloitte. 2015. "Accelerating the adoption of connected health" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/461479/BIS-15-544-digital-health-in-the-uk-an-industry-study-for-the-Office-of-Life-Sciences.pdf
52. Google Cloud. 2017. "Transforming Chile's health sector with connectivity" https://www.blog.google/products/google-cloud/transforming-chiles-health-sector-connectivity/

Improving patient outcomes

Cloud can also be a contributing factor to improving patient outcomes, for example by supporting research efforts, enhancing preventive care, improving the accuracy of diagnoses or supporting healthcare delivery. In many cases these effects result from the savings or ways of working discussed above, where these are enabling physicians or researchers to improve the care offered to patients.

MSNNG

Autism Speaks and Google have collaborated to create MSNNG, the world's largest genome resource for autism research. Built on Google Cloud, it is supporting the research community and ultimately individuals and families affected by autism by:

- Expanding access and supporting collaboration: The information held on a common platform is made available for free to researchers around the world along with analytics tools, with more than 90 researchers at 40 academic and medical institutions using the data. Google has supported researchers by offering "innovative new ways to look at datasets".[53]

- Enabling new discoveries and improved patient outcomes: By providing advanced storage and computation and promoting collaboration, the platform facilitates autism research that is leading to new discoveries expected to help develop more effective, personalized treatments.[54]

Allcyte

Allcyte uses thousands of microscopic images from blood cancer patients to "very quickly predict the clinical effectiveness of large libraries of drug treatments", helping physicians choose adequate courses of treatment. Google Cloud has provided the scalability and computing power to enable the rapid screening of more than 150 billion blood cells in total.[55]

Innovation

In other cases, Cloud is supporting innovation, with entirely new services, insights and approaches developed by third parties to improve processes and patient outcomes. A key area to illustrate this is in imaging, where AI and ML tools are increasingly being used to create new opportunities for diagnosis of serious diseases. These tools can also be used in other contexts to derive new insights from text or speech data. There is significant potential though many of these innovations are in a nascent state and therefore quantitative evidence of benefits remains limited. New initiatives using Cloud to analyse healthcare data in order to provide new insights are being developed by major global providers, such as Change Healthcare,[56] and academic research confirms the potential of algorithm-based solutions, for example to identify potential heart risks from retina photos.[57]

NextPlane

Patient Safety Organisation (PSO_ platform, built on Google Cloud, is used by more than 700 US healthcare ogranisations. The platform collects a wealth of information and reports related to patient safety . NextPlane is using Google Cloud's ML tools for automated analysis of natural language and speech to create structured data and streamline data entry and search processes. These capabilities allow NextPlane to focus on solving healthcare problems to increase patient safety, with more than one million patient safety stories collected to date.[58]

Zebra Medical Vision

An AI start-up in Israel, is offering a set of algorithms via Google Cloud for use in medical scanning. The software, run on Google Cloud's ML Engine, can detect issues such as liver and lung disease and provide findings in real time. Google Cloud makes the software widely accessible, and scans are available at $1 each.

Maxwell MRI

Similarly, Maxwell MRI has used ML to analyse hundreds of thousands of prostate cancer cases to improve diagnosis. The platform is delivering scan results to physicians within 10-15 minutes, compared to a usual delay of two days or more.

53. Google Cloud Case Study: Autism Speaks. Available from: https://cloud.google.com/customers/autism-speaks/
54. Autism Speaks. 2017. "world's largest autism genome database shines new light on many "autisms" https://www.autismspeaks.org/science/science-news/world%E2%80%99s-largest-autism-genome-database-shines-new-light-many-%E2%80%98autisms%E2%80%99
55. Google Cloud Case Study: Allcyte. Available from : https://cloud.google.com/customers/allcyte/
56. Blog Google. 2017. "Google Cloud at RSNA: engaging with the medical imaging community https://www.blog.google/products/google-cloud/google-cloud-rsna-engaging-medical-imaging-community/
57. Business Insider UK. 2018. "Google has developed a way to predict your risk of a heart attack just by scanning your eye" https://www.businessinsider.com/google-verily-predicts-cardiovascular-disease-with-eye-scans-2018-2
58. Nextplane Solutions, see: https://www.nextplanesolutions.com/pso

Education

The use of ICT in education has become commonplace: it can allow students to learn in different and flexible ways with access to a wealth of materials and resources; educators can use ICT to make their teaching more effective and efficient; gaining experience of using ICT tools may help to prepare students for their future careers. The potential transformative impact of ICT in education is highlighted by the United Nations, which is helping countries to understand how ICT can be leveraged in achieving the Sustainable Development Goal 4 (ensure inclusive and quality education for all and promote lifelong learning).[59]

Within education, Cloud is becoming increasingly prominent. Cloud is providing the education sector with tools that can increase efficiency and creativity within the classroom and outside of it.

Google Cloud Initiatives

Google Cloud provides **G Suite For Education,**[60] the G Suite service tailored to educational institutions, free of charge. Some schools purchase Chromebooks[61] (laptops that run Google's Chrome Operating System and use Google Cloud to store and load content) to support the use of G Suite For Education.

There are currently 80 million users of G Suite for Education globally.[62] Outside of the education sector, commercial licences for this number of users would have an associated cost of at least USD 4.8 billion per year.[63]

In response to feedback from educational institutions, Google is also planning to release G Suite Enterprise for Education. This paid service will incorporate additional features including voice/video conferencing and enhanced security features.[64]

Separately, Google offers **GCP Education Grants**[65] in the form of free Cloud Credits allowing students and teachers to access and explore tools on GCP. This is mainly aimed at computer science programmes, with grants provided to around 40,000 teachers and faculties at more than 500 institutions across 30 countries.

Other Google Cloud initiatives are providing specialised tools for educational uses. For example:

- **Kaggle**[66] is a platform that allows users to learn data science techniques and encourages them to compete by producing the best models for predicting and describing datasets. Kaggle joined Google Cloud in early 2018[67] and has more than 1 million users.[68]
- **Google Open Online Education**[69] is a tool for educators to develop tailored online courses on GCP. Courses created include Citizen Maths,[70] a free online course for people to improve their mathematics ability for use in everyday life.

59. UNESCO, see: https://en.unesco.org/themes/ict-education
60. Google for Education, see: https://edu.google.com
61. Google for Education, see: https://edu.google.com/k-12-solutions/chromebooks/
62. Blog Google. 2018. "Tools for every school: G Suite for Education updated" https://www.blog.google/outreach-initiatives/education/tools-every-school-g-suite-education-updates/
63. This calculation is based on the monthly price per user of G Suite Basic. The amount may not represent the value of G Suite for Education to educational institutions.
64. Blog Google. 2018. "Tools for every school: G Suite for Education updated" https://www.blog.google/outreach-initiatives/education/tools-every-school-g-suite-education-updates/
65. Google for Education, see: https://cloud.google.com/edu/
66. Kaggle Inc., see: https://www.kaggle.com/
67. The Official Blog of Kaggle.com. 2017. "Kaggle joins Google Cloud" http://blog.kaggle.com/2017/03/08/kaggle-joins-google-cloud/
68. The Official Blog of Kaggle.com. 2017. "Your year on Kaggle: Most memorable community stats from 2017" http://blog.kaggle.com/2017/12/26/your-year-on-kaggle-most-memorable-community-stats-from-2017/
69. Google for Education, see: https://edu.google.com/openonline/index.html
70. Citizens Maths, see: https://www.citizenmaths.com/

The impact of Google Cloud

Cloud services are used by different educational institutions and organizations: schools; Higher Education institutions; and third parties who offer educational services or apps supported by Google Cloud.

Schools

NEW WAYS OF LEARNING

In schools, the use of G Suite for Education can support new ways of teaching and learning. Educational apps can be loaded onto devices from Google Cloud and Google Drive, allowing students and staff to access documents online from any location or device. The Classroom tool enables teachers to manage lesson plans, material and student assignments more efficiently, including through instant feedback. In combination, the suite of services can contribute to efficiency, personalized teaching and collaboration.

Productivity tools and the opportunities they offer, such as instant feedback, may also enhance student engagement and performance. As with other ICTs in general, benefits may *"depend on the way in which the teacher selects and organises ICT resources, and how this use is integrated into other activities in the classroom and beyond".*[71]

At Tring School in the UK, Chromebooks have been introduced and all students are using G Suite for Education. Students and teachers have reported positive impacts in terms of increased student engagement and accountability to teachers. From a teacher perspective, G Suite has helped to better monitor students, gauge their progress and engagement, and direct them to specific resources accordingly. From a student perspective, G Suite allows them to receive real-time feedback in complete privacy.

These benefits appear to have supported stronger student performance. One student reported that "the increased feedback and interaction with teachers improved my marks. Before G Suite for Education, we never had this level of detail or ability to ask specific questions back within the work."[72] Overall, though other factors may have affected student performance, after the introduction of Chromebooks and G Suite 21% more students performed above their expected level in science classes and 20% more students reached an average level of performance.

In Sweden, Sollentuna Municipality has been at the forefront of digitalisation in schools and opened up G Suite for Education to all students and staff members across its 30 schools. Among other benefits, the use of Google for Education enabled the development of the 'Integrated Write to Read' method, which lets early years students use computers to develop literacy skills in a collaborative environment. The method has been found to result in reading and writing improvements in the order of 20%, also reducing the gap between low and high performers.[73] It is now being extended to other age groups and municipalities as the 'Write to learn' method.[74]

The appropriate application of ICT in a collaborative environment was found to be closely linked to outcomes. In one of the studies, a control group using technology individually (without integrated social interaction and formative feedback) performed worse than a separate 'traditional' control group with no ICT, suggesting that ICT "must be well integrated into the pedagogy to be useful".[75]

71. Becta. 2003. "ICT and pedagogy. A review of the research literature" http://mirandanet.ac.uk/wp-content/uploads/2016/04/ict_pedagogy.pdf
72. Google for Education. "Tring school" https://www.blog.google/outreach-initiatives/education/how-tring-school-creates-culture-student-sharing-improves-classroom-results/
73. Science Direct. 2013. "Improving literacy skills through learning reading by writing: the iWTR method presented and tested" https://www.sciencedirect.com/science/article/pii/S0360131513000857 and Science Direct. 2016. "Closing the gaps – Improving literacy and mathematics by ict-enhanced collaboration" https://www.sciencedirect.com/science/article/pii/S0360131516300859
74. Örebro University. 2017. Write to learn – using ICT to improve learning in early ages https://www.oru.se/english/research/research-projects/rp/?rdb=p1695
75. Science Direct. 2016. "Closing the gaps – Improving literacy and mathematics by ict-enhance collaboration" https://www.sciencedirect.com/science/article/pii/S0360131516300859

Schools

COST SAVINGS

G Suite for Education can also be a source of cost savings, since it is provided as a free service to educational institutions, saving schools money on buying software licences and access to content. Where G Suite is rolled out effectively, it may provide further productivity gains.

Academies Enterprise Trust

The Academies Enterprise Trust (AET) in the UK is the largest multi-academy sponsor in the UK and supports around 75 schools. In the short term, AET reports it experienced savings of £33,000 on web developer and hosting fees. However, long-term savings are projected to be far greater, from cost reductions on licensing, power consumption, server hardware and maintenance. They have estimated total savings at £7.7 million over five years.[76]

Oak Hills Local Schools District

Oak Hills Local Schools District, in Cincinnati, US, has rolled out G Suite across nine schools. By switching to these products, available for free, the district reports it has achieved savings of over $100,000 per year by removing the need for software licences and a support server.[77]

SPARK Schools

In South Africa, SPARK Schools implemented G Suite for Education, migrating all files to Google Drive and introducing Chromebooks in learning labs. With this Cloud-based model, SPARK only required one technical support personnel, as opposed to eight staff that would be required under a conventional model. Between these savings and those achieved by using Chromebooks rather than other devices, SPARK projected combined annual savings of $111,500.

76. Google for Education. 2015. "Academies Enterprise Trust leads the way for UK academies with Google Apps" https://static.googleusercontent.com/media/edu.google.com/es/pdfs/case-studies/aet-case-study.pdf

77. Google for Education. 2017. "Oak hills local school district" https://www.ohlsd.us/media/documents/OakHillsImpactPortrait.pdf

Higher Education

In Higher Education, institutions have adopted productivity tools to pursue similar benefits as those observed in schools, including cost savings and new ways of learning and teaching. For example, the University of Minnesota expected annual savings of $2-3 million from moving to G Suite, replacing multiple tools with a single cohesive and flexible system.[78]

Aside from G Suite, the use of GCP is more prevalent in Higher Education than in schools, offering access to advanced computing resources and tools on a pay-per-use basis – or for free where Cloud Credits are used.

ENHANCED STUDENT SUPPORT

Institutions may be able to provide enhanced student support, analogously to businesses in other sectors who use Cloud tools to improve customer service and relationship management. In particular, AI tools are beginning to be deployed for this purpose and hold potential for wider use in the future.

Strayer University

Strayer University focuses on education and re-skilling programmes for those in full-time work, with more than 80% of students taking at least one online class. Given that most students learn in their own time, providing responsive and quality student support has been a challenge.

GCP

Using GCP and Google's Dialogflow, a virtual assistant named 'Irving' was developed that could not only answer students' questions and support them in real-time, but that could improve from repeated interactions through ML. Feedback from students has also been positive.[79]

ACCESS TO ADVANCED RESOURCES AND TOOLS

For specific faculties within Higher Education institutions, Cloud provides access to advanced resources and tools for computing, data science, engineering and related disciplines. Students and researchers are making use of the flexibility, scalability, processing power and variety of tools offered by GCP, with Big Query and Compute Engine among the most popular GCP products. GCP is currently used by around a third of the 100 top institutions for computer science.

Illustrating the potential offered by these resources, in 2017 an MIT math professor created the largest-known high-performance computing cluster ever run on public Cloud, reaching 580,000 cores.[80] The flexibility of GCP can help make computer science resources accessible for students and enable academics solve problems faster, spending more time on newer or more complex problems.

San Jose State University adopted GCP in the face of limited virtual machine capacity. University staff used GCP to develop CodeCheck, a web-based program with customizable programming exercises for students. Using this program, students are able to work at home without any constraints from the University's server capacity and they receive instant feedback. The system appears to have enhanced student performance: students using CodeCheck are reported to have scored between 20% and 50% higher on tests than a control group.[81]

At Northeastern University, researchers used GCP to model the spread of the Zika virus. Using virtual machines, more than 10 million simulations were run and analysed, using processes that took hours rather than weeks previously. The analysis contributed to the understanding of the outbreak, providing a template for future analysis of epidemics.[82]

78. Google for Education. "University of Minnesota deploys G Suite – with an expected annual saving of between $2 – 3 million" https://edu.google.com/latest-news/stories/university-of-minnesota/?modal_active=none

79. Google for Education. "Using machine learning to transform online education and improve student outcomes" https://edu.google.com/intl/en_uk/latest-news/stories/strayer-university-gcp/?modal_active=none

80. Google for Education. "MIT professor pushes computing limits with the largest cluster ever built in the public cloud" https://edu.google.com/intl/en_in/latest-news/stories/mit-gpc/?modal_active=none

81. Google for Education. "San José State University supports students to teach themselves programming basics" https://edu.google.com/latest-news/stories/sjsu-gcp/?modal_active=none

82. Google for Education. "Researchers at Northeastern use Google Cloud Platform to model Zika's spread" Researchers at Northeastern use Google Cloud Platform to model Zika's spread

Innovative third-party educational apps and services

Outside of traditional institutions, Cloud has supported innovative third-party educational apps and services. These can act as a useful complement to traditional education services, or they may make some educational resource accessible to those who are less likely to obtain it through traditional channels, providing remote on-demand access to content and resources.

Khan Academy

Khan Academy is a non-profit organization whose stated mission is to provide a free world-class education to anyone, anywhere. Khan Academy uses Google App Engine to easily house its expanding collection of 2,000-plus videos, addressing server and maintenance issues. This allows Khan's five developers to focus on products for end-users, which number more than 3.8 million per month.[83]

In the UK, Ocado Technology – part of a large retail organization – has developed Code for Life as a non-profit initiative providing free, open-source games to help students learn computing. The platform is built on Google Cloud and has reached more than 100,000 registered users.

83. Google Cloud Case Study: Khan Academy. Available from: https://cloud.google.com/customers/khan-academy/

Other impacts - Environment

ICT can have both positive and negative impacts on the environment. The production, transportation and operation of ICT equipment itself, including cloud-computing infrastructure, may require substantial energy consumption. The US Department of Energy's Berkeley Lab estimates that in the US, data centres have consumed 70 billion kWh or around 1.8% of total electricity consumption in the country in 2014.[84] Cloud computing is at the core of technological advancement as an enabler of application development, advanced data processing and storage. The demand for Cloud computing is therefore accelerating.

However, Cloud entails lower energy consumption than on-premise solutions due to energy efficiency gains related to the data centres' scale. By centralising computing requirements, resources are better coordinated and spread over the infrastructure required, with higher utilization rates and reduced idle time. The US Department of Energy's Berkeley Lab has identified Cloud as a key driver of energy efficiencies, noting that "*the growing trend of Cloud computing has resulted in significantly larger data centres that are more efficient, both in terms of server utilization and infrastructure power usage effectiveness (PUE), compared to traditional enterprise data centres*".[85]

Cloud is also becoming more efficient over time. In view of the increasing service demand, Cloud service providers and the ICT sector more widely are making efforts to increase energy efficiency and 'go green'.

The same research by the Berkeley Lab describes that electricity consumption from US data centres has remained relatively steady "*while simultaneously meeting a drastic increase in demand for data center services*", thanks in part to energy efficiency improvements in the industry. In fact, the research estimates that the electricity consumption of data centres in the US from 2010-2014 increased by around 4%, which is significantly lower than the 24% increase estimated for the 2005-2010 period, or 90% from 2000-2005.[86]

Google Cloud's environmental contribution

Google Cloud contributes to environmental sustainability through:

- Energy efficiency. As described above Cloud data centres consume less energy than on premise alternatives. According to Google its data centres are more efficient than the industry average data centre.[87] This is complemented by Google's environmental initiatives (see below).

- Google's commitment to carbon neutrality. All of Google's data centres and offices match 100% of their energy consumption with renewable energy.[88] The emissions associated with Google Cloud are offset through Google's purchases of renewable energy and carbon neutrality efforts

Greenpeace has highlighted Google Cloud's contribution to environmental sustainability, awarding Google an 'A' rating in its Clean Energy Index of ICT companies. Greenpeace notes Google has taken "several significant steps forward since our last report toward a renewably powered Google Cloud".[89]

Google has taken forward other initiatives to support the environment. For example:

- In 2016, Google jointly developed an Artificial Intelligence system to optimize its data centres' energy use. At facilities where it has been implemented, this system has so far produced an average of 30% reduction in overall energy use for cooling.[90]

- Google uses remanufactured machines in its data centres, built from a combination of reused, repaired and new server components. In 2017, remanufactured machines accounted for 18% of the total newly deployed servers.[91]

84. Shehabi et al., Ernest Orland Lawrence. Berkeley National Laboratory. 2016. "United States Data Center Energy Usage Report". Available from: http://eta-publications.lbl.gov/sites/default/files/lbnl-1005775_v2.pdf

85. Shehabi et al., Ernest Orland Lawrence. Berkeley National Laboratory. 2016. "United States Data Center Energy Usage Report".

86. Shehabi et al., Ernest Orland Lawrence. Berkeley National Laboratory. 2016. "United States Data Center Energy Usage Report".

87. Google. 2018. "Environmental report" https://storage.googleapis.com/gweb-sustainability.appspot.com/pdf/Google_2018-Environmental-Report.pdf

88. Google. 2018. "Environmental report" https://storage.googleapis.com/gweb-sustainability.appspot.com/pdf/Google_2018-Environmental-Report.pdf

89. Greenpeace. 2017. "Clicking clean: Who is winning the race to build a green internet?" Available from: https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/20170110_greenpeace_clicking_clean.pdf

90. Google, see: https://www.blog.google/inside-google/infrastructure/safety-first-ai-autonomous-data-center-cooling-and-industrial-control/

91. Google. 2018. "Environmental report" https://storage.googleapis.com/gweb-sustainability.appspot.com/pdf/Google_2018-Environmental-Report.pdf

Barriers to Cloud adoption and use

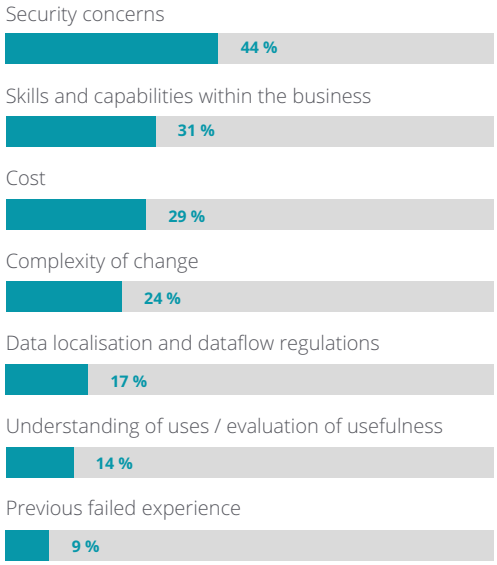
Despite the benefits of Cloud, barriers to adoption still exist, including limited awareness of its benefits and its security features, skills and capabilities, and barriers related to the cross-border flow of data.

Organisations may face various barriers to adopting Cloud services. Even among businesses that already use at least one type of public Cloud services, there are several barriers reportedly preventing more extensive use of Cloud services, with data security concerns being the most prevalent. These barriers may be higher among those businesses that have not yet adopted any form of Cloud computing.

As a result, businesses and countries forego productivity benefits and competitive advantage.

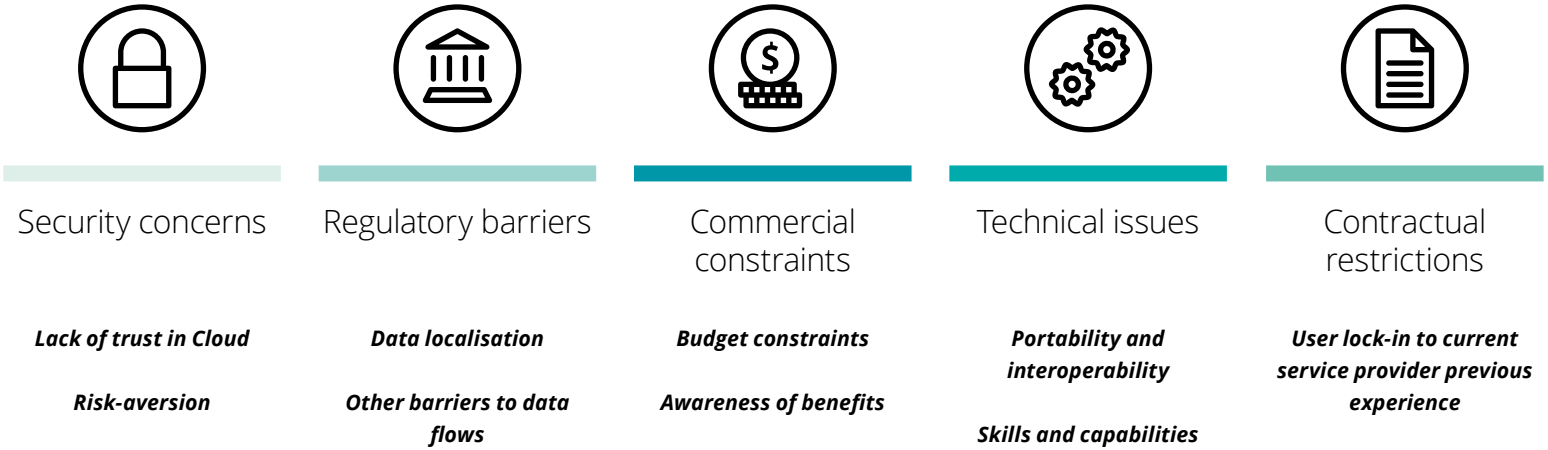
Based on survey evidence, interviews and desk-research, the types of barriers experienced by some organisations are classed as follows.

Figure 8: Barriers to further use of Cloud (among public Cloud users)



Source: the public Cloud business users survey

Figure 9: Taxonomy of key barriers to Cloud adoption and use



Source: Deloitte based on research of various sources including the public Cloud business users survey and pubic references reported throughout this section

Security concerns. For some organisations, security concerns are driven by the perception that outsourcing data storage or processing to a third-party inherently entails some risk of compromising security, control and access.[92] Though perceptions are changing over time, and use of Cloud is gaining wider acceptance and legitimacy, security concerns remain a barrier mentioned by 44% of businesses that already use some Cloud services.

This barrier may be exacerbated if organisations lack clear awareness and understanding of data security capabilities offered by Cloud providers, or if they are unable to distinguish providers that offer high standards of security.

Regulatory barriers often arise in terms of restrictions on where data may be stored, processed or transferred; if such restrictions are disproportionate or unwarranted, they may act as a barrier to use of Cloud and may also reinforce commercial barriers, if users are unable to purchase cheaper Cloud-based services across borders.[93]

Restrictions may result from data protection laws, trade agreements or procurement rules. They vary in form and can involve outright prohibitions on transfers of data outside national borders, requirements to hold local copies of data, or requirements to process data locally. The scope of such restrictions may be limited to certain types of data, such as information related to national security, personal information, or regulated industries. Even where no outright restrictions exist, conditional regimes may involve a significant regulatory burden for organisations wishing to store or process data outside of national borders.

17% of Cloud users surveyed for this study report experiencing data localization regulations as a barrier to Cloud use, while more broadly a 2014 survey by Eurostat found that uncertainty about applicable law, jurisdiction and dispute resolution mechanisms was a barrier for 46% of large businesses and 29% of small and medium businesses.[94]

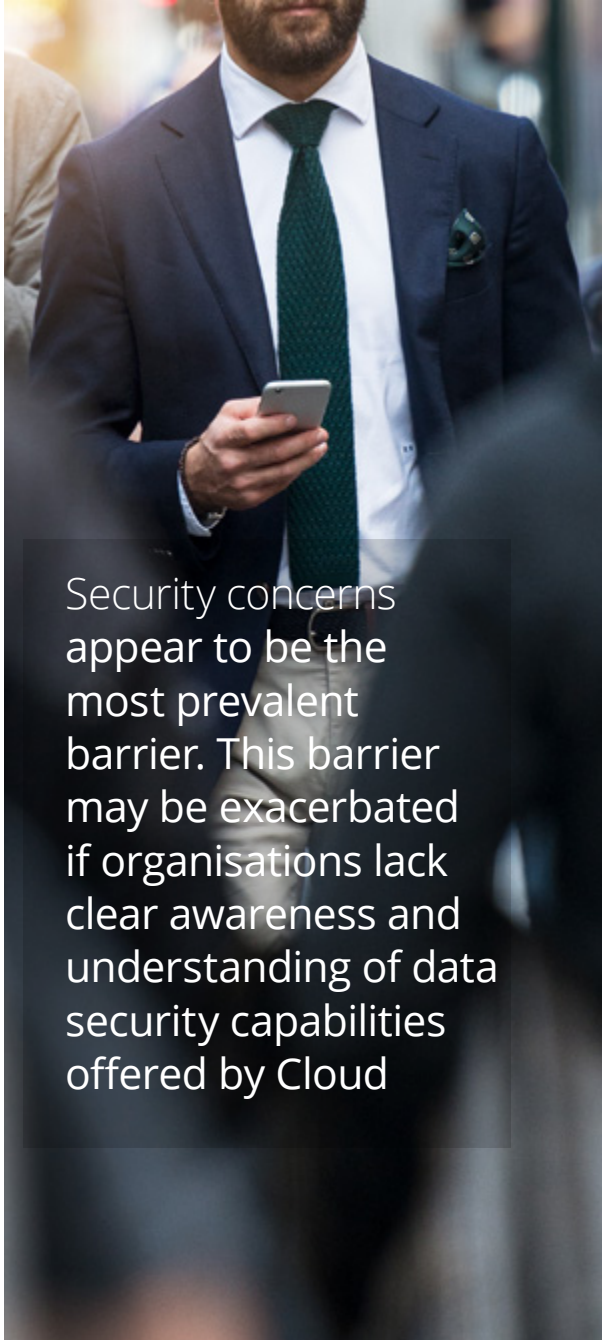
Commercial barriers for Cloud adoption exist, as may be the case for digital transformation projects in general. Some businesses or public bodies lack funds to invest in migration to Cloud, even if benefits would outweigh costs in the medium or long term. 29% of businesses that use public Cloud services noted cost as a barrier for more extensive use of Cloud.

