

UNLOCKING SINGAPORE'S DIGITAL POTENTIAL: THE ECONOMIC OPPORTUNITIES OF DIGITAL TRANSFORMATION AND GOOGLE'S CONTRIBUTION

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UNLOCKING SINGAPORE'S DIGITAL POTENTIAL



BY 2030, IF LEVERAGED FULLY, DIGITAL TRANSFORMATION CAN CREATE UP TO...



**SGD65.3 BILLION
(USD47.4 BILLION)**
in annual economic value¹
(this is equivalent to 13% of
Singapore's GDP today)

66%
of this value¹ could come
from technologies that
mitigate the impact of the
COVID-19 pandemic



THREE PILLARS OF ACTION

**SUPPORT DIGITAL
ADOPTION
PARTICULARLY
FOR SMES**



1

**DIGITALLY UPSKILL
THE NATION
IN EMERGING
TECHNOLOGIES**



2

**POSITION
SINGAPORE AS A
REGIONAL HUB FOR
DIGITAL TRADE**



3

EXAMPLES OF GOOGLE'S CONTRIBUTIONS TO EACH PILLAR

The **Google-UOB SME Leadership Academy** equipped **OVER 4,000 SMES** in Singapore with digital skills

Google's **Skills Ignition SG** aims to boost the employability of **3,000 SINGAPOREANS** through digital skills training

Google's **data centres and submarine cable investments** in Singapore support the growing demand for digital services in Asia

GOOGLE'S BROADER ECONOMIC BENEFITS

BUSINESSES

Google supports **SGD2.4 BILLION
(USD1.7 BILLION)** in annual benefits to businesses in Singapore²

CONSUMERS

Google supports **SGD2.4 BILLION
(USD1.7 BILLION)** in annual benefits to consumers in Singapore²

SOCIETY

By enabling businesses to unlock new revenue streams and expand their businesses, Google indirectly supports **AROUND 6,600 JOBS** in Singapore. Google also provides other intangible benefits such as extending digital skilling opportunities to underserved communities in Singapore

1. Economic value refers to GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection.

2. Figures are estimated based on the latest available annual data at the time of study in February 2021.

Note: Estimates are based on AlphaBeta analysis using a range of original and third-party sources. See report's Appendix for methodology.

EXECUTIVE SUMMARY

Singapore is a destination of choice for technology and innovative businesses today. 80 of the world's top 100 technology firms (by revenue) have a presence in Singapore.¹ This is attributed to a combination of factors, including modern physical and digital infrastructure, a strong digital talent base, and robust Intellectual Property (IP) regulations. The country has also been ranked second globally out of 63 countries (behind the United States) in the 2020 IMD World Digital Competitiveness Index, which measures the capacity and readiness of economies to adopt digital technologies as a key driver of economic transformation in business, government and the wider society.² Singapore also has a flourishing digital economy. The e-Conomy SEA 2020 report jointly issued by Bain, Google, and Temasek has found that Singapore's Internet economy is worth USD9 billion in 2020 but could grow further at 19 percent annually to reach USD22 billion by 2025.³ The country is also a destination of choice for technology and innovative businesses.

However, the country currently faces several barriers to unlocking the full benefits of digital transformation. One such barrier is the limited adoption of advanced digital technologies. While most businesses in Singapore have Internet access and an online presence, adoption rates for advanced technologies such as the Internet of Things (IoT) are considerably lower.⁴ In particular,

small and medium-sized enterprises (SMEs) face greater challenges in adopting such technologies. Research has shown that Singaporean SMEs adopt an average of 1.9 digital platform tools (such as e-payments, e-commerce and software as a service) or advanced digital tools (such as IoT, data analytics and artificial intelligence), which is lower than the average of 2.6 tools adopted by larger enterprises. Another barrier is the lack of specific digital skills that have become higher in demand, particularly with the COVID-19 pandemic. While Singaporean workers are generally IT-savvy, the pandemic has laid bare some gaps in increasingly critical digital skill sets. For example, a survey conducted within the first six months of the outbreak found that although 94 percent of employers were using data to make business decisions more often than a year ago, 93 percent of them felt that their staff lacked adequate data skills.⁵

Digital transformation will be important for Singapore to "build back better" from the pandemic, and gain long-term resilience. This notion is well reflected in recent government strategies to build Singapore's resilience in the post-pandemic future. For example, announced in May 2021, Singapore's Emerging Stronger Taskforce laid out six broad shifts that the nation needs to be prepared for, to steer the country on a new path forward.⁶ This includes accelerating digital transformation and innovation by increasing

1. EDB (2018), "Singapore flexes its standing as Asia's technology capital".

Available at: <https://www.edb.gov.sg/en/business-insights/insights/singapore-flexes-its-standing-as-asias-technology-capital.html>

2. IMD World Competitiveness Center (2020), "The IMD World Digital Competitiveness Ranking 2020 results".

Available at: <https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2020/>

3. In this research, the value of the Internet economy refers to the Gross Merchandise Value (GMV) of products and services of sectors under the Internet economy. These sectors include e-Commerce, transport and food, online travel, online media and financial services. For more details, see source: Google, Temasek and Bain & Company (2020), e-Conomy SEA 2020.

Available at: https://storage.googleapis.com/gweb-economy-sea.appspot.com/assets/pdf/Singapore-e-Conomy_SEA_2020_Country_Insights.pdf

4. Ministry of Trade and Industry (2019), "Digital adoption among firms and impact on firm-level outcomes in Singapore".

Available at: <https://www.mti.gov.sg/Resources/feature-articles/2019/Digital-Adoption-Among-Firms-and-Impact-on-Firm-Level-Outcomes-in-Singapore>

5. NTUC Learning Hub (2020), Closing the data skills gap in the COVID-19 era and beyond. Available at: <https://www.ntulearninghub.com/data-skills-2020/>

6. Emerging Stronger Taskforce (2021), Emerging Stronger Taskforce Report. Available at: https://emergingstronger.sg/assets/pdf/EST%20Report_Single%20Page.pdf



the adoption of technology-enabled alternatives, such as digital communications, remote working tools and contactless e-commerce and e-services, as well as intensifying research and development (R&D) particularly in sectors like biomedical sciences and healthcare, where novel regulatory approaches and advanced technologies were used to rapidly develop innovative solutions in areas directly impacted by the pandemic. There is also a call to focus on sustainability, with the **Singapore Green Plan 2030** aiming to harness technology-driven solutions to “secure a green, liveable, and sustainable home for generations of Singaporeans”.⁷ This includes the deployment of 60,000 electric vehicle charging points by 2030, and an SGD60-million (USD43-million) **Agri-Food Cluster Transformation Fund** to support technology adoption in the agri-food sector.⁸ In the same month, the Singapore Government announced the investment of SGD25 billion (USD18 billion) in the **Research, Innovation and Enterprise 2025 Plan**, which seeks to deepen the country’s science and technology capabilities for the economy to emerge stronger post-pandemic.

This report finds that digital transformation could deliver an annual economic value of SGD65.3 billion (USD47.4 billion) by 2030.⁹ To put this in perspective, this is equivalent to about 13 percent of Singapore’s GDP in 2020.¹⁰

The insights of this report include:

- **Eight key technologies hold transformative potential for businesses and workers in Singapore.** These include the mobile Internet; cloud computing; big data; Artificial Intelligence (AI); financial technology (fintech); IoT and remote sensing; advanced robotics; and additive manufacturing. By allowing the creation of new business models and productivity savings, these technologies could create significant economic value for both businesses and the government in Singapore.
- **If leveraged fully, digital transformation can unlock SGD65.3 billion (USD47.4 billion) worth of economic value in Singapore by 2030.** By

7. Ministry of Finance (2021), “E. Building A Sustainable Home For All”. Available at: <https://www.mof.gov.sg/singaporebudget/budget-speech/e-building-a-sustainable-home-for-all>

8. Ministry of Finance (2021), Singapore Green Plan 2030.

Available at: https://www.mof.gov.sg/docs/librariesprovider3/budget2021/download/pdf/fy2021_singapore_green_plan_2030.pdf

9. Economic value refers to GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection.

10. Based on AlphaBeta analysis. See Appendix A for details on the methodology.



generating productivity gains, revenue boosts, cost savings and GDP increments, digital technologies can unlock up to SGD65.3 billion (USD47.4 billion) worth of economic value annually in Singapore's economy by 2030. The sectors projected to be the largest beneficiaries are consumer, retail and hospitality; manufacturing; and education and training.

- **Digital adoption is also crucial for the country to gain resilience during the COVID-19 crisis and in the post-pandemic future.** By allowing businesses to engage customers digitally and manage logistical bottlenecks amidst global supply chain disruptions, technologies can help businesses manage the severe economic impacts of COVID-19. It is estimated that two-thirds (66 percent) of Singapore's digital opportunity, or SGD43.2 billion (USD31.3 billion), could be derived from such applications.¹¹
- **Three pillars of action are required for Singapore to fully capture its digital opportunity.** While

Singapore is already making significant progress in some of these areas, there is scope for the country to push further on some parts of its policy agenda. The three pillars include:

- First, it is important to ensure that businesses in Singapore are provided adequate support to **adopt digital technologies, particularly among SMEs**. To ride on the momentum of businesses shifting online during the pandemic, the Singapore Government has set aside SGD1 billion (USD724 million) to fund a series of digital transformation schemes (e.g., **Digital Leaders Programme, Chief Technology Officer-as-a-Service** initiative and **Emerging Technology Programme**) to develop new digital capabilities for businesses. To support SMEs in this process, the Infocomm Media Development Authority (IMDA) launched the "SMEs Go Digital" programme, which has supported more than 50,000 SMEs in adopting entry-level digital solutions such as e-commerce. However, there is scope for Singaporean SMEs

11. Based on AlphaBeta analysis. See Appendix A for details on the methodology.

to accelerate their digital adoption efforts, particularly for more advanced technologies like AI.

- Second, there is scope to further *upskill the nation digitally in emerging technologies like AI and cloud computing*. Singapore has been actively building digital talent through the **SGUnited Jobs and Skills Package** (launched during the pandemic) and facilitating lifelong learning through the **SkillsFuture** initiative. The Ministry of Education has also been active in championing digital learning in schools through the **National Digital Literacy Programme**, which equips students with digital skills at different stages of their education journey. Beyond developing students' technical know-how, the current digital skills education could be complemented with a focus on the development of “soft skills”, such as problem-solving, critical thinking and adaptive learning.¹² The country could also develop more digital skilling programmes to train current digital workers in advanced digital skill sets that are in rising demand and provide incentives to shift employers' mindset towards “skilling as a first resort”.
- Third, it is crucial that the country continue its current efforts in *positioning Singapore as a regional hub for digital trade*. Given its small domestic market, Singapore's economy is heavily reliant on international trade. The Singapore Government has been an early advocate of digital economy agreements by initiating discussions with like-minded trade partners to develop digital trade rules and a framework for collaboration in the digital era while supporting businesses in accessing these digital trade opportunities.¹³ To encourage greater participation in digital trade, the government could continue its current efforts of promoting

digital trade in the region and globally, for example, through its participation in the Digital Economy Partnership Agreement (DEPA) with New Zealand and Chile.

- **Through both its initiatives and products, Google is making a significant contribution to advancing Singapore's digital transformation journey.** The company contributes actively to the three pillars of action. Google supports SMEs in their digital adoption journeys, including in advanced technologies. As a member of Singapore's Advisory Council on the Ethical Use of AI and Data, Google works closely with industry partners and the government to develop advisory guidelines on the use of AI. At the same time, the **Google-UOB SME Leadership Academy** facilitates SME digital adoption through courses that help businesses create a strong online presence through tools like Google Ads and Business Profile (previously called Google My Business). Google also digitally upskills Singapore's workers and students through skilling programmes developed in collaboration with the government and educational institutions, such as **Skills Ignition SG** and **SMU-Google Squared Data and Analytics Programme**. To advance digital trade and connectivity in the region, the company has also been investing in regional network infrastructure, including four submarine cable systems and three data centres.
- **Google's products also deliver wider benefits to businesses, consumers and the broader society in Singapore.** Businesses and consumers in Singapore were estimated to have derived total annual economic benefits from these products worth **SGD2.4 billion (USD1.7 billion)** and **SGD2.4 billion (USD1.7 billion)**, respectively.¹⁴ These products include Google Search, Google Ads, AdSense, Google Play, YouTube, Google Maps, Google Drive, and Google Docs,

12. AlphaBeta, commissioned by Amazon Web Services (2021), *Unlocking APAC's Digital Potential: Changing Digital Skill Needs and Policy Approaches*.

Available at: <https://pages.awscloud.com/APAC-public-DI-APAC-Digital-Skills-Research-2021-learn.html>

13. The Straits Times (2019), “Singapore to lead digital trade efforts and shape new digital trade architecture: Iswaran”.

Available at: <https://www.straitstimes.com/singapore/singapore-to-lead-digital-trade-efforts-and-shape-new-digital-trade-architecture-iswaran>

14. Based on AlphaBeta analysis. See Appendix A for details on the methodology.

Sheets and Photos. For businesses, such benefits come in the form of increased revenue through better customer outreach and access to new markets, as well as improved productivity through time savings. Consumers experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic contribution to businesses and individuals, Google also supports benefits to the broader society in Singapore. By enabling businesses to unlock new revenue streams and expand their businesses through the use of Google Ads,

AdSense, and YouTube, Google indirectly supports around 6,600 jobs in Singapore.¹⁵ The Android operating system also supports more than 49,500 jobs in Singapore's economy.¹⁶ Furthermore, Google delivers intangible benefits through its programmes and initiatives, such as supporting non-profit organisations, enabling safe Internet use, championing environmental sustainability, and providing access to digital skilling opportunities for all in Singapore through free programmes, such as **Code in the Community** which provides free coding classes to 6,700 young Singaporeans.



15. Jobs supported refer to new jobs that may have been created through a business' use of Google's platforms, as well as ongoing employment of jobs that previously existed.
16. See Appendix B for details on the methodology.



**SIZING THE PRIZE
— THE ECONOMIC
OPPORTUNITY OF DIGITAL
TRANSFORMATION
IN SINGAPORE**

Digital transformation is not just about the technology sector – it affects every sector in Singapore. Neglecting the impact of digital technology on traditional sectors like infrastructure, tourism, agriculture, retail and banking would risk overlooking the full transformative impact of technologies. If leveraged fully, digital transformation can create up to SGD65.3 billion (USD47.4 billion) worth of economic value annually in Singapore by 2030. This is equivalent to about 13 percent of the country's GDP in 2020. The largest projected beneficiary of digital transformation in Singapore is its consumer, retail and hospitality sector, which is estimated to account for about 20 percent of the total economic value.

Digital adoption is also crucial for the country to gain resilience during the COVID-19 crisis and in the post-pandemic future. By supporting businesses in engaging customers digitally, resuming business operations, and minimising logistical bottlenecks amidst supply chain disruptions, technology applications can help businesses manage the economic ramifications of the COVID-19 pandemic. It is estimated that 66 percent of Singapore's digital opportunity – at SGD43.2 billion (USD31.3 billion) – could be derived from technology applications that help businesses manage COVID-19's impacts. In the post-pandemic era, digital technologies will continue playing an instrumental role in boosting the competitiveness and resilience of businesses in adapting to the evolving business environment.





“SIZING THE PRIZE”

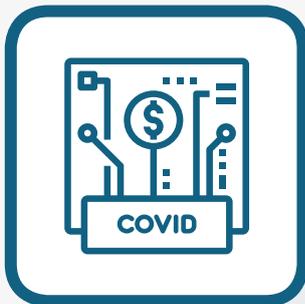
THE ECONOMIC VALUE OF DIGITAL TRANSFORMATION

IF LEVERAGED FULLY,
DIGITAL TRANSFORMATION CAN CREATE AN
IMPACT OF UP TO...



**SGD65.3 BILLION
(USD47.4 BILLION)**

in annual economic value¹



66%

of this value¹ could come from technologies
that help mitigate the economic impacts of the
COVID-19 pandemic

... IN SINGAPORE BY 2030

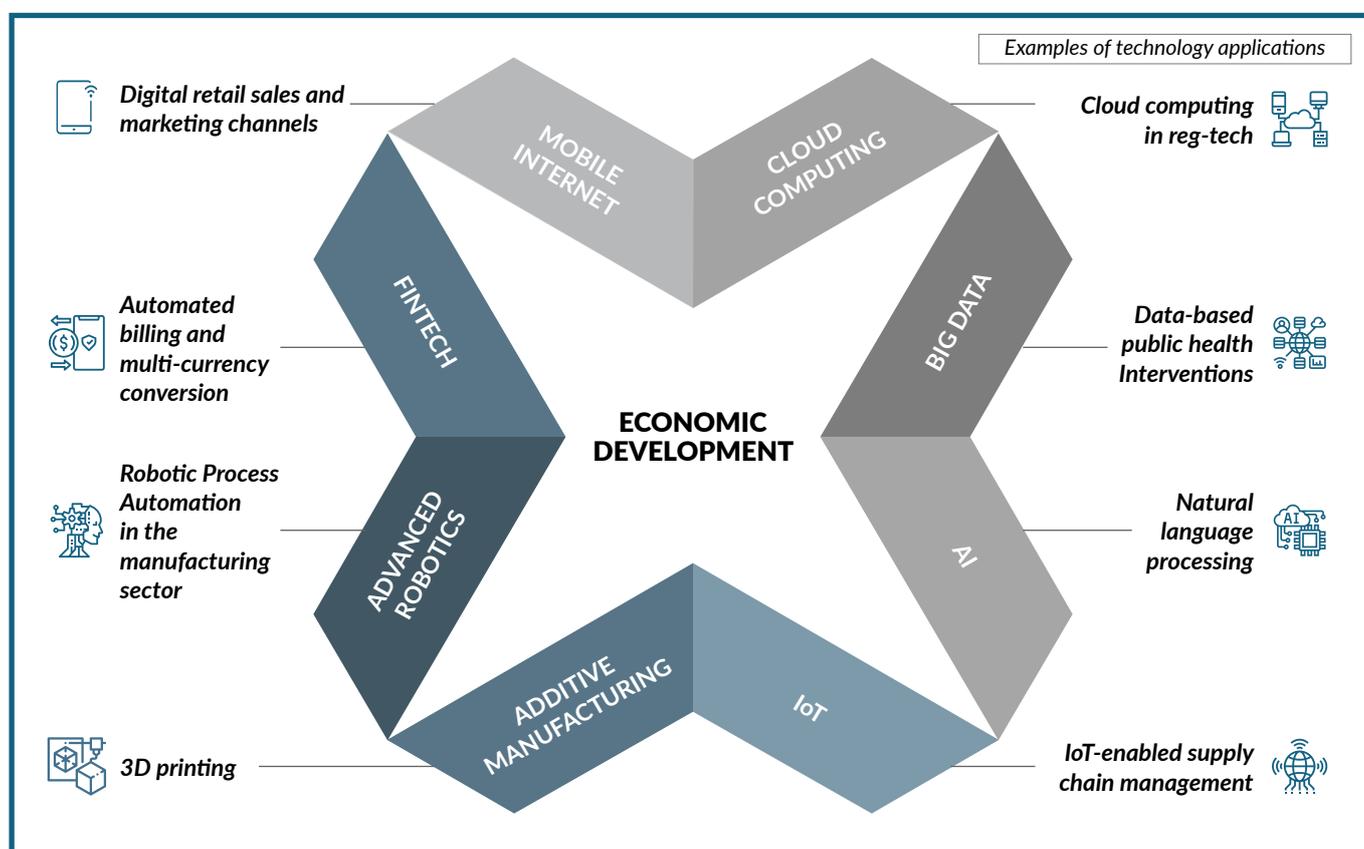
1. Economic value refers to GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection. Note: Estimates are based on AlphaBeta analysis using a range of original and third-party sources. See report's Appendix for methodology.

1.1 DIGITAL TRANSFORMATION CAN UNLOCK UP TO SGD65.3 BILLION (USD47.4 BILLION) WORTH OF ECONOMIC VALUE IN 2030

Digital technologies can unlock significant economic value in Singapore. In particular, eight key technologies hold transformative potential for the country (Exhibit 1). Box 1 shows an overview of these technologies, and the potential each has for creating productivity boosts for businesses and workers in

Singapore. Forty technology applications – each mapping to one of the eight technologies – were identified across nine industry sectors. To assess the economic potential of digital transformation in Singapore, the economic value of each technology application was estimated under a full adoption scenario in 2030 (Exhibit 2).

EXHIBIT 1: CURRENT RESEARCH REFLECTS EIGHT TRANSFORMATIVE TECHNOLOGIES WITH STRONG ECONOMIC POTENTIAL



BOX 1.

EIGHT KEY TECHNOLOGIES WITH TRANSFORMATIVE POTENTIAL FOR SINGAPORE

Drawing upon an extensive range of literature on emerging technologies and their potential economic benefits, eight key technologies that hold transformative potential for workers, businesses and the government have been identified.¹⁷

These include:

- **Mobile Internet.** The rapid rise of the smartphone and associated increase in mobile Internet penetration rates have accelerated the growth of Internet services worldwide. While the mobile Internet in Singapore has already driven the adoption of new business models such as the app economy, over-the-top (OTT) services and mobile-commerce (or “m-commerce”), there are several mobile Internet-enabled applications that have yet to see full adoption in the country. These include the use of mobile telehealth applications in the healthcare sector, and the use of smartphone-based government e-services to streamline the delivery of public services.
- **Cloud computing.** Referring to the delivery of information technology (IT) resources over the Internet, cloud computing technologies allow individuals and entities to access technology services such as enhanced computing power, data storage and management tools on an as-needed basis. Buying, owning and maintaining physical data centres and servers can be cost-prohibitive particularly for SMEs. In addition, public cloud hosting boosts productivity by providing tailored productivity tools, enabling improved security and making resources available on an on-demand basis. Cloud computing has also become essential for leveraging other technologies such as AI and machine learning.
- **Big data.** Big data analytics refers to the ability to analyse extremely large volumes of data, extract insights and act on them – often in or close to real-time. Predictive analytics can help workers and businesses analyse customer preferences more effectively to increase customer satisfaction. With the information derived from analytics, businesses can also design targeted programmes for customer engagement.
- **Artificial Intelligence (AI).** AI refers to the ability of software or hardware to exhibit human-like intelligence. This entails a set of technologies that enable computers to perceive, learn, reason and assist in decision-making to solve problems in ways similar to people.¹⁸ Examples of AI applications include virtual assistants, autonomous vehicles and speech recognition tools.
- **Financial technology (Fintech).** Sometimes referred to as Digital Financial Services (DFS), fintech has been instrumental in boosting the financial services sector through facilitating deposits, payments and providing individuals with access to more advanced financial products such as loans, savings and

17. Sources include: McKinsey Global Institute (2013), *Disruptive technologies: Advances that will transform life, business, and the global economy*. Available at: <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/disruptive-technologies>; Wilkinson (2019), “5 frontier technology trends shaping international development”, Bond News. Available at: <https://www.bond.org.uk/news/2019/06/5-frontier-technology-trends-shaping-international-development>; Google and AlphaBeta (2020), *The Digital Sprinters: Public policies to support economic development through digital technologies*. Available at: <https://alphabeta.com/our-research/the-digital-sprinters-capturing-a-us34-trillion-through-innovative-public-policy/>
18. Microsoft (2018), *The future computed*. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf



investments. Moreover, by allowing for cashless payments, fintech has also been responsible for driving greater growth in other sectors (e.g., retail).

