

ASCENT TO THE CLOUD

HOW SIX KEY APAC ECONOMIES CAN LIFT-OFF



BCG

Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we help clients with total transformation—inspiring complex change, enabling organizations to grow, building competitive advantage, and driving bottom-line impact.

To succeed, organizations must blend digital and human capabilities. Our diverse, global teams bring deep industry and functional expertise and a range of perspectives to spark change. BCG delivers solutions through leading-edge management consulting along with technology and design, corporate and digital ventures—and business purpose. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, generating results that allow our clients to thrive.



ASCENT TO THE CLOUD

HOW SIX KEY APAC ECONOMIES CAN LIFT-OFF

ABHINAV GUPTA

KAUTUK KUSHANSH

PRASANNA SANTHANAM

TAKAHITO OSAKO

THU NGUYEN

VAISHALI RASTOGI

Commissioned by:



CONTENTS

3	EXECUTIVE SUMMARY
5	THE RISE OF THE CLOUD
8	KEY BENEFITS OF THE PUBLIC CLOUD
14	THE ECONOMIC IMPACT ON THE REGION
19	KEY CHALLENGES TO DEPLOYMENT OF THE PUBLIC CLOUD
25	10 KEY LESSONS FOR BREAKING DOWN BARRIERS
32	THREE SCENARIOS FOR THE FUTURE OF PUBLIC CLOUD
36	THE SIX APAC MARKETS IN DEPTH
	Australia
	India
	Indonesia
	Japan
	Singapore
	South Korea
87	APPENDIX
92	GLOSSARY

EXECUTIVE SUMMARY

THE PUBLIC CLOUD HAS emerged as an important technology platform since its advent about two decades ago, offering benefits to businesses that extend far beyond convenient data storage and innovative applications. By boosting internal productivity, ensuring a robust security environment and providing the technology and tools such as artificial intelligence and machine learning to enable digital transformation, the public cloud makes it possible for companies to develop new revenue streams and drive higher productivity within their organizations.

In this report we will look at the benefits the public cloud has brought to six key markets in Asia Pacific (APAC) – Australia, India, Indonesia, Japan, Singapore, and South Korea – and the economic impact that each of these markets stand to gain from the adoption of the public cloud over the next five years.

Each of these six markets are at different stages in the evolution of their use of the public cloud. Each of them, however, will experience a positive economic impact as industries in these markets explore new revenue streams and improve productivity by operating applications over the public cloud.

Our research into public cloud use in both the public and private sector in each of these markets finds that if growth in public cloud spending continues at its present compound annual growth rate (CAGR) of 25%, it will contribute to a total economic impact of about US\$450 billion across the six markets between 2019 and 2023. This impact, which includes the direct impact on the industry users of public cloud as well as second order effects driven by business growth across the supply chain of industry users and increased consumer spending, is comparable to the annual GDP impact of many of the region's large traditional industry sectors. Our survey of business leaders and senior IT decision makers reveals that most expect revenue uplift to be a meaningful driver of the overall economic impact within their business. In addition to the economic impact, public cloud provides potential to improve productivity of the economy through availability of digital government services which drives a significant improvement in citizen experience within these markets.

The direct effects of the economic boost will produce approximately 425,000 jobs, with about 1.2 million additional jobs being influenced by second order effects of deployment of public cloud. Industry users

rather than cloud service providers (CSPs) will be the major source of GDP contribution and job growth.

Challenges lie ahead

While public cloud technology holds a great deal of promise for the region, we also found that there are a number of challenges that, if left unchecked, may slow down the potential economic growth that can be activated.

There is a growing need for digital talent skilled to use public cloud technology, part of which can be addressed through the re-skilling and up-skilling of the existing workforces. Large traditional businesses can also find it cumbersome to migrate their massive workloads to the public cloud. In some of these markets, the connectivity infrastructure needs to be improved so that public cloud service can be more reliable. Data privacy is another concern for many businesses, and CSPs need to invest more time in educating users on the benefits that public cloud can provide on these fronts. A policy regime consistent with international best practices would also make it easier for CSPs to rapidly launch new products that cater to market requirements and drive interoperability within their services in a cost-optimal manner.

This reports looks at how all three stakeholders—service providers, user organizations, and governments—can work together to mitigate such challenges in order to maximize the impact they can derive from the public cloud.

Growth can be further enabled or inhibited

If these challenges were to persist or even worsen, the overall economic impact would reduce by about US\$ 75 billion , producing a total economic impact of around US\$375 billion over 2019-23, resulting in the addition of about 235,000 direct jobs and influence another 715,000 through the second order effects.

On the other hand, **if the challenges in these six markets can be overcome**, the total economic impact due to public cloud could increase to about US\$580 billion, and result in the addition of about 770,000 direct jobs and influence as many as 2.1 million jobs from the second order effects.

The path forward for all six markets points to continued growth in their use of the public cloud. The extent to which they experience an economic lift-off, however, will depend on whether the environment is conducive to investing in the new technology-driven engines powered by advanced analytics, artificial intelligence (AI), machine learning (ML) and productivity tools. Each of these markets can seize the opportunity to unlock the potential benefits of the public cloud, but providers, users and governments must recognize the transformative opportunities that lie ahead, and make favorable growth conditions a priority.

CHAPTER 1

THE RISE OF THE CLOUD

EVERY BUSINESS AND GOVERNMENT organization has data that it needs to maintain, store and process digitally. Depending on the nature of the organization, the data might include customer transactions, market analysis, product information, and increasingly, algorithms for advanced technologies including artificial intelligence and machine learning.

There are multiple technology infrastructure options that organizations can use. The most conventional infrastructure involves using on-premise systems and data centers. Since the advent of cloud computing about two decades ago, however, many businesses have moved their data and applications onto either the public cloud, in which one or multiple third-party cloud service providers (multi-cloud) own the architecture and deliver the service over the Internet; a private cloud operated by the company for its own use; or a hybrid cloud that combines both public and on premise/private cloud resources.

The public cloud offers the advantage of flexible, pay-as-you-go delivery of computing services, and enables end users to share a scalable infrastructure. In addition, it removes the need for an organization to maintain and manage their own infrastructure.

This is becoming an increasingly essential service in the Asia Pacific region, as both

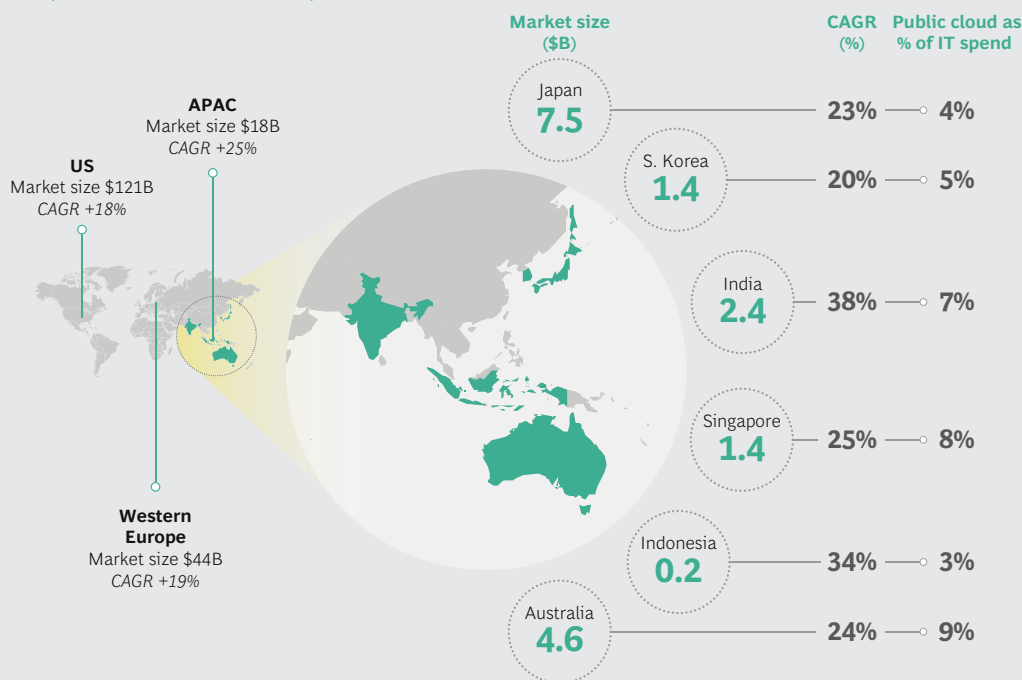
private and government sectors begin to recognize the benefits to be gained from utilizing a third-party provider for functions such as administration of storage, provision of virtual machines and other advanced services to help with the management of IT infrastructure, and business support with relevant digital tools and platforms.

Businesses in the APAC region are finding that the public cloud enables them to fuel growth by enhancing productivity, customer service and customer engagement, as well as reducing the time and cost of bringing new products or services to market. Many organizations also find significant benefit in the public cloud's ability to provide security at a scale that often surpasses what even large companies can afford.

In this report we will look at the economic impact that deployment of the public cloud is likely to unleash in six key APAC markets: Australia, India, Indonesia, Japan, South Korea, and Singapore. Although the public cloud market in these six countries is in an emerging stage compared to the U.S. and Western Europe, growth rates are notably higher, demonstrating great potential for further development.

In 2018, these six APAC markets spent US\$18 billion on the public cloud, including managed services. The U.S. spent US\$121 billion in the same year, while Western Europe—France, Germany, Italy, Netherlands,

EXHIBIT 1 | Market overview: Public Cloud market is growing faster in APAC with ~25% CAGR but is smaller compared to Western Europe and US



Source: Expert interviews, Industry reports, BCG analysis

Note: Public cloud market size includes managed services; APAC refers to the six markets Australia, India, Indonesia, Japan, South Korea and Singapore; Western Europe includes France, Germany, Italy, Netherlands, Spain and the United Kingdom; All market sizes shown are in \$B and for 2018; All CAGRs shown are 3 year CAGR for 2016-18; The public cloud spend % of IT spend is high for India due to relatively low IT spend in India

Spain and the United Kingdom—spent US\$44 billion. However, the compound annual growth rate from 2016 to 2018 in APAC stood at 25%, compared to a CAGR in Western Europe and the U.S. that hovered just below 20% (See Exhibit 1). In India and Indonesia, the fastest growing markets among the six, growth rates were more than 30%.

As a percentage of overall IT spending, the public cloud outlay from the six markets has increased from 3% in 2016 to 5% in 2018 and, according to estimates, is likely to reach approximately 10% by 2023. By comparison, public cloud spend in the U.S. was 14% of overall IT spending in 2018, while in the Western European markets it was 8% (See Exhibit 1). We believe there is room for even greater growth in the APAC countries if companies take advantage of the cloud’s full potential.

There is a wide range of cloud adoption rates within the six APAC markets studied. Japan and Australia are among the largest markets, and are more advanced in their use of the public cloud. India is the next largest market,

and as one of the world’s strongest emerging economies, it continues to show enormous potential for rapid growth in public cloud use over the next five years. Singapore and South Korea are relatively small markets, but Singapore in particular is advanced in its public cloud adoption rates. Both markets continue to demonstrate strong growth potential. Indonesia, while at a nascent stage of cloud adoption, is expected to see a rapid growth in public cloud use over the coming years.

While businesses are driving much of this growth, governments are in a position to encourage and support growth throughout the region. The regulatory climate is an important factor, but what also carries a great deal of weight is when the government encourages its own agencies to adopt the public cloud. This acts as a signal to the private sector that the public cloud is secure and conducive to innovations that can be good for the economy as well as citizen services. In a majority of these markets, there is significant interest from within the highest levels of government, a view evidenced by

Singapore Prime Minister Lee Hsien Loong, speaking in 2018 at the Singapore Government's first annual technology developer conference.

“Over the next few years, we will begin to migrate some systems onto the cloud, gain experience in this mode of operation, and take bolder steps in light of what we can learn.”

– Lee Hsien Loong, Prime Minister, Singapore.

To better understand both the benefits and barriers to public cloud adoption in the six APAC markets, Boston Consulting Group (BCG) conducted a survey alongside a series of interviews with senior executives and IT decision makers from a cross-section of industries. We looked at the use of public cloud by individual companies, by industry and by country, as well as the overall economic impact we expect to see from its use over the next five years.

Unquestionably, organizations are ready to expand their use of the public cloud. Among companies that are currently using the cloud, 54% of respondents said their public cloud spend has been increasing in recent years, while 64% said they expected spending on the public cloud to further increase in the next five years.

As this expansion continues, we can expect to see more organizations migrate to cloud models, allowing them to develop better applications and use their data more effectively through advanced digital tools on the public cloud. Software as a Service (SaaS) is the most widely used model across the six markets, accounting for just over 50% of the market, with about US\$9.7 billion spent across all sectors on SaaS in 2018. SaaS is generally easier to introduce into business

verticals, and can be deployed with minimal disruptions to existing operations.

However, adoption of the Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) cloud computing models is on the increase. The IaaS and PaaS models allow businesses to move their applications to cloud infrastructure. With the highly scalable infrastructure these models provide, businesses can expand their capabilities in areas like customer service, digital streaming, inventory or account management and much more, benefiting from virtually unlimited capacity and bandwidth.

Digital native businesses (DNBs) tend to prefer the IaaS model because the upfront capital required is less than it would be to build in-house servers, and the infrastructure platform allows a small company or a startup to introduce new product roll-outs and scale up quickly, thereby driving growth.

We expect to see IaaS and PaaS usage to grow faster than SaaS in the next few years. The IaaS market is likely to increase by roughly 23% annually on average between 2018 and 2023, with PaaS growing by approximately 20%, while SaaS will increase by an estimated 17% over the same period.

BCG analyzed multiple scenarios for public cloud adoption in each of the six markets, taking into account the fact that these six economies vary greatly by stage of development. In each market we have explored triggers for growth as well as circumstances that could decelerate growth. Measures taken by cloud service providers, company readiness, and government policy will all play important roles in the growth of public cloud use over the next five years.

Our findings reveal that over the next five years, in circumstances that encourage lower barriers to adoption and a stronger vision of how businesses can use the public cloud, spending could be far higher than survey respondents anticipate.

CHAPTER 2

KEY BENEFITS OF THE PUBLIC CLOUD

AS COMPANIES IN THE six APAC markets have migrated their business functions onto the public cloud, they have begun to recognize that it offers benefits that go well beyond traditional on-premise or even private cloud architecture. While the public cloud makes business-as-usual operations more efficient, it also enables a company to reimagine the entire business. At a time when new innovations can alter customer habits from one day to the next, and businesses regardless of industry have to keep one step ahead of the next trend, organizations are looking to the public cloud to provide technology that helps them manage continuous change.

To further gauge how the cloud is changing the way companies operate, and how it can lead to greater advances, we asked participants in our survey to describe the most important benefits they see emerging from their use of the public cloud. They consistently identified six key benefits (see Exhibit 2).

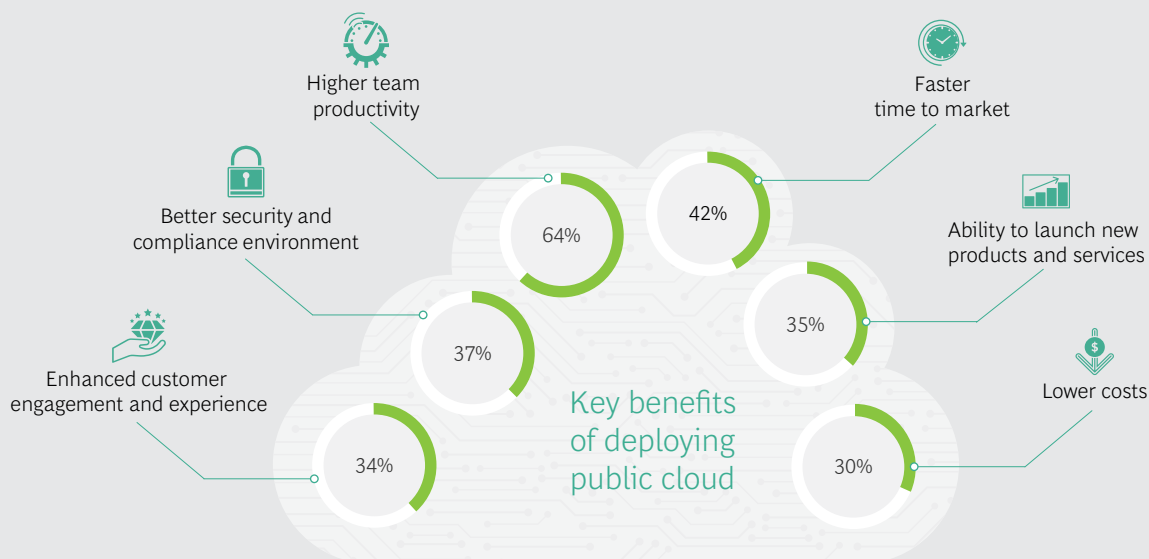
1. Higher team productivity. All markets ranked enhanced productivity as the leading benefit of using the public cloud. Users said

they found that operating techniques such as DevOps and agile@scale can be comprehensive game-changers.

From an IT perspective, the cloud creates a standardized environment, scalable back-end systems and functions, and provides access to proven tools that IT teams can use to develop systems. Thanks to the IT efficiencies that result, the core business can perform all matter of tasks—targeting customers, developing content, and taking new products to market, for example—at a faster rate and at reduced cost. Better collaboration tools such as G Suite, Slack, and Skype create administrative and communication efficiencies, while advanced applications such as artificial intelligence or machine learning enable faster, clearer insights that enhance the overall productivity of the organization.

2. Faster time to market. The public cloud allows users to take new products and services to market quickly, helping organizations develop a fail-fast approach that alerts them to problems immediately, and makes a fast turnaround possible when something needs to be fixed.

EXHIBIT 2 | Benefits of adoption: Public cloud users identify six key benefits



Sources: Survey of public cloud users and decision makers (n=1026), BCG analysis

Note: Respondents in survey were asked to select key benefits of public cloud deployment

“What used to take weeks now takes days, [and that] allows us to experiment and be aggressive.”

– Executive Director,
Government agency

3. Better security and compliance environment. Hyper-scale public cloud service providers such as AWS, Google Cloud and Microsoft Azure each spend billions of dollars every year on cyber security upgrades—far more than most organizations can spend on their own, with the ability to achieve scale at a level not available to most users. This is a key incentive to using the public cloud, and more and more users are recognizing this aspect.

While concerns about security remain, and some users believe their data is safer on a private cloud, we find that a sizable portion of those using the public cloud see security as a key benefit. It is important to educate potential users about the security that the public cloud provides. The CTO of a large retailer in Australia told us that security was a key reason the company decided to migrate to the cloud. The user organizations still need to have their own risk management policies in place, but a large number of respondents said the public cloud has capabilities that help to reduce the overall security risk.

4. Ability to launch new products and services. Users said that one of the most important benefits is the support they get from the computing infrastructure in allowing them to introduce new products and services, as well as the internationalization of new digital products and services. With the

public cloud they are better able to expand the business model around such offerings. A cab-hailing platform, for example, can easily offer products like ride sharing, use analytics to offer dynamic fares, keep their riders engaged with entertainment systems and offer loyalty programs to their customers.

5. Enhanced customer engagement and experience. New digital capabilities and services have enabled users to improve the customer experience, particularly from using advanced ML and AI tools to drive personalization, supported by the scalable infrastructure and computing resources provided by public cloud. For example, if an online retailer wants to draw in a select group of customers with a one-day sale, the scalability of cloud infrastructure provides assurance that the retailer's website can accommodate the surge in traffic that is likely to result. No matter how heavy the server load, customers will be able to make quick, seamless purchases with no slowdowns.

More advanced markets in APAC like Australia and Singapore place a great deal of importance customer engagement and experience. In these markets, buyers already have access to multiple services and products. To win over new customers, a business needs to excel over its competitors when it comes to engaging the clientele and offering a positive experience.

6. Lower costs. Not all organizations realize immediate cost reductions. This is especially the case for larger enterprises. More often than not, they end up with a hybrid model which results in a more complex operating environment for the organizations, and as a result they do not realize immediate cost savings.

To realize cost benefits, these businesses need to transform their entire architecture and make their systems compatible with the public cloud, including, in some cases, redesigning applications rather than simply using public cloud to store data or for computing tasks. Users that consolidate their

IT management functions under the public cloud are able to achieve cost efficiencies that result from operating with smaller, fully autonomous agile IT teams that are able to focus on business rather than on managing IT infrastructure.

How industries reap the benefits

The public cloud is a key business enabler, especially for Internet and mobile-first companies—so-called digital native businesses (DNBs). The tech-savvy professionals who start such businesses understand better than anyone how critical it is to be able to execute easily and quickly, host and manage their data, and be ready to work in agile sprints to drive rapid change. The public cloud makes it possible to accomplish all of these goals with less capital expenditure than would otherwise be needed. Without the public cloud, DNBs would have to create in-house data centers and hire IT teams to manage them, which could make it difficult for them to pursue rapid growth that they otherwise target.

By lowering the barriers to entry, the public cloud makes it possible for many DNBs to initially launch. For DNBs, the cloud is core to their business model and services. Many of these businesses say that without back-end cloud support they might have trouble sustaining their business model and keeping pace with the rapid growth that is necessary. Digital native businesses have to attract and engage customers quickly, with a constant flow of new or improved products and services. As a result, they depend on the public cloud as a tool to help them scale up, launch new products and services, and enhance the customer experience with analytic tools.

In traditional industries, too, the public cloud is proving to be a tool for strengthening capabilities among companies in areas such as financial services, media and gaming, retail and wholesale, manufacturing as well as among government and education agencies in the public sector. Looking across a range of

industry verticals, we found that users were very much looking to the benefits of the public cloud for industry-specific needs.

Media and gaming industry users place particular importance on enhanced customer engagement. The public cloud helps them reach a wider, sometimes global, audience, with personalized content and games as well as personalized ad placement and meta-tagging of videos for quick search access and easy analytics.

Financial institutions, which use the public cloud for fraud detection, risk analytics, smart pricing, and personalization, ranked a better security and compliance environment as a key benefit.

For the manufacturing industry, where use cases center around smart manufacturing, digital twins for simulations to save testing time and predictive analytics, key benefits included the public cloud's ability to help companies launch and scale up new products quickly.

Retail companies are keen to deploy onto the public cloud for personalization, augmented reality and optimizing their customer contact centers, and appreciate the public cloud's ability to deliver such capabilities at lower costs. This is not surprising, considering that most retailers have to survive with constant pressure on their margins.

The public cloud offers an additional attraction to industries — it optimizes electricity usage. The scale of public cloud hyper-scale data centers, along with their significant investment in highly efficient energy management and cooling technologies, makes it possible for them to consume about 50% less energy in their operations than a typical data center or on-premise infrastructure.

Traditional small and medium enterprises (SMEs), such as small component suppliers and retailers, also find the public cloud very useful as a tool for maximizing productivity

on a lean budget, along with providing more personalized customer outreach and engagement.

Revenue growth for users tops the financial benefits

Cloud service providers will, of course, grow and earn revenues as more and more organizations in the six markets migrate applications. But in studying the economic effects of public cloud usage in the region, we find that industry verticals that adopt the cloud stand to gain far more in economic benefits than the providers themselves.

If Australia, India, Indonesia, Japan, Singapore and South Korea continue to deploy the public cloud at current rates, we expect cloud usage to contribute approximately US\$112 billion in economic uplift between 2019 and 2023, emerging directly from financial gains for the key industry vertical users. Although this direct gain to industry verticals is only a part of the overall impact in the economy due to the use of the public cloud (See Exhibit 5), it is essential to discern where the financial benefits for the users are expected to emerge.

The reason that industry verticals will experience such dramatic financial benefits is a result of the way the public cloud makes it easy for businesses to innovate and transform. Conventional wisdom might assume that a significant part of the added value will come from IT cost savings, but our survey finds that the majority of senior executives and IT decision makers across the region hold a different view. Of the participants, 70% said revenue uplift was a principal driver of value-add from public cloud usage, 64% said productivity improvements were an important driver, while only 30% said IT cost savings were an important driver (See Exhibit 3).

In Chapter 3, we will discuss the economic impact in more detail, including how much of the value generated will come from indirect and induced versus direct forces. First,

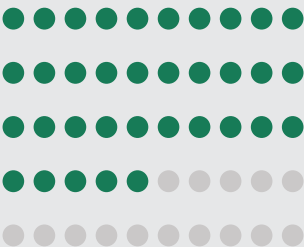
EXHIBIT 3 | Impact drivers: Revenue uplift is the key driver of value for public cloud users

○ ————— % of respondents who agree with this being the key benefit ————— ○

70%

Revenue
Uplift

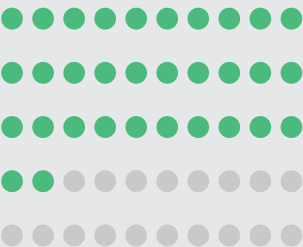
Faster launch of new
business models, products
and services



65%

Productivity
Improvement

Collaboration tools,
advanced analytics, focus on
core workloads



30%

IT Cost
Saving

Infrastructure cost,
optimized head count



Sources: Expert interviews, Survey of public cloud users and decision makers (n=1026), BCG analysis
Note: Respondents in survey were asked to select key value drivers after public cloud deployment

however, we will look at where the economic value begins—with the financial impact on the companies that use the public cloud.

We have identified four ways that the cloud has a financial impact on user businesses.

One impact is on the digital native businesses that could not exist without the public cloud. Whatever revenues and profits that many of these companies earn can thus be attributed to the public cloud.

For other users, a financial impact can come in one or more of the following forms:

Revenue uplift. The public cloud enables rapid launches of new products and services, helps internationalize businesses and engages customers with enhanced targeting and personalization through AI and ML, bringing a boost to revenues. Public cloud users are expected to gain about US\$84 billion in revenue uplift over the next five years, which is roughly 3% of their current revenue base.

Productivity improvements. In addition to improved productivity in non-IT functions, using cloud-enabled analytics and other advances such as AI and ML, organizations are able to improve decision making, leading to greater cost efficiencies. Public cloud users should save about US\$21 billion due to productivity enhancement over the next five years, equal to about 2% of their current non-IT cost base.

IT cost saving. Several companies reported that they have been able to save on infrastructure and staffing within the IT budget. These savings are likely to account for approximately US\$6 billion over the next five years across user industry verticals.

The revenue increase will be a result of the proven benefits from which companies stand to gain, such as increased productivity, faster time to market, ease of launching new products and services including digital services, and enhanced customer targeting.

Take, for example, a mobile e-commerce platform in India that delivers groceries, fresh produce, cosmetics and electronics, and has been able to grow by migrating its operations to the public cloud. When the company was launched, its logistics system was wholly manual, with staff at the headquarters contacting drivers by phone. Within two years the number of deliveries it fulfilled was growing ten-fold monthly, but customers were logging in only to find that the database had crashed, especially on weekends when the traffic hit a peak.

The company resolved the server problem when they moved onto a public cloud platform, and were able to scale up from 10,000 orders a day to more than 70,000. When an order comes in, the system

identifies the nearest delivery driver instantly, and sends them the order through a mobile app. Additionally, each driver now handles an average of 15 orders per day, compared to only five previously. As a result, the company has been able to take on more business without additional spending.

We see many companies recognizing the benefits that can lead to revenue uplift, and hence spending more on growth engines and newer applications rather than on simply replacing their old infrastructure. Our survey found that 51% of public cloud spending is going into growth. This also means that the public cloud is not just replacing traditional infrastructure, but is actually creating new business opportunities.

CHAPTER 3

THE ECONOMIC IMPACT ON THE REGION

WITH THE REVENUE ENHANCEMENT that the public cloud is expected to bring to businesses in the APAC region, it offers the potential to produce economic gains that reach well beyond the financial returns of individual companies.

If Australia, India, Indonesia, Japan, Singapore and South Korea continue to adopt public cloud at the current rates of deployment, we expect it to contribute approximately US\$450 billion to the combined GDP of these six economies between 2019 and 2023. Approximately 425,000 jobs will be created as a direct result of the economic boost, with a potential for another 1.2 million jobs being influenced from second-order effects of stimulating the economy.

Our projections are based on BCG's preferred methodology for assessing economic impact, which models the direct, indirect and induced effects on the economy (See Appendix for details on our methodology).

While the impact is likely to be considerable across these six economies, it varies according to the size and growth expectations of each. The actual economic uplift is expected to range from 0.5% to 0.6% of annual GDP across Japan, South Korea, India and Indonesia. This uplift is projected to achieve

the higher rate of approximately 1.5% of annual GDP in Australia and Singapore.

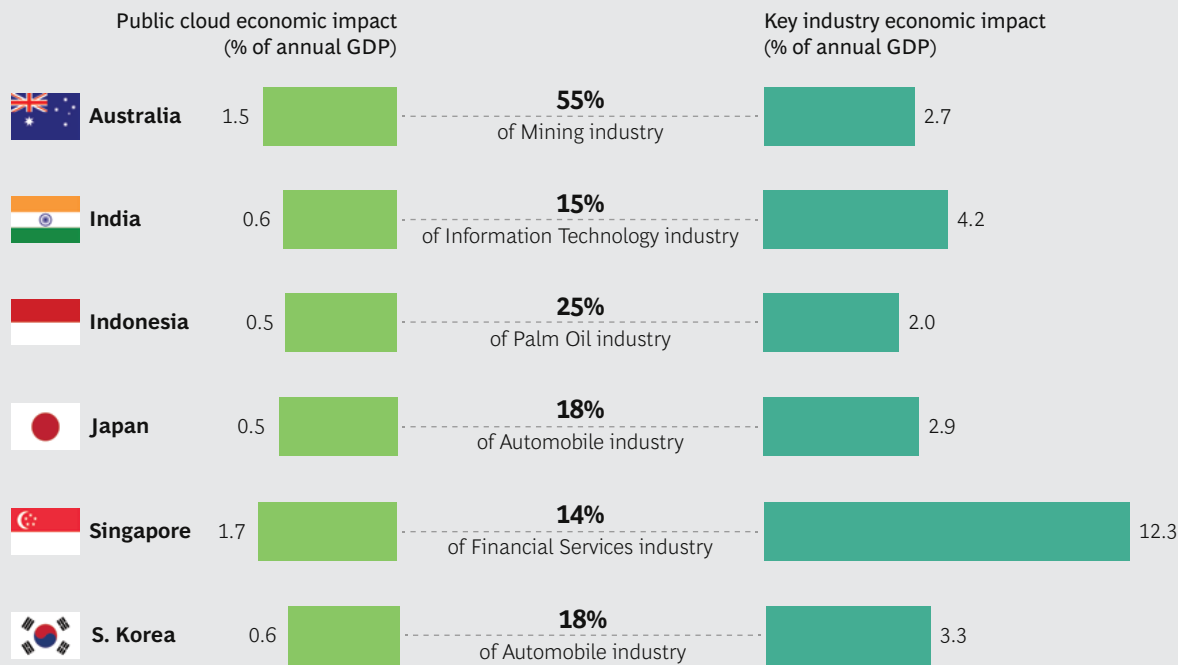
In each market, however, we foresee that the use of the public cloud will lead to growth that makes a significant contribution to the economy—a contribution large enough to rival some of the most important and long-established industries such as auto manufacturing, mining, and financial services (See Exhibit 4).

Where the value will come from

As discussed in Chapter 2, our research shows that the public cloud enables user industries to grow by enabling better productivity alongside unlocking a wealth of opportunities to build new revenue streams. When the public cloud helps facilitate productivity and revenue growth, it yields a direct impact that is clear and easy to measure. A company develops new revenue streams and grows, hiring more people and increasing its spend, thereby affecting its supply chain. The cloud also helps increase productivity while reducing both non-IT and IT costs, freeing more capital for investment in growth avenues and core business functions.

Furthermore, the impact doesn't end with the immediate financial benefits to user companies. The productivity and revenue

EXHIBIT 4 | Economic impact: Annual GDP impact of public cloud is sizeable compared to key industries for each market



Sources: Industry reports, BCG analysis

Note: The overall impact of public cloud across 2019-23 is annualized to compare with annual GDP contribution of key industries

uplift will create two categories of second order effects.

There will be an indirect impact across the supply chain of user companies due to new money being pumped into regional economies as a result of increased organizational spending. Additionally, there will be an induced impact as employee salaries go back into the economy as a result of spending by individuals.