A lack of awareness and understanding of Cloud may exacerbate this issue, if it leads decision-makers to underestimate the potential financial benefits. 14% of businesses that use public Cloud services reported that understanding potential uses and benefits was a barrier to further use of Cloud; this share might be higher among organisations that have yet to adopt any Cloud service.

Technical barriers may affect the ability to use Cloud services, particularly when this requires transferring data or applications and achieving interoperability between different systems. Where common standards and interfaces are not used, these issues may be complex from a technical perspective and may require specialist skills and expertise. 24% of Cloud users surveyed for this study mentioned complexity of change as a barrier to further use of Cloud and 31% highlighted skills and capabilities within the business.

Contractual barriers can lead to users being 'locked in' to a Cloud provider and unable to transfer data or applications to a new provider. This risks creating an uneven playing field and may prevent organisations from adopting multi-Cloud solutions and using a wider range of services. In 2014, around a third of large businesses and a quarter of small and medium businesses reported difficulties in unsubscribing or changing services provider, according to Eurostat.[95] Legacy IT contracts may also delay or hinder migration to the Cloud.

Given the prevalence of data security concerns, the issue of data security in the Cloud and security features of Cloud are examined in more detail below.



92. Deloitte. 2014. "How to ensure control and security when moving to SaaS/Cloud applications".How to ensure control and security when moving to SaaS/Cloud applications

93. Leviathan Security Group. 2015. "Quantifying the cost of forced location" Quantifying the cost of forced location

94. Eurostat Statistics Explained. 2017. "File: Factors limiting enterprises from using cloud computing services, by size class, EU – 28, 2014 (% enterprises using the cloud). png" https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Factors_limiting_enterprises_from_using_cloud_computing_services,_by_size_class,_EU-28,_2014_(%25_enterprises_using_the_cloud).png&oldid=322938

95. Eurostat Statistics Explained. 2017. "File: Factors limiting enterprises from using cloud computing services, by size class, EU – 28, 2014 (% enterprises using the cloud). png" https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Factors_limiting_enterprises_from_using_cloud_computing_services,_by_size_class,_EU-28,_2014_(%25_enterprises_using_the_cloud).png&oldid=322938

Data security in the Cloud

The prominence of data security concerns as a barrier to Cloud adoption reflects the importance of online security in today's economy, with the majority of the world's data now being transferred or stored digitally. High-profile breaches can cause damage to businesses, governments and individuals. The Ponemon Institute estimates that the average cost of a data breach in 2017 was $3.62 million and involved around 24,000 individual records, based on interviews with over 400 predominantly large companies that experienced breaches.[96]

There may be perceptions that on-premise solutions provide users with greater control and the ability to specify additional, bespoke security measures, or that consolidating vast volumes of data from different sources in a public Cloud creates a large point of failure.[97] Some organisations may also be inherently wary of outsourcing vital business functions to a third party.

However, some features of Cloud can lead to enhanced security. Large public Cloud providers have access to extensive and expert resources, and benefit from economies of scale, whereby investments in security can be recovered across a broader customer base. They also have a strong incentive to make such investments, as a breach would have major commercial and reputational repercussions

Through a combination of access to resources, economies of scale and incentive effects, public Cloud providers may therefore offer a level of security that customers may find harder to achieve by operating their own physical infrastructure. Gartner estimates that businesses using Public Cloud IaaS capabilities will experience 60% fewer breaches by 2020 than those using traditional data centres.[98] Perceptions appear to be shifting accordingly, with 67% of IT leaders in businesses citing direct experience with Cloud versus on-premise security as a primary reason for increased confidence in Cloud security, according to a study by MIT Sloan Management Review.[99]

The potential data security advantages of using certified, high-quality public Cloud services include the following areas:

- **Data encryption.** Cloud providers may be able to offer superior data encryption techniques than individual organisations could otherwise achieve, complementing these with additional features. An example is the technique of "sharding", where each data file is broken up into chunks, encrypted and stored in different locations, meaning that even in the event of a breach in one location, the data overall remains secure.

- **Authentication.** Public Cloud services can offer a diverse range of authentication methods including 2-step authentication for normal users and physical security keys for critical or vulnerable users.

- **Control and flexibility.** Even though users of public Cloud services do not own and operate the underlying infrastructure, depending on the services chosen they can still use a range of controls to configure bespoke access and security settings.

- **Physical security.** Large Cloud providers may have the resources to achieve high levels of security at the location of individual data centres, compared to the physical security that individual organisations may provide for their own premises.

- **Innovation.** Given the resources and incentives mentioned above, public Cloud providers are well placed to develop new ways to mitigate risks, taking advantage of new technologies, as well as responding to novel threats as they emerge.

- **Automatic processes.** When organisations deploy and manage proprietary IT infrastructure, there may be security risks related to human error, for example due to not checking that all user passwords are sufficiently secure, or not installing new software updates and security patches. In many cases, such processes can be automated by public Cloud services, potentially mitigating these risks.

- **Division of labour.** To the extent that the public Cloud provider focuses on technical aspects of data security (such as encryption methods) it allows customer organisations to specialize on other areas (such as human security).

96. Ponemon Institute. 2017. "2017 Cost of data breach study". https://public.dhe.ibm.com/common/ssi/ecm/se/en/sel03130wwen/security-ibm-security-services-se-research-report-sel03130wwen-20180122.pdf

97. Deloitte. 2014. "How to ensure control and security when moving to SaaS/Cloud applications". https://www2.deloitte.com/lu/en/pages/technology/articles/how-to-ensure-control-and-security-when-moving-to-saas-cloud-applications.html

98. Gartner. 2017. "Cloud strategy leadership". http://www.gartner.com/imagesrv/books/cloud/cloud_strategy_leadership.pdf

99. MIT SMR Custom Studio. 2017. "Survey report: behind the growing confidence in Cloud security". https://lp.google-mkto.com/rs/248-TPC-286/images/SMR Google Cloud Security Survey Report, Final Approved Version, 9.8.17.pdf

Features of Google Cloud related to data security

Google's global scale and technical expertise have given rise to specific features of Google Cloud that contribute towards keeping data secure.

Global network: Google Cloud operates on Google's backbone network, which is one of the largest fibre networks in the world.[100] This minimises the extent to which customer data transits on the public internet, where the likelihood of data interception may be higher. Moreover, using proprietary infrastructure entails full control over security design and can facilitate fast responses to risks identified.

Innovation: Google has developed new technologies and systems related to data security, such as BeyondCorp, a new enterprise security model, to allow its own employees to work remotely without needing to use a Virtual Private Network (VPN), which can be time-consuming and can affect network performance. This technology is now available to GCP customers through products such as Cloud Identity-Aware Proxy.[101]

Google also developed the system known as Kubernetes, which has since been made available on an open-source basis. Kubernetes allows rapid deployment of software changes and patches without downtime, so that any vulnerabilities identified can quickly be addressed.

Other tools recently launched by Google Cloud provide new ways for users to manage security risks, such as the Data Loss Prevention API, which can automatically discover and redact sensitive data, and Cloud Armor, designed to defend against Distributed Denial of Service (DDoS) attacks.[102]

Data encryption: Since 2013, Google Cloud encrypts all customer data by default, without any action required from the customer,[103] regardless of whether the data is at rest, being used in a database or being transferred. Research suggests only a minority of Cloud providers may consistently encrypt all data at rest as well as in transit.[104]

Physical security: Google has invested in securing its data centres using electronic access cards, alarms, vehicle access barriers, perimeter fencing, metal detectors, biometrics, laser beam intrusion detection and cameras. Only approved employees with specific roles may enter; fewer than one percent of Google employees ever step foot in a Google data centres.[105]

Customer support: In addition to the above tools, Google Cloud offers support to customers in meeting security objectives, for example with dedicated teams to answer data protection enquiries and offers model clauses for contracts to meet data protection requirements.

100. Google Cloud, see https://cloud.google.com/security/infrastructure/

101. Blog Google Cloud Platform. 2017. "Cloud Identity-Aware Proxy: Protect application access on the Cloud".

102. Blog Google Cloud Platform. 2017. "Introducing new ways to protect and control your GCP services and data". https://cloudplatform.googleblog.com/2018/03/introducing-new-ways-to-protect-and-control-your-GCP-services-and-data.html

Even where public Cloud services can offer enhanced security, several key aspects of security in the Cloud typically remain dependent on end users. Where data breaches do take place in the Cloud, industry forecasts predict that 95% of Cloud security failures through 2020 will be attributable to customers rather than providers.[106]

As set out in the UK's National Cyber Security Centre's Cloud Security Principles,[107] Cloud users face a number of key responsibilities in ensuring that they use Cloud services securely, including:

- understanding the security features offered by the chosen public Cloud provider and ensuring these meet requirements;
- configuring security settings appropriately;
- supporting personnel security by screening personnel and providing security training;
- supporting operational security by monitoring, identifying vulnerabilities and responding to incidents; and
- choosing adequate identity and authentication controls.

As such, awareness and action in relation to these issues among organisations that use public Cloud services can play a critical role in mitigating the risk of human error leading to breaches.

103. Blog Google Cloud Platform. 2017. "Google Cloud Storage now provides server-side encryption". https://cloudplatform.googleblog.com/2013/08/google-cloud-storage-now-provides.html

104. McAfee, see https://www.skyhighnetworks.com/cloud-security-blog/only-9-4-of-cloud-providers-are-encrypting-data-at-rest/

105. Google Cloud, see https://cloud.google.com/security/infrastructure/

106. Gartner. 2016. "Why Cloud security is everyone's business". https://www.gartner.com/smarterwithgartner/why-cloud-security-is-everyones-business/

107. NCSC, see https://www.ncsc.gov.uk/guidance/implementing-cloud-security-principles

Policy actions to support Cloud adoption

Policymakers can boost their economies by undertaking measures to address the remaining barriers to Cloud use. This study proposes a list of actions for policymakers to foster Cloud adoption.

The barriers identified in the previous section delay or prevent Cloud adoption for many organisations that could benefit from use of Cloud. This means businesses and countries forego opportunities to gain competitive advantage, as well as the associated economic benefits. Policymakers can boost their economies by undertaking measures to address these barriers, working alongside industry.

Through the study of best practices in a number of jurisdictions, as well as interviews and surveys, this study proposes a policymakers playbook in order to foster Cloud adoption. The playbook comprises action across developing a national Cloud strategy, reviewing existing requirements to store data in the country, building awareness of Cloud benefits and applications, and helping develop standards to facilitate interoperability between Cloud services.

While industry is playing a role together with policymakers in raising awareness of the benefits and security features of Cloud, and in helping develop standards and portability, areas like data localization barriers and the development of national Cloud strategies require policymakers' leadership.

Supranational institutions such as the European Commission are developing measures to tackle barriers related to data localization, interoperability and standards.

National policymakers can support and accelerate these processes, as well as develop measures to support adoption among smaller as well as larger businesses; and promote the development of digital skills, connectivity, open data and R&D.

National policymakers should analyze residual barriers in each policy area and shape policy in line with best practices in Figure 1. The appendix provides a description of the state of policy for each country.

The rest of this section describes key policy actions in each of the policymakers' playbook areas, and provides examples of policies implemented in some countries.

Public sector leadership through a national Cloud strategy

A number of national Governments have taken steps to promote Cloud adoption in the public sector directly to achieve cost savings or innovation in public service delivery. Aside from promoting adoption specifically within the public sector, such steps can help to support Cloud adoption more widely, through the public sector leading by example. The OECD observes that governments can influence the diffusion of innovation as lead users of new technologies[108],including as lead users of Cloud computing to spur wider use.[109] Public bodies are expected to follow high standards in relation to security and compliance, so their use of Cloud may help to build trust also within the private sector and give legitimacy to Cloud use.

For the public sector to lead by example and give adequate consideration to Cloud services in public procurement decisions, policymakers can implement a Cloud First approach that encourages administrations to consider Cloud before other solutions.[110] Effective Cloud First policies are often accompanied by supporting measures. Examples of recognised best practices in this area include:[111]

- Adopting common frameworks and marketplaces for procurement of Cloud services, with a governance structure in place.
- Developing standardised rules, processes and contracts for all public bodies to use.
- Carrying out activities to raise engagement and awareness among public sector stakeholders, to change mind sets and address cultural barriers.
- Establishing tools to set and monitor cost saving targets from Cloud adoption.

The US and UK have both developed Cloud First policies to encourage Cloud adoption in the public sector. In addition, the UK has recently simplified the security classification of public sector data, with 3 levels of data (Official, Secret and Top Secret), with different protocols for storing the data depending on the security level.

In countries such as Germany and the Netherlands, public sector Cloud initiatives have focused on developing more mature and secure solutions; in this way, public authorities can contribute to building and disseminating best practice.[112]

The **US** is recognised as a leader in Cloud and released a Cloud First policy as early as 2011, recognizing the potential to address inefficiencies in the Federal Government's IT environment and promoting innovation.[113] The policy sets out clear guidelines for identifying services to move to the Cloud and provisioning Cloud services effectively. These efforts were supported by a Government Cloud computing community and resources such as a centralized online storefront. Among other things, the policy aimed to ensure that agencies considered potential security benefits of Cloud alongside any potential vulnerabilities.

In the **UK,** a Cloud First Policy was published in 2013 to mandate that central Government agencies consider and fully evaluate potential Cloud solutions before considering other options. This approach was also strongly recommended across the wider public sector. To support this policy, the Government created G-Cloud, which consists of:

- A series of framework agreements with suppliers, to streamline procurement; and
- An online store where public bodies can search for services covered by these agreements.

Key suggested policy actions for the public sector to champion Cloud use

Develop a national strategy to prioritise Cloud ("Cloud First strategy")

- Define a classification for Public sector data to streamline decisions to use Cloud and implement it. For example, the simplified model defined in the UK with 3 levels of data (Official, Secret and Top Secret) with different protocols for storing the data depending on the level.
- Require public organisations to evaluate Cloud solutions first before considering other options when procuring IT services, and to justify the decision taken regarding use of Cloud.
- Develop framework agreements with suppliers to streamline public sector procurement.
- Nominate 'Cloud Ambassadors' in the public sector to act as leaders and promote Cloud. This may be done through Agencies tasked with promoting Cloud in the public sector or through training public sector employees to promote Cloud within their organisations.
- Create sandboxes to enable public entities to experiment with Cloud solutions, helping to identify priority use cases with the greatest potential benefits.
- Develop tools to set and monitor cost savings targets from Cloud adoption in the public sector.
- Publish energy consumption of public sector data centres to enhance accountability and illustrate improvements achieved over time through Cloud.

108. growth and inclusiveness: the role of policies for the successful diffusion of ICT" https://www.oecd-ilibrary.org/docserver/5jlwqvhg3l31-en.pdf?expires=1537529854&id=id&accname=guest&checksum=4F9A9FCFB0CEF1412D8171808C6E1518

109. Organisation for Economic Co-operation and Development (OECD). 2014. "Cloud computing: the concept, impacts and the role of government policy" https://www.oecd-ilibrary.org/docserver/5jxzf4lcc7f5-en.pdf?expires=1537529899&id=id&accname=guest&checksum=ED5FD035EEA838A93EE38062FB2C14F5

110. European Commission. 2013. "Analysis of cloud best practices and pilots for the public sector" https://ec.europa.eu/digital-single-market/en/news/analysis-cloud-best-practices-and-pilots-public-sector

111. European Commission. 2013. "Analysis of cloud best practices and pilots for the public sector"

112. European Commission. 2013. "Analysis of cloud best practices and pilots for the public sector"

113. Vivek Kundra, U.S. Chief Information Officer of The White House. 2011. "Federal cloud computing strategy" https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/assets/egov_docs/vivek-kundra-federal-cloud-computing-strategy-02142011.pdf

Data localisation

Data localisation rules may represent a regulatory barrier to use of Cloud, when providers are based in a different jurisdiction from the customer. Several policymakers and international institutions have taken the view that data localisation restrictions are not always justified. The UK Government, among others, has expressed the view that data localisation does not tend to improve data security and may in fact entail additional risks and vulnerabilities.[114]

Data localization concerns tend to focus on certain types of data, such as personal data or data related to national security. In cases where data is particularly sensitive such as for data related to national security, exceptions to the principle of free flow of data may be warranted, but exceptions should take into account the full range of possible alternatives, including any bespoke solutions offered by Cloud providers that may allay security concerns.

Examples of emerging best practice in this area include developing simple, clear and narrowly tailored classifications of Public Sector data depending on security requirements (such as the UK security classification of public sector data), using trade agreements to reduce barriers to cross-border data flows and build bridges between different data protection frameworks, and raising awareness of the potential downsides of data localization laws.[115]

Steps being taken by the European Commission provide an example of policy initiatives to reduce data localization barriers for personal and non-personal data within the EU, and through adequacy decisions in relation to non-EU countries where it is determined that data protection measures in the country are adequate. Other examples are the Privacy Shield agreement, which preserves data protection rights when data is transferred from the EU to the US; or the Trans-Pacific Partnership which prohibits barriers on data flows between signatories.

As part of its Digital Single Market strategy, the **European Commission** has made it a priority to support the data economy, specifically by removing data localization restrictions to achieve the free flow of data within the EU. Its stakeholder consultation confirmed that businesses incurred high costs because of data localization restrictions and most stakeholders agreed that restrictions should be removed.[116] Another key obstacle identified was legal uncertainty about legislation applicable to cross-border data storage and sharing.[117]

For non-personal data, the Commission has proposed a framework which enshrines in law the principle of free flows of data across borders for storing or processing within the EU.[118]

For personal data, the General Data Protection Regulation (GDPR) separately provides for the free movement of personal data within the EU and Member States may not impose data localization restrictions on the grounds of protecting personal data.[119]

In relation to movements of data between EU Member States and non-EU countries, the Commission has endorsed horizontal provisions for cross-border data flows and personal data protection in trade negotiations.[120] However, free flows of data outside of the EU depend on the EU adopting an 'adequacy decision' in relation to each specific non-EU country, determining that data protection measures in that country are adequate. The limited harmonization of data protection frameworks internationally can render this a complex process. Twelve countries have been recognised as providing adequate protection thus far, while talks with Japan and South Korea are ongoing.[121]

Key suggested policy actions to review restrictions on the use of public Cloud

Review existing requirements to store data in the country:

- Review the applicable requirements to store data in the country taking into account the security features of Cloud.
- Engage in regulatory cooperation internationally to define shared principles and rules to meet minimum acceptable levels of data protection so that countries are more readily willing to let data flow to other countries. These could be for example in relation to the rights of data subjects to be informed about the uses of personal data and transfer to third parties, or reasonable limits on data retention
- Continue to foster international cooperation and bilateral agreements to streamline provision of information by the countries where data is stored to law enforcement agencies from the countries where the data originates, while respecting the objectives of the respective legal systems.

114. e.g. European Commission. "UK Government response to the European Commission's consultation on building the European data economy" http://ec.europa.eu/information_society/newsroom/image/document/2017-30/consultation_data_eco-uk_653FBCB9-F30C-9431-7A77F4C6C08AF57B_46171.pdf

115. Information Technology & Innovation Foundation (ITIF). 2017. "Cross – border data flows: Where are the barriers, and what do they cost? http://www2.itif.org/2017-cross-border-data-flows.pdf

116. European Commission. 2017. "Synopsis report of the public consultation on building a European data economy" https://ec.europa.eu/digital-single-market/en/news/synopsis-report-public-consultation-building-european-data-economy

117. European Commission Policy: "Free flow of non – personal data" https://ec.europa.eu/digital-single-market/en/free-flow-non-personal-data

118. European Commission. 2017. "Proposa for a Regulation of the European Parliament and of the Council on a framework for the free flow of non-personal data in the European Union " (COM(2017)495) https://ec.europa.eu/digital-single-market/en/news/framework-free-flow-non-personal-data-eu

119. European Commission. 2017. "A framework for the free flow of non-personal data in the EU" https://ec.europa.eu/digital-single-market/en/news/framework-free-flow-non-personal-data-eu

120. European Commission. "Daily News 31/01/2018" http://europa.eu/rapid/press-release_MEX-18-546_en.pdf

121. European Commission. "Adequacy of the protection of personal data in non-EU countries" https://ec.europa.eu/info/law/law-topic/data-protection/data-transfers-outside-eu/adequacy-protection-personal-data-non-eu-countries_en

Awareness and understanding

Though this is gradually changing, limited awareness and understanding of benefits and risks inhibits more extensive Cloud use. As discussed in Section 4, some organisations may have limited awareness of security features available from public Cloud providers. There is also scope for wider awareness of potential benefits, both in terms of migration to the Cloud in general and in relation to more innovative or sophisticated Cloud-based services, such as ML tools.

Policymakers and industry can help educate stakeholders on the security features of Cloud services from providers with recognised certifications, while ensuring that Cloud users are aware of remaining security risks, including vulnerabilities that may result from human error in configuring access and security settings. A few examples of policy action in this area in a number of countries are described below, which include the publication of security principles to help evaluate the security of any Cloud service, or the provision of free expert advice or financial aid.

In **Belgium,** the Government has published several studies on the impact of Cloud computing in the country, which contributes to greater awareness of its benefits. Belgian SMEs have also been provided the opportunity to access free expert advice on various practical issues, including the use of Cloud computing, through a scheme funded by the European Fund for Regional Development.[122]

Norway's Cloud Computing Strategy seeks to increase awareness of the security benefits of using Cloud services, noting that Cloud computing can enhance security when the service provider has more advanced expertise and resources than the customer.[123] The guidance follows previous work published by Norway's Commission on Digital Vulnerability, to highlight potential security benefits from Cloud as well as key user responsibilities. The Cloud Computing Strategy has been supported by complementary activities, such as Guidelines for Cloud Computing in the health sector, with a focus on "demystifying the Cloud" and promoting awareness of potential uses, benefits and risks.[124]

In **Spain,** the national Government has offered a combination of guidance and financial aid to help SMEs understand available Cloud services and choose among these. This demand-side program has been supplemented by supply-side action to develop new tools that can help SMEs migrate to the Cloud more easily.

In the **UK,** the National Cyber Security Centre has published 14 Cloud Security Principles, with the aim of helping public and private bodies evaluate the security of any Cloud service, as well as ensuring that decisions about the use and configuration of Cloud services become part of regular risk management processes.[125]

A related initiative is taking place at EU level as a **European Commission** working group aims to develop a harmonized certification scheme for Cloud security. This would allow organisations to more easily compare Cloud providers with respect to security. In the Commission's view, the rapid development of this scheme is crucial for Cloud uptake and the free movement of data.[126]

Key suggested policy actions to raise awareness of, and trust in Cloud

Develop guidance for businesses on the benefits of Cloud and best practices for adoption

- Develop an "online hub" containing information to "demystify the Cloud". For example information on the benefits of Cloud, practical steps on how to transition to Cloud, and best practice examples.
- Develop user-friendly guides for businesses on the security features of Cloud.

Facilitate comparison of providers based on compliance with key quality criteria (e.g. security, compliance with industry specific regulatory requirements), for example through certification schemes.

Provide resources and support for businesses to facilitate transition to Cloud

- Invest in a Centre of Excellence hub for talent that can help tackle the challenges of Cloud adoption, bringing together experts from different sectors, and large and SME businesses. Make this hub provide training and information to IT decision makers in businesses about Cloud adoption.
- Provide SMEs with access to free expert advice on practical issues regarding Cloud adoption and transition, including how to minimise security risks resulting from human error.
- Consider making financial support available to SMEs in the IT sector to develop new tools that can help SMEs across all sectors migrate to the Cloud more easily.

122. Getting the Deal Through. See: https://gettingthedealthrough.com/area/100/jurisdiction/31/cloud-computing-belgium/

123. Norwegian Ministry of Local Government and Modernisation. 2016. "Cloud computing strategy for Norway" https://www.regjeringen.no/en/dokumenter/cloud-computing-strategy-for-norway/id2484403/

124. Direktoratet for w-helse. 2016. "Norwegian Code of conduct for information security in the health and care sector and our guidelines for cloud computing" https://www.enisa.europa.eu/events/NorwegianCodeofconductforinformationsecurityandcloudguidelineEnisa23.11.16.pdf/

125. National Cyber Security Centre. 2016. "Introduction: Understanding cloud security" https://www.ncsc.gov.uk/guidance/introduction-understanding-cloud-security

126. European Commission. 2018. "Cloud stakeholder working groups start their work on cloud switching and cloud security certification" https://ec.europa.eu/digital-single-market/en/news/cloud-stakeholder-working-groups-start-their-work-cloud-switching-and-cloud-security

Data portability and system interoperability

Organisations may experience contractual barriers preventing data or applications from being transferred between systems, while there may also be technical barriers that impede portability or interoperability of different systems, for example where there are compatibility issues. Reducing these barriers can facilitate the adoption of hybrid or multi-Cloud solutions that organisations are increasingly considering.[127] It can also help to ensure a level playing field, with users able to switch between providers where this allows adoption of a wider range of Cloud services or other incremental benefits.

Policymakers can take a range of steps to reduce contractual barriers, from issuing guidance to users to prohibitions of particular contractual terms. Institutions such as the European Commission are still developing possible responses to this issue.

Portability of data and interoperability of different systems may also be challenging if providers adopt a variety of different proprietary technical standards. Policymakers can play a role by supporting standardization efforts, for example through the International Standards Organisation, or by promoting awareness and adoption of open source platforms and standards, such as Cloud Foundry and Kubernetes.

The **European Commission** has been studying options to ensure users are able to switch between Cloud service providers, with research suggesting that demand for public Cloud services could be up to €7 billion higher in the EU if policy effectively supports portability.[128]

To address this, the Commission proposes to encourage and facilitate the development of EU codes of conduct to remove obstacles to switching, which are expected to *"define best practices and information requirements to facilitate the switching of Cloud service providers and to ensure that these providers supply professional users with sufficiently detailed, clear and transparent information before a contract for data storage and processing is concluded".*[129]

Providers will be required to implement the relevant codes of conduct within one year of the new Regulation being applied.[130] Working groups have begun developing these codes.[131]

This follows previous efforts by the Commission, in conjunction with industry, to support international standardization and create a more consistent environment for Cloud providers and users, including through developing standardized Service Level Agreements and working in collaboration with the International Standards Organisation.[132]

Key suggested policy actions to reduce frictions in the market for Cloud services

Promote interoperability and data portability through open standards and industry codes of conduct:

- Promote understanding and adoption of open standards working with industry bodies and SMEs.
- Actively support the development of relevant common technical standards and standardised Service Level Agreements through international organisations.
- Develop codes of conduct to ensure that Cloud providers do not unduly restrict portability of user data and applications, working with industry.