- **Internet of Things (IoT) and remote sensing.** IoT systems relate to the network of physical objects (“things”) that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. These systems can monitor and manage the performance of the connected objects and machines.¹⁹ IoT has a number of applications across sectors with significant economic potential: wearable devices can help monitor and maintain health and wellbeing thereby lowering public health expenditure; energy consumption can be monitored and optimised in buildings; equipment use can be enhanced, and the health and safety performance of factories improved.

- **Advanced robotics.** While simple robots have increasingly been a staple of factory floors in mature economies like Singapore, the advent of advanced robotics has allowed for an expanding range of tasks that robots can perform. Compared with conventional robots, advanced robots have a superior perception, integrability, adaptability, and mobility.²⁰ These improvements permit faster setup, reconfiguration, as well as more efficient and stable operations. For instance, in the manufacturing sector, advanced robotics can increase productivity and flexibility in both the factory and the supply chain and enable producers to rapidly adjust to changing customer needs.
- **Additive manufacturing.** This relates to technologies that build 3D objects by adding layer upon layer of material. There is a range of potential benefits, such as the ability to handle complex, low-volume components where rapid turnaround is critical.²¹

19. MGI (2019), *The rise of Digital Challengers – How digitisation can become the next growth engine for central and eastern Europe*. Available at: https://digitalchallengers.mckinsey.com/files/McKinsey%20CEE%20report_The%20Rise%20of%20Digital%20Challengers.pdf
20. Boston Consulting Group (2019), *Advanced robotics in the factory of the future*. Available at: <https://www.bcg.com/publications/2019/advanced-robotics-factory-future>
21. Sharp (2019), “Is additive manufacturing the right choice for your electronic assembly?” JJS Manufacturing Blog. Available at: <https://blog.jjsmanufacturing.com/additive-manufacturing-electronic-assembly>

EXHIBIT 2:

40 DIGITAL TECHNOLOGY APPLICATIONS ACROSS 9 SECTORS WERE IDENTIFIED TO SIZE SINGAPORE’S ECONOMIC OPPORTUNITY FROM DIGITAL TRANSFORMATION

Consumer, retail & hospitality 	Education & training 	Financial services 	Government 
<ul style="list-style-type: none">  Digital retail sales and marketing channels  IoT-enabled inventory management  Automation & AI customer service in hotels  Data analytics on travel patterns  Online F&B delivery channels 	<ul style="list-style-type: none">  E-career centres and digital jobs platforms  Personalised learning  Online retraining programmes 	<ul style="list-style-type: none">  Big data analytics  Reg tech  Digital banking services  Smart contracts  Robo advisory services 	<ul style="list-style-type: none">  E-services  Cloud computing  E-procurement  Geographic Info. System enabled tax collection  Data analytics for government transfer payments
Health 	Infrastructure 	Manufacturing 	Professional services 
<ul style="list-style-type: none">  Remote patient monitoring  Telehealth applications  Data-based public health interventions  Detection of counterfeit pharmaceutical drugs  Smart medical devices  Electronic medical records 	<ul style="list-style-type: none">  Smart grids  5D BIM & project management technologies  Predictive maintenance technologies  Smart buildings 	<ul style="list-style-type: none">  Big data analytics  Additive manufacturing  IoT-enabled supply chain management  Automation & robotics 	<ul style="list-style-type: none">  Cloud storage  Data analytics and visualisation  Natural language processing  Automated billing and multi-currency conversion
Transport services 	<p>Key technologies:</p> <ul style="list-style-type: none"> <li style="width: 50%;"> Mobile Internet <li style="width: 50%;"> Fintech <li style="width: 50%;"> Advanced robotics <li style="width: 50%;"> Additive manufacturing <li style="width: 50%;"> Cloud computing <li style="width: 50%;"> Big Data <li style="width: 50%;"> AI <li style="width: 50%;"> IoT 		
<ul style="list-style-type: none">  Smart roads  Smart ports  Autonomous vehicles  Geospatial services 			

Exhibit 3 shows the distribution of Singapore's digital opportunity across the nine industry sectors in 2030. **The consumer, retail and hospitality sector is projected to be the largest economic beneficiary of digital technologies in Singapore.** This sector is estimated to be able to gain annual economic benefits of up to SGD12.9 billion (USD9.4 billion) in 2030 – amounting to about 20 percent of the country's total digital opportunity.²² Other top sector beneficiaries include manufacturing (SGD9.7 billion or USD7.1 billion); education and training (SGD8.7 billion or USD6.3 billion); professional services (SGD7.8 billion or USD5.6 billion); and financial services (SGD7.6 billion or USD5.5 billion).

The key opportunities in these sectors are as follows:

- Consumer, retail and hospitality.** There is significant scope for businesses in this sector to benefit from digital technologies. In the retail industry, the productivity gains experienced by businesses from marketing and selling goods through digital channels are estimated to range from six to 15 percent.²³ These arise as a result of being able to enhance labour productivity, harness inventory efficiencies and cutting real estate costs (e.g., rental of shop space). For example, a minimart in Singapore, Food-Joy, reduced waiting time in queues from three minutes to one minute through the implementation of a self-checkout and cash management system.²⁴ In the hospitality industry, AI-driven conversational interfaces in hotels can facilitate quicker check-in and check-out procedures (a study found that AI could reduce the time needed for these tasks by up to 70 percent), and allow staff to focus on providing more personalised customer service.²⁵ Such customised service is one of the most important drivers
- Manufacturing.** There is potential for technology applications such as big data analytics, additive manufacturing (more commonly known as 3D printing), IoT-enabled supply chain management, and advanced robotics to boost productivity and value-add in the manufacturing sector. By improving demand forecasting and production planning for customer needs, big data analytics can bring about a three percent increase in the profit margins of manufacturers.²⁶ Such applications are already being adopted by some companies. For example, engineering company Onn Wah Precision Machining improved its productivity by ten to 15 percent after implementing a Manufacturing Execution System, which enables the company to access and analyse factory data on an integrated platform.²⁹ AI and IoT technologies may also be used in "smart factories" to forecast when machinery is likely to experience downtime, and proactively address them before failures occur – an application known

22. Based on AlphaBeta analysis. See Appendix A for details on the methodology.

23. McKinsey Global Institute (2013), *Disruptive technologies: Advances that will transform life, business, and the global economy*.

Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies>

24. MTI (2020), *Retail redefined: An industry transformation guide*. Available at: <https://www.mti.gov.sg/-/media/MTI/ITM/Lifestyle/Retail/Retail-ITM---booklet.pdf>

25. Sources include: Singapore Tourism Board (2019), "Industry-wide initiatives to transform hotels for sustainable growth." Available at: <https://www.stb.gov.sg/content/stb/en/media-centre/media-releases/industry-wide-initiativestotransformhotelsforsustainablegrowth.html>; Ministry of Business, Innovation and Employment (2018), *Artificial Intelligence: Shaping a future New Zealand*. Available at: <https://www.mbie.govt.nz/dmsdocument/5754-artificial-intelligence-shaping-a-future-new-zealand-pdf>

26. Colliers International (2018), "AI and automation to increase hotel revenues by 10%."

Available at: <https://www.hoteliermiddleeast.com/34362-ai-and-automation-to-increase-hotel-revenues-by-10>

27. Boston Consulting Group (2020), "Bionic Revenue Management in Travel and Tourism."

Available at: <https://www.bcg.com/publications/2020/bionic-revenue-management-travel-tourism>

28. McKinsey Global Institute (2011), *Big data: The next frontier for innovation, competition and productivity*.

Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation>

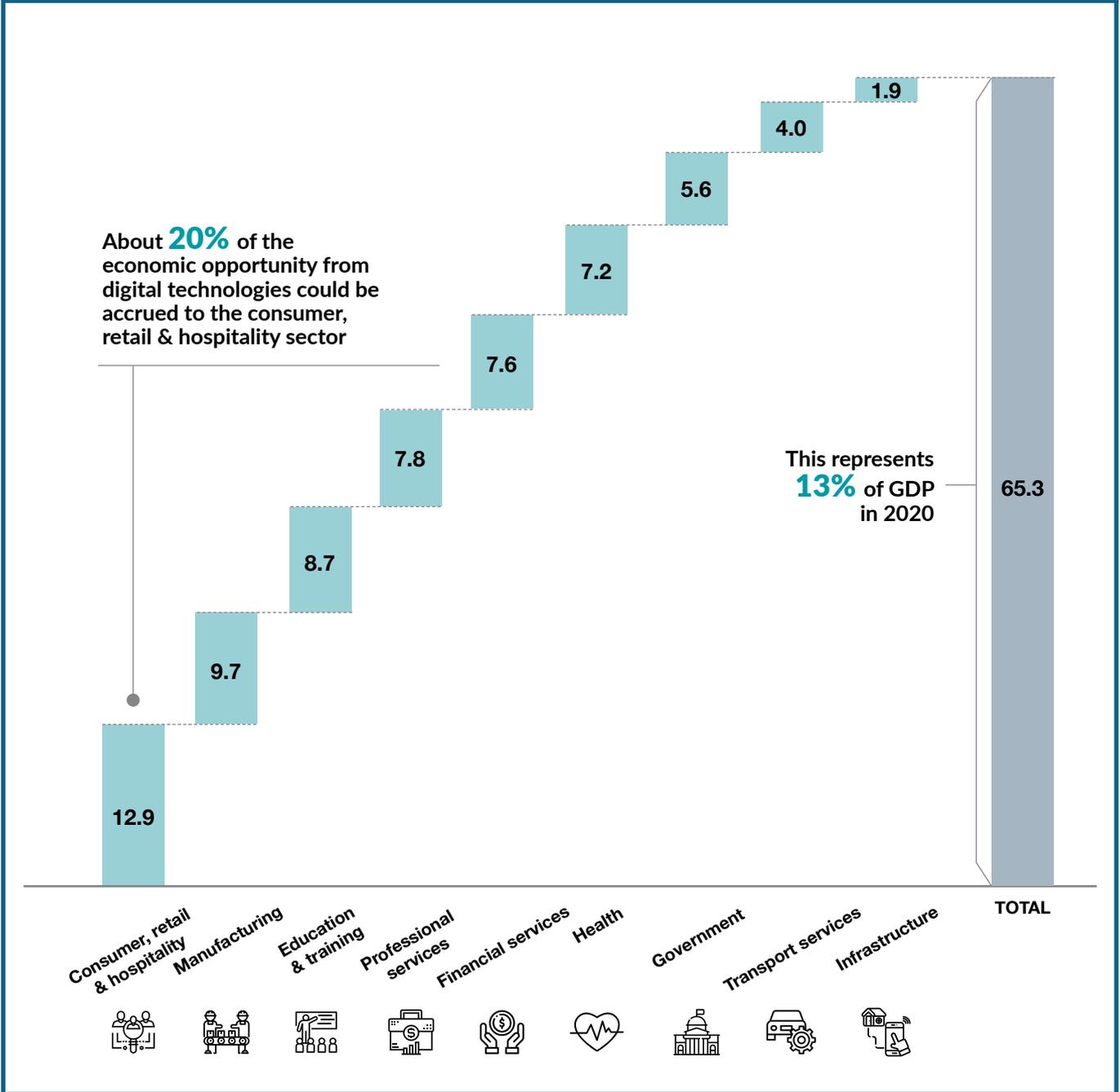
29. EDB Singapore (2020), "Digital transformation in manufacturing: three business leaders offer insights on their breakthroughs."

Available at: <https://www.edb.gov.sg/en/business-insights/insights/digital-transformation-in-manufacturing-three-business-leaders-offer-insights-on-their-breakthroughs.html>

EXHIBIT 3:

BY 2030, DIGITAL TECHNOLOGIES COULD SUPPORT UP TO SGD65.3 BILLION (USD47.4 BILLION) OF ANNUAL ECONOMIC IMPACT IN SINGAPORE

POTENTIAL ANNUAL ECONOMIC VALUE FROM DIGITAL TECHNOLOGIES, BY SECTOR¹
 SGD BILLION, 2030



1. These estimates do not represent GDP or market size (revenue), but rather economic impact, including GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection. In this analysis, 40 technology applications were considered.

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis



as “predictive maintenance”. The potential annual economic impact from predictive maintenance in ASEAN could be between USD38-91 billion by 2025.³⁰ By enabling rapid, “on-time” and customised manufacturing, additive manufacturing or 3D printing technologies can help businesses in Singapore expand their customer bases, such as clients requiring bespoke services, as well as improve operational efficiencies. Infineon Technologies, a semiconductor company, is investing USD20 million in 25 projects, including additive manufacturing, to increase productivity by ten percent and save USD1 million annually in energy costs.³¹ This technology is projected to bring about between USD100 billion and USD250 billion in economic value globally by 2025.³²

- **Education and training.** Digital technologies do not only hold the promise of enhancing the quality and reach of education but also facilitate demand and supply matching in the job market. In the education industry, digital personalised learning tools allow teachers to track students’ performance on different subjects, and serve to complement classroom instruction with a customised style, content, sequencing, and pace of instruction to meet the educational needs of each student. For example, big data and analytics could be used to create personalised study plans to address each student’s weaknesses while identifying programmes to grow their strengths.³³ Outside the education system, digital job platforms and e-career centres are important digital tools

30. McKinsey & Company (2018), *Industry 4.0: Reinventing ASEAN Manufacturing for the Future*.

Available at: <https://www.mckinsey.com/~/media/mckinsey/business%20functions/operations/our%20insights/industry%204%200%20reinventing%20asean%20manufacturing%20for%20the%20future/industry-4-0-reinventing-asean-manufacturing-for-the-future.ashx>

31. Sources include: McKinsey & Company (2018), *Industry 4.0: Reinventing ASEAN Manufacturing for the Future*. Available at: <https://www.mckinsey.com/~/media/mckinsey/business%20functions/operations/our%20insights/industry%204%200%20reinventing%20asean%20manufacturing%20for%20the%20future/industry-4-0-reinventing-asean-manufacturing-for-the-future.ashx>; Nikkei Asia (2020), “Infineon pumps \$20m into establishing Singapore as AI hub.” Available at: <https://asia.nikkei.com/Business/Technology/Infineon-pumps-20m-into-establishing-Singapore-as-AI-hub>

32. McKinsey & Company (2017), *Additive manufacturing: A long-term game changer for manufacturers*.

Available at: <https://www.mckinsey.com/business-functions/operations/our-insights/additive-manufacturing-a-long-term-game-changer-for-manufacturers>

33. McKinsey Global Institute (2015), *A labour market that works: Connecting talent with opportunity in the digital age*.

Available at: <https://www.mckinsey.com/featured-insights/employment-and-growth/connecting-talent-with-opportunity-in-the-digital-age>

that enhance efficiencies and address information asymmetries in the labour market. The multiplier effects generated by an expanding network of job seekers and employers have enabled digital jobs platforms to gather a wider universe of work opportunities, providing jobseekers with more options and a better understanding of wages they can command. Shorter search times and better job matching through digital platforms are projected to raise employment by 1.9 percent in Singapore by 2030.³⁴

- **Professional services.** Professional services in Singapore, covering a wide range of activities from legal to consulting, can tap on a range of digital technologies to enhance service delivery and cost-efficiency. AI technology can help improve the efficiency of the legal system by completing monotonous legal work such as proofreading, research, preliminary document review, or due diligence.³⁵ A study conducted by the National Legal Research Group found that attorneys using AI-powered legal research platforms finish their projects on average 25 percent faster than those using traditional legal research platforms.³⁶ Beyond the legal industry, Singapore start-up, Evie.ai, created an AI scheduling assistant that increases the productivity of hiring managers by 30 percent through scheduling meetings and sending out invitations to candidates.³⁷ Cloud technologies provide businesses with the ability to take advantage of newer ways of computing, storing and analysing data in a cost-effective and scalable manner. For example, Myers-Briggs Company,

a provider of personality, career and professional development assessments, reduced its bandwidth costs by two-thirds after adopting cloud storage solutions.³⁸

- **Financial services.** Digital technologies, such as blockchain technology, unlock significant productivity benefits in the financial sector. For example, PolicyPal, an insurance technology startup, uses blockchain to automate the creation of new insurance products, distribution, and claims processing.³⁹ Apart from using blockchain, Singapore's financial sector is making use of predictive analytics to improve the operations of bank branches and Automated Teller Machines (ATMs).⁴⁰ For example, using predictive analytics, DBS Bank, a Singaporean multinational banking and financial services corporation, was able to understand the patterns of ATM cash flow and to predict when ATMs would run out of cash. Since implementing it, the bank has recorded a 98 percent reduction in cash-out situations, as well as a 92 percent reduction in customer complaints, and helped save customers 800 thousand hours' worth of ATM queue time.⁴¹ Big data is also instrumental in responding to cyber threats faced by businesses in the financial services sector. For example, the Oversea-Chinese Banking Corporation (OCBC), another multinational banking and financial services corporation in Singapore, used predictive analytics and big data to prevent 55 percent of cyber threats from materialising.⁴² Data analytics is also used to improve the ease of detecting money laundering activities.

34. McKinsey Global Institute (2015), *A labor market that works: Connecting talent with opportunity in the digital age*.

Available at: https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/Connecting%20talent%20with%20opportunity%20in%20the%20digital%20age/MGI_Online_talent_A_labor_market_that_works_Full_report_June_2015.ashx

35. The ASEAN Post (2019), "AI and big data in the legal profession." Available at: <https://theaseanpost.com/article/ai-and-big-data-legal-profession>

36. National Legal Research Group, Inc. (2018), *The real impact of using artificial intelligence in legal research*.

Available at: <https://www.lawsitesblog.com/wp-content/uploads/sites/509/2018/09/The-Real-Impact-of-Using-Artificial-Intelligence-in-Legal-Research-FINAL2.pdf>

37. CIO (2019), "How Singapore is using artificial intelligence". Available at: <https://www.cio.com/article/3292616/how-singapore-is-using-artificial-intelligence.html>

38. ITProToday (2020), "ClearSky's Cloud Storage Passes Myers-Briggs' Data Management Test."

Available at: <https://www.itprotoday.com/cloud-storage/clearskys-cloud-storage-passes-myers-briggs-data-management-test>

39. The Edge Markets (2019), "Insurtech: Automating insurance claims with blockchain."

Available at: <https://www.theedgemarkets.com/article/insurtech-automating-insurance-claims-blockchain>

40. Fintech News Singapore (2019), "5 Ways Banks in Singapore are Using Big Data."

Available at: <https://fintechnews.sg/30505/bigdata/5-ways-banks-in-singapore-are-using-big-data/>

41. Enterprise IT News (2016), "How DBS Bank uses big data, analytics and machine learning."

Available at: <http://www.enterpriseitnews.com.my/how-dbs-bank-uses-big-data-analytics-and-machine-learning/>

42. OCBC (2018), "OCBC Bank's Purpose-built Regional Data Centre is the First by a Singapore Bank."

Available at: https://www.ocbc.com/group/media/release/2018/ocbc_purpose-built_data_centre

1.2 TECHNOLOGIES WILL BE CRUCIAL IN ADDRESSING THE ECONOMIC IMPACTS OF COVID-19

COVID-19 has had a significant impact on Singapore's economy. Despite having one of the greatest successes globally in curbing the domestic spread of the virus, the country's economy shrank 5.8 percent in 2020 – its first annual contraction since 2001 and its worst recession since independence.⁴³ This contraction was largely driven by outward-oriented sectors, including tourism, which relies heavily on international travel. Global travel restrictions introduced to contain the pandemic's spread have crippled Singapore's tourism industry, which contributes to four percent of the country's GDP.⁴⁴ Visitor arrivals fell by 85.7 percent in 2020 to 2.7 million visitors while tourism receipts declined by 78.4 percent to SGD4.4 billion (USD3.2 billion) in the first three quarters of 2020.⁴⁵ At the same time, other outward-oriented sectors like manufacturing and wholesale trade have been affected by the fall in external demand and supply chain disruptions. Although the economies of Singapore's major trade partners are expected to rebound, the GDP of two of Singapore's three largest trade partners (the United States of America and the Europe Union) still fall short of pre-COVID levels.⁴⁶

Technology adoption will be crucial for businesses and workers to manage the crisis's impacts. **Of Singapore's total digital opportunity of SGD65.3 billion (USD47.4 billion), two-thirds (66 percent) – SGD43.2 billion (USD31.3 billion) – could be driven by technologies that help businesses mitigate the economic impacts of COVID-19** (Exhibit 4).

This economic value of SGD43.2 billion (USD31.3 billion) is made up of technology applications that allow businesses to navigate and even flourish during the pandemic and in the post-COVID future (Exhibit 5).

There are three channels in which such technology applications allow for this:

- Enabling the continuity of business operations amid remote working arrangements.** With precautionary measures implemented at workplaces to safeguard workers' safety, the resultant reduction in on-site employees has decreased operating capacity for many businesses. A range of digital technologies allows for business continuity in these circumstances by facilitating virtual collaboration among co-workers, automating production processes and the remote control of physical operations from off-site locations. While there have been intensifying worries of extensive job losses as a result of automation, digital adoption has the potential to create high-quality work opportunities for Singaporeans. In the hospitality industry, AI-enabled customer check-in and service procedures can help boost staff productivity and create greater service value overall. Remote check-ins, such as the E-Visitor Authentication in Singapore which uses facial recognition technology, are estimated to reduce the time taken to verify visitors' particulars by up to 70 percent.⁴⁷ By freeing up more time for workers

43. CAN (2021), "Singapore economy shrinks a record 5.8% in a pandemic-hit 2020".

Available at: <https://www.channelnewsasia.com/news/singapore/gdp-singapore-economy-2020-q4-contrast-covid-19-13888300>

44. Singapore Tourism Board (2021), "Overview". Available at: <https://www.stb.gov.sg/content/stb/en/about-stb/overview.html#:~:text=The%20tourism%20sector%20currently%20contributes.to%20Singapore's%20gross%20domestic%20product.&text=This%20is%20a%20unified%20brand.for%20tourism%20and%20business%20purposes.>

45. Singapore Tourism Board (2021), "Singapore's tourism sector emerges from 2020 with greater resilience and reinvention".