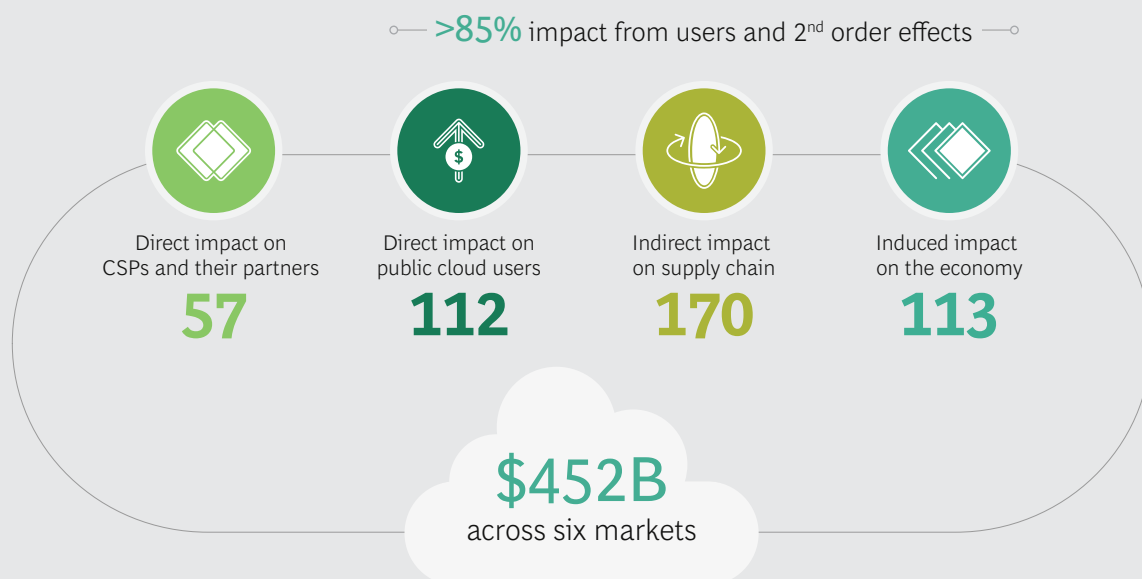
Of the US\$450 billion in impact, about US\$170 billion will come from the direct economic impact across the six APAC markets over the next five years— around US\$60 billion from cloud service providers and IT vendors and another US\$110 billion from the industry users—with an indirect impact of about US\$170 billion and an induced impact of about US\$110 billion (See Exhibit 5).

The BCG report [Capturing the Data Center Opportunity](#) points out the shortcomings of a common public perception that technology

providers create revenue mostly for international IT companies. In reality, the revenue earned reverberates all the way down the supply chain. We have found that the overall economies of the six markets will receive a far greater share of the economic benefit than the cloud service providers themselves will, with user industries emerging as the economic engines in their economies. Cloud service provider growth will be a factor, but we expect the direct contribution from providers to be only US\$60 billion. The remaining 85% of the impact will come either from direct users of the public cloud or from benefits to the overall economy through secondary indirect or induced effects.

The key verticals in public cloud use—retailers, financial institutions, telecom, media and gaming companies and manufacturers—are expected to contribute 95% of the overall impact from industry verticals. Companies and organizations in these verticals have room to use the public cloud to conduct their business with vastly improved efficiencies that will greatly benefit

EXHIBIT 5 | Economic impact: GDP impact due to public cloud deployment expected to be \$452B cumulatively over 2019-23 across six markets



Source: BCG analysis

Note: All GDP impacts are for 2019-23 and are shown in \$B; Direct impact refers to financial impact on organizations using public cloud; Indirect impact refers to the gains across the supply chain of the direct users; Induced impact refers to the gains created because of an economic stimulus coming from increased household incomes; CSP refers to cloud service providers

their top and bottom lines. In some cases they will utilize artificial intelligence and other advances to expand their product and service offerings as well as their geographic footprint. Internationalization of operations thus achieved can also be a key growth driver for these enterprises.

Across all industry verticals, the digital native businesses will be the predominant engine of public cloud-enabled economic growth in the next few years. DNBs will account for 50% of the direct impact from all users— about US\$50 billion of the US\$110 billion.

It is also worth considering how the public cloud will affect the public sector. It will not be a major contributor to the GDP because organizations like schools and government agencies are less focused on earning revenue. Yet they use the cloud to increase productivity and reduce costs—benefits that can provide an important impact of their own to their constituencies in the form of improved public services and citizen experience, which is in addition to the overall economic impact of the public cloud.

Where the jobs will be

As the public cloud gains momentum across the six key APAC markets, we expect it to contribute significantly to employment opportunities. The direct economic impact will net approximately 425,000 jobs in the six markets between 2019 and 2023.

Inevitably, the digital transformation that comes in tandem with public cloud use changes the nature of the jobs that businesses need to fill. While that will require adjustment of certain jobs, there will also be a growing demand for a technologically skilled workforce. The jobs resulting from an outgrowth of the financial benefits of public cloud use will require upskilling and reskilling, training people in a variety of roles and professions. This is needed for non-IT sectors as well with a wide range of industries working with advanced digital technologies. Beyond digital jobs, public cloud will also help create new non-digital jobs in the wider economy. For example, as the sales of a fashion retailer increase due to e-commerce, the company would need more workers in its production centers, more employees for its

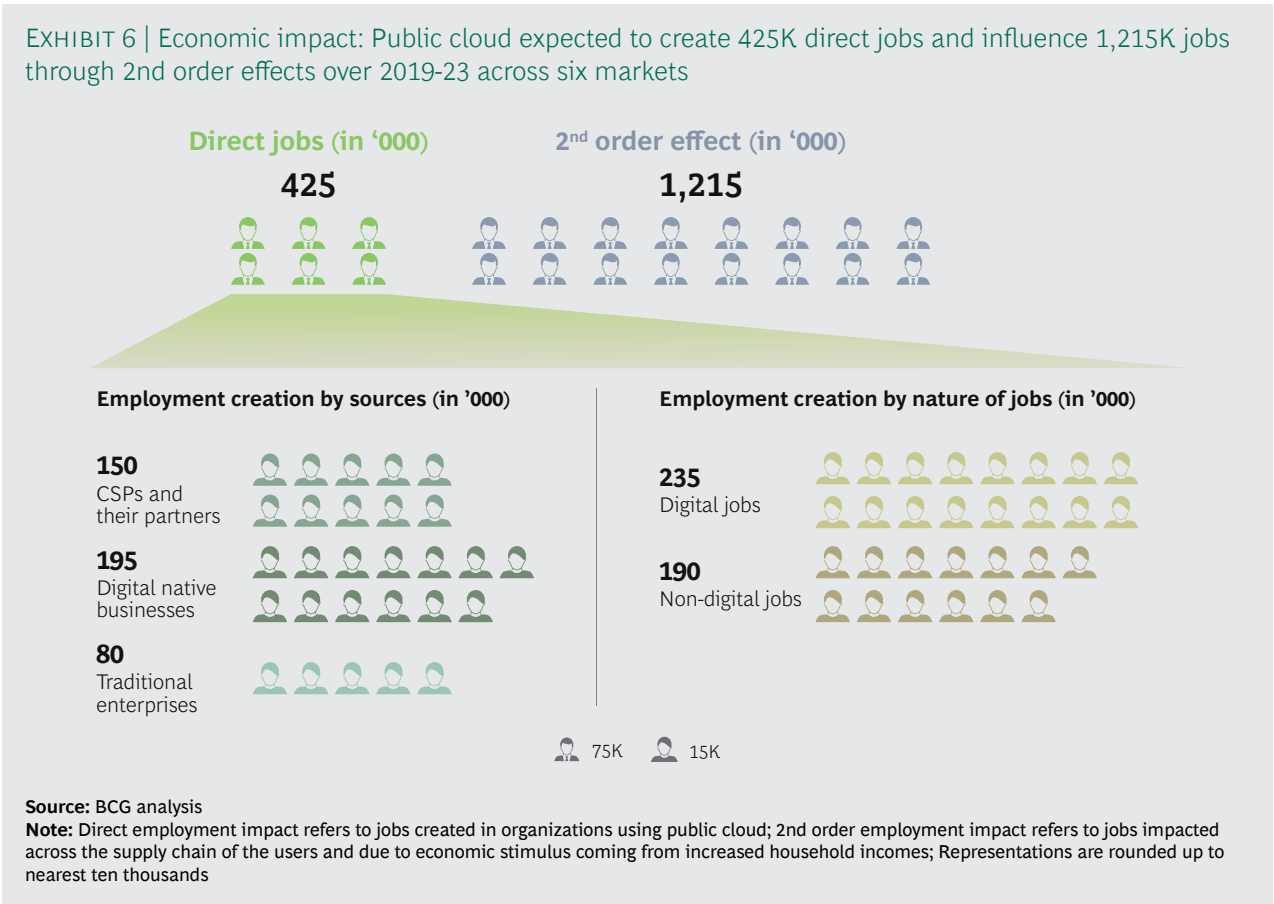
in-bound and out-bound logistics, and a higher number of accountants to look after its finances.

At the same time, public cloud-enabled growth will also drive demand that will lead to indirect jobs impacted further down the supply chain, as well as other additional jobs, resulting from the induced impact upon industries that benefit from the increased consumer spending. These include both new jobs as well as roles where the requirements have changed and require reskilling and upskilling of an existing workforce. The total number of jobs impacted as a result of public cloud should amount to about 1.6 million over the five-year period.

With the growth in direct and indirect jobs related to public cloud deployment gaining momentum, they will have a sizeable impact for the six APAC regional economies. Actual employment impact will range from 0.2% to 0.3% of the current workforce across Japan, South Korea, India and Indonesia, to 0.6% in Australia and 1.2% in Singapore.

DNBs will be the source of a sizeable portion of the direct jobs created, accounting for around 195,000 in total, with about 60,000 in digital roles and another 135,000 in traditional areas including sales and marketing, human resources, business, risk and compliance, finance, operations and logistics. DNBs will also have a strong indirect impact on jobs as they grow and raise sales in areas like retail and B2B merchants in the e-commerce marketplace. Industry verticals in general are expected to gain approximately 25,000 digital jobs and 55,000 non-digital jobs as the result of public cloud use.

The increased use of the public cloud will fuel a rise in demand for digital talent, and we estimate that about half of the direct jobs that result will be digital positions. Of these, 150,000 will be jobs with CSPs and IT firms, while 85,000 will be digital roles within industry verticals. That will amount to approximately 235,000 jobs requiring highly specialized digital skills—an increase amounting to approximately 1% to 4% of the current information and communications



technology (ICT) workforce in the six markets. By comparison, the total cumulative jobs that will result from public cloud use are equal to 0.2% to 1.2% of the workforce in the six markets as of 2018 (See Exhibit 6).

The six markets will need to make sure they have the supply of digital talent to meet the growth in demand. Service providers, industry users, and policy makers alike will need to help develop a skilled pool of digital professionals with the capabilities to guarantee that public cloud platforms not only run smoothly, 24/7, but also foster advanced analytics and new ways to innovate. This requires adequately training the current workforce in new digital skills.

A number of digital roles such as product management, design and user experience, engineering and data science, are core foundational roles. All players—CSPs and cloud integrators, digital native businesses, and traditional businesses—will be equally keen on hiring professionals trained to fill these roles.

While the effort to retrain talent is underway, there is also a need to adequately impart relevant skills to the new workforce. CSPs are increasingly developing plans to partner with universities, as well as online learning platforms such as Coursera, to develop courses that offer certifications, practice sessions, role-based learning experience and more, often including instructions in local languages. This is an opportune time for all stakeholders to look at where the jobs of tomorrow will be.

CHAPTER 4

KEY CHALLENGES TO DEPLOYMENT OF THE PUBLIC CLOUD

THE PUBLIC CLOUD HAS shown that it can provide measurable benefits to users and the overall economy. Yet, to unlock the full economic value that the cloud can bring, users will need to feel more comfortable with the public cloud in a number of important ways.

A significant majority of survey participants (70%) said their organizations faced some degree of challenges in deploying the public cloud. The challenges they face are both internal and external, but they can be broadly classified in three categories:

- Challenges related to the understanding of the public cloud as a product
- Challenges linked to their internal organization
- Challenges linked to unclear policies or regulations

Among the participants experiencing some challenges, the majority said issues were related to lack of understanding about public cloud as a product, followed by organizational challenges with deployment of the public cloud. Select users also had concerns about navigating the policy or regulatory environment (See Exhibit 7).

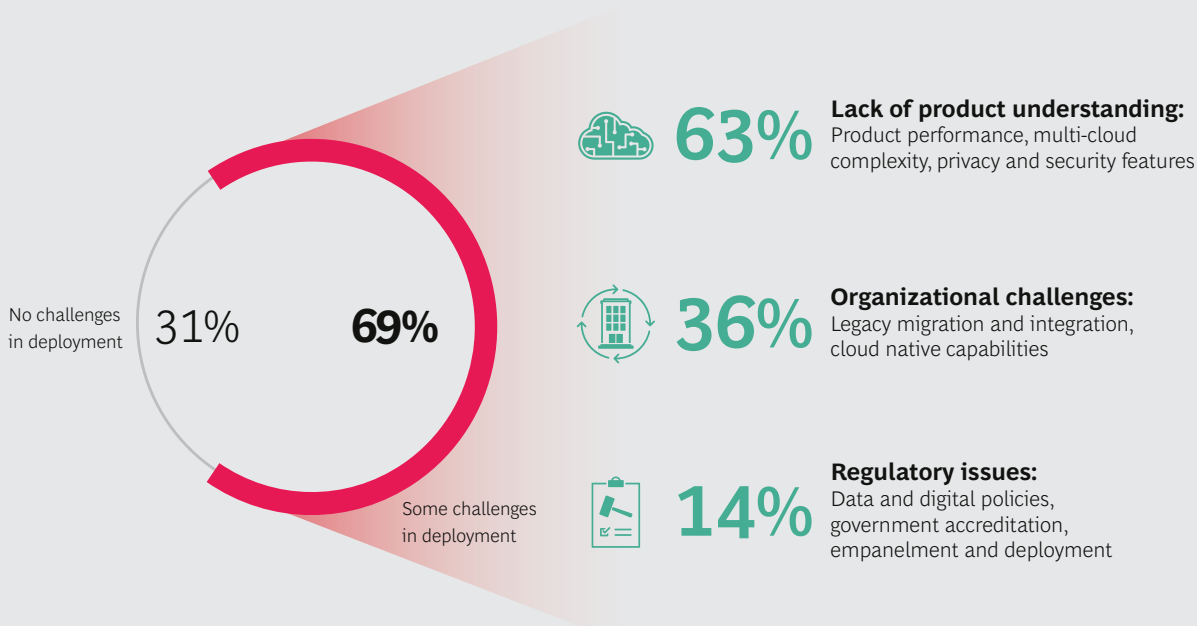
Below, we look at the concerns that business and IT decision makers across the private and public sectors say present the most serious barriers to more widespread use of the public cloud.

Challenges related to understanding the public cloud

A number of the six APAC markets are in the early days of moving onto the public cloud, and organizations that are using it for the first time often find that they don't fully understand how it works. Cloud service providers themselves can do a great deal to educate their clients on crucial concerns like privacy and security, as well as how to operate on the cloud based on their particular needs. Of course, providers need to do their part to provide an excellent product for their clients. According to our survey respondents, providers could also do more to assure that their customers are both satisfied and aware of their own responsibilities, particularly in these four areas:

Lack of clear understanding of data privacy features. There has long been a misconception that because the public cloud platform is shared, users and CSPs might have access to one another's data, especially among more traditional industry users. Although that view has begun to change over the last few years,

EXHIBIT 7 | Key deployment challenges: ~70% public cloud users face challenges during deployment



Sources: Survey of public cloud users and decision makers (n=1026), BCG analysis

Note: Respondents in survey were asked to select key challenges they faced during deployment and utilization of public cloud in their organization

users in industries that make heavy use of proprietary customer data, like financial services and public sector agencies, told us they would be more likely to put their most critical information on the private cloud or on-premise data centers even if they used the public cloud for peripheral applications such as human resources management, operations management, and finance.

Our survey found that one in four users that spend more on the private cloud than on the public cloud believes the private cloud offers stronger privacy, security and compliance provisions. While users tend to understand general IT risks, they remain uncertain about the overall system risks, which leads them to believe that their infrastructure is safer than public cloud. This is also driven by an under-assessment of the risk of on-premise and private infrastructure and a lack of complete understanding of public cloud features.

What not all users understand, however, is that privacy and security breaches are not public cloud specific. Cyber risks are not necessarily higher in the public cloud than

they are in traditional on-premise IT infrastructure. CSPs have the means and the scale of operations to invest in security at a rate that even some of their largest client companies cannot afford. In addition, CSPs can continually access the latest security technology and capabilities, but the customer shares the responsibility for protecting its own data and access.

Complexity of managing multi-cloud environment. There are several reasons why users might adopt multiple-cloud systems, for example they have become advanced in their public cloud use and want to avoid being dependent or locked in with a single vendor, or they want to leverage the expertise of different cloud service providers across different dimensions.

Yet users can find that utilizing multiple service providers presents a variety of technical and managerial challenges, with little or no standardization from one to another. The multiple cloud environments might require training several employee

teams in managing different systems, which can lead to unnecessary complexity and higher costs. When that happens it can be difficult for an organization to realize the anticipated productivity and cost benefits of moving to the public cloud.

There are solutions to the complexity problem, however. Technologies such as the open source orchestration system Kubernetes, for example, provide interoperability across on-premise servers and multiple clouds, so that applications can be portable. Such systems have been designed to recognize that the future is in hybrid and multi-cloud environments in which organizations are going to have to run and manage multiple services and applications simultaneously in different environments.

Concerns around cloud service provider lock-in and relationship. Businesses are concerned that if they start migrating to the public cloud with a particular vendor, they're going to be locked in. Once that happens, they fear the vendor could extract higher prices, or the level of service might decline, and they may not have enough control in future. Lengthy and complex procurement policies and brief time periods for renewals can also keep users locked in with a certain vendor. Organizations in general want assurance that their public cloud providers are going to continue to serve their interests in a long-term relationship.

While technologies such as Kubernetes can help a company function across multiple cloud platforms and thereby avoid lock-ins, CSP vendors can alleviate many of these concerns by making appropriate modification to the commercial terms for their users.

Lack of clear understanding of product performance. Businesses generally want assurance of reliable on-line performance, whether their applications are on a server connected with their own system, a private cloud or the public cloud. In certain industries with critical applications, this is a major concern—airport operators, for example, are particularly sensitive to downtime. Media and gaming companies would also suffer if a

customer were to experience a stretch of downtime.

A concern for many users is whether the public cloud's performance will match that of their existing infrastructure. Most hyper-scale CSPs provide a guarantee of high cumulative system uptime, often over 99.99%, and have provisions for compensation if they are unable to meet this requirement over the course of a year. Such performance standards meet the requirements of most businesses, and generally are in line or even better than private cloud or on-premise systems.

While there have been instances of longer network blackouts from CSPs—for example a blackout of more than an hour in South Korea in November 2018 that affected many online businesses—these instances are exceptions. They do, however, color the perception of the public cloud's performance. Public cloud players need to continue to demonstrate to potential users that their product performs well compared to standard on-premise systems. Users should also benchmark uptime of their on-premise and private cloud systems to properly reflect existing downtime risks.

Challenges linked to the organization

Moving to the public cloud requires a commitment to transformation for the entire organization. Managing this shift within the business is not just the responsibility of IT, but needs to be driven at a leadership level. It can be a challenge to get all parties on board. Equally important, it is not always easy to hire or train people with the skills needed for a smooth transition. Key organizational barriers that survey respondents cited were legacy integration and migration, managing internal capability, and driving cultural change.

It is a challenge to migrate or integrate legacy data, especially in heavy data generating industries such as financial institutions, telecom players and public sector agencies. Such businesses face a complex transition once they make the decision to move large

amounts of information and applications to the public cloud, with a long list of questions to consider before they can start. They must map out a plan with answers to such questions as how do we do migrate? In what sequence? Do we rebuild the existing applications and architecture, or just make alterations? If we rebuild, how long will it take?

Our survey respondents said that the sheer logistics involved in moving legacy systems onto the cloud was one of the most daunting barriers to greater adoption.

“We have 25 to 30 years of data, sometimes on tapes. Even if regulations allow us, we are not sure how all that data will be moved. We’d prefer to move applications in steps over time and redesign systems.”
– CIO, BFSI player

Strong partnerships with CSPs can help companies navigate portability and compliance concerns. CSPs are increasingly building controls into the public cloud environment to meet regulatory, portability and compliance issues. CSPs need to continue this active engagement to keep evolving their offerings and adapt to the changing needs of the market.

Additional challenges that companies face often have to do with their own internal culture, an area in which providers can also lend support and experience. For example, the organization might encounter pushback from managers and IT specialists, who for many reasons might prefer to stick with the existing infrastructure. They might resist the idea of the public cloud out of concern for security or any of the other challenges we’ve discussed in this chapter.

“It is difficult for many team members to understand why they want to put their data up with others over the public cloud. They have zero tolerance of changing the way they operate.”

– Senior executive, Large enterprise

Additionally, employees in legacy organizations might be worried about their jobs. There are often questions about what will happen to the IT administration and operations teams when a company migrates to the public cloud. This is a legitimate concern, because the capabilities required for public cloud technology, where tech practices tend to follow the DevOps model of participating in a team over the whole service lifecycle, are not quite the same as those required in traditional IT administration and operations roles.

Business leaders will have to oversee a certain degree of cultural transition in order to develop the internal team capabilities they need for a successful migration to the public cloud. Traditional companies, whether large or small, might be looking for simple ways to hire more digital talent. BCG’s [Decoding Digital Talent](#) report found, however, that many industries are having difficulties in attracting the talent they need for digitized functions due to the gap between what organizations want and what the digital experts they’re trying to hire desire in a role.

CSPs need to continue to engage with their existing and potential clients in skill building and training. Still, all stakeholders need to work in partnership to address the internal organizational challenges to cloud adoption.

Challenges linked to unclear policies or regulations

In many cases, it is typical for a business in the APAC region to keep only limited functions on the public cloud. A bank might keep its digital services system on a public cloud platform, or a manufacturer might perform its operational management functions on the public cloud. But many companies are reluctant to migrate financial transactions or sensitive data because they can't be certain of whether they're doing it in compliance with regulations in their country.

Throughout many parts of the APAC region, public cloud users and potential users are finding that government regulations can be uncertain, and potentially discourage public cloud use. Depending on the country, regulations might lack clarity on what constitutes personally identifiable information (PII), for example, or whether it is permissible to keep PII on the public cloud. Policy makers need to accelerate their efforts to develop harmonization standards around data, so that policy frameworks are interoperable across geographies, failing which the cost of the service for users would increase, making it financial unviable for many users, thereby limiting its economic impact.

The policy-related concern that came up most frequently in our study was that organizations did not have clear guidelines around data protection and classification. What this means in practice is that users are uncertain as to exactly what types of data their domicile allows them to store on the public cloud vs. what types of data are protected as classified—and if it's classified, whether they are allowed to use encryption or other means of concealing the content.

Financial institutions and public sector organizations struggle to utilize the public cloud without greater clarity on data classification guidelines. These are sectors that retain a great deal of personally identifiable information on their clients or constituency, so they need to know how they should handle storage of such highly sensitive data.

“Clarity on regulatory requirements would be helpful. Not all data is equally important. We can make critical data anonymous, but we're not sure how that would be interpreted by the regulatory authorities.”

– Head, Regional payments company

Also of deep concern are questions around cross-border data flow. Restrictive data flow laws imply that a company needs to store the data within the geographic boundaries of the country. This kind of restriction could potentially inhibit cloud adoption in two ways.

First, if there is no hyper-scale cloud storage within the geographic boundary, organizations cannot move critical applications to the public cloud. Second, if a company operates in multiple countries, it may need to manage the data in each geography separately. In either case, the company might miss out on any number of benefits to be gained from use of the public cloud. It will not be able to take advantage of the economies of scale and standardization that make the public cloud more productive and cost efficient. In addition, restrictions on data flow can impede the development and adoption of ever more advanced AI and ML capabilities.

These missed opportunities affect the national economy as well. Smaller players could be punching above their weight by utilizing the public cloud, local suppliers could be expanding their partnerships, and the local workforce could be developing capabilities in areas like AI and ML that are

in global demand. A lack of deployment due to regulatory complexity may impact those opportunities.

Our survey found that financial institutions, telecom companies, manufacturers and retailers all want to have clearer data security standards to ensure they can be confident that they will not be at odds with any existing regulatory guidelines. There are multiple ways to establish these guidelines. The governments could issue clear data classification guidelines that are interoperable to guide public and private sector users. Alternately, industry groups in a country could come together to create industry guidelines that are interoperable with international standards, and incorporate global best practices applicable to their industries. Once clear data classification guidelines that are interoperable with international standards are established, it makes the operating environment simpler for all stakeholders.

Another policy matter that is important to businesses, especially traditional SMEs but also to a degree larger companies, is a government mandate to help make public cloud adoption easier through financial assistance. For smaller traditional companies, managing expenses and cash flows during the transition in order to realize long-term benefits might be challenging. They would be more inclined to use the public cloud if they were able to finance the move through some form of government-backed tax credits or incentives. CSPs are starting to provide credit-based discounts to early stage startups, but government support would give a further boost to public cloud use by SMEs. Such programs could be worthwhile, especially if they help small businesses grow their

revenue and boost their economic impact in the region through use of public cloud and associated technologies.

Cloud service providers are helping their clients make the transition with workshops and training programs. Businesses are partnering with systems integrators and IT consultants to address the talent issue as they move more of their applications onto the public cloud. Government agencies in some APAC markets are formulating clearer policies about data classification and cloud usage, and many are adopting the public cloud themselves.

What is needed throughout the region, however, is a deeper ecosystem for education and information that includes the contributions of systems integrators, partners, and all entities that can help provide resources for a more skilled and informed user base. In the next chapter we will look at the steps that service providers, individual organizations, and policy makers can take to help break down the barriers to public cloud migration.

CHAPTER 5

10 KEY LESSONS FOR BREAKING DOWN BARRIERS

AS WE HAVE SEEN in previous chapters, the public cloud has a great deal to offer the APAC region in terms of productivity and economic gain, but potential users don't always have a clear path to adopting the cloud and realizing these benefits. Cloud service providers and regulators can undertake a range of steps to make it easier for users to deploy bigger applications on public cloud.

For cloud providers, an effort to ease the transition for clients would lead directly to an increase in users and demand for more sophisticated products and services. Businesses can find cloud migration or integration complicated, and in some cases costly, but providers can act as long-term strategic partners with the goal of setting up users to succeed.

A supportive regulatory environment is equally important to enabling deployment of the public cloud. A specific set of policies on data classification and security standards works as a catalyst to encourage businesses to use it.

Equally important, governments can contribute to more widespread public cloud adoption by setting clear processes in place, utilizing it themselves, and serving as an example to the market, providing targeted

financial incentives where needed, and upgrading supporting infrastructure.

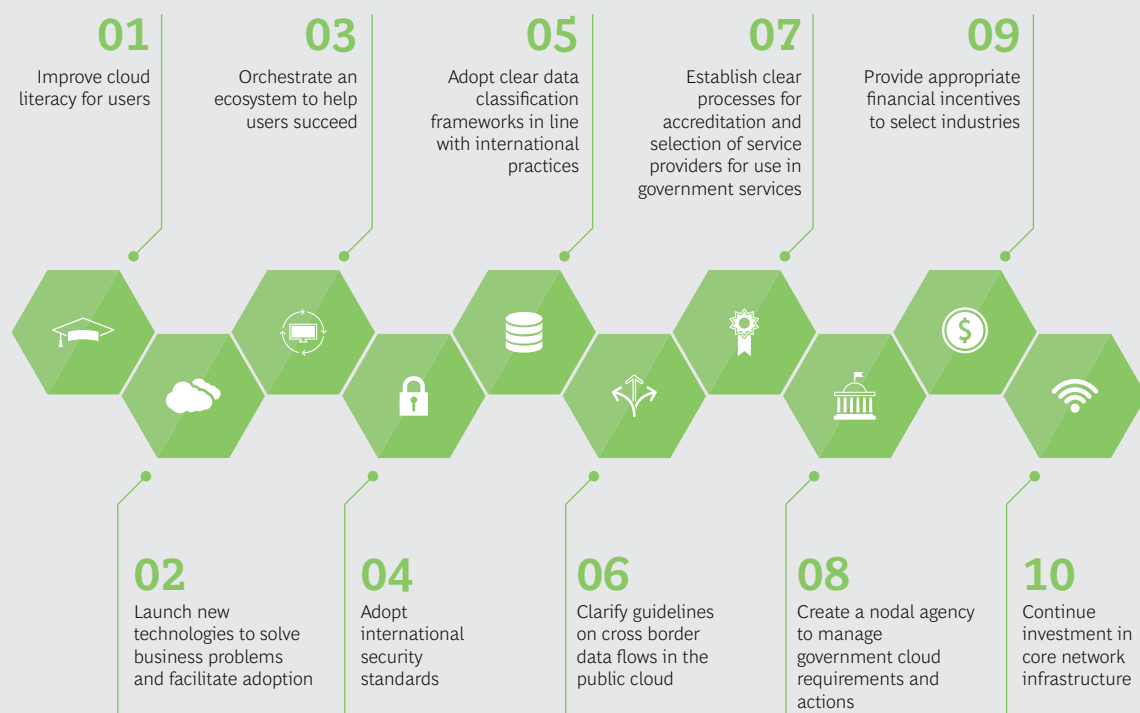
With the benefits to all stakeholders in mind, we have mapped out 10 key lessons derived from the best practices of public cloud usage in global markets. These are practices and lessons that can help mitigate the challenges and make public cloud adoption an attractive proposition for all potential users (See Exhibit 8).

1. IMPROVE CLOUD LITERACY FOR USERS.

CSPs consider it an ongoing job to educate both the decision makers who are in charge of buying public cloud services for their business and the developers in the organization who will be the ones who ultimately operate the cloud services. The public cloud is a transformative technology in terms of the way it can change an organization's capabilities, and as with all transformative technologies, the organization will go through a learning curve. CSPs can speed up the process by collaborating with governments on capacity-building initiatives such as cloud certification and digital upskilling programs.

Providers can help the decision makers understand how the public cloud can deliver benefits specific to their business. For example, how will the public cloud enable

EXHIBIT 8 | Mitigations for challenges: Ten key lessons for breaking down barriers



Source: BCG analysis

them to add revenue-enhancing lines of business and save costs? Part of this education should also revolve around security, with the provider demonstrating that the public cloud is a lot more secure than most local installations and explaining which controls are in the hands of the user. It should also highlight the public cloud's reliable and scalable server performance.

In less mature markets, not all users are going to be aware that they have the option of a hybrid or multi-cloud approach, moving only select applications to the public cloud. In legacy organizations, senior leaders have to be prepared to institute cultural changes when applications move to the public cloud. Providers should make themselves available to advise the company's management on their options, and provide guidance through the transition.

At the same time, senior managers who are considering an initial migration or a deeper integration of applications onto the public cloud are going to need buy-in from their IT teams. Ease of use is critical for engineers

and developers, and CSPs should be prepared to help them ramp up their skills.

“Our internal teams are still getting to play with the features of the product. If services are not easy, it will be difficult to create talent at a quick pace.”
– Head of IT infrastructure,
Large manufacturer

Most providers have already developed in-house training for clients and sponsor courses on public cloud technology, sometimes helping design course content for universities, industry associations, or government skill-building programs and offering hands-on experience to students. Nevertheless, there remains an acute need for them to continue

to invest in building the supply of cloud-native talent across the APAC region in order to meet the growing demand.

It also falls within the providers' mandate to sponsor certification courses for developers, in local languages if needed, so that users can be sure of having enough support for their applications on the public cloud.

2. LAUNCH NEW TECHNOLOGIES TO SOLVE BUSINESS PROBLEMS AND FACILITATE ADOPTION.

As CSPs develop advances in public cloud technology, they have an opportunity to continue to engage their existing clients, with particular attention to creating technology that offers solutions to problems the clients have experienced, with an emphasis on making it easier to use the cloud.

Providers are continuing to develop solutions that help clients integrate their on-premise functions with the cloud through hybrid applications. They are also guiding clients in supporting hybrid and multi-cloud infrastructures. Some providers have developed technologies that help clients move applications seamlessly between hybrid and multi-cloud architectures with consistent security controls.

Providers are also offering technologies to clients that can help improve their compliance with the existing regulations. For example, Data Loss Prevention, available through many CSPs, makes it possible to discover, identify, classify, and manage sensitive or PII data. Moreover, providers are facilitating technology transformations using such advances as state-of-the-art machine learning models on structured data, video intelligence, artificial intelligence, and Internet of Things (IoT).