127. ECIS. 2016. "Special paper on cloud computing: portability and interoperability" http://www.ecis.eu/2016/06/special-paper-on-cloud-computing-portability-and-interoperability/

128. IDC and Arthur's Legal. 2017. "Smart 2016/0032 switching of cloud services providers" http://ec.europa.eu/information_society/newsroom/image/document/2017-51/porting_and_switching_study_27C76E4F-A1CF-21EB-8796108C19D7B7AF_49049.pdf

129. European Commission. 2018. "Cloud stakeholder working groups start their work on cloud switching and could security certification" https://ec.europa.eu/digital-single-market/en/news/cloud-stakeholder-working-groups-start-their-work-cloud-switching-and-cloud-security

130. European Commission. 2017. "A framework for the free flow of non-personal data in the EU" https://ec.europa.eu/digital-single-market/en/news/framework-free-flow-non-personal-data-eu

131. European Commission. 2018. "Cloud stakeholder working groups start their work on cloud switching and cloud security certification" https://ec.europa.eu/digital-single-market/en/news/cloud-stakeholder-working-groups-start-their-work-cloud-switching-and-cloud-security

132. European Commission. 2014. "New guidelines to help EU businesses use the Cloud" https://ec.europa.eu/digital-single-market/en/news/new-guidelines-help-eu-businesses-use-cloud

There are several wider areas where policy can help to create conditions that support Cloud adoption and its benefits, as well as supporting digitalisation more generally.

Digital skills

Education and training can support other initiatives that aim to improve individuals understanding of the benefits of Cloud and their ability to make use of techniques such as advanced analytics and ML. The European Commission's Digital Education Action Plan[133] provides a useful framework for best practice digital skills policy initiatives, with objectives to:

- Develop digital competences and skills: This is likely to include achieving an adequate basic level of digital literacy across the population, while providing sufficient specialized education and training to meet demand in key areas such as AI, ML, data science and cyber security.
- Make use of digital technology for teaching and learning (see Section 3 – "Education" for a discussion).
- Improve education systems through data analysis and related techniques.

R&D

Policymakers around the world are pursuing policies to support R&D in technologies related to Cloud, often in collaboration with the private sector. There is particular attention on promoting AI at present, with the European Commission recently launching measures to ensure at least €20 billion of investment in AI by the end of 2020, while countries such as France and the UK also launched national AI strategies in 2018 including R&D funding. Such measures can accelerate the discovery of new use cases, with potential economic benefits in terms of productivity and growth.

There are strong links between Cloud computing and technologies such as AI and IoT. In the European Commission's view, *"Cloud computing technologies have evolved into the major driver that brought together IoT, Big Data and mobile computing … The capability offered by the Cloud platforms to deliver on-demand computing power and the ability to process the vast amount of data coming from an abundance of devices/sensors will provide a huge impetus to AI technologies"*.[134] R&D initiatives have the potential to support the development of this broad set of technologies as a whole, as well as disseminating awareness of their potential benefits.

Connectivity

A fundamental advantage of using Cloud services is that they provide ubiquitous access to data or applications from any location and from a range of devices. The benefits from this may be diluted if fixed or mobile broadband coverage does not deliver consistent availability and performance across geographic areas. Various institutions globally are actively exploring solutions to facilitate connectivity in challenge areas.[135]

The proliferation of IoT devices and increasing demands for capacity also affect the need for advanced connectivity. The number of IoT devices globally is estimated to be growing by 20-30% annually[136] and volumes of mobile data are growing exponentially including from machine-generated data.[137] Cloud computing offers opportunities for this data to be stored and analysed efficiently, but telecom networks may come under increasing pressure. Policymakers can play a role by continuing to take steps to ensure that investment in fibre or 5G networks keeps pace with demand for capacity.

Open Data

The benefits of Cloud adoption may be enhanced in the context of an innovative, data-driven economy. Open Data policies can support this and are complementary to Cloud computing, as both enable a wide range of stakeholders to share data more seamlessly. By making public datasets more widely available in standardized formats, institutions can create new opportunities for businesses, entrepreneurs and researchers to innovate, using this data in the context of Cloud-based analytics or new app development.

133. European Commission. 2018. "Proposal for a council recommendation on key competences for lifelong learning" http://ec.europa.eu/education/sites/education/files/recommendation-key-competences-lifelong-learning.pdf

134. European Commission. 2018. "EUK-01-2018: Cloud, IoT and AI technologies" EUK-01-2018: Cloud, IoT and AI technologies

135. Body for European Regulators for Electronic Communications (BEREC). 2018. "BEREC and RSPG joint report on facilitating mobile connectivity in "Challenge areas"" https://berec.europa.eu/eng/news_and_publications/whats_new/4618-berec-rspg-joint-report-on-facilitating-mobile-connectivity-in-challenge-areas-berec-and-rspg-seek-your-views-ends-28-november-2017

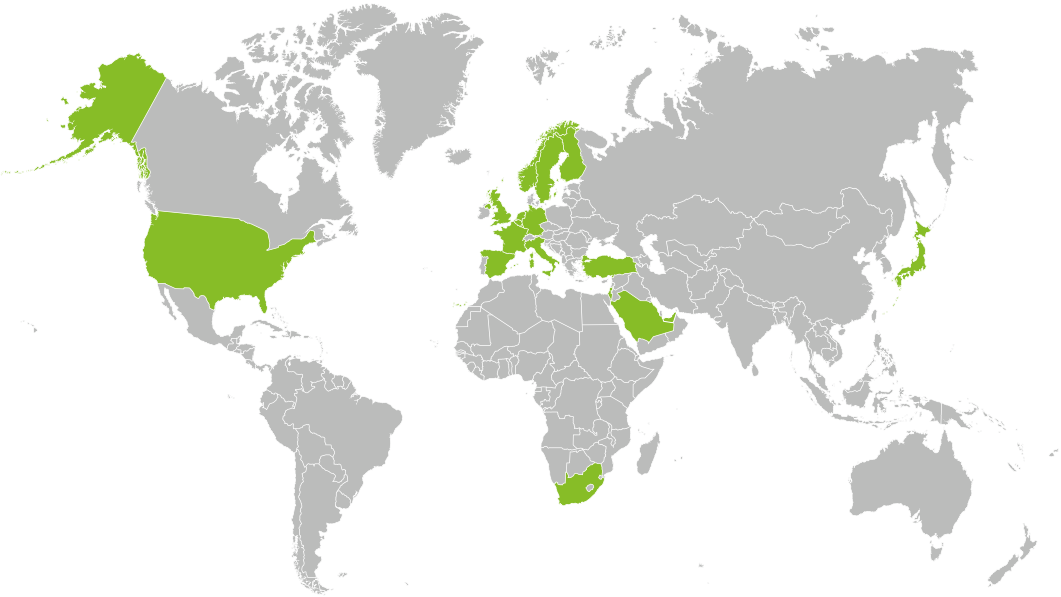
136. Ericsson. "Internet of Things forecast" https://www.ericsson.com/en/mobility-report/internet-of-things-forecast

137. Seagate. 2017. "Data age 2025: the evolution of data to life-critical" https://www.seagate.com/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf

Appendix 1. Country Sections

The summaries in this section cover the following countries or regions:

- United Kingdom (UK)
- Japan
- Nordics
- Benelux
- United States (US)
- France
- Germany
- Italy
- Spain
- Turkey
- Israel
- Saudi Arabia
- South Africa
- United Arab Emirates (UAE)



The summaries include:

- An overview of the **state of Cloud** including the rate of Cloud adoption among businesses[138] as well as key enablers for Cloud use, including connectivity, e-government and digital literacy. More detail on the enablers and how they are measured is presented in the section below.
- Illustration of **the role of Google Cloud** including the local partners and businesses with which Google works, and case studies to illustrate the business impacts of Google Cloud on its users.
- An overview of key **Cloud-related policies**, based on available information of existing government initiatives to stimulate Cloud adoption across key policy enablers identified in section 5.

138. For the majority of countries, Cloud adoption data is provided by Eurostat or the OECD. For countries where such data is not available (US, UAE, South Africa, Israel, Saudi Arabia), an indicative rate of Cloud adoption is estimated based on observed correlations between Cloud adoption and other variables, such as total Cloud spend and connectivity metrics.

Cloud Enablers

In addition to key indicators of the state of Cloud, such as the adoption rate of Cloud services among businesses, the summaries cover 'Cloud enablers': socio-economic indicators that underpin some of the enabling conditions for Cloud adoption and use to develop.

There are three sets of Cloud enablers presented: connectivity, e-government and digital literacy.

Connectivity measures the development of service infrastructure for businesses to access online services such as Cloud services. In order to support usage of Cloud services, businesses must have an internet connection with sufficient bandwidth and some skills to use ICT. Previous evaluations of Cloud computing across countries have included indicators related to connectivity and infrastructure.[139] One connectivity measure used is the World Economic Forum's (WEF) rating of business usage of ICT, which includes the extent of business internet use and capacity to absorb new technologies such as Cloud. The second connectivity measure is a ranking based on cross border data flows produced by the McKinsey Global Institute (MGI). This captures connectivity across national borders, which is an enabler to develop competitive Cloud services and for domestic Cloud users to make use of international Cloud services.[140] In addition, average connection speed is a relevant factor as increasing use of Cloud services is expected to require higher bandwidth for connections.[141] This is included based on data from Akamai.[142]

E-government measures national governments' use of digital technologies in the delivery of public services to citizens. According to analysis for the European Commission, "there are strong links between e-government and Cloud", with Cloud often forming part of e-Government strategies.[143] The United Nations' (UN) Online Services Index and the level of government procurement of advanced technology according to the WEF are used to measure the extent to which the public sector in each country is open to using digital technologies and proactively involved in adopting and developing these.

Digital literacy measures how well national education systems develop the basic skills necessary to understand and use technologies such as Cloud. The OECD states that developing ICT skills is important for technologies such as Cloud services for a number of reasons: specialist skills are required to produce these services; and workers across a range of occupations need to possess ICT skills in order to integrate these technologies into their daily work and develop new ways of working.[144] Digital literacy is approximated in this report by the quality of math and science education, given that these disciplines are seen as important foundations for the development of digital skills and development of more advanced technologies.[145 - 146] In addition, an index measuring ICT skills from the International Telecommunication Union's (ITU) is also included. This index is composed of proxy indicators for capabilities or skills that are important for use of ICT such as mean years of schooling and enrolment ratios.[147] For more details on all these indicators, see Table 1 below.[148]

139. For example, the 2018 BSA Global Cloud Computing Scorecard includes a set of indicators measuring 'IT readiness and Broadband Deployment', these indicators include 'International Connectivity Scores' as measured by the ITU and WEF as well as internet penetration and international internet bandwidth. In addition, the Asia Cloud Computing Association's Cloud Readiness Index 2018 includes 'International Connectivity' measured in terms of bandwidth as part of the Cloud Infrastructure segment of the index. See: BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" and Asia Cloud Computing Association. 2018. "Cloud Readiness Index 2018".

140. Asia Cloud Computing Association. 2018. "Cloud Readiness Index 2018"

141. Wik Consult. 2018. "The Benefits of Ultrafast Broadband Deployment"

142. Akamai. 2017- "The state of the internet"

143. European Commission. 2013. "Analysis of cloud best practices and pilot for the public sector"

144. https://www.oecd-ilibrary.org/science-and-technology/oecd-digital-economy-outlook-2017_9789264276284-en see p.177

145. World Economic Forum. 2016. "Global Information Technology Report 2016"

146. European Commission. "Education and training. School policy" Section "Basic Skills"

147. International Communication Union (ITU). "The ICT Development Index (IDI): conceptual framework and methodology"

148. Possible frameworks for a comprehensive measure of digital literacy have been discussed by institutions such as UNESCO and the G20 with a view to further development. See G20 Insights. 2018. "Bridging the Digital Divide: Measuring Digital Literacy" and World Education Blog. 2018. "A global framework to measure digital literacy"

Table 1: 'Cloud Enabler' indicators

Connectivity	
Business usage of ICT (score 1-7)	The WEF scores countries from 1 (worst) to 7 (best) based on indicators including the extent of business internet use, firm's technology absorption capacity and capacity to innovate. These indicators were developed based on the WEF's Executive Opinion Survey.[149]
Data flows rank (out of 139 countries)	The MGI produces a rank of countries globally based on cross-border Internet bandwidth used sourced from TeleGeography.[150]
Average connection speed (Mbps)	Akamai produce data on the average connection speed for IPv4 addresses based on connections to its network.[151]

e-Government	
Government procurement of advanced technology (score 1-7)	The WEF scores countries from 1 (worst) to 7 (best) based on the extent that government purchasing decisions foster innovation. This evaluation is based the WEF's Executive Opinion Survey.[152]
Online Service Index (score 0-1)	The UN scores countries from 0 (worst) to 1 (best) based on governments' online presence including national government websites, e-services portals and websites related to specific government ministries.[153]

Digital literacy	
IDI Skills index (score 0-10)	The ITU produces an index as part of the Global ICT Development Index measuring development of ICT skills. The skills index is composed of proxy indicators for capabilities and skills for the use of ICT (mean years of schooling, secondary and tertiary gross enrolment ratios).[154]
Quality of math and science education (score 1-7)	The WEF scores countries from 1 (worst) to 7 (best) based on the quality of math and science education. This evaluation is based the WEF's Executive Opinion Survey, which was targeted at between 30 and 100 business executives regarding only their own country's math and science education quality.[155]

Source: WEF, MGI, Akamai, UN and ITU

149. World Economic Forum. 2016. "Global Information Technology Report 2016" Section "Technical Notes and Sources"
150. McKinsey & Company. 2016. "Digital globalization: The new era of global flows"
151. Akamai. 2017- "The state of the internet"
152. World Economic Forum. 2016. "Global Information Technology Report 2016" Section "Technical Notes and Sources"
153. United Nations. 2016. "United Nations E-Government Survey 2016"
154. International Communication Union (ITU). 2017. "Measuring the Information Society Report 2017"
155. World Economic Forum. 2016. "Global Information Technology Report 2016" Section "Technical Notes and Sources"

United Kingdom

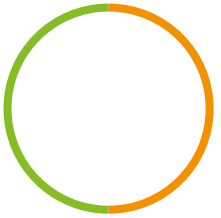
Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	35%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	5.2	in a range from 1 to 7	
Data flows rank	3rd	out of 139 countries	
Average connection speed	16.9	Mbps average speed	
e-Government			
Procurement of technology	3.8	in a range from 1 to 7	
Government Online Service	1.00	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.2	in a range from 0 to 10	
Math and science education	4.4	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Active promotion of Cloud computing in the UK	The UK's Cloud first policy is a reference for other countries	Absence of data localisation requirements is acting as an important Cloud computing enabler	There is room to further promote awareness and understanding of Cloud computing among stakeholders	The UK is an active participant in many ICT standards committees like ISO's top level ICT standards committee (JTC-1)

The UK is a leading country in public sector adoption of Cloud computing, with its Cloud First policy contributing to awareness and adoption, particularly at Central Government level.



Some research suggests that awareness and understanding of Cloud is still limited, particularly among SMEs and local Government organisations, with security concerns remaining a key barrier.

Google's contribution

Productivity Impact

$420m-$1,160m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in the UK

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[156] was 35%, higher than the average of 30% across the countries analysed in this report and above the average of 21% across the European Union. Adoption in the UK has grown 46% in two years and as of 2016, it was higher than the EU average across all business sizes, types of Cloud service and sectors of the economy.[157] However, Cloud adoption remains below the level observed in geographies such as the Nordics, the US and Japan.

As in other geographies, adoption of Cloud technology is being led by large businesses. In the UK, 61% of large businesses have adopted Cloud technology, as opposed to 45% and 32% for medium and small businesses respectively.

According to Equinix,[158] one fifth of Cloud Services Providers (CSPs) operating in EMEA are headquartered in the UK. London is also one of the most popular data centre locations in Europe for US Cloud companies. The city has the joint-highest concentration of Cloud providers in Europe together with Frankfurt.

Cloud enablers

Across key Cloud enablers of connectivity and e-government the UK is generally among the more advanced of the geographies studied in this report. However, indicators for digital literacy suggest that progress is slower in the UK than in the majority of countries studied.

- Within connectivity, business usage of ICT in the UK is below the levels observed in other northern European countries, the US, Japan and Israel; however, the UK benefits from high connectivity in terms of cross-border data flows. The UK also benefits from higher than average connection speeds than the majority of other countries studied.

- Online Government services are well developed, though there is potential for increased procurement of advanced technologies relative to other geographies.

- With regard to supporting digital skills, the quality of math and science education is below the level of leading countries such as Finland and Belgium, while the level of development of ICT skills and usage in the UK is in line with the median of the countries studied.

Google Cloud in the UK

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, Cloud Technology Solutions is a Google certified expert in G Suite planning, migration, technical deployment and responding to the ongoing support needs of each client. The company provides services and support to many well-known businesses, public companies and education organisations.

The UK also hosts a Google Cloud region in London, which means that UK users benefit from decreased network latency in using Google Cloud services. Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across the UK. Google Cloud is being used by companies in sectors such as financial services, retail, media and gaming, education, public sector and healthcare. For example, Google Cloud customers in the UK include the likes of HSBC in the financial services sector, Ocado and John Lewis in the retail sector, Telegraph Media Group in the media sector, National Institute for Health Research in the healthcare sector and Coleg Cambria in the education sector. Public sector users include Department for Transport and Manchester City Council.

156. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

157. Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

158. Equinix, Inc. 2013. "Cloud cover in Europe – An assessment of the business climate for cloud services" https://www.firstbaseunlimited.com/wp-content/uploads/2017/11/Equinix_cloud_WP_final.pdf

Ocado (UK) – Improving customer centre efficiency and customer satisfaction

Ocado is reportedly the world's largest dedicated online grocery retailer,[159] with over 600,000 active customers in the UK. Ocado Technology, which develops the software and systems that power Ocado's business activities, uses GCP for a variety of purposes, including to improve customer service and user experience, provide business teams with improved insights, reduce IT overheads, automate warehouse robotics and build a platform enabling other companies to deploy online grocery business models.

Ocado has been recognised as a leading example of AI-driven innovation in the UK Government's industrial strategy.[160] Using GCP's ML tools, Ocado has been able to enhance its CRM activities. A key example is a ML model built using GCP, which was trained on a database of three million emails previously classified by staff manually. Using this model, Ocado is able to automatically classify customer emails in terms of urgency, based on content key words, queuing them accordingly for its staff to respond. In some cases, emails can be identified as not requiring a manual response, in which case an automated response is provided.

Using GCP's Cloud AI tools, Ocado saw significant improvement in customer centre efficiency and customer satisfaction:

- An annual saving of £100,000 was realized.
- Average response to customer emails 4 times faster. Similarly, the proportion of emails answered within 24 hours rose from 74% in 2016 to more than 95% in 2017.
- On the independent review website Trustpilot, Ocado's customer satisfaction score increased from 4.6/10 in 2016 to 7.9/10 in 2017. Ocado considers that the Google Cloud-enabled improvements were an important contributor to this.

Ocado also uses GCP tools for other CRM activities, for example to improve the personalised recommendations shown to individual customers, based on data about past purchases.

In other areas of the business, Google Cloud has been used to:

- Improve analytics, by enabling data to be queries around 80 times faster than Ocado's previous platform, while also reducing the costs of doing so by around a third.
- Enable the monitoring and optimization of robotics system performance in warehouses. This involved building a machine learning based analytics system running on GCP which provides monitoring and oversight of the swarms of thousands of robots in each warehouse – effectively a remote healthcare system for robots.
- Develop and deploy the Ocado Smart Platform (OSP), an end-to-end ecommerce, fulfilment and logistics platform that allows large bricks & mortar grocery retailers to operate scalable and profitable online grocery businesses. Using GCP enabled Ocado's developers to focus efforts on feature development and work in a modular, scalable and flexible way. OSP is now being used by UK retailer Morrisons and Ocado has signed international deals with Bon Preu in Spain, Casino in France, Sobeys in Canada, ICA in Sweden and Kroger in the US.

159. Ocado Group PLC. 2018. "Annual report and accounts for the 53 weeks ended 3 December 2017".
160. Gov.UK. 2018. "Policy paper – AI Sector Deal"

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in the UK in the order of **$420 million to $1,160 million** in 2017, based on the estimated net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in the UK

There has been a strong focus on promoting Cloud computing as part of a broader digital society in the UK. However, there is potential to further promote awareness of Cloud and its benefits, and to help stakeholders address concerns or uncertainty about security in the Cloud.

Public sector leadership

The UK Government has been proactive in seeking to lead by example on Cloud adoption. The introduction of a Cloud First policy in 2013 aimed to ensure that all public sector organisations consider potential Cloud solutions first before considering any other option. This is mandatory for central government and encouraged throughout the public sector. To support this, G-Cloud was created to facilitate public procurement of Cloud computing with:

- A series of framework agreements with suppliers, from which public sector organisations can buy services without needing to run a full tender or competition procurement process.
- An online store – the "Digital Marketplace" (previously "CloudStore") that allows public sector bodies to search for services that are covered by the G-Cloud frameworks.

UK Government lies below the median of our sample regarding the promotion of free trade according to the Business Software Alliance (BSA) Scorecard[161] on the basis that of the Procurement Policy Note 07/15, "open standards for technology" (March 2015),[162] which establishes a strong preference for open standards and includes a catalog of open standards that have been accepted for use across government. In contrast, the EU Directive on Public Procurement Law requires that technical specifications afford equal access for tenderers and do not have the effect of creating unjustified obstacles to the opening up of public procurement to competition.

Data localisation

According to the BSA, the absence of data localization requirements, tariffs and other trade barriers for Cloud computing has been a significant enabler for Cloud.[163] The UK Government has recognised that, "while there may be areas where localisation of data is justified, such as for national security and carrying out law enforcement activities, data localisation has many negative consequences".[164]

Awareness and understanding

Steps have been taken to try to promote awareness of Cloud, including through the Cloud First policy, and of key security issues, including through the publication of Cloud Security Principles.[165] However, some research suggests that awareness and understanding is still limited, particularly among SMEs and local Government organisations, with security concerns remaining a key barrier. Educating and engaging further with these stakeholders could help to promote a wider understanding of how Cloud can be used securely and effectively.[166]

Portability and Interoperability

The British Standards Institution (BSI) has existed since 1901. The BSI has a Memorandum of Understanding with the UK Government, which establishes the position of BSI as the recognized UK National Standards Body.

The BSI represents the UK in international standards development processes, and is an active participant in many ICT standards committees. The UK is a participant in the top level ICT standards committee (JTC-1). According to the BSA,[167] the UK favours international standards over national standards, although the adoption of internationally based EU standards is common in many sectors.

Broader policy areas

Most recently, the Government published in March 2017 its Digital Strategy 2017, including objectives that should help to create an enabling environment for Cloud:

- Building world-class digital infrastructure and connectivity.
- Improving digital skills and inclusion.
- Create the best environment for digital businesses and boost digitization of other sectors.
- Strengthen cybersecurity.
- Promote Digital Government.
- Unlock the power of data in the economy and for the public to use.

The UK Government has also adopted a recent Sector Deal to promote AI as part of the country's Industrial Strategy. Based on analysis by Oxford Insights, the UK is currently ranked first worldwide in terms of its Government's preparedness for implementing AI in public service delivery.[168]

161. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
162. Cabinet Office and Crown Commercial Service. 2015. "Procurement Policy Note 07/15: open standards for technology"
163. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
164. European Commission. 2017. "UK government response to the European Commission's consultation on building the European data economy" http://ec.europa.eu/information_society/newsroom/image/document/2017-30/consultation_data_eco-uk_653FBCB9-F30C-9431-7A77F4C6C08AF57B_46171.pdf
165. National Cyber Security Centre. 2016. "Implementing the Cloud Security Principles" https://www.ncsc.gov.uk/guidance/implementing-cloud-security-principles
166. Federation of Small Businesses (FSB). 2015. "Security fears stop firms using cloud computing services, says FSB" Eduserv. 2016. "Up in the Air. The state of cloud adoption in local government in 2016"
167. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
168. Oxford Insights. 2017. "Government AI readiness index" https://www.oxfordinsights.com/government-ai-readiness-index/

Japan

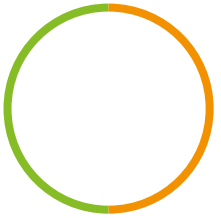
Cloud adoption and enablers *

Cloud Adoption	Metric	Status
Business used Cloud services	47% used a Cloud service	
Cloud Enablers		
Connectivity		
Business Usage of ICT	5.9 in a range from 1 to 7	
Data flows rank	20th out of 139 countries	
Average connection speed	20.2 Mbps average speed	
e-Government		
Procurement of technology	4.1 in a range from 1 to 7	
Government Online Service	0.88 in a range from 0 to 1	
Digital literacy		
IDI skills sub-index	8.2 in a range from 0 to 10	
Math and science education	5.3 in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Japan is among leading countries in fostering innovation and digitalisation, including Cloud computing	Japan has implemented different Cloud computing initiatives in the public sector like the Kagumaseki Cloud or the Government Shared Platform in the past decade although it lacks a Cloud first policy	Membership in international collaboration agreements such as the APEC Cross-border Privacy Rules or the Trans-Pacific Partnership along with effective data protection of privacy have created an enabling environment	Publications like Japan's "Declaration to be the World's Most Advanced Nation" with updates on Cloud computing action plans are key for raising awareness	Japan is an active participant in ISO's top level ICT standards committee (JTC-1). It is recognised as "very active in the development of international standards" by the BSA

The publication of periodical updates of the state of the national "Declaration to be the world's most advanced IT nation", which include the economic benefits of the migration of public services to the Cloud, helps foster awareness and understanding



The lack of a Cloud first policy may be limiting Cloud adoption in the public sector. A Cloud first strategy could also serve as a reference for enterprises.

Google's contribution

Productivity Impact

$380m-$1,220m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Japan

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[169] was 47%, among the highest rates globally. This is higher than the average of 30% across the countries analysed in this report and above the average of 25% across OECD countries. Adoption in Japan has grown 21% in two years since 2016.

As in other geographies, adoption of Cloud technology is being led by large businesses. In Japan, 62% of large businesses have adopted Cloud technology, as opposed to 38% of medium-sized businesses.

The Asian Cloud Computing Association selected Japan as the top Cloud market in Asia and Oceania in their Cloud Readiness Index, being ranked among the top Asian markets for almost all categories used in the rankings, including broadband quality and intellectual property protection.

Cloud enablers

Across key Cloud enablers – connectivity, e-government and digital literacy – Japan is generally among the more advanced of the geographies studied in this report.

- Business usage of ICT in Japan is among the highest of all the geographies studied in this report.[170] Japan has lower connectivity in terms of cross-border data flows in relation to other countries studied. The Mckinsey report[171] that measures this variable proposes language and cultural barriers as a partial explanation to this result. On the other hand, Japan benefits from an average connection speed higher that the majority of other countries.

- E-government services and procurement of technology are above the median for the geographies studied.

- Japan is also leading in its quality of math and science education, providing a strong foundation for the use and development of Cloud services, while the level of development of ICT skills in Japan is around the median for the countries studied.

Google Cloud in Japan

Google Cloud has a developing partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, White Stratus Ltd is a global organisation that provides support services for G Suite to customers in sectors including energy, telecommunications, real estate, financial services and public companies.