Available at: <https://www.stb.gov.sg/content/stb/en/media-centre/media-releases/Singapore-Tourism-Sector-Emerges-From-2020-With-Greater-Resilience-and-Reinvention.html>

46. The Straits Times (2021), "Covid-19's impact to still weigh on Singapore's economy in 2021".

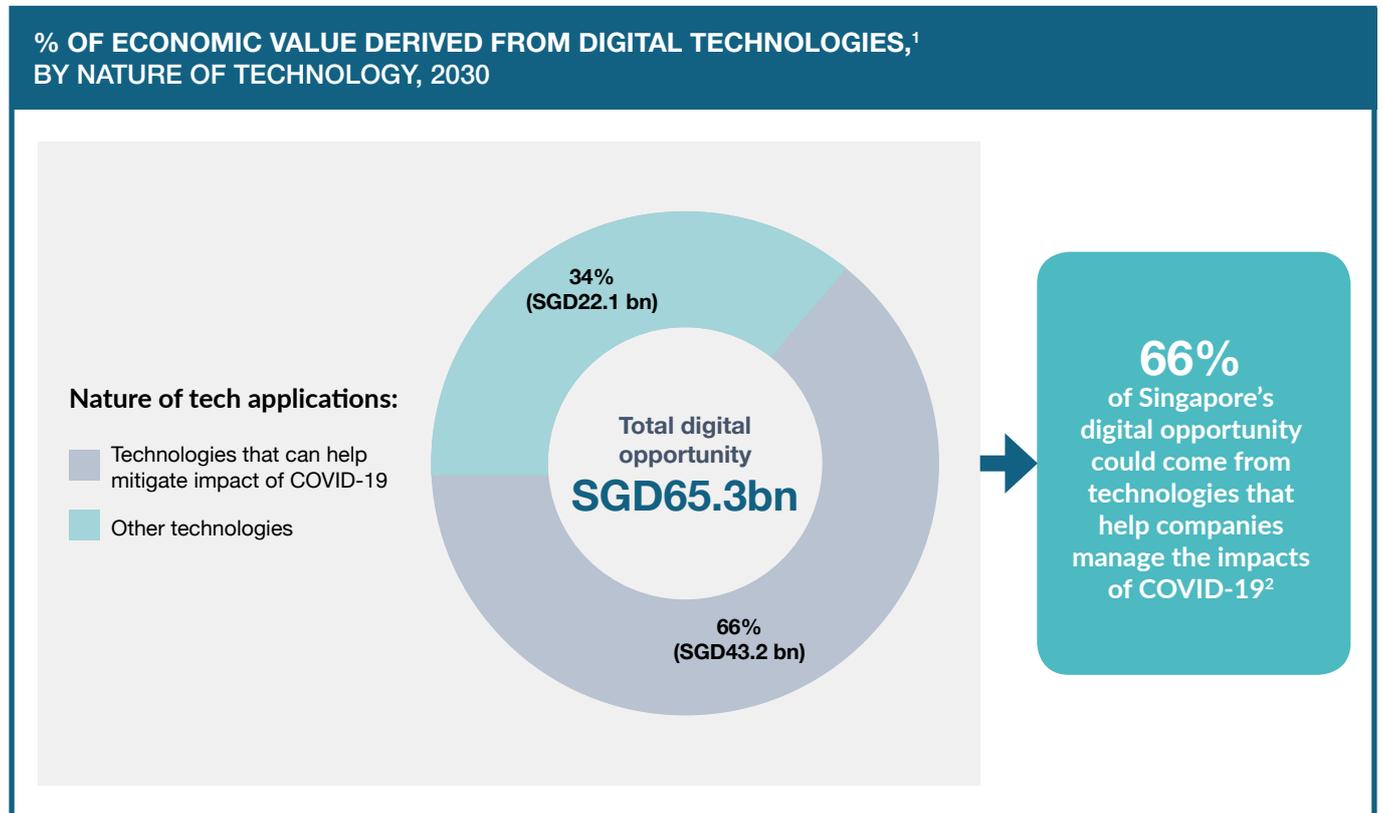
Available at: <https://www.straitstimes.com/opinion/virus-impact-to-still-weigh-on-economy-0>

47. The Straits Times (2019), "Faster check-in at Singapore hotels with new automated facial recognition system".

Available at: <https://www.straitstimes.com/singapore/speedier-check-in-process-for-hotels-possible-with-new-automated-facial-recognition-system>

EXHIBIT 4:

**OF THE TOTAL DIGITAL OPPORTUNITY OF SGD65.3 BILLION (USD47.4 BILLION),
66% IS DRIVEN BY TECHNOLOGIES THAT CAN HELP MITIGATE THE IMPACTS OF COVID-19**



1. These estimates do not represent GDP or market size (revenue), but rather economic impact, including GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection. In this analysis, 40 technology applications are considered.

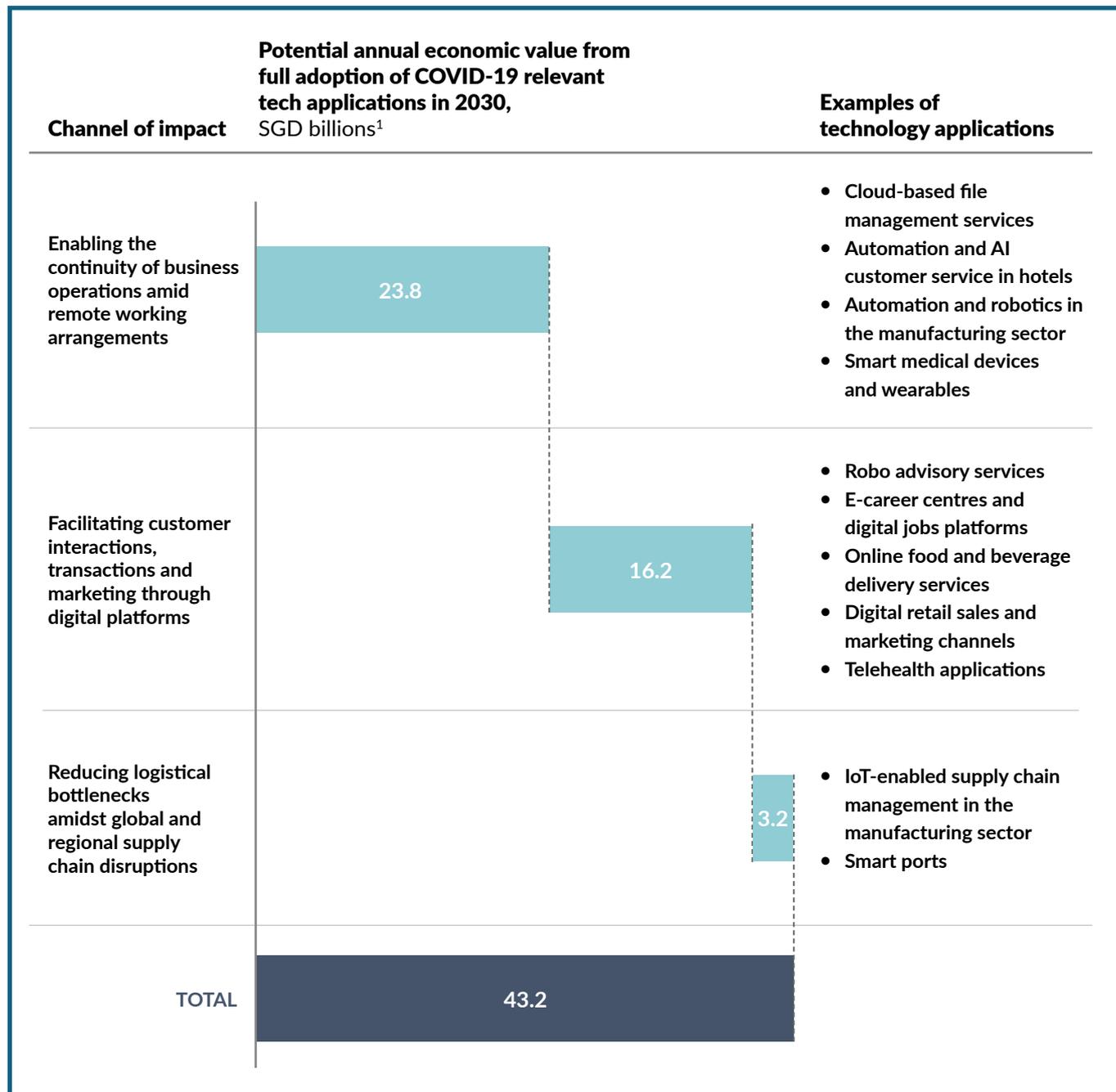
2. These refer to technology applications that enable companies to sustain business continuity and improve business performance despite implications of the COVID-19 pandemic. For example, in the retail sector, the digitisation of retail platforms (e-commerce) enable companies to continue selling their products and services despite government-mandated social restrictions and reduced physical crowds as a result of the pandemic.

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis

EXHIBIT 5:

TECHNOLOGIES THAT MITIGATE THE BUSINESS IMPACTS OF COVID-19 CAN GENERATE UP TO SGD43.2 BILLION (USD31.3 BILLION) IN ANNUAL ECONOMIC VALUE BY 2030



1. These estimates do not represent GDP or market size (revenue), but rather annual economic impact, including GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection. In this analysis, 40 technology applications are considered.

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis



to perform higher value-add tasks, technologies allow workers to switch their attention to more interesting and value-adding work, such as responding to more complex customer queries and problems. Combined, such technology applications are projected to deliver a total annual economic value of SGD23.8 billion (USD17.3 billion) if fully adopted by 2030 (Exhibit 5). During the COVID-19 pandemic, contactless takeout and delivery services enable customers to order food and drinks online while adhering to safe distancing measures. As a result, the share of total food and beverage (F&B) revenue from online sales, including those transacted via food delivery platforms, increased from 15.6 percent in March 2020 to over 23 percent in March 2021.⁴⁸

- **Facilitating customer interactions, transactions, and marketing through digital platforms.** Social distancing measures targeted at containing the COVID-19 outbreak have severely restricted customer interactions and transactions for businesses that heavily rely on physical

interactions. As customers gravitate towards online marketplaces and services, technologies enable businesses to continue customer interactions and marketing activities online. Examples of relevant technology applications include digital e-commerce platforms in the retail industry, e-career centres and digital jobs platforms in the recruitment industry, and telehealth apps in the healthcare sector. Combined, such technology applications are projected to deliver a total annual economic value of SGD16.2 billion (USD11.6 billion) if fully adopted by 2030 (Exhibit 5). Box 2 shows an example of Singapore Airlines adopting digital technologies to ensure the safe reopening of its terminals and services during the pandemic.

- **Reduce logistical bottlenecks amidst global and regional supply chain disruptions induced by the pandemic.** Businesses have had to cope with supply chain bottlenecks when lockdown measures disrupted the supply of important raw materials and components, resulting in delays of shipments. These disruptions can be

48. Sources include Singapore Department of Statistics (2021), Retail Sales Index and Food & Beverage Services Index (March 2021). Available at: <https://www.singstat.gov.sg/-/media/files/news/mrsmar2021.pdf>; Singapore Department of Statistics (2020), Retail Sales Index and Food & Beverage Services Index (March 2020). Available at: <https://www.singstat.gov.sg/-/media/files/news/mrsmar2020.pdf>



managed by technologies that allow for the remote tracking of goods that cross borders, and that enhance the capabilities of businesses to search and switch to alternative channels or sources. Examples of relevant technology applications include IoT-enabled supply chain management in the manufacturing sector and smart ports in the transport services sector. Combined, such technology applications are projected to deliver a total annual economic value of SGD3.2 billion (USD2.3 billion) if fully adopted by 2030 (Exhibit 5). In the manufacturing sector, sensor data-driven operations analytics from IoT devices allow businesses to optimise transportation and improve their distribution management. The adoption of IoT in manufacturing supply chains is estimated to reduce distribution and supply chain operating costs by five percent.⁴⁹ Similarly in the transport services sector, IoT devices can be attached to specific storage containers or to raw materials or products themselves to allow for such tracking. “Smart ports” enabled by IoT devices provide

comprehensive real-time data on cargo schedule and ship positions which allows terminal staff to plan anchorage areas and avoid critical berths from being taken out of service by quarantined vessels, reducing bottlenecks and idle time.⁵⁰

Beyond the immediate impacts of the COVID-19 pandemic, digital technologies can boost the long-term export capabilities of firms across multiple sectors in Singapore post-pandemic. Digital advancements have meant that Singapore companies may export digital goods and services seamlessly to other countries despite restrictions on physical cross-border flows. Without establishing a physical presence in multiple markets, digital tools ranging from simple Internet search engines to more sophisticated cloud computing technologies allow enterprises to operate with ease across geographies by connecting with consumers, suppliers and investors across the globe. Box 3 shows examples of how digital technologies have provided an important medium of exchange for Singapore’s businesses to export their products and services.

49. McKinsey Global Institute (2011), *Big data: The next frontier for innovation, competition, and productivity*. Available at: https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Big%20data%20The%20next%20frontier%20for%20innovation/MGI_big_data_full_report.pdf

50. World Ports Sustainability Program (2020), *WPSP COVID-19 guidance documents for Ports*. Available at: https://safety4sea.com/wp-content/uploads/2020/05/WPSP-COVID-19-Guidance-document-for-ports-2020_05.pdf

BOX 2.

SINGAPORE AIRLINES: ADOPTING DIGITAL TECHNOLOGIES TO STAY RESILIENT IN A PANDEMIC-CHALLENGED INDUSTRY

Following the disruption to air travel as a result of the COVID-19 pandemic, Singapore Airlines (SIA), the country's national carrier, started trials on a new digital health verification process to facilitate the safe resumption of air travel. As countries increasingly roll out vaccination drives around the world, the digital health verification service offers users the ability to securely store and present information related to the COVID-19 test, as well as their vaccination status. In line with the national requirements for COVID-19 testing and vaccine information, vaccinated travellers who have provided valid test results or vaccination certification are given a QR code, which will be verified by front-line airport workers before they are allowed to board the plane.⁵¹ If the trial proves effective, SIA will replace the current paper-based and manual checking during check-in and transition toward a seamless travel experience for air travellers. In addition, this system is built based on the International Air Transport Association (IATA)'s framework, which enables SIA to scale and roll out this system for multiple destination airports, beyond Singapore.



51. Singapore Airlines (2020), "Singapore Airlines Starts Trials On Digital Verification Of Covid-19 Test Results And Vaccination Information". Available at: https://www.singaporeair.com/de_DE/de/media-centre/press-release/article/?q=en_UK/2020/October-December/ne2420-201223

BOX 3.

DIGITAL TECHNOLOGIES CONNECT BUSINESSES TO OVERSEAS MARKETS AND FACILITATE THE DIGITAL EXCHANGE OF GOODS AND SERVICES

Singapore's consumers and businesses have benefited from the use of digital technologies to connect with the domestic and international markets. By matching buyers to sellers with a few clicks, digital technologies have driven down the cost of communications and transactions. This box outlines how digital platforms have supported local businesses in accessing new markets and expanding overseas during and after the pandemic.

LEVERAGING DIGITAL PLATFORMS TO EXPORT PHYSICAL GOODS

Digital platforms create opportunities for businesses to expand overseas without requiring in-market physical presence and create new income sources to tide through the crisis. During the "circuit breaker" period, Nanyang Optical created an online presence and adopted e-commerce platforms, such as OneSME and Shopee, in a bid to reach more customers.⁵² The crisis has turned into an opportunity for the company to expand its e-commerce business to Indonesia. Similarly, homegrown seasoning food powder brand, Lilo, owed its survival to reaching new customer segments online. After food fairs were cancelled due to the crisis, Lilo's income fell drastically as earnings from these events had traditionally made up over 90 percent of its takings. Fortunately, the company successfully expanded to overseas markets, such as Malaysia, Thailand and Indonesia, and generated sales online.⁵³ These e-commerce platforms enable businesses in Singapore to partner with complementary business services providers such as logistics and financing who are operating in multiple overseas markets. For example, OneSME is an online platform that facilitates trusted business matching between SMEs in Singapore and four million merchants in the Chinese market with integrated e-Know Your Customer features and financing options.⁵⁴ By leveraging its smart business matching algorithm, the platform enables SMEs in Singapore to sell industrial equipment, medical devices and food and beverage products to the businesses in China that have shown keen interest in Singapore products.

LEVERAGING DIGITAL CHANNELS TO EXPORT SERVICES

Through increased Internet connectivity and speed, online freelancing platforms, including Fiverr and Upwork, have enabled freelancers to access short-term job opportunities across countries and occupations. Particularly during the pandemic, freelancers who work digitally are benefitting from overseas openings. For example, Juliana Iskandar, who does digital marketing for retailers and service providers, saw an increase in assignments from overseas clients, from countries such as the United States of America and the United Kingdom, from just ten to 60 percent.⁵⁵

52. Enterprise Singapore (2020), "Over 500 SMEs gain digital access to new markets overseas".

Available at: <https://www.enterprisesg.gov.sg/media-centre/news/2020/june/over-500-smes-gain-digital-access-to-new-markets-overseas-bt>

53. The Straits Times (2020), "More than 500 SMEs access new overseas markets under Grow Digital initiative".

Available at: <https://www.straitstimes.com/singapore/more-than-500-smes-access-new-overseas-markets-under-grow-digital-initiative>

54. Business Times (2020), "Electronic KYC, financing and 'smart' matching among OneSME trade platform features".

Available at: <https://www.businesstimes.com.sg/sme/electronic-kyc-financing-and-smart-matching-among-onesme-trade-platform-features>

55. Business Times (2020), "Gigged out". Available at: <https://www.businesstimes.com.sg/brunch/gigged-out>



CAPTURING THE PRIZE — THREE PILLARS OF ACTION

To fully capture the digital opportunity, three pillars of action will be required in Singapore: 1) Facilitate digital adoption, particularly for SMEs; 2) Digitally upskill the nation in emerging technologies; and 3) Position the country as a regional hub for digital trade. The government and businesses in Singapore have benefited from significant strides made across all three pillars. To ensure businesses develop new digital capabilities, Singapore has placed a strong emphasis on facilitating digital adoption, particularly for SMEs. The government has set aside SGD1 billion (USD724 million) to fund a series of digital transformation schemes, such as the **Emerging Technology Programme**, and launched the **SMEs Go Digital** programme to support SMEs in adopting digital solutions. To digitally upskill the nation in emerging technologies, Singapore has unveiled multiple policy initiatives such as the **SGUnited Jobs and Skills Package** and the **SkillsFuture** scheme to build digital talent and facilitate lifelong learning. The government has also been promoting Singapore as a regional hub for digital trade by seeking like-minded trade partners in developing digital trade rules, such as the **Digital Economy Partnership Agreement (DEPA)** between New Zealand, Chile and Singapore, and providing support for businesses to participate in digital trade.

To expedite the digital-led recovery from the impacts of the pandemic, it is recommended that Singapore can support SMEs in advanced technology adoption, such as **Finland's Artificial Intelligence Accelerator (FAIA)**. The country could also develop more digital skilling programmes to train current digital workers in advanced digital skillsets that are in rising demand and provide incentives to shift employers'

“CAPTURING THE PRIZE”

THREE PILLARS OF ACTION



Three pillars of action are required to fully unlock the digital opportunity



Significant effort has already been made in the following areas

- Providing capacity-building support for businesses
- Creating sector-specific roadmaps for digital adoption by SMEs
- Investing in 5G infrastructure
- Supporting businesses in capturing digital opportunities in the “green economy”
- Supporting graduates and workers through digital skilling programmes
- Promoting continual skill upgrading and incentivising workers to invest in digital skills development
- Leveraging EdTech to build digital skills
- Participating in digital trade agreements that promote digital trade in the region
- Providing support for businesses to participate in digital trade

However, there are areas in which Singapore can further strengthen its approach

- Address barriers to the adoption of advanced digital technologies for SMEs
- Develop more digital skilling programmes in advanced digital skillsets
- Provide incentives to shift employers’ mindset towards “skilling as a first resort”
- Increase “soft skills” focus to complement technical education
- Seek like-minded trade partners to build a network of digital trade agreements
- Champion digital trade at international forums

mindset towards “skilling as a first resort”. Beyond developing students’ technical know-how, the current digital skills education could be complemented with a focus on the development of “soft skills”, such as problem-solving, critical thinking and adaptive learning. To encourage greater participation in digital trade, the government could continue its current efforts of promoting digital trade in the region and globally.

2.1 PILLAR 1: FACILITATE DIGITAL ADOPTION, PARTICULARLY FOR SMES

SMEs are a key pillar of Singapore’s economy that employs about 65 percent of its workforce and constitutes 99 percent of all its enterprises.⁵⁶ However, the costs of adopting technologies – particularly advanced technologies like IoT and AI – tend to be prohibitive for them. It is thus critical that they are provided with the support to do so. Singapore is already making significant headway in this area, and current policy actions include:

- **Providing capacity-building support for businesses to develop digital capabilities.** To accelerate digitalisation efforts during the COVID-19 pandemic, the government announced during the annual Budget speech in February 2021 the intention to set aside SGD1 billion (USD724 million) to fund a series of digital transformation schemes for businesses. This includes the **Digital Leaders Programme**, which will entail the development of digital transformation roadmaps to guide businesses towards transforming their operational processes digitally.⁵⁷ Another programme, targeted at lean SMEs with limited tech expertise, the **Chief Technology Officer-as-a-Service** (CTOaaS) enables businesses to tap on professional information technology consultancies to receive end-to-end digital advice and transform

their business operations. The **Emerging Technology Programme** incentivises both SMEs and larger local companies in commercialising their innovations and diffusing technologies. Through this programme, the government will co-fund the costs of trials and adoption of frontier technologies like the fifth generation technology (5G), AI and blockchain technologies.

- **Creating sector-specific roadmaps for digital adoption by SMEs.** To simplify the digitisation process for SMEs, the Infocomm Media Development Authority (IMDA) launched the **SMEs Go Digital** programme in 2017.⁵⁸ Since then, more than 50,000 SMEs have adopted digital solutions through the programme in 2020. Through this programme, sector-specific **Industry Digital Plans** (IDPs) are created to guide SMEs on the digital solutions they could adopt, and relevant training is provided for firms at different stages of growth. For example, the **Food Services Industry Digital Plan** outlines both front-of-house and back-of-house digital solutions and serves as a reference on the training programmes required to raise employees’ digital skills.⁵⁹ In addition, SMEs can apply for the **Productivity Solutions Grant**, which helps offset up to 80 percent of the cost

56. UOB Group (2017), Singapore SMEs. Available at: https://www.uobgroup.com/assets/pdfs/research/SME_1q17.pdf

57. Ministry of Finance (2021), Annex C-1: Accelerating digital transformation to emerge stronger.

Available at: <https://www.mof.gov.sg/docs/librariesprovider3/budget2021/download/pdf/annexc1.pdf>

58. Infocomm Media Development Authority (2020), Helping SMEs Go Digital.

Available at: https://www.imda.gov.sg/-/media/Imda/Files/Programme/SMEs-Go-Digital/Media-Factsheet_SMEs-Go-Digital_31-December-2020.pdf?la=en

59. Front-of-house digital solutions aim to improve customer experience such as queue management, whereas back-of-house solutions aim to optimise operations such as kitchen management. Infocomm Media Development Authority (2020), The Food Services Industry Digital Plan. Available at: <https://www.imda.gov.sg/-/media/Imda/Files/Programme/SMEs-Go-Digital/Industry-Digital-Plans/Food-Services-IDP/Food-Services-IDP-Media-Statement.pdf?la=en>



of adopting digital solutions recommended in the IDPs.⁶⁰

- **Investing in 5G infrastructure to support the deployment of technology applications.**

Recognising the importance of 5G as a key enabler in supporting the growth of Singapore's digital economy, IMDA announced an SGD30-million (USD21.7-million) fund to accelerate the adoption and commercialisation of 5G solutions.⁶¹ Under IMDA's **5G Innovation Programme**, businesses are encouraged to adopt and implement new 5G applications in a live operating environment. For example, Razer, Singtel and IMDA held the country's first 5G cloud gaming trial in October 2019 to design low latency cloud gaming hardware that delivers a broader range of gaming experiences. In the maritime sector, IMDA partnered with the Maritime & Port Authority of Singapore (MPA) and PSA Singapore to test the use of 5G for Automated Guided Vehicles (AGV)

and Automated Rubber Tyred Gantry Cranes (aRTG). Due to 5G's faster speeds and lower latency, maritime operations enjoyed the enhanced performance.⁶²

Supporting businesses in capturing digital opportunities in the "green economy". To chart the country's way towards a more sustainable future, the government released the **Singapore Green Plan 2030**.⁶³ One of the plan's pillars includes the **Enterprise Sustainability Programme** that aims to transform Singapore's industries and develop sustainability as a competitive advantage. The programme will help SMEs leverage technologies to create sustainable products and services to capture opportunities in the "green economy".⁶⁴

Despite the increasing prevalence of digital technology usage among businesses in Singapore, with over 80 percent of SMEs with digital transformation strategies in place, only 39 percent perceived their efforts to be

60. Infocomm Media Development Authority (2020), *Helping SMEs Go Digital*.

Available at: https://www.imda.gov.sg/-/media/Imda/Files/Programme/SMEs-Go-Digital/Media-Factsheet_SMEs-Go-Digital_31-December-2020.pdf?la=en

61. Infocomm Media Development Authority (2021), "Singapore accelerates 5G adoption and commercialisation with new \$30m fund".