Advanced tools such as the Kubernetes platform, AI and ML applications, and hybrid or multi-cloud management tools, generally require a certain amount of skill and training to use to their full potential, and providers are in the best position to demystify these for their users. There is much that a provider can do as a partner to clients, for example, some have set up learning labs in which the

company's employees can receive immersive training in specific technologies such as machine learning and artificial intelligence.

3. ORCHESTRATE AN ECOSYSTEM TO HELP USERS SUCCEED.

Businesses need to know that an entire ecosystem exists around the public cloud to support their needs, help resolve IT problems, enforce security, ensure high operating standards, make advanced trainings available, and assist them when it comes to regulatory policies. It falls to the CSPs, as the originators of the public cloud infrastructure, to build this kind of ecosystem that helps their clients achieve all of the potential value that the public cloud can deliver.

Cloud service providers should work with their business clients in facilitating an extended interactive partnership that includes users, systems integrators, consultants, industry associations, regulators, and CSPs themselves. The network that results would have numerous purposes, including education and training, sharing information about new technologies, challenges, best practices and user needs, as well as engaging the industry associations to help anchor discussions between users, CSPs and regulators.

An ecosystem built around traditional SME clients is an excellent way to provide a forum for dialogue between smaller businesses and the partners that can help this business segment. Traditional SMEs can benefit from partnerships that are set up to help them learn about how the public cloud can assist them in building their businesses, advocate for financial resources to help them transition to the cloud, and give them access to digital training and expertise.

4. ADOPT INTERNATIONAL SECURITY STANDARDS.

Data privacy and IT security are among the most critical challenges that users in the APAC region cite when discussing what might keep them from migrating data to the public cloud. Regulators could do much to ease their concerns.

It is particularly helpful to organizations when regulators provide security frameworks that draw from international standards, and are therefore interoperable across borders. Clarity of standards would boost public cloud adoption by assuring users that their data is protected. Depending on the level of deployment for different types of data, this can also help in articulating which elements of the security is their own responsibility to protect.

Not all users are aware of the grades of responsibility that come with different cloud models. CSPs are committed to doing their part to keeping customers' data secure, but security is a shared responsibility, and requires collaboration. CSPs are generally responsible for securing their infrastructure, while customers are responsible for securing access to their data—often with guidance on best practices, security products, and other information from their CSP partners. The customer's specific obligations vary according to whether they are using IaaS, PaaS, or SaaS models. Under SaaS, most of the responsibility falls onto the CSP, with the user managing the access and content. Under IaaS, the provider is responsible for securing the infrastructure foundation and the user for securing the software and applications that they set up.

If there were uniform security standards across markets, it would be easier for CSPs to launch new products that meet standards everywhere, and for businesses to broaden their adoption of the public cloud. A robust security framework also supports the creation of opportunities for CSPs to serve sector-specific security requirements, such as the security structures required for financial services, healthcare, and other industries with large loads of PII.

To this end, Australia's Information Security Registered Assessors Program (IRAP), Singapore's Multi-Tier Cloud Security Standards (MTCS), and South Korea's Cloud Security Assurance Program (CiSAP) have set up security frameworks for the public cloud that are patterned after international best practice frameworks such as the ISO 27000 series, and are interoperable. The frameworks

created by agencies such as the National Institute of Standards and Technology (NIST) and the Federal Risk and Authorization Management Program (FedRamp) in the United States, and the European Union Agency for Cybersecurity (ENISA) can also serve as effective benchmarks for security standards.

5. ADOPT CLEAR DATA CLASSIFICATION FRAMEWORKS IN LINE WITH INTERNATIONAL PRACTICES.

Users believe they can take cloud migration only so far without clear guidelines around classification, otherwise they run the risk of violating regulations around how they can store sensitive data. CSPs generally do not have visibility into their customers' data, so it falls to the user, the owner of the data, to determine what data is stored and processed in the cloud.

The classification of data rests on two factors. The first is the nature of the data itself. Basically, sensitive data contains personal information about user clients—for example, PII, financial transactions and health records. Other sensitive data elements could include proprietary information such as account numbers or product formulas.

The second factor is the determination of which industry is using the data and how it will use it. The data is likely to be considered more sensitive when it is coming from critical areas such as a country's defense systems, utility infrastructure, or air traffic control records. There is data that can be innocuous in some cases, for example records on food purchases by a hotel chain, but subject to a more sensitive classification in a different context. If, for example, the food purchase records are coming from the defense industry, they might reveal information about the whereabouts and size of military installations, and therefore be subject to additional security configuration on the cloud.

Establishing clear classification practices about each type of data makes it easier for industries to determine what sort of security controls they need to put in place when they migrate data to the public cloud.

South Korea, through its Personal Information Protection Act (PIPA) and Network Act, and Australia, through its Privacy Act, have established classification frameworks identifying how public cloud providers and users should handle personally identifiable information which is classified as sensitive. For example, in South Korea, users are not allowed to collect PII unless they have explicit consent or special exception, and even data that is not personal is considered PII if it can be easily combined with another data set to enable individual identification.

6. CLARIFY GUIDELINES ON CROSS-BORDER DATA FLOWS IN THE PUBLIC CLOUD.

Cross-border data flow regimes vary from free-flowing non-restrictive environments to heavily restricted ones, but most countries in the APAC region are becoming exceedingly protective about how and where sensitive data is stored. What this means is that just when the public cloud is available to store massive amounts of data priced to scale, regulations can make it difficult for a business to make use of the public cloud's scale and efficiencies.

While the public cloud can readily accommodate the growing reams of geo-diverse data, cross border data flow rules can limit the ability of businesses to make use of the opportunity. Cross border data flow restrictions can even inhibit the growth of machine learning, which depends on access to hyper-scale computing of data to expand the scope and sophistication of its algorithms.

There are a number of ways to establish flexible systems for clarifying whether data can be transferred, allowing conditional flows of data through prior authorization from regulatory authorities, consent from citizens, and the use of prescribed contractual clauses with downstream data recipients.

Bilateral frameworks such as the EU-US Privacy Shield are one way to set up such a system. The G20, under Japan's chairmanship in 2019, is also exploring a Data Free Flow with Trust framework. Select frameworks such as the APEC Cross-Border Privacy Rules (CBPR) System and the EU's Binding Corporate Rules allow organizations to

transfer data within a corporate group or to specific recipients on an ongoing basis.

Data adequacy agreements across countries are also a way to make digital business easier. Japan has this kind of agreement with the EU, with built-in protections to allow cross-border data flows across markets. Such agreements include provisions that if an individual in the EU is not happy with the way their data has been treated, or believes their rights have been violated, they have various channels through which they can file complaints in Japan.

7. ESTABLISH CLEAR PROCESSES FOR ACCREDITATION AND SELECTION OF CSPs FOR USE IN GOVERNMENT SERVICES.

Numerous industry leaders told us that when government bodies use the cloud, it creates more interest because it signals that CSPs can offer government-grade services and are secure and reliable.

To bring more public sector and government agency users on board, however, governments first have to establish the kind of standard security requirements for cloud adoption discussed in Lesson No. 4, thus ensuring a transparent and well-defined accreditation process.

To put such standards in place, it is necessary for the government to create a process for cloud accreditation and compliance certification, with clear steps to make the process easy, transparent and, to the extent possible, consistent across boundaries. The region is beginning to see progress on this front. For example, Australia's IRAP initiative includes a benchmark accreditation program that institutions throughout the federal government use, along with global protocols like the ISO 27000s, to indicate that a CSP is secure for usage.

8. CREATE A NODAL AGENCY TO MANAGE GOVERNMENT CLOUD REQUIREMENTS AND ACTIONS.

Government use can spur growth among private sector businesses, thereby boosting the economic impact that comes from industry public cloud use. Besides being an economic catalyst, however, government

agencies can use the cloud to provide better services for the citizens—for example, people can file taxes, apply for visas or passports, and renew licenses on their computers or mobile devices rather than having to travel long distances to the nearest city and wait in long queues.

An important step toward more government sector use of the public cloud is the formation of an agency to establish best practices for migration, along with clear procurement policies for government agencies to use in selecting a cloud service provider. The procurement policy should spell out such considerations as the tendering process and the criteria for evaluation and selection. The objective would be to facilitate a smooth transition to the public cloud, with a clear message that the migration will reduce the costs of government services and improve accessibility, quality, efficiency, and security. A strong transition plan would also provide a useful template to the private sector as businesses undergo digital transformations.

The governments of Singapore and Australia were early innovators in establishing nodal agencies and setting a ‘cloud-first’ procurement policy, which directs government agencies to evaluate the public cloud first when considering where to house new applications, and consider other options only if the public cloud doesn’t turn out to be viable.

Singapore’s nodal agency, GovTech, has had a ‘cloud-first’ policy in place since 2013. The agency has enabled interoperability between the Government Cloud (G-Cloud) and the public clouds through a set of internal G-Cloud standards. A Government Commercial Cloud Infrastructure (GCCl) project was set up to oversee an upgrade of the existing IT infrastructure, and also gives quick clearance to government agencies to procure public cloud services. The government’s use of the public cloud has been an important catalyst for the local technology industry.

“Adopting the public cloud throughout the Singapore government’s technology solutions connects us to our local tech ecosystem. Since we are all on the same platform, we can use APIs developed by startups on our government platform and continue to develop and refine a core set of e-services.”
– Director, Government agency

Australia launched its cloud-first policy in 2014, also creating a Digital Transformation Agency to support public sector’s cloud adoption. It currently has about 400 government apps available to residents. In 2017, the government conducted a survey on the cloud to gauge support for a marriage equality law.

Japan has established a cloud-first policy through federal and local bodies, in consultation with the government chief information officer. South Korea and India have a government cloud-first guideline for public sector applications, while Indonesia has no central governing body or cloud-first policy in place yet.

9. PROVIDE APPROPRIATE FINANCIAL INCENTIVES TO SELECT INDUSTRIES.

Along with the need for greater cloud literacy, industry advocacy and security guidance, traditional SMEs participating in our survey discussed the need for financial incentives such as tax relief and government

subsidies to encourage the use of public cloud. Digital native startups can also benefit from government-sponsored financial incentives that help them launch and grow quickly.

We are starting to see incentive programs in the APAC region for companies that need support. Singapore's GoCloud program provides funding along with consulting and training to equip DevOps team at small businesses and startups with cloud-native digital capabilities. South Korea's public cloud adoption support program for SMEs subsidizes public cloud fees and offers consulting and security support for small financial technology (Fintech) firms using the public cloud.

This kind of support is aimed at making it easier for smaller businesses to use the public cloud. Since cloud applications enable SMEs to become more agile, flexible and scalable, policy makers should look at such programs as an investment in economic expansion.

10. CONTINUE INVESTMENT IN THE CORE NETWORK INFRASTRUCTURE.

The public cloud needs advanced telecom network capabilities to deliver an optimal performance. Local and national governments can make an aggressive push for state-of-the-art communications infrastructure, encouraging telecom companies to test and adopt advanced network capabilities so that the country can meet growing data needs and support higher cloud service availability and quality.

While many of the six countries have addressed these issues, India and Indonesia are continuing to invest in their network infrastructure to meet the data demands of their rapidly growing populations through internet access. Indonesia now has the Palapa Ring fiber-optic upgrade plan under construction, enhancing connectivity throughout the archipelago with undersea cables. India is expanding its telecom network coverage so that more than the present 25% of mobile network towers will be connected to fiber networks. South Korea launched its first 5G networks this year, while Australia, Singapore and Japan are planning to start testing commercial 5G in the next one or two years.

The level at which each of the six APAC markets have addressed barriers varies widely. If the APAC region is to successfully mitigate the challenges to public cloud adoption, the increased adoption rates that result will have a significant impact on the economy. In the next chapter we will look at how a positive change in the forces that determine the current pace of adoption would lead to a greater economic impact than our baseline forecast, while the impact would diminish if CSPs or regulators are unable to break down barriers.

CHAPTER 6

THREE SCENARIOS FOR THE FUTURE OF PUBLIC CLOUD

IN OUR OVERVIEW OF the economic impact that the public cloud will have upon the APAC region over the next five years, our estimates reflect the current natural progression, or what we call the baseline scenario. This is the landscape that will unfold if existing market trends and regulatory conditions continue as they are now.

Yet, as we saw in Chapters 4 and 5, there are barriers that could limit the level of growth if CSPs, user organizations, or policy makers pull back on the conditions that make public cloud adoption desirable. Conversely, if all barriers are mitigated throughout the APAC region in the near future, public cloud adoption could soar well beyond our baseline forecast.

We have developed models for a number of scenarios. The Big Bang Growth Scenario represents the most optimal forecast, while the Sluggish Growth scenario represents a restricted growth. The status quo scenario is represented in our Baseline Scenario. These models are archetypes that could vary dramatically from one APAC economy to the other.

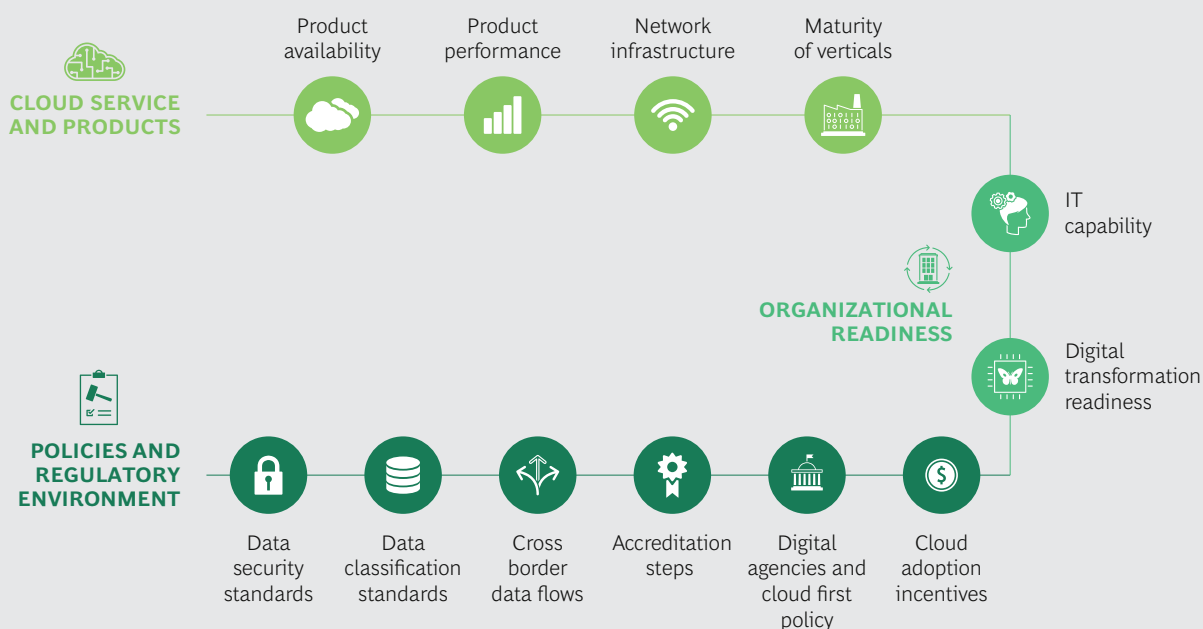
In this chapter we will show what the overall economic and employment picture across all six markets would look under each scenario. Given that each of the markets is at a

different stage of public cloud adoption in the base case, the specific factors defining the Big Bang Growth Scenario and the Sluggish Growth Scenario would also differ. In the country reports that follow we will assess the country-specific details that could affect how each of the scenarios would play out in each market.

What would cause a Big Bang Growth, Baseline, or Sluggish Growth Scenario?

Our models factor in the variables that would trigger growth on one end, and, on the other, those that would arrest rapid growth. We gauged the impact of each scenario through the lens of CSPs, industry verticals, and the policy and regulatory structure. We looked at parameters within each that would affect public cloud usage rates and serve as indicators of the sophistication of the market. These parameters include product availability and performance, maturity of the user industries in the market, network infrastructure quality, IT capability and digitization readiness, data standards, presence of digital agencies, and public cloud policies (See Exhibit 9). How these factors play out, especially in combination with one another, will determine the scenario that occurs in each of the six markets. (See Appendix for more details on estimation of

EXHIBIT 9 | Cloud Adoption Index: 12 parameters in 3 clusters used in estimation of Cloud Adoption Index



Source: BCG analysis

Cloud Adoption Index using these parameters for each of the markets).

Behind each scenario we've modeled lies a combination of conditions that could affect the growth rate. Although the actual economic and employment impact could fall somewhere between the Big Bang Growth, Baseline and Sluggish Growth scenarios depending on the balance and severity of those conditions, here is a look at the key forces and outcomes for each scenario:

BASILINE SCENARIO: MARKETS EVOLVE IN THEIR NATURAL PROGRESSION

This is the scenario that will unfold if the current rate of progression continues. It represents a situation where providers continue to launch newer products and services at their current rate, and partner with users to help them in adapting to the public cloud. It involves industries and public sector organizations continuing to recognize the benefits of the public cloud and move newer applications to the cloud at the current rate, and policy makers keep their current stance. In this scenario, public cloud investment will remain consistent with what we are currently witnessing.

Under the Baseline Scenario, the CAGR of public cloud spending will be approximately 25% over the next five years, with 50% of that spending going into growth.

BIG BANG GROWTH SCENARIO: PUBLIC CLOUD ADOPTION ACCELERATES

This is the most optimistic scenario, and has the potential to yield a greater economic impact than the effects we discussed in Chapter 4. For greater growth to ensue, users, providers and governments would have to work together to break down barriers to adoption. Traditional enterprises would develop strong digital transformation agendas, and government policies would be designed to support public cloud adoption. Small businesses and startups would, through providers' efforts, gain easier access to the public cloud, and large numbers of digital native businesses would launch. All parties would begin a strong push to address the talent supply constraints and increase cloud literacy.

In the Big Bang Growth scenario, the CAGR of public cloud spending would be as high as 30% over the next five years, and 60% of the money spent would go toward growth in the

form of new or enhanced public cloud products and services.

SLUGGISH GROWTH SCENARIO: PUBLIC CLOUD ADOPTION IS INHIBITED

If providers were to slow down their expansion plans, and organizations found that the challenges of adopting the public cloud outweighed the benefits, the economic impact of the public cloud would be slower than our baseline projection. Other factors that could cause a slowdown are constrained adoption by the public sector, more restrictive policies concerning data such as localization or stringent classification, or limited use of enablers like machine learning and artificial intelligence. In addition, growth can be negatively impacted in any market that is not able to develop the digital talent that is needed to operate on the public cloud.

In the Sluggish Growth Scenario, the CAGR in public cloud spending could be reduced to roughly 20%, with only 45% going to growth.

Understanding different economic impacts

The cumulative GDP impact of each scenario would vary from around US\$580 billion over the next five years under the Big Bang Growth Scenario to just under US\$375 billion in the Sluggish Growth Scenario. In short, the contributions of all stakeholders—providers, user organizations, and policy makers—can generate a potential difference of close to US\$200 billion in the GDP impact across the six markets over the next five years (See Exhibit 10).

Similarly, under the Big Bang Growth Scenario, the region is likely to add as many as 770,000 new jobs through direct economic impact, while under the Sluggish Growth Scenario approximately 235,000 jobs would result from the direct impact. If we include the indirect and induced jobs influenced by economic stimulation, the number of jobs impacted could vary from less than about 750,000 in the sluggish growth scenario to be

EXHIBIT 10 | Economic impact scenarios: Cumulative GDP impact ranges from ~\$375B to ~\$580B and total employment impact ranges from 950K to 2,900K



Source: BCG analysis

Note: Direct employment impact refers to jobs created in organizations using public cloud; 2nd order employment impact refers to jobs impacted across the supply chain of the users and due to economic stimulus coming from increased household incomes

as high as about two million in the big bang growth scenario. Thus, the contributions of all stakeholders could make a difference of 535,000 direct jobs and influence another 1.5 million second order jobs in the six markets over the next five years.

While the scenarios represented in this chapter factor in the actions of cloud service providers, user organizations, and policy makers, our estimates are based on the assumption that the macroeconomic conditions will remain as they are today.

If an economic downturn occurs between now and 2023, all scenarios could deliver a lower impact, especially the Sluggish Growth Scenario, with the overall GDP impact reaching no more than US\$320 billion, and the number of newly-created direct jobs as low as 170,000. Total jobs impacted, including those influenced from indirect and induced impact, would be about 620,000, approximately 30% less than the sluggish market would produce under non-recessionary conditions.

The uncertainties in the global economy heighten the need for urgency in providers, users and policy makers taking steps that will accelerate adoption of the public cloud, because the financial benefits from cloud use can increase resilience for businesses in APAC economies in the face of a downturn.

“Governments across the region should work together to develop a common set of standards for digital identity, interoperability and shared sovereignty for data. This would go a long way in determining how much impact the public cloud can have on the region’s economy.”

– Senior official, Government agency

The comparable difference in impact of these identified scenarios demonstrates why it is critical that every country in the region get the public cloud right. With so much economic value at stake, CSPs, organization and policy makers need to act together while there is momentum gathering toward public cloud adoption in order to realize the maximum benefits that the public cloud can deliver.

CHAPTER 7

THE SIX APAC MARKETS IN DEPTH

EACH OF THE SIX APAC markets is at a unique stage of development in its adoption of the public cloud. Singapore, Australia and Japan are more advanced markets. India and South Korea are in intermediate stages of growth, while Indonesia is in early stages of public cloud adoption. The more advanced markets are focused on using the public cloud to develop new technological capabilities and revenue sources. Users in these markets tend to seek multi-cloud services, aided by a conducive regulatory climate and the powerful signaling effect of government agencies deploying the public cloud to upgrade citizen services. Users in the markets that are in earlier stages of growth tend to look to the cloud more for cost savings, but face such challenges as lack of product understanding and clear, interoperable regulatory frameworks.

Consequently, the growth potential across markets and economic impact varies, and the potential for a more aggressive or a more sluggish economic impact depends on what steps different stakeholders in the individual markets are taking to mitigate the challenges and encourage both public and private sector use of the public cloud. In the country reports that follow, we will look at the special circumstances surrounding cloud adoption, benefits, challenges, and outlook in each of the six markets.

Australia

EXECUTIVE SUMMARY

Australia is one of the most advanced public cloud markets in APAC, and is projected to grow at a CAGR of 17% from US\$5 billion in 2018 to US\$11 billion in 2023. Large enterprises across all business sectors including media, retail, and financial services have adopted the public cloud, with interest growing among manufacturing and mining players. The government is also focused on public cloud migration and is now developing enhanced citizen services through the public cloud. There is a strong appetite among users for a multi-cloud environment to benefit from the experience and strengths of different service providers. The cumulative economic impact from the deployment of the public cloud is expected to be about US\$110 billion over the next five years, which when annualized is equivalent to about 55% of the annual GDP impact from large traditional sectors such as mining. The direct impact would generate approximately 26,000 jobs, with another 47,000 influenced by second order effects. Optimal growth conditions, including an increase in the pool of digital talent and continued regulatory support, could increase the total GDP impact to an estimated US\$130 billion, and the total employment impact to about 110,000 jobs over the next five years.

Snapshot of Public Cloud Adoption in Australia (2019-23)



Impact on GDP

\$108B

55%



of annual impact from mining industry

Direct jobs created

~26K

47K



jobs influenced by 2nd order effects

Industries leading the adoption



Media and Gaming



Retail and Consumer Goods



Financial Services



Public Sector

What industry users say

Benefits



Faster TTM for products and services



Higher team productivity & collaboration



Enhanced ability to launch new products and services

Challenges



Legacy migration cost & risk



Gaps in organizational capabilities

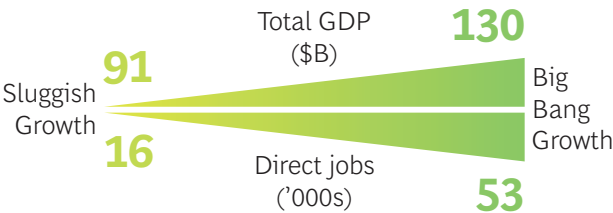


Complexity of managing multi-cloud environment

Range of impact

Key factors driving impact

- Deployment of multi-cloud solutions by providers
- Addressing supply of cloud native talent
- Accelerated deployment of government applications
- Evolution of new data & digital regulations



INTRODUCTION

Australia is one of the most advanced public cloud markets in APAC. The market is expected to grow from a value of US\$4.7 billion in 2018 to US\$10.5 billion in 2023, with a CAGR of 17% over the next five years (See Exhibit 11).

Large enterprises across all business sectors have adopted the public cloud. This has been driven by a strong impetus from the government, which has created clear guidelines for data classification and other regulatory frameworks, and led the way to public cloud migration with its own cloud-first policy.

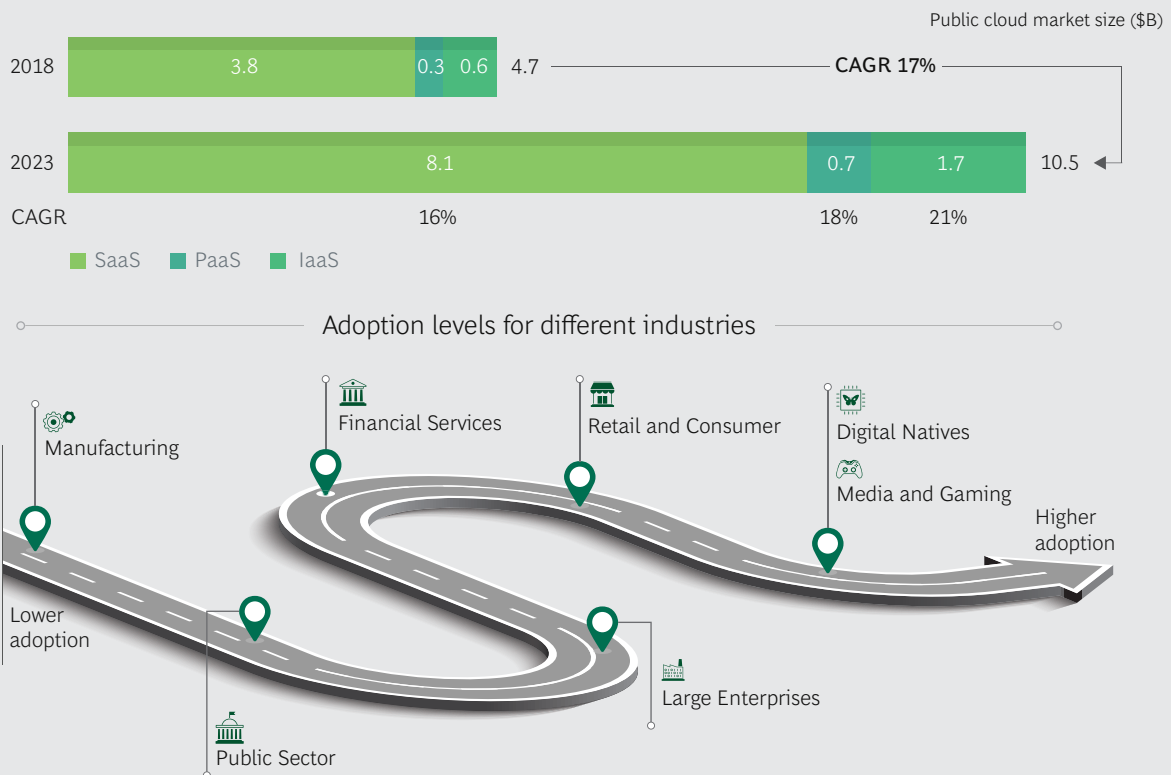
The largest users among industry verticals are media and gaming, retail and consumer, financial services, and the public sector. There is also increasing interest and traction with manufacturing and mining players in

the market. Public cloud use has become increasingly sophisticated, with a focus on enhancing the customer or citizen experience.

SaaS is by far the largest segment, accounting for close to 70% of the market, but IaaS is expected to be the fastest growing between 2019 and 2023, with a CAGR of 21%.

Before 2014, users migrated to the public cloud largely as a means for achieving cost efficiencies. After that, however, the market began to evolve. Large companies were rapidly digitalizing their business functions and saw the value the public cloud brought when it came to developing new products and services. The government launched a cloud-first policy, and in recent years has greatly expanded its use, with federal and state agencies operating a variety of citizen-centric e-services.

EXHIBIT 11 | Market overview: Public cloud market in Australia is expected to grow from \$4.7B to \$10.5B at a CAGR of 17% over 2018-23



Sources: Expert interviews, Survey of public cloud users and decision makers (n=1026), Industry reports, BCG analysis

Note: SaaS refers to Software as a Service and includes business processes and support projects market, PaaS refers to Platform as a Service and IaaS refers to Infrastructure as a Service model; all CAGRs shown are 3 year CAGR for 2018-23

INDUSTRY ADOPTION

Media and gaming companies, followed by retailers and financial services institutions, have been major drivers of public cloud adoption in Australia. However, nearly all industry verticals are aware of the benefits of the public cloud when it comes to unlocking efficiencies across the value chain, and have harnessed it to some degree.

As the volume of applications deployed on the public cloud grows, businesses are using multiple vendors and hybrid clouds. There is a strong appetite among them for technology solutions that make it easy for the user to manage a multi-cloud environment.

The media industry has been at the forefront of adopting IaaS and PaaS. Use cases include such functions as data storage and encryption, content sharing and streaming, and digital content delivery, as well as meta-data analytics. Media companies are using these platforms to facilitate interactive customer experiences, real-time analytics to measure user engagement, strategic placement of ads, and real-time television viewing data and ratings.

“The public cloud allows us to scale quickly, spinning channels and events in seconds. The infrastructure is scalable to cater to spikes, and it’s easier to drive online viewing.”

– Director, Media player.

Retail players, too, have found that the public cloud is essential for increasing their supply chain efficiency as well as their operational efficiency across the value chain. Retailers told us that they’ve begun to use cognitive services as well, developing personalization technology to deliver ever more customer-centric experiences, and they are seeing a

great deal of potential for real-time cross-channel customer engagement. One of Australia’s largest retailers, for example, is deepening its business intelligence through public cloud based advanced analytics and driving its loyalty program.

Many financial services players have adopted a cloud-first strategy. Although migration can be a slow process for legacy institutions, banks and other financial institutions are moving peripheral applications onto the cloud. ANZ Bank, one of Australia’s largest banks, is using cloud services to help analyse aggregated, de-identified data sets in order to deliver insights to their institutional customers, a task previously done manually. (See ANZ Bank case study). Some banks are evaluating the advantages of moving their core applications, which would require redesigning their applications as well as adhering to clear regulatory guidelines for how they can treat customer data. Moving their core functions such as foreign exchange platforms, loan approval systems, and leveraging big data and advanced analytics for product pricing, will make it possible for legacy banks to compete with newer financial technology businesses.

Use cases are also growing among manufacturing companies, especially in mining. In this industry, however, there has been some reluctance to move core applications onto the public cloud due to concerns about latency in connectivity.

The Australian government has taken a number of measures that help mitigate challenges to public cloud adoption and encourage its use. Its cloud-first policy has served as an endorsement to industry, signaling that data is secure on the public cloud, with cloud service providers offering classified services that are secure enough to receive government accreditation. Private sector users are well aware of the security and compliance standards set by the government, and the tendency is to follow or raise those standards internally, and hence when selecting a vendor they look for one that will meet their organization’s own standards.

CASE STUDY
ANZ BANK



ABOUT THE COMPANY

ANZ Bank is one of Australia’s largest financial services institutions. The Bank serves retail, commercial and institutional customers in Australia and New Zealand, and has an institutional presence in 33 markets around the world.

CHALLENGE

In an effort to enhance its data and analytics capabilities, ANZ bank needed to accelerate the delivery of data-driven business insights to its institutional customers.

Smart Analytics to drive productivity and insights capability

ANZ is using cloud computing to analyse aggregated, de-identified data sets for customer insights. The bank found Institutional customers were looking for more than just financial products and services, they wanted insights into how to run their business more efficiently. Public Cloud allows the Banks data scientists to process data sets 250 times faster than before, in the past this task was done manually.



Reduces credit analysis time to **20 seconds from 5 days** with parallel systems



Uses machine learning to work on **data containers stored by the bank**



Uses cloud to **drive customer insights**



Over time we can help customers make informed business decisions more quickly on issues like liquidity, risk and cash management, or strategic calls like store locations, inventory and market positioning. A cloud based platform can deliver our bankers meaningful data insights instantly which saves time and increases productivity.

*Joss Raines
ANZ head of
data and digital
ANZ Institutional Bank*

In 2016, the government set up an online platform, cloud.gov.au, which provides tools and insights to make it easier for government agencies to install and operate public cloud services. Some 400 apps have been developed through cloud.gov.au and there is an ongoing process to add more applications on the cloud.