Japan also hosts a Google Cloud region in Tokyo, with another region planned to be opened in Osaka.[172] These Google Cloud regions in Tokyo and Osaka mean that customers in Japan will benefit from low latency and higher performance of their cloud-based workloads when using Google Cloud services.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across Japan such as media, technology, retail and healthcare. Among Google Cloud's customers in Japan are Sony in the technology and media sectors, the retail company FamilyMart, and Kewpie in the consumer goods sector as well as Toyota in the automotive sector. Google Cloud has provided a guide to help customers comply with the local FISC guidelines on Computer Systems for Banking and Related Financial Institutions.

In terms of developing Cloud-related infrastructure, in 2014 Google invested $300 million in order to build an underwater trans-pacific internet cable system that connects the west coast of the US to the cities of Chikura and Shima in Japan.

169. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

170. Sweden's is higher, however the overall score for the Nordics is slightly lower.

171. McKinsey Global Institute. 2016. "Digital Globalization: The New Era of Global Flows"

172. Based on a search of regions where Google Cloud is located in the Google Cloud Locations directory available from: https://cloud.google.com/about/locations/

Fairy Devices Co, Ltd. – Efficiency and scalability in speech and sound recognition

Fairy Devices is a Japanese company that develops technology predominantly based around speech signal processing and natural language processing. The company's flagship product is "mimi®" which comprises a number of different audio recognition services such as Automatic Speech Recognition and Environmental Sound Recognition.

Google Cloud Platform is an integral part of "Mimi®". Backed by GCP services, the system is able to recognize environmental sounds such as laughter and applause and leverages deep learning technology to be able to understand intonation and convert sound into text. The GCP products that Fairy Devices uses are Compute Engine, BigQuery, Cloud SQL and Cloud DNS.

Cost has been a driver in the company's transition to GCP. In particular, GCP's pay-per-use billing system allows the company to avoid expense on on premise servers and at the same time to be confident that the system will scale automatically as demanded by users. GCP's autoscaler has been a key consideration, with the number of active users expected to grow exponentially from about 100,000 to potentially millions as new commercial agreements come into place.

The company reports a smooth transition to GCP, assisted by an effective support team, which answered the client inquiries in Japanese. Fairy reports that this level of technical support was valuable for Fairy Devices, which as a relatively small company was unable to maintain a dedicated, full-time IT support team.

Aggregate productivity impact

Use of Google Cloud services is associated with aggregate productivity impacts across all Google users including revenue expansion and cost savings in Japan estimated to be in the order of **$380 million to $1,220 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Japan

Japan is recognised as a leader globally in fostering innovation and digitalisation, and is ranked second by the BSA for its policy environment in relation to Cloud specifically.[173] The country benefits from advanced connectivity, as successive broadband plans in the country have resulted in comprehensive fibre-to-the-home deployment, while the Asian Cloud Computing Association (ACCA)[174] has noted recent amendments to the Act on the Protection of Personal Information (APPI) and the establishment of a new central data protection regulator as positive developments. The BSA has also noted that Japan is *"very active in the development of international standards.*[175]

Public sector leadership

The Japanese government began to examine Cloud adoption for the public sector with the *"KASUMIGASEKI Cloud",* proposed in 2009 as a private Cloud to be used throughout the public sector in the future. The initiative has led to annual rollouts of new Government Cloud services and is reported to have *"played a prominent role in growing Japan's Cloud market".*[176]

For example, a Platform as a Service (PaaS) service called *"Government Shared Platform"* (GSP) was introduced in March 2013 and 23 information systems were consolidated and transferred onto GSP by March 2015.[177] The expected savings in 2015 were a 24% reduction of total cost for the transferred systems, reaching €47 million per year after 2022 when its development is expected to be completed.

In 2017, the Japanese authorities issued the updated version of the *"Declaration to be the World's Most Advanced It Nation",* which reviews the implementation of a reform to government information systems for the purpose of halving the number of central government systems and lowering operating costs by thirty percent. The number of systems will be reduced to 894 by FY 2018 (sixty-two percent less than in FY 2012) while operating costs will be reduced by 110.4 billion yen per year by 2021 (twenty-nine percent less than in FY 2013).

This includes a Cloud-by-default principle similar to the Cloud first policy implemented in the UK. They propose a Cloud-utilization count as a KPI to monitor progress and the amount of cost reduction as an outcome KPI.

173. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/

174. Asian Cloud Computing Association. 2018. "Cloud Readiness Index 2018" http://www.asiacloudcomputing.org/research/2018-research/cri2018

175. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/

176. International Trade Administration. 2016. "2016 Top Markets Report Cloud Computing. Country Case Study. Japan"

177. OECD. "Digital Government Strategies: Good Practices - Japan. Government Shared Platform on Cloud Computing Technology"

They also propose the implementation and monitoring of the progress of other initiatives involving Cloud adoption in municipalities, education, the health sector, forest land registers and forest management.

These initiatives along with potential new ones are positive steps towards fostering the adoption of Cloud services in the public administration more extensively.

Data localisation

Analysis by the US International Trade Administration finds that "*to date, Japan has developed a regulatory environment that preserves free flow of data while protecting privacy*".[178] Japan is part of the APEC Cross-Border Privacy Rules (CBPR) framework, which requires data privacy policies to be respected by all enterprises from any of the member countries, and of the Trans-Pacific Partnership, which prohibits barriers on data flows between the signatories. Ongoing discussions are taking place to align rules on cross-border transfers of personal data with the EU framework.[179]

There are no legally binding data localization requirements in Japan, but some guidelines (for example the MIC guidelines for the medical industry) require private information processing operators to store data within the area where Japanese laws are in force.

Awareness and understanding

The Japanese government issues a periodic review of their "Declaration to be the World'sMost Advanced IT Nation"[180] that covers the evolution and implementation of several initiatives related to ICT including the migration of national and local government services to Cloud. Publishing this information helps raise awareness about Cloud and its benefits.

The Government has acted to address specific potential barriers in this area. For example, guidance has been published to clarify the application of privacy laws in a Cloud context, including the circumstances in which consent may or may not be required for the transfer of personal data.[181]

Article 20 of the Personal Information Protection Act (Security Control Measures) is the only binding legal requirement regarding security and provides that "an entity handling personal information must take necessary and proper measures for the prevention of leakage, loss, or damage, and for other control of security of the personal data." The clarification of guidelines for entities to adopt Cloud services with proper controls could help build further trust and awareness in the country.

Portability and Interoperability

Japan is committed to the development of international standards. It is a full member in the relevant International Standards Organization (ISO) and participates in the International Electrotechnical Commission (IEC) standard-setting processes. Japan is also a participant in the top-level ICT standards committee (JTC-1). However, the absence of a general law on e-commerce in the country is what has dragged Japan to the eighth position among the nine countries of our sample included in the BSA Cloud Computing Scorecard.

Broader policy areas

The *"Declaration to be the World's Most Advanced IT Nation"* includes broader initiatives such as the promotion of IT utilization as a driver for a more competitive industry, regional revitalization and modernization of the Social Security and Tax Number System. Other initiatives include implementing Solution-oriented Open Data (Open Data 2.0), and promoting smooth circulation and utilization of data. All these initiatives support the expansion of Cloud computing either directly or indirectly.

178. International Trade Administration. 2016. "2016 Top Markets Report Cloud Computing. Country Case Study. Japan"
179. Lexology. 2018. "Japan EU Data Transfers – Mutual adequacy findings under APPI and GDPR"
180. Japanese Government. 2017. "Declaration to be the World's Most Advanced IT Nation"
181. Getting the Deal Through. 2017. "Data Protection & Privacy. Japan" https://gettingthedealthrough.com/area/52/jurisdiction/36/data-protection-privacy-japan/

The Nordics

Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	46%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	5.8	in a range from 1 to 7	
Data flows rank	11th	out of 139 countries	
Average connection speed	21.8	Mbps average speed	
e-Government			
Procurement of technology	3.8	in a range from 1 to 7	
Government Online Service	0.85	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.5	in a range from 0 to 10	
Math and science education	5.0	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
High levels of promotion of Cloud through national and international efforts	Different initiatives exist, the most developed ones in Denmark and Norway	Some specific data localisation requirements exist across the Nordic countries	International collaboration, informative papers and Cloud strategies have helped raise awareness	All Nordic countries are members of the ISO ICT standards committee

Publications such as Norway's Cloud Computing Strategy and Denmark's Digital Strategy 2016-2020 provide useful information on the region's long term digital vision to individuals and enterprises. There are some initiatives in place to promote Cloud in the public sector

There are remaining data localisation requirements related to accounting or health in Nordic countries. Applicable requirements could be reviewed taking into account the security features of Cloud.

Google's contribution

Productivity Impact

$180m-$470m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in the Nordics

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[182] was 46%, among the highest Cloud adoption rates globally. This is higher than the average of 30% across the countries analysed in this report and above the average of 21% across the European Union. Adoption in the Nordics has grown 18% in two years and as of 2016 it was higher than the EU average across all business sizes, types of Cloud service and sectors of the economy.[183]

As in other geographies, adoption of Cloud technology is being led by large businesses. In the Nordics, 73% of large businesses have adopted Cloud technology, as opposed to 58% and 44% for medium and small businesses respectively.

Cloud enablers

According to McKinsey research, the Nordics are among the nine European countries labelled as "*digital front-runners*"[184], because of their levels of digital integration and public initiatives to boost the digital economy. Companies in these countries have digitalized large parts of their businesses in recent years, fostering skills development and raising productivity.
The Nordics are among the most advanced regions in terms of connectivity and digital literacy.

- Business usage of ICT in the Nordics is among the highest of the geographies studied, similar to levels observed in Germany, Japan, Israel and the US. They benefit from high connectivity in terms of cross-border data flows. The Nordics also benefit from having the fastest average connection speed among all countries studied.

- Finland, Denmark and Sweden have high scores in the EU's Digital Economy and Society Index (DESI) including in relation to digital public services. However the perception about online Government services of respondents to the UN's survey referenced in this report is less positive than in other countries.

- Both the quality of math and science education and digital literacy are higher than in the majority of geographies studied.

Google Cloud in the Nordics

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. Google partners in the Nordics offer services in digital transformation, migration to Cloud, website design and development as well as geo data collection and sale. For example, EVRY is a Google partner covering a broad range of solutions including G Suite, G Suite for Education, Chrome Management and Google Cloud Platform. They offer their services to companies from sectors such as manufacturing, education, healthcare, media and government.

Google has launched a new Google Cloud region in Finland, which means that customers in the Nordics can run applications based in the Cloud with reduced network latency. In addition, this means that data can be stored within the Finland region.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across the Nordics. Google Cloud is being used by companies in sectors such as education, gaming, media, financial services, healthcare, retail, telecommunications, marketing, technology and the public sector. For example, Google Cloud customers in the Nordics include Spotify in Sweden in the media sector or Kolumbus in the Norwegian public transport sector. In addition, Google customers from the technology sector are using Google Cloud as part of their highly advanced products and services. For example, Digiexam is a producer of automated assessment technology, CCP Games uses Cloud and Kubernetes to run their games and Omnigen is a company making access to DNA sequencing possible for the public.

182. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

183. Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

184. McKinsey & Company. 2017. "Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners"

Kolumbus – Using Machine Learning to improve customer experience

Kolumbus is a Norwegian public company that offers transport services to 500,000 people in Rogaland (Norway). They offer bus and boat services to Norwegian citizens with their fleet of 450 buses, 10 speedboats and 3 ferries.

Kolumbus uses GCP to improve customer experience and reduce IT overhead. The GCP tools used by Kolumbus are Google Cloud Dataflow, Google BigQuery, Google Cloud SQL, Tensorflow, and Google Cloud Machine Learning Engine.

In order to improve customer experience, Kolumbus developed an app that would show users where Kolumbus' buses and boats were located in real-time and where they were going to be in the future. To develop this platform, Computas, a Norwegian company and GCP partner, supported the company and developed solutions for IT work processes and collaboration.

The app was developed using GCP to analyse and store the huge amount of data on the location of the buses and boats at any particular time. Cloud Machine Learning is used to forecast the future locations of buses and boats based on historical data.

Kolumbus began developing this app by building a "real-time" location map of its buses and boats by using Google Maps. Across this map, buses and boats can send their data on their location every few seconds. The buses and boats in Kolumbus' fleet make 85,000 journeys a day, so the information transferred to the database is about two terabytes each day.

To store and analyse this large volume of data requires substantial computing power and GCP provides this to Kolumbus at lower costs, compared with an on premise solution. A key benefit for Kolumbus from using GCP is the cost savings from not needing physical space to locate the IT servers and equipment and from the associated equipment maintenance costs saved.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in the Nordics in the order of **$180 million to $470 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in the Nordics

Overall, the Nordic countries have exhibited a proactive approach to creating an enabling policy environment for Cloud, through a combination of international collaboration and country-specific initiatives, as set out below.

Public sector leadership through a national Cloud strategy

Along with Norway's Cloud Computing Strategy[185] and the Nordic cooperation, both of which explicitly target an objective of increasing public sector Cloud adoption, other Nordic countries such as Denmark include Cloud computing initiatives in their e-government strategy.

Denmark's Digital Strategy 2016-2020[186] includes an initiative for Cloud computing in the public sector, including issuing updated legal guidelines based on the European General Data Protection Regulation describing the possibilities available for the authorities with regard to Cloud computing, and which addresses the assessment and management of security risks. Denmark is fairly advanced in the rollout of independent Cloud-based applications and has seen successful implementations with cost savings for the public sector of 50%-80% from specific Cloud initiatives.[187]

Data localisation

Data localisation restrictions apply in some cases, including the following:[188]

- Denmark's Book Keeping Act requires companies to store accounting data in Denmark for five years and in 2011, the Danish Data Protection Agency denied the city of Odense permission to transfer "sensitive data" such as health or data related to purely private matters to Google Apps.[189]
- Finland's Account Act (1997) requires that a copy of companies' accounting records be stored in Finland. Alternatively, the records can be stored in another EU country if a real-time connection to the data is guaranteed.

185. Ministry of Local Government and Modernisation. 2016. "Cloud Computing strategy for Norway" https://www.regjeringen.no/en/dokumenter/cloud-computing-strategy-for-norway/id2484403/

186. The Government / Local Government Denmark / Danish Regions. 2016. "A STRONGER AND MORE SECURE DIGITAL DENMARK The Digital strategy 2016-2020"

187. European Commission. 2013. "Analysis of Cloud best practices and pilots for the public sector" https://ec.europa.eu/digital-single-market/en/news/analysis-cloud-best-practices-and-pilots-public-sector

188. Information Technology & Innovation Foundation. 2017. "Cross-Border Data Flows: Where Are the Barriers, and What Do They Cost?" http://www2.itif.org/2017-cross-border-data-flows.pdf

189. Information Technology & Innovation Foundation. 2017. "Cross-Border Data Flows: Where Are the Barriers, and What Do They Cost?"

- Swedish accounting requirements force companies to store data about current company records and accounts in Sweden for seven years. In addition, there is the potential for Swedish government regulations to be interpreted such that data processed by a government agency needs to be held within Sweden, which would affect Cloud computing and ultimately result in data localization.

Awareness and understanding

The Nordic countries cooperated through a joint working group to develop a discussion paper, published in 2012,[190] which offered a detailed analysis of Cloud technology and set out the importance of objectives including the definition of common standards, the exchange of best practices, and the removal of barriers to Cloud computing.

In individual countries, separate initiatives have contributed to raising awareness and understanding. For example, the Swedish Pensions Agency published a 2016 report on the impact of Cloud computing, highlighting benefits in terms of innovation, cost-efficiency, flexibility and accessibility. Swedish authorities (the Swedish Civil Contingencies Agency and the Swedish Data Protection Authority) have also issued guidelines and policies for public authorities regarding security requirements in the public procurement process for Cloud services and privacy concerns that must be considered.[191]

Norway's Cloud Computing Strategy[192] reviews the advantages and disadvantages of Cloud computing and encourages the adoption of these solutions by ICT decision makers in the country. It seeks to increase awareness of the security benefits of using Cloud services, noting that *"Cloud computing can enhance technical ICT security when the service provider has better expertise and resources than the customer"*. The Cloud Computing Strategy has been supported by complementary activities, such as Guidelines for Cloud Computing in the health sector, with a focus on "*demystifying the Cloud*" and promoting awareness of potential uses, benefits and risks.

Portability and Interoperability

All Nordic countries promote interoperability of ITC systems in some way. For example, Sweden published its National Strategy for Interoperability[193] in February 2013. It aimed at increasing collaboration and harmonization at organisational, informational and technical level for public authorities. The conceptual architecture model for government ICT in Norway includes interoperability as a main principle.

In addition, all five Nordic countries are full members of the International Organisation for Standardization (ISO), participating in the development of international standards through their respective agencies. Iceland is just an observing member of the top-level ICT standards committee (JTC-1) while all other four countries are participants.

Broader policy areas

All Nordic countries have strategies for the digital modernisation of the country: The recent Digital Strategy[194] in Sweden, "*21 paths to frictionless Finland*"[195], "*Icelandic National Cyber Security Strategy 2015–2026 Plan of action 2015–2018*"[196] , Denmark's "*Digital Strategy 2020*" and the "*Digital Agenda for Norway*"[197]. These all promote the adoption and development of Cloud computing in the region.

190. Nordic Council of Ministers. 2012. "Nordic Public Sector Cloud Computing – a discussion paper" http://norden.diva-portal.org/smash/record.jsf?pid=diva2%3A701433&dswid=1036
191. Getting the Deal Through. 2017. "Data Protection & Privacy. Sweden" https://gettingthedealthrough.com/area/52/jurisdiction/38/data-protection-privacy-sweden/
192. Ministry of Local Government and Modernisation. 2016. "Cloud Computing strategy for Norway"
193. Factsheet: Access to Base Registries in Sweden
194. Ministry of Enterprise and Innovation. 2017. "For sustainable digital transformation in Sweden – a Digital Strategy"
195. Ministry of Employment and the Economy Innovation. 2013. "21 paths to a Frictionless Finland"
196. Ministry of the Interior. 2015. "Icelandic National Cyber Security Strategy 2015–2026 Plan of action 2015–2018"
197. Ministry of Local Government and Modernisation. 2016. "Digital Agenda for Norway"

Benelux

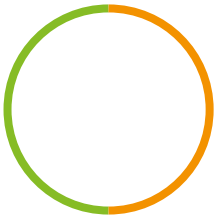
Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	32%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	5.5	in a range from 1 to 7	
Data flows rank	4th	out of 139 countries	
Average connection speed	17.0	Mbps average speed	
e-Government			
Procurement of technology	3.8	in a range from 1 to 7	
Government Online Service	0.84	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.4	in a range from 0 to 10	
Math and science education	5.7	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
The region exhibits a policy environment generally supportive of Cloud	Different initiatives exist, the Belgian G-Cloud being the most developed	Some specific data localisation requirements exist across the Benelux countries	The publication of informative papers and Cloud strategies have helped raise awareness	All Benelux countries are participants of the ISO ICT standards committee

Several publications such as the yearly barometer covering the state of ICT in the region and "Cloudcomputing – een kans voor de Belgische Economie" which studies the specific state of Cloud computing in Belgium are a great example of public initiative to raise awareness



There are remaining data localisation restriction on accounting data in Belgium and Netherlands and client's personal data in Luxembourg. Applicable requirements could be reviewed taking into account the security features of Cloud

Google's contribution

Productivity Impact

$140m-$470m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Benelux

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[198] was 32%, just above the average of 30% across the countries analysed in this report and above the average of 21% across the European Union. Adoption in the Benelux region has grown 28% in 2 years and as of 2016, it was higher than the EU average across all business sizes, types of Cloud service and sectors of the economy.[199] However, Cloud adoption remains below the level observed in geographies such as the Nordics, the US and Japan.

As in other countries, adoption of Cloud technology is being led by large businesses. In the Benelux region, 60% of large businesses have adopted Cloud technology, as opposed to 41% and 29% for medium and small businesses respectively.

According to Equinix[200], and based on Gartner data, the Netherlands is among the six largest European Cloud markets in terms of end-user spending on public Cloud services, and Netherlands Cloud providers are the most likely to have data centre locations in other European countries. In addition, Amsterdam is an attractive European location for US-based Cloud companies to locate service delivery with 36% of US Cloud providers delivering services from data centres in Amsterdam. According to Equinix, this is due to English being widely spoken, relatively unrestrictive legislation and that it is a continental location.

Cloud enablers

According to McKinsey research, the Benelux countries are among the nine European countries labelled as "*digital front-runners*"[201], because of their levels of digital integration and public initiatives to boost the digital economy. Companies in these countries have digitalized large parts of their businesses in recent years, fostering skills development and raising productivity. For example, the Netherlands was the first country to set up a nationwide network to enable IoT.

Across connectivity and digital literacy, the Benelux region is generally among the more advanced of the geographies studied in this report, while it is below the median of the countries studied in relation to e-Government.

- Business usage of ICT is higher than in the majority of geographies, but below that of geographies such as the Nordics and Germany. Regarding connectivity, the Benelux countries are among the leading countries, behind the UK and Germany in terms of cross-border data flows. Benelux has an average connection speed higher than the majority of the countries studied.

- It is a leading region in math and science education and has high levels of digital literacy.

- E-government in the Benelux region is reported to be less developed compared with the median of countries analysed in this report.

Google Cloud in Benelux

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, Signpost België is a Google Cloud partner in Belgium that focuses on the education sector, in particular synchronising existing data systems with G Suite for Education. Claranet Group is a Google Cloud partner in the Netherlands that is specialized in helping companies migrate workloads into GCP, utilising Compute Engine, Container Engine and Cloud SQL.

Belgium and the Netherlands also host Google Cloud regions, which means that customers in the Benelux region can run applications based in the Cloud with reduced network latency. In addition, this means that customers can store data within these regions if required.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across the Benelux region. Google Cloud is being used by companies in sectors such as media, financial services, retail, telecommunications, technology and public sector. For example, Google Cloud customers in the Benelux region include BNP Paribas Fortis in the financial services sector, the Netherlands Organization for Applied Scientific Research (TNO), a knowledge-based industry association, and Weepee in the telecommunications sector.

198. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

199. Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

200. Equinix, Inc. 2013. "Cloud cover in Europe – An assessment of the business climate for cloud services" https://www.firstbaseunlimited.com/wp-content/uploads/2017/11/Equinix_cloud_WP_final.pdf

201. McKinsey & Company. 2017. "Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners"

Weepee – Reducing costs to deliver better services

Weepee, a Belgian telecoms company, provides VoIP (voice over IP) services to more than 30,000 customers and 75,000 registered phone numbers. The company also runs Platform Alpha, a self-service platform for developers hosting over 75 projects.

Before making the transition to Google Cloud Platform, the company used pre-financed IT hardware, which could accommodate a lifecycle of three to five years for a new platform. Now that the lifecycle of a platform is around six months to one year, Cloud offers advantages for managing this shorter lifecycle relative to on premise equipment. Weepee migrated 30 machines to GCP in the course of two days, with the support of Google partner CloudEndure.

Having physical hardware also translated into higher capital expenditure and limited flexibility in adapting to a constantly evolving market. With Google Compute Engine, Weepee reports benefits from pay-as-you-go pricing and auto-scalability. This approach has allowed the company to reduce financial risks associated with investments in servers.

Weepee has clients located outside of Europe. With Google Cloud's globally distributed server network, Weepee has been able to choose datacentres closer to different clients, to minimise the lag experienced when using Weepee's services.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Benelux in the order of **$140 million to $470 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Benelux

Countries in the Benelux region exhibit a policy environment generally supportive of Cloud although some data localisation requirements exist across the Benelux.

Public sector leadership through a national Cloud strategy

In 2012, the Dutch Ministry of the Interior and Kingdom Relations issued a policy note on "The Netherlands iStrategy"[202] explaining the intention to eliminate fragmented IT infrastructure and develop government-wide infrastructure that should be based on the concept of Cloud computing.
In line with this, the data centre in Groningen (ODC-Noord)[203] is now serving 18 central Government customers and is aiming to promote an ethos based on open source and open standards, to reduce vendor lock-in.
The Dutch government expects that all public administrations use open standards, or otherwise explain why an exception is made.

In Belgium, the G-Cloud[204] was born as a hybrid Cloud combining services in public Cloud environments and national data centres based on a joint initiative of several public institutions and implemented by the "Cloud Governance Board". An expanding range of services is made available via an online marketplace, including IaaS, PaaS and SaaS services from various vendors.

In Luxembourg, government representatives meet the Luxembourg information and communications technology (ICT) sector representatives yearly. After the last meeting, the latter have praised the government's efforts and progress in the digital sector, such as the development of the fintech sector, the adoption of an open data philosophy, the implementation of projects such as the Luxembourg digital skills bridge as well as the evolution of the infrachain initiative.[205]

202. Government of The Netherlands. 2012. "The Netherlands' iStrategy" https://www.government.nl/documents/policy-notes/2012/03/30/the-netherlands-istrategy
203. Joinup. 2017. "Open source makes Dutch government cloud a reality"
204. Based on a search of G – Cloud available from: https://www.gcloud.belgium.be/fr/home
205. Based on information found here: https://luxtimes.lu/luxembourg/34334-ict-sector-praises-digital-luxembourg-initiative

Data localisation

Data localisation rules in the Benelux region include the following:[206]

- The Netherlands Public Records Act requires public records to be stored in archives in specific locations in the country.
- Belgium's laws require accounting and tax documents to be kept in the office, agency, branch, or other private premises of the taxpayer where they have been kept, prepared, or sent.
- Luxembourg's financial institutions were required to process their clients' personal data in-country, unless the overseas entity is part of the same company or if the data is transferred with explicit consent. However, the Luxembourg supervisory authority of the financial sector, the CSSF, launched in May 2017 Circular 17/654 to clarify the regulatory environment on IT out-sourcing based on a Cloud computing infrastructure, and now, Luxembourg's regulated institutions face a new opportunity to subscribe to cloud computing services with a third party located abroad. In addition, certain classes of personal data of Luxembourg nationals and sensitive data of companies registered in Luxembourg are restricted from leaving the country and company accounts have to be kept at the company's registered office in Luxembourg.

Awareness and understanding

Authorities in the Netherlands and Belgium have identified the benefits of Cloud computing in their published ICT strategies and other publications.

The Belgian Federal Public Service Economy has published several studies on the impact of Cloud computing in Belgium. For example, "*Barometer van de informatiemaatschappij 2017*", a yearly barometer covering the state of the information and communication technologies in the country, and "*Cloudcomputing - een kans voor de Belgische Economie*", which is a specific study on the state of Cloud computing in Belgium including definitions, potential opportunities and recommendations. In addition, the European Fund for Regional Development has been used to provide SMEs with free expert advice on various practical issues, including the use of Cloud computing.[207]

The Dutch Government has played a role in promoting awareness of open source systems, open standards and avoidance of vendor lock-in through its public sector activities (described above).

Portability and Interoperability

Belgium has mapped the architecture of its Digital Transformation Office upon the European Interoperability Reference Architecture.[208]

The Dutch government promotes open standards for the public sector in order to ensure interoperability and supplier independence. In the Netherlands, open standards are mandatory, on a 'comply or explain' basis.[209] The Standardisation Forum and the Standardisation Board are the entities that promote the use of open standards in the Netherlands. Interoperability is promoted within government, between government agencies but also for citizens and businesses. In addition, the Forum offers a guide, which describes how to maintain and manage open standards.[210]

In addition, all three countries are full members of the International Organisation for Standardization (ISO) and participants in the top-level ICT standards committee (JTC-1), participating in the development of international standards through their respective agencies.