Available at: <https://www.imda.gov.sg/news-and-events/Media-Room/Media-Releases/2021/Singapore-accelerates-5G-adoption-and-commercialisation-with-new-30m-fund>

62. Of under 20ms latency.

63. *The Straits Times* (2021), "New scheme to help SMEs adopt sustainable practices".

Available at: <https://www.straitstimes.com/business/new-scheme-to-help-smes-adopt-sustainable-practices>

64. *Business Times* (2021), "Budget 2021: Companies can tap Enterprise Sustainability Programme to go green".

Available at: <https://www.businesstimes.com.sg/government-economy/singapore-budget-2021/budget-2021-companies-can-tap-enterprise-sustainability>



successful, based on an **SME Digital Transformation Study** conducted in 2020.⁶⁵ In addition, many SMEs which have leveraged government grants to implement digital solutions failed to consider if such solutions were appropriate for their business needs. An economic survey conducted by the Ministry of Trade and Industry in 2019 found that the adoption rates for Digital Platform Tools (DPT) and Advanced Digital Tools (ADT) were considerably lower.⁶⁶ Although there has been a growing appetite for more advanced technologies among local SMEs during the pandemic, particularly for cloud productivity and storage services, there is room to further support SMEs in advancing their digitisation efforts in the long term.⁶⁷ Singapore could consider the following policy measures:

- **Address barriers to the adoption of advanced digital technologies for SMEs.** SMEs face several challenges in the adoption of advanced digital tools, including high implementation costs that were cited as a key barrier to digital transformation.⁶⁸ Other factors include the lack of a digitally

skilled workforce, economic uncertainties and low awareness of government initiatives, such as the **Productivity Solutions Grant** and **SMEs Go Digital** programme, to support firms in their digital transformation journeys. For Singapore to fully embrace opportunities in the digital economy, the government could explore creating a one-stop platform for SMEs to receive tailored support, mentorship and funding required to deploy advanced technologies in their companies. Finland offers an international best practice in this regard. Recent research has shown that due to the robust ecosystem, over 31 percent of Finnish companies, with more than five employees, utilise AI daily.⁶⁹ A key player in the ecosystem is **Finland's Artificial Intelligence Accelerator (FAIA)**, an organisation dedicated to helping firms deploy AI, launched by the Ministry of Economic Affairs and Employment.⁷⁰ Unlike typical start-up accelerators that support companies providing AI solutions, this programme is designed to help non-tech companies utilise AI in their operations. (see Box 4)

65. The Straits Times (2020), "Over half of SMEs in Singapore blame digitalisation delay on coronavirus".

Available at: <https://www.straitstimes.com/singapore/over-half-of-smes-blame-digitalisation-delay-on-virus>

66. Digital Platform Tools include e-payments, e-commerce and software as a service. Advanced Digital Tools include the IoT, data analytics and AI. Ministry of Trade and Industry (2019), "Digital adoption among firms and impact on firm-level outcomes in Singapore".

Available at: <https://www.mti.gov.sg/Resources/feature-articles/2019/Digital-Adoption-Among-Firms-and-Impact-on-Firm-Level-Outcomes-in-Singapore>

67. The Straits Times (2020), "Over half of SMEs in Singapore blame digitalisation delay on coronavirus".

Available at: <https://www.straitstimes.com/singapore/over-half-of-smes-blame-digitalisation-delay-on-virus>

68. SME Horizon (2020), "83% of Singapore SMEs embrace digital transformation".

Available at: <https://www.smehorizon.com/83-of-singapore-smes-embrace-digital-transformation/>

69. SILO AI (2020), "State of AI in Finland: public sector is the pacemaker, and more than 1200 companies are using artificial intelligence on a daily basis".

Available at: [https://silo.ai/state-of-ai-in-finland/#:~:text=Finnish%20public%20sector%20is%20a,tripled%20from%202017%20\(0.9%25\)](https://silo.ai/state-of-ai-in-finland/#:~:text=Finnish%20public%20sector%20is%20a,tripled%20from%202017%20(0.9%25)).

70. Finland's Artificial Intelligence Accelerator (2020), "Market Research". Available at: <https://faia.fi/market-research/>

BOX 4.

FINLAND'S ARTIFICIAL INTELLIGENCE ACCELERATOR DEDICATED TO SUPPORTING FIRMS IN DEPLOYING AI SOLUTIONS

Within two years of the launch of the country's **National AI Strategy** in 2017, the number of companies applying AI in Finland almost tripled.⁷¹ Of the 1,250 Finnish companies utilising AI in their daily operations in 2019, roughly 60 percent had developed their own AI solutions. A separate study of SMEs carried out in 2018 also found that eight percent of the country's SMEs were already using or testing AI, while 24 percent were considering implementing AI technology in their businesses.⁷² To support SMEs that lack the resources to invest in their own AI development, the Ministry of Economic Affairs and Employment partnered with the industry associations, Technology Industries of Finland and Silo AI, to establish **Finland's AI Accelerator** (FAIA).

Under this six-month accelerator programme, companies can pilot the use of AI in production without having to invest heavily in AI projects. During the initial phase, companies have the opportunity to work with service providers, AI start-ups and academia to develop and deploy AI applications in their processes and deliverables.⁷³ In addition, FAIA publishes publicly available playbooks on the Basics of AI, Chatbots and Continuous AI Development based on learnings from every programme cycle to share with other companies embarking on their AI adoption process. The organisation also publishes an annual report on **The State of AI** in Finland which offers a comprehensive outlook of the Finnish AI market while showcasing various AI solutions that have been put into production to serve as use cases.⁷⁴



Photo Source: <https://silo.ai/faia-publishes-the-fourth-ai-landscape-the-finnish-ai-ecosystem-is-growing/>

71. SILO AI (2020), "State of AI in Finland: public sector is the pacemaker, and more than 1200 companies are using artificial intelligence on a daily basis". Available at: [https://silo.ai/state-of-ai-in-finland/#:::text= Finnish%20public%20sector%20is%20a, tripled%20from%202017%20\(0.9%25\)](https://silo.ai/state-of-ai-in-finland/#:::text= Finnish%20public%20sector%20is%20a, tripled%20from%202017%20(0.9%25).).

72. Ministry of Economic Affairs and Employment (2019), *Leading the way into the age of artificial intelligence*. Available at: https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/161688/41_19_Leading%20the%20way%20into%20the%20age%20of%20artificial%20intelligence.pdf?sequence=4

73. McKinsey & Company (2020), "Unlocking growth in small and medium-size enterprises". Available at: <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/unlocking-growth-in-small-and-medium-size-enterprises>

74. Finland's Artificial Intelligence Accelerator (2020), "Market Research". Available at: <https://faia.fi/market-research/>

2.2 PILLAR 2: DIGITALLY UPSKILL THE NATION IN EMERGING TECHNOLOGIES

It is critical to ensure that Singaporean workers are able to use digital technologies to access job opportunities, run businesses and enhance productivity in their work. At the same time, the seeds for a future generation of adaptable and digitally skilled workforce must be planted early to ensure a healthy digital talent pipeline. Singapore is already advancing this goal of building digital talent through the following actions:

- **Supporting fresh graduates and displaced workers in transitioning into new jobs through digital skilling programmes and apprenticeships.**

To support workers affected by the COVID-19 pandemic, the Singapore Government launched an SGD2-billion **SGUnited Jobs and Skills Package** which placed nearly 76,000 individuals into jobs, traineeships, company attachments, and skills

training.⁷⁵ This also builds upon pre-pandemic concerns on lower productivity among workers in Singapore due to a lack of data literacy under the backdrop of increasing data usage to drive business decisions.⁷⁶ To help accelerate hiring and traineeships in the growing digital economy, Workforce Singapore, a statutory board under the Ministry of Manpower, facilitated 21,000 traineeship positions in the Research and Development (R&D) sector, including universities, A*STAR (Agency for Science, Technology and Research) research institutes, AI Singapore, and local deep-tech start-ups.⁷⁷ This provides recent graduates with opportunities to gain industry-relevant work experience and build professional networks. Similarly, the **SGUnited Mid-Career Pathways Programme** matches



75. Ministry of Finance (2021), Annex C-2: SGUnited Jobs and Skills Package. Available at: <https://www.mof.gov.sg/docs/librariesprovider3/budget2021/download/pdf/annexc2.pdf>

76. The Straits Times (2020), "Report: Lack of data skills hinders productivity of 94% of employers". Available at: <https://www.straitstimes.com/business/companies-markets/report-lack-of-data-skills-hinders-productivity-of-94-of-employers>

77. Workforce Singapore (2020), SGUnited Traineeships Programme factsheet for trainees. Available at: https://www.wsg.gov.sg/content/dam/ssg-wsg/wsg/saunited-trainees/SGUT_Factsheet_Trainees_Dec2020_Online.pdf



mid-career individuals with approved host organisations to gain new, in-demand skills while preparing for more permanent jobs in the future, such as data analytics.⁷⁸ To bridge the industry needs and skilling programmes, Continuing Education and Training (CET) Centres collaborated with industry partners to curate certifiable courses, such as automation system technician training for advanced manufacturing, under the **SGUnited Skills** programme.⁷⁹ Moreover, according to the scheme, trainees will have the chance to apply the skills learnt during the programme, through opportunities like workplace immersions and industry projects.

- **Promoting continual skill upgrading and incentivising workers to invest in their digital skills development.** For Singapore's workforce to retain its competitive edge in today's fast-changing world, it is crucial for the country to develop national lifelong learning frameworks that

ensure workers increase their skill sets and build deep capabilities to stay relevant. The National University of Singapore (NUS) developed the **NUS Lifelong Learning** (NUS L3) programme in 2017. The programme entitles its alumni to two free course modules over three years.⁸⁰ The university's **NUS Lifelong Learners** programme offers a catalogue of Continuing Education and Training courses, which refer to courses guided by the Singapore Government's **Industry Transformation Maps**, with a focus on emerging skill areas identified by the government.⁸¹ At the same time, to incentivise workers in investing their own digital skills development, the **SkillsFuture** initiative provides Singaporeans with the opportunities to develop the right competencies to thrive in a knowledge-based economy.⁸² Under this initiative, Singaporeans are given up to SGD1,500 (USD1,095) in credits to enrol in courses to reskill and upskill themselves. This has helped stimulate increased personal investment by workers in their

78. Workforce Singapore (2020), SGUnited Mid-Career Pathways Programme – company attachments. Factsheet for mid-career individuals.

Available at: https://www-wsg-gov-sg-admin.cwp.sg/content/sgunitedmidcareerpathways/sgup_factsheet_midcareerind_111220_feb21_final.pdf

79. The Straits Times (2021), "Budget 2021: Support for hiring of 200,000 locals this year under the Jobs Growth Incentive".

Available at: <https://www.straitstimes.com/singapore/budget-2021-target-to-support-hiring-of-200000-locals-this-year-under-sgunited-jobs-and>

80. Nicky Lung (2018), "Singapore Minister of Education on the importance of higher education reform for Industry 4.0". OpenGovAsia.

Available at: <https://opengovasia.com/singapore-minister-of-education-on-the-importance-of-higher-education-reform-for-industry-4-0/>

81. National University of Singapore, School of continuing and Lifelong Education (2020), "What is NUS L3".

Available at: <https://scale.nus.edu.sg/programmes/lifelong-learning/alumni>

82. SkillsFuture (2020), "Mid-Career Enhanced Subsidy". Available at: <https://www.skillsfuture.sg/Credit>



training, as they tend to be motivated to continue with their selected courses even after the credit limit has been reached. These courses cover various competencies, including data literacy, cloud computing, and digital problem-solving. Over two years between 2016 and 2018, more than 285,000 Singaporeans had utilised their **SkillsFuture Credit**.⁸³ In 2019 and 2020, 500,000 and 540,000 individuals benefited from the initiative's online and offline courses respectively.⁸⁴

- **Leveraging Education Technology (EdTech) to build digital skills.** To enhance the classroom experience and create a more engaging learning process through e-pedagogy (which refers to teaching using technology), the Ministry of Education introduced personal learning devices in classrooms at all secondary schools from June 2020.⁸⁵ Students can use these personal learning devices to access **Singapore Student Learning Space (SLS)**, an online learning portal that provides curriculum-aligned

learning resources for major subjects from primary to pre-university level. The SLS also provides teachers with a range of tools to customise and create meaningful learning experiences such as making students' thinking processes visible, enabling teachers to provide targeted support to address any gaps in students' understanding.⁸⁶ Beyond deepening the technical expertise of students, the government has highlighted the importance of developing soft skills, such as empathy.⁸⁷ The use of these SLS applications will enable students to develop competencies such as problem-solving and digital communications that will be crucial in acquiring more advanced digital skillsets in the future.

While Singapore has implemented a comprehensive range of policies to deepen the digital capabilities of its current skilled workers, the country could go further in expanding its digital skilling programmes to improve the digital capacities of its working population:

83. Joanna Seow (2018), "285,000 Singaporeans have used SkillsFuture Credit, with more doing so in 2017". *The Straits Times*.

Available at: <https://www.straitstimes.com/singapore/manpower/285000-singaporeans-have-used-skillsfuture-credit-with-more-doing-so-in-2017>

84. SkillsFuture (2020), "500,000 Individuals and 14,000 Enterprises Benefitted From SkillsFuture Programmes in 2019" Available at: <https://www.skillsfuture.sg/NewsAndUpdates/DetailPage/5ed87fff-39df-4dc3-b63b-6f2763db6aa9> and *The Straits Times* (2021), "540,000 Singaporeans benefited from SkillsFuture initiatives in 2020". Available at: <https://www.straitstimes.com/singapore/540000-singaporeans-benefitted-from-skillsfuture-initiatives-in-2020-skillsfuture-singapore>

85. Ministry of Education (2020), "MOE FY2020 Committee of Supply Debate Response by Minister for Education Ong Ye Kung".

Available at: <https://www.moe.gov.sg/news/speeches/20200304-moe-fy2020-committee-of-supply-debate-response-by-minister-for-education-ong-ye-kung>

86. Ministry of Education (2020), "Singapore Student Learning Space (SLS)". Available at: <https://www.moe.gov.sg/education/syllabuses/singapore-student-learning-space-sls>

87. *The Straits Times* (2020), "Digital skills alone not enough for future, says EDB MD".

Available at: <https://www.straitstimes.com/singapore/education/digital-skills-alone-not-enough-for-future-says-edb-md>

- Develop more digital skilling programmes to train current digital workers in advanced digital skillsets such as cloud and digital content creation skills.** Recent research has shown that current digitally skilled workers are expected to see the largest skill needs by 2025, at 58 percent of total digital skill training needs in Singapore.⁸⁸ To ensure that the current digital skill base of workers is constantly upgraded to take into account new technologies, it is necessary to continually expand the availability of skilling programmes that address these skill needs. In particular, advanced cloud computing skills are projected to see the highest growth in skill needs by 2025, followed by advanced digital content creation. It is therefore imperative for the Singapore Government to develop structured skilling programmes and professional training courses to upskill workers in areas such as designing and refining new cloud and hybrid architecture patterns as well as creating different forms of original digital content. Singapore could also facilitate stronger industry-academia partnerships in order to develop new expertise in these fields. For instance, RMIT and La Trobe University in Australia have worked with cloud service providers to develop degrees and courses on cloud computing that are delivered entirely online to accommodate full-time and part-time learners.⁸⁹
- Provide incentives to shift employers' mindset towards "skilling as a first resort".** Recent research by AlphaBeta has shown that while Singapore has a large digitally skilled workforce today (with over 60 percent of workers in the country applying digital skills in their jobs), there is a strong need for those who are not digitally skilled to rapidly gain new skills over the next five years to stay relevant in the job market.⁹⁰ While the SkillsFuture initiative provides workers with credits (that can be used to offset course fees) to reskill and upskill



themselves digitally,⁹¹ the research found that there is still a need to shift the mindsets of firms and workers towards digital upskilling. In particular, rather than rely on hiring external candidates or outsourcing their IT capabilities, there is a need to pivot towards the perspective of "skilling as a first resort". To do this, Singapore could explore the development of incentives for companies to develop and utilize in-house digital talents. Singapore firms could benefit from technical assistance in workforce planning and digital skills development that are tailored to their employees' needs, similar to the **Digital Skills Bridge** programme in Luxembourg. The **Digital Skills**

88. AlphaBeta, commissioned by Amazon Web Services (2021), *Unlocking APAC's Digital Potential: Changing Digital Skill Needs and Policy Approaches*. Available at: <https://pages.awscloud.com/APAC-public-DI-APAC-Digital-Skills-Research-2021-learn.html>

89. Sources include: La Trobe University (2018), "First Cloud Technology degree". Available at: <https://www.latrobe.edu.au/news/articles/2018/release/first-cloud-technology-degree>; RMIT, "Cloud & Software Solutions". Available at: <https://online.rmit.edu.au/software-development/cloud-software-solutions>

90. AlphaBeta, commissioned by Amazon Web Services (2021), *Unlocking APAC's Digital Potential: Changing Digital Skill Needs and Policy Approaches*. Available at: <https://pages.awscloud.com/APAC-public-DI-APAC-Digital-Skills-Research-2021-learn.html>

91. Skillsfuture SG (2019), "Funding support for employers". Available at: <https://www.ssg.gov.sg/programmes-and-initiatives/funding/funding-for-employer-based-training.html>

Bridge programme launched by the Ministry of Labor, Employment and the Social and Solidarity Economy in Luxembourg provides another good example of how companies could be supported in conducting workforce planning and digital skill training for their employees (see Box 5).

- **Increase “soft skills” focus to complement technical education.** Beyond developing students’ technical know-how, the current digital skills education could be complemented with a focus on the development of “soft skills”, such as problem-solving, critical thinking and adaptive learning. In Singapore, the recently announced **National Digital Literacy Programme** aims to incorporate digital learning across different



subjects.⁹² This includes teaching students to code and implement algorithms that solve mathematical problems, learning about the use of nanorobots in nanotechnology to deliver drugs into the bloodstream in biology lessons, to mandatory modules for polytechnic students in computational thinking and data competencies. While these are significant efforts to develop digital skills learning across different subjects, there are concerns that a traditionally strong focus on rote learning in the education system could inhibit students’ adaptive learning and creative thinking capabilities.⁹³ To address these challenges, it would be critical for Singapore to double down on its efforts to pursue digital skills education through a multidisciplinary approach. An example of an education system that adopts a multidisciplinary approach is Finland’s, which is regarded as one of the best in the world. The country has been leading the world in The Economist’s **Worldwide Educating for the Future Index** in 2019 for its effectiveness in preparing students for the demands of work and life in a rapidly changing landscape.⁹⁴ The country introduced the concept of phenomenon-based teaching and learning (PBL) to school curriculums in 2017. Intended to equip students with critical thinking skills, PBL lessons are a shift away from learning in silos, towards multidisciplinary learning where students are divided into small groups to observe a real-life scenario and learn about world topics (e.g., climate change) in a holistic manner. They are even involved in planning these lessons and assessing what they learn from them.⁹⁵ By breaking down subject-based compartmentalisation of knowledge instead of focusing on a specific subject, phenomenon-based classes explore phenomena that cross subject boundaries. This approach could be used to develop skills that are often cross-cutting such as problem-solving and digital communication and collaboration.

92. Ministry of Education (2020), “Infosheet on strengthening digital literacy”.

Available at: <https://www.moe.gov.sg/docs/default-source/document/media/press/2020/infosheet-on-strengthening-digital-literacy.pdf>

93. The Economist (2018), “It has the world’s best schools, but Singapore wants better”.

Available at: <https://www.economist.com/asia/2018/08/30/it-has-the-worlds-best-schools-but-singapore-wants-better>

94. The Economist (2019), “The Worldwide Educating for the Future Index 2019”.

Available at: https://educatingforthefuture.economist.com/?utm_source=PR&utm_medium=Perspectives&utm_campaign=YidanPrize

95. Sources include: World Economic Forum (2017), “Is this Finnish school the perfect design?” Available at: <https://www.weforum.org/agenda/2017/10/why-finland-is-tearing-down-walls-in-schools>; David Tay (2017), “Finn and fun: lessons from Finland’s new school curriculum”. The Straits Times. Available at: <https://www.straitstimes.com/singapore/education/finn-fun>

BOX 5. SWEDEN'S DIGILYFT KICKSTART PROGRAM: HELPING MICRO, SMALL, AND MEDIUM ENTERPRISES (MSMES) IN THE MANUFACTURING SECTOR ADOPT NEW TECHNOLOGIES AND GAIN DIGITAL SKILLS

To increase the use of digital technology among MSMEs and their workers in Sweden's manufacturing industry, the Swedish Agency for Economic and Regional Growth (Tillväxtverket) developed the **Digilyft Kickstart** programme in partnership with industry bodies such as the Association of Swedish Engineering Industries (Teknikföretagen).⁹⁶

Recognising that industrial and industrial service MSMEs are among the least digitised firms in the country and often lack the time and resources to develop a digital transformation strategy, this programme involves the delivery of Kickstart workshops over a number of days to managers in such firms.⁹⁷ In these free-to-attend workshops, MSME managers are educated about the opportunities afforded by digitisation - largely in business development processes and business systems. Facilitators hailing from both industry and government work directly with them to develop plans for incorporating digital technologies into their businesses. These include opportunities in marketing, sales, customer support, and administration. External resources such as funding and training in specific digital skills are also shared with MSME managers. For example, vouchers are provided to firms in the workshops that propose a project that makes innovative and strategic use of digital technology - such a voucher can subsidise up to 50 percent of the total project value within a limit of EUR 25,000 (USD26,700).⁹⁸ Firms can spend these funds on either information technology-related equipment or services. To minimise the time burden for MSME managers, the workshops span only one full day and two half-days.

The workshops are highly curated, with the content of each being tailored to include examples and opportunities that are relevant to the specific mix of companies in the workshop. To maximise the potential for collaboration, companies with similar or complementary business activities are also placed in the same workshop sessions.

Originally started as a pilot that ran from 2016 to 2017, its success led to a larger-scale initiative in 2018, with EUR2 million (USD2.1 million) funded by the Swedish Agency to support over 1,000 companies that year.⁹⁹

96. Nesta and Readie (2018), *Delivering digital skills: a guide for preparing the workforce for an inclusive digital economy*.