KEY BENEFITS

The key benefits identified by users of public cloud include:

Faster time to market for products and services. Many advanced users of the public

cloud see agility as the most important benefit. As a highly developed market, Australia has many businesses that value the fast time to market that the public cloud makes possible. The time it takes to research newer digital products is much shorter than it would be otherwise; they can test early stage iterations of products at a lower cost, then receive quick feedback and quickly launch a completed version. The ability to try, and fail fast, with newer products, services, or business models gives a significant advantage to digital businesses, whether they are startups or new digital models for established companies.

“The turnaround time for results from cloud-based applications is weeks and days, instead of months and years. It accelerates minimum viable product development, and reduces the R&D costs and execution risk. It significantly changes the whole value proposition for us.”

– CDO, Retail company

Higher team productivity and collaboration.

Australian companies value both productivity and the way in which the public cloud fosters more efficient team collaboration, so that they can do more with the resources they have.

“The public cloud helps our teams coordinate and focus on solving problems in the core business, rather than on non-core requirements like administration and infrastructure.”

– Senior Director, Tech firm

Enhanced ability to launch new products and services.

Business leaders in Australia told us they place high importance on the way the public cloud allows their companies to be experimental and aggressive with new products. It is not just a matter of speed; the public cloud also facilitates new capabilities

that make it possible to add new revenue streams. Financial institutions appreciate the way they can use analytics to personalize their products. E-commerce sites can run special sales that increase their web traffic without the risk of the server slowing down, and use advanced analytics to let individual consumer buying patterns guide their promotions.

KEY CHALLENGES

The key challenges identified by users of public cloud include:

Legacy migration cost and risk. Migrating and integrating existing systems and databases is a particular challenge in Australia because a large proportion of businesses are large, established multi-nationals with significant investments in legacy technologies. They also tend to hold large storehouses of legacy data. Transferring historical data from traditional devices such as tapes or disks is a complex and risky exercise for large enterprises, including many banks, financial firms, insurance companies, and public sector agencies.

Gaps in organizational capabilities. While both providers and users are investing in employee training for the public cloud, and working with systems integrators to meet gaps, there are concerns that the gap will widen. The current supply of cloud-native talent is not large enough to match the rapidly growing demand, and many organizations in Australia say they are struggling to develop their internal team capabilities. In selecting a cloud provider, organizations look for one with services that are easy to use. A provider that offers internal training is also highly valued, particularly if the training is aimed at day-to-day management of public cloud platforms and fostering a deeper understanding of how the public cloud can enable advanced digital capabilities.

Complexity of managing multi-cloud environment. Most companies in Australia are interested in advanced uses for the public cloud, but are eager to explore operating in a multi-cloud environment so that they can gain from the expertise of a variety of

providers, along with their private cloud and on-premise setups, and avoid being locked in with one vendor.

An IT leader at a systems integrator told us that when a company wants help with moving to the cloud, one of the requirements is that the integrators build systems for the company that are provider-agnostic, so that the organization doesn't have to depend on a single provider. Working with multiple providers is a complicated proposition, and users need support in managing their multiple environments.

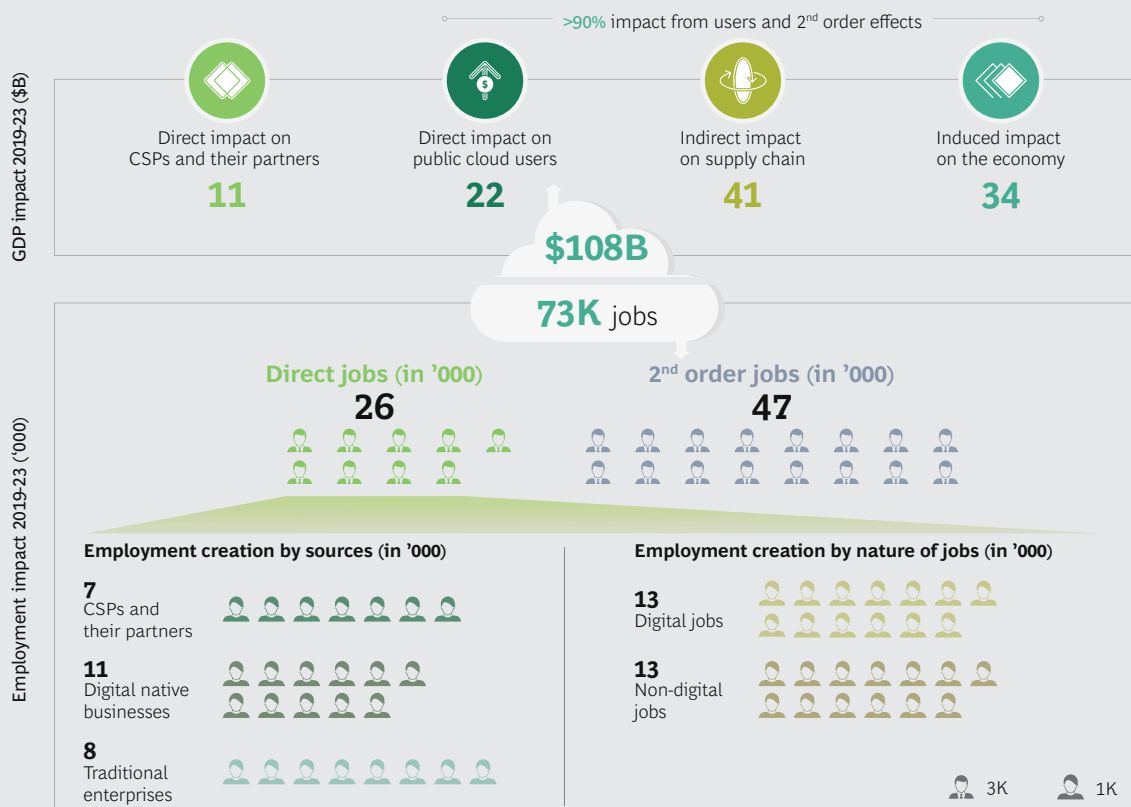
THE ECONOMIC IMPACT

The overall cumulative economic impact from direct, indirect and induced sources is expected to be about US\$110 billion, if CSPs continue to launch new products and services at their present rate and policymakers maintain their

current stance on public cloud deployment (See Exhibit 12). When annualized, this is a sum equivalent to 1.5% of Australia's annual GDP, about 50% of the annual economic impact of large traditional sectors such as mining, and about 15% of the annual impact of financial services. Around 90% of the total impact will be generated within industry verticals, particularly retail, financial services, media and gaming, and manufacturing, with about 10% from the growth of cloud service providers and the IT industry.

Public cloud usage stands to create close to 26,000 direct jobs over the next five years. Roughly 13,000 of the direct jobs will be in non-digital roles such as sales, marketing, human resources, finance, logistics and operations. Another 13,000 of those will be digital jobs, 7,000 of which will be with cloud service and IT system providers and the other

EXHIBIT 12 | Economic impact: Public cloud is expected to drive cumulative GDP impact of \$108B and total employment impact of 73K jobs over 2019-23 in Australia



Source: BCG analysis

Note: Direct impact is the gain by users of public cloud; Indirect impact is the gain across their supply chain; Induced impact is the gain due to economic stimulus from higher household incomes; 2nd order impact includes indirect and induced impact; CSP refers to cloud service providers; Representations are rounded up to nearest thousands

6,000 with industry verticals. This represents approximately 1.8% of the current information and communications technology workforce.

The second order effects are expected to influence another 47,000 indirect and induced jobs, bringing the total potential jobs that are influenced due to public cloud use to 73,000, which is equivalent to 0.6% of the current workforce. A large proportion of these jobs will likely be taken up by the existing workforce after their retraining and upskilling.

TWO ALTERNATE SCENARIOS

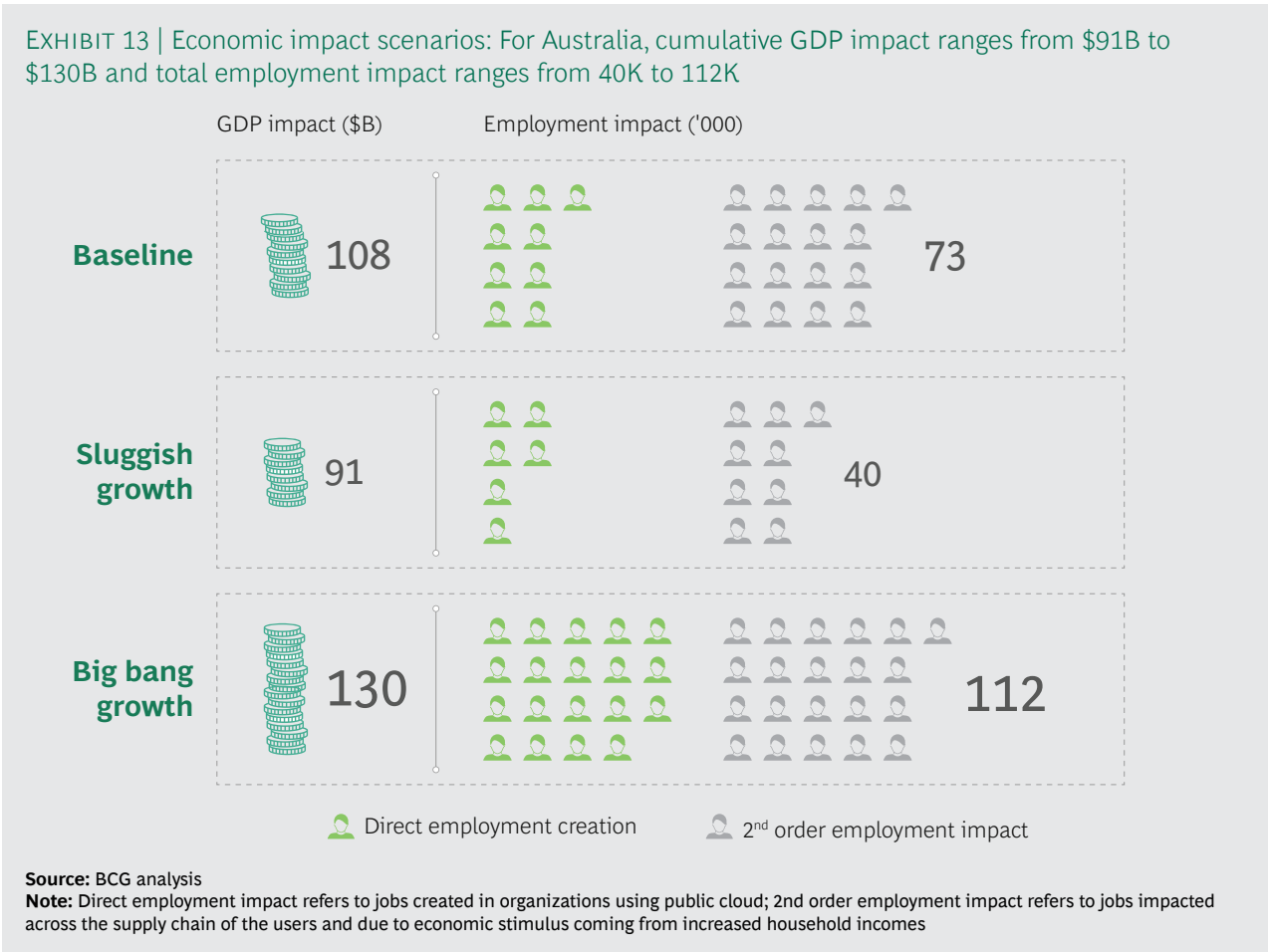
The economic impact we have assessed above is the Baseline Scenario, but we have drawn up two additional scenarios. The Big Bang Growth Scenario and the Sluggish Growth Scenario show the economic impact that would occur if the forces that shape the public cloud market cause growth to either speed up or slow down. If either of these scenarios were to unfold, the full cumulative economic impact of the public cloud could

vary by a difference of nearly US\$40 billion between 2019 and 2023 (See Exhibit 13).

The Big Bang Growth Scenario. Optimal growth would be the result of continued regulatory support and deployment of government applications, combined with the government and CSPs taking measures together to increase the pool of digital talent available in Australia. They would need to invest heavily in IT talent and enhance existing cloud literacy through strong promotion of cloud use.

In this scenario a CAGR of 22% would lead to a total impact of about US\$130 billion, or 1.8% of Australia’s annual GDP. The growth would spur the creation of 53,000 direct jobs and influence 59,000 additional indirect and induced jobs, for a total of about 112,000 new jobs.

The Sluggish Growth Scenario. This scenario could be the outcome if the



government were to become more restrictive, and the supply of cloud-literate talent comes under serious pressure, without enough training to close the gap between supply and demand. Restrictive data and digital policies including restrictions on cross-border data flows can impact sentiment and potentially reduce deployment, thereby inhibiting growth.

Here, CAGR would drop to 13%, bringing the total impact to US\$90 billion, or 1.3% of annual GDP. Direct job creation would amount to about 16,000, with another 24,000 jobs influenced from the indirect and induced impact, for a total impact of 40,000 jobs.

The stage is set for Australia's public cloud market to continue on a strong path, with businesses increasingly interested in using the cloud to help develop advanced digital capabilities, and government agencies actively using the public cloud to enhance citizen services. The main stumbling block to a more rapid growth scenario than the baseline is the supply of cloud-savvy talent that the country will need as demand for public cloud services increases. Australia would do well to push for more widespread cloud literacy and hands-on training of IT professionals. With a joint effort on the part of CSPs, government and business, use of the public cloud stands to generate a particularly notable effect on the economy and employment.

India

EXECUTIVE SUMMARY

India is a large and fast-growing public cloud market, projected to grow at a CAGR of 25% from US\$3 billion in 2018 to US\$8 billion in 2023. Digital native businesses and web-streaming media players are the main drivers of growth, while industries such as retail, financial services and manufacturing are in early stages of adoption. The cumulative economic impact from the deployment of the public cloud is expected to be over US\$100 billion between 2019 and 2023, which when annualized represents about 15% of annual GDP impact from the country's IT industry. The total employment impact stands to impact nearly one million jobs, including creation of about 240,000 direct jobs. Favorable advances such as increased deployment of the public cloud among traditional large enterprises, and a regulatory framework in line with international best practices can help increase deployment and drive the cumulative GDP impact to as much as US\$130 billion, and total employment impact to about 1.7 million jobs over the next five years.

INTRODUCTION

India is one of the largest public cloud markets in the APAC region, and one of the fastest growing, projected to grow from US\$2.6 billion to US\$8 billion with a CAGR of 25% between 2018 and 2023 (See Exhibit 14). The potential for deeper penetration of public cloud in India becomes all the more evident given that the market is still in an early stage in terms of public cloud and IT spending.

Even so, India has set global benchmarks in public cloud usage. Hotstar, an Internet streaming service provider, had 18.6 million simultaneous viewers for a live streaming of a cricket match in May 2019, the global record for viewership of a live program on streaming media. That kind of surge in viewership can be accommodated reliably only with the public cloud's scalable architecture.

The SaaS model has been key to growth, with companies adopting public cloud to make basic functions such as collaboration, accounting, and human resources data analysis more efficient. SaaS currently

Snapshot of Public Cloud Adoption in India (2019-23)



Impact on GDP

\$102B

15%



of annual impact
from IT industry

Direct jobs created

~240K

743K



jobs influenced
by 2nd order effects

Industries leading the adoption



Digital Natives



Media and Gaming



Financial Services

What industry users say

Benefits



Higher team productivity



Faster launch of
new products & services



Better security

Challenges



Lack of clear understanding
of data privacy features



Lack of clear understanding
of product performance



Lack of robust
network infrastructure

Range of impact

Key factors driving impact

- Adoption by traditional large enterprises
- Launch of new products & services by cloud service providers
- Addressing supply of cloud native talent
- Interoperable data & digital policies in-line with international standards

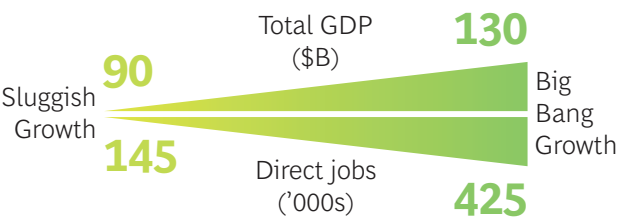
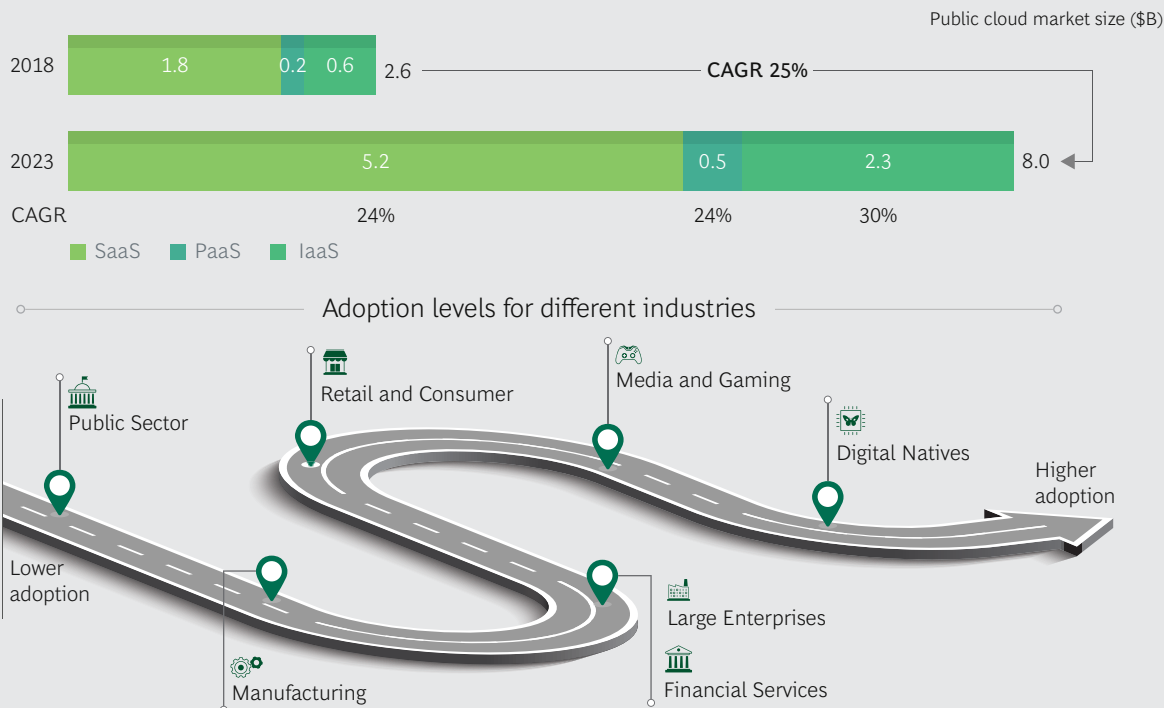


EXHIBIT 14 | Market overview: Public cloud market in India is expected to grow from \$2.6B to \$8.0B at a CAGR of 25% over 2018-23



Sources: Expert interviews, Survey of public cloud users and decision makers (n=1026), Industry reports, BCG analysis

Note: SaaS refers to Software as a Service and includes business processes and support projects market, PaaS refers to Platform as a Service and IaaS refers to Infrastructure as a Service model; all CAGRs shown are 3 year CAGR for 2018-23

accounts for just over 50% of the market, but as more companies seek to run their own systems, applications and platforms over the cloud, PaaS and IaaS use is picking up. IaaS is expected to be the fastest growing segment, with growth expected to be about 30% annually over the next five years.

Digital natives and media companies are driving public cloud adoption in India, with interest growing among retailers, financial services institutions, manufacturers, and large enterprises across industries.

INDUSTRY ADOPTION

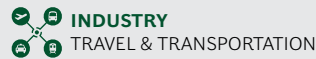
Digital native businesses have embraced the public cloud as a core enabler for a reliable, scalable infrastructure that allows them to expand rapidly within both domestic and international markets, all with lower upfront costs than they would otherwise have. India has over 20 tech startups that have achieved unicorn status, valued at US\$1 billion or more by investors, and more than 80% of them have found IaaS and PaaS platforms integral to their success. Most are deploying some

form of advanced application such as artificial intelligence or machine learning to embed such tools as market analytics, product recommendations and customer loyalty programs within their offerings. Unicorns in a range of businesses including transportation, food delivery, mobile learning, online grocery shopping, hotel booking, and mobile restaurant reservations are partnering with public cloud providers to deploy advanced analytics and grow their customer base through personalization.

The online travel company Iiboo Group used the public cloud to improve its service quality for travelers while at the same time developing faster collaboration tools for its nearly 500 employees (See Iiboo Group case study).

Another digital native business, a delivery platform, moved to the public cloud because its previous logistics system was not able to keep pace with the rapid growth in orders being placed, causing a negative impact to its customer experience and reputation. With an IaaS platform on the public cloud they were

CASE STUDY
IBIBO GROUP



ABOUT THE COMPANY

Ibibo Group is an online travel company that owns online travel aggregator Golbibo and online bus ticketing platform Redbus.

CHALLENGE

Ibibo Group wanted to leverage cloud services to improve the service quality for travelers while streamlining collaboration among its employees.

E-commerce makes traveling easier

Public cloud platforms support new features including real-time directions and automated check-in through Cloud Vision data extracting. Productivity tools are used by ibibo engineering and product teams for faster collaboration and file sharing.



Enables customers to **locate desired hotels** and manage bus bookings and journeys



Reduces guest queueing times at hotels and improves promotional scores



Eases document sharing and **improves workforce collaboration**



We selected [public cloud products] and their APIs because of their reliability, richness of data, and ease of integration.

*Gaurav Khurana
VP Technology Support
Ibibo Group*

able to scale up instantly from zero orders to a million orders.

In the media industry, conventional print and broadcast companies are using the public cloud to engage their online customers in new ways such as targeted real-time news delivery. The cloud also enhances their internal productivity by transforming the editorial process.

However, it is the newer companies delivering streaming content that find the public cloud critical to their growth. Major streaming media players are using the cloud for content delivery and consumer research to enhance their customer experience. Most large content providers have scaled rapidly on the back of the public cloud infrastructure, using AI and ML to target audience programming.

Retail and consumer goods players are also increasingly exploring opportunities to digitalize and develop capabilities in AI and ML, enabled by the public cloud. While deployment of public cloud services is in its initial phases here, the retail industry offers

significant growth potential. Traditional retailers looking to venture into e-commerce observe that they need heavy investments to create on-premise data centers, and hence the public cloud becomes an attractive option that also gives them the ability to scale up quickly to handle erratic loads during special campaigns or sales.

“We ran some campaigns that caused traffic to spike up to five times above the normal pattern. The public cloud supported these peaks with no reduction in performance or availability to our customers.”

– CTO, Traditional Fashion Retail company

Others in the retail industry say that having data on the public cloud and leveraging tools has improved their overall decision making process.

In other large industry verticals such as manufacturing and financial services, the migration is slower. Manufacturing companies and many of India’s large enterprises tend to use the cloud for team collaboration and basic applications, partly because migrating legacy data would be cumbersome.

Financial services institutions are not yet migrating core applications onto the public cloud and have some concerns about government regulations and how they could impact their security configurations. Nevertheless, some segments of the industry, notably insurance, lending, and fintech, have taken steps to make the public cloud an important tool to adopt. L&T Financial

Services, which has developed a base among rural customers who may be in remote areas, for example, has greatly accelerated the time it takes to process a loan by using the public cloud (See L&T Financial Services case study).

The Indian government has issued a cloud-first initiative aimed at requesting that government agencies adopt a government cloud for all new projects, the GI Cloud (MeghRaj), which is supported by various cloud service providers. The initiative is expected to help build awareness of cloud computing and how it can accelerate the delivery of e-services to citizens while increasing efficiency, scalability and standardization.

KEY BENEFITS

The key benefits identified by users of public cloud include:

CASE STUDY L&T FINANCIAL SERVICES



ABOUT THE COMPANY

L&T Financial Services offers a wide range of financial products and services in India including farm equipment financing, micro- loans and two-wheeler finance to consumers across rural markets.

CHALLENGE

L&T Financial Services needed a strong digital and analytics platform to reach rural customers and support its business expansion.

Using the public cloud to reach rural customers digitally

L&T’s digital loan approval app, which runs on the public cloud, makes it significantly faster and easier for people to apply for financial assistance. L&T also uses productivity tools to allow its staff to collaborate more efficiently and analytic tools to generate behaviour scorecards and track the credit quality of its microloan customers.



Launches an **easy-to-use digital loan approval application** in just 30 days



Reduces loan disbursement **from 6 hours to under 2 hours**



Processes 95% of motorcycle loans in **less than 2 minutes**



The public cloud technology enables us to achieve scale and reach. It makes it possible to personalize our products to serve customers better. With access to faster compute power, we can also on-board consumers more efficiently. Our rural businesses have clocked a disbursement CAGR of 60% over the past three years.

Sunil Prabhune
Chief Executive of Rural Finance and Group Head of Digital IT and Analytics
L&T Financial Services

Higher team productivity. As a CTO of a mass media company told us, the public cloud “allows developers to focus on what they need to do, which increases agility of team and makes them more productive.” Productivity tools have been the most common use cases of the public cloud; users appreciate the internal and external collaboration using such features as document sharing tools and communication apps, as well as the standardized platform for code development. The efficiencies the cloud brings allow the organization to focus on its core business issues.

Faster launch of new products and services. Digital native businesses need to test and launch new products and services quickly to stay competitive, and have seen that the public cloud gives them the ability to move fast in testing and fine-tuning prototypes and getting something new out to their markets quickly. The cloud also gives them easy access to analytics tools that they can use to broaden their geographic scope and cultivate international markets. When a business is selecting a cloud provider, a vendor with a global footprint is an important consideration if the business is expanding its own global reach.

Better security. Large enterprises are particularly aware of the security advantages of the public cloud, noting that hyper-scale cloud service providers can invest in security at a scale that isn’t available to even large multi-national corporations. Also, the providers can continually access the latest security technology and capabilities. Continuing education of users is needed, however, to strengthen the understanding of the security features of the public cloud among all users.

KEY CHALLENGES

The key challenges identified by users of public cloud include:

Lack of clear understanding of data privacy features. While some of India’s businesses are recognizing that cloud service providers can enhance security, data privacy and security remain a concern across most industry verticals because users are not

always familiar with the security measures that cloud service providers offer them. This concern is especially prevalent among public sector organizations and financial services institutions. Clearer guidelines on data classification that is interoperable with international standards would help mitigate this challenge. Some enterprises are starting cautiously, by moving smaller or non-critical applications onto the public cloud to test its security and build their own confidence in the way it works, and also to cushion themselves against any risk of having critical applications on the public cloud in the event of a sudden adverse change in regulations.

Lack of robust network infrastructure and understanding of product performance. India is expanding its telecom network coverage to connect more of its mobile network towers to fiber networks, to provide fast and reliable connectivity across the country. The slow connectivity of legacy networks often result in latency issues, thus raising concerns among businesses about the performance and reliability of the service, especially for critical applications.

A well-designed deployment of the public cloud can actually be helpful in mitigating these problems. Users can design architecture that minimizes the network load, with more processing handled by the cloud. For this reason, users look for vendors and partners that have a track record for reliability of performance.

“Most cloud players are very competitive on their offerings and pricing. While prices are important, we are also interested in the level of product and service reliability.”

– CTO, Retail company

Legacy migration cost and risk. While DNBs have been able to start using the public cloud early on, and are benefitting from the way it enables them to scale up quickly, large enterprises across verticals have only recently started migrating. For the most part they have moved only their peripheral applications onto the public cloud because they struggle to transfer historical data and integrate their existing IT systems with public cloud systems. The process is complex and consumes a great deal of time and money, all of which is a further deterrent in a market where IT and cloud spend is already low.

THE ECONOMIC IMPACT

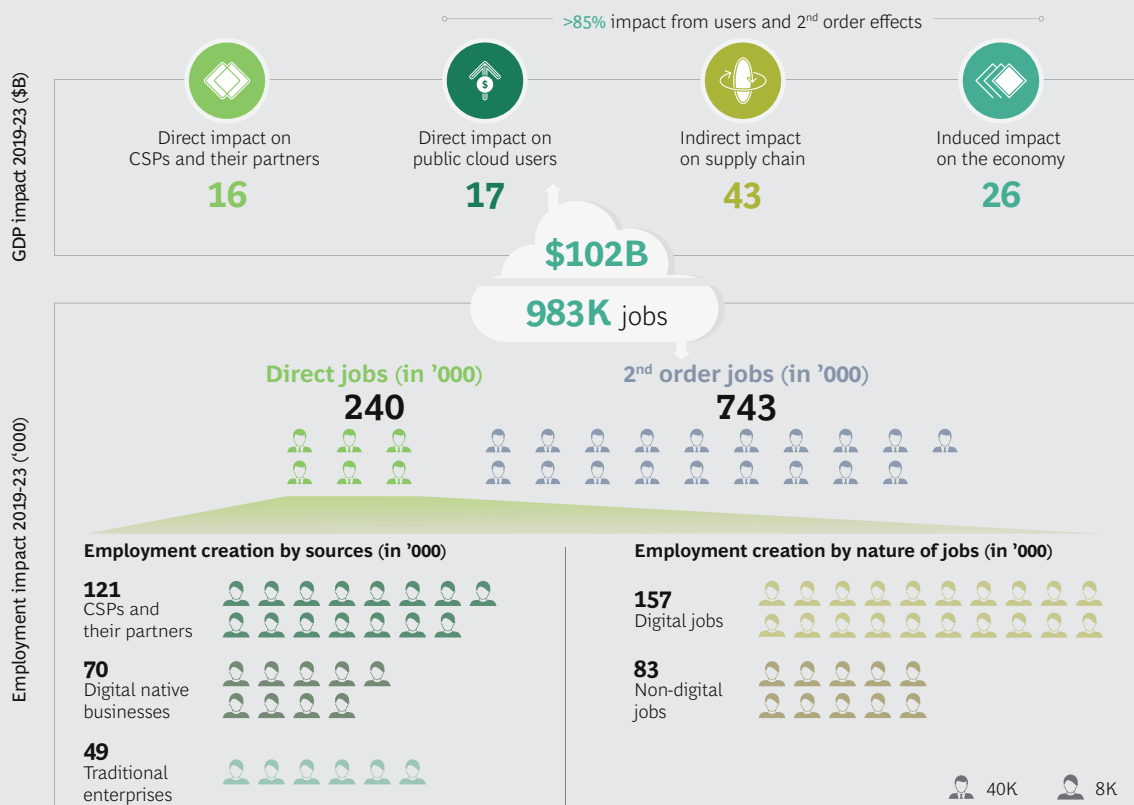
The overall cumulative impact from direct, indirect and induced sources between 2019 and 2023 is expected to be US\$102 billion, if CSPs continue to launch new products and services, there is high traction in adoption in the market, and policymakers keep their

existing stance on public cloud deployment (See Exhibit 15). When annualized, this is a sum equivalent to 0.6% of the annual GDP, similar to about 25% of the annual impact that now comes from the textile industry and 15% of the annual impact from the IT industry.

Approximately 85% of the impact will come from the gains to industry verticals such as digital natives, media, retail, and financial services, with only about 15% coming from the cloud service providers themselves.

Of the direct gains to industry, a major percentage will come from enhanced business revenues. A total of US\$14 billion revenue uplift could be generated, while a further US\$1.7 billion may emerge from productivity benefits, with US\$1.4 billion value achieved as a result of IT-related cost reduction and avoidance.

EXHIBIT 15 | Economic impact: Public cloud is expected to drive cumulative GDP impact of \$102B and total employment impact of 983K jobs over 2019-23 in India



Source: BCG analysis

Note: Direct impact is the gain by users of public cloud; Indirect impact is the gain across their supply chain; Induced impact is the gain due to economic stimulus from higher household incomes; 2nd order impact includes indirect and induced impact; CSP refers to cloud service providers; Representations are rounded up to nearest ten thousands

Public cloud usage stands to create 240,000 direct jobs over the next five years, which is equivalent to 0.7% of all new jobs created in the previous five years. Though many of these jobs will require a certain amount of digital upskilling, about 83,000 of the direct jobs will be in non-digital roles such as sales, marketing, human resources, finance, logistics and operations. Another 157,000 will be jobs for digital and IT specialists, with around 121,000 roles within cloud service and IT system providers and another 36,000 with industry verticals, representing 3.8% of the current information and communications technology workforce.