Broader policy areas

All three countries in the region have developed digital strategies in recent years, with the common objective of modernising each country through the enhancement of infrastructures, the support of digital skills programs, the digitalisation of government, the development of the digital economy, and the reinforcement of security and trust in the digital world.

In the area of Open Data policies[211] specially Belgiumis less developed than leading countries such as the UK, with detailed data on government spend and public contracts not being publicly available in any way and other types of data not available free of charge.[212]

206. Information Technology & Innovation Foundation (ITIF). 2017. "Cross-Border Data Flows: Where are the barriers, and what do they cost?" http://www2.itif.org/2017-cross-border-data-flows.pdf

207. European Commission. 2018. "Cloud stakeholders working groups start their work on cloud switching and cloud security certification" https://ec.europa.eu/digital-single-market/en/news/cloud-stakeholder-working-groups-start-their-work-cloud-switching-and-cloud-security

208. European Commission. 2017. "European Interoperability Framework" https://ec.europa.eu/isa2/eif_en

209. European Commission. 2018. "eGovernment in Netherlands"

210. Based on a webinar by Marijke Salters & Marco Aarts in 2015 available from: https://joinup.ec.europa.eu/news/webinar-standard

211. World Wide Web Foundation. 2017. "Open Data Barometer" https://opendatabarometer.org/?_year=2017&indicator=ODB

212. This is particularly the case for Belgium, ranked 29th globally for its Open Data policies.

United States

Cloud adoption and enablers *

Cloud Adoption	Metric	Status
Business used Cloud services	40% - 50% used a Cloud service	
Cloud Enablers		
Connectivity		
Business Usage of ICT	5.9 in a range from 1 to 7	
Data flows rank	7th out of 139 countries	
Average connection speed	18.7 Mbps average speed	
e-Government		
Procurement of technology	4.3 in a range from 1 to 7	
Government Online Service	0.93 in a range from 0 to 1	
Digital literacy		
IDI skills sub-index	9.1 in a range from 0 to 10	
Math and science education	4.5 in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
The US is a leading country in the development of Cloud-related policy, especially creating favourable conditions for the public sector use of Cloud	The Federal Cloud Computing Strategy which includes a Cloud first principle serves as a reference for other countries	Some specific data localisation requirements exist in the USA	Although Cloud computing is generally well promoted, where possible harmonization and simplification of security requirements may help promote further Cloud use	The USA is an active participant in ISO's top level ICT standards committee (JTC-1).

The US is a global leader in adoption of Cloud computing in the public sector with a Federal Cloud Computing Strategy that includes a Cloud first principle, published in 2011

Security requirements are scattered across multiple documents and regulators. In addition, privacy laws are covered in different acts for health insurance, electronic communications, telephone industries and others. Where possible harmonization and simplification may help promote further use of Cloud

Google's contribution

Productivity Impact

$3,000m-$9,300m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in the US

Cloud adoption

An indicative Cloud adoption rate for 2016, reflecting the percentage of businesses that use some form of Cloud services,[213] is estimated as 40%-50%,[214] among the highest Cloud adoption rates globally. This is higher than the average of 30% across the countries analysed in this report and above the average of 25% across OECD countries.

Cloud enablers

Across key Cloud enablers – connectivity, e-government and digital literacy – the US is generally among the more advanced of the geographies studied in this report.

- Business usage of ICT in the US is among the highest alongside Japan and Germany. Regarding connectivity, the US benefits from high connectivity in terms of cross-border flows and it has an average connection speed higher than in the majority of the countries studied.

- E-government, measured by both the UN's Online Service Index as well as the WEF's score of procurement of advanced technology, is higher than the majority of the other geographies.

- The US is ranked highly on the IDI skills index, reflecting high secondary and tertiary enrolment rates, though it scores less highly on quality of math and science education, below countries in northern Europe, UAE and Japan.

Google Cloud in the US

Google Cloud has an established partner ecosystem in the US that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, Igneous specialises in developing innovative solutions for enterprise data storage in the Cloud and Object Computing, Inc. uses GCP to develop solutions for Industrial IOT, data analytics and Machine Learning.

The US also hosts a number of Google Cloud regions in Oregon, Iowa, Virginia and South Carolina with a further region planned for Los Angeles. This means that US customers can run applications based in the Cloud in their nearest region with reduced network latency.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across the US. Google Cloud is being used by companies in sectors such as financial services, gaming, media, marketing, healthcare, retail, technology, telecommunications, education and public sector. For example, Google Cloud customers in the US include companies such as the New York Times in the media space, Kohl's in the retail sector, Johnson & Johnson in the healthcare and life science sector and Sony Music in the music and entertainment sector.

213. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

214. For the majority of countries, Cloud adoption data is provided by Eurostat or OECD. For countries where such data is not available (US, UAE, South Africa, Israel, Saudi Arabia), an indicative rate of Cloud adoption is provided based on observed correlations between Cloud adoption and other variables, such as total Cloud spend and connectivity metrics.

Chicago Department of Transportation – Delivering improved efficiency and public sector savings

The Chicago Department of Transportation (CDOT) is a local government authority responsible for public transport infrastructure in Chicago, including planning, design, construction, maintenance and management.

In 2011, CDOT decided to implement an investment plan to repave streets and roads, replace sewer and gas lines and install new water pipes all across the city, with a number of simultaneous projects to be carried out by 26 different utilities and agencies. In order to coordinate construction projects, drive efficiency and minimise disruption, the CDOT team decided to implement a new management software built on GCP and Google Maps.

In collaboration with a Google partner, CDOT designed and built DotMaps, an interactive web mapping service that allowed the city and external utilities to better manage all the projects that were taking place by using the real-time geolocation information collected and shown by the tool.

DotMaps allows people to collaborate by editing and updating the information related to the status of the projects in progress in real-time, avoiding possible conflicts, saving taxpayer money and reducing unnecessary roadwork easing traffic congestion. DotMaps solved a bedevilling problem for city officials and planners: coordinating public and private construction projects to avoid duplicate work. According to CDOT, the new tool helped save $24 million in 2014.

A key benefit reported from using Google Cloud products is the data analytics capabilities provided. DotMaps manages information of 30,000 current projects on a live interactive map, including details like type of project, agency in charge, data of construction and other data. Making all this information available in a single place has reportedly saved time for city employees, construction teams and citizens themselves.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in the US in the order of **$3,000 million to $9,300 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in the United States

The United States is seen as a leading country in the development of Cloud-related policy, notably in terms of promoting a Cloud First approach in the public sector, as well as creating favourable conditions for the public sector.

Public sector leadership through a national Cloud strategy

The Federal Cloud Computing Strategy establishes a Cloud First principle with the purpose of helping the Federal Government in reaching the level of productivity that the private sector is realizing through Cloud computing. It requires agencies to evaluate safe, secure, Cloud Computing options before making any new investments. Similar principles were subsequently considered or implemented by a number of other countries internationally.

Analysis by the Government Accountability Office (GAO) has documented the growth of Cloud adoption at seven agencies, finding that the number of Cloud services increased from 21 to 101 between 2012 and 2014, achieving savings of around $96 million, based on analysis of just a minority of the services used.[215]

More recently, the US President signed an executive Order on cybersecurity mandating that federal systems move to the Cloud.[216]

Data localisation

A review by the Information Technology & Innovation Foundation identifies a limited number of data localisation requirements in the USA, such as the Tax Information Security Guidelines For Federal, State and Local Agencies, which state that federal agencies must "*restrict the location of information systems that receive, process, store, or transmit [federal tax information] to areas within the United States territories, embassies, or military installations.*"[217]

The country has signed important international agreements in the context of cross border collaboration like the EU-US Privacy Shield that increases the trust in data transfer between Europe and the United States by adhering to commonly agreed rules on data privacy. In addition, the United States used to be part of

215. Cogressional Research Service. 2015. "Overview and issues for implementation of the federal cloud computing initiative: implications for federal information technology reform management".

216. GeekWire. 2017. "Trump signs cybersecurity executive order, mandating a move to cloud computing" https://www.geekwire.com/2017/trump-cybersecurity-cloud/

217. Information Technology & Innovation Foundation (ITIF). 2017. "Cross-Border Data Flows: Where are the barriers, and what do they cost?" http://www2.itif.org/2017-cross-border-data-flows.pdf

the Trans Pacific Partnership that prohibited members from enacting barriers to data flows but the Trump administration decided to leave the partnership in January 2017.

Awareness and understanding

The main objectives of the Federal Cloud Computing Strategy include articulating the benefits, considerations and trade-offs involved in the use of Cloud computing to support effective decisions. While the Strategy was aimed at public agencies, the prominence of this Strategy may have contributed to awareness and understanding more widely.

Steps have also been taken to address potential mistrust in public Cloud providers and provide reassurance regarding data security.[218]

The creation of general security requirements in the US and harmonization of the existing sectoral security requirements which are scattered across multiple documents and regulators could help further reinforce trust in Cloud services in the country based on BSA.

Portability and Interoperability

The American National Standards Institute (ANSI) is a non-profit organization that represents the United States in international standards development processes and the National Institute of Standards and Technology (NIST) is the relevant standards-setting body for the digital economy and Cloud computing.

Most relevant standards in the United States have been developed through international cooperation, and these standards either reflect international standards or are themselves adopted as international standards. Like other countries in this study, the United States is a participant in the top-level ICT standards committee (JTC-1) and provides the current chair of the JTC-1.

Broader policy areas

Other initiatives related to Cloud include the Digital Government Strategy & Open Data Policy.[219] The former was developed to provide agencies with guidance on improving digital services and to enable the government to thrive within the fast-paced, ever-changing world of technology. The latter was developed to enable government to more easily deliver information and services through multiple channels, including mobile, and engage the public and America's entrepreneurs as partners in building a better government.

218. CIO. 2015. "U.S. CIO tells IT leaders to trust the cloud" " https://www.cio.com/article/2996268/cloud-computing/us-cio-tells-it-leaders-to-trust-the-cloud.html

219. Based on information published by CIO.gov available from: https://www.cio.gov/fed-it-topics/modernization/digital-strategy/

France

Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	17%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	5.0	in a range from 1 to 7	
Data flows rank	4th	out of 139 countries	
Average connection speed	10.8	Mbps average speed	
e-Government			
Procurement of technology	4.0	in a range from 1 to 7	
Government Online Service	0.94	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.1	in a range from 0 to 10	
Math and science education	5.1	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
The recent announcement of a Cloud computing strategy is expected to help promote Cloud	The national or sovereign Cloud is expected to be replaced by a hybrid cloud based on a classification of data sensitivity	Uncertainties in relation to certain types of public data can delay adoption	Further development and implementation of a Cloud computing strategy in France would help promote awareness and understanding	France is an active participant in ISO's top level ICT standards committee (JTC-1).

Very recently, the Secretary of State for Digital announced a State's Cloud strategy consisting of a hybrid cloud solution based on the classification of data by usage and sensitivity

There is uncertainty in relation to the obligation to use a Sovereign Cloud or "State Cloud" for certain public data. Clarification of requirements in this regard could help promote adoption

Google's contribution

Productivity Impact

$170m-$610m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in France

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[220] was 17%, lower than the average of 30% across the countries analysed in this report and below the average of 21% across the European Union. Adoption in France has grown 42% in two years. As of 2016 Cloud adoption was higher than the EU average in large enterprises (48%) and lower in medium (28%) and small enterprises (15%). However, Cloud adoption among all the business sizes and sectors, as well as types of Cloud service used is gradually rising.[221]

Though Cloud adoption in France is lower than in some geographies studied, according to Equinix[222] France is the third largest market in terms of end-user spending on public Cloud services in Europe, driven by use of Cloud by large businesses and growth in Cloud-based technology providers and start-ups.

Cloud enablers

Across key Cloud enablers of connectivity, e-government and digital literacy, France is generally more advanced than other geographies studied in this report in relation to some metrics but not in others.

- Business usage of ICT in France is below the levels observed in other European geographies, such as the Nordics, Benelux, Germany and the UK, but it is higher than in Spain and Italy. In addition, average connection speed in France is relatively low in relation to the countries studied in this report. However, France benefits from high connectivity in terms of cross-border data flows.

- Online government services are well developed, though there is potential for increased procurement of advanced technologies relative to other geographies such as Germany and those in the Middle East.

- In terms of supporting digital skills, the quality of math and science education is also relatively advanced, similar to that in the Nordics and Germany but lower than that of Benelux, Japan and the UAE, while the level of development of ICT skills in France is broadly in line with the median of the countries studied.

Google Cloud in France

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, Cirruseo offers tailored support and solutions to its customers in the implementation of Cloud technologies, such as G Suite and Google Cloud Platform, as part of wider digital transformations. Their clients include large French companies such as Veolia, Europcar and Groupe Chantelle. Other companies are using Google Cloud in sectors such as media, gaming, retail, manufacturing, real estate and technology. For example, Google Cloud customers in France include the likes of Airbus Defense and Space in the manufacturing sector, the agricultural cooperative Groupe Dauphinoise and MeilleursAgents in the real estate sector.

220. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

221. Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

222. Equinix, Inc. 2013. "Cloud cover in Europe – An assessment of the business climate for cloud services" https://www.firstbaseunlimited.com/wp-content/uploads/2017/11/Equinix_cloud_WP_final.pdf

Ubisoft – Leveraging scalability to reach a wider audience

Ubisoft is a video game creator with more than 30 studios around the world and around 10,000 employees. It is known for popular titles such as "Prince of Persia" and "Assassin's Creed".

In 2012, Ubisoft decided to adapt its popular game "From Dust" to Google Chrome to benefit from Chrome's rising number of users and to reach a wider audience. They turned to Google Cloud searching for both a powerful tool and specialist expertise and support.

Specific GCP features that attracted Ubisoft to the platform included:

- Big workload management. Ubisoft wanted to prioritise game experience and performance, which required a flexible platform able to manage highly variable player traffic. To do so they relied on Google App Engine, which also enabled interaction with other Google Cloud Platform tools.
- Infrastructure management delegation. Ubisoft wanted a platform that would automatically maintain and manage infrastructure without the company's oversight. Google App Engine helped Ubisoft focus on the game and enhance player experience.
- Data management. Ubisoft's game generated large volumes of gameplay data. This was managed with Google Cloud Storage, which brings together different applications related to Big Data, storage and advanced analytics.

In a fast-moving industry, Ubisoft reports particular benefits from being able to develop the adapted version of the game quickly. Its team was able to prepare a beta version in two months, despite limited prior knowledge of web-based games development.

With Google Cloud, scalability allowed Ubisoft to meet a vast rise in demand when, in May 2012, the number of users increased by nearly a factor of ten, preserving stability of the game. Acording to Ubisoft feedback, with Google App Engine and Google Cloud Storage, they are sure the game will remain available no matter what the demand is, which helps to enhance the user experience.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in France in the order of **$170 million to $610 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in France

France's overall policy environment related to Cloud is ranked ahead of Italy and Spain by the BSA,[223] but behind leading countries such as Germany, Japan, US and UK. The significance of data localisation restrictions is noted, including the use a "sovereign" Cloud provider for public archives along with the non-transferability of public administration data out of the country.[224] Nevertheless, Mounir Mahjoubi, the French Secretary of State for Digital, has recently stated that amendments to the Archives law will be made and has announced a State Cloud strategy. France is ranked as a leader globally on Open Data.

Public sector leadership through a national Cloud strategy

While there have been pilots and initiatives related to Cloud computing in the public sector, these have not been the main focus of past ICT Strategies, which focused primarily on vertical applications such as e-Health and e-Learning.[225]Past initiatives have often focused on the use of private Cloud; for example with the first Government administration Cloud data centre being developed for the Directorate of Legal and Administrative Information.[226]

Challenges such as the decentralisation of IT in the French government along with concerns regarding change and potential costs have reportedly made the transition from traditional IT structures to Cloud solutions difficult.[227] A project for the creation of a national Cloud provider called Andromede did not succeed initially but gave rise to a new initiative assigned to two partially state owned providers, Cloudwatt and Numergy. The latter started offering enterprise-focused services in September 2012, while the former commenced its IaaS service offerings in October 2013.[228] Nonetheless, a recent announcement by Mounir Mahjoubi, Secretary of State for Digital, confirmed a State's Cloud strategy aimed at facilitating and promoting Cloud adoption by the French administration. It consists of the development of a hybrid cloud solution based on the classification of data by usage and sensitivity:[229]

223. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/

224. Source: ECIPE

225. Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

226. Accenture. 2013. "French Government Administration: DILA Enters the Cloud" https://www.accenture.com/t20150713T223250__w__/za-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Technology_4/Accenture-DILA-Enters-the-Cloud.pdf

227. Computer Weekley. 2016. "French public sector's never-ending struggle with the cloud" https://www.computerweekly.com/news/450300488/French-public-sectors-never-ending-struggle-with-the-cloud

228. Gigaom. 2013. "A guide to the French national cloud(s)" https://gigaom.com/2013/11/18/a-guide-to-the-french-national-clouds/

229. Based on an article available here: https://www.numerique.gouv.fr/cloud-gouvernement-strategie

- An "internal cloud" dedicated to sensitive data and applications, accessible to all ministries via an interministerial portal. Hosted by the administration, this cloud will comply with specific security requirements.

- A "dedicated cloud" for data and applications of lower sensitivity, based on a customized external offer for the needs of the State and hosted on dedicated infrastructures. The ANSSI will oversee security. FranceConnect Platform bricks will be pre-integrated to simplify service and application development.

- An "external cloud", dedicated to data and applications of "low sensitivity", consisting of a catalog of cloud offers accessible on the internet, carried out by public purchasing centres to facilitate ordering.

Public bodies will then be able to choose among Cloud solutions based on these criteria. In addition, regulatory adaptations will be made to secure cloud offers with hosting outside the national territory.

Another initiative for Cloud computing in the public sector is UnivCloud,[230] an R&D project aimed to set up an "inter-university community Cloud" platform. This platform will provide users and institutions with shared and personalized services, better skills management and lower costs.

Data localisation

For the storage and processing of all data from public administrations, the French government issued a note in 2016 including the obligation to use of a Sovereign Cloud,[231] that is, a "*deployment model in which the hosting and all the processing performed on data by a Cloud service are physically performed within the national territory by an entity governed by French law and in application of French laws and standards*". However, this note no longer appears in the Official Journal online, but the provisions of the "Code du Patrimoine" are still subject to an interpretation that could restrict the use of cloud computing by any institution producing public archives. This legal uncertainty can hamper the use of cloud computing.

In addition, information involved in legal proceedings cannot be transferred overseas unless permitted by a French court order as stated in the French Blocking Statute.[232]

According to the Digital Trade Restrictiveness Index,[233] France is among the countries with relatively strict data restrictions globally.

Awareness and understanding

France has seen some relevant initiatives managed by the Direction of Inter-ministry ICT systems (DISIC),[234] the main authority at Government level involved in Cloud computing policy. The recent announcement by the French Secretary in charge of Digital and the Head of DINSIC announced on 3rd of July of 2018 a strategy for the use of cloud computing by the administration aims to promote adoption in the public sector (see description above).[235]

Recently, the public agency in charge of IT security, Agence Nationale de la Sécurité des Systèmes d'Information (ANSSI), has published the final version of the requirements repository applicable to cloud computing service providers (SecNumCoud).[236] This is a set of rules for service providers seeking qualification for their services in this area. It covers requirements for the cloud service provider, its staff and the delivery of services.

Qualification may be issued to cloud service providers for SaaS (Software as a Service), PaaS (Platform as a Service) and Infrastructure as a Service (IaaS) services.

Portability and Interoperability

According to the BSA,[237] France favours EU standards above domestic standards in most sectors. Both France and the EU give priority to international standards in the ICT sector. AFNOR represents France in international standards setting processes. France is a founding member and an active participant of the International Standards Organization (ISO). France is a participant in the top-level ICT standards committee (JTC-1).

Broader policy areas

With the aim of tackling concerns about cyber security, the French government issued the French National Digital Security Strategy in 2015.

In addition, the main initiative for the digital transformation of France was published in 2017, the International Digital Strategy.[238] It includes the following objectives that can support an enabling environment for Cloud:

- Promote an open digital environment with universal access and reinforced trust among users

- Promote a transparent European online ecosystem with effective protection of rights and openness of public data.

- Strengthen France's role as a digital hub by supporting the local digital ecosystem and ensuring a focus on cybersecurity.

230. Based on information published by UnivCloud Consortium available from: http://univcloud.fr/

231. Cultural Ministers Council of France. 2016. "Note d'information n°2016/004 du 5 avril 2016 relative à l'informatique en nuage (cloud computing)"

232. Law No. 80-538

233. European Centre for International Political Economy (ECIPE). 2018. "Digital Trade Restrictiveness Index" http://ecipe.org/dte/dte-report/

234. Direction interministérielle du numérique et du système d'information et de communication de l'Etat

235. Direction interministérielle du numérique et du système d'information et de communication de l'Etat. 2018. "Le gouvernement annonce sa stratégie en matière de Cloud"

236. Based on information found here: https://www.ssi.gouv.fr/actualite/secnumcloud-la-nouvelle-reference-pour-les-prestataires-dinformatique-en-nuage-de-confiance/

237. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/

238. France Diplomatie. "Stratégie Internationale de la France pour le numérique"

Germany

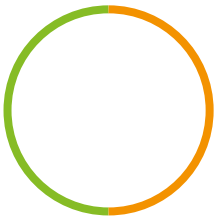
Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	16%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	5.8	in a range from 1 to 7	
Data flows rank	2nd	out of 139 countries	
Average connection speed	15.3	Mbps average speed	
e-Government			
Procurement of technology	4.3	in a range from 1 to 7	
Government Online Service	0.84	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.5	in a range from 0 to 10	
Math and science education	5.2	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Although some initiatives are helping lower barriers to the use of Cloud, there is scope to further develop an enabling environment	Lack of prioritisation of Cloud computing in the public sector through a Cloud first strategy	Specific data localisation restrictions apply in Germany	Initiatives such as Trusted Cloud and the Competence Network Trusted Cloud are good examples of mechanisms to promote the understanding of Cloud services	Germany is an active participant in ISO's top level ICT standards committee (JTC-1).

Certification schemes for Cloud services such as Trusted Cloud and platforms for the exchange of knowledge and best practices like the Competence Network Trusted Cloud (CNTC) are key enablers for the expansion of Cloud computing in the country



Data localisation requirements affect tax, accounting and citizens' registration data. Applicable requirements could be reviewed taking into account the security features of Cloud

Google's contribution

Productivity Impact

$330m-$1,120m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Germany

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[239] was 16%, nearly half the average of 30% across the countries analysed in this report and below the average of 21% across the European Union. Notwithstanding this, other data sources suggest that the extent of Cloud use among those organisations that use it is relatively advanced and that adoption rates today may be significantly higher than indicated by the 2016 statistics. Adoption in Germany has grown 45% in two years and as of 2016 it was lower than the EU average across all business sizes, types of Cloud service and sectors of the economy.[240]

As in other geographies, adoption of Cloud technology is being led by large businesses. In Germany, 38% of large businesses have adopted Cloud technology, as opposed to 20% and 15% for medium and small businesses respectively.

Equinix[241] puts Germany as the second largest European market (after the UK) according to size based on end-user spending in public Cloud services. Frankfurt is estimated to have the joint-highest concentration of Cloud providers in Europe together with London. It is also a popular destination for European Cloud companies for data centre location, due to its geographic central position, the high density of network providers and peering exchanges as well as its stable political system and business environment.

Cloud enablers

Regarding key Cloud enablers – connectivity, e-government and digital literacy – Germany is generally among the more advanced of the geographies studied in this report. In relation to connectivity, Germany is one of the leaders among the countries studied.

- Business usage of ICT in Germany is among the highest, similar to that of the US. Additionally, Germany benefits from high connectivity in terms of cross border data flows. Germany also benefits from an average connection speed higher than the majority of other countries.

- According to the UN's Online Service Index, the Government's online presence remains limited compared to leading countries; however, the government is relatively advanced in terms of procurement of advanced technologies.

- With regard to supporting digital skills, the quality of math and science education is comparatively high in Germany relative to other countries and the level of development of ICT skills in Germany, according to the proxies used by the ITU, is among the top 3 of the countries studied.

Google Cloud in Germany

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions.

Germany also hosts a Google Cloud region in Frankfurt, which means that German customers can run applications based in the Cloud with significantly reduced network latency. Google Cloud is being used by German companies in sectors such as gaming, financial services, healthcare, retail, manufacturing, automotive, marketing and technology. For example, Google Cloud customers in Germany include Metro AG in the food industry, the manufacturer Viessmann and BOTfriends, which provides technological services to Porsche in the automotive sector.

239.The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

240.Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

241. Equinix, Inc. 2013. "Cloud cover in Europe – An assessment of the business climate for cloud services" https://www.firstbaseunlimited.com/wp-content/uploads/2017/11/Equinix_cloud_WP_final.pdf

Scitis – Optimising productivity and efficiency in manufacturing

Scitis.co is an independent digital platform for industry, plant construction and mechanical engineering. Scitis collects, connects and analyses live data from industrial machinery in order to improve efficiency and optimize the value supply chain.

Scitis was born from the collaboration of Achenbach and SOTEC. Achenbach is an independent family-owned company looking back on more than 560 years of history. Today, it is a global provider of non-ferrous rolling mills, especially for aluminium as well as foil slitting machines for winding, separating and slitting thinnest metal foils and converting material. Following its strategy to deliver as specialist all from a single source, the Achenbach OPTILINK® platform opens up an additional USP of great importance.

In order to create a pool of data and use it to optimise productivity, quality and efficiency, Achenbach engineers partnered with manufacturing software experts at SOTEC. SOTEC's Cloudplug technology allows streaming of data from digital controller equipment on machinery to the Cloud. In order to collect and analyse this data in real-time, cost-effectively and at scale, the team reports it identified Google Cloud as the solution offering the best value for money for the performance required.

The result of the collaboration was Scitis, a platform enabled by GCP services such as App Engine, Cloud Storage and BigQuery, which collects data from machines distributed around the world on a daily basis. Based on this, companies can communicate and manage their manufacturing activities much more effectively. They also use GCP Machine Learning as well as a statistical MatLab model to carry out deep analysis of the data in order to forecast future trends and help improve Achenbach's products. According to Scitis, in the past they were not able to compare or analyse live data between plants or to create a full history of data due to capacity limits on local computers. Cloud enables that, so they can have all data centrally without dialling in or sending hard drives around the world.

Scitis is compatible with many digital controllers, meaning that factories can avoid investments of as much as €1 million in proprietary equipment that may otherwise be required to stream manufacturing data. Achenbach reports expected cost savings from efficiency gains over 2-3 years, as well as potentially accessing new markets and building new products based on the Scitis platform.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Germany in the order of **$330 million to $1,120 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Germany

Although some initiatives are helping lower barriers to the use of Cloud, there is scope to further develop an enabling environment. Additional policy steps could be considered, such as Cloud First or similar policies for the public sector, while organisations such as ECIPE[242] have noted that restrictions on cross-border data transfers are relatively strict in the country.

Public sector leadership through a national Cloud strategy

Initial e-government projects, such as BundOnline and the National e-government strategy started as early as 1998. However, Germany has not opted thus far to explicitly promote or prioritise Cloud adoption in the public sector. Technopolis[243] identified two main barriers for the adoption of a public Cloud by the German public administration:

- Application of the e-government initiatives within each *Länder* strategy.
- Each administration has its own data centre established as a private system, so the tendency would be to choose a private Cloud solution over a public Cloud solution.