Available at: https://media.nesta.org.uk/documents/Readie_Digital_Skills_booklet_online.pdf

97. Region Västerbotten (2020), "Digilyft Västerbotten".

Available at: <https://regionvasterbotten.se/naringsliv-och-samhallsbyggnad/regional-digitalisering/digilyft-vasterbotten>

98. OECD (2018), *OECD reviews of digital transformation: Going digital in Sweden*, OECD Publishing, Paris.

Available at: <http://dx.doi.org/10.1787/9789264302259-en>

99. Nesta and Readie (2018), *Delivering digital skills: a guide for preparing the workforce for an inclusive digital economy*.

Available at: https://media.nesta.org.uk/documents/Readie_Digital_Skills_booklet_online.pdf

2.3 PILLAR 3: POSITION SINGAPORE AS A REGIONAL HUB FOR DIGITAL TRADE

Given its small domestic market, Singapore's economy is heavily reliant on connections with the global economy to fuel economic growth. In 2019, exports accounted for 174 percent of the country's GDP.¹⁰⁰ Amid the rise in the adoption of digital technologies such as electronic transactions used in cross-border services, the country has been exploring ways to forge digital trade relationships to facilitate cross-border data flows and promote the growth of the digital economy. To connect businesses with international partners, Singapore has ratified a number of international trade agreements such as the **Comprehensive and Progressive Agreement for Trans-Pacific Partnership** (CPTPP) which builds trust and confidence in the use of electronic commerce across borders among 11 countries (which collectively account for 13 percent of the global GDP). Singapore is also the first participating country to have ratified the **Regional Comprehensive Economic Partnership** (RCEP), the world's largest free trade agreement, which is estimated to add USD500 billion to world trade by 2030.¹⁰¹ In addition, the country has undertaken the following actions to build an extensive network of digital trade agreements and supported businesses in maximising opportunities arising from these trade corridors:

- **Participating in digital trade agreements that promote digital trade in the region.** With an OECD report highlighting that a ten percent rise in "bilateral digital connectivity" could improve trade in goods and services by about two and three percent respectively, cross-border data flows are critical for enabling digital exports.¹⁰² To enhance

digital connectivity with its international partners, Singapore has set up **Digital Economy Agreements** (DEAs) to establish digital trade rules and digital economy collaborations between economies.¹⁰³ The country has concluded negotiations for two DEAs, namely the **Digital Economy Partnership Agreement** (DEPA) with New Zealand and Chile, and the **Singapore-Australia Digital Economy Agreement** (SADEA).¹⁰⁴ The country is also currently in talks with the Republic of Korea and the United Kingdom on its potential subsequent DEAs.¹⁰⁵ These agreements enable businesses to better tap on the opportunities in the digital economy.¹⁰⁶ The DEPA, for instance, includes provisions to improve digital trade between these countries, including the streamlining of trading procedures using digital technologies (e.g., the DEPA's **International Connectivity System**, which digitises trading documentation), and promoting open cross-border data flows with the necessary data safeguards. Through the DEPA, businesses operating in the three signatory countries can transfer information seamlessly across borders, with the assurance that the data is protected by the relevant security mechanisms and requisite regulations. This provides a conducive environment for data-driven business models such as software-as-a-service and with businesses increasingly reliant on electronic transactions and digital solutions to serve customers regardless of where they are located. In addition, SMEs looking to better understand foreign markets can now access and use open government data to discover

100. Trading Economics (2020), "Singapore - Exports of Goods and Services (% of GDP)".

Available at: <https://tradingeconomics.com/singapore/exports-of-goods-and-services-percent-of-gdp-wb-data.html>

101. Sources include: Focus Taiwan (2020), "Taiwan notifies CPTPP members of intent to join: MOFA". Available at: CNA (2021), "Singapore ratifies RCEP trade deal, becomes first country to do so." Available at: <https://www.channelnewsasia.com/news/business/singapore-ratifies-rcep-trade-agreement-first-country-asean-14588416>

102. OECD (2019), Trade in the digital era. Available at: <https://www.oecd.org/going-digital/trade-in-the-digital-era.pdf>

103. Ministry of Trade and Industry Singapore (2020), "Digital Economy Agreements". Available at: <https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements>

104. Ministry of Trade and Industry Singapore (2020), "Singapore-Australia Digital Economy Agreement".

Available at: <https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/The-Singapore-Australia-Digital-Economy-Agreement>

105. CNA (2021), "Singapore, UK begins talks on digital economy agreement".

Available at: <https://www.channelnewsasia.com/news/business/uksdea-singapore-united-kingdom-digital-trade-agreement-15107016>

106. Ministry of Trade and Industry Singapore (2020), Singapore substantially concludes negotiations for Digital Economy Partnership Agreement with Chile and New Zealand.

Available at: <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/01/Joint-press-release---Conclusion-of-Digital-Economy-Partnership-Agreement---21-Jan.pdf>

new business opportunities and innovate new products and services.¹⁰⁷

- **Providing support for businesses to participate in digital trade.** Besides expanding the country's scope and network of free trade agreements to include the digital economy such as e-commerce, the government offers several schemes and grants to support businesses in making market connections and participating in digital trade. For example, under the **SMEs Go Digital** programme, the **Grow Digital** initiative launched by the Enterprise Singapore and IMDA supports SMEs in participating in Business-to-Business (B2B) and Business-to-Consumer (B2C) e-commerce platforms to sell overseas.¹⁰⁸ For B2C platforms, the **Multichannel E-commerce Platform (MEP)** programme under Grow Digital enables SMEs to list on major e-marketplaces and maximise their research and networks across multiple countries to seize new business opportunities.¹⁰⁹ To encourage SMEs to kick-start their online operations, eligible

businesses that signed up for the programme will also receive a 70 percent subsidy of the programme costs for a year.¹¹⁰ In addition, the **Market Readiness Assistance** scheme provides SMEs with financial assistance, of up to 70 percent funding on exporting costs, when expanding their products and services to overseas markets.¹¹¹ To facilitate knowledge transfers, Enterprise Singapore is leveraging its network of overseas centres to provide advisory support and in-market assistance to SMEs embarking on their internationalisation journey.¹¹² The Singapore Business Federation also launched **GlobalConnect@SBF** to provide dedicated market access support for companies new to internationalisation.

While there is already a comprehensive range of policies to facilitate digital trade in Singapore and the region, the country could consider the following areas to encourage greater participation in digital trade in the region while continuing its current efforts in advocating cross-border data flows:

107. Ministry of Trade and Industry Singapore (2020), *Singapore substantially concludes negotiations for Digital Economy Partnership Agreement with Chile and New Zealand*. Available at: <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/01/Joint-press-release---Conclusion-of-Digital-Economy-Partnership-Agreement---21-Jan.pdf>

108. Sources include Ministry of Communications and Information (2020), "Committee of Supply 2020". Available at: <https://www.mci.gov.sg/pressroom/news-and-stories/pressroom/2020/3/speech-by-mr-s-iswaran-at-the-mci-committee-of-supply-debate-2020-on-3-mar-2020>; Infocomm Media Development Authority (2020), *Grow Digital Helps SMEs Go International*. Available at: <https://www.imda.gov.sg/-/media/Imda/Files/News-and-Events/Media-Room/Media-Releases/06/Factsheet-Grow-Digital-Helps-SMEs-Go-International.pdf?la=en>

109. Infocomm Media Development Authority (2020), "More than 500 SMEs access new overseas markets with Grow Digital".

Available at: <https://www.imda.gov.sg/news-and-events/Media-Room/Media-Releases/2020/More-Than-500-Smes-Access-New-Overseas-Markets-With-Grow-Digital>

110. Enterprise Singapore (2020), "Multichannel E-commerce Platform (MEP)".

Available at: <https://www.enterprisesg.gov.sg/non-financial-assistance/for-singapore-companies/new-market-entry-support/multichannel-e-commerce-platform-mep-programme>

111. Enterprise Singapore (2020), "Market Readiness Assistance".

Available at: <https://www.enterprisesg.gov.sg/financial-assistance/grants/for-local-companies/market-readiness-assistance-grant>

112. Ministry of Trade and Industry Singapore (2020), "Speech by Ministry Chan Chun Sing, Ministry of Trade and Industry at Ministry of Trade and Industry (MTI)'s Committee of Supply debate" Available at: <https://www.mti.gov.sg/Newsroom/Speeches/2020/03/Speech-by-Minister-Chan-Chun-Sing-at-MTI-COS-debate>



- **Seek like-minded trade partners to build a network of digital trade agreements.** Singapore's Digital Economy Agreement (DEA) is crucial in advancing digital trade rules and connectivity in the region. Beyond New Zealand, Chile, Australia and existing negotiations with South Korea on the Korea-Singapore Digital Partnership Agreement, the country should continue seeking like-minded economies to embark on DEAs. This includes aligning digital rules and standards, encouraging cooperation in nascent but growing areas such as digital identifies, AI and data innovation, and addressing regulatory challenges that restrict data transfers. When DEAs enter into force, cross-border businesses will be able to reap benefits from better digital connectivity and enhance digital economic opportunities.
- **Champion digital trade at international forums.** While forging international digital trade agreements can establish market openings for cross-border data flows, not every country may be willing to take on

such commitments especially in the ASEAN region that is made up of different markets with varying demographics and needs.¹¹³ Thus, Singapore can continue advocating for non-binding best practices at international forums such as the Asia-Pacific Economic Cooperation (APEC) forum and the 1st Association of Southeast Asian Nations (ASEAN) Digital Ministers' Meeting.¹¹⁴ These platforms present an opportunity for countries to share best practices and set principles on complex issues such as balancing cross-border data flows with the government's need to protect safety and national security. For instance, in January 2021, the 1st ASEAN Digital Ministers' Meeting approved the ASEAN Data Management Framework (DMF) and Model Contractual Clauses for Cross Border Data Flows (MCCs).¹¹⁵ By establishing template contractual terms and conditions, the MCCs help to reduce the negotiation and compliance cost and time, especially for SMEs, while ensuring personal data protection when data is transferred across borders.

113. *Business Times* (2019), "Expanding overseas still not an easy task for SMEs".

Available at: <https://www.businesstimes.com.sg/hub/emerging-enterprise-2019/expanding-overseas-still-not-an-easy-task-for-smes>

114. ASEAN refers to the Association of Southeast Asian Nations.

115. Personal Data Protection Commission (2021), "ASEAN Data Management Framework and Model Contractual Clauses on Cross Border Data Flows".

Available at: <https://www.pdpc.gov.sg/help-and-resources/2021/01/asean-data-management-framework-and-model-contractual-clauses-on-cross-border-data-flows>



**ADVANCING THE
PRIZE — GOOGLE'S
CONTRIBUTION TO
ADVANCING THE
DIGITAL OPPORTUNITY
IN SINGAPORE**

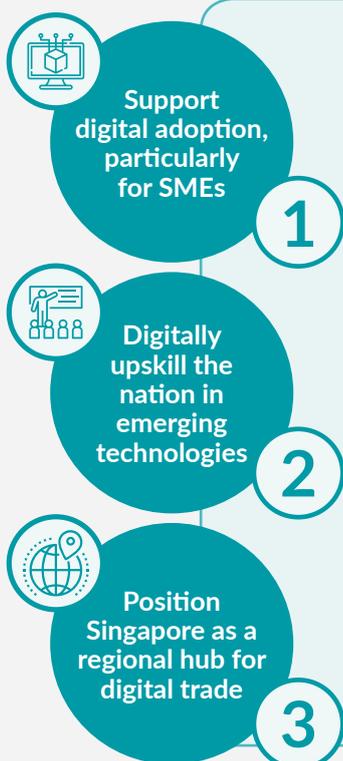
A person is sitting on the floor, using a laptop that is placed on a wooden stand. The person is wearing a dark blue long-sleeved top and dark pants. The background is a light blue wall with a white horizontal line. The overall scene is bright and modern.

An important player spearheading digital transformation in Singapore, Google has made significant contributions in each of the three pillars for digital transformation in Singapore outlined in Chapter 2. This also echoes Google's mission to empower Singaporeans today, for tomorrow by supporting the country in its economic recovery efforts through skills training and building helpful tools to ensure everyone stays safe, informed and connected in the face of the global pandemic. For example, Google supports SMEs in their digital adoption journeys, including in advanced technologies. As a member of the AI Advisory Council, Google works closely with industry partners and the government to develop advisory guidelines on the use of AI. At the same time, the **Google-UOB SME Leadership Academy** facilitates SME digital adoption through courses that help businesses create a strong online presence through tools like Google Ads and Business Profile (previously called Google My Business). Google also digitally skills Singapore's workers and students through skilling programmes developed in collaboration with the government and educational institutions, such as **Skills Ignition SG - A Grow with Google Programme** and the **SMU-Google Squared Data and Analytics Programme**. To support Singapore's digital interconnectedness in the region, the company has also been investing in regional network infrastructure, including four subsea cable systems and three data centres in Singapore.

In addition, Google's products create various economic benefits for businesses, consumers and the broader society in Singapore. Businesses and consumers in the country are estimated to derive total annual economic benefits from

“ADVANCING THE PRIZE”

GOOGLE’S CONTRIBUTION TO SINGAPORE’S DIGITAL TRANSFORMATION JOURNEY



EXAMPLES OF INITIATIVES BY GOOGLE

- The **GOOGLE-UOB SME LEADERSHIP ACADEMY** equipped over 4,000 SMEs with digital skills and tools by 2020
- Google’s **SKILLS IGNITION SG** aims to boost the employability of 3,000 Singaporeans through digital skills training
- Google’s **DATA CENTRES AND SUBMARINE CABLE INVESTMENTS** in Singapore support the growing demand for digital services in Asia

GOOGLE ALSO DELIVERS WIDER BENEFITS TO BUSINESSES, CONSUMERS AND SOCIETY IN SINGAPORE

BUSINESSES

Google is estimated to contribute **SGD2.4 billion (USD1.7 billion)** worth of annual business benefits¹

CONSUMERS

By helping consumers save time and generating value through their free products, Google is estimated to support **SGD2.4 billion (USD1.7 billion)** worth of annual benefits for consumers in Singapore²

SOCIETY

By enabling businesses to unlock new revenue streams and expand their businesses, Google indirectly supports around **6,600 jobs** in Singapore. The Android operating system also supports more than **49,500 jobs** in Singapore's economy

1. Business benefits refer to the estimated economic impact from the following products: Google Search; Google Ads; YouTube; AdSense; and Google Play.

2. Consumer benefits refer to the estimated economic impact from the following products: Google Search; Google Maps; YouTube; Google Drive; Docs, Sheets and Photos; Google Play.

Note: All data is based on AlphaBeta analysis using a range of original and third-party sources. See Appendix in report for detailed methodology. Figures are estimated based on the latest available annual data at the time of study in February 2021.

Google’s products worth SGD2.4 billion (USD1.7 billion) and SGD2.4 billion (USD1.7 billion), respectively. These products include Google Search, Google Ads, AdSense, YouTube, Google Play, Google Drive, and Google Docs, Sheets and Photos. For businesses, economic benefits come in the form of increased revenue through increased customer outreach and access to new markets, as well as improved productivity through time savings. Consumers experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic contributions to businesses and individuals, Google also supports benefits to the broader society in Singapore. By enabling businesses to unlock new revenue streams and expand their businesses through the use of Google Ads, AdSense, and YouTube, Google indirectly supports around 6,600 jobs in Singapore today. The Android operating system also supports more than 49,500 jobs in Singapore’s economy. Furthermore, Google delivers intangible benefits through its programmes and initiatives, such as supporting non-profit organisations, enabling safe Internet use, championing environmental sustainability, and providing access to digital skilling opportunities for all through free programmes, such as **Code in the Community**, an initiative to bring free coding classes to 6,700 young Singaporeans from disadvantaged backgrounds.

3.1 GOOGLE CONTRIBUTES TO EACH OF THE THREE PILLARS OF DIGITAL TRANSFORMATION IN SINGAPORE

Across the three pillars of action, Google has made significant contributions in Singapore through its programmes, products and services.

To **facilitate digital adoption particularly for SMEs (Pillar 1)**, Google is involved in the following:

- **Providing digital tools and platforms for SMEs to transform their business.** In partnership with UOB, a local bank, Google launched the **Google-UOB SME Leadership Academy** in 2019 to help SMEs accelerate their digital transformation and boost their competitiveness in the digital economy. During the COVID-19 pandemic, the training programme expanded its capacity and pivoted the curriculum online to digitally upskill small businesses from sectors that were hit hard during the COVID-19 pandemic, such as

retail, tourism and food and beverage sectors.¹¹⁶ Since April 2020, over 4,600 SMEs were trained, which was ten times more than the number of SMEs trained in 2019.¹¹⁷ Beyond the tech sector, Box 6 showcases how the **Google-UOB SME Leadership Academy** supported non-tech businesses undergoing digital transformation during the COVID-19 pandemic and equipped them with the right tools and confidence to navigate the crisis. In addition, Google Cloud



116. Google The Keyword (2020), "A new skills partnership for Singaporeans". Available at: <https://blog.google/around-the-globe/google-asia/new-skills-partnership-singapore/>
 117. SME Leadership Academy (2021), Available at: <https://smeleadershipacademy.withgoogle.com/>

BOX 6. GOOGLE-UOB SME LEADERSHIP ACADEMY: SUPPORTING SMES ACROSS VARIOUS SECTORS IN THEIR DIGITAL TRANSFORMATION TO BUILD RESILIENCE IN THE POST-PANDEMIC ERA

LEMONGRASS HOUSE

Lemongrass House is a natural body care shop. Since the opening of its first flagship store in 2008, Lemongrass House depended largely on tourists and purchases from its brick and mortar stores due to the sensory nature of the business. When Singapore entered the Circuit Breaker during the COVID-19 pandemic, the Director of the company, Raymond Wee, was forced to find new ways of driving traffic to his website and pivot towards online sales amid closures to

physical stores. After learning about digital tools such as Business Profile (formerly Google My Business), Google's Market Finder, and Google Trends through the **Google-UOB SME Leadership Academy**, Raymond identified potential business opportunities overseas and learnt to build a virtual 3D store on Business Profile to provide customers with an interactive in-store experience.¹¹⁸ As a result of implementing these digital tools, the share of online sales at Lemongrass House increased by four folds from just five percent in 2019 to 20 percent in 2020.



118. Google Maps (2021), Available at: <https://www.google.com/maps/@1.2936648,103.8529484,3a,75v,3.56h,92.91t/data=!3m7!1e1!3m5!1sAF1QipPzhvFhC2a-fGGXoALHMllkpK4a28KHkY6GaJ5xe!2e10!3e12!7i12000!8i6000>

BAR BAR BLACK SHEEP

Bar Bar Black Sheep is an F&B establishment reminiscent of Singapore's local "Kopitiam" culture with a twist. In 2019, the director of business development, Reuben Tan signed up for the **Google-UOB SME Leadership Academy** and learned how to better optimise Google Ads to reduce expenditure on unnecessary online ads by 30 to 40 percent, which enabled the cash-strapped company to stretch its dollars on branding. In addition, the programme exposed him to a range of digital tools such as Google Workspace, which enabled the company to work remotely across its four branches in Singapore during the 2020 Circuit Breaker in 2020, which was a particularly challenging period for the food services period.



Photo Source: <https://www.homeanddecor.com.sg/uncategorized/shop-at-cluny-court/>

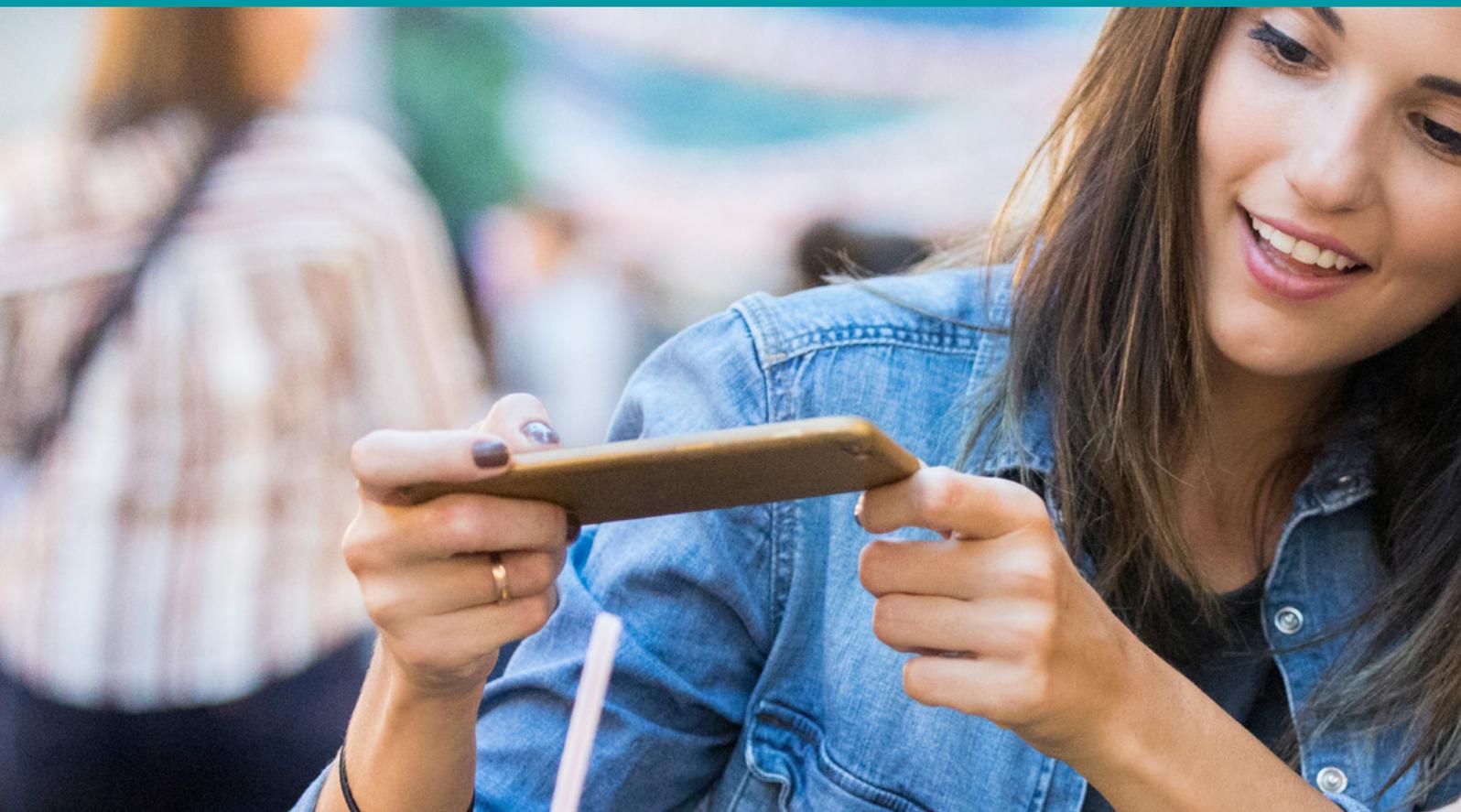
NEW ECON HOLDINGS

New Econ Holdings is a group of next-generation minimarts with business owners who are working together to implement digital technologies in their business.¹¹⁹ After Kelvin, the director of New Econ Holdings, joined the **Google-UOB SME Leadership Academy** in August 2019 to better understand the digital solutions available to businesses through the programme, he migrated his business to Google Workspace, which enabled greater collaboration and effective communication between retailers and their customers. In particular, Google Meet and Google Drive have facilitated remote working when social distancing measures were implemented during the COVID-19 pandemic. By learning how to utilise digital solutions effectively, Kelvin was able to increase his efficiency at work by 20 to 30 percent. Apart from the digital know-how gleaned from the academy, Kelvin also gained a growth mindset from the programme and applied this to his business.