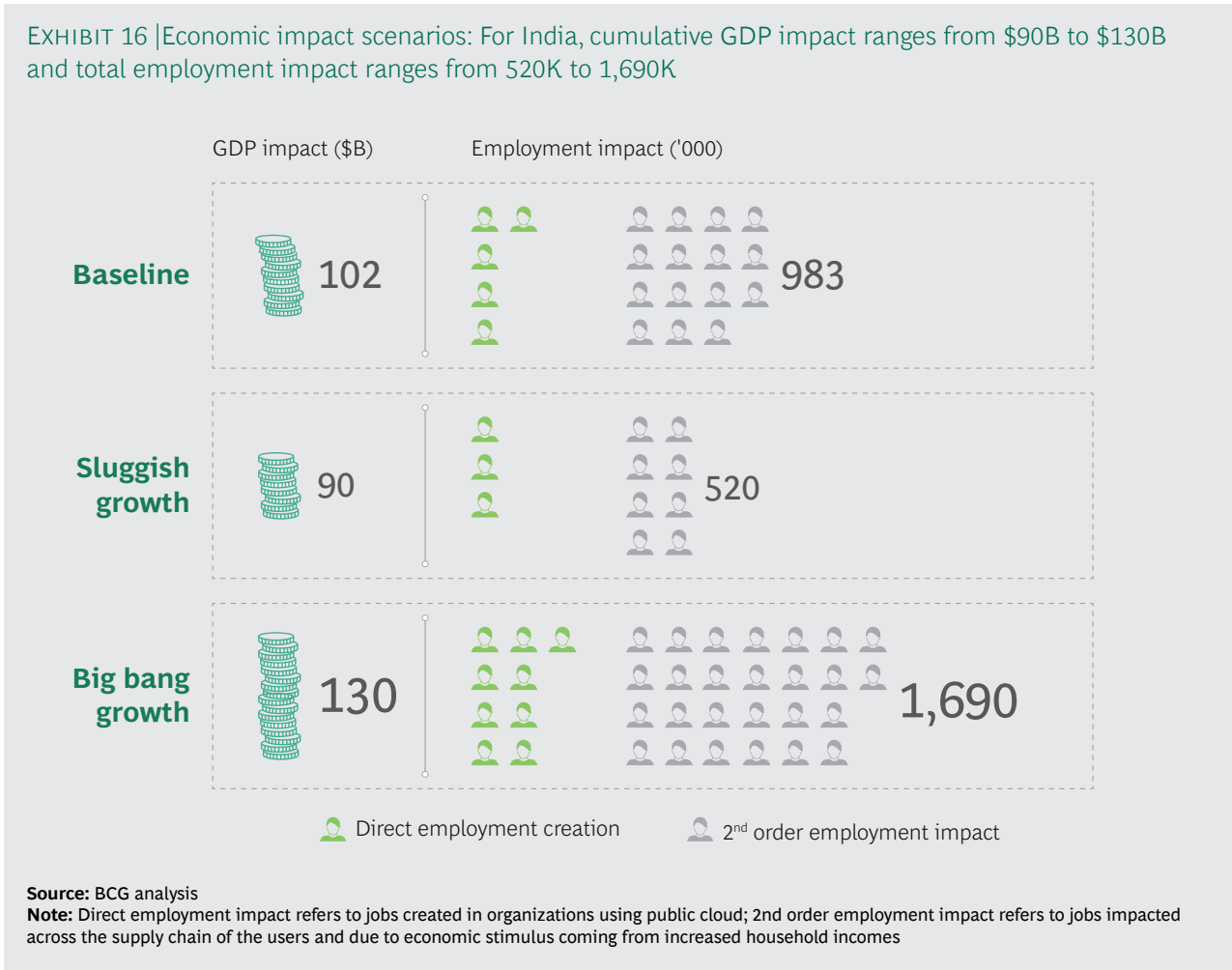
The second order effects are expected to influence another 743,000 indirect and induced jobs, bringing the total potential jobs impacted due to public cloud deployment to nearly one million, which is 0.4% of the current workforce. A large proportion of these jobs will likely be taken up by members

of the existing workforce who have been retrained and upskilled. Training the workforce on data science, artificial intelligence and machine learning will provide lasting benefits to the country's economy.

TWO ALTERNATE SCENARIOS

The economic impact we have assessed above is the Baseline Scenario, but we have drawn up two additional scenarios. The Big Bang Growth Scenario and the Sluggish Growth Scenario show the economic impact that would occur if the forces that shape the public cloud market cause growth to either speed up or slow down. If either of these scenarios were to unfold, the full cumulative economic impact of the public cloud could vary by a difference of US\$40 billion between 2019 and 2023 (See Exhibit 16).

The Big Bang Growth Scenario. Faster growth is likely to ensue if industry and government



step up their efforts to take advantage of the benefits of public cloud use. Traditional large enterprises would increase their use of the cloud as part of a complete digital transformation journey, while regulators would recognize the strong case for enacting cloud adoption and data policies aligned to international best practices. A collaborative effort on the part of organizations, service providers and government to boost the supply of digital talent would ensure that India has the expertise it needs for its rapid growth in public cloud deployment.

If these factors come together, a CAGR of 36% would boost the cumulative economic impact to as much as US\$130 billion between 2019 and 2023, or 0.7% of GDP. About 425,000 jobs would result from the direct impact with another 1.25 million influenced by the second order effects.

The Sluggish Growth Scenario. A slowdown in growth would most likely stem from more protectionist policies that lead to cross border data flow laws that are less cloud-friendly. Less clarity on security standards, or standards that diverge from international practices, would also inhibit the ability of companies to migrate data and applications to the public cloud. Either of these would result in a more limited launch of new cloud products and slower traction among industries.

In this slower-growth scenario, we have estimated that the cumulative economic impact would be no more than US\$90 billion, or 0.5% of annual GDP. At this level, the jobs that arise directly from public cloud usage would amount to around 143,000, with another 376,000 influenced from the indirect and induced impact, for a total of around 520,000 jobs—about half the total jobs that are expected to result from the Baseline Scenario and less than a third of the number that a Big Bang Growth Scenario could produce.

With digital native businesses and new media companies leading the way, India's nascent public cloud market shows tremendous growth potential. As the connectivity infrastructure in the country improves, and government data and digital policies evolve,

some of the existing challenges the users face can be mitigated which would drive higher engagement and adoption from many more businesses as they embark on their digital transformation journey and adopt advanced technologies. The impact of a more public cloud-centric approach would be dramatic, particularly as an influence for more than 1.6 million jobs in total.

Indonesia

EXECUTIVE SUMMARY

Indonesia's public cloud market is in its formative stages, representing one of the fastest growing markets in the APAC region. A projected CAGR of 25% is expected to raise the market size from US\$0.2 billion in 2018 to US\$0.8 billion in 2023. The country's tech unicorns have relied on the public cloud to scale their businesses and grow rapidly, while large enterprises and the financial services industry are increasing their use of the public cloud. As hyper-scale cloud providers deepen their presence in the market, use will increase further. The cumulative economic impact of the public cloud is projected at US\$35 billion between 2019 and 2023, which when annualized, is equivalent to about 25% of the annual GDP impact from large traditional sectors such as the palm industry. The direct impact is likely to create an estimated 70,000 jobs, with another 275,000 influenced by second order effects. However, the war for digital talent is acute, supporting telecom infrastructure needs to be significantly improved, and the country needs to adopt international best practices on data and digital policies. If these challenges can be mitigated, the overall cumulative GDP impact of public cloud spending could rise to over US\$50 billion, with the total employment impact projected to reach 635,000 over the next five years.

INTRODUCTION

Indonesia's public cloud market is in its formative stages, with a great potential to grow and add value to the economy. It is currently one of the fastest growing markets in the APAC region, with a projected CAGR of 25% over the next five years, from US\$0.2 billion in 2018 to US\$0.8 billion in 2023 (See Exhibit 17).

Snapshot of Public Cloud Adoption in Indonesia (2019-23)



Impact on GDP

\$36B



25%

of annual impact from palm oil industry

Direct jobs created

~70K

275K



jobs influenced by 2nd order effects

Industries leading the adoption



Digital Natives



Financial Services



Retail and Consumer Goods

What industry users say

Benefits



Higher team productivity & collaboration



Faster TTM for products and services



Enhanced ability to launch new products and services

Challenges



Gaps in organizational capabilities



Lack of clear understanding of data privacy features



Lack of robust network infrastructure

Range of impact

Key factors driving impact

- Launch of new products & services by cloud service providers
- Adoption by traditional large enterprises
- Addressing supply of cloud native talent
- Interoperable data and digital policies in-line with international standards
- Enhanced connectivity infrastructure

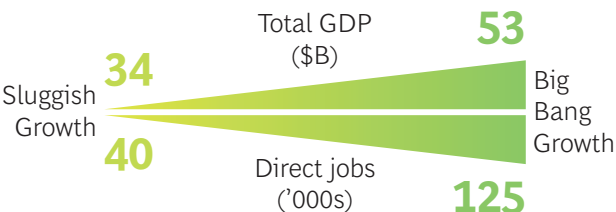
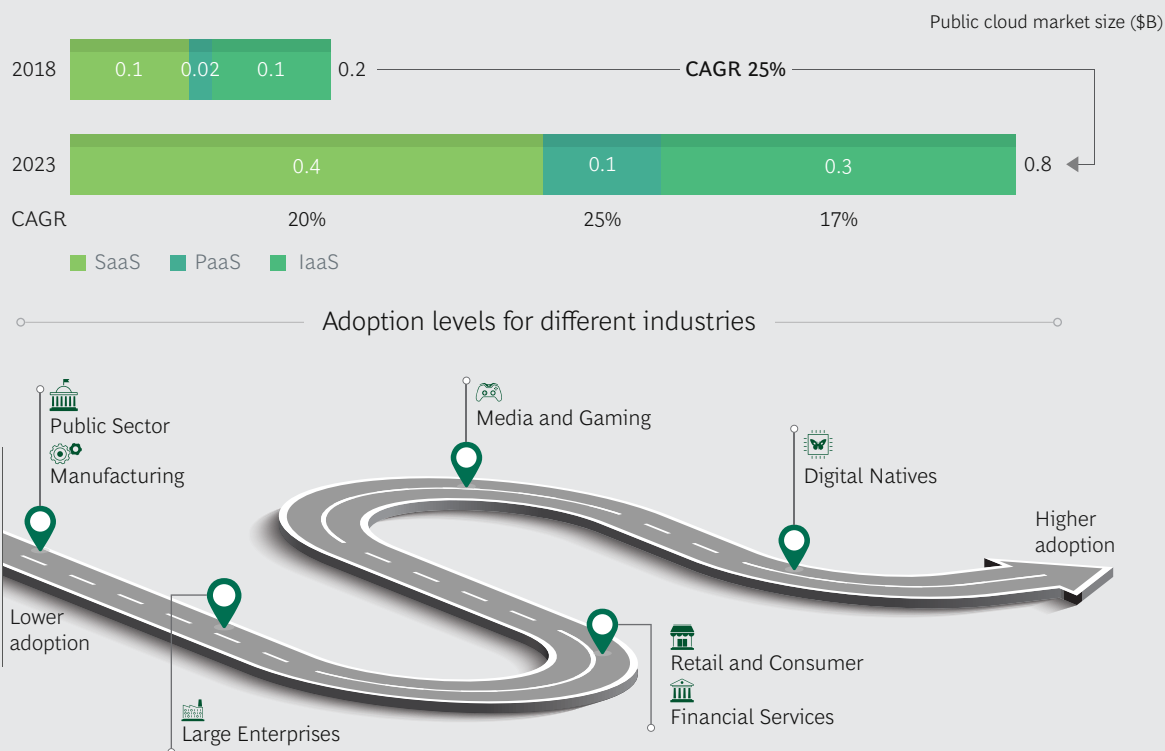


EXHIBIT 17 | Market overview: Public cloud market in Indonesia is expected to grow from \$0.2B to \$0.8B at a CAGR of 25% over 2018-23



Sources: Expert interviews, Survey of public cloud users and decision makers (n=1026), Industry reports, BCG analysis
Note: SaaS refers to Software as a Service and includes business processes and support projects market, PaaS refers to Platform as a Service and IaaS refers to Infrastructure as a Service model; all CAGRs shown are 3 year CAGR for 2018-23

As a result of these high growth prospects, many of the world’s major cloud service providers are considering setting up cloud regions within its borders. The SaaS and IaaS models are the largest segments of the public cloud market today, but PaaS is expected to be the fastest growing segment between now and 2023, with a CAGR averaging 25%.

Digital native businesses are the main forces driving this growth, with increasing traction from media players, financial institutions, retailers and large family run conglomerates.

INDUSTRY ADOPTION

Indonesia currently has four tech unicorns, and these US\$1 billion-plus startups have relied on the public cloud to grow and scale their businesses rapidly, powered by such cloud-enabled advantages as faster time to market and the ability to easily harness artificial intelligence and machine learning.

The ride-hailing, logistics and e-payments company Go-Jek, for example, is able to support hundreds of thousands of concurrent transactions over the public cloud, as well as analyze massive amounts of data to identify new opportunities and new ways to improve its services (See Go-Jek case study).

The financial services industry is an increasingly active user. With Indonesia’s unique geography—an archipelago of more than 17,000 islands spanning more than 3,000 miles east to west—there is a large ‘underbanked’ population living in sparsely populated villages. For the past decade banks and fintech firms have been using mobile apps to serve these remote locations, and the public cloud has made it possible to enhance customer engagement as well as ensure reliable mobile connectivity. Bank BRI, one of the country’s largest banks, can now process its microloans throughout the island chain

CASE STUDY
GOJEK



INDUSTRY
RIDE HAILING, LOGISTICS AND PAYMENTS

ABOUT THE COMPANY

Gojek is a technology startup specializing in ride-hailing, logistics and digital payments. Founded in 2010, it was the first unicorn of Indonesia.

CHALLENGE

Gojek needed to support its rapid growth and automate key processes in order to deliver the availability and stability required to provide the best possible customer service.

Data analytics support a fast-growing business

Cloud-based computer engine creates high-performance and scalable virtual machines that power hundreds of back-end services, from ride hailing and food delivery to tickets and shopping. The system is supported by tools that analyze massive amounts of data.



Supports hundreds of thousands of concurrent **transactions**



Generates up to **4 terabytes of data** per day and supports more than 100M internal programming interface **calls per second**



Delivers 50 millisecond response times and achieves nearly 100% payment success rates



We receive a lot of data across multiple products. Using [Public Cloud] has enabled us to capture and analyze this data to identify new opportunities and areas for improvement.

*Ajeey Gore
Group CTO
GO-JEK*

instantaneously over the cloud (See Bank BRI case study).

Local players in such industries as retail and media are seeing the potential uses of the public cloud when it comes to digitizing their product offerings, using advanced analytics and improving productivity.

The largest, most established enterprises are for the most part using private clouds or on-premise data centers out of concerns over cross border data flows and latency, but with entrance of hyper-scale providers, they are already beginning to show some initial traction and interest in this space.

KEY BENEFITS

The key benefits identified by users of public cloud include:

Higher team productivity and collaboration.

Most of Indonesia's public cloud users are digital native businesses that have used the public cloud from the outset. They have seen that with the public cloud they can develop code in a standardized environment, which makes for much greater efficiency than on-premise architecture. Moreover, the public cloud fosters efficient internal communication and the ability to focus their organizational resources on the core business rather than on managing IT infrastructure. Large enterprises and digital startups alike said their companies benefited from collaboration tools, which can make coordination between teams easier, and software development faster and more effective.

The retail chain AlfaMart, for example, has found that the public cloud has enabled the company to boost its efficiency and

CASE STUDY
BANK BRI



ABOUT THE COMPANY

Bank Rakyat Indonesia is one of Indonesia’s largest banks and is committed to increasing financial inclusion among underserved populations.

CHALLENGE

Bank BRI needed help to create its award-winning digital banking platform to enhance financial inclusion in rural areas.

Digital products increase financial inclusion in rural areas

Combining the bank’s data with public cloud tools, BRI has been able to identify customers who can be recruited as agents. Empowered with the cloud-based Pinang microfinance mobile app, these agents can open new accounts, take deposits, pay out withdrawals, and process and disburse loans in less than two minutes.



Reduces loan approval and disbursement **from 2 weeks to 2 minutes**



Reduces agent onboarding **from 6 months to under 1 hour**



Identities of new customers are **verified in seconds through facial recognition**

“Customers download the app and scan their ID, capturing their credit score in just a few seconds. The digital offer letter says how much they’re approved for. They can then accept it, go to the approval screen, and do facial recognition. The money is disbursed immediately. [Public Cloud] has transformed us into a fintech.”

Kaspar Situmorang
Executive Vice President
Bank Rakyat Indonesia

productivity in ways that have reduced costs as much as 15% and accelerated time-to-market by around two weeks (See AlfaMart case study).

Faster time to market for products and services. The public cloud makes it possible to “really crunch development time” using DevOps and leveraging off-the-shelf services, as a CIO at a fintech firm told us. Users appreciate the way the cloud enables them to reduce their R&D time and develop prototypes faster, at similar or lower costs compared to development over traditional on-premise architecture.

Enhanced ability to launch new products and services. Technology startups find the data analytics capabilities they can deploy over the public cloud to be a major factor in a successful product or service launch. Fintech

firms, for example, can easily customize their products for a mass clientele. Even traditional family-held businesses value the analytics that help them engage more deeply with their customers, as well as the potential that digitalization opens up for new products and new revenue streams. Examples include Bank BRI’s use of digital apps to increase financial inclusion, Go-Jek’s ride-hailing, and the increasingly popular use of digital payments apps.

KEY CHALLENGES

The key challenges identified by users of public cloud include:

Gaps in organizational capabilities. The demand for cloud-native talent will outweigh supply as the public cloud becomes more widely available. Many organizations are already struggling with internal team

CASE STUDY
ALFAMART



ABOUT THE COMPANY

Alfamart is a retail chain with over 13,000 stores and about 10 million customers. It sells food items, groceries and daily essentials.

CHALLENGE

Alfamart wanted to operate like a startup, where it is easy to keep everything running smoothly and to improve their employee productivity. They needed effective tools to support this transformation.

Collaboration tools increase productivity

With cloud based productivity tools, Alfamart deployed a suite of intelligent applications designed to deliver collaboration within and between businesses. These tools play crucial parts in the company's increased productivity.



Collaboration & improved communication on priorities **reduced costs by 10-15%**



Automated workflows based on real-time information **accelerate time to market and save 2 weeks** per project



Continuous improvement is achieved by measuring progress against desired targets



The public cloud has been an enabler for our digital transformation. The tools are helping our chain of over 13,000 stores operate like a startup company by enhancing collaboration. It has helped us increase productivity in ways that save us time and money.

*Bambang Setyawan D
International Business &
Technology Director
Alfamart*

capabilities, and are starting to work with IT consulting firms and systems integrators to develop training programs. One of the biggest organizational concerns is the need to have a stronger emphasis on training and certification programs that are focused on practical training to develop IT specialists who are well-versed in the day-to-day work with public cloud technology. Universities and cloud service providers are running training and certification courses in local languages, but more needs to be done in this area. Businesses look for service providers that can help make it easy to migrate to the public cloud, through hands-on training and easy-to-use systems.

Lack of clear understanding of data privacy features. Data privacy and security remains a concern across Indonesia's industry verticals and enterprises of all sizes, because users are not always familiar with the security measures that cloud service providers offer

them. Early adopters have tested the safety of cross-border data storage by moving non-critical applications, seeking to boost their confidence in privacy and security practices. As hyper-scale CSP infrastructure becomes available in Indonesia, some of these concerns should ease.

Lack of robust network infrastructure. Although Indonesia has the Palapa Ring Fiber Optic Upgrade Plan under construction to enhance archipelago connectivity with undersea cables and increase fiber optic speeds, its communications infrastructure is currently not strong enough to support critical applications over the Internet. Public cloud users might experience latency issues due to this lack of a robust core infrastructure—a situation that can also result in users having concerns about performance, especially when dealing with critical applications.

THE ECONOMIC IMPACT

The overall cumulative economic impact from direct, indirect and induced sources between 2019 and 2023 is expected to be US\$36 billion, if public cloud growth in Indonesia continues at its present rate (See Exhibit 18). When annualized, this is a sum equivalent to 0.5% of the annual GDP, and similar to 25% of the annual economic impact from the palm oil industry or 10% of energy mining. Over 95% of the impact will come from gains to industry verticals, and no more than 5% will be from the direct gains experienced by cloud service providers and technology services in this still-nascent public cloud market.

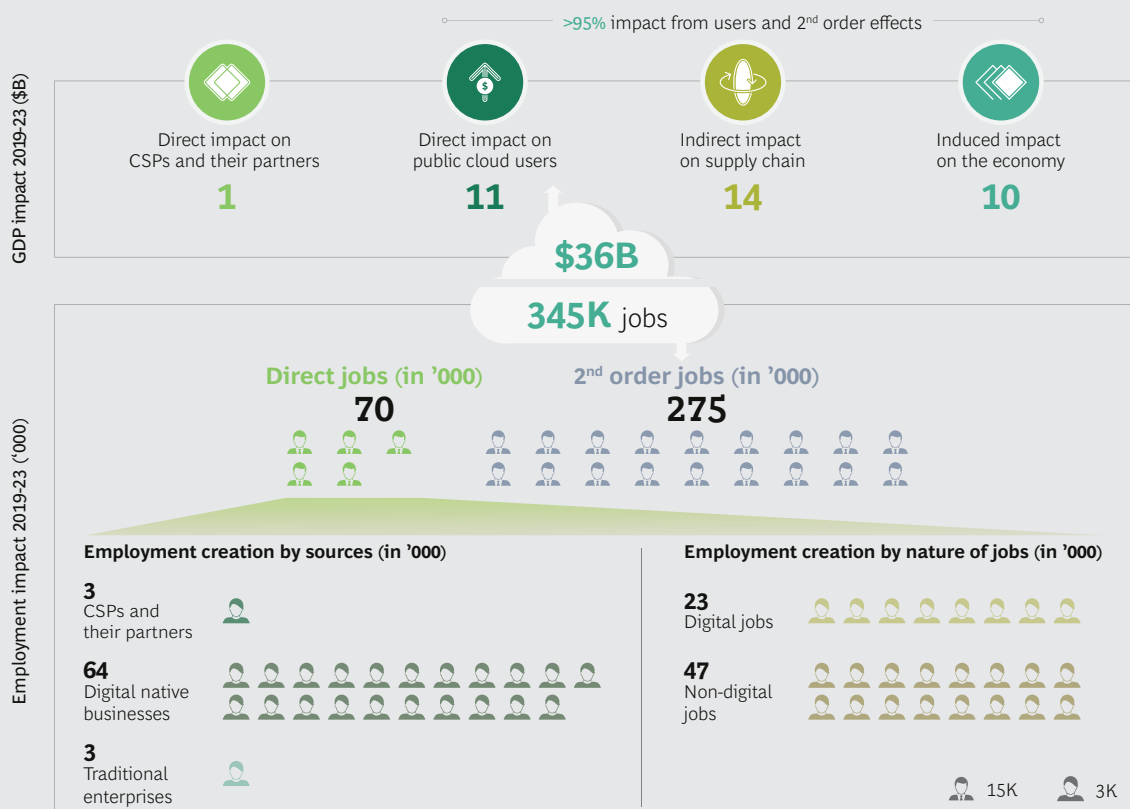
Of the direct gains to industry, a major percentage will come from enhanced business revenues. A total of US\$11 billion will be the result of revenue uplift, while

another US\$0.3 billion will come from productivity benefits and US\$0.1 billion from IT-related cost reduction and avoidance.

Public cloud usage stands to create 70,000 direct jobs over the next five years, which is equal to 0.6% of all new jobs created in the previous five years. About 47,000 of the direct jobs will be in non-digital roles such as sales, marketing, human resources, finance, logistics and operations. Another 23,000 will be digital jobs, 3,000 of which will be with cloud service and IT system providers and the remaining 20,000 within industry verticals, representing 1% of the current information and communications technology workforce.

The second order effects are expected to influence another 275,000 indirect and induced jobs, bringing the total potential jobs that are offshoots of public cloud use to

EXHIBIT 18 | Economic impact: Public cloud is expected to drive cumulative GDP impact of \$36B and total employment impact of 345K jobs over 2019-23 in Indonesia



Source: BCG analysis

Note: Direct impact is the gain by users of public cloud; Indirect impact is the gain across their supply chain; Induced impact is the gain due to economic stimulus from higher household incomes; 2nd order impact includes indirect and induced impact; CSP refers to cloud service providers; Representations are rounded up to nearest three thousands

345,000, which is equivalent to 0.3% of the current workforce. A large proportion of these jobs will likely be taken up by the existing workforce after their retraining and upskilling.

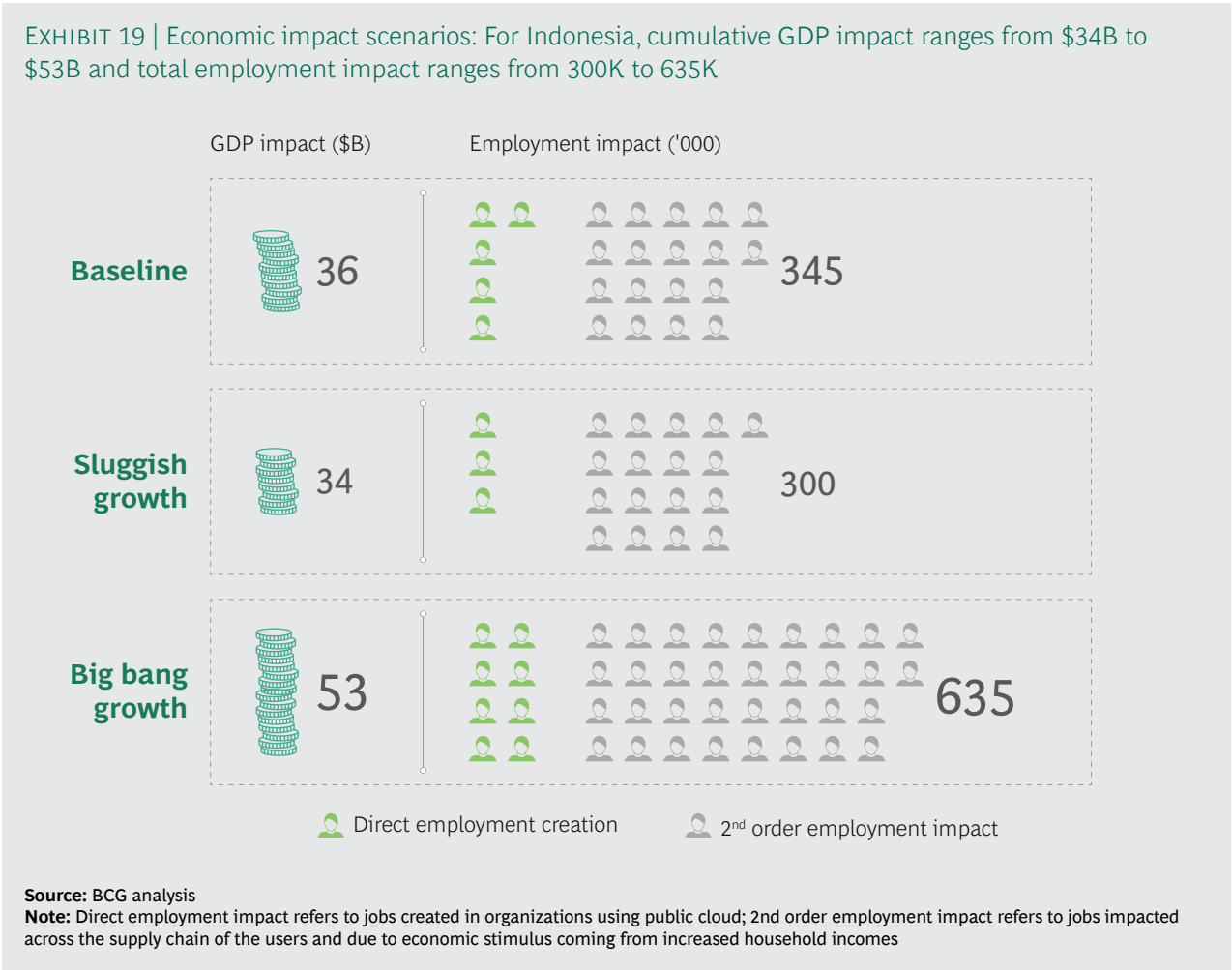
TWO ALTERNATE SCENARIOS

The economic impact we have assessed above is the Baseline Scenario, but we have drawn up two additional scenarios. The Big Bang Growth Scenario and the Sluggish Growth Scenario show the economic impact that would occur if the forces that shape the public cloud market cause growth to either speed up or slow down. If either of these scenarios were to unfold, the full cumulative economic impact of the public cloud could vary by a difference of around US\$20 billion between 2019 and 2023 (See Exhibit 19).

The Big Bang Scenario. Growth would accelerate if a combination of forces in Indonesia were to help potential users

overcome the challenges discussed above. The government would need to adopt international best practices on data and digital policies, including a campaign to promote public cloud adoption among government agencies. Cloud service providers would step up their investment in user education and practical on-the-job training. Large enterprises would increase their efforts to train and develop cloud-savvy digital talent and accelerate their deployment of the public cloud, while entrepreneurs would continue to start digital native businesses at a rapid rate.

If these factors come together, a CAGR of 37% would lead to a cumulative economic impact as large as US\$53 billion between 2019 and 2023, or 0.7% of the GDP. About 125,000 jobs would result from the direct impact with another 510,000 influenced by the second order effects, for a total of 635,000 jobs, almost double the number in the Baseline Scenario.



The Sluggish Growth Scenario. This is what could occur if the current challenges to growth became more adverse. If the government were to adopt less cloud-friendly policies for security, data classification and cross border data flows, or there were limited cloud products on offer and limited user adoption, growth would slow. There will also be constraints on growth if IT and cloud talent gaps widen further, or if the supporting infrastructure is not significantly improved so that the public cloud can be fully scalable.

In this scenario, current growth would stagnate and Indonesia would fall behind other markets in the region when it comes to achieving a sizeable economic impact from the public cloud. A Sluggish Growth Scenario would bring only about a third of the direct jobs that a Big Bang Scenario could produce.

With growth led by some of Indonesia's most successful tech startups and financial services firms that stand to develop a vast rural customer base through the use of digital apps, the public cloud market in Indonesia has strong growth potential. In initially developing the market, the country would miss a prime opportunity to build an upskilled workforce if it were to let the Sluggish Growth Scenario unfold. On the other hand, it has much to gain economically from stepping up efforts to encourage growth, and the jobs that would result when the business sector expands its use of the public cloud. With a strong government push for regulatory reform, especially if combined with a public sector cloud-first policy, upgrading of the supporting infrastructure, and a joint effort on the part of CSPs, government and users to provide practical training to create more cloud specialists, Indonesia could experience an additional US\$20 billion of GDP impact by 2023, and yield almost twice the number of jobs that will result at the current growth rate.

Japan

EXECUTIVE SUMMARY

Japan is one of the largest public cloud markets in APAC, and is expected to grow at a projected CAGR of 18% from US\$8 billion in 2018 to US\$18 billion in 2023. While most

large organizations have a high awareness of the public cloud, additional traction is expected to come from deeper penetration of IaaS across the industry landscape. Media, gaming and retail players are among the most advanced users, but interest is increasing among financial services institutions and the public sector. The government has set an ambitious goal of having 1,600 local government entities using the public cloud by 2023. The cumulative economic impact is expected to be about US\$130 billion [JP¥14 trillion] between 2019 and 2023, which when annualized, is equivalent to about 20% of the annual GDP impact from large traditional sectors such as the automobile industry. An estimated 51,000 jobs would be created through direct impact, and another 95,000 influenced by the second order effects. Addressing the challenge of digital talent shortage and adoption of public cloud within government agencies can drive the cumulative GDP impact as high as about US\$166 billion [JP¥18 trillion], with the total employment impact reaching about 288,000 jobs over the next five years.