The German Regulation on the Award of Public Contracts (updated in 2009) promotes a technology-neutral approach to all procurement, subject to some limited exceptions.

One example of public administration use of Cloud is the marketplace 'www.govCloud.de', created by municipal Cloud computing providers to offer tailor-made Cloud services for public authorities in the areas of finance, construction, traffic and health, among others.[244] Another innovative initiative has been the goBerlin project,[245] which has provided citizens with online services through a Cloud-based marketplace.

Data localisation

Restrictions apply in Germany regarding certain types of data.[246] Tax and some accounting and financial data must be kept in Germany. For example, in Brandenburg the registry of residents can only utilise private Cloud computing services which are located in the state. At federal level, the German Federal CIO Council Decision for the use of Cloud services

242. ECIPE. "Digital Trade Restrictiveness Index" http://ecipe.org/dte/dte-report/

243. European Commission. 2013. "Analysis of Cloud best practices and pilots for the public sector" prepared by Technopolis https://ec.europa.eu/digital-single-market/en/news/analysis-cloud-best-practices-and-pilots-public-sector

244. Getting the Deal Through. 2017. "Cloud computing. Germany" https://gettingthedealthrough.com/area/100/jurisdiction/11/cloud-computing-germany/

245. Based on information available from: http://www.goberlin-projekt.de/

246. London Economics. 2017. "Facilitating cross border data flow in the Digital Single Market" https://ec.europa.eu/digital-single-market/en/news/facilitating-cross-border-data-flow-digital-single-market

by German federal organisations states that sensitive information held by German federal institutions must be processed exclusively in Germany.

Even where specific restrictions may not exist, there appears to be a particular focus on the location of data among Cloud users. Research by the US International Trade Administration has found that *"some Cloud industry watchers indicate that Germany is the lone Western European country where opening a local office is virtually a requirement due to consumer concerns about cross-border data transfers and security outside of German borders".*[247]

German authorities have pushed for the development of a more secure environment at a European level, as they state in their current digital strategy[248] *"We must develop a European data region policy based on common principles (e.g. data security and informational autonomy). Trust in the digital environment is weakened whenever there is any concern that basic rights, such as the protection of personal data by the service provider, are not being observed".* According to the BSA, German Data Protection Authorities are among the most active regulators in enforcing cross-border data transfer requirements.[249]

Awareness and understanding

With the purpose of addressing consumers' fears regarding data security, the German authorities have been active in promoting transparency around secure Cloud services. The main initiative is the Federal Ministry for Economic Affairs and Energy's Trusted Cloud,[250] which certifies Cloud services based on compliance with key quality criteria. The Competence Network Trusted Cloud (CNTC) was established after the Trusted Cloud programme formally ended, to continue supporting organisations in transitioning to Cloud services. It does this via a platform for stakeholders to exchange knowledge and best practice, with decision-making guidance for implementing Cloud solutions.

Germany is gradually developing more specific and detailed security requirements for organizations through expansion of key legislation and regulations. The requirements are generally transparent and risk-based.

Portability and Interoperability

Germany is active in the adoption and development and standards. The German Institute for Standardization (Deutsches Institut für Normung, DIN) is contracted by the German government to manage standards development, certification, and accreditation. Germany favours and implements EU standards and international standards in the ICT sector. The DIN represents Germany on the International Standards Organization (ISO), and Germany is an active participant in the international standards process. Germany is a participant in the top-level ICT standards committee (JTC-1).

Broader policy areas

The plan for the digital transformation of Germany is currently captured in its Digital Strategy 2025, which includes a range of action points including the acceleration of digitalisation among SMEs, improvements in broadband connectivity, and facilitating investment in digital technologies. The recent coalition voted by Germany's Social Democratic Party (SPD) has set new goals regarding the digitalization of Germany:

- Bringing gigabit speeds to every part of the country by 2025. Up to €12 billion in subsidies will be available to support the private sector's roll out.

- Granting the states with €3.5 billion to connect schools and universities to the internet under an initiative called "Digitalpakt#D".

- Srengthening Germany's federal information security agency, the BSI. The BSI will be expected to improve its security advice and offerings to citizens, civil society and small- and medium-sized companies, adding to its current responsibility of advising government and industry.

247. Export.gov. 2016. "Overview of Cloud Computing in Germany"
248. Federal Ministry for Economic Affairs and Energy. "Digital Strategy 2025" https://www.export.gov/article?id=Overview-of-Cloud-Computing-in-Germany
249. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
250. Federal Ministry for Economic Affairs and Energy of Germany. "Competence Network Trusted Cloud"

Italy

Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	22%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	3.8	in a range from 1 to 7	
Data flows rank	19th	out of 139 countries	
Average connection speed	9.2	Mbps average speed	
e-Government			
Procurement of technology	2.8	in a range from 1 to 7	
Government Online Service	0.87	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	7.9	in a range from 0 to 10	
Math and science education	4.6	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Italy's policy environment is evolving with scope to further develop an enabling environment	Lack of prioritisation of Cloud computing in the public sector through a Cloud first strategy	There are no general data localisation requirements but tenders by local Public Administrations may sometimes favour data localisation	Initiatives such as The National Industry 4.0 Plan are positive developments but an specific focus on Cloud is missing	Italy is an active participant in ISO's top level ICT standards committee (JTC-1).

Recent steps have been taken towards the digital modernisation of the country. The National Industry 4.0 Plan offers financial and technical support for the digital transformation of the economy including for Cloud adoption

Cloud initiatives for the public sector are included in the Italian Digital Strategy, however, a detailed Cloud computing strategy is missing

Google's contribution

Productivity Impact

$100m-$340m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Italy

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[251] was 22%, lower than the average of 30% across the countries analysed in this report and just above the average of 21% across the European Union. According to Eurostat, more Italian businesses use Cloud-based services for email than the EU average.[252] Cloud adoption in Italy is around the median place of the geographies analysed in this report, below the levels observed in geographies such as the UK, Benelux and Israel.

As in other countries, adoption of Cloud technology is being led by large businesses. In Italy, 50% of large businesses have adopted Cloud technology, as opposed to 30% and 20% for medium and small businesses respectively.

Cloud enablers

Across key Cloud enablers – connectivity, e-government and digital literacy – Italy is generally among the less advanced of the geographies studied in this report.

- Measures of connectivity, including business usage of ICT, cross-border data flows and average connection speed are lower than for the majority of countries studied in this report.
- The UN's score for e-government in Italy is around the median of the geographies studied, however government procurement of advanced technologies is among the lowest only ahead of South Africa.
- With regard to supporting digital skills, the quality of math and science education is below the level of leading European geographies such as the Benelux region, Germany and France, while the level of development of ICT skills and usage in Italy is below that of the majority of countries studied.

Google Cloud in Italy

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, Noovle is a Google Cloud premier partner that specialises in digital transformation and system integration projects for several sectors such as automotive, financial services, retail, media, real estate, energy, public administration, healthcare, education and technology.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across Italy. Google Cloud is being used by companies in sectors such as media, financial services, healthcare, retail, marketing, technology and public sector. For example, Google Cloud customers in Italy include the likes of Banca Mediolanum in the financial services sector, Barilla in the retail sector and Sky Italia in the media and entertainment sector. Banca Mediolanum uses Google BigQuery as a data hub to create customised campaigns on social media. Barilla uses it to improve the efficiency of internal communication by developing an app for factory workers to report issues to other teams and schedule maintenance. Sky Italia has improved the security of its data storage and optimize the time taken by data processing.

251. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

252. Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

Centro Medico Santagostino – Supporting efficiency and growth with G Suite

Centro Medico Santagostino is a network of healthcare specialists operating from 14 locations in Italy. It connects private healthcare providers with more than 240,000 patients and uses technology to make healthcare affordable.

When Centro Medico Santagostino was created, it used on premise IT infrastructure and experienced some obstacles to growth. The company needed to budget based on future expectations and, due to its rapid growth and the discrete nature of IT infrastructure investment, it would often find itself either lacking the necessary capacity or having paid for hardware that was not yet being used. Other barriers included difficulties in responding to new developments with the necessary speed, and problems with email service availability.

To address these barriers the company opted to migrate to G-Suite. It now has 850 G Suite accounts open and nine virtual machines running on GCP, handling some special diagnostic imaging applications.

These changes have eliminated the company's email stability issues and allowed the company to create a simple, accessible, mobile hub to enhance coordination through Google Calendar. Centro Medico Santagostino was also particularly concerned with protecting confidential information. A key benefit reported by the company is the ability to control who reads documents and where information is sent or shared.

The company has also benefited from using Google Forms to collect information from patients via email and use this to obtain new insights, for example regarding dietary and exercise habits. These insights are reportedly helping the organization to refine services and produce marketing.

Thanks to efficiencies made with G Suite, Centro Medico Santagostino reports it connects over 240,000 patients with affordable private healthcare. Going forward, further innovative uses are being explored in conjunction with a Google partner, including the use of BigQuery, ML toots services and IoT for care services in the home.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Italy in the order of **$100 million to $340 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Italy

Italy's policy environment related to Cloud is evolving although it appears less developed than in leading countries. Across policy areas, analysis suggests that there is potential for further action to support digitalisation in general, as well as Cloud specifically.

Public sector leadership through a national Cloud strategy

Italian authorities began considering the potential of Cloud computing around 2010, including through a workshop on "*eGovernment and Cloud computing*", and in 2012 published "*Recommendations and propositions for the use of Cloud computing in public administration*".[253] The document serves as a collection of guidelines aiming to increase the use of Cloud in the Italian public sector.

The Digital Growth Strategy 2014 - 2020[254] was published in 2015. This more recent strategy puts emphasis on the "*extraordinary*" innovative potential of Cloud computing and sets a clear objective to rationalise the public sector's use of IT and stimulate the use of Cloud. The strategy refers to a Cloud-first principle, but it is not clear to what extent this has been applied in practice. Similarly, the strategy set targets for Cloud migration levels to be achieved by 2018 and 2020, but information about progress in relation to these targets is limited.

Subsequently, the Three Year Plan for ICT in Public Administration (PA) 2017 – 2019[255] reasserts objectives to realise cost savings from migrating to Cloud and to create a homogeneous Cloud environment for the public sector that helps address contractual and technical barriers.

A report for the European Commission noted that "*a main barrier to Cloud uptake in the public sector is the law which impedes the sharing of services across different public administrations*".

According to the BSA, there are no national laws or policies in place that specifically promote technology neutrality. Italy has a complex system of national, regional, and local procurement, and neutrality is promoted in some specific regions and localities.

Data localisation

A recent report for the European Commission on cross-border data flows[256] did not identify

253.European Commission. 2013. "Analysis of cloud best practices and pilots for the public sector" https://ec.europa.eu/digital-single-market/en/news/analysis-cloud-best-practices-and-pilots-public-sector

254.Presidency of the Council of Ministers. 2016. "Strategia per la crescita digitale 2014 – 2020"

255.Agenzia per l'Italia Digitale. 2018. "Three-year plan for ICT in Public Administration 2017 – 2019"

256.London Economics. 2017. "Facilitating cross border data flow in the Digital Single Market" https://ec.europa.eu/digital-single-market/en/news/facilitating-cross-border-data-flow-digital-single-market

relevant restrictions in Italy, nonetheless, tenders by local Public Administrations may sometimes envisage stricter data localization requirements, including higher scores for suppliers storing data on a specific territory.[257] The Italian Data Protection Authority has issued guidance explaining the roles of data controllers and processors in a Cloud context.[258]

Awareness and understanding

Government publications, such as the Digital Growth Strategy 2014 – 2020, have emphasised the potential benefits of Cloud. However, less developed digital skills and other barriers may be hampering progress in these areas, as discussed below.

According to the BSA,[259] the measures in the Italian Data Protection Code are quite specific. This may limit its homogenization with other countries' data protection codes. However, this code will soon be repealed and replaced by a legislative decree to adapt the Italian national legislation to the provisions of regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data, and the free movement of such data (General Data Protection Regulation). The decree is currently in a preliminary stage but will be submitted to the Italian Parliament for the review by the competent commissions and then it will be examined and approved definitively by the Government before entering into force.

The National Industry 4.0 Plan[260] includes an objective to create a national network of centres of excellence supporting Italian firms for technology transfer. This initiative includes financial aids for start-up, set-up and project costs of the centres.

Portability and Interoperability

According to the BSA, Italy gives priority to EU standards and international standards in most sectors and international standards are favoured in the ICT sector. Italy (through the Italian Organization for Standardization (UNI) is an active participant in international standards development processes and is a participant in the top-level ICT standards committee (JTC-1).

Broader policy areas

The Agenda for Digital Italy, in line with the Digital Agenda for Europe, covers objectives in areas including IT infrastructure, security, public data, digital skills and digital administration. Alongside this, the Ministry of Economic Development is implementing the Italian strategy for high-speed broadband and has seen increased public and private investment, resulting in ultra-fast coverage increasing from 41% in 2015 to 72% in 2017.[261]

Despite recent efforts, there appears to be significant potential for policy to support further digitalisation in Italy and to create a more enabling environment for Cloud. The European Commission's 2017 Digital Progress Report remarks that Italy's "*slow performance*" is mainly driven by low levels of digital skills, which affect usage of various internet activities.[262]

Companies, due to their limited size, sometimes lack capital and capabilities to invest further in cloud technologies. For this reason, the government launched the National Industry 4.0 plan aimed at providing companies with incentives on investments in cloud-enabled technology. It includes aid through funding, tax credits and loan guarantees. The results of these initiatives have already resulted in new investments in cloud from manufacturing firms.[263]

257. Based on information found here: http://www.ao-garibaldi.catania.it/servizi-e-attivit/bandi-di-gara-e-appalti/allegati/CAPITOLATO-TECNICO(17).pdf

258. Getting the Deal Through. 2017. "Data Protection & Privacy. Italy" https://gettingthedealthrough.com/area/52/jurisdiction/15/data-protection-privacy-italy/

259. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/

260. Ministry of Economic Development. 2017. "National Industry 4.0 Plan"

261. European Commission. 2017. "Europe's Digital Progress Report (EDRP) 2017. Country Profile Italy" https://ec.europa.eu/digital-single-market/en/news/europes-digital-progress-report-2017

262. European Commission. 2017. "Europe's Digital Progress Report (EDRP) 2017. Country Profile Italy"

263. Ministero dello sviluppo economico. 2018. ITALY'S NATIONAL PLAN IMPRESA 4.0 Results from 2017 – Actions for 2018

Spain

Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	18%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	3.9	in a range from 1 to 7	
Data flows rank	16th	out of 139 countries	
Average connection speed	15.5	Mbps average speed	
e-Government			
Procurement of technology	3.2	in a range from 1 to 7	
Government Online Service	0.91	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.5	in a range from 0 to 10	
Math and science education	3.8	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Spain's policy environment is evolving with scope to further develop an enabling environment	Cloud computing has not been prioritised in past digital strategies, however, this may change in the near future	There are no general data localisation requirements but specific requirements insectors like banking may delay Cloud adoption exist	Active initiatives like "Súbete a la nube" to promote awareness and adoption among SMEs are enablers of Cloud computing	Spain is an active participant in EU standards development processes. It is also a participant in ISO's top-level ICT standards committee (JTC-1)

Public authorities have taken action to accelerate awareness and adoption of Cloud among enterprises through a combined program supporting both the demand and supply sides through financial assistance and guidance

Lack of a national Cloud strategy although this may change in the near future with the possible introduction of a new digital strategy in which Cloud computing may play a prominent role

Google's contribution

Productivity Impact

$60m-$200m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Spain

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[264] was 18%, lower than the average of 30% across the countries analysed in this report and below the average of 21% across the European Union. Adoption in Spain has grown 29% in two years and as of 2016, generally, it was similar to the EU average across most business sizes, types of Cloud service and sectors of the economy, except for medium enterprises and certain sectors of the economy.[265] Although Cloud adoption in Spain is low relative to the majority of geographies analysed in this report, it is higher than in other European countries such as France.

As in other countries, adoption of Cloud technology is being led by large businesses. In Spain, 45% of large businesses have adopted Cloud technology, as opposed to 33% and 15% for medium and small businesses, respectively.

Cloud enablers

Across key Cloud enablers – connectivity, e-government and digital literacy – Spain presents a mixed picture.

- Spain benefits from high connectivity in terms of cross-border data flows and from an average connection speed higher than in other countries studied. However business usage of ICT in Spain is among the lowest of the geographies studied, only higher than Turkey and Italy.

- According to the UN, online Government services are relatively prevalent, similar to levels in France and the US. However, in government procurement of advanced technologies Spain is among the least advanced, higher only than Italy and Turkey.

- With regard to supporting digital skills, the level of development of ICT skills is high relative to the other countries studied. However the quality of math and science education is low in Spain relative to other countries, below the level of the other EU geographies analysed in this report and higher only than in Turkey and South Africa.

Google Cloud in Spain

Google Cloud has an established partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across Spain such as financial services, technology and retail. For example, Google Cloud customers in Spain include the likes of BBVA in the financial services sector, BQ and Amadeus in the technology sector and the hotel company NH Hotels. BQ uses Google's Kubernetes engine to keep its team focused on innovation rather than IT maintenance. NH Hotels uses Google Cloud to monitor and improve the quality of service to its customers, through a bespoke solution that hotel guests can use on their mobile devices to deliver feedback.

264.The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

265.Eurostat. 2018. "Cloud computing services" https://ec.europa.eu/eurostat/statistics-explained/index.php/Cloud_computing_-_statistics_on_the_use_by_enterprises

BBVA – Improving collaboration and efficiency through G Suite and GCP

BBVA is a banking and financial services company based in Spain, with presence in more than 30 countries, 8,200 branches over the world and more than 130,000 employees. For a company of this size, internal processes and information management pose challenges.

BBVA regards staying at the forefront of technology and business practice as key for success. Back in 2011, it identified the need to look for a technology that would transform the business operations to increase efficiency and to help teams to collaborate, communicate and share ideas more easily, regardless of location.

The Company decided to integrate G-Suite with its own tools to introduce a new way of working. Through the migration of all email systems to the Cloud with Gmail, and the use of Google Hangouts Meet, Google Sites and Google Docs, the Company wanted to help teams to communicate more seamlessly. With Google Docs for example they were excited about the opportunities for real time collaboration.

The Company has also developed the global intranet by using Google's collaboration tools. This has allowed BBVA to transform the intranet from a corporate communications and process management site to a place where all employees are able to share, contribute and manage knowledge globally. With all these solutions, employees have access to all the information they need with just one click, no matter where they are or what kind of device they use.

BBVA highlights that one of the most valuable aspects of the implementation was how Google took responsibility for the general platform management, allowing the Company to focus on creating value for their teams and clients.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Spain in the order of **$60 million to $200 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Spain

Spain has seen recent improvement in IT infrastructures, cybersecurity measures and participation in the development of international standards and interoperability. Nevertheless, the country's overall policy environment related to Cloud remains less advanced than in other leading European countries. Spanish authorities are continuing to explore initiatives related to adoption and the development of Cloud computing in the context of Spain's digital agenda.

According to industry sources, there is no specific Cloud section in the expected Digital Strategy for an Intelligent Spain. This strategy covers five areas: Data Economy, IT infrastructure, Better Regulation, Industry 4.0 and skills and employment. Responses to public consultations highlighted the need to include a Cloud specific section, or at least, consider measures to boost Cloud in the IT Infrastructure section. According to conversations held with experts in the matter, these public consultations are expected to be taken into account in the final strategy. Work is also being carried out in relation to data privacy, through two taskforces, one in charge of Digital Rights and another one in charge of AI. However, after the recent political changes in Spain, there is some uncertainty in relation to the continuity of these initiatives and the final publication of the Strategy for an Intelligent Spain.

Public sector leadership

The financial crisis, which had profound effects on public sector budgets, has encouraged authorities to focus on improving the cost efficiency of the public administration. For this reason in February 2013, the government issued a communication stating that: "*The Spanish public administration was taking big steps to make of Cloud-Computing the reference model for the provision of ICT services*". A priority project was established to create a private Cloud for the Spanish public administration. This action shows "*the firm and determined bet from the Spanish government to implement the Cloud Computing model within the administration*". Experts interviewed for this study mentioned data security as a concern for the migration of public agencies' IT systems to a public Cloud provider.

However, although experts expect the inclusion of more specific Cloud initiatives in the Digital Strategy for an Intelligent Spain,[266] the development of a specific Cloud computing strategy is what is missing for a decisive impulse on the adoption of Cloud computing in both the public and private sectors.

266. Its publication is uncertain at the time of writing due to the change in Government in Spain

Data localisation

Although according to the BSA[267] there are no formal data localisation requirements in place, certain cross-border data transfers may be restricted. For example, transfers between contractors and the Ministry of Defence are forbidden. Also financial institutions in Spain are reported to be reluctant to outsource core data operations outside of Spain due to compliance requirements around this; requirements such as notify and obtain approval by the Spanish financial supervisor before outsourcing, if core activities are affected.[268]

Awareness and understanding

The Spanish government has pursued initiatives to raise awareness of Cloud computing in the private sector as a mean to increase the competitiveness of Spanish companies, including through the following initiatives.

The Demand-side Program from 2016 was called "Get on the Cloud" ("Súbete a la nube" in Spanish)[269] offering both guidance and financial aid of up to 15.000€ per company to SMEs. The beneficiaries could choose among 300 Cloud products from 100 different certified providers. This program is financially supported by the European Fund for Regional Development.

The Supply-side Program is intended for the creation of new software solutions (SaaS) and the development of tools to facilitate the migration of software that is currently being used by SMEs, to the Cloud in the SaaS model but with the particularity that all these new developments and solutions are to be used by SMEs and micro-SMEs. The program offers financial aid up to €60,000 per SME adding to a total of €25 million. Participation in this program has been successful with more than 600 proposals received.

According to the BSA,[270] security requirements are very limited in Spain and these are generally not applicable to general Cloud computing services and products. Reinforcing transparency in security could help build trust in this technology.

Portability and Interoperability

According to the BSA,[270] Spain favours EU and international standards. Spain is an active participant in EU and International Standards Organization (ISO) standards development processes. Spain is a participant in the top-level ICT standards committee (JTC-1).[271]

Spain also has the National Interoperability Framework intended at supporting the development of e-government in the country. Three key success factors are identified for this framework: the support of a sound legal basis, the role of common infrastructures and services and a strong cooperation effort between public bodies.[272]

Broader policy areas

The Spanish Digital Agenda[273] is the strategy that sets out the guidelines for decision-making regarding ICT and e-government in the country in line with the European Digital Agenda. Six main objectives are identified in the Agenda:

01. Promote the enhancement of networks and services in order to guarantee digital connectivity
02. Develop the digital economy to boost growth, competitiveness and internationalisation of Spanish companies
03. Enhance the electronic administration and digital public services
04. Reinforce trust in the digital world
05. Incentivise R&D for future industries
06. Promote inclusion, digital literacy and training of new ICT professionals

For the second objective the development of Cloud computing is mentioned as a particular area of focus: "*The development of future industries is key to continue with the modernisation and sustainable growth of the Spanish economy. For this purpose, the Agenda proposes measured lines of action to boost the development and use of Cloud computing, smart cities and Big Data, among others*".

267. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
268. European Commission. 2016. "Facilitating cross border data flow in the Digital Single Market" https://ec.europa.eu/digital-single-market/en/news/facilitating-cross-border-data-flow-digital-single-market
269. Spanish Government. 2016. "The Ministry of Industry, Energy and Tourism launches the campaign "Get on the cloud"
270. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
271. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
272. Miguel A. Amutio. 2014. "The National Interoperability Framework of Spain, a Global Approach to Interoperability Integrated in the eGovernment Legal Framework"
273. Spanish Government. 2016. "The Ministry of Industry, Energy and Tourism launches the campaign "Get on the cloud"

Turkey

Cloud adoption and enablers *

Cloud Adoption	Metric		Status
Business used Cloud services	10%	used a Cloud service	
Cloud Enablers			
Connectivity			
Business Usage of ICT	3.8	in a range from 1 to 7	
Data flows rank	29th	out of 139 countries	
Average connection speed	7.6	Mbps average speed	
e-Government			
Procurement of technology	3.7	in a range from 1 to 7	
Government Online Service	0.6	in a range from 0 to 1	
Digital literacy			
IDI skills sub-index	8.0	in a range from 0 to 10	
Math and science education	3.3	in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
There is scope to further develop an enabling environment for Cloud	There are intentions for the creation of a Cloud infrastructure for the public sector but it is not developed yet	There are data localisation restrictions in relation to internet-based payment services providers	Public initiatives to promote awareness and understanding could help foster Cloud adoption	Turkey is only an observer in ISO's top ICT committee (JTC-1).

In their e-Government strategy, Turkish authorities have established the intention to introduce a Cloud computing infrastructure

Data localisation requirements and uncertainty can act as a barrier to Cloud adoption

Google's contribution

Productivity Impact

$10m-$30m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Turkey

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[274] was 10%, lower than the average of 30% across the countries analysed in this report and below the average of 25% across OECD countries.

As in other countries, adoption of Cloud technology is being led by large businesses. In Turkey, 20% of large businesses have adopted Cloud technology, as opposed to 14% and 9% for medium and small businesses, respectively.

Cloud enablers

With reference to key Cloud enablers – connectivity, e-government and digital literacy – Turkey has made progress in some areas while it still has scope for further development in other areas.

- Regarding connectivity, Turkey has business usage of ICT in the middle of the possible range, and average connection speeds half of those of countries such as the UK.
- Government procurement of advanced technologies is ranked as more developed than in Spain, Italy and South Africa, while online Government services rank behind other countries.
- With regard to supporting digital skills, proxy indicators of ICT skills are higher than Spain, Saudi Arabia, South Africa and the United Arab Emirates while the quality of math and science education is seen as relatively low by local business executives.

Google Cloud in Turkey

Google Cloud has a developing partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. For example, Ritmus Turkiye and Inspark Intelligent Business Solutions help other companies migrate to Cloud and the latter was named in "Deloitte Technology Fast 50 Turkey"[275] and "Deloitte Technology Fast 500 EMEA"[276] lists of fastest-growing companies in 2014. In addition, partners such as Basarsoft have specialized in activities such as geolocation technology and others such as Adresgezgini offer digital marketing solutions and web based software development.

Google provides Cloud services to a wide variety of enterprises and organizations in different sectors of the economy across Turkey such as retail, technology and marketing. For example, Google Cloud customers in Turkey include Arcelik in the durable consumer goods industry, the travel technology company MetGlobal and Kale in the ceramic industry. MetGlobal or Arcelik are good examples of advanced Cloud use for data management and analytics. MetGlobal uses high velocity data processing from its software platforms and payment solutions used by those in the travel industry. Arcelik uses big data management and analytics with machine learning tools to analyse data from different business branches and enable a more personalized targeting for its advertisements.

274. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

275. Deloitte Technology Fast 50 Turkey report is available from: https://www2.deloitte.com/tr/en/pages/technology-media-and-telecommunications/articles/Technology-Fast-50-report.html (2014 edition)

276. Deloitte Technology Fast 500 EMEA report is available from: https://www2.deloitte.com/be/en/pages/technology-media-and-telecommunications/articles/technology-fast-500-emea.html

Arcelik – Enabling innovation and improved service

Arcelik is a household appliances manufacturer from Turkey. The Company engages in the production and marketing of durable goods, including household appliances, consumer electronics and after-sale services. Arcelik started its activity in 1955, and now it has eighteen different production facilities in seven countries with 30,000 employees.