WOOPA TRAVELS

Woopa Travels is a travel agency and tour operator that hopes to reinvent the travel experience by combining adventure with professional storytelling to create quality experiences. Through the **Google-UOB SME Leadership Academy**, founder TY Suen, was introduced to a vast suite of digital tools and gained tips on how to manage and lead an effective team. He was introduced to re:Work, a resource with practices, research and ideas from Google on shaping the employee experience and fostering constructive workplaces. Although he attended the Google-UOB SME Leadership Academy in 2019 before the pandemic, learnings from the programme have proven to be crucial in ensuring the survival of the company during COVID-19 because it introduced him to various financial solutions and capital resources available that his SME could tap into.

119. New Econ (2021), "About Us". Available at: <https://newecon.sg/>



supports IMDA's GoCloud initiative to equip local ICT SMEs with digital capabilities in Cloud Native, Microservices and DevOps, as they adapt to cloud-native development.¹²⁰

- **Supporting hawkers in adopting digital technologies to reach new audiences.** Evolved from a street food culture, hawkers in Singapore are small business owners who work in community dining rooms known as "hawker centres" and adapt dishes to local tastes and contexts.¹²¹ Following the addition of Singapore's "Hawker Culture" on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity, Google partnered with the Singapore Government and relevant stakeholders to document the country's hawker centres on Google Maps and Search.¹²² Not only does this help hawkers establish an online presence, but these digital tools also drive footfall to the hawker centres and provide the global

platform to help the world learn more about the "hawker culture" in Singapore. To create an immersive 360-degree imagery of the country's "hawker culture", Google collected indoor imagery of all 114 hawker centres, including Chinatown Market and Golden Mile Food Centre, among others. On Google Maps' Street View, visitors can browse and explore each hawker centre and look up information about each stall such as its name, stall number and photos that locals and tourists can easily access through an online search. In 2020, more than 6,000 hawkers created an online presence on the platform and that number has more than doubled in 2021. Besides driving footfall to physical stores, Google Pay's Menu Discovery feature lists food options available from more than 250 coffee shops, restaurants and hawker stalls for users to choose from and enables business owners to capture online orders on Google Pay platform.¹²³

120. Infocomm Media Development Authority (2020), "Go Cloud". Available at: <https://www.imda.gov.sg/programme-listing/gocloud>

121. United Nations Educational, Scientific and Cultural Organization (2020), "Hawker culture in Singapore, community dining and culinary practices in a multicultural urban context". Available at: <https://ich.unesco.org/en/RL/hawker-culture-in-singapore-community-dining-and-culinary-practices-in-a-multicultural-urban-context-01568>

122. National Environment Agency (2019), "Google Puts Singapore Hawker Centres On The Map". Available at: <https://www.nea.gov.sg/media/news/news/index/google-puts-singapore-hawker-centres-on-the-map>

123. CNA (2020), "You can now search for Singapore food places with delivery, pick-up options on Google Pay". Available at: <https://cna.lifestyle.channelnewsasia.com/dining/google-pay-singapore-menu-discovery-option-12686182>



- **Partnering with local government agencies to develop guidelines on the use of AI.** Apart from supporting businesses in developing AI solutions, Google was appointed by IMDA to sit on Singapore's Advisory Council on the Ethical Use of Artificial Intelligence (AI) and Data (Advisory Council), alongside legal experts from tech companies such as Microsoft and Alibaba, as well as leaders of local companies, such as Temasek International.¹²⁴ With the increasing use of AI applications in Singapore, having guidelines that address common issues faced in ethical AI usage, such as the burden of responsibility in an autonomous car accident, will be important in directing the country's future AI development. The council guides the government on how to responsibly adopt and develop AI in Singapore while publishing advisory guidelines and codes of practices, which businesses can adopt.
- **To digitally upskill the nation in emerging technologies (Pillar 2),** Google has launched the following efforts in Singapore:
 - **Developing digital skills programmes in emerging technologies, particularly for mid-career job seekers.** In light of the increasing role of digital technologies in today's workplaces, further highlighted by the shift towards remote work during the pandemic, Google partnered with several government agencies (i.e. Infocomm Media Development Authority and TechSkills Accelerator, SkillsFuture SG, the Singapore Economic Development Board) to launch **Skills Ignition SG**. The programme is part of the broader **Grow with Google** initiative and aims to help 3,000 Singaporeans and permanent residents gain digital marketing and cloud technology skills and globally recognised certificates to seize technology-related opportunities in the shifting

124. Today Singapore (2018), "Google, Microsoft and Alibaba legal experts among members of S'pore's AI advisory council".

Available at: <https://www.todayonline.com/singapore/google-microsoft-and-alibaba-legal-experts-among-members-spores-ai-advisory-council>

125. Google The Keyword (2020), "A new skills partnership for Singaporeans". Available at: <https://blog.google/around-the-globe/google-asia/new-skills-partnership-singapore/>

job market.¹²⁵ The Skills Ignition SG programme comprises two pathways. One pathway is a six-month vocational course for 2,400 mid-career job seekers. As of May 2021, the digital marketing track has been oversubscribed and over 1,000 cloud job seekers have enrolled. 60 percent of the vocational course participants were aged 40 and above. The second pathway features a “place and train” programme for which 600 participants will undergo online training for three months before getting six months of on-the-job traineeships hosted by companies such as Dentsu Aegis Network and Sephora. As of May, over 250 people were matched to partners in the “place and train” programme, including 100 trainees in Google Singapore. Box 7 highlights two Skills Ignition SG trainees and how they have benefited from the programme.

- **Partnering with the government and academia to train young professionals.** Together with IMDA and the Singapore Management University (SMU), in 2019 Google launched the **SMU-Google Squared Data and Analytics Programme** to increase the pool of graduates with industry-ready data analytics skills in light of the increasing demand for graduates trained in analytics. As part of the programme, SMU undergraduates complete two analytics courses in 26 weeks and then take on five-month internships at Google's partner companies, which Google and SMU match them with. In 2021, 24 SMU students will be graduating from the programme.¹²⁶ In another partnership with IMDA and local universities in Singapore, Google launched **Digitise**, which focuses on training local talent to be future experts and leaders of the Singapore digital marketing industry. The programme equips students with the necessary skills to navigate the fast-growing digital advertising market. Upon completion of the 13-week module, students are offered an opportunity to pursue an internship with top advertisers, agencies,

and partners in the digital industry. 150 students and graduates have benefitted from the programme since its initial launch in 2016, till its latest batch in 2020.¹²⁷

- **Providing resources and community support for budding entrepreneurs.** Besides providing training to nurture future talent, Google has also provided resources and created developer communities to support local entrepreneurs. To enable local tech businesses to grow and scale rapidly, Google has dedicated a physical space whereby Southeast Asian developers, entrepreneurs and community groups can benefit from insights, hands-on mentorship and networking opportunities with various teams at the Google office, known as **Google Developers Space**.¹²⁸ The **Google Developers Space** runs programmes such as the Machine Learning (ML) bootcamp. The four-day intensive bootcamp provides instructor-led Machine Learning Crash Course training and participants are also taught how to use Cloud AI/ML technologies by Googlers and experts.¹²⁹ One of the data scientists at Chope, a local real-time restaurant reservation platform, who attended the bootcamp gained a deeper understanding of Google Cloud Platform (GCP) and was able to better structure approximately 775,000 records daily.¹³⁰ In addition, **Google Developers**



126. Singapore Management University (2021), “SMU-Google Squared Data & Analytics Programme”.

Available at: <https://scis.smu.edu.sg/programmes/undergraduate/beyond/smu-google>

127. The Drum (2016), “Google tackles programmatic talent deficit by partnering with Singapore government”.

Available at: <https://www.thedrum.com/news/2016/09/22/google-tackles-programmatic-talent-deficit-partnering-with-singapore-government>

128. Google The Keyword (2019), “A new space for Southeast Asian developers in Singapore”.

Available at: <https://www.blog.google/around-the-globe/google-asia/developer-space-singapore/>

129. TensorFlow (2021), Available at: <https://events.withgoogle.com/machine-learning-bootcamp-singapore/>

BOX 7.

SKILLS IGNITION SG: EQUIPPING JOB SEEKERS WITH DIGITAL SKILLS

SINDOORI S, 24 YEARS OLD

9-month "Place and Train" Programme (Digital Marketing) including on-the-job training in Google

Sindoori graduated from the class of 2020 in Nanyang Technological University (NTU) with a degree in shipping, but it was difficult to find meaningful jobs in the maritime industry due to the COVID-19 pandemic. As such, she decided to make a switch to Digital Marketing, acknowledging that it is a growing industry. She first took up free online courses after graduation to get introduced to the topic and decided to sign up for Skills Ignition SG to expand her horizon in Digital Marketing and attain practical training after generating keen interest in it. The three-month online training course which started in October 2020 was very thorough and allowed Sindoori to deepen her knowledge beyond what she had previously learnt, giving her a good foundation for the on-the-job training at Google in January 2021. Sindoori is enjoying her current sales & marketing role, thriving in Google's open culture to pick up new practical skills beyond the technical knowledge and network with new people in the field. She hopes to pull off her projects successfully by the end of the traineeship and graduate with a better skill set to navigate the job market. Sindoori believes that this knowledge in Digital Marketing is meaningful and will help her in whatever she pursues in the future, be it at another job in the industry, or even when she opens her own business. She is also currently pursuing a Mini Masters in Marketing.

KENNY TIANG (TIANG WEN CHERNG), 54 YEARS OLD

6-month training course in Cloud Technology

Before joining Skills Ignition SG, Kenny has had over two decades of experience in the design industry where he worked as a Design Implementor. After his company ceased operations in 2018, he continued with contract and freelance work but faced difficulties in securing jobs when COVID-19 struck. He was also unsuccessful in applying for additional COVID-19 grants. Seeing the growing demand for jobs that require digital skills, Kenny was motivated to make a career switch from design to IT. When his friend recommended the Skills Ignition SG programme, he took up the opportunity to transition into the IT industry by enrolling in the 6-month Cloud Technology training track, while getting financial support from the training allowance. As a person of disability (with hearing impairment) and with his first deep dive into Cloud Technology, Kenny faced challenges learning remotely during the course. He overcame this with the help of classroom technologies such as Google Meet's live captions during lessons, and with help from his teammates who had IT-related backgrounds. He completed the 6-month course with flying colours and hopes that the skills he gained will give him a stronger edge in his search for IT-related jobs in disability-friendly companies.

Space” will support activities run by community groups like **Google Developer Groups**, **Google Business Groups** and **Women Techmakers**. More than 16,000 developers and 600 startups have benefitted from the programmes conducted in the space.

- **Organising accelerator programmes to develop the local tech ecosystem.** To nurture local technology startups, Google launched the **Google for Startups Accelerator: Southeast Asia** programme. The programme is a three-month online accelerator bootcamp for high potential tech-based start-ups that are solving the region's challenges in the post-pandemic era.¹³¹ Through the programme, startups receive tech and business mentorships, opportunities to connect with relevant teams from Google and its network of industry partners and workshops focused on product design, customer acquisition, and leadership development for founders. Thus far, applying the learnings from the accelerator program, the 15 startups of the cohort have generated 81 new jobs and raised over USD2.6 million in funding. Amongst them is DeafTawk, a mobile application that provides online sign language interpretation at an affordable cost, to eradicate hurdles in communication for the deaf community. In 2020, the app had more than 1,100 interpreters and helped nearly 18,000 people in Singapore and Pakistan.¹³² To help home-grown game developers to achieve their full potential, Google organised the **Indie Games Accelerator**, an annual accelerator programme for small game development companies that have demonstrated strong technical skills and innovative game design across 37 countries, including Singapore. Game developers receive training and mentoring from industry experts and Googlers to help them grow their business, including promotions

on the Google Play Store and consultations with members of the Google Play team. Box 8 showcases Singapore-based gaming start-ups which have benefited from the Indie Games Accelerator programme.

To **position the country as a regional hub for digital trade (Pillar 3)**, Google has done the following:

- **Investing in digital infrastructure to support growing demand in the region.** Along with the rapid growth in users and usage of Google's products in the region, the demand for Google Cloud's offerings has also increased steadily with companies like Singapore Press Holdings (SPH), National Trades Union Congress (NTUC) and One Republic using Google Cloud Platform and Google Workspace to serve their customers globally. To keep up with the demand, Google announced that it would start work on its third data centre in Singapore, bringing its long-term investment in data centres in Singapore to USD850 million.¹³³ In line with the company's commitment to achieving “Zero Waste to Landfill” which means diverting waste to a more sustainable pathway, the facility uses recycled water and is one of the most efficient and environmentally friendly sites in Asia.¹³⁴ Google has also made significant investments of more than USD2 billion in network infrastructure to help improve the capacity of network services in the Asia Pacific (APAC) region, including Singapore.¹³⁵ These investments are crucial in providing the underlying infrastructure layer for businesses to deliver their products and services through the Internet, and thus boosting the country's overall economic activity and digital connectivity. Box 9 shows the impact of Google's network infrastructure investments on businesses in Singapore.

130. Danamic (2019), “Google Launches Its First Developer Space In Singapore”. Available at: <https://www.google.com/url?q=https://danamic.org/2019/05/03/google-launches-its-first-developer-space-in-singapore/&sa=D&source=editors&ust=1613886649129000&usq=AOvVaw3PafUvEQ4kXxus-HF6Vgar>

131. Google for Start-ups (2020), “Google for Start-ups Accelerator: Southeast Asia”. Available at: <https://sites.google.com/view/gfs-accelerator-sea/home>

132. Google The Keyword (2020), “A sign language app to bridge the hearing gap”. Available at: <https://blog.google/around-the-globe/google-asia/sign-language-app/>

133. Sources include The Straits Times (2018), “Google building third data centre in Singapore with added investment of US\$350m”. Available at: <https://www.straitstimes.com/business/companies-markets/google-building-third-data-centre-in-singapore-with-likely-added>; Construction (2020), “Google takes Singapore data centre spending to \$850 million with third data centre”. Available at: <https://constructionglobal.com/digital-construction/google-takes-singapore-data-centre-spending-to-dollar850-million-with-third-data-centre>, and Google (2018), “Building a new data center in Singapore”. Available at: <https://www.blog.google/around-the-globe/google-asia/building-new-data-center-singapore/>

134. Google The Keyword (2018), “Building a new data center in Singapore”.

Available at: <https://www.blog.google/around-the-globe/google-asia/building-new-data-center-singapore/>

135. Analysys Mason (2020), Economic impact of Google's APAC network infrastructure – Focus on Singapore.

Available at: <https://www.analysismason.com/contentassets/b8e0ea70205243c6ad4084a6d81a8aa8/singapore-country-chapter.pdf>

BOX 8.

INDIE GAMES ACCELERATOR PROGRAMME: PROVIDING MENTORSHIP AND GUIDANCE FOR START-UPS TO SCALE AND GROW

THE GENTLEBROS

Gentlebros is a Singapore-based indie-game developer which participated in the **Indie Games Accelerator** programme and gained invaluable advice on monetisation methods through mentorship.¹³⁶ When Gentlebros started, they came up with their first game, Slashy Hero, which was featured by a well-known United States publisher, Kongregate. Despite the initial encouraging development, revenue for Slashy Hero started dipping and the game development studio was faced with a difficult decision on whether to continue. The studio eventually decided to press on and created its second game, Cat Quest. After learning about the short-term nature of popular games from its first game, the Gentlebros had to find ways to create a sustainable stream of revenue.

Through the **Indie Games Accelerator** programme, the studio was introduced to monetisation methods such as in-app purchases, downloaded content (DLC), as well as differentiating prices for different geographical regions. In collaboration with custom toy manufacturer, Symbiote Studios, the Gentlebros produced a limited run of 300 plush toys based on its main hero from Cat Quest, creating more revenue streams for the studio.¹³⁷ The programme also provided a platform for game developers to tap on the expertise of mentors and learn from the mistakes made by other game developers. By connecting with developers from around the world, Gentlebros improved the quality of its game. The studio was also introduced to data analytics (e.g., knowing when a player gets a game over, how often he levels up) to provide the team with the necessary insights to improve the gaming experience.

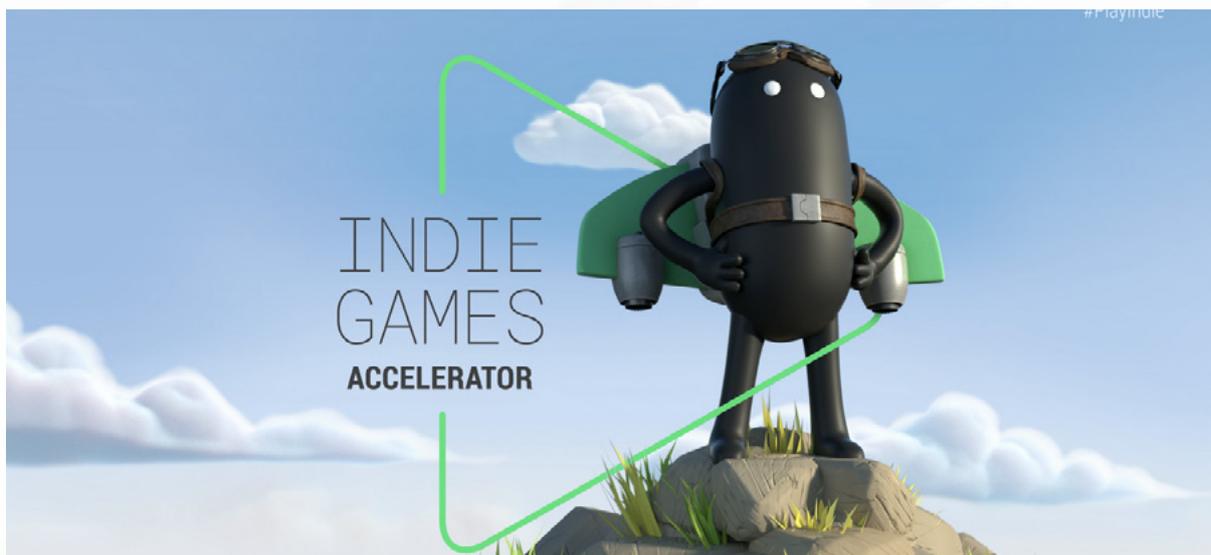


Photo Source: <https://blog.google/around-the-globe/google-asia/indie-games-accelerator/>

136. YouTube (2019), "Indie Games Accelerator journey | The Gentlebros (Android Developer Story)".

Available at: <https://www.youtube.com/watch?v=dONsvi8Voj0>

137. Danamic (2019), "Google's Indie Game Accelerator Bootcamp: Supporting Asia's Burgeoning Startup Culture".

Available at: <https://danamic.org/2019/01/03/googles-indie-game-accelerator-bootcamp-supporting-asias-burgeoning-startup-culture/>

BOX 8. (CONT'D)

INDIE GAMES ACCELERATOR PROGRAMME: PROVIDING MENTORSHIP AND GUIDANCE FOR START-UPS TO SCALE AND GROW

BATTLEBREW PRODUCTIONS

Battlebrew Productions is a Singapore-based gaming start-up started by several developers who had worked at reputable gaming studios in the region. Beyond leveraging deep technical expertise from mobile gaming experts, the programme offered start-up lessons on business development. These include guidance on shaping the company culture, aligning goals of founders and employees, as well as practical tips on how to resolve human resource challenges. The co-founder and CEO, Shawn Toh, remarked, "Getting them to dissect your work and also just knowing that they faced similar struggles is an amazing experience. We also got more insight into the Google side of things and a little bit of what goes on behind the scenes, and that was helpful."¹³⁸ During the programme, the studio was introduced to Android Vitals, an initiative that displays an app's performance metrics to improve its stability and performance of Android devices, and the **Android Open Beta Programme**, which allows selected users to try new apps and features before they are officially released to the general public. Battlebrew has since developed popular mobile games such as BattleSky Brigade Tap Tap which was downloaded more than 300,000 times.¹³⁹



Photo Source: <https://cnalifestyle.channelnewsasia.com/trending/battlebrew-battlesky-brigade-tap-tap-singapore-gaming-company-12126790>

138. Vulcan Post (2019), "Like Playing On The Hardest Level/ - Indie Game Studios On What Developing Games In S'pore Is Like".

Available at: <https://vulcanpost.com/652953/indie-game-developers-singapore-google-accelerator/>

139. CAN Lifestyle (2019), "Nerf battles and banana costumes: Welcome to work at this Singapore gaming company".

Available at: <https://cnalifestyle.channelnewsasia.com/trending/battlebrew-battlesky-brigade-tap-tap-singapore-gaming-company-12126790>

BOX 9. GOOGLE'S NETWORK INFRASTRUCTURE INVESTMENTS IN SINGAPORE

By improving the capacity of network services, investments in network infrastructure such as edge infrastructure allow local Internet service providers to better manage higher Internet traffic and enable faster data transfers. These in turn allow them to deliver innovative services such as cloud services, video conferencing and gaming. Google's infrastructure investments in the APAC region have contributed to the decline in the cost of international bandwidth – Internet Protocol (IP) transit prices in Singapore are amongst the lowest in the region, at around 79 percent lower than countries which are less well-connected.¹⁴⁰ In addition, Google is an investor in four subsea cable systems that land in Singapore, namely SJC, Indigo, Echo and Apricot.¹⁴¹ For instance, Echo is the first-ever cable that will directly connect the United States to Singapore and will decrease latency for users connecting to applications running the Google Cloud Platform (GCP) regions in the area.¹⁴² A recent study found that by allowing for increased business activity through higher rates of Internet use, Google's investments in network, submarine cables and edge infrastructure in APAC collectively contributed a total USD9 billion to Singapore's GDP cumulatively from 2010 to 2019, and are expected to contribute an additional USD2 billion to USD16 billion from 2020 to 2024.¹⁴³ The study also found that Google's network infrastructure investment spurred job creation through two channels: direct job creation in the construction and telecommunications sectors, and indirect job creation facilitated by the improvement of broadband connectivity (especially in the IT, financial services and manufacturing sectors). The same study estimated that a total of 8,600 jobs were created in Singapore as a result of Google's network investments in APAC in 2019.