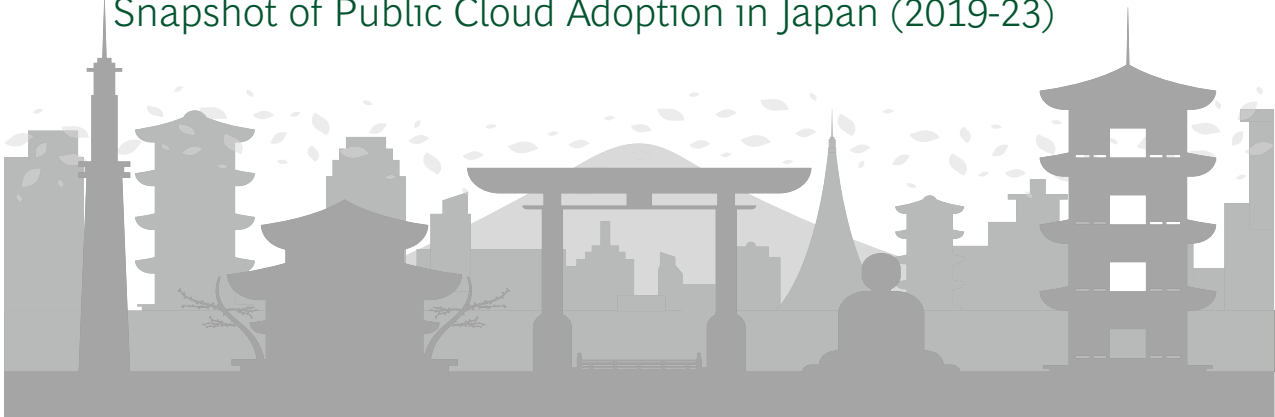
INTRODUCTION

Japan is one of the largest public cloud markets in APAC, and is expected to develop further, from US\$8 billion in 2018 to US\$18 billion in 2023, with a compound annual growth rate of about 18%.

Japan continues to expand its uses of more advanced public cloud technologies. A number of key sectors are now looking beyond the basic functions and considering migrating their core applications. As that happens over the next five years, IaaS and PaaS are likely to become the fastest growing segments, surpassing the growth of the SaaS model, which currently accounts for more than 40% of the market and has been a key growth driver of public cloud migration.

Among the industry verticals, retail and consumer products companies, along with media and gaming players, are the most advanced users of the public cloud in Japan, but traction is increasing among financial services institutions and the public sector (See Exhibit 20).

Snapshot of Public Cloud Adoption in Japan (2019-23)



Impact on GDP

\$129B

20%



of annual impact from automobile industry

Direct jobs created

~51K

95K



jobs influenced by 2nd order effects

Industries leading the adoption



Media and Gaming



Retail and Consumer Goods



Financial Services

What industry users say

Benefits



Higher team productivity



Faster TTM for products and services



Better security

Challenges



Legacy migration cost & risk



Gaps in organizational capabilities



Lack of clear understanding of product performance

Range of impact

Key factors driving impact

- Faster adoption of existing and new applications across industries
- Addressing supply of cloud native talent
- Interoperable data policies in-line with international standards
- Supportive cloud procurement and accreditation steps

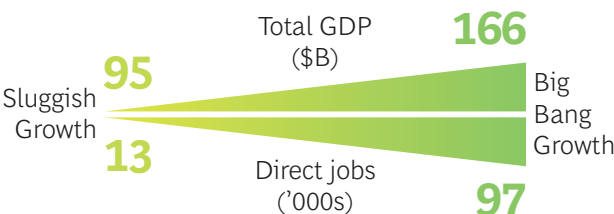
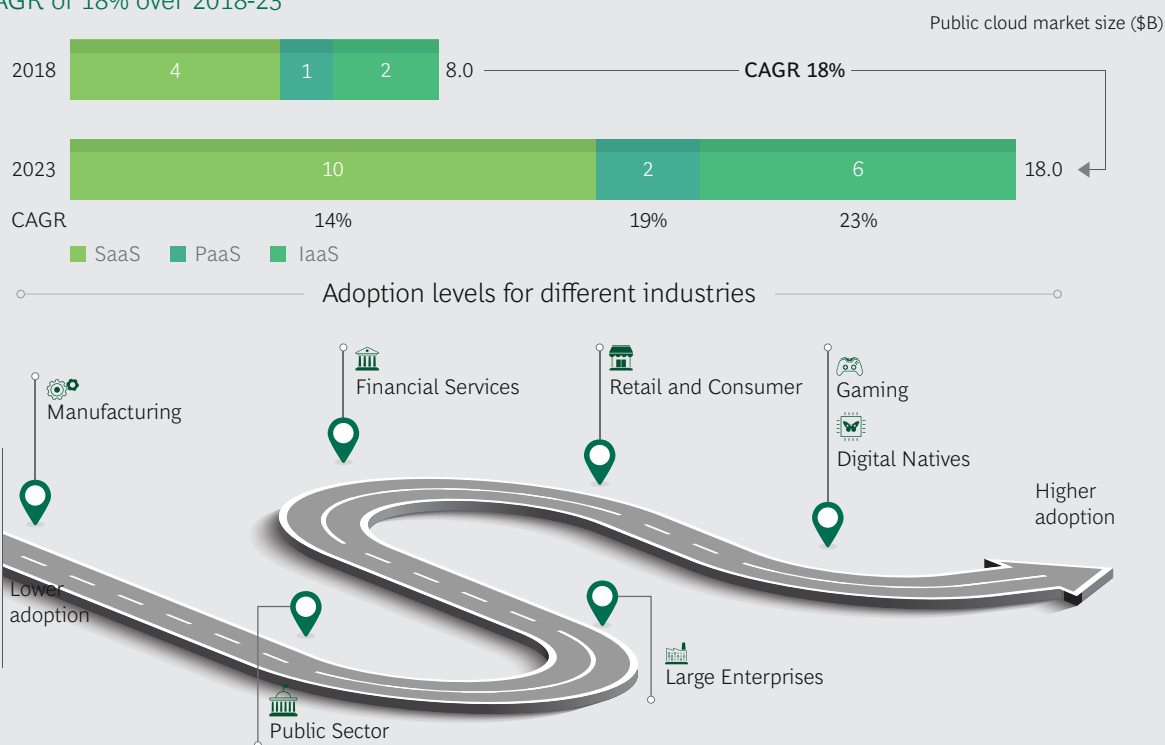


EXHIBIT 20 | Market overview: Public cloud market in Japan is expected to grow from \$8B to \$18B at a CAGR of 18% over 2018-23



Sources: Expert interviews, Survey of public cloud users and decision makers (n=1026), Industry reports, BCG analysis

Note: SaaS refers to Software as a Service and includes business processes and support projects market, PaaS refers to Platform as a Service and IaaS refers to Infrastructure as a Service model; all CAGRs shown are 3 year CAGR for 2018-23

When one of Japan’s largest banking institutions announced in 2017 that it was beginning an aggressive migration onto the public cloud, it created a powerful signaling effect to other businesses that the public cloud is secure and reliable. A second potential game-changer for the public cloud was the Japanese government’s announcement in 2018 that it was embarking on a ‘cloud by default’ policy. The idea is that when government agencies are procuring new IT for their applications, they should consider the public cloud as the first option—then, in order of priority, the private cloud and on-premises storage. The government has set an ambitious goal of having 1,600 local government entities using the public cloud by 2023.

INDUSTRY ADOPTION

Among retailers and consumer product companies, the demand for public cloud services is strong, especially for the PaaS model and analytics offerings, which make it easy for users to create highly segmented and personalized products and services for their

customers. In addition, they appreciate the quick time-to-market with changes to existing digital products and services and the efficiencies the cloud affords when it comes to internal functions.

“We are planning to move all of our IT infrastructure that we can onto a hyper-scale public cloud to standardize security standards, lighten the infrastructure management burden, and have more collaboration across the board.”
– CTO, Global Consumer Goods company.

Gaming companies, too, are migrating core applications onto the cloud to meet their needs for reaching and serving a global audience. These are industries in which reliable, always-on delivery of services and a positive, rich customer experience are critical, and the cloud has shown that it can deliver those benefits.

The 20-year old gaming company DeNA, which operates mobile and online services including games, e-commerce and entertainment content distribution, has announced that it will move all of its applications to the public cloud by 2021. DeNA has said that even if migrating to the public cloud increases some of its costs, the expense will be outweighed by the advantages of being able to improve the customer experience and having the infrastructure scale to accommodate new influxes of traffic (See DeNA case study).

Use of the public cloud is rising among financial institutions, which along with the public sector are expected to be the next major drivers of growth in Japan. It is becoming common for banks to use the public cloud for such functions as new application testing, big data analysis, fraud detection, risk modeling, and customer-facing services such as trading and mobile apps.

Few banks have gone to the trouble and expense of overhauling their legacy core banking systems of deposits, lending, and transaction processing, which operate on older technology infrastructure. However, that is beginning to change. A large financial institution has announced that there will be “no sanctuary” where cloud cannot be deployed, thereby not ruling out moving any applications to the public cloud. The announcement provides additional credence that even the largest financial institutions are

CASE STUDY
DeNA



ABOUT THE COMPANY

DeNA develops and operates a broad range of mobile and online services including games, e-commerce and entertainment content distribution.

CHALLENGE

DeNA's popular game “Gyakuten Othellonia” is highly complex for beginners, and therefore had a high churn rate. The company wanted to use AI to create a deck recommendation system for beginners and a smart AI player that would match the player's skill level.

Machine learning improves gaming experience and lowers churn rate

DeNA leverages public cloud-based machine learning to improve the onboarding experience for new players of its game “Gyakuten Othellonia.” It deploys several cloud-based products to ensure that its complex ML models create an experience that helps beginners learn the game and keep improving their performance.



Supports beginner on-boarding and increases their **win rate by about 5%**



Enables **error-free auto-scaling** and low latency



Significantly increases system **speed and stability**



By collaborating with [Public Cloud], we have been able to leverage their expertise in AI as well as building and serving different components in our game. We are also able to leverage [Public Cloud's] open and serverless technologies to host our AI models without worrying about scalability of infrastructure or portability of code.

Kenshin Yamada
Director of AI Dept
DeNA Co. Ltd

beginning to see the advantages of migrating their core systems.

The manufacturing industry is not as active a user as these other three. Most manufacturing players have limited perceived need for public cloud, and business leaders tend to be reluctant to put proprietary manufacturing data online.

However, with the importance of the transportation industry in Japan, over the longer-term future we see growth opportunities with the evolution of Mobility as a Service (MaaS) and Industry 4.0 as the next wave in digital manufacturing. Automakers in Japan have already begun to partner with cloud service providers to build MaaS infrastructure and develop connected cars.

The government's own adoption of the public cloud is expected to increase with the new 'cloud by default' policy, even as it acts as a trigger for further growth in the private sector. A sizeable number of local government offices are trying SaaS-based productivity tools, along with IaaS and PaaS, and have improved citizen services. This would further strengthen as the commitment develops.

KEY BENEFITS

The key benefits identified by users of public cloud include:

Higher team productivity. Businesses using the public cloud in Japan placed increased team productivity and the ability to digitize their front line staff at the top of the list of key benefits. In a country that is facing a labor shortage due to an aging population, the public cloud has enabled corporate teams to be more productive and focus on their core functions. Aided by standardized development environments and internal and external collaboration using doc sharing, communication apps and other basic features of the public cloud, most users agree that the productivity benefits are the most critical and visible directly.

“Developers and new engineers are getting well versed in the cloud native environment. They do not care as much about knowing legacy infrastructure.”

– CTO, Fast-growing startup

The Tokyo-based convenience store chain FamilyMart started using the public cloud in 2017 to boost productivity in its stores around the world. The company has been able to transform its collaboration strategies, not just at the corporate level, but also between corporate offices and front-line staff members, so that everyone in the organization is able to communicate freely in a way that improves efficiency (See FamilyMart case study).

Faster time to market for products and services. For DNBs and companies relying heavily on digitalization—retailers and consumer products, media and gaming, and to a growing extent banking—agility is an important requirement. These companies increasingly value the ability to introduce new products and services with no lag time in order to make adaptations quickly.

Better security. Whereas security was once a top concern when it came to public cloud adoption in Japan, business leaders and IT professionals are now well aware of the security advantages that public cloud vendors can offer through their large-scale investments. Education about how the security measures work needs to continue to show decision makers on the business side that CSPs have robust technology, systems and processes that maintain security and offer improvements over on-premise systems.

Reduced cost. Users that consolidate their IT functions under the public cloud typically achieve significant cost benefits over time. Smaller companies report that they have

CASE STUDY
FAMILYMART

 **INDUSTRY**
RETAIL AND CONSUMER GOODS

ABOUT THE COMPANY

FamilyMart is Japan's second largest convenience store chain with over 24,000 stores around the world.

CHALLENGE

In June 2017 FamilyMart's president, Takashi Sawada announced a plan to improve efficiency among the company's employees across the different stores, and would use the public cloud to drive the change.

Productivity tools encourage collaboration and transform work styles

FamilyMart is using cloud-based productivity tools to facilitate a collaborative culture and dramatically improve operational efficiency. The tools have also been used for real-time disaster situation sharing. FamilyMart is also planning to leverage big data analytics and machine learning to develop more efficient operations systems in its stores.



35% reduction of work
for its new business
development division



40% more efficiency in
documentation



160 hangout calls per month
after migration



By collaborating on [cloud based productive tools], the work of collecting data was reduced by about 80% in one job, and the work of creating and working on materials involving many members was eliminated. About 40% efficiency improvement has been confirmed.

*Takashi Niino
Manager, IT Promotion Division
UNY FamilyMart Holdings Co., Ltd.*

been able to cut costs of ownership of their IT systems by half or more through their use of the public cloud. Even among large companies, cost savings led by IT as well as core business savings through productivity increases remain an important benefit for migrating applications to the public cloud.

KEY CHALLENGES

The key challenges identified by users of public cloud include:

Legacy migration cost and risk. Users face difficulties in migrating and integrating their legacy systems. Migration takes time, requires upfront costs and carries a degree of risk in terms of a smooth continuity of system applications. Companies need to begin such a migration with a strategic plan that articulates how the process will be carried out and how long it will take, with time built

in for troubleshooting, while driving home the message that the goal is to transform digitally, modernize product offerings and become more agile in order to remain competitive. Keeping all parties apprised of these long-term benefits can help overcome objections to the initial difficulties. For this reason, companies should work with systems integrators and IT consultants to help them through the hurdles of cloud migration.

Gaps in organizational capabilities. Having enough IT specialists trained in cloud capabilities is a key challenge for most organizations—users and CSPs alike are finding that there isn't enough cloud-trained talent as usage grows. This is a challenge throughout the APAC region, but the organizational challenges are especially acute in Japan as a result of the country's labor scarcity.

When companies look at vendor options, it is important to find a cloud provider with easy-to-use systems and reliable performance to help mitigate this challenge. Leading companies are also starting to leverage support from systems integrators and IT consultants while they take steps to build A-teams for public cloud deployment and overall digital transformation. By partnering with users to train and upskill their employees, the CSPs can take a step forward to alleviate the talent scarcity that organizations are facing.

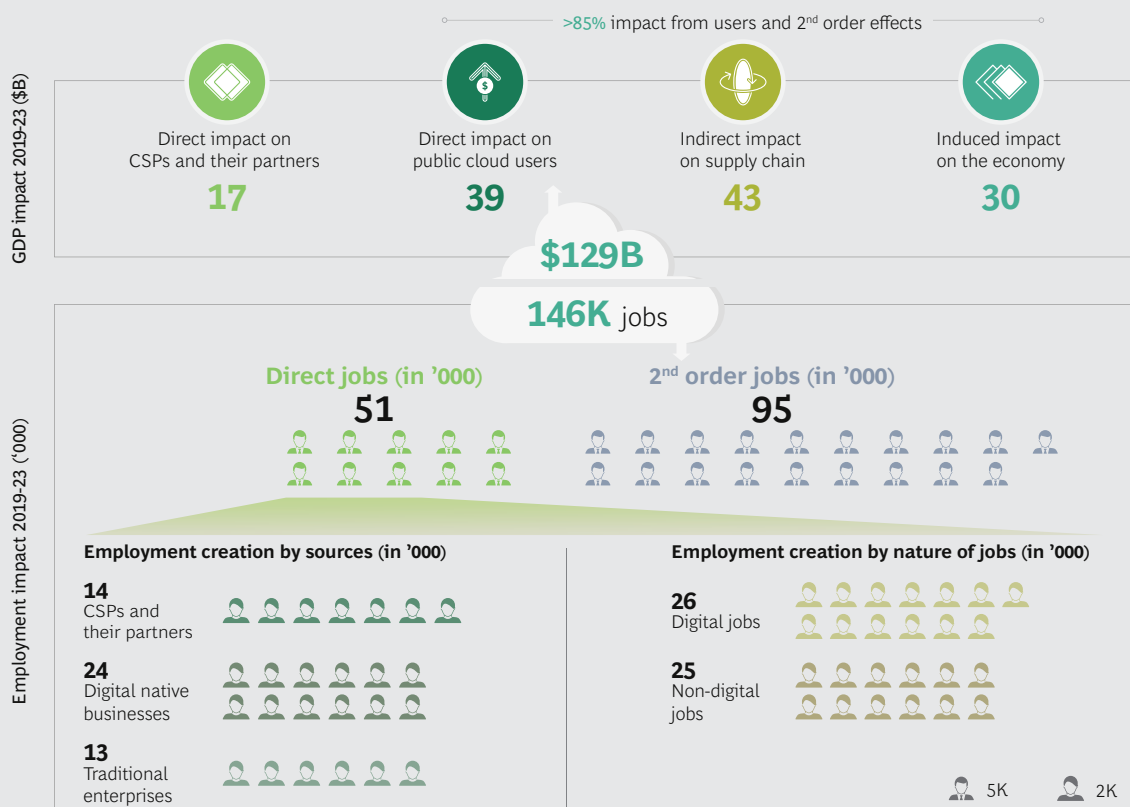
Lack of cloud capabilities has been a serious barrier to smaller businesses adopting the public cloud—advanced SMEs are training their staff, but more educational programs throughout Japan would be very helpful in mitigating this challenge.

Lack of clear understanding of product performance. Many companies harbor a misconception that the public cloud doesn't provide the resources to serve mission-critical applications, and that stops them from migrating important functions to the cloud. Some users are trying to address this concern by adopting multiple techniques to avoid a single point of failure, for example by using hybrid and multi-cloud models.

THE ECONOMIC IMPACT

The overall cumulative impact from direct, indirect and induced sources between 2019 and 2023 is expected to be US\$129 billion [JP¥14 trillion] if CSPs continue to introduce newer products and services and deployment keeps pace. In addition, this is also supported by policymakers maintaining their existing stance on public cloud deployment (See Exhibit 21). When annualized, this is a sum

EXHIBIT 21 | Economic impact: Public cloud is expected to drive cumulative GDP impact of \$129B and total employment impact of 146K jobs over 2019-23 in Japan



Source: BCG analysis

Note: Direct impact is the gain by users of public cloud; Indirect impact is the gain across their supply chain; Induced impact is the gain due to economic stimulus from higher household incomes; 2nd order impact includes indirect and induced impact; CSP refers to cloud service providers; Representations are rounded up to nearest thousands

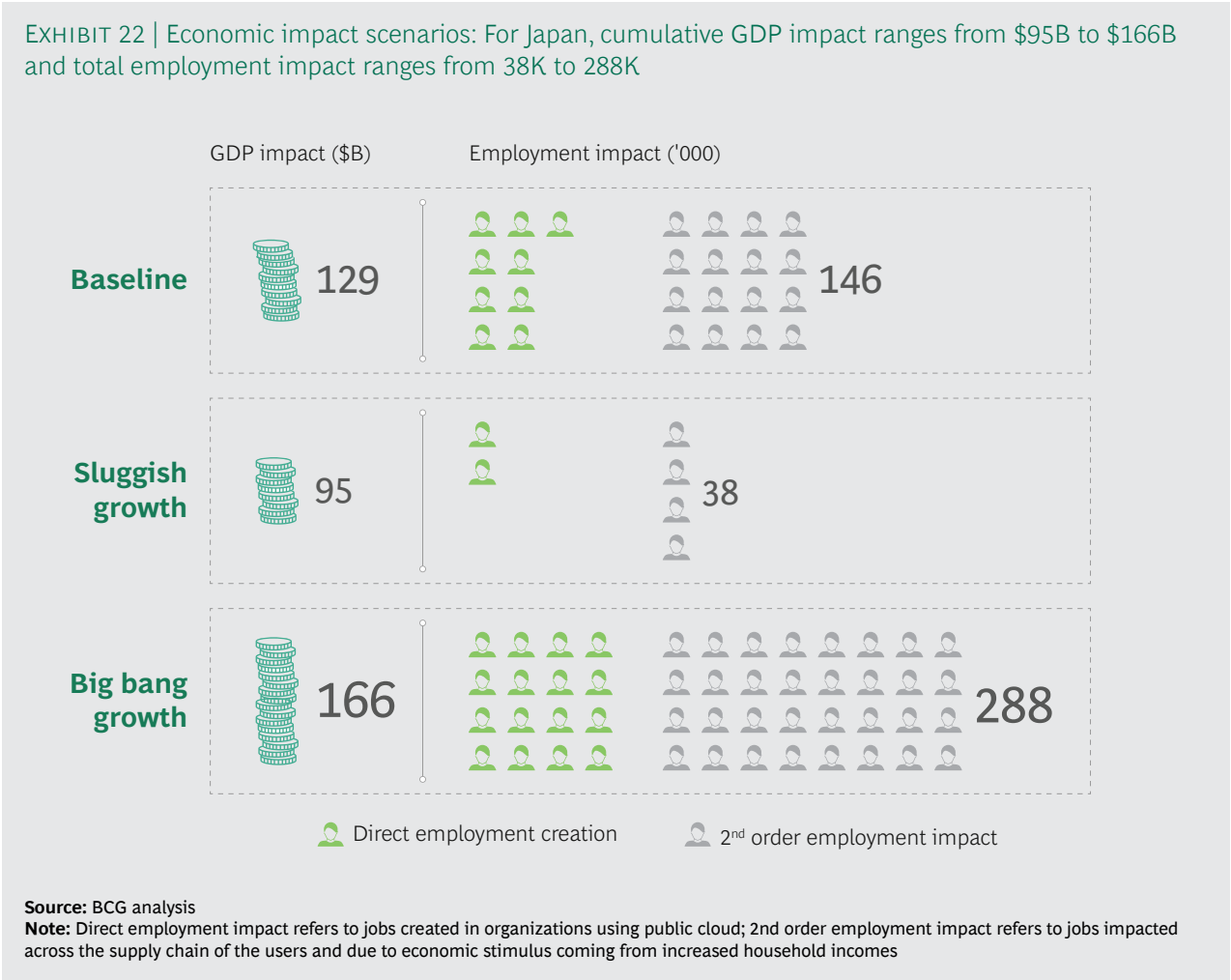
equivalent to about 25% of the annual impact of the electronics industry, about 20% of that of Japan’s automobile industry, and 0.5% of the country’s annual GDP. Approximately 85% of the added value will be generated through industry verticals.

Public cloud usage stands to create close to 51,000 direct jobs over the next five years. Roughly 25,000 of the direct jobs will be in non-digital roles such as sales, marketing, human resources, finance, logistics and operations. About 26,000 will be digital jobs, 14,000 of which will be with cloud service and IT system providers and the remaining 12,000 with industry verticals, representing approximately 1.3% of the current information and communications technology workforce. A large proportion of these jobs will require training incoming workforce as well as retraining and upskilling the existing workforce.

The second order effects are expected to influence another 95,000 indirect and induced jobs, bringing the total potential jobs that generated as offshoots of public cloud use to 146,000, which is 0.2% of the current workforce.

TWO ALTERNATE SCENARIOS

The economic impact we have assessed above is the Baseline Scenario, but we have drawn up two additional scenarios. The Big Bang Growth Scenario and the Sluggish Growth Scenario show the economic impact that would occur if the forces that shape the public cloud market cause growth to either speed up or slow down. If either of these scenarios were to unfold, the full cumulative economic impact of the public cloud could vary by a difference of about US\$70 billion [JP¥8 trillion] between 2019 and 2023 (See Exhibit 22).



The Big Bang Growth Scenario. The government's efforts to encourage public cloud adoption within its own agencies, if successful, would be a powerful factor in the optimal growth scenario. For Japan to realize the maximum impact from the public cloud, however, it will need a full range of supportive government policies, including a cloud procurement policy with clear accreditation steps and effective incentives to drive government deployment. Along with such policies, Japan's growth could be faster if the government, the CSPs and user organizations all work together to resolve the problem of talent constraints and foster further cloud literacy.

In this scenario, a CAGR of 23% would lead to a total impact of about US\$166 billion [JP¥18 trillion], or 0.7% of annual GDP. This growth would create 97,000 direct jobs and influence 191,000 additional indirect and induced jobs, thus yielding nearly 288,000 jobs.

The Sluggish Growth Scenario. Although the Japanese government has been supportive of the public cloud, and has enacted not just policies in support but also appropriate cooperation frameworks, lack of clarity in the regulatory regime can increase uncertainty and slow adoption, especially if the policy and regulatory stance were to become more restrictive. Inadequate supply of cloud-native talent in the country would also slow down adoption.

Here, CAGR would drop to only 13%, and total impact from all sources of US\$95 billion [JP¥10 trillion], or 0.4% of annual GDP. Direct job creation would amount to about 13,000, and second order effects would influence another 25,000, for a total impact of about 38,000 jobs.

The public cloud market is strong in Japan, and the announcements over the last couple of years that a number of marquee private and public players intend to migrate significant applications will be an important boost to growth. The country does, however, have a critical need to make a concerted effort to develop and retrain a larger pool of IT and cloud-native talent to keep up with growing demand. If the country is able to

address the talent shortage, and the government develops a more active procurement policy encouraging its own agencies to migrate applications to the public cloud, Japan will see particularly robust growth in public cloud use that will continue to foster innovation and digital transformation, and drive impact within the overall economy.

Singapore

EXECUTIVE SUMMARY

Singapore has one of the most highly penetrated public cloud markets in the region, and is expected to grow at a CAGR of 20% to US\$3.5 billion by 2023. Digital native businesses that use public cloud to scale up and grow rapidly along with government's focus on digital transformation and a supportive policy regime have been key drivers of public cloud adoption. There is high awareness across industry verticals including media, retail and financial services who are migrating their applications to the cloud, with some traction also coming from manufacturing industries and traditional enterprises. The cumulative economic impact due to public cloud adoption is expected to be US\$31 billion between 2019 and 2023, which when annualized, is equivalent to about 15% of the annual GDP impact of large traditional sectors such as financial services. The direct impact is projected to create 22,000 jobs, and influence another 21,000 jobs by second order effects. Managing demand for digital talent and maintaining the status as a regional hub for cloud infrastructure is critical to increase adoption. Continued regulatory support and deployment of government applications will also play a crucial role in further growth. Together, these factors can drive the cumulative GDP impact as high as US\$43 billion, with the total employment impact being about 80,000 jobs over the next five years.

INTRODUCTION

Singapore is one of the most advanced public cloud markets in the APAC region. Investment in the public cloud is expected to grow at a CAGR of 20% over the next five years, from US\$1.5 billion in 2018 to about

Snapshot of Public Cloud Adoption in Singapore (2019-23)



Impact on GDP

\$31B

15%



of annual impact from financial services industry

Direct jobs created

~22K

21K



jobs influenced by 2nd order effects

Industries leading the adoption



Digital Natives



Financial Services



Public Sector



Manufacturing

What industry users say

Benefits



Higher team productivity



Faster TTM for products and services



Enhanced ability to launch new products and services

Challenges



Legacy migration cost & risk



Complexity of managing multi-cloud environment

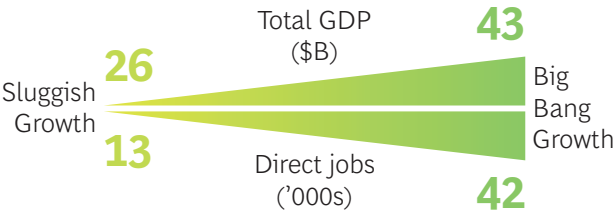


Gaps in organizational capabilities

Range of impact

Key factors driving impact

- Achieving Smart Nation through technology
- Accelerated deployment of government applications
- Maintain status as regional digital hub
- Drive adoption in SMEs through custom products
- Addressing supply of cloud native talent



US\$3.6 billion in 2023, which at 0.4% of the GDP is one of the largest public cloud spending-to-GDP ratios of all six markets (See Exhibit 23).

The government itself has adopted an active policy to promote use of public cloud for its systems, except the most sensitive, and there is significant traction across most industry verticals, especially digital native businesses. Financial services institutions, retailers, media companies and public sector organizations are also active users.

Most large enterprises in Singapore have begun to use some form of cloud storage or computing, and are starting to tap into more advanced use cases such as artificial intelligence and machine learning. The SaaS model currently has the largest share of the market, at 45%, but with interest growing in operating advanced applications over the

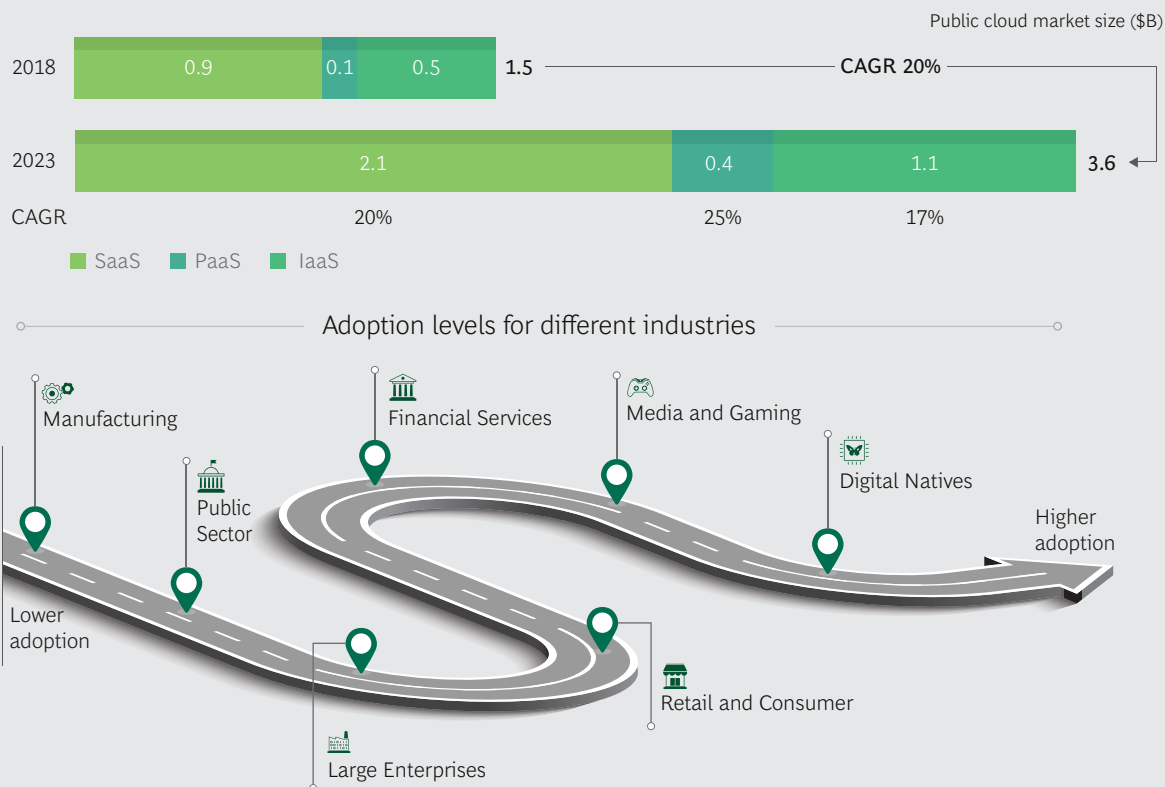
cloud, the PaaS model is the fastest growing segment, projected to grow by about 25% between now and 2023.

INDUSTRY ADOPTION

Digital native businesses are the largest users of the public cloud in the market. As businesses that are heavily dependent on having a reliable and scalable technology infrastructure, many started out using the public cloud from their incubation, and as they grow and expand into other markets in the region, have further developed the scalable infrastructure. Carousell, a large mobile marketplace for classified listings, is an example of a company using the public cloud to assure that it has the infrastructure to support continued growth (See Carousell case study).

Many DNBs say that the public cloud has allowed them to operate in an agile way

EXHIBIT 23 | Market overview: Public cloud market in Singapore is expected to grow from \$1.5B to \$3.6B at a CAGR of 20% over 2018-23



Sources: Expert interviews, Survey of public cloud users and decision makers (n=1026), Industry reports, BCG analysis

Note: SaaS refers to Software as a Service and includes business processes and support projects market, PaaS refers to Platform as a Service and IaaS refers to Infrastructure as a Service model; all CAGRs shown are 3 year CAGR for 2018-23

because of the relatively low upfront capital expenditures and the infrastructure resources they get from the cloud service provider.