Arcelik started to use Google Cloud Platform for a variety of reasons including to:

- Innovate. They operate in a competitive market with high capital expenditure where everything has to be connected. Connecting to the Cloud allows the Company to offer new value added services to its clients.
- Enhance knowledge of their customers. The insight derived from data from products is a very valuable asset for the Company. With GCP they are able to leverage machine learning in order to understand better how their customers use their products. This allows the Company to analyse valuable information on an on-going basis instead of through a one-time sale as was the case originally before using cloud solutions. This has helped the Company to provide more post-sale value added services.

GCP applications being used by Arcelik include G suite, Machine Learning, Cloud Natural Language and IoT. According to Arcelik, GCP has allowed the Company to compete by multiplying their resources. For Arcelik the data security is very important and that is an additional reason why they use GCP.

Arcelik and its parent company Koc Holding is the largest conglomerate in Turkey. Arcelik would like to expand their services to the other countries. They believe that leveraging GCP, would allow them to offer similar capabilities in new markets as they have in Turkey.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Turkey in the order of **$10 million to $30 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Turkey

There are two main strategies in Turkey related to the modernisation of the country on one side and the public sector on the other. The first one is The 2015-2018 Information Society Strategy and Action Plan[277] that follows the national development plan, the second one is the 2016-2019 National e-Government Strategy and Action Plan[278] deriving from the previous one and covering e-government specifically.

Turkey's new privacy law in 2016 has been recognised as a positive development in providing regulatory clarity and certainty and there are plans to develop a Cloud computing infrastructure for public agencies.

In other areas, the BSA[279] finds that internet content regulation and the treatment of international providers in government procurement processes act as barriers for Closud computing in Turkey.

Expert interviews held for this study suggest that strict data localisation requirements and uncertainty about potential future changes act as a barrier to Cloud adoption.

Public sector leadership through a national Cloud strategy

Turkey has some relevant initiatives in place in the context of its e-government policies. These include:

- A research project on big data and Cloud computing called Cloud Computing and Big Data Research Laboratory (B3LAB).
- The 2019-2022 National Smart Cities Strategy and Action Plan described further below.

According to the 2017 report on e-government by TÜBITAK BILGEM (YTE) [280] there is no public Cloud for the central government but a Cloud computing infrastructure will be established for public agencies. *"In line with the action of "64. Building a Government Cloud Computing Infrastructure"* included in the 2015-2018 Information Society Strategy and Action Plan and "*E2.1.1-Establishing and Implementing Public Integrated Data Centres*" included in the "*2016-2019 National e-Government" Strategy and Action Plan, a Cloud computing infrastructure will be established for public agencies. In this scope a road map will be determined to realize principles, bases and standards with R&D work on the integration of public data centres with priority and, at the same time, solutions and technologies like the cloud computing infrastructure and thin client planned to operate on this infrastructure."* In addition,

277. Information Society Department. 2015. "2015 – 2018 Information society strategy and action plan" http://www.bilgitoplumu.gov.tr/en/2015-2018-information-society-strategy/
278. Maritime Ministry and Communications. 2016. "2016 – 2019 National e-government strategy and action plan" http://www.edevlet.gov.tr/wp-content/uploads/2016/07/2016-2019%20National-e-Government-StrategyAnd%20Action-Plan.pdf
279. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
280. Bilgem YTE. 2017. "2017 E-Government in Turkey: an outlook"

The Ministry of Transport and Infrastructure is carrying out studies for the establishment of the PublicNet (Kamu-Net) in accordance with the provisions of Article 5, paragraph 1, Article 5809 of the Electronic Communication Law, the National Cyber Security Strategy and the 2013-2014 Action Plan and the Cyber Security Council Resolutions.

However, no law ensures technology neutrality in the government and Turkey's public tender law provides a preference for domestic bidders. The Law establishes certain threshold values for goods and services to be provided by bidders. The law states that contracting entities "*can bring provisions to the tender documents regarding the restriction of participation to only domestic bidders in case the tender is below the thresholds determined above. Further, in case the tender is above such thresholds, in tendering such services and works, a price advantage up to 15% for all domestic bidders shall be granted.*"

Data localisation

Industry experts and organisations such as ECIPE have noted that Turkey has restrictive data localisation laws. The Information Technology and Innovation Foundation[281] provides examples, such as the Law on Payments and Security Settlement Systems, Payment Services and Electronic Money Institutions. From 2013, this forced internet-based payment services to store all data in Turkey for ten years. This reportedly resulted in some providers, such as PayPal, ending operations in the country.

In 2016, Turkey enacted the Law on Protection of Personal Data requiring firms to store data on Turkish citizens within the country unless the affected citizen gives "express consent" for the transfer of the data to another country. In addition, the "Data Protection Board" of Turkey has a country-by-country assessment of privacy protection approach. Allowing data transfers only to those countries that assure "adequate" privacy protection.

International collaboration on privacy protection and international harmonization of regulations in this area could help foster cloud adoption.

Awareness and understanding

There is limited evidence of initiatives in this area, though initiatives such as the 2019-2022 National Smart Cities Strategy and Action Plan on which the authorities are currently working day to day are a promising development towards the introduction of Cloud solutions in citizens' lives.

Regarding security, the Data Protection Law does not prescribe any specific technical requirements and there are no other enforceable security requirements in place.[282]

Portability and Interoperability

According to the BSA,[283] Turkey favours a mix of EU and international standards over domestic standards. It is an active participant in International Standards Organization (ISO) committees and working groups. Turkey is an observer in the top-level ICT standards committee (JTC-1). However, Turkey's progress toward integration with the European and international communities has stalled, and some domestic preferences are still in place for government procurement opportunities.

Broader policy areas

There are two main strategies in Turkey related to the modernisation of the country on one side and the public sector on the other: The 2015-2018 Information Society Strategy and Action Plan[284] and the 2016-2019 National e-Government Strategy and Action Plan[285] setting four main objectives:

01. Ensure the Efficiency and Sustainability of the e-Government Ecosystem
02. Activate Joint Systems for Infrastructure and Administrative Services
03. Ensure e-Transformation in Public Services
04. Increase Usage, Participation and Transparency

In addition, the 2016-2019 *National Cyber Security Strategy and Action Plan* covers security issues regarding national cyber space, helping to build trust in online technologies such as Cloud computing.

281. Information Technology & Innovation Foundation. 2017. "Cross – Border Data Flows: Where are the barriers, and what do they cost?" http://www2.itif.org/2017-cross-border-data-flows.pdf
282. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" http://cloudscorecard.bsa.org/
283. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" http://cloudscorecard.bsa.org/
284. Information Society Department. 2015. "2015 – 2018 Information society strategy and action plan" http://www.bilgitoplumu.gov.tr/en/2015-2018-information-society-strategy/
285. Maritime Ministry and Communications. 2016. "2016 – 2019 National e-government strategy and action plan"

Israel

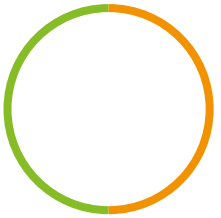
Cloud adoption and enablers *

Cloud Adoption	Metric	Status
Business used Cloud services	20% - 30% used a Cloud service	
Cloud Enablers		
Connectivity		
Business Usage of ICT	5.8 in a range from 1 to 7	
Data flows rank	56th out of 139 countries	
Average connection speed	13.7 Mbps average speed	
e-Government		
Procurement of technology	4.4 in a range from 1 to 7	
Government Online Service	0.86 in a range from 0 to 1	
Digital literacy		
IDI skills sub-index	8.4 in a range from 0 to 10	
Math and science education	4.1 in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
The regulatory environment is favourable to Cloud although there is room for further policy development	The public sector is lagging behind the private sector and public sector Cloud adoption is limited	Public sector data is subject to restrictions on data flows	High levels of innovation and digital literacy translate into positive awareness of Cloud in Israel	Israel is only an observer of the ISO ICT standards committee

Digital literacy is highly supported as reflected in the ranking of the Technion-Israel Institute of Technology as the 1st in the world in teaching digital skills according to the Times Higher Education survey and the 5x2 initiative to double the number of high school students majoring in math, science or engineering



Cloud adoption in the public sector remains relatively limited. Approaches to IT infrastructure development and operation are sometimes fragmented across Ministries. A national Cloud strategy is missing

Google's contribution

Productivity Impact

$70m-$220m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Israel

Cloud adoption

In 2016, the estimated Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[286] was 20%-30%,[287] close to the average of 30% across the countries analysed in this report. However, Cloud adoption is below the level observed in countries such as the Nordics and Japan.

The World Bank[288] has described Israel as a leading country in IT security, cybersecurity solutions, Cloud computing, business intelligence, virtualization and internet applications. It estimates that more than 100 Israeli software companies are active in the Cloud computing space, including in the areas of IT security and management, business intelligence, CRM, ERP, knowledge and content management, and industry-specific applications.

More widely, Israel is characterised by an entrepreneurial and innovative business environment, as shown by the relatively large number of start-ups in the country. [289] The agility of Israel's businesses, lends itself towards adoption of new technologies such as Cloud and creation of new business models based around these.

Cloud enablers

With regard to key Cloud enablers – connectivity, e-government and digital literacy – the picture of Israel is a mixed one.

- Regarding connectivity, business usage of ICT in Israel is above the levels observed in other Middle East and African countries, and some European countries such as France, Spain, Italy or UK. However, Israel is less advanced in terms of cross-border data flows and average connection speeds.

- In terms of e-government, government online services are less developed than in the majority of countries, however government procurement of advanced technologies is among the highest relative to other countries studied, according to a survey completed by local business executives.

With regard to supporting digital skills, the quality of math and science education is below the level of leading countries such as Finland and Belgium and only better ranked than South Africa, Turkey, Spain and Saudi Arabia. The level of development of ICT skills and usage in Israel is in line with the median of the countries studied. The 5x2 initiative[290] founded in 2013, led by the Ministry of Education and supported by different foundations, aims at developing a highly skilled IT workforce in the future through the increase of high school graduates majoring in science and technology.

Google Cloud in Israel

Google Cloud has a developing partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. Among those partners, some offer more general IT consultancy services to help customers migrate to Cloud and specifically G Suite and some others offer more specialised services. For example, Softimize, a company highly experienced in IoT, helps its customers develop Cloud, mobile and web components of IoT technology to build into their products.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across Israel such as gaming, media and technology. For example, Google Cloud customers in Israel include Breezometer, Liveperson and Jelly Button. Breezometer develops technology for monitoring air quality. Liveperson produces messaging platforms for communication with customers and uses GCP with Kubernetes and flexible Docker-based technology to ensure its services are capable of being used by its customers with different systems and adapting to variable traffic workload. Jelly Button is a mobile gaming company with a need for scalable infrastructure.

286. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

287. For the majority of countries, Cloud adoption data is provided by Eurostat or OECD. For countries where such data is not available (US, UAE, South Africa, Israel, Saudi Arabia), an indicative rate of Cloud adoption is provided based on observed correlations between Cloud adoption and other variables, such as total Cloud spend and connectivity metrics.

288. "Best practices and lessons learned in ICT sector innovation: a case study of Israel", World Development Report 2016 http://documents.worldbank.org/curated/en/657111468185331183/Best-practices-and-lessons-learned-in-ICT-sector-innovation-a-case-study-of-Israel

289. Embassy of Israel in Vietnam. 2017. "What made Israel a startup nation" http://embassies.gov.il/hanoi/opinions/Pages/What-made-Israel-a-startup-nation.aspx

290. Based on information found here: http://www.5p2.org.il/about-the-5x2-initiative/

SelectMedia – Innovation through rapid data-driven decision-making

SelectMedia is a media and online advertising company based in Israel and founded in 2012. The company uses an innovative proprietary algorithm to place online video advertisements. It serves customers in 55 countries.

SelectMedia relies on Google Cloud to ensure that it maintains the required levels of compute power in a rapidly changing marketplace and that it keeps delivering fast in an industry where speed of service is important. Key features of Google Cloud that it highlights include:

- Big workloads management. SelectMedia creates value by placing the right advertisements in the right places and doing so at high speed. For this task, the company relies on Google App Engine's versatility and scalability, which also saves on time and money spent on infrastructure maintenance, to allow the IT team to focus instead on adding value to the customers and improving its algorithm.

- Data analytics. To analyse optimal advertisement display the company needs to process massive amounts of data and for this they rely on Google BigQuery.

"We're a startup company. If we didn't use Google App Engine, our learning curve, the number of people and working hours that we would need to arrive to the place we are now, would be much higher. It let us focus on our business logic and the needs of our customers." says Nir Zigler, Vice President of Research and Development at SelectMedia.

SelectMedia also uses Google Cloud Content Delivery Network (CDN), a service specifically designed to accelerate content delivery and reduce network latency, and Compute Engine for some development environments, noting the benefit of scaling these up or down very quickly.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Israel in the order of **$70 million to $220 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Israel

Industry experts recognise that the regulatory environment in Israel is favourable to Cloud adoption, compared to other countries in the region. Nevertheless, there may be scope for further policy development, for example in relation to public sector Cloud adoption, legislation related to ICTs, and Open Data policy.

Public sector leadership through a national Cloud strategy

According to interviews held, at present, Cloud adoption in the public sector remains relatively limited. Approaches to IT infrastructure development and operation are sometimes fragmented across Ministries and Government data centres are operating at low utilisation rates. Public sector organisations in Israel are typically less agile than the relatively entrepreneurial private sector in terms of adopting new IT technologies.

Israel's ICT Authority was established in 2012 and a 2014 Government decision set an objective to move towards a harmonised, Cloud-centric model.[291] Further work has sought to promote Cloud use throughout Government and define which non-sensitive workloads could be moved to the Cloud.[292] Nevertheless, Israel's current policy for Cloud in the public sector is currently focused on achieving Cloud readiness', which could pave the way for further policy change in the future, such as a Cloud First policy.

A step recently taken has been a change in the public procurement process for public agencies to choose IT providers, including for Cloud services. With the establishment of a Framework of providers, public bodies are able to receive quotes and make procurement decisions in days, whereas previously tender processes would typically have taken six months or longer. In the future, this could be supplemented by an online marketplace, similar to other countries such as the UK.

Data localisation

Israel's data localisation laws prevent cross-border transfers of much of the data held by public authorities. Industry experts have suggested that this acts as a barrier to wider use of Cloud in the public sector.

In the private sector, data localisation restrictions appear less prevalent, with territorial localisation of data typically only required in specific

291. Government of Israel. 2014. "Expanding the fields of government ICT, encouraging innovation in the public sector, and promoting the "Digital Israel" https://www.gov.il/BlobFolder/news/digital_israel_national_plan/en/The%20National%20Digital%20Program%20of%20the%20Government%20of%20Israel.pdf

292. Cloud Security Alliance Israel (CSAIL). 2017. "RSA Conference 2017 - Balancing Innovation and Security – Cloud Adoption at Governments" https://www.rsaconference.com/events/ap17/agenda/sessions/4633-balancing-innovation-and-security-cloud-adoption-at

instances, such as for particular types of data held by financial or insurance companies. Nevertheless, there may still be areas of uncertainty around the application of Israel's Privacy Law, data export restrictions and database registration requirements in a Cloud context, with some industry commentators suggesting that further guidance on these topics could help enhance certainty among organisations.[293]

Israel is one of the countries considered by the EU to provide an adequate level of data protection allowing the transfer of personal data between the EU and Israel without any restrictions.[294]

Awareness and understanding

The country's entrepreneurial and innovative business environment favours relatively high levels of awareness and understanding of ICT in general, and Cloud in particular. This is supported by relatively high levels of education and digital literacy, as well as Government R&D funding and incubator programmes, which have created an enabling environment for Cloud.

Portability and Interoperability

The Standards Institutions of Israel (SII) is the national standardization body of Israel. It works with the public and private sector in three main areas: Standardization, testing and certification. Furthermore, it is a founding member of the International Standards Organization (ISO). However, Israel is just an observing member of the top-level ICT standards committee (JTC-1).

Broader policy areas

The Ministry for Social Equality issued The National Digital Program of the Government of Israel. One of its primary goals is focused on accelerating economic growth through digitalization. The development of Big Data, digital health, digital education, smart cities along with better digital competencies are highlighted as the main drivers for the realization of several socio-economic benefits for the country. As the program itself puts it: "*The challenge facing the State of Israel is to utilize the advantages of digitization to create an innovative, advanced and competitive economy, while utilizing the advantages of ICT to deepen economic growth and its penetration to all economic sectors and the population at large.*"

Advanced digital skills are also supported in various ways in Israel. At secondary education level, the 5x2 initiative aims at doubling the number of students who excel in math, science and engineering tracks at the 5-study unit level.

At a higher education level, the Technion-Israel Institute of Technology was ranked No. 1 in the world in teaching digital skills to its graduates[295] and the Government's cybersecurity unit 8200 has instilled advanced capabilities in thousands of Israelis working there, spawning a number of start-ups. By one estimate, more than 1,000 start-ups have been founded by 8200 alumni.[296]

293. Lexology. 2016. "Thinking out loud about cloud" https://www.lexology.com/library/detail.aspx?g=12b3aef2-80d0-44fd-8212-1f40eb0bd8bd

294. European Commission. "Adequacy of the protection of personal data in non-EU countries" https://ec.europa.eu/info/law/law-topic/data-protection/data-transfers-outside-eu/adequacy-protection-personal-data-non-eu-countries_en

295. Haaretz. 2017. "Israel's technion beats MIT in teaching digital skills to graduates" https://www.haaretz.com/israel-news/.premium-technion-beats-mit-in-teaching-digital-skills-to-graduates-1.5627086

296. Forbes. 2016. "Inside Israel's secret stratup machine" https://www.forbes.com/sites/richardbehar/2016/05/11/inside-israels-secret-startup-machine/

Saudi Arabia

Cloud adoption and enablers*

Cloud Adoption	Metric	Status
Business used Cloud services	12% - 17% used a Cloud service	
Cloud Enablers		
Connectivity		
Business Usage of ICT	3.9 in a range from 1 to 7	
Data flows rank	53rd out of 139 countries	
Average connection speed	6.7 Mbps average speed	
e-Government		
Procurement of technology	4.5 in a range from 1 to 7	
Government Online Service	0.67 in a range from 0 to 1	
Digital literacy		
IDI skills sub-index	7.6 in a range from 0 to 10	
Math and science education	4.1 in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Policy progress has been made recently although there is still scope for further development	Some recent initiatives are promoting public sector Cloud adoption, however a Cloud strategy is missing	Cross-border data transfers are allowed depending on levels of data sensitivity	Guides to the recent Cloud Computing Regulatory Framework have been published	Saudi Arabia is only an observer of the ISO ICT standards committee

Along with the recent Cloud Computing Regulatory Framework, four related guides were issued for providers, individuals, enterprises and government agencies aimed at facilitating the understanding of cloud computing and the new regulatory framework

Low levels of connectivity in the Kingdom, with slow average connection speeds and low usage of ICT among businesses, may be limiting Cloud adoption in the country

Google's contribution

Productivity Impact

$10m-$35m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in Saudi Arabia

Cloud adoption

In 2016, the estimated Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[297] was 12%-17%,[298] lower than the average of 30% across the countries analysed in this report and close to the average of 18% across Middle East and African countries studied.

Cloud enablers

Across key Cloud enablers – connectivity, e-government and digital literacy – Saudi Arabia is generally among the less developed of the countries studied in this report.

- Regarding connectivity, business usage of ICT in Saudi Arabia is below the levels observed in other countries and the least developed of the Middle East countries analysed in this report. Additionally, Saudi Arabia sees limited cross-border data flows and slow average connection speeds, relative to the other countries studied.

- Online Government services are among those less developed across the countries analysed in this report. However, the Saudi Arabian government has been recognised for its prevalent procurement of advanced technologies relative to other countries.

- With regard to supporting digital skills, the quality of math and science education is below the level of Middle East countries analysed such as Israel and the United Arab Emirates, but it is higher than in Spain, Turkey and South Africa. Other proxies for ITCT skills in Saudi Arabia are among the lowest of the countries studied.

Google Cloud in Saudi Arabia

Google Cloud has a developing partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions.

According to Forbes,[299] the Middle East data centre market is underserved and competition is heating up. According to Google parent Alphabet, Google is planning to build a Cloud region in Saudi Arabia in a venture with Saudi Aramco, the public oil and gas company in Saudi Arabia.

Google provides Cloud services to a wide variety of enterprises and organizations across Saudi Arabia. For example, Google Cloud customers in Saudi Arabia include Naghi Group, which operates in various sector across their different subsidiary companies such as automotive, private and public transportation, consumer goods and logistics and distribution.

297. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

298. For the majority of countries, Cloud adoption data is provided by Eurostat or OECD. For countries where such data is not available (US, UAE, South Africa, Israel, Saudi Arabia), an indicative rate of Cloud adoption is provided based on observed correlations between Cloud adoption and other variables, such as total Cloud spend and connectivity metrics.

299. Forbes. 2018. "Google and Saudi Aramco may build data centres in the desert" https://www.forbes.com/sites/ellenrwald/2018/02/01/google-and-saudi-aramco-may-build-data-centres-in-the-desert/

Naghi Group – Improving efficiency and reducing costs

Mohamed Yousuf Naghi & Brothers Group is a group of companies, which operates in various sectors such as automotive sales and distribution, private and public transportation services, fast moving consumer goods and logistics and distribution services through numerous international and well-known brands. The company also operates and manages one of the largest bus and coach companies in the Middle East with over 12,000 units and is a major trader of fast moving consumer goods.

Naghi Group decided to adopt G Suite for its business email service, having previously migrated from on premise solutions to Cloud around three years earlier using an alternative public Cloud provider. With the support of Google and a local Google Partner, Naghi Group was able to migrate approximately 3,700 users to the new system in the space of two months, with no data loss and without any significant downtime for users.

The decision to switch to G Suite was based on a combination of financial and performance advantages that Naghi Group identified.

Relative to the previous provider used, adopting G Suite has delivered licence cost savings of around 40-50%, in addition to key performance benefits such as:

- Improved spam filtering and security. Naghi has experienced a vast decrease in the number of spam emails arriving in inboxes, with improved protection from potential phishing attacks or similar risks.
- Improved efficiency. For example, searching through email histories is a notably faster process since adopting G Suite.

Relative to the on premise email service originally used, there were further benefits of using G Suite, according to the Company. This includes further savings from the significantly improved availability and reliability of the email service using G Suite; with the original system, the company reports it experienced multiple incidents and service disturbances per year, causing downtime, as well as occasional major crashes, which were costly to resolve.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in Saudi Arabia in the order of **$10 million to $35 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in Saudi Arabia

The Government has recently moved to clarify the regulatory environment for Cloud with the Cloud Computing Regulatory Framework (CCRF)[300] that entered into force in early 2018. The purpose of this framework is to set out the rights and obligations of the service providers, individual customers and government entities and enterprises, with the objective of providing increased regulatory clarity and encouraging Cloud adoption.[301] The impact of the new Framework in practice is likely to become clearer over the next few years.

Public sector leadership through a national Cloud strategy

Saudi Arabia does not have specific rules regarding public procurement of Cloud services but, as described further below, there is a Guide to Cloud Computing Service for Government agencies.[302] The Guide provides an introduction to the concept of Cloud computing and its benefits, examples of how Cloud can be used, and guidelines related to information security and data protection.

Going forward, the country's e-Government program (YESSER) includes an objective for the development of a Hybrid Cloud model including Iaas, Paas and Saas documents, products and services.

Data localisation

The CCRF classifies data in four categories by level of required information security. According to this, data-localisation restrictions apply to content pertaining to the third category, which includes data from private sector regulated industries and sensitive public sector data. The CCRF states that: "*CSPs must ensure that no Level 3 Customer Content is transferred outside the Kingdom, for whatever purpose and in whatever format, whether permanently or temporarily (e.g. for aching, redundancy or similar purposes), unless this is expressly allowed under the laws or regulations of the Kingdom, other than this Regulatory Framework*". The fourth level refers to highly sensitive or secret customer content belonging to relevant governmental agencies or institutions, where the non-transfer of this data is presumed.

Awareness and understanding

As a complement to the CCRF, the Communications and Information Technology Commission issued four guides to Cloud Computing Services, for Cloud providers,

300. Communications and Information Technology Commission. "Government Agencies' Guide to Cloud Computing Service" http://www.citc.gov.sa/en/RulesandSystems/RegulatoryDocuments/Documents/GovernmentAgenciesGuidetoCloudComputingService_en.pdf

301. Lexology. 2016. "CITC's new cloud computing regulatory framework in Saudi Arabia" https://www.lexology.com/library/detail.aspx?g=1647717b-8262-4c75-9072-461ccff0cd5a

302. Communications and Information Technology Commission. "Cloud computing regulatory framework" http://www.citc.gov.sa/en/RulesandSystems/RegulatoryDocuments/Pages/CCRF.aspx

individuals, enterprises and government agencies respectively. The latter three have a common objective: provide these stakeholders "*with a basic understanding of Cloud Computing services, as well as examples and information on the new Regulatory Framework's provisions and implications*". The guide for Cloud service *providers explains the registration process and requirements for Cloud Service Providers (CSPs) operating in the Kingdom.*

Portability and Interoperability

The Saudi Standards, Metrology and Quality Organization (SASO) is the organization representing Saudi Arabia in the ISO. Its board of directors is composed of a combination of representatives from different ministries along with representatives of the private sector, so that, different points of views are taken into account in the standard-setting process. Saudi Arabia is only an observing member of the top-level ICT standards committee (JTC-1).

Broader policy areas

The Kingdom is currently implementing a National Transformation Program 2020. This corresponds to the commitment of Saudi Arabia's Vision 2030 to develop the digital infrastructure, activate economic sectors, support industries and private sector entities, and advocate for the development of public-private business models

The main initiatives related directly or indirectly to the support of Cloud computing are launching:

- a comprehensive digital literacy program,
- ICT training centres in partnership with major companies in the ICT sector,
- the government Cloud and increasing the level of government integration, and
- the "Broadband Stimulation Fund" to raise the competitiveness of operators and accelerate the deployment of fibre optics in urban areas.

South Africa

Cloud adoption and enablers*

Cloud Adoption	Metric	Status
Business used Cloud services	12% - 17% used a Cloud service	
Cloud Enablers		
Connectivity		
Business Usage of ICT	4.2 in a range from 1 to 7	
Data flows rank	80th out of 139 countries	
Average connection speed	6.7 Mbps average speed	
e-Government		
Procurement of technology	2.8 in a range from 1 to 7	
Government Online Service	0.56 in a range from 0 to 1	
Digital literacy		
IDI skills sub-index	6.0 in a range from 0 to 10	
Math and science education	2.0 in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
There is room for further policy development	The public sector is lagging behind the private sector. There are some fragmented ad-hoc Cloud computing solutions developed by some authorities	According to different sources like BSA or ECIPE data localisation is not a barrier for Cloud computing in South Africa	Awareness and understanding of Cloud computing is limited in South Africa as there are no public initiatives to promote it	South Africa is a participant in ISO's top ICT committee (JTC-1)

Data localisation requirements in South Africa do not appear to represent a major barrier to the use of Cloud. Initiatives such as the South African Development Community (SADC) plan to develop an integrated, interoperable Cyber Infrastructure in the South African region are a positive example of international collaboration that can support use of Cloud

The public sector is lagging behind the private sector in Cloud adoption due to factors such as skill shortages and lack of a specific Cloud computing policy

Google's contribution

Productivity Impact

$20m-$65m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in South Africa

Cloud adoption

In 2016, the estimated Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[303] was 12%-17%,[304] lower than the average of 30% across the countries analysed in this report and below the average of 18% across Middle East and African countries studied.