140. Analysys Mason (2020), *Economic impact of Google's APAC network infrastructure – Focus on Singapore*.

Available at: <https://www.analysismason.com/contentassets/b8e0ea70205243c6ad4084a6d81a8aa8/singapore-country-chapter.pdf>

141. Google (2021), "Announcing Apricot: a new subsea cable connecting Singapore to Japan". Available at: <https://cloud.google.com/blog/products/infrastructure/new-apricot-subsea-cable-brings-more-connectivity-to-asia>

142. Google Cloud (2021), "This bears repeating: Introducing the Echo undersea cable".

Available at: <https://cloud.google.com/blog/products/infrastructure/introducing-the-echo-subsea-cable>

143. Analysys Mason (2020), *Economic impact of Google's APAC network infrastructure – Focus on Singapore*.

Available at: <https://www.analysismason.com/contentassets/b8e0ea70205243c6ad4084a6d81a8aa8/singapore-country-chapter.pdf>

GOOGLE’S ECONOMIC IMPACT IN SINGAPORE



BUSINESS BENEFITS

Google supports **SGD2.4 BILLION (USD 1.7 BILLION)** in annual benefits to businesses in Singapore¹



Google Search saves the average Singaporean employee about **3.4 DAYS PER YEAR** through almost instantaneous access to information online



CONSUMER BENEFITS

Google supports **SGD2.4 BILLION (USD 1.7 BILLION)** in annual benefits to consumers in Singapore²



The average Singaporean **Google Search** user saves **3.7 DAYS A YEAR** looking for answers, as compared to traditional offline methods



57% of surveyed Singaporeans indicated that their organisation has made use of **Google Workspace** tools to facilitate teamwork and coordination while working from home



Google Maps reduces driving times by **7.8 HOURS**, and shaves off over **10.8 HOURS** of commute time on public buses and trains per year



SOCIETAL BENEFITS



Revenue gains from the use of Google products indirectly support around **6,600 jobs** in Singapore. The Android operating system also supports more than **49,500 jobs** in Singapore's economy



To serve underprivileged youths,³ Google launched the **“Code in the Community”** programme to bring free coding classes to **6,700** youths in 2020 to 2022

1. Business benefits refer to the estimated economic impact from the following products: Google Search; Google Ads; YouTube; AdSense; and Google Play.
 2. Consumer benefits refer to the estimated economic impact from the following products: Google Search; Google Maps; YouTube; Google Drive; Docs, Sheets and Photos; Google Play.
 3. Underprivileged youths refer to children from low-income families.
 Note: All data is based on AlphaBeta analysis using a range of original and third-party sources. See Appendix in report for detailed methodology. Figures are estimated based on the latest available annual data at the time of study in February 2021.

3.2 BENEFITS OF GOOGLE SEARCH AND OTHER TECHNOLOGIES TO BUSINESSES, CONSUMERS AND SOCIETY

Google's applications and services, such as Google Search, Google Ads and Google Maps, bring about various economic benefits in Singapore. This study finds that the annual economic value presented by Google's applications and platforms is worth SGD2.4 billion (USD1.7 billion) for businesses and SGD2.4 billion (USD1.7 billion) for consumers.¹⁴⁴ An overview of the assessed economic benefits of Google products to businesses and consumers in Singapore is provided in

Exhibit 6. It is important to note that these benefits relate to direct economic benefits received, and do not include the flow-on economic effects generated (see Box 10 for further details). In addition, Google brings intangible benefits to the broader society by supporting non-profit organisations, enabling safe Internet use, championing environmental sustainability, and providing access to digital skilling opportunities to all in Singapore.

BENEFITS TO BUSINESSES

GOOGLE HELPS BUSINESSES BOOST THEIR REVENUES

Google applications broaden the reach of Singaporean businesses to new customers and markets, allowing them to boost their revenues. Online advertising platforms such as **Google Ads** and **YouTube** allow businesses to conduct targeted advertising, bringing their products and services to the right audiences and growing their customer base. **Google Ads** is estimated to generate SGD1.8 billion (USD1.3 billion) annually in the form of net returns to businesses in Singapore from advertising on Google Search results of relevant keywords.¹⁴⁵ Beyond search advertising, Singaporean businesses also benefit from displaying advertisements on Google's network of publisher sites such as websites, blogs, and forums through **AdSense**. These net returns are estimated at SGD22 million (USD16 million) annually. Meanwhile, by leveraging the various formats of advertisements enabled by **YouTube**, businesses are estimated to achieve SGD131 million (USD95.2 million) net

advertising returns annually.¹⁴⁶ Box 11 illustrates how local SMEs were able to modernise their business and expand overseas through Google Ads and YouTube, while Box 12 shows the wider contributions made by Google to support the country during the crisis.

In addition, Google provides new sources of income for content creators in Singapore. By allowing content creators such as online journalists, media sites, bloggers and writers to earn income by hosting advertisements on their sites, AdSense is estimated to have helped content creators in Singapore monetise space on their websites, and generate a total annual income of SGD68 million (USD49.4 million). YouTube also benefits video content creators in Singapore who earn revenue through placing advertisements on their videos. This is estimated to bring content creators in Singapore a total of SGD53 million (USD38.8 million) in annual advertising revenue. Box 13 illustrates examples of how YouTube videos enable enterprising content creators to capitalise on this platform to build a ground-up business with a community of followers.

144. The products included in these estimations include Google Search, Google Ads, AdSense, YouTube, Google Play, Google Maps, Google Drive, and Google Docs, Sheets and Photos.

145. This refers to the increase in revenues and sales that can be directly attributed to advertising minus the related advertising expenditure.

146. This refers to the increase in revenues and sales that can be directly attributed to advertising minus the related advertising expenditure.

EXHIBIT 6:

OVERVIEW OF BENEFITS ANNUALLY SUPPORTED BY GOOGLE IN SINGAPORE

TYPE OF BENEFIT	EASE OF ACCESS TO INFORMATION 	ENTERTAINMENT AND ENRICHMENT 
RELEVANT PRODUCT/S	Google Search	YouTube, Google Play & Android
BUSINESS BENEFITS	<ul style="list-style-type: none"> By allowing for almost instantaneous access to information online, Google Search helps businesses save 3.4 days a year per worker in Singapore 	<ul style="list-style-type: none"> App developers in Singapore earn about SGD289 million (USD210 million) in revenue from both domestic and international markets through the Google Play platform per year Android enables app developers to save up to 25% of development time and target more than 1 billion users worldwide¹
CONSUMER BENEFITS	<ul style="list-style-type: none"> By providing almost instantaneous access to information, the average Google Search user in Singapore saves about 3.7 days looking for answers online each year The total annual consumer benefits derived from Google Search are estimated at SGD529 million (USD384 million) 	<ul style="list-style-type: none"> Consumers can choose from over 3.5 million apps available on the Android ecosystem² By gaining access to a range of digital entertainment options through Google Play and YouTube, the consumer surplus benefits of this platform to consumers in Singapore are estimated at SGD842 million (USD611.4 million) annually

1. App Annie (2017), "Top Predictions for the App Economy in 2018". Available at: <https://www.appannie.com/en/insights/market-data/predictions-app-economy-2018/>

2. Net advertising benefits refer to additional revenue earned from advertising less the advertising cost.

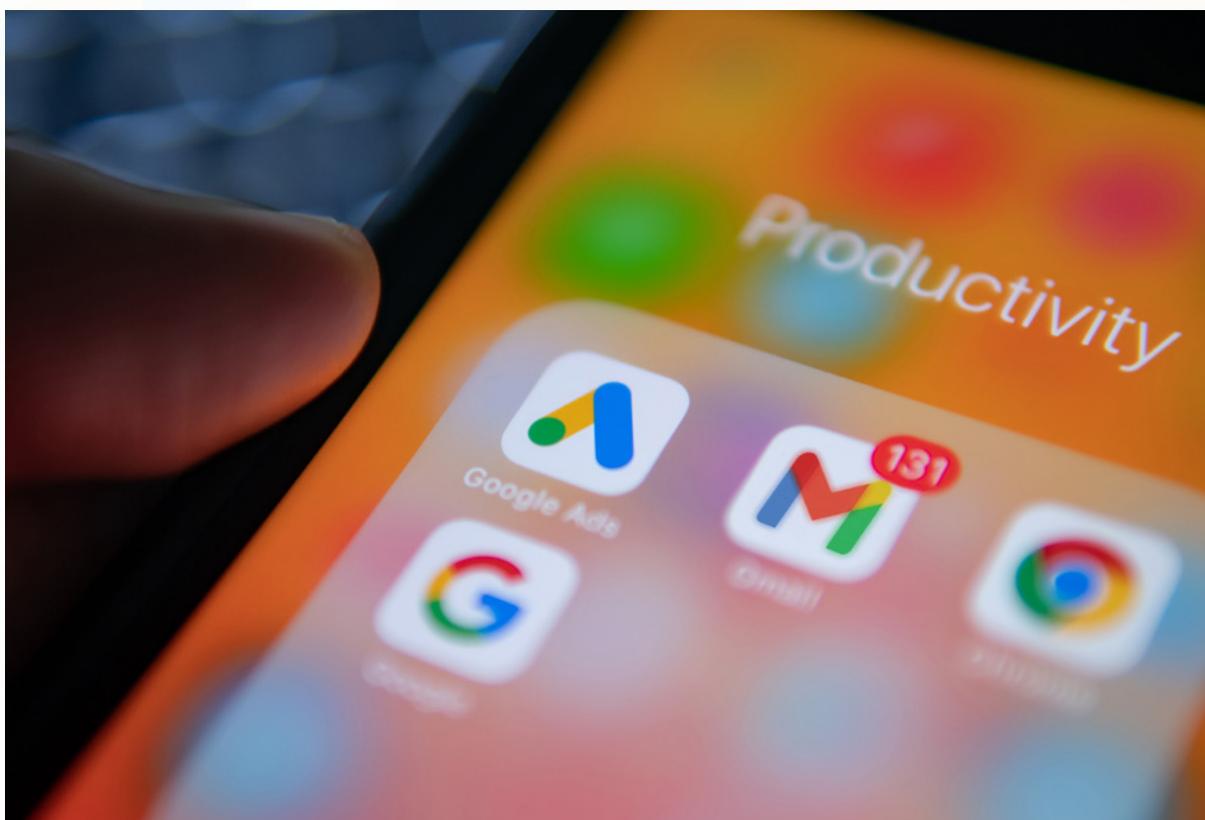
Note: Figures are estimated based on the latest available annual data at the time of study in February 2021.

SOURCE: AlphaBeta analysis

<p>INCREASED PRODUCTIVITY AND CONVENIENCE</p> 	<p>ADVERTISING BENEFITS</p> 	<p>TOTAL BENEFITS:</p>
<p>Google Maps, Drive, Photos, Docs & Sheets</p> <ul style="list-style-type: none"> • Business Profile (previously called Google My Business) function in Google Maps allows customers to discover local businesses. Globally, the additional revenue earned by small and medium-sized businesses as a result of Business Profile has been estimated to be between USD212-250 per year 	<p>YouTube, Google Ads & AdSense</p> <ul style="list-style-type: none"> • Google Search and Ads bring about SGD1.81 billion (USD1.3 billion) in net advertising benefits to businesses in Singapore annually² • Web publishers and content creators in Singapore earn about SGD121 million (USD88.2 million) in revenue from AdSense and YouTube annually • Advertisers in Singapore gain SGD153 million (USD111 million) in net advertising benefits annually from displaying advertisements on websites and videos using AdSense and YouTube² 	
<ul style="list-style-type: none"> • The total annual consumer benefits derived from productivity-enhancing tools of Google Maps, Drive, Photos, Docs, and Sheets are estimated at SGD1 billion (USD738 million) • 57% of surveyed Singaporeans indicated that their organisation has made use of Google Workspace tools to facilitate teamwork and coordination while working from home 	<p>Nil</p>	<p>SGD2.4 BILLION (USD1.7 BILLION)</p>

BOX 10. MEASURING THE BENEFITS OF GOOGLE'S PRODUCTS TO BUSINESSES AND CONSUMERS

The benefits of Google's products to businesses and consumers estimated in this research focus on the direct economic impact received by them. Because of the different nature of the benefits experienced from the products, different approaches were utilised for businesses and consumers. The business benefits supported by Google include the gross revenue, income or savings generated by businesses using Google products. It is important to note that these benefits do not include the flow-on economic effects generated, such as further purchases from their suppliers, or the economic activity generated by the employees of these businesses who spend their wages in the broader economy (indirect or induced spend). This is because of the intention to gauge the direct impacts that business users of Google's products receive. On the other hand, for benefits to consumers, it is important to note that these are challenging to measure and calculate because individuals typically do not pay for the services. In the absence of price indicators, the economic "willingness to pay" principle was used to estimate the value of consumer benefits by asking individuals how much they value specific products. Time savings accrued to consumers from their use of Google Maps (which optimises their driving and public transport journeys) and Google Search (which increases the efficiency of information gathering) were also measured to derive a measure of the convenience these products bring to them. Appendix B shows a detailed methodological explanation of how the benefit of each product was sized.



BOX 11.

GOOGLE'S ADVERTISING PLATFORMS BRING TRADITIONAL BUSINESSES ONLINE AND ENABLE SMES TO EXPAND BEYOND SINGAPORE'S SHORES

BRINGING TRADITIONAL BUSINESSES ONLINE

By accessing Google's advertising platforms, many traditional businesses in Singapore, including those in the F&B and cleaning services sectors, utilised digital channels to promote their goods and services and experienced higher growth and sales through more effective digital marketing campaigns. OfficeCleans SG, for example, is a local home and office cleaning business started by Lily Loo in 2014. Initially, Lily was "cold-calling" and emailing potential customers. However, it was hard for her to reach out to potential customers at the right time when they required her cleaning services, and her cleaners were not necessarily digitally savvy. In 2015, Lily decided to explore digital tools, such as Google AdWords, to enhance business leads. OfficeCleans also began building a database of cleaners and designed its mobile app that leverages Google Maps Application Programming Interface (API) to search for potential cleaners closest to the assignment's location. Within three years, the company generated SGD4 million (USD2.9 million) in revenue and the digital advertising campaign achieved more than 800 percent return on investment.¹⁴⁷ In addition, the customer lifetime value doubled, and its customer base expanded rapidly. Albeit its lean operations, the company has successfully gained global clients such as Boeing, LG and Deliveroo.

Launched in 2001, Lamitak supplies eco-friendly, innovative, design-led high-pressure laminates to its professional customer base of architects, interior designers and carpenters. However, the company found it hard to reach this customer audience. To capture a larger share of the consumer market, Lamitak decided to raise awareness about its brand to aspiring homeowners. The company crafted a comprehensive digital strategy that utilised Google Ads to ensure their business listing would be recommended to potential customers making both brand-specific and general searches. In addition, Lamitak advertised on websites that were relevant and frequently visited by their target audience through Google Display Network. Within three months, nearly 1,000 customers registered on its website to receive more information via email and its unique website visitors increased by 225 percent.¹⁴⁸

147. Vulcan Post (2019), "This S'porean Is Sweeping In \$4M With Her Cleaning Company, And It All Started From Household Chores".

Available at: <https://vulcanpost.com/646868/lily-foo-cleaning-company-singapore/>

148. Google Ads (2021), "Lamitak grows its web traffic by 225% by using Google Ads".

Available at: https://ads.google.com/intl/en_sg/home/success-stories/lamitak/

BOX 11. (CONT'D) GOOGLE'S ADVERTISING PLATFORMS BRING TRADITIONAL BUSINESSES ONLINE AND ENABLE SMES TO EXPAND BEYOND SINGAPORE'S SHORES

ENABLING SMES TO EXPAND BEYOND SINGAPORE'S SHORES

Besides launching effective digital marketing campaigns in Singapore, Google Ads and YouTube enable businesses to expand their customer outreach to overseas markets. Homegrown gaming chair retailer, Secretlab, optimised its digital marketing strategy using Google Display and Shopping ads to reach customers in Australia and the United States. Within six months of using Google's advertising tools, the company experienced over 170 percent growth in paid conversions year on year.¹⁴⁹ Secretlab has since expanded to over 13 countries, including Japan, South Korea, Europe and Canada.



Photo Source: <https://www.techinasia.com/secretlab-singapores-billiondollar-company>

149. Geek Culture (2019), "Gaming Chairs Get A Whole Lot Bigger With The Secretlab TITAN XL". Available at: <https://geekculture.co/gaming-chairs-get-a-whole-lot-bigger-with-the-secretlab-titan-xl/>

BOX 12.

GOOGLE'S CONTRIBUTIONS TO THE GOVERNMENT AND BUSINESSES DURING THE COVID-19 PANDEMIC

SAFEGUARDING PUBLIC HEALTH AND ENABLING EFFICIENT INFORMATION DELIVERY

In partnership with the World Health Organization (WHO) and the Ministry of Health (MOH), Google is working with the government to make resources about COVID-19 more easily accessible through information panels on **Google Search** and **YouTube**. Google has also been marking up frequently asked questions on Google Search to help Singaporeans access important public health information such as the number of masks on the **MaskGoWhere** site. As public health authorities ramp up vaccination drives, Google has made COVID-19 vaccination locations available in Google Search and **Google Maps** so users can easily find the nearest centre when they are eligible to receive a vaccine.¹⁵⁰ A search for "COVID-19 vaccine centres near me" on Google Search and Google Maps displays a list of vaccination centres across the island, including a callout on instructions for making vaccination appointments.



SUPPORT JOB SEEKERS TO FIND EMPLOYMENT OPPORTUNITIES

Albeit introduced before the pandemic in 2018, the **Google Search** job feature provides a comprehensive listing of jobs across the web and enables job seekers to find jobs efficiently, which is particularly helpful amid the rise in the number of job seekers during the COVID-19 pandemic.¹⁵¹ The job search feature provides hundreds of thousands of job listings from more than 1,500 sites, including MyCareersFuture.sg, FastJobs, JobsCentral, LinkedIn, Monster, Payscale and Randstad. By searching for keywords such as "software developer jobs", Google Search filters for job listings based on job type, location, posting date, or company type, that can be expanded to open an at-a-glance view of comprehensive information about the posting. Users who click on the listing are then directed to the job listing page on the respective website to submit their applications.

150. Google The Keyword (2021), "How we're helping get vaccines to more people". Available at: <https://blog.google/technology/health/vaccines-how-were-helping/>

151. Google (2018), "First in South East Asia: Google launches new search experience for job seekers in Singapore". Available at: <https://docs.google.com/document/d/1qHSGilpHGdY1agcVN9QUsi-aONP0w5ztbA43s-oSVas/edit>

BOX 12. (CONT'D)

GOOGLE'S CONTRIBUTIONS TO THE GOVERNMENT AND BUSINESSES DURING THE COVID-19 PANDEMIC

ENABLING REMOTE WORKING ARRANGEMENTS DURING THE PANDEMIC

As more businesses adjust to work-from-home arrangements during the COVID-19 pandemic, the **Google Meet** premium video-conferencing software was made available free of charge to all Singaporean businesses. This allowed companies to stay connected and work remotely from anywhere on the glob.¹⁵² The video-conferencing software features a set of security controls that are turned on by default to prevent counter-abuse and help protect data and safeguard privacy. In April 2020, Google Meet hosted three billion minutes of video meetings globally and added roughly three million new users worldwide daily.

SUPPORTING BUSINESS CONTINUITY

On **Google Pay**, a mobile payment app that enables contactless transactions, food and beverage establishments can list their menus on the free "Menu Discovery" feature to help strengthen their online presence. Launched during Singapore's circuit breaker where the food services industry saw reduced footfall, the menu discovery option helps businesses increase their discoverability. Customers can browse menus, select items and contact the food establishment to place their order and pay. As of February 2021, close to 2,000 food merchants have joined the Google Pay platform.

Additionally, as of September 2020, consumers of three local banks could link their bank accounts to Google Pay to pay anyone in Singapore through PayNow, an electronic fund transfer service, including online payments to businesses through their unique entity number (UEN) or PayNow Quick Response (QR) codes.



152. Google The Keyword (2020), "Google Meet premium video meetings—free for everyone". Available at: <https://blog.google/products/meet/bringing-google-meet-to-more-people/>

BOX 13.

YOUTUBE BECOMES AN INSTRUMENTAL PLATFORM FOR LOCAL CONTENT CREATORS TO BUILD A GROUND-UP BUSINESS WHILE PURSUING THEIR PASSION IN MEDIA AND ENTERTAINMENT

JIANHAO TAN (4.9 MILLION SUBSCRIBERS)¹⁵³

Founded in 2010, the YouTube channel was started by JianHao who took on YouTube as a full-time job after national service. After attaining one million subscribers on his channel in 2017, JianHao further cements his belief that YouTube is the most effective social media platform. By extracting data from YouTube analytics, JianHao improved on his videography and increased audience engagement. Today, his comedy sketches and “types of people” videos on the channel have attracted over 4.5 million subscribers and his marriage proposal video topped the list of Most Watched Creator Videos in Singapore in 2019. With a large part of his life documented on YouTube, JianHao launched “Jebbey Family”, a vlog channel dedicated to documenting his family life in 2019 and has a huge following of 500 thousand subscribers. With a cumulative following of seven million subscribers globally on YouTube, JianHao Tan’s Titan Digital Media expanded over the years and now owns ten YouTube channels covering categories across lifestyle, gaming, beauty, kids, food and more. The company currently hires 30 full-time team members on its payroll.

WAH!BANANA (1.3 MILLION SUBSCRIBERS)¹⁵²

Founded in 2012 with 90 percent of its audience from Singapore, Wah!Banana started out producing gaming-related content on YouTube and soon discovered a demand for local comedy. Over time, the channel gained audiences from overseas markets such as Malaysia, Indonesia, Australia, India and the Philippines, and the share of audiences from Singapore dropped to less than 40 percent. With over 1.3 million subscribers, the YouTube channel hires seven full-time employees and engages about a dozen talents. They are also well-known for their listicle videos such as their ‘Types of’ series, ‘How people ____’ series where they do parodies of common behaviours and ‘VS’ series where they show comparisons of people or situations.

NIGHT OWL CINEMATICS (1 MILLION SUBSCRIBERS)¹⁵²

Founded in February 2013 by co-founders Ryan Tan and Sylvia Chan, Night Owl Cinematics was established as a practice platform for the duo to improve their storytelling and videography skills as wedding videographers.¹⁵⁴ Over time, the YouTube channel developed into an official comedy channel driven by their shared passion to entertain. At the same time, the content celebrates and captures the quirks and spirit of the Singaporean culture by telling compelling stories close to their heart while giving a voice to fellow Singaporeans.

153. The subscriber count was the most updated figure captured at the time of writing in October 2021.

154. CNA (2020), “The Big Read: Power, fame and fortune - a glimpse into Singapore’s lucrative YouTube industry”.

Available at: <https://www.channelnewsasia.com/news/singapore/singapore-youtube-industry-social-media-influencers-vloggers-12254882>

Google’s digital product distribution system, **Google Play**, as well as its operating system, **Android**, have resulted in a variety of benefits to Singaporean app developers. App developers were estimated to have earned an annual income of about SGD289 million (USD210 million) from Google Play in both the domestic and global markets.¹⁵⁵ Further, through the Android operating system, app developers in Singapore can readily reach more than one billion users globally.¹⁵⁶ It was additionally found that Android app developers can save up to 25 percent in development time from not having to port their apps across different operating systems.¹⁵⁷

Exhibit 7 summarises the estimated business benefits in the form of revenue gains experienced by Singaporean

businesses from Google Search and Ads, YouTube, AdSense and Google Play.¹⁵⁸

GOOGLE HELPS BUSINESSES INCREASE PRODUCTIVITY AND SAVE TIME

Google helps businesses save time by enhancing employees’ productivity by improving the speed and ease of access to information and research. In particular, **Google Search** minimises the time for businesses to acquire information by arranging and simplifying the vast array of content on the Internet. The ability to rapidly find relevant data and information provides tremendous productivity benefits for employees, with each employee saving on average about 3.4 days annually. **Google Workspace** also plays an

EXHIBIT 7:

GOOGLE IS ESTIMATED TO BRING ABOUT SGD2.4 BILLION (USD1.7 BILLION) WORTH OF ANNUAL BENEFITS TO BUSINESSES IN SINGAPORE

PRODUCT	DESCRIPTION OF BENEFITS	ESTIMATED ANNUAL BENEFITS
Google Search & Ads	Net advertising benefits for businesses ¹	SGD1.8 billion (USD1.3 billion)
AdSense	Net advertising benefits for businesses ¹	SGD22 million (USD16 million)
	Income generated by website publishers through AdSense	SGD68 million (USD49.4 million)
YouTube	Net advertising benefits for businesses ¹	SGD131 million (USD95.2 million)
	Advertising revenue earned by YouTube video creators	SGD53 million (USD38.8 million)
Google Play	Income generated by app developers in Singapore from both the domestic and international markets through Google Play	SGD289 million (USD210 million)
TOTAL ANNUAL BUSINESS BENEFITS IN SINGAPORE:		SGD2.4 BILLION (USD1.7 BILLION)

1. Net advertising benefits refer to additional revenue earned from advertising less the advertising cost.

Note: Figures are estimated based on the latest available annual data at the time of study in February 2021. Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis

155. Google Play is a digital distribution service operated and developed by Google. It serves as the official app store for the Android operating system, which refers to the mobile operating system developed by Google for touchscreen mobile devices such as smartphones and tablets. Google Play users are able to browse and download applications developed with the Android software development kit.