“If we’d had to build our own data centers, I would have needed an infrastructure operations team comparable in size to my current tech team.”
– Head of Engineering, e-Commerce company

Prime Minister Lee Hsien Loong has encouraged the government sector to adopt public cloud-enabled technologies that will “re-engineer” and “re-design” the way the government operates. Singapore’s Government Technology Agency (GovTech)

and Smart Nation and Digital Government Office (SNDGO) were created to drive the digital transformation of government, build the public sector’s long term capabilities, and promote public cloud adoption in both the public and private sectors. These agencies are playing a significant role in orchestrating a cloud-first policy within all government departments.

To make public cloud adoption easy, there is the Singapore Government Technology Stack (SGTS), a platform that enables government agencies to build and test new applications with shared software and infrastructure services, and additional support from the Infocomm Media Development Authority (IMDA), which helps users clarify the security responsibilities of cloud service providers and sets standards for accountability and transparency.

Most government organizations are starting to move non-critical applications onto the cloud, as well as using it for citizen e-services. Although the government has a private

CASE STUDY
CAROUSELL



INDUSTRY
RETAIL AND CONSUMER GOODS

ABOUT THE COMPANY

Carousell is a mobile classifieds marketplace that makes selling as easy as taking a photo, and buying as simple as chatting. With over 80M listings, it is one of the world's largest and fastest growing marketplaces.

CHALLENGE

Carousell needed an efficient and powerful infrastructure service that would be able to keep up with its growth and support its over 80M listings.

A powerful infrastructure for a large and fast-growing marketplace

Carousell uses public cloud-based infrastructure for data storage, virtual machine instances, and scalability in heavy traffic loads. Messaging and advanced data processing tools provide a reliable and efficient back-end infrastructure to support the business.



More than **80M listings**
and **1B chats**



Kept headcount at **5—rather**
than 30—team members
working on system reliability



Improved **availability**
from 90% to 99.99%



Working with a platform that is designed and tuned to customers’ specific requirements is very important to us.

Jordan Dea-Mattson
Vice President
Engineering, Carousell

government cloud (G-Cloud), it has developed a set of internal standards that enable interoperability between the G-Cloud and public cloud. The use of the public cloud by government agencies has had a positive signaling effect on industries.

DNBs and government agencies have been the main drivers of cloud adoption to date, but other active users include financial institutions, retail players, media companies, and large enterprises across industries.

Most of Singapore's largest financial institutions are using the public cloud in some form. While there has been limited use of the public cloud for core banking applications so far, banks and financial institutions are using it to deliver web and mobile offerings for a better customer experience, deploy artificial intelligence and machine learning applications that help them personalize their customer engagement, and increase the efficiency of their business processes.

“By being a leader in adopting cloud technologies, we can iterate and deliver products to our customers at a much faster rate and increase our energy efficiency, as well as drastically reduce our carbon footprint.”
– CIO, BFSI player.

Large corporations, including traditional ones, are aggressively adopting public cloud to provide digital services, drive personalization, and run advanced analytics. It has made it possible for long-established companies to provide new services such as e-commerce, personalized in-flight entertainment, and automated logistics.

The public cloud has also gained traction in the manufacturing industry, especially for enterprise applications and customer-facing applications, with a growing interest in deploying it for core operations.

Smaller businesses have government support that has made it possible for them to adopt the public cloud at much faster rates than in the other five APAC markets. IMDA has a program in which it appoints partners to offer consultancy and training to equip DevOps teams at small businesses with cloud-native digital capabilities at subsidized fees. In a four to six month training period, the small business can work with an expert to develop a cloud plan, receive certification in cloud-native applications, and develop applications for their business.

KEY BENEFITS

The key benefits identified by users of public cloud include:

Higher team productivity. Numerous companies are using internal and external collaborative tools such as document sharing, communication apps, and other basic features of products based on public cloud that allow them to accomplish tasks more efficiently and focus on growing the core business.

The telecommunications company My Republic has found the public cloud invaluable in reducing operating costs while also developing competitive packages that have helped expand its customer base (See My Republic case study).

Faster time to market for products and services. The ability to try and ‘fail fast’ is invaluable to DNBs, large enterprises, and traditional companies alike. The public cloud allows faster iterations of prototypes, with launch costs which are generally lower than those that can be achieved with comparable on-premise architecture.

Enhanced ability to launch new products and services. Also important to users are the data analytics capabilities they can develop over the public cloud. Advanced data analysis is a

CASE STUDY
MYREPUBLIC



ABOUT THE COMPANY

MyRepublic is a multinational telecommunications and internet company. The company primarily offers fibre broadband services.

CHALLENGE

MyRepublic wanted to continue operating as a lean business while at the same time deliver competitive packages to consumers and businesses in several markets.

Collaboration tools keep the company lean with increased productivity

My Republic deployed a public cloud-based suite of intelligent applications designed to deliver collaboration within and between business divisions. The tools have played a crucial role in the company's increased productivity.



Helped establish a **lean operation** with 80 employees in ANZ



Delivered supported business **growth to 1,000 employees supporting 3K customers**



Allowed the business to **control operating costs** and **deliver competitive products**

“

[Productivity tools] have enabled us to create a collaborative, close-knit culture. We can interact deeply without having to fly constantly to different locations, which helps us work as a unified team rather than as disparate groups in silos.

*Eugene Yeo
Group Chief
Information
Officer, MyRepublic*

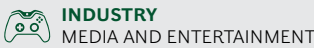
key enabler in designing newer products and services for a targeted customer base in such areas as e-commerce, ride-sharing, and media content. Singapore Press Holdings, an established media company, is using the public cloud as it expands to online platforms in order to analyze audience data in ways that allow them to provide more relevant content for viewers alongside targeted advertising, thus driving audience engagement as well as advertisement revenues. The cloud has also made it possible for the company to increase collaboration internally between business units, thereby enhancing productivity (See Singapore Press Holdings case study).

Better security. Singapore is a fairly advanced market in which public cloud users understand the product well, and have easy access to transparent information about cloud security. Many told us they have no worries about security at all.

“A few years back when we were starting our journey, we evaluated security, and even then the public cloud was better. Today they have scaled up security features even more”
– CIO, Global manufacturing company

Scalability and flexibility of infrastructure. The scalability of the public cloud infrastructure is an important benefit, particularly to companies that have ebbs and flows in their server traffic, such as startups trying to meet customer demand. As more

CASE STUDY
SINGAPORE PRESS HOLDINGS



ABOUT THE COMPANY

A leading media organization in Asia, SPH has a business portfolio that includes newspapers, magazines, online portals, and radio stations, as well as real estate and healthcare investments.

CHALLENGE

SPH needed effective tools to embark on a digital transformation journey that would speed up collaboration and data insights.

Using analytics and productivity tools to enhance operational efficiency

With public cloud-based productivity tools, SPH deployed a suite of intelligent applications designed to deliver collaboration within and between businesses. These tools play crucial parts in the company's increased productivity. It also uses advanced analytics tools for customer analytics.



Analyzes 1.4TB of active data using analytics tools



Drives content engagement & ad revenues by analyzing audience data



Improves productivity across the organization **speeding up editorial workflows**



Our journalists and analysts can access deep insights into how readers use our publications, which helps us serve the content they want. With [cloud based analytics tools], we can analyze data with more granularity and depth, which is invaluable.

*Fiona Chan
Head of Media
Strategy and Analytics
Singapore Press Holdings*

companies use artificial intelligence, machine learning, big data and other advanced technologies, they will need to have a scalable, flexible infrastructure in place to tap into all the possible uses of these advances.

“Scalable deployment of artificial intelligence and machine learning will be the biggest advantage of the public cloud in the coming days. This will significantly enhance decision making capabilities in businesses.”
– Senior VP, Global manufacturing company

KEY CHALLENGES

The key challenges identified by users of public cloud include:

Legacy migration cost and risk. This is a particularly fraught issue for large enterprises facing the task of migrating and integrating their existing databases and applications to the public cloud, including banks and other financial services players, large enterprises in all industries, and established public sector agencies.

Complexity of managing multi-cloud environment. A multi-cloud environment is important to users that have a wide range of applications to deploy on public cloud so that they can benefit from the expertise of a variety of providers. They want the flexibility to choose the best service providers for their needs, and avoid being locked in with any one vendor. Yet operating in a hybrid environment that includes on-premise architecture, private cloud and multiple public clouds is a complex undertaking.

There are concerns about system compatibility across different providers, and there is a need for technology solutions to manage the environment more effectively.

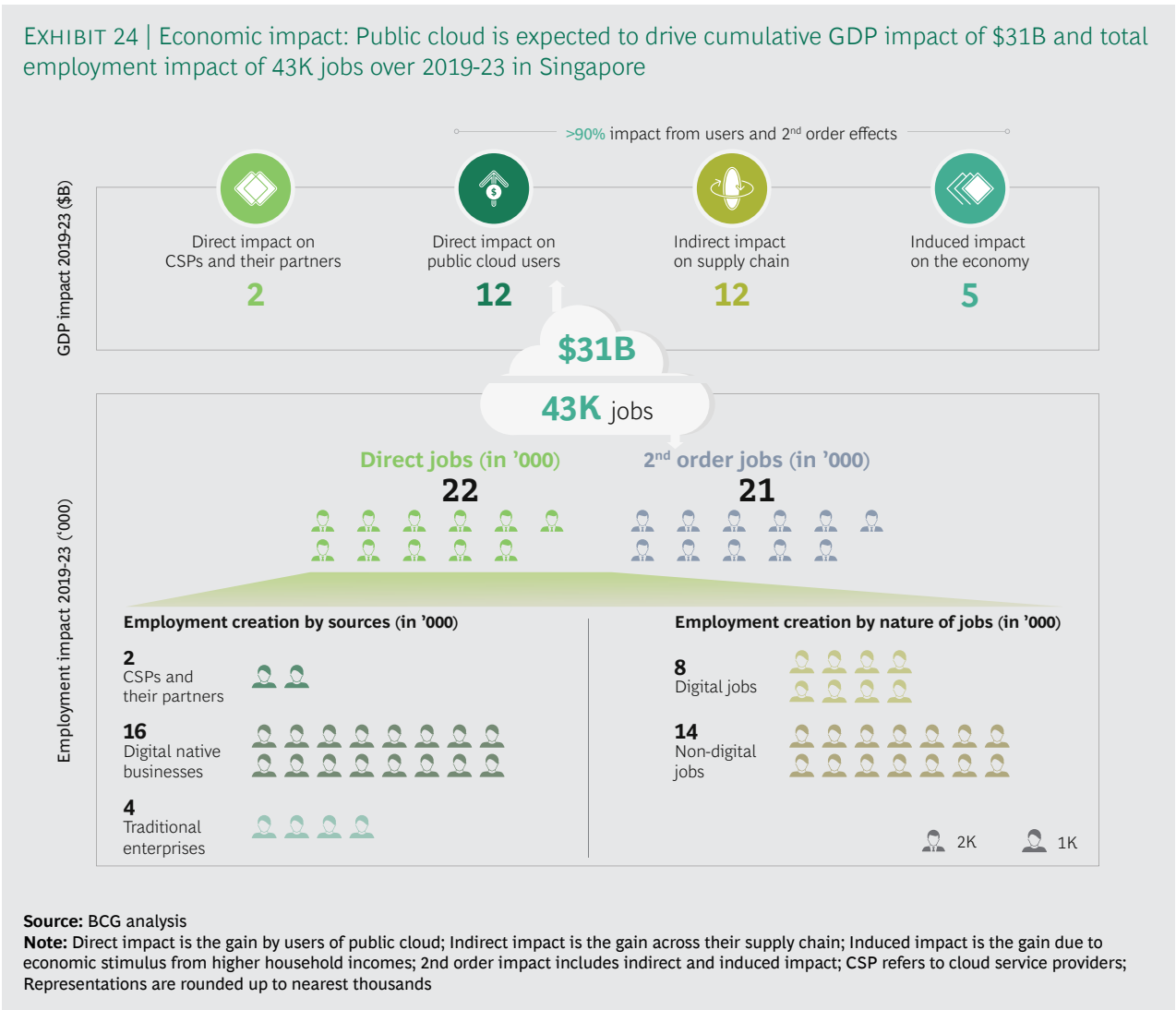
Businesses are examining what the appropriate strategies are for their partnerships with vendors, as well as how to train their internal teams so that they can optimize their use of the provider’s infrastructure over the long term.

Gaps in organizational capabilities. Businesses that use the public cloud or are planning to migrate will need an abundant supply of digital talent. Like other APAC markets, Singapore is facing a shortage of public-cloud trained IT professionals. In selecting a cloud provider, organizations look for one with services that are easy to use so

as not to strain their internal team capabilities, but a provider that offers advanced training is also highly valued. What is particularly needed is a greater emphasis on practical hands-on training and certification programs so that Singapore has a pool of IT specialists who understand the day-to-day aspects of running applications on the public cloud, and how to utilize it to develop new capabilities.

THE ECONOMIC IMPACT

The overall cumulative impact from direct, indirect and induced sources between 2019 and 2023 is expected to be US\$31 billion, if CSPs continue to launch new products and services, deployment continues to expand rapidly, and policymakers keep their existing stance on public cloud deployment (See Exhibit 24). When annualized, this is a sum



equivalent to 1.7% of annual GDP, 70% of the annual impact from the hospitality industry, 20% of that from the logistics industry, and 15% of that from financial services.

An estimated 90% of the impact will come from the gains to industry verticals in Singapore, while only 10% of the impact will be from the direct gains experienced by cloud service providers and technology services. Enhanced business revenues will be the key driver of these gains.

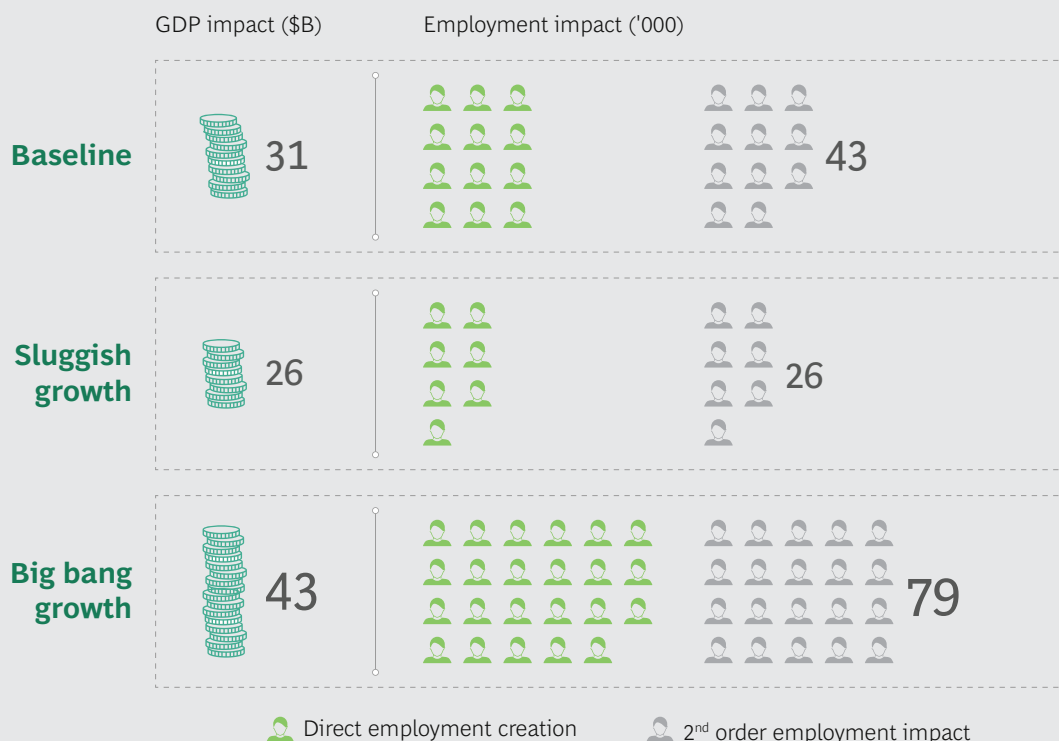
Public cloud usage stands to create 22,000 direct jobs over the next five years. About 14,000 of those jobs will be in non-digital roles such as sales, marketing, human resources, finance, logistics and operations. Another 8,000 of those will be digital jobs, 2,000 of which will be with cloud service and IT system providers and the remaining 6,000 within industry verticals—representing approximately 4% of the current information and communications technology workforce.

The second order effects are expected to influence another 21,000 indirect and induced jobs, bringing the total potential jobs that are offshoots of public cloud use to 43,000, equivalent to 1.2% of the current workforce. A large proportion of these jobs will likely be taken up by the existing workforce after their retraining and upskilling.

TWO ALTERNATIVE SCENARIOS

The economic impact we have assessed above is the Baseline Scenario, but we have drawn up two additional scenarios. The Big Bang Growth Scenario and the Sluggish Growth Scenario show the economic impact that would occur if the forces that shape the public cloud market cause growth to either speed up or slow down. If either of these scenarios were to unfold, the full cumulative economic impact of the public cloud could vary by a difference of US\$17 billion between 2019 and 2023 (See Exhibit 25).

EXHIBIT 25 | Economic impact scenarios: For Singapore, cumulative GDP impact ranges from \$26B to \$43B and total employment impact ranges from 26K to 79K



Source: BCG analysis

Note: Direct employment impact refers to jobs created in organizations using public cloud; 2nd order employment impact refers to jobs impacted across the supply chain of the users and due to economic stimulus coming from increased household incomes

The Big Bang Growth Scenario. In this rapid-growth scenario, Singapore's 'Smart Nation' initiative to achieve better living through technology would succeed in further transforming Singapore into a highly digitalized society, including in e-government services. The government's success in enhancing its services through public cloud would continue to create a signaling effect that spurs new digital native businesses and digital transformation of larger enterprises. This growth would lead to heavy demand for cloud-savvy talent, but providers, users and government agencies will work together to create the training programs that are needed to effectively manage the talent pipeline.

If these factors come together, a CAGR of 23% would lead to a total economic impact as large as US\$43 billion between 2019 and 2023, or 2.2% of GDP. About 42,000 jobs would result from the direct impact, with another 37,000 influenced by the second order effects.

The Sluggish Growth Scenario. This scenario would be the outcome if Singapore were to lose its present status and relevance as an important regional digital hub. That situation would arise primarily from neighboring countries increasing protections around their data flows, although Singapore's business as a regional hub could also decline if neighboring countries improve their infrastructure. Within its own borders, too, there is a risk of growth slowing down if Singapore is unable to develop a digital talent force large enough to meet the demands of a rapidly growing public cloud market. The city-state needs to continue to address its cloud-native talent gap through a combination of university programs for newer graduates as well as retraining and upskilling existing workforce in advanced technologies.

If these circumstances were to drag down growth, a CAGR of 14% would bring the cumulative economic impact down as far as US\$26 billion, or 1.4% of annual GDP. The jobs that arise directly from public cloud usage would amount to around 13,000, with another 13,000 influenced from the indirect and induced impact.

Although Singapore has an advanced public cloud market, it stands to gain significantly from a greater push on the part of government and industries to create an even more digitalized society. As a regional digital hub, Singapore has an important role to play in orchestrating frameworks around cross-border data sharing, thereby influencing the further development of regional standards on public cloud utilization of cloud. At the same time, as other countries in the region develop their public cloud use, Singapore will need to build the strength of its own market. Part of the push should involve extensive practical training so that Singapore's business community can develop the next generation of talent to meet the growing demand for public cloud experts who can help drive digital transformation in their organization. A stepped-up effort to make it easier for all businesses, large traditional sectors and SMEs alike, to use the public cloud for transformative strategies would make a notable impact upon Singapore's GDP and employment. These efforts would serve the additional purpose of mitigating the risks that come with being a regional public cloud hub. Optimal growth will make the market resilient, whether or not neighboring countries need Singapore's public cloud infrastructure.

South Korea

EXECUTIVE SUMMARY

South Korea's public cloud market has robust growth potential. With a CAGR of 15%, the market is expected to double in size from US\$1.5 billion in 2018 to US\$3 billion in 2023. While digital native businesses and gaming companies are the main drivers, there is increasing traction from retail players and large conglomerates—the 'chaebols'—as they seek to support their digital arms and expand businesses internationally. With the continued support of local partners and systems integrators, the cumulative economic impact of public cloud adoption is expected to reach approximately US\$45 billion [₩54 trillion] between 2019 and 2023, which when annualized, is equivalent to about 20% of the annual GDP impact from large traditional sectors such as automobile manufacturing.

Snapshot of Public Cloud Adoption in South Korea (2019-23)



Impact on GDP

\$45B

20%



of annual impact from automobile industry

Direct jobs created

~15K

35K



jobs influenced by 2nd order effects

Industries leading the adoption



Media and Gaming



Retail and Consumer Goods



Large Enterprises (Chaebols)

What industry users say

Benefits



Higher team productivity & collaboration



Digitization and launch of new products and services



Scalability & flexibility of infrastructure

Challenges



Gaps in organizational capabilities



Legacy migration cost & risk

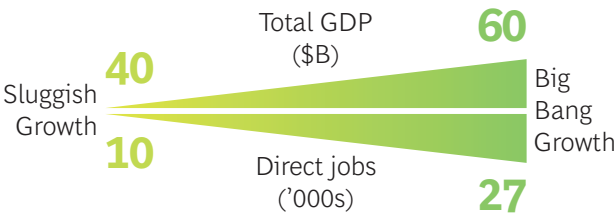


Lack of clear understanding of data privacy features

Range of impact

Key factors driving impact

- Acceleration of digital transformation & push for digital nation
- Launch of new products & services by cloud service providers
- Addressing supply of cloud native talent
- Government accreditation steps in line with international practices



The direct impact is expected to create about 15,000 jobs, with second order effects influencing another 35,000 jobs. Acceleration of the government’s ‘digital nation’ push, and a greater presence of hyper-scale service providers, will help drive further growth. Together with effective management of cloud-native talent and supportive regulations, these factors could produce a cumulative GDP impact as high as US\$60 billion [SK₩71 trillion], and a total employment impact of over 100,000 jobs in the next five years.

INTRODUCTION

South Korea’s public cloud market is expected to double in size over the next five years from US\$1.5 billion to US\$3.1 billion, enjoying a compound annual growth rate of 15%.

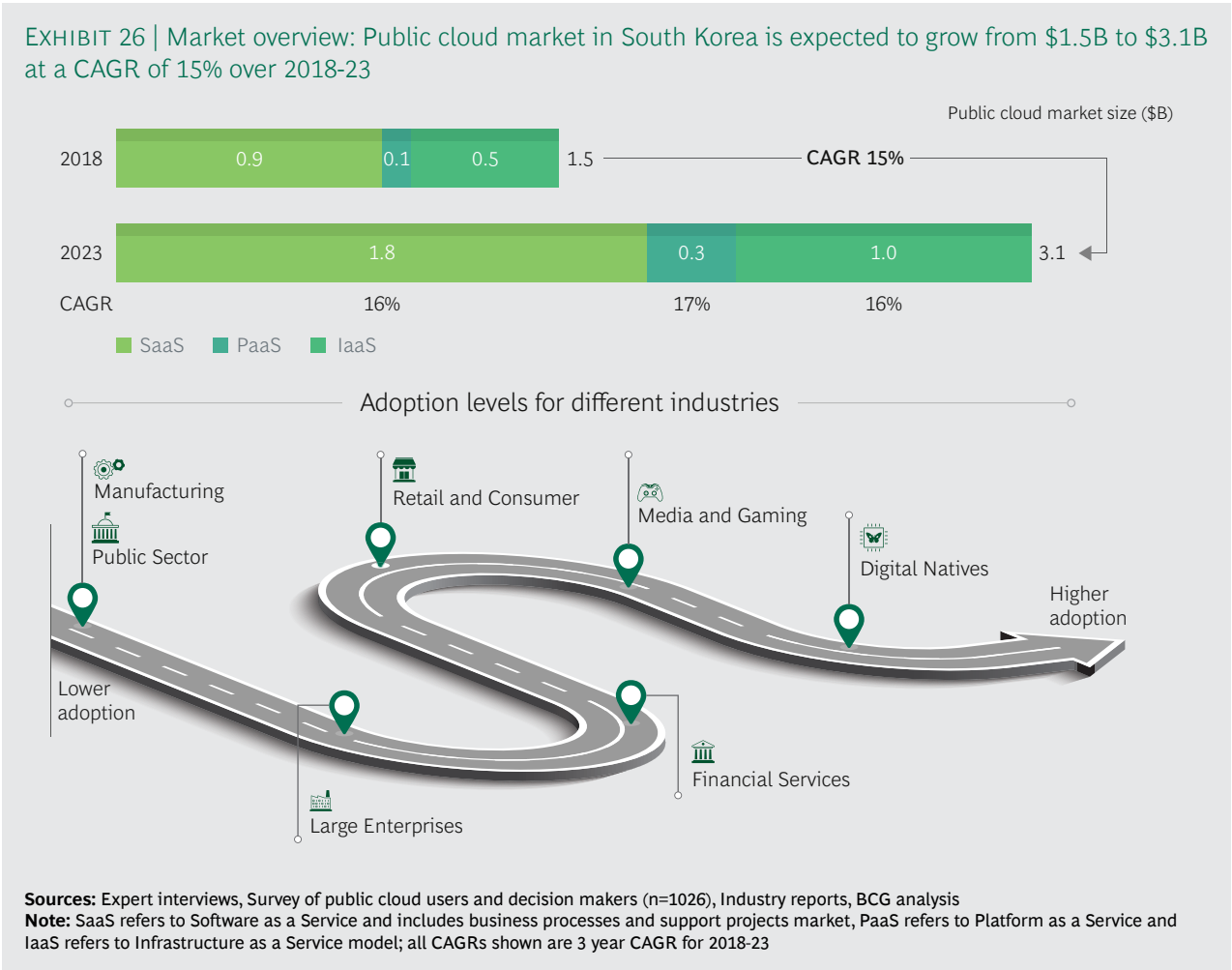
The SaaS model is the largest and fastest growing segment, accounting for 45% of the

market. IaaS is slowly gaining market share, and is expected to account for about one-third of the market by 2023 (See Exhibit 26).

INDUSTRY ADOPTION

Digital native businesses, along with media and gaming companies, are major spenders in South Korea’s public cloud market. Online gaming, e-commerce, and other wholly digital businesses that need to deliver the best possible online experience can give their customers unprecedented speed, along with experimental games and features using augmented reality and virtual reality. The mobile game maker Netmarble, for example, uses smart analytics and machine learning to gain insights into its customers that help fuel further innovation, and has also found that the public cloud boosts its team productivity (See Netmarble case study).

E-commerce companies are using the public cloud to tap into big data that helps them



CASE STUDY
NETMARBLE



ABOUT THE COMPANY

Netmarble is one of the top-10 global mobile-gaming companies and the largest is South Korea. It makes some of the world’s most popular mobile games.

CHALLENGE

Netmarble being committed to consistently improving the gaming experience, needed advanced analytics and innovations to better serve players, while at the same time increase its internal productivity.

Smart analytics and machine learning enhance the customer experience and increase productivity
Netmarble uses advanced public cloud based tools including analytics and machine learning to support new game development, manage infrastructure, and infuse business intelligence throughout its operations. The company also uses productivity tools for real-time collaboration across front and back offices.



Public cloud enhances player experience with better underlying infrastructure and player insights



Machine learning fuels innovation and helps with the development of new products



Productivity tools **improve real-time workforce collaboration**



[Public Cloud] aligns with our vision for innovation and is as committed as we are to building better player experiences with advanced artificial intelligence and reliable, scalable cloud infrastructure.

*Duke Kim
SVP, Head - Netmarble
AI Revolution Center
Netmarble*

personalize customer service. A large online seller of consumer products, for example, offers customers a subscription-based regular delivery service with automatic recommendations on products based on purchasing patterns. The rapid adoption by e-commerce startups has triggered interest from large retailers seeking to compete with DNBs. Both established retailers and e-commerce startups are using the public cloud to optimize delivery time by prediction of demand spikes, automate their warehouse logistics, and calculate the fastest routes. The public cloud also facilitates special promotions, with the scalability to handle surges in web traffic.

The financial services sector’s use of the public cloud was limited by law, but that is now changing. Until the guidelines were revised effective January 2019, South Korea’s Credit Information Act allowed only non-critical, non-identifying data to be stored on the public cloud. Now the Financial Services

Commission (FSC) is making changes aimed at promoting more innovative growth in financial technologies. Financial institutions are moving cautiously, however.

“Right now, most banks are uploading only non-critical data on the public cloud to test it out. They are waiting to see what the Financial Services Commission will allow.”

– Cloud Head, Large IT firm

Other industries are also taking note of the transformative technologies they can readily access when they have the public cloud to

facilitate a level of sophistication that would be hard for individual companies—even massive conglomerates like South Korea’s ‘chaebols’—to develop on their own. The potential for such advanced functionality has been an incentive for new industry verticals to expand their usage, and we expect to see large enterprises using more IaaS and PaaS models. South Korea embarked on 5G network rollout this year, and this next generation of connectivity has the potential to create newer use cases which can further encourage public cloud use.

Many ‘chaebols’ built their own private clouds over the past few years, sometimes incorporating a hybrid cloud model, but South Korea’s conglomerates and other large established organizations have begun to migrate more of their applications to the public cloud, particularly to take advantage of the easy access to advanced technologies such as artificial intelligence, big data and machine learning. A large electronics manufacturer, for example, has announced it will migrate all of its data center applications to the public cloud. Some large players have started moving data to the public cloud for their global operations and adding newer use cases for local operations.

Once corporations and institutions make a decision to migrate applications to the public cloud, they tend to seek a hybrid or multi-provider arrangement to avoid vendor lock-in, and make the most out of each vendor. As a result, there is room for South Korean companies with experience in running their own private clouds to expand as local cloud service providers. These providers are likely to play an instrumental role in encouraging further public cloud adoption, but as demand accelerates, the market will grow for all providers.

In the past, regulations prevented government institutions from using any infrastructure other than the private government cloud (G-cloud), but these rules were relaxed beginning in 2018. In expanding the number of public sector institutions that

are allowed to use the public cloud, the government is looking ahead to the growth of smart cities in which extensive connectivity will be needed for transportation and communication. To encourage further use of the public cloud by the public sector, the government has established a cloud security certification process and a clarified procurement process. If these processes are set up to conform to international standards, it will be possible for a broader range of cloud service providers, including hyper-scale providers, to offer more options and technologies including artificial intelligence and advanced machine learning technologies to government agencies through their public cloud platform.

KEY BENEFITS

The key benefits identified by public cloud users include:

Higher team productivity and collaboration.

South Korean users, like those in all of the APAC markets we surveyed, expressed appreciation for the tools, techniques and operating models that can boost productivity. The public cloud’s development approach and collaboration tools drive benefits for user teams, driving an increase in the speed and productivity not only for IT but for core business and operations as well.

Digitization and launch of new products and services.

South Korean users see the public cloud as a key enabler for a digital transformation. The diverse range of cloud-based offerings and services such as big data and AI are seen as among the more attractive reasons for migrating, and users are choosing their cloud service providers based on these capabilities.

LG CNS has developed a ‘smart factory’ using the Internet of Things, artificial intelligence, and other advanced technologies over the public cloud to test and model its products (See LG CNS case study).

CASE STUDY
LG CNS



ABOUT THE COMPANY

LG CNS is a subsidiary of LG Corporation and is one of the largest IT service providers in South Korea.

CHALLENGE

LG Chem with the help of LG CNS, needed support for harnessing advanced technology to improve model accuracy for a glass substrate used in LCD TV manufacturing. Previously, inspection of the models was labor intensive and time consuming, with 5-6 quality inspection processes for every production line.

Internet of Things, artificial intelligence and edge computing save time and labor on the factory floor
LG Chem with the help of LG CNS, uses Edge IoT Core to run cloud-trained machine learning (ML) models for defect detection to process images across thousands of machines.



1 Junior engineer **takes 2-9 hours** to perform modeling, achieving **99.9% accuracy** in glass inspection



The public cloud **saves about \$1M per year per production line**



Deep learning models are **run locally through** computer vision system

“ [Public Cloud] based artificial intelligence and edge tensor processing units, combined with our data analytics solution, DAP, will provide a great value for our customers in the smart factory arena.

Sungwook Lee
VP, AI/bigdata unit
of LG CNS

“Users are interested in adopting the public cloud less for the benefits of the actual cloud migration such as cost saving, but more for the fact they can more freely and easily try out additional services such as AI, big data, and analytics.”
– Director, ICT accelerator

Scalability and flexibility of infrastructure. Respondents told us that the scalability of the cloud can help curb capital investments in capacity for peak load usage, and facilitate a flexible, on-demand infrastructure to support peak loads. This is particularly important to

South Korea’s gaming and e-commerce companies, which might have very heavy traffic to their site at certain times of day, and a notable dip at other times. Additionally, as more users begin developing big data analytics, they are likely to turn to the public cloud for its virtually unlimited data storage and processing capabilities.