Cloud enablers

Across key Cloud enablers – connectivity, e-government and digital literacy – South Africa is generally less advanced than the countries studied in this report.

- Regarding connectivity, business usage of ICT in South Africa is similar to countries such as Spain and Italy, but cross-border data flows and average connection speeds are lower than other countries studied.

- E-government metrics are the lowest among the countries studied, as are digital literacy indicators.

Google Cloud in South Africa

Google Cloud has a developing partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions. To achieve this goal Google partners in South Africa mainly offer advisory services related to Cloud implementation and tailored solutions relying on Google Cloud Platform.

Google provides Cloud services to a wide variety of enterprises and organizations in different economic sectors across South Africa such as media, financial services, retail and public sector. For example, Google Cloud customers in South Africa include Tiso Blackstar in the digital media sector, Nomanini in the development of payment methods and Multichoice, the largest pay-TV company in Africa. By analysing customer data with BigQuery and data warehousing, Multichoice was able in just one month to extract valuable business intelligence and improve client retention.

Nomanini – Enabling innovation and growth in payments through GCP

Based in South Africa, Nomanini provides enterprise payments platforms. Many people around the world don't have a bank account, and instead use prepaid vouchers to buy services such as phone airtime, electricity and insurance through a network of regional distributors. However, managing payments and distributing vouchers to customers living in far-flung locations presents logistical challenges.

That is where Nomanini comes in. The Cape Town, South Africa-based company has built a handheld prepaid vending terminal tied to a cloud-based transactional platform. The Nomanini platform creates a direct conduit from remote points-of-sale to service providers and prepaid distributors.

The Company relies on different Cloud Platforms components such as Google Cloud Data Store, Big Query and Google Prediction API to analyze terminal data and send sales trends and predictions back to the regional distributors, who use a dashboard to access the information. The platform averages about 20 to 30 queries per second running on 10 to 20 instances on App Engine.

GCP supports Nomanini's need for a high-performance platform while obviating the need for software engineers to spend time on administrative chores. The Company estimates that App Engine saves software team's time equivalent to one full-time employee in a team of six. This gives them a 15 percent to 20 percent productivity boost because now that person can work on new features for their product.

In the long run, the company hopes to expand across many markets in the developing world, bringing technology to more people. According to Nomanini Cloud Platform gives them a platform that can easily grow along with them.

303. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

304. For the majority of countries, Cloud adoption data is provided by Eurostat or OECD. For countries where such data is not available (US, UAE, South Africa, Israel, Saudi Arabia), an indicative rate of Cloud adoption is provided based on observed correlations between Cloud adoption and other variables, such as total Cloud spend and connectivity metrics.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in South Africa in the order of **$20 million to $70 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in South Africa

South Africa's policy environment related to Cloud computing is significantly less advanced than in leading countries globally, though its policies in relation to cross-border data transfers appear favourable to Cloud adoption.[305] The country faces challenges in terms of connectivity costs, access and skills, which currently constrain Cloud adoption. BSA[306] identifies barriers such as copyright laws that do not align with current international best practices, low levels of broadband penetration and public procurement that may be biased against international providers.

Public sector leadership through a national Cloud strategy

Industry experts have suggested that the public sector is lagging behind the private sector in Cloud adoption due to such factors as skills shortages, the lack of a specific Cloud computing policy for the public sector and inconsistent approaches to Cloud computing across different public bodies. Some authorities are deploying their own ad-hoc Cloud computing solutions but fragmentation has been identified as a significant barrier by researchers.[307]

In addition, South Africa has complex government procurement laws and policies that according to the BSA favour domestic providers.

Data localisation

Based on analysis by BSA[308]and ECIPE, data localisation requirements in South Africa do not appear to represent a major barrier to the use of Cloud services and products.

Awareness and understanding

An independent study from 2014[309]analyses the awareness of Cloud computing in South African SMEs through case studies revealing that most participants have limited knowledge and understanding of Cloud computing.

According to the BSA,[310] there are no relevant security requirements in place.

Portability and Interoperability

According to the BSA,[311] South Africa favours international standards and was a founding member of the International Standards Organization (ISO) and remains active in international standards development processes. South Africa is a participant in the top-level ICT standards committee (JTC-1).

Broader policy areas

The South African authorities are pursuing several initiatives towards the modernisation of the country. The National Integrated ICT Policy White Paper[312] from 2016 included a list of objectives focused on the development of ICTs as a tool to reach the goals of the South African National Development Plan. Relative to more mature Cloud markets, policies to support wider access to high-speed broadband connectivity and higher rates of digital literacy may be important foundations for future growth of Cloud computing.

305. Some laws allow authorities to request user information and mandate data retention
306. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
307. Microsoft Foundation. 2017. "Modernising the public sector through the cloud" https://researchictafrica.net/wp/wp-content/uploads/2017/10/Cloud-Computing-in-the-public-sector-final-25052017_V03.pdf
308. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
309. International Journal of Trade Economics and Finance. 2014. "The awareness of Cloud Computing: A case study of South African SMEs" " http://www.ijtef.org/papers/332-N00004.pdf
310. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
311. BSA. 2018. "2018 BSA Global Cloud Computing Scorecard" https://cloudscorecard.bsa.org/2018/
312. Department of Telecommunications and Postal Services of Republic of South Africa. 2016. "National Integrated ICT Policy White Paper" https://www.dtps.gov.za/images/phocagallery/Popular_Topic_Pictures/National_Integrated_ICT_Policy_White.pdf

United Arab Emirates

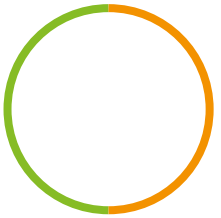
Cloud adoption and enablers*

Cloud Adoption	Metric	Status
Business used Cloud services	15% - 20% used a Cloud service	
Cloud Enablers		
Connectivity		
Business Usage of ICT	4.6 in a range from 1 to 7	
Data flows rank	46th out of 139 countries	
Average connection speed	8.6 Mbps average speed	
e-Government		
Procurement of technology	5.4 in a range from 1 to 7	
Government Online Service	0.89 in a range from 0 to 1	
Digital literacy		
IDI skills sub-index	5.6 in a range from 0 to 10	
Math and science education	5.3 in a range from 1 to 7	

Policy environment
Cloud policy areas**

Overall Cloud policy environment	Public sector leadership	Data localisation and flows	Awareness and understanding	Portability and interoperability
Developed policy environment in comparison to other countries in the region but there is scope for further development with respect to global leaders	Different Cloud initiatives in the public sector exist across the UAE, however a general strategy is missing	Some specific data localisation requirements exist in the UAE	Initiatives like Dubai Silicon Oasis are positive steps but general promotion of Cloud computing would help raise awareness	The UAE is a participant of the ISO ICT standards committee

Cloud solutions have been implemented in the public sector. This is the case of Abu Dhabi's FedNet or Dubai's CloudOne. Actions like these from public authorities serve as an encouragement for individuals and enterprises and at the same time improve efficiency and collaboration among public agencies



Some data transfer restrictions are in place such as those imposed by the Central Bank of the UAE on Payment System Providers, which are obliged to store and retain all user and transaction data within the borders of the UAE for a period of five years

Google's contribution

Productivity Impact

$10m-$40m

*Green highlights values higher than the median of the geographies studied and Orange highlights values lower than the median.

**Green indicates the country is taking significant steps in relation to this policy area, while Orange indicates areas with slower progress to date relative to other countries.

Source: Deloitte analysis of data from Eurostat, OECD, MGI, Akamai, ITU, UN and WEF. Average connection speed relates to Q1 2017. Business use of Cloud services, Business Usage of ICT and Government Online Services numbers relate to 2016. Procurement of technology, IDI skills sub-index and Match and science education are 2015 numbers. Data flows rank relates to 2014.

The state of Cloud in the United Arab Emirates

Cloud adoption

In 2016, the Cloud adoption rate, reflecting the percentage of businesses that use some form of Cloud services,[313] was 15%-20%,[314] lower than the average of 30% across the countries analysed in this report and similar to the average of 18% across the Middle East and African countries studied.

Cloud enablers

The picture of the UAE in terms of the key Cloud enablers – connectivity, e-government and digital literacy – is mixed.

- Connectivity measures are generally lower than the average among analysed countries.
- E-government is well developed, especially regarding procurement of advanced technology.
- With regard to supporting digital skills, the quality of math and science education is above the level of most countries and only below leading countries such as Finland, Belgium or Japan. However, other proxies for ICT skills, including levels of secondary and tertiary enrolment, are the lowest among the countries analysed.

Google Cloud in United Arab Emirates

Google Cloud has a developing partner ecosystem, that helps other businesses and other organisations to adopt and implement Google Cloud solutions, with a particular focus on spreading G Suite adoption. As an example of this, Almeka and Gulf Infotech help customers in the UAE to transition to G Suite.

Abu Dhabi Grammar School – Supporting enhanced education through G Suite

Abu Dhabi Grammar School is a private educational institution that employs more than 50 teachers, covering from kindergarten to Grade 12. The school has more than 1,000 students from 50 different nationalities.

The school has previously considered use of ICTs such as tablets in its classrooms, but teachers and students encountered some difficulties in using these. It eventually decided to adopt G Suite for Education, together with Chromebooks to replace old infrastructures and manage the entire network of students. They purchased 60 Chromebooks in the first place. And they increased that amount until they reached the current 500 Chromebooks.

The school reportedly was able to better manage its internal network as well as solve previous problems with the functioning of devices. According to the school, this change has contributed to an improvement in the school's ranking by the UAE Department of Education and Knowledge.

313. The OECD defines this as "ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on".

314. For the majority of countries, Cloud adoption data is provided by Eurostat or OECD. For countries where such data is not available (US, UAE, South Africa, Israel, Saudi Arabia), an indicative rate of Cloud adoption is provided based on observed correlations between Cloud adoption and other variables, such as total Cloud spend and connectivity metrics.

Aggregate productivity impact

Use of Google Cloud services is associated with estimated aggregate productivity impacts across all Google users including revenue expansion and cost savings in UAE in the order of **$10 million to $40 million** in 2017, based on the estimated average net returns experienced across all Google Cloud users.

For more details on the methodology used to estimate these impacts, please see Annex 2.

Cloud-related policy in the United Arab Emirates

The UAE has a relatively advanced policy environment compared to other countries in the region, while there is scope for further initiatives to support adoption. An independent study based on the BSA methodology suggests that there are barriers specifically in relation to data protection and security,[315] while Open Data policies are less developed than in leading countries.

Public sector leadership through a national Cloud strategy

The public authorities in the Emirates have shown an intent to modernise the public sector and incorporate Cloud computing in the public administration. For example the Abu Dhabi government is looking to liberate its workforce from operating hardware by drawing on the private sector for Cloud services. Also in Abu Dhabi, the government's Cloud platform will adopt G-Cloud technology to raise efficiency, increase productivity, limit costs and drive digital innovation.

Data localisation

Data transfer restrictions exist in the UAE. For example, the Central Bank of the United Arab Emirates issued the Regulatory Framework for Stored Values and Electronic Payment Systems[316] in January 2017 including, among others, the obligation for Payment Systems Providers to store and retain all user and transaction data exclusively within the borders of the UAE, (excluding UAE financial Free Zones), for a period of five years from the date of the original transaction.

Awareness and understanding

Initiatives currently in place in the Emirates such as "Dubai Silicon Oasis", "Dubai Internet City" or Abu Dhabi eGovernment show the commitment of the UAE's authorities to support the country's status as a digital hub, though initiatives do not generally target Cloud specifically. The Ministry of Economy echoed a report by the United Nations Conference on Trade and Development promoting the understanding and adoption of Cloud computing.[317]

Dubai presented its government's CloudOne in 2015 as a smart infrastructure for Dubai Government entities,[318] intended at easing access to IT resources for all Dubai government.

In addition, the Emirates eGovernment offers Cloud computing services, though limited information is available on these.[319]

Portability and Interoperability

The UAE is a full member of the International Standards Organization, represented by Emirates Authority for Standardization and Metrology (ESMA). In addition, the UAE is a participating member of the top-level ICT standards committee (JTC-1).

Broader policy areas

There are many different initiatives related to digitisation and innovation in the UAE. Some of these are the Centre of Digital Innovation (CoDI)[320] created to enable the digital journey of both the UAE's citizens and the Government, the Mobile Government Initiative in order to make the government services available to the people wherever they are 24/7 or the Emirates eGovernment, responsible for developing, establishing and maintaining the eGovernment programme at the federal level in the UAE.

315. Maurice Danaher, Saif al Rumaithy, College of Technological Innovation, Zayed University, Abu Dhabi. "Examining the Policy Environment for the Cloud in the UAE" http://www.wseas.us/e-library/conferences/2015/Dubai/CEA/CEA-53.pdf

316. Central Bank of the United Arab Emirates. 2017. "Regulatory Framework for stored values and electronic payment systems" https://www.centralbank.ae/en/pdf/notices/Regulatory-Framework-For-Stored-Values-And-Electronic-Payment-Systems-En.pdf

317. UNCTAD, 2013. Information Economy Report: "The Cloud Economy and Developing Countries" http://unctad.org/en/PublicationsLibrary/ier2013_en.pdf

318. Gulf News. 2015. "Dubai Smart Government launches Dubai Government's CloudOne at Gitex 2015 to improve IT infrastructure https://gulfnews.com/business/sectors/technology/dubai-smart-government-launches-dubai-government-s-cloudone-at-gitex-2015-to-improve-it-infrastructure-1.1604762

319. Based on information published by Emirates eGovernment available from: https://www.abudhabi.ae/portal/public/en/departments/eg

320. Based on information published by The Official Portal of the UAE Government available from: https://government.ae/en/information-and-services/g2g-services/codi

Appendix 2. Methodology

This study includes qualitative and quantitative analysis of economic, social and other impacts of Google Cloud.

The analysis draws on multiple information sources, including:

- 15 telephone interviews conducted with Google Cloud customers and policymakers; additional interviews were conducted with Google Cloud experts.
- Data obtained through bespoke business surveys (see description below).
- Existing literature, third-party data and other publically available material.

Productivity impacts

The study estimates productivity impacts of Google Cloud through cost-savings or revenue enabled. Impacts are quantified based on measures of the investment made by businesses on Google Cloud services and of the return realised on that investment.

The aggregate impacts being estimated can be described as 'gross impacts'. This means that:

- The impact being estimated is relative to a counterfactual where no public Cloud services are used, but where businesses may use on-premise of private Cloud solutions instead. The methodology does not consider as part of the quantitative estimation the impact that use of Google Cloud has relative to other providers of public Cloud services that could have been adopted in Google's absence, hence this approach considers the value that Google 'supports'.
- The methodology only considers impacts on Google Cloud users and therefore does not measure to what extent any advantage enjoyed by these users may divert activity away from non-users.

Equally, if Google Cloud contributes to lower barriers to entry and increased competition, this may lead to other economic effects, such as consumer benefits from lower price levels or increased choice, which are not considered by the methodology.

The following sections describe the survey methodology used and the quantitative approaches used to estimate impacts.

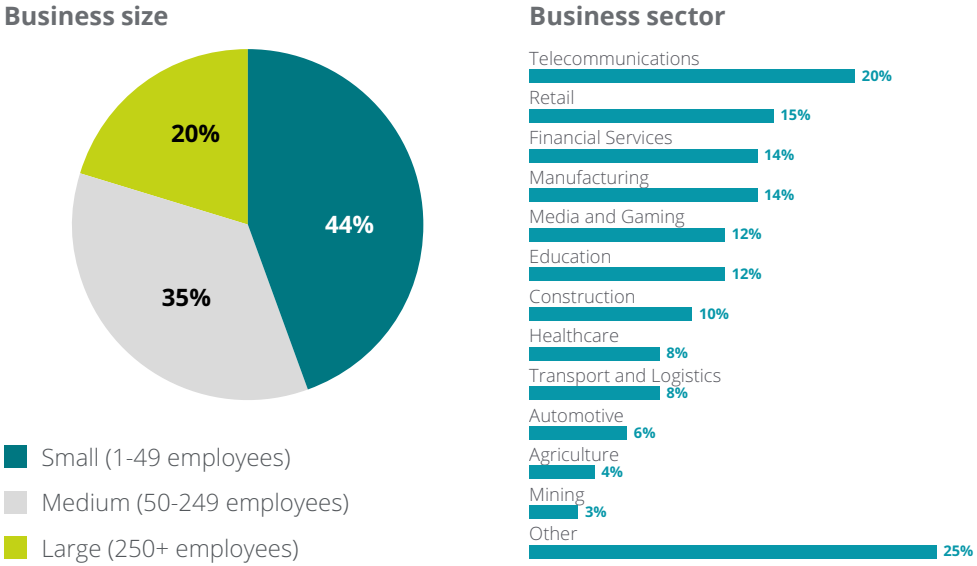
Survey methodology

Survey of public Cloud users

A survey of IT decision-makers was conducted by Opinion Matters, a specialist third-party market research firm, using a questionnaire prepared by Deloitte. The sample for this survey consists of 1488 businesses, each of which reports using at least one type of public Cloud service, including IaaS and PaaS offerings as well as SaaS tools such as collaborative applications. The sample consists of users of various public Cloud providers, including Google Cloud among others.

As shown below, the sample includes businesses of different sizes and sectors.

Figure 10: Summary of public Cloud user survey sample



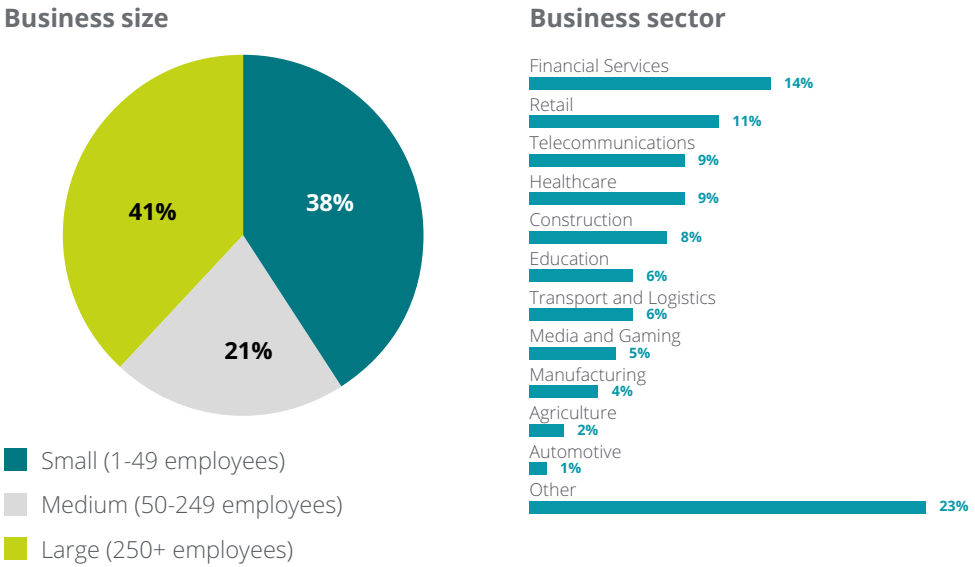
Source: Survey of 1488 IT decision-makers in businesses using public Cloud services. Some businesses report being active in multiple sectors.

The sample includes at least 100 businesses in each of the following countries: Spain, Germany, France, Sweden, UK, USA, South Africa, Turkey, Saudi Arabia.

Survey of Google Cloud users

A separate survey of IT decision makers was conducted by 10EQS, a specialist third-party market research firm, using a questionnaire prepared by Deloitte. The sample for this survey consists of 80 businesses, each of which reports using at least one Google Cloud service. The sample is primarily drawn from customers listed as Google Cloud case studies. It may therefore include particularly successful users of Google Cloud services and may not be representative of the entire population of businesses using Google Cloud services of the entire population of businesses using Google Cloud services.

Figure 11: Summary of Google Cloud user survey sample



Source: Survey of 80 IT decision-makers in businesses using Google Cloud services. Some businesses report being active in multiple sectors.

The sample includes businesses in the USA, Netherlands, UK, Spain, Italy, France and Norway.

Estimation of business-level productivity impacts

Business-level impacts are estimated based on data collected through the survey of public Cloud users previously described.

Survey respondents were asked to provide a range of information, including in relation to the business' expenditure on public Cloud services in the most recent financial year, and the revenue expansion and/or cost saving impacts associated with using public Cloud services relative to a hypothetical scenario where only on-premise solutions are available.

Using this data, for each business a Return On Investment (ROI) is estimated as follows:

$$\frac{Return - Investment}{Investment}$$

In this context:

Return captures the gross productivity benefits associated with use of public Cloud services in the most recent financial year. These benefits capture improvements in business performance relative to a hypothetical counterfactual where the business does not use any public Cloud services, but may use on-premise or private Cloud alternatives instead. The return includes:

- Reported cost savings associated with using public Cloud services.
- Reported increases in revenue associated with using public Cloud services.

Where revenue expansion is reported, the return is based on the estimated additional revenue associated with public Cloud, net of additional costs required to support the higher output level (such as additional staff or other resources). Two alternative approaches are used to estimate this net additional revenue:

- The first approach multiplies the reported increase in revenue associated with public Cloud by the profit margin of the business, as reported by each respondent.
- The second approach instead applies an indicative profit margin based on Eurostat data.[321]This approach is potentially conservative as the data relates to all businesses in the economy (excluding financial services) rather than Cloud users specifically which could include businesses with a competitive edge in their respective markets.

Investment captures estimates of spend on public Cloud services and implementation costs incurred in the most recent financial year.

Implementation costs are additional costs that may be incurred in adopting Cloud in the most recent financial year (e.g. training, change management, professional service fees). Based on survey responses, additional costs in the most recent financial year on average are estimated to lie between one third and two thirds of the fees spent on public Cloud services. This range appears broadly consistent with previous studies. For example, previous research suggests that:

- Implementation costs related to G Suite adoption for a large organization may amount to 38% of the fees spent on G Suite licences.[322]
- Implementation costs related to a selection of ML projects considered amounted to up to 40% of total project cost, suggesting implementation costs were about two thirds of spend on public Cloud.[323]

On the basis of survey responses and previous studies, implementation costs in a range of between one third and two thirds of public cloud spend are applied to the estimates.

Having estimated ROIs for individual businesses using the above approach, the average ROI is estimated as the mean across businesses in the sample. When calculating the mean, a small minority of outliers are excluded, where it is possible that the ROI values are based on erroneous data. Outliers are based on analysis of the distribution of ROI values, which indicates a break in the distribution of values between the included values and those values excluded as outliers. The exclusion of these data points has the effect of reducing the average ROI estimates.[324]

The average ROIs reported in Section 2 – "Quantifying impacts of Google Cloud on business performance" are expressed as a range, rather than an exact figure. This reflects variation in the data due to:

- Alternative approaches to excluding outliers, so that the upper bound of the ROI range is relatively more likely to also include less common, particularly successful uses of Cloud, whereas the lower bound of the ROI range is relatively more likely to reflect more common uses of Cloud.
- The range of implementation cost values used (from one third to two thirds of public Cloud spend), reflecting that the size of these costs may vary materially depending on the type of project or application of Cloud or stage of Cloud development.
- The alternative approaches used to estimate returns associated with increased revenue (as described above).
- Small differences in survey data between countries.

The same approach is used to estimate ROI among the smaller sample of 80 case study businesses using Google Cloud, where responses enable estimation of net returns

321. The proxy data used is the Gross Operating Rate from Eurostat. Eurostat states that this "is an indicator of profitability that corresponds to the share of gross operating surplus in turnover" (see http://ec.europa.eu/eurostat/web/products-datasets/-/tin00155). For countries where data is not available, an average Gross Operating Rate is assumed.

322. Forrester. 2015. 'Total Economic Impact of G Suite'.

323. Deloitte Access Economics. 2017. "Business impacts of machine learning".

324. Based on this analysis, a minimum of 2% and a maximum of 12% of observations are excluded at the lower and upper bounds of the range of observations.

realised by some of the most successful uses of Google Cloud services.

Through these methods, it is estimated that businesses using public Cloud received a net return in the order of $1 to $2.50 for every $1 invested in using Cloud services in the last financial year on average, compared to an alternative of using on-premise or private Cloud solutions instead. The impact estimates have been cross-checked with relevant estimates in the existing literature and information collected through telephone interviews with Google Cloud users. For example, previous studies[325] suggest that:

- A large organization adopting G Suite may realise an ROI of around 3 over the first three years.[326]
- ROI from a selection of ML projects can range from 1 to 4 during the first year.[327] Most of these are published cases and therefore they may include some of the most successful applications.
- For European Cloud users, using Cloud may give rise to total benefits in the order of €112 billion relative to total costs in the order of €25 billion, suggesting an indicative ROI of around 3.4.[328] However, this study may not have fully taken into account the implementation costs associated with using Cloud.

Estimation of aggregate productivity impacts

In each country, the aggregate productivity impact is estimated as:

Total investment on Google Cloud services x Indicative ROI range

The indicative ROI range in each country used to estimate aggregate productivity reflects the output of average ROI calculations as described above, using the survey data for businesses using public Cloud services. This is used as a proxy for the ROI realised by users of Google Cloud services specifically, on the basis that:

- Robustly estimating ROI from the use of Google Cloud services specifically is challenging due to the widespread use of multiple Cloud providers by businesses, as well as Google Cloud's relatively small market share compared to some other large providers, which makes it difficult to be able to isolate the impact from Google Cloud services specifically.[329]
- Analysis of the survey data of public Cloud users suggests that business-level productivity impacts experienced by businesses that use Google Cloud services are typically in line with impacts experienced by users of Cloud services that do not include Google Cloud, with no evidence to suggest that impacts when businesses use Google Cloud are systematically lower. Analysis of survey data suggests that in some cases returns realised by businesses whose use of Cloud includes Google services may be higher than those that use public Cloud services excluding Google Cloud, but sample sizes combined with the prevalence of multi-Cloud usage mean that it is not possible to establish a significant difference related to Google Cloud specifically.

The total investment on Google Cloud services consists of spend on Google Cloud services and any additional costs related to the implementation of these services. Spend on Google Cloud services is estimated for 2017 based on third-party estimates in each country of public Cloud market value and of Google Cloud's market share; sources for this data include IDC and Gartner. Additional costs are estimated in the range of one third to two thirds of spend on Google Cloud services, consistently with the estimation of business-level productivity impacts, as described above.

325. Other studies examined include Forrester. 2014. "The total economic impact of Google Cloud Platform". CEBR. 2010. "Cloud Dividend". IDC. 2014. "Uptake of Cloud in Europe: Follow-up of IDC Study on Quantitative estimates of the demand for Cloud Computing in Europe and the likely barriers to take-up".

326. Forrester. 2015. "The total economic impact of G Suite".

327. The study reports that gross returns can range from 2 to 5 times the cost, which implies an ROI of 1 to 4 based on the ROI formula set out in this chapter. Deloitte Access Economics. 2017. "Business impacts of machine learning".

328. Deloitte. 2016. "Measuring the economic impact of Cloud computing in Europe". Published by the European Commission.

329. While some evidence for Google Cloud services specifically is available from survey data for the sample of 80 businesses using Google Cloud, this data is not used to estimate aggregate productivity impacts as this sample includes particularly successful implementations of Google Cloud and may not be representative of the entire population of Google Cloud users.

Deloitte.