KEY CHALLENGES
The key challenges identified by public cloud users include:

Gaps in organizational capabilities. There is also much concern related to managing internal team capabilities. There is not enough cloud-native talent to meet the growth in demand for specialists who are equipped in the day-to-day practicalities of running applications on the public cloud. Leading companies are setting up internal programs to train cloud-native engineers at an aggressive rate. Users say, however, that cloud service providers can help mitigate this challenge by offering more training programs

to increase not just cloud literacy, but also cloud capabilities, with training and certification programs aimed at practical training in the use of cloud technology.

With many South Korean companies becoming increasingly interested in developing capabilities in such areas as artificial intelligence and machine learning, users are looking for partnerships with providers that can support these skills.

Legacy migration cost and risk. South Korea's 'chaebols' generally have their own legacy systems built by their IT subsidiaries, either on-premises or on a private cloud. Migrating these massive applications is a serious challenge to any established organization, and for that reason ease of use is an important factor that organizations consider when they're selecting a cloud vendor. It may be hard to overcome concerns that the costs of migrating or integrating data to the public cloud will outweigh the cost savings, especially over the shorter term, although as more digital transformation opportunities arise, companies are starting to look beyond the costs of migration, focusing more on the need to be digitally competitive and explore newer sources of revenue.

Lack of clear understanding of data privacy features. Users said they remain worried about the privacy of their PII, and data leaks, though these risks exist whether data is hosted on-premise, on a private cloud, or on a public cloud. Strong security and compliance standards can be a deciding factor when they are choosing among public cloud vendors. While South Korea's policy makers are considering a series of data privacy policy revisions, businesses are erring on the side of caution when it comes to storing sensitive data on the public cloud. One approach that is popular is the hybrid model, using a private cloud for more sensitive data, and the public cloud for front-end work. More advanced users of public cloud continue to deploy most applications, using different levels of security controls for different classification of data. Regulators can help by issuing stronger evidence of public cloud feasibility for government agencies, as well as

supporting security standards and data classification systems that are interoperable with international standards.

Lack of clear understanding of product reliability and performance. Businesses expressed concern that any vendor they work with should have a track record for highly reliable service. This is a question that has arisen more often after one incident in 2018, a rare exception, in which a network failure shut down much of the country's e-commerce activity for more than an hour. The hybrid cloud or multiple provider model is one way users ensure reliability. CSPs can also take measures to avoid network failures and enhance the reliability of their service, and reassure their clients that they're doing so. Users should benchmark the online performance of their on-premise and private cloud systems against the public cloud to assess any differences.

THE ECONOMIC IMPACT

The overall cumulative economic impact from direct, indirect and induced sources is expected to be US\$45 billion [SK₩54 trillion], if CSPs continue to launch new products and services at their present rate, and policymakers keep their existing stance on public cloud deployment. When annualized, this is equivalent to roughly 20% of the annual impact from large traditional sectors such as the automotive industry, about 10% of the annual impact of the electronics industry, and about 0.6% of the country's annual GDP (See Exhibit 27).

About 85% of the total impact will be generated within user verticals, while around 15% of the impact will come from the growth of cloud service providers and the IT industry. Of the direct gains to industry, a major percentage will come from enhanced business revenues. A total of US\$10 billion [SK₩12 trillion] will come from revenue uplift, while another US\$1.3 billion [SK₩1.5 trillion] will result from productivity benefits, and US\$0.5 billion [SK₩0.5 trillion] from IT-related cost reductions.

Half of the total impact is expected to come from the industries that have been the big

EXHIBIT 27 | Economic impact: Public cloud is expected to drive cumulative GDP impact of \$45B and total employment impact of 50K jobs over 2019-23 in South Korea



Source: BCG analysis
Note: Direct impact is the gain by users of public cloud; Indirect impact is the gain across their supply chain; Induced impact is the gain due to economic stimulus from higher household incomes; 2nd order impact includes indirect and induced impact; CSP refers to cloud service providers; Representations are rounded up to nearest thousands

spenders on the public cloud—digital native businesses, especially those in retail, along with media and gaming companies and select chaebols driving public cloud within their businesses.

Public cloud usage stands to create close to 15,000 direct jobs over the next five years. Roughly 7,000 of the direct jobs will be in non-digital roles such as sales, marketing, human resources, finance, logistics and operations. Another 8,000 will be digital jobs, of which an estimated 4,000 will be with cloud service and IT system providers and the remaining 4,000 will be with industry verticals— representing approximately 1% of the current information and communications technology workforce.

The second order effects are expected to influence another 35,000 indirect and induced jobs, bringing the total potential jobs that are offshoots of public cloud use to 50,000. That is equal to about 0.4% of the current workforce. A large proportion of these jobs will likely be taken up by the existing workforce after their retraining and upskilling.

TWO ALTERNATE SCENARIOS
The economic impact we have assessed above represents the Baseline Scenario, but we have drawn up two additional scenarios. The Big Bang Growth Scenario and the Sluggish Growth Scenario show the economic impact that would occur if the forces that shape the public cloud market cause growth to either speed up or slow down. If either of

these scenarios were to unfold, the full cumulative economic impact of the public cloud could vary by a difference of nearly US\$20 billion [SK₩24 trillion] between 2019 and 2023 (See Exhibit 28).

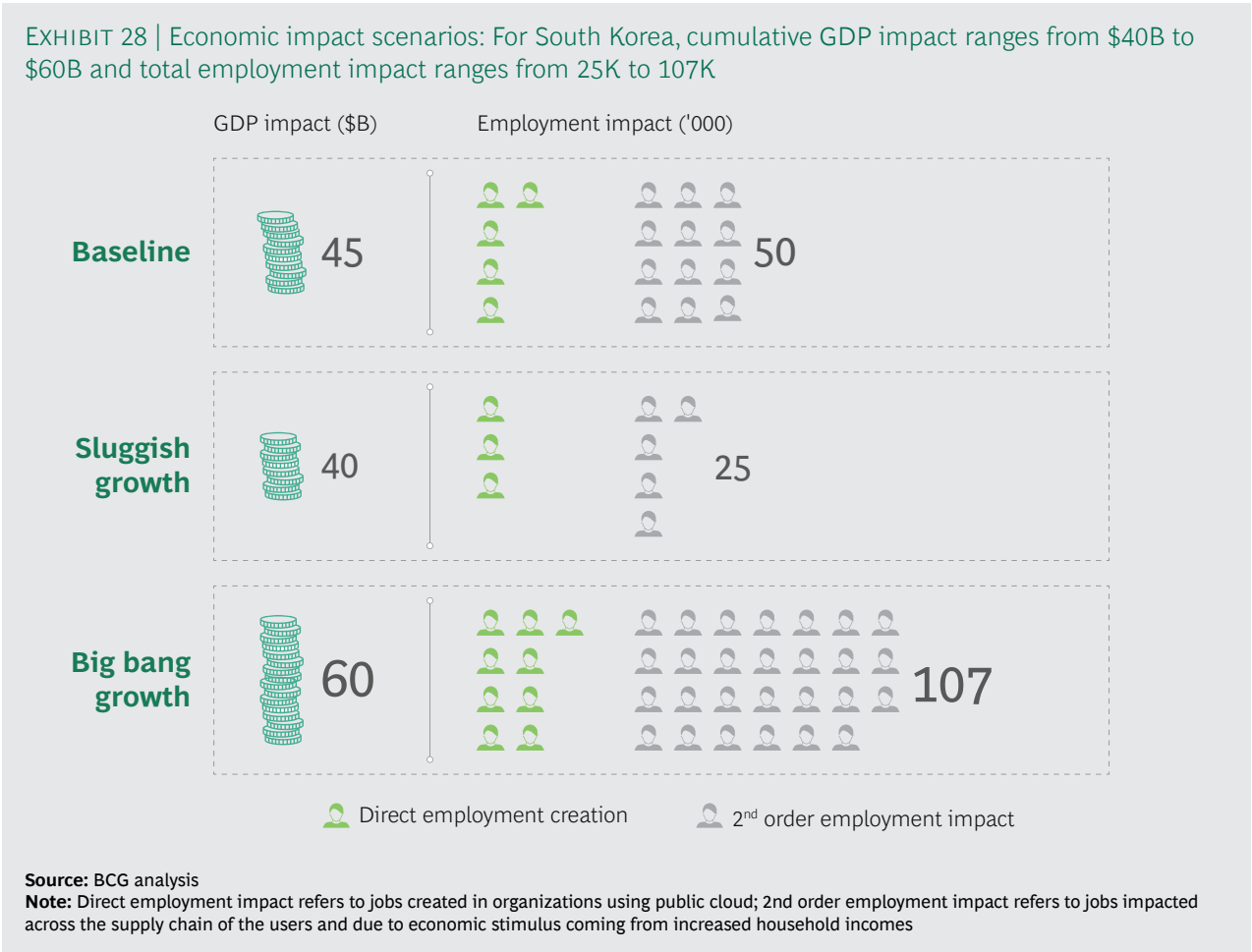
The Big Bang Growth Scenario. This is the value that could be unlocked if the government, users, and cloud service providers combine their best efforts. All stakeholders need to work together to develop a pool of cloud-trained talent to meet future demands. Acceleration of the government’s ‘digital nation’ push and a greater presence of hyper-scale service providers can also help drive further growth, as will a heightened emphasis on achieving digital transformation in large organizations and deploying newer technologies like AI and machine learning in business and government applications.

In this scenario, a CAGR of 24% would lead to a total economic impact of about US\$60

billion [SK₩71 trillion], or 0.7% of annual GDP. This growth would spur the creation of 27,000 direct jobs and influence 80,000 additional indirect and induced jobs, for a total impact of approximately 107,000 jobs.

The Sluggish Growth Scenario. This scenario would be the outcome of a more restrictive policy environment, inadequate management of the cloud talent supply, and particularly, increasing moves toward market localization. A key trend to watch is the new government accreditation system—if it is not interoperable with international standards, it could affect the ability of global hyper-scale providers to introduce the best of breed technologies in the market, potentially slowing down and impacting deployment within organizations.

In this scenario, CAGR would sit at just 12%, with a total impact of US\$40 billion [SK₩48 trillion], or 0.5% of annual GDP. Direct job creation would amount to about 9,000 jobs,



with another 16,000 jobs influenced due to the indirect and induced impact, for a total of 25,000 jobs.

With digital native businesses and gaming industries driving the initial growth of the public cloud in South Korea, the country is expected to see even stronger growth over the next five years as ‘chaebols’ and other large traditional sectors, including banking, seek digital transformation and advanced capabilities in such technologies as artificial intelligence and machine learning. The government could do a great deal to further fuel this growth with a concerted effort to push for more migration and work with CSPs to educate digital talent in working with cloud technology. If government, providers, and users can work together to mitigate challenges such as the shortage of tech talent and the difficulties ‘chaebols’ and other very large traditional businesses have in migrating applications, by 2023 the use of the public cloud could produce, through the direct and second order effects, more than twice the jobs it would under our Baseline Scenario.

The future of the public cloud in the APAC markets

Though they are in different stages of public cloud growth, the six APAC markets are all coming to an inflection point in their ability to reap the potential economic gains. The difference between a scenario in which the various stakeholders are proactively addressing the challenges versus a scenario in which less is being done, can mean a difference of billions of dollars in economic impact, as well as representing an additional gain of tens of thousands of jobs.

The public cloud represents an unparalleled opportunity for these markets in the next five years. They must act quickly to maximize the economic advantages that lie just overhead, floating in the cloud.

APPENDIX

DETAILED METHODOLOGY

THE FOCUS OF THIS report is to assess the economic benefits of the public cloud across the APAC region, while identifying key learnings and best practices that can be employed in order to unlock these benefits. We conducted both qualitative and quantitative studies to develop the findings in this report.

ANALYSIS CONDUCTED

Qualitative: Qualitative assessment through Interviews

The qualitative research conducted as part of this report took the form of in-depth interviews with senior IT and business leaders in order to understand their perspectives on the public cloud. BCG researchers interviewed over 80 industry experts, policy experts and senior leaders from each of the six markets, representing digital native businesses (DNBs) alongside all key industry verticals such as education, banks and financial services, manufacturing, media and gaming, public sector, retail and consumer, systems integrators and telecommunications.

Among the key questions discussed were the evolution of spending and use cases being deployed on public cloud, key benefits and challenges faced during deployment of public cloud in the organization, and the steps taken to mitigate the challenges. Other focus areas

included how decision makers predict that spending on public cloud would evolve, and the newer use cases and applications of interest for their organizations on public cloud in the near future.

Quantitative: Quantitative assessment through Surveys and Econometric analysis

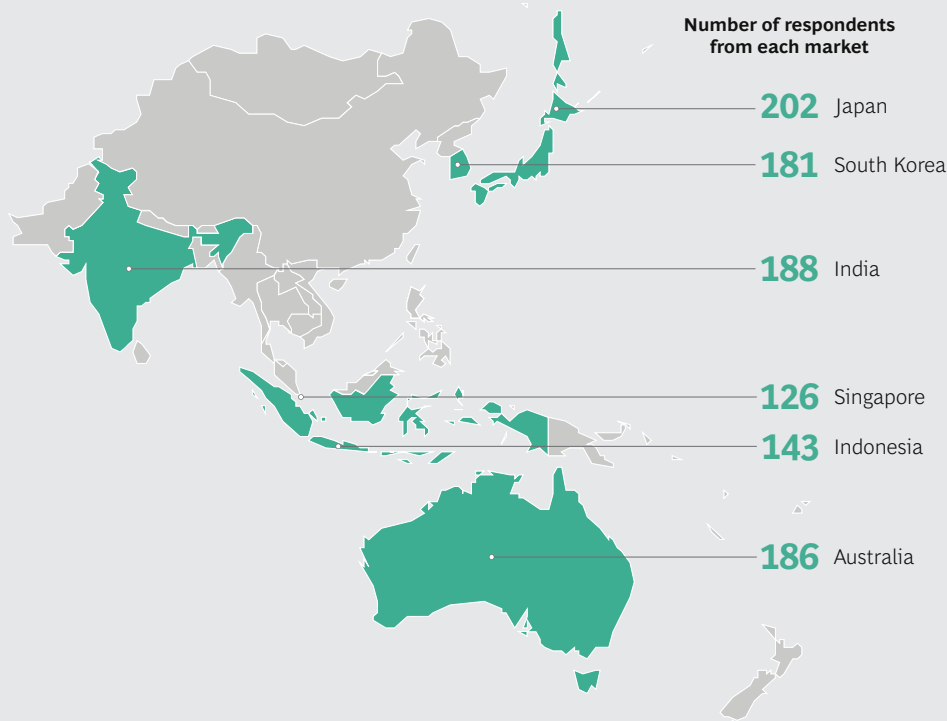
Three kinds of quantitative analysis were used: quantitative assessment through surveys; detailed econometric models to assess the impact of public cloud deployment in each of the six markets; and scenarios analysis to assess the impact of various drivers for public cloud adoption.

1. Quantitative assessment through surveys

A survey of senior IT and business decision makers asked them to verify the hypothesis established through the qualitative interviews, and share their perspectives on the public cloud. The survey covered questions about the key benefits and challenges in their business due to deployment of public cloud, relevant use cases of interest, and the most pressing concerns from a regulatory perspective.

Over 1,000 respondents from across the markets answered the survey questions (See Exhibit 29). Respondents included business leaders and IT decision makers, including

EXHIBIT 29 | Survey sample size: Over 1000 respondents participated in the survey across markets



Source: Survey of public cloud users and decision makers (n=1026)

chief technology officers, chief information officers, and chief data officers who are responsible for technology spending.

The respondents came from verticals in a range of industries that included financial institutions such as banks and insurance, internet startups and digital native businesses, manufacturing, retail and wholesale, healthcare and life sciences, public sector agencies, educational institutions, telecommunications, media and gaming, and information technology.

2.Econometric model to assess the impact of public cloud deployment

Using input from the interviews and surveys, we developed an overall econometric model using input-output table methodology to assess the impact that use of the public cloud by the relevant industry verticals would have upon GDP and employment growth in each of the six markets.

Econometric modeling methodology

We utilized publicly sourced data, with additional inputs from our interviews and surveys, which we combined with our analysis to arrive at the estimated impact that spending on public cloud service is likely to have upon the six selected economies (Australia, India, Indonesia, Japan, Singapore, and South Korea) over the five year period of 2019-2023.

We began by breaking down the impact into direct, indirect, and induced impact. This was followed by an analysis of all three of these categories of impact from the perspectives of both cloud services providers and cloud users in various industry verticals (See Exhibit 30). BCG has used this methodology in multiple economic impact assessment studies earlier (See [Capturing the Data Center Opportunity, Digital Infrastructure and Economic Development](#)). It is a globally recognized and accepted methodology combining rigor and practicality.

Direct Impact

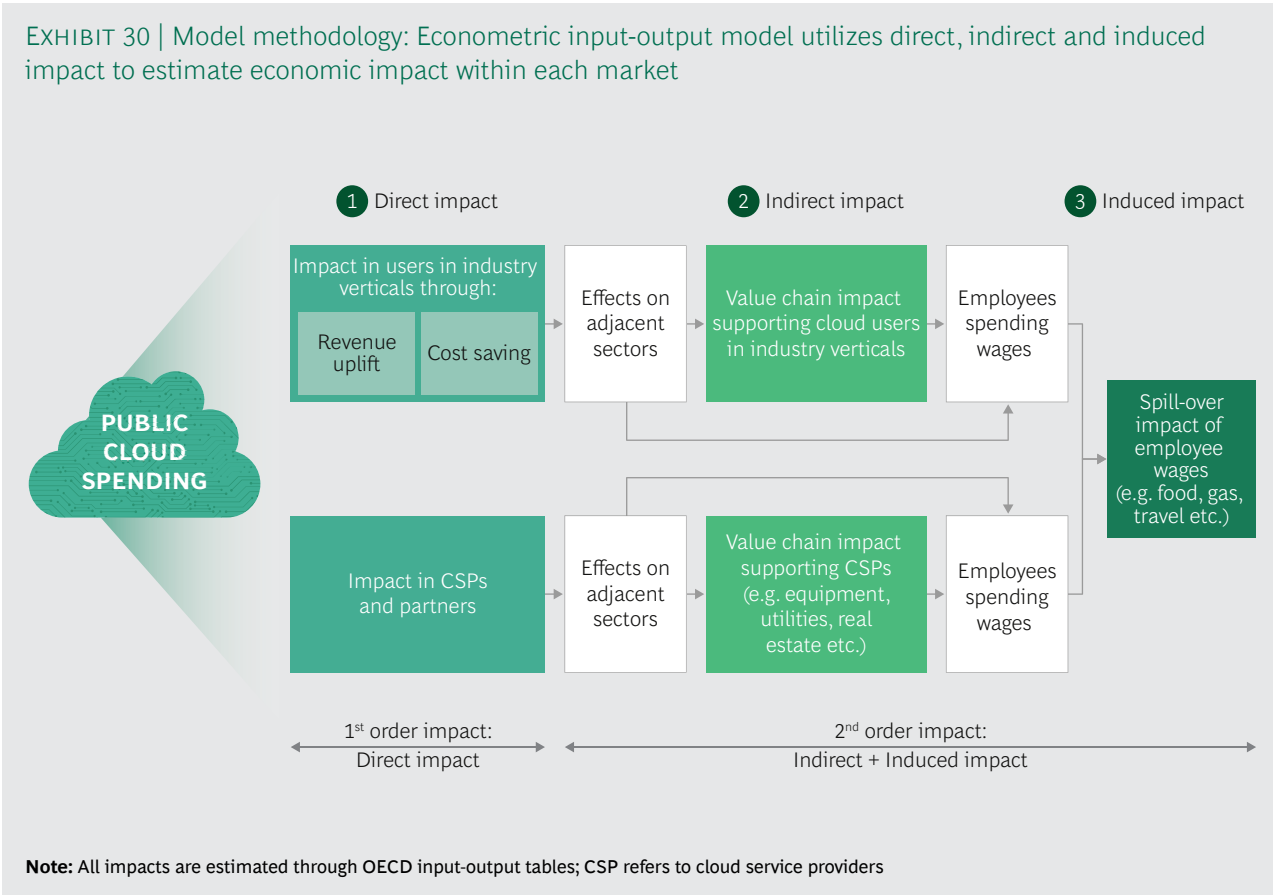
As noted, our estimation of the direct impact produced by public cloud services spending comes from two main segments—cloud service providers and cloud users in industry verticals.

Direct impact is the impact that can be approximated as the product of public cloud service spending, domestic supply, and public cloud value-added ratio. Data is obtained and synthesized from various sources, including but not limited to industry and market reports, publicly available financial data, Organization for Economic Cooperation and Development (OECD) statistics, and expert interviews and surveys.

The calculation can be further segmented into four sources of direct impact: digital business creation, revenue uplift, cost savings in IT functions, and cost savings in core business and non-IT functions or the productivity benefit. While the first two

sources incur indirect and induced impact, cost savings would have no further spillover effect.

- Digital Native Business: Estimated as the product of the size of the digital native business economy, public cloud attribution, and value-added ratio of profits and salaries.
- Revenue Uplift: Estimated as the product of public cloud service spending, revenue uplift per cloud spend, and value-added ratio of profits and salaries.
- Productivity Benefit: Estimated as the product of public cloud service spending and non-IT cost savings per unit of cloud spending.
- IT Cost Reduction: Estimated as the product of public cloud service spending on replacement of traditional IT spending and IT cost saving as compared to that of non-public cloud.



Indirect and Induced Impact

In order to capture the full economic impact of cloud services spending, we also need to look at two categories that reflect the spillover effects from the direct impact: indirect and induced impact.

- **Indirect impact:** Also known as supply chain impact, this is the impact created by the direct suppliers of the public cloud users as they, too, spend money on their supplies.
- **Induced impact:** This is the impact generated in industries such as retail and travel as a result of the increase in total household income created by the establishment of new business.

To quantify both the indirect and induced impacts of public cloud services, we leveraged the commonly-used econometric model using OECD input-output tables. This helped us identify the relations of inter-industry and inter-sector transactions, i.e. how many units of each sector's output are required to produce a unit of another sector's output. With the input-output tables sourced from OECD and other national statistics authorities, we were able to assign the indirect and induced multipliers that result when cloud service providers and cloud users in industry verticals increase their spending in other sectors of the economy.

Similar to the approach we took in measuring direct impact, we looked at two main segments for indirect and induced impact as well: cloud service providers (inclusive of their partners) and cloud users in various industry verticals. With inputs from each industry category and their respective value-added multipliers, we were able to apply the values accordingly to our models.

3.Scenarios analysis to assess the impact of various drivers for public cloud adoption

To define a base scenario, we used inputs from interviews and surveys to characterize each of the six markets by their current status in terms of public cloud deployment and

penetration, organizational adoption and regulatory frameworks. We then analyzed the impact that would occur if any of these conditions were to change in ways that either accelerated or constrained public cloud adoption, using the resultant data to construct, respectively, a Big Bang Growth Scenario in which the economic impact would surpass the Baseline Scenario, and a Sluggish Growth Scenario that would result in a lower impact than the Baseline Scenario.

Scenario methodology




Three steps were used to estimate the economic impact under the three different scenarios:

Step 1: Define the conditions for Big Bang Growth, Baseline and Sluggish Growth Scenario for each market. We start qualitatively by constructing the potential growth drivers and inhibitors for each of the six selected economies. These narratives are country and context specific.

An archetypical baseline case entails the current natural progression, with policymakers adhering to their current stance and cloud service providers keeping their current pace of product launch. For the Sluggish Growth case, we envision more policy restrictions, less cloud-native talent and limited cloud uptake by both industry verticals and the public sector, while the opposite would occur in a Big Bang Growth case.

Step 2: Apply a cloud adoption evaluation framework to each market to assign an index score to different market conditions. We fed these qualitative scenarios into 12 metrics that are clustered into three groups: cloud service product, user organization readiness, and policy and regulatory support. With quantification, we are able to estimate a Cloud Adoption Index for each metric in accordance with the prevailing market conditions in the baseline scenario and the expected condition in each of the other two scenarios, and calculate a weighted overall cloud adoption index for each scenario for each country (See Exhibit 31).

EXHIBIT 31 | Scenario methodology: Estimation of Cloud Adoption Index for different markets under baseline scenario

	Parameters	Description	Singapore	Australia	Japan	S. Korea	India	Indonesia
 Cloud service and product	Product availability	Access of IaaS, SaaS and PaaS products for users	High	High	High	Medium	Medium	Low
	Product performance	Reliability and speed of service	High	High	High	Medium	Medium	Low
	Maturity of verticals	Understanding and adoption by industry users	Medium	Medium	Medium	Medium	Medium	Low
	Network Infrastructure	Core infrastructure like optical fibers and data cables	High	Medium	Medium	Medium	Medium	Low
	Total of cloud service and product		High	High	High	Medium	Medium	Low
 Organization readiness	IT capability	Cloud native talent within organizations	Medium	Medium	Medium	Medium	Medium	Low
	Digital transformation readiness	Ability to undergo organizational change	Medium	Medium	Medium	Medium	Medium	Low
	Total of organization readiness		Medium	Medium	Medium	Medium	Medium	Low
 Policy support and regulation	Data security standards	Framework suggesting security levels of a provider	High	Medium	Medium	High	Medium	Low
	Data classification standards	Clarity on sensitivity and criticality of data	High	Medium	Medium	High	Medium	Low
	Cross border data flows	Laws on storage of data within national boundaries	High	Medium	High	Medium	Medium	Low
	Accreditation steps	Certification of providers basis their service standards	High	Medium	Medium	High	Medium	Low
	Digital agencies and cloud first policy	Nodal agency to manage government workloads	High	Medium	Medium	Medium	Medium	Low
	Cloud adoption incentives	Subsidized trainings, tax reliefs and credits to early users	High	Medium	Medium	Medium	Medium	Low
	Total of policy support and regulation		High	Medium	Medium	High	Medium	Low
OVERALL CLOUD ADOPTION INDEX			High	High	High	Medium	Medium	Low

High

Medium

Low

Sources: Expert interviews, BCG analysisNote: High, medium or low score for a parameter is defined with respect to global best practice benchmarks for the respective parameter

Step 3: Translate the score into model assumptions. We regressed the cloud adoption index over the cloud market size as a percentage of GDP to estimate the cloud market size in 2023 under different scenarios. Consequently, we were able to estimate the range of CAGR under the three different scenarios for each country.

Projecting the market size under each of the three scenarios and the expected percentage of public cloud spend for growth applications, we estimated the economic impact and level of job creation using the econometric model.

CURRENCY ASSUMPTIONS

All \$ numbers mentioned in this report to US\$. In analyzing the economic impact for Japan and South Korea, we have provided

localized currency values using SK₩ (South Korean won) and JP¥ (Japanese yen) for the respective markets. This conversion is based on a five-year average currency exchange rate between the local currency and the US dollar (US\$). For South Korea, that exchange rate is set at US\$1 = SK₩ 1190. For Japan, that exchange rate is set at US\$1 = JP¥ 110.

GLOSSARY

AI: Artificial Intelligence	DNBs: Digital Native Businesses are defined to be the technology based startups in a market (irrespective of their size of revenue).
APAC: The Asia-Pacific region for the study is denoted by the six markets covered in the report, namely Australia, India, Indonesia, Japan, Singapore and South Korea.	ENISA: European Union Agency for Cybersecurity
APEC: Asia-Pacific Economic Cooperation	EU: European Union
API: Application Programming Interface	FedRamp: Federal Risk and Authorization Management Program, U.S.
CAGR: Cumulative Annual Growth Rate	FSC: South Korea's Financial Services Commission
CBPR: Cross-Border Privacy Rules System set by the Asia-Pacific Economic Cooperation forum	GCCI: Singapore's Government Commercial Cloud Infrastructure
CDO: Chief Data Officer	GDP: Gross Domestic Product
CIO: Chief Information Officer	IaaS: Infrastructure as a Service is a cloud service model which provides instant computing infrastructure, managed over the internet. It offers a scalable architecture while avoiding the expense and complexity of buying and managing own data centers.
CiSAP: South Korea's Cloud Security Assurance Program	ICT: Information and Communications Technology
CSPs: Cloud Service Providers for public cloud e.g. AWS, Google Cloud, Microsoft Azure etc.	IMDA: Singapore's Infocomm Media Development Authority
CTO: Chief Technology Officer	
DevOps: DevOps refers to a set of software development practices that aim to shorten a system's development life cycle.	

IRAP: Australia's Information Security Registered Assessors Program	South Korea: less than 300 employees. Some like India and Indonesia use revenue e.g.
ISO 27000 series: International Organization for Standardization. The ISO 27000 series of standards are designed to address information security matters.	India: Revenue less than 250 Crore INR and Indonesia: Revenue less than 50B IDR.
IT: Information Technology	Others like Australia and Singapore use a combination of both employee size and revenue e.g. Australia: Revenue less than 50M AUD or less than 200 employees and Singapore: Revenue less than 100M SGD or less than 200 employees. DNBs are not included as a part of SMEs for this study.
MaaS: Mobility as a Service	
ML: Machine Learning	SNDGO: Smart Nation and Digital Government Office, Singapore
MTCS: Singapore's Multi-Tier Cloud Security Standards	Western Europe: Western Europe includes France, Germany, Italy, Netherlands, Spain and the United Kingdom for this study.
NIST: National Institute of Standards and Technology, U.S.	
OECD: Organization for Economic Cooperation and Development	
PaaS: Platform as a Service is a cloud service model where the service provider offers a cloud-based development and deployment environment. Cloud service providers manage the servers for storage while the users manage the applications and services they develop.	
PII: Personally Identifiable Information	
PIPA: South Korea's Personal Information Protection Act	
SaaS: Software as a Service is a cloud service model in which the users rent out the use of an application from the cloud service provider. All the underlying infrastructure, middleware, application software and data are managed by the service provider either through their own infrastructure or on the public cloud.	
SGTS: Singapore Government Technology Stack	
SMEs: Small and Medium Enterprises are defined as per the definitions followed by the labor departments of the respective countries. Some countries like Japan and Korea use the employee size e.g. Japan and	

FOR FURTHER READING

Organizing for Digital Operations at Scale

A report by The Boston Consulting Group, June 2019

[Read the report](#)

Six Simple Steps Pave the Way to the Cloud

A report by The Boston Consulting Group, February 2019

[Read the report](#)

Capturing the Data Center Opportunity

A report by The Boston Consulting Group, June 2016

[Read the report](#)

Decoding Digital Talent

A report by The Boston Consulting Group, May 2019

[Read the report](#)

For Many Enterprise Applications, the Cloud Is Ready for Prime Time

A report by The Boston Consulting Group, January 2019

[Read the report](#)

Digital infrastructure and Economic Development

A report by The Boston Consulting Group, June 2014

[Read the report](#)

Seven Forces Reshaping Enterprise Software

A report by The Boston Consulting Group, March 2019

[Read the report](#)

NOTE TO THE READER

Acknowledgments

The authors would like to thank Anand Chawra (Principal, BCG Singapore), Claus Helbing (Platinion Managing Director, BCG Platinion Sydney / Singapore), Donghyun Ko (Managing Director & Partner, BCG Seoul), Ipshita Bhattacharya (Partner, BCG Singapore), Masayuki Sekine (Associate Director, BCG GAMMA Tokyo), Vipin Gupta (Managing Director & Partner, BCG New Delhi) and Yoshihisa Niwa (Managing Director & Partner, BCG Tokyo) for helping with the trends and research in different markets.

The authors would also like to thank Kim Friedman, Clarys Chan, Jan Alexander, Josh Turner, BCG knowledge teams and the BEK design studios for editorial, design and production assistance.

For Further Contact

Vaishali Rastogi

Senior Partner and Managing Director
BCG Singapore
+65 9474 0351
Rastogi.Vaishali@BCG.com

Prasanna Santhanam

Managing Director and Partner
BCG Singapore
+65 9728 0009
Santhanam.Prasanna@bcg.com

Abhinav Gupta

Principal
BCG Singapore
+65 9899 3006
Gupta.Abhinav@bcg.com

© Boston Consulting Group 2019. All rights reserved.

For information or permission to reprint, please contact BCG at permissions@bcg.com.

To find the latest BCG content and register to receive e-alerts on this topic or others, please visit bcg.com.

Follow Boston Consulting Group on Facebook and Twitter.



ASCEND TO THE CLOUDS—HOW SIX KEY PACIFIC ISLANDS CAN LEAD THE

EDGE