156. AlphaBeta (2018), "AlphaBeta research brief: The estimated economic impact from Android across five Asian markets".

Available at: <https://www.alphabeta.com/wp-content/uploads/2017/08/180820-Android-Economic-Impact.pdf>

157. AlphaBeta (2017), Android impact: How the Android ecosystem supports economic impact in South Korea.

Available at: https://www.alphabeta.com/wp-content/uploads/2017/08/South-Korea-Android-Economic-Impact_Aug2017.pdf

158. While the benefits to Ad Grants are in the form of free advertising provided to non-profits (not returns on advertising), they are also included in this section as this amount of free advertising will also lead to increased donor interest and funding for non-profits.

integral role in enabling workers to collaborate more easily, particularly during the COVID-19 pandemic. Through features such as Chat and Drive, employees can dynamically create and collaborate on a document with others in a Chat room. According to AlphaBeta

research, about 57 percent of surveyed Singaporeans indicated that their organisation has made use of Google Workspace tools to facilitate teamwork and coordination while working from home.

BENEFITS TO CONSUMERS

CONSUMERS IN SINGAPORE EXPERIENCE TOTAL ANNUAL BENEFITS WORTH SGD2.4 BILLION (USD1.7 BILLION) FROM GOOGLE’S SERVICES

The consumer benefits supported by Google are challenging to measure and calculate because individuals typically do not pay for the services. In the absence of price indicators, the economic “willingness to pay” principle was adopted to estimate the value of consumer benefits by asking individuals how much they value specific products (see Box 10). Taken together, the total value placed by consumers on these products – which takes into account their perceived functionality and ease of using these products – is estimated at SGD2.4 billion (USD1.7 billion). This value includes three main categories of benefits provided by Google applications: ease of access to information (Google Search), entertainment and enrichment (Google Play and YouTube), and enhanced productivity and convenience (Google Maps, Drive, Photos, Docs and Sheets). Exhibit 8 shows the breakdown of consumer surplus by category.

GOOGLE ENABLES CONSUMERS BETTER ACCESS TO INFORMATION

Google provides benefits to consumers in Singapore by allowing them to instantly access a vast array of information online. The total annual consumer surplus brought about by **Google Search** was estimated at SGD529 million (USD384 million) (Exhibit 8). Based

on an international study showing that a search for a piece of information that takes 21 minutes in the library takes only seven minutes online, it is estimated that Google Search saves Singaporean consumers an average of 3.7 days per year.¹⁵⁹ According to AlphaBeta research, over 30 percent of Google Search users in Singapore say they use online search engines to research self-enrichment, such as learning new skills.¹⁶⁰

GOOGLE’S SERVICES IMPROVE PRODUCTIVITY AND CONVENIENCE FOR CONSUMERS IN SINGAPORE

Google Maps brings about productivity in the public transport and driving journeys of Singaporean citizens through the service’s wayfinding and navigation feature, which optimises these trips using real-time data such as public transport arrival times and road traffic conditions. Commuters who use Google Maps to optimise their public transport journeys are estimated to save over 10.8 hours per year on buses and trains. Drivers spent 7.8 hours less on the roads per year by using Google Maps to optimise their driving journeys (Exhibit 9). By displaying business listings on the map, users can conveniently locate, discover and obtain the most complete and up-to-date information about local businesses. According to AlphaBeta research, over 60 percent of respondents in Singapore have tried to locate restaurants and a similar share of respondents tried locating offices of business partners and/or clients by using Google Maps.

159. Yan Chen, Grace Young Joo Jeon and Yong-Mi Kim (2014), A day without a search engine: an experimental study of online and offline search. *Experimental Economics*. Available at: <https://link.springer.com/article/10.1007/s10683-013-9381-9>

160. Google/AlphaBeta Economic Impact Report survey, n = 501. Percent represents use of online search engines to conduct research for self-enrichment amongst Singaporeans for whom Google Search is their most frequently used online search engine.

In addition, by allowing digital data to be stored and accessed through multiple devices including laptops, tablets and smartphones, Google’s cloud-based services such as **Google Drive, Photos, Docs, and Sheets** provide great convenience to Singaporean consumers. These services enable them to manage files, folders, music and photos on the fly – without having to retrieve the information from a piece of hardware. The total annual consumer benefits derived from productivity-enhancing tools of Google Maps, Drive, Photos, Docs, and Sheets are estimated at SGD1 billion (USD738 million).

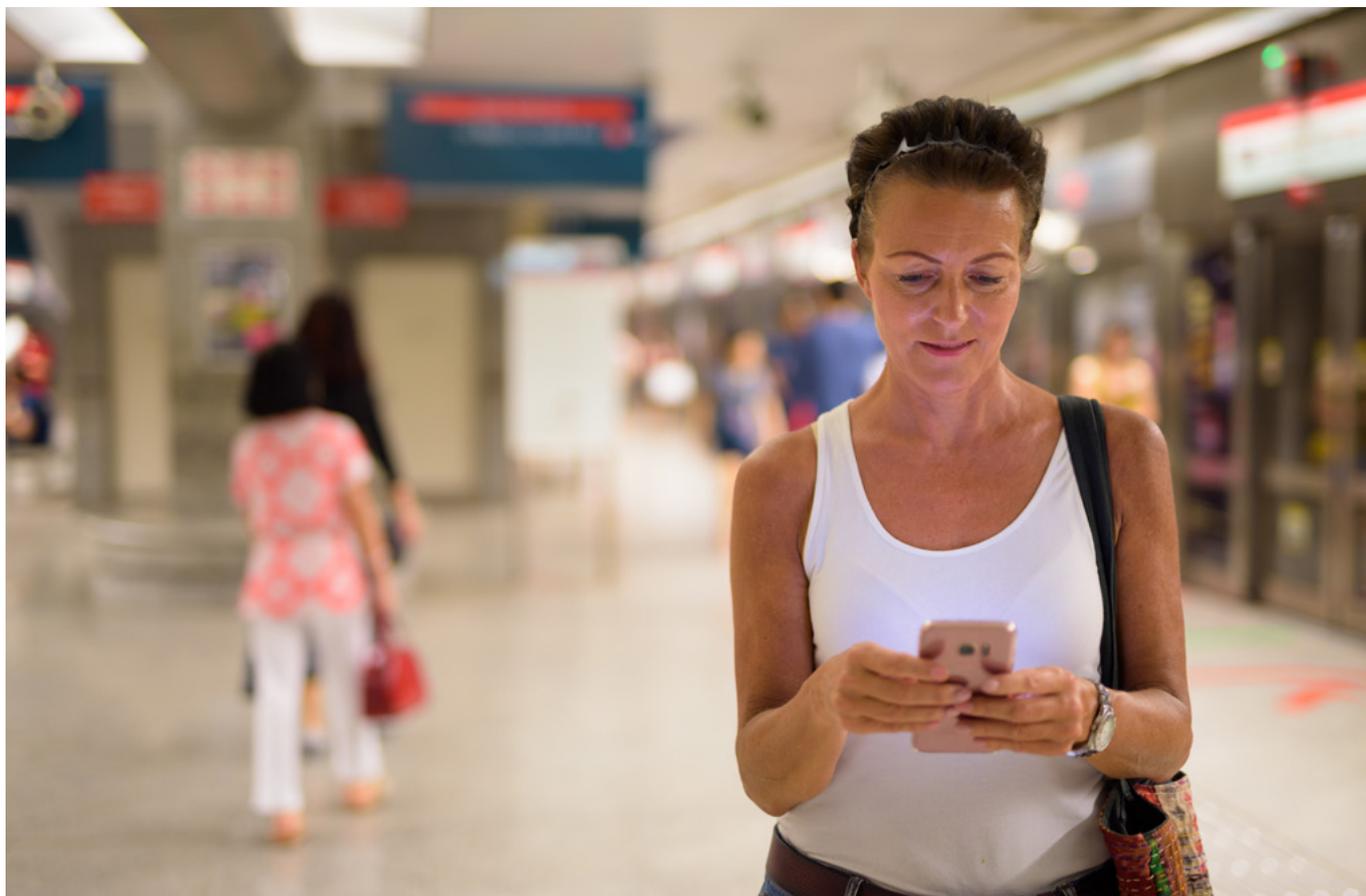
GOOGLE PROVIDES VARIOUS OPTIONS FOR ENTERTAINMENT AND ENRICHMENT

YouTube has presented substantial benefits to consumers as a source of free entertainment as well as a channel for consumers to learn new

skills (e.g., online “how-to” videos) or gain new knowledge (e.g., online documentaries). According to AlphaBeta research, over 30 percent of YouTube users in Singapore say they use online video services to learn advanced digital skills such as coding, software programming, and mobile application and website development.¹⁶¹

Google Play and **Android** have also brought a variety of benefits to Singaporean consumers. For example, Android enables consumers to choose from over 3.5 million apps available on the Android ecosystem.¹⁶² Meanwhile, **Google Play** is a convenient platform for consumers to access a range of smartphone applications, as well as digital books, music and films.

YouTube and Google Play are estimated to bring a total consumer surplus of SGD842 million (USD611.4 million) to consumers in Singapore annually.¹⁶³



161. Google/AlphaBeta Economic Impact Report survey, n = 501. Percent represents use of online video services to learn advanced digital skills amongst Singaporeans for whom YouTube is their most frequently used online video service.

162. App Annie (2017), “Top Predictions for the App Economy in 2018”. Available at: <https://www.appannie.com/en/insights/market-data/predictions-app-economy-2018/>

163. Google/AlphaBeta Economic Impact Report survey, n = 501. The total consumer surplus represents the economic benefits to consumers in Singapore from using Google Play. See more details in Appendix B for the methodology.

EXHIBIT 8:

GOOGLE IS ESTIMATED TO SUPPORT A TOTAL SGD2.4 BILLION (USD1.7 BILLION) WORTH OF ANNUAL CONSUMER SURPLUS IN SINGAPORE

ESTIMATED ANNUAL CONSUMER SURPLUS OF GOOGLE PRODUCTS IN SINGAPORE CONSUMER SURPLUS (SGD)		
TYPE OF BENEFIT	PRODUCT	ANNUAL CONSUMER SURPLUS
Ease of access to information	Google Search	SGD529 million (USD384 million)
Entertainment and enrichment	Google Play	SGD842 million (USD611.4 million)
	YouTube	
Enhanced productivity and convenience	Google Maps	SGD1 billion (USD738 million)
	Google Drive, Photos, Docs and Sheets	
TOTAL ANNUAL CONSUMER SURPLUS:		SGD2.4 BILLION (USD1.7 BILLION)

Note: Figures are estimated based on the latest available annual data at the time of study in February 2021. Numbers may not sum due to rounding.
SOURCE: AlphaBeta analysis

EXHIBIT 9:

GOOGLE’S APPLICATIONS LIKE GOOGLE SEARCH AND GOOGLE MAPS BRING ABOUT TIME SAVINGS TO CONSUMERS

ESTIMATED ANNUAL TIME SAVINGS OF GOOGLE SEARCH AND GOOGLE MAPS TO CONSUMERS AMOUNT OF TIME SAVED PER YEAR	
PRODUCT	ANNUAL TIME SAVINGS PER USER
Google Search	3.7 days per year
Google Maps	7.8 hours per year (driving)
	10.8 hours per year (public transport)

Note: Figures are estimated based on the latest available annual data at the time of study in February 2021.
SOURCE: AlphaBeta analysis

JOB CREATION AND OTHER BENEFITS TO THE BROADER SOCIETY

Google's products also support benefits to the broader society in Singapore. These include the creation of new jobs in its economy (brought about by business expansions enabled by Google's products), as well as other intangible benefits through its programmes and initiatives.

GOOGLE INDIRECTLY SUPPORTS AROUND 6,600 JOBS IN SINGAPORE

At a broader level, Google has facilitated job creation in the economy through its products. Through Google Ads, AdSense and YouTube, Google indirectly supports the creation of around 6,600 jobs in Singapore.¹⁶⁴ These jobs are created through the use of Google products that lead to businesses expanding their customer bases and increasing revenue.¹⁶⁵ For instance, businesses that expand their reach to new markets through advertising via Google Ads, AdSense and YouTube would require increased labour to meet this additional demand.

Through the Android operating system, it was estimated that over 49,500 Singaporeans were employed in jobs that were linked to Android in 2020.¹⁶⁶ This includes more than an estimated 16,500 Singaporeans who are employed directly in Android app development jobs. In addition to this direct employment, Android generates employment through indirect jobs (non-tech-related jobs within the app economy), as well as spillover jobs (jobs created outside of the app industry, such as firms supplying app developers with products and services).

GOOGLE PROVIDES ACCESS TO DIGITAL SKILLING OPPORTUNITIES FOR ALL

These benefits are a result of the use of Google products or direct initiatives and strategic partnerships Google has engaged in Singapore. Beyond the digital

skills programmes discussed in Chapter 3.1, the company's products and programmes provide a range of societal benefits through supporting broader human capital development and raising awareness on online safety. Box 14 provides further examples of how Google supported Singaporeans from disadvantaged backgrounds by contributing SGD1 million to bring free coding classes to 6,700 young Singaporeans via the **Code in the Community** programme.

GOOGLE ENSURES SAFE AND SECURE INTERNET USE

Google helps parents to create a safe online environment for children by developing family-friendly online safety tools such as **YouTube Kids**, **Family Link**, and **Google SafeSearch**. Through **YouTube Kids**, kids can explore YouTube and watch their favourite shows in a contained environment that makes it easier for parents and caregivers to guide their journey. Families can also visit the **Google Safety Center** to learn tips on how to keep the family safe online. In addition, Google conducts **Internet Safety Workshops** for parents and children to learn how to protect themselves online while being kind to others.

In response to concerns raised in a survey conducted by Google on parents and teachers, Google launched an interactive event, **Online Safety Park** to educate children on how to navigate the Internet confidently and safely in four key areas – privacy and security (**Be Internet Strong**), care in information sharing (**Be Internet Smart**), flagging inappropriate content (**Be Internet Brave**) and preventing cyberbullying (**Be Internet Kind**) among children.¹⁶⁷ Together with the Media Literacy Council (MLC), Google hosted over 100 primary school students, teachers, parenting media and bloggers for an **Online Safety Park** experience held at Google's office in 2019.¹⁶⁸ The interactive event brought children through daily scenarios like

164. Refers to jobs supported by Google Ads, AdSense and YouTube. The job estimate excludes revenue gained by website publishers who use AdSense and YouTube video creators as it may comprise freelancers and individuals who publish websites and videos recreationally, and thus do not fall under any formal industry sector.

165. Jobs supported refer to new jobs that may have been created through a business' use of Google's platforms, as well as ongoing employment of jobs that previously existed.

166. Based on AlphaBeta estimates. See Appendix B for details on methodology.

167. Google (2021). Available at: https://beinternetawesome.withgoogle.com/en_us

168. Today Singapore (2019). "Students pick up tips on staying safe online – and being kind".

Available at: <https://www.todayonline.com/singapore/students-pick-tips-staying-safe-online-and-being-kind>

the bus stop and the bedroom, where they would encounter experiences that mirror online threats and test their ability to navigate the web safely. To keep the momentum going, MLC and Google also collaborated in 2020 to help primary school students learn about online safety virtually through a free browser-based game, Interland. Through this initiative, over 2,000 children took up the **Be Internet Awesome** curriculum. In 2021, Google partnered with IMDA for the **Digital For Life** national movement in 2021 to empower Singaporeans with digital technologies. Through this movement, Google and the National University of Singapore’s (NUS) Teach Singapore volunteer community aims to bring the **Be Internet Awesome** curriculum to disadvantaged school-going children and youths.¹⁶⁹ NUS students are encouraged to coach and mentor children and youth about staying protected online, as well as upskill their technological know-how.

GOOGLE SUPPORTS NON-PROFIT ORGANISATIONS THROUGH GRANTS

Google’s philanthropic arm, Google.org, has supported The Asia Foundation with a USD3.3-million grant to launch the **Go Digital ASEAN** programme. Endorsed by the Association of Southeast Asian Nations’ Coordinating Committee on MSMEs, the programme aims to equip MSMEs and underemployed youth, particularly those in rural and isolated areas, with crucial digital skills and tools.¹⁷⁰ In Singapore, the foundation is working with the local non-profit organisation, Engineering Good, to empower disadvantaged communities by improving their quality of life through sustainable engineering solutions.

Google.org has also granted USD600,000 to the Ashoka: Innovators for the Public, an organisation that supports the creation of innovative alliances between social entrepreneurs, businesses and governments to address fundamental human needs, helping them launch a six-month capacity-building programme for



28 non-profits from Singapore, Indonesia and India.

The Changemaker Journey programme aims to help non-profits get the tools, knowledge and skills to meet their immediate priorities during the COVID-19 pandemic and sustain their efforts over the long term and build a community where organisations can learn from one another, collaborate, and discover new ideas together.¹⁷¹

Google.org also provided a USD2.5-million grant to the Youth Business International’s **Rapid Response and Recovery Programme**, which is targeted at supporting underserved business owners across Asia through challenging times as a result of COVID-19.¹⁷² In Singapore, the organisation is working closely with TiE Singapore to launch **Project EMERGE**. EMERGE is a ten-month long programme created to aid the recovery and growth of entrepreneurship in Singapore during

169. IMDA (2021), “Playing Games To Be Safe Online”. Available at: <https://www.imda.gov.sg/digitalforlife/stories-listing/google>

170. ASEAN (2020), “Go Digital ASEAN: Digital skills to address the economic impact of COVID-19” Project.

Available at: https://asean.org/storage/2020/06/Factsheet-Go-Digital-ASEAN-as-of-19-June-2020_final.pdf

171. Google The Keyword (2020), “Help for Asia’s change-making nonprofit leaders”.

Available at: <https://www.blog.google/around-the-globe/google-asia/help-for-asias-nonprofit-leaders/>

172. Google (2020), “Youth Business International (YBI): Supporting underserved business owners through challenging times”.

Available at: <https://www.google.com/url?u=https://www.grow.google/intl/uk/story/youth-business-international-ybi-supporting-underserved-business-owners-through-challenging-times&sa=D&source=editors&ust=1625453136390000&usq=AOvVow1QCxM3n-x2v6i9PxMnufco>

BOX 14.

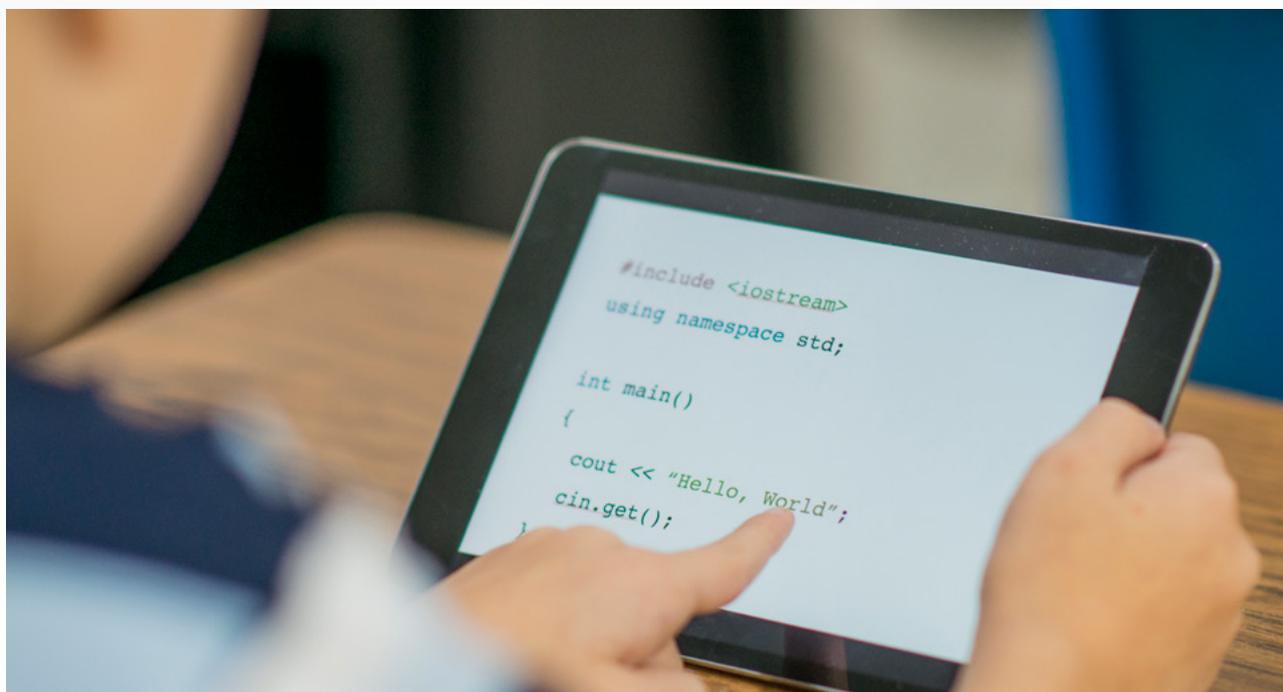
CODE IN THE COMMUNITY AIMS TO BRING FREE CODING CLASSES TO 6,700 YOUNG SINGAPOREANS FROM DISADVANTAGED BACKGROUNDS IN 2020-2022

Supported by Google and IMDA, Code in the Community (CITC) provides disadvantaged children with free, multi-level coding classes to teach them basic coding skills and inspire them to discover and explore technology. The foundational programme teaches pupils aged eight to 12 “Scratch” programming language (using block-based codes), while students aged 13 to 16 were taught “Python” programming language, which is widely used in the tech sector. Since its introduction in 2017, 1,700 volunteers participated in the programme, which has also equipped about 3,460 students from low-income families with basic coding skills from a young age and aims to expand and reach out to 6,700 more young

Singaporeans from disadvantaged backgrounds from 2020 to 2022.¹⁷³ With the expansion, graduates from the foundational programme will be able to go on to a new applications programme, which will introduce more complex concepts and encourage children to apply what they have learnt through activities, such as programming a robot.

IAN SIM, EGAN SIM AND ELI SIM- BENEFICIARIES OF CITC

Ian, Egan and Eli are brothers who were enrolled in CITC after their mother, Carol, learnt about the programme through a Google event a few years ago. The brothers attended their first CITC class



173. The Straits Times (2020), “More free coding classes to benefit kids”. Available at: <https://www.straitstimes.com/tech/more-free-coding-classes-to-benefit-kids>



Photo Source: <https://www.straitstimes.com/lifestyle/parents-mistakes-at-exam-time>

in early 2020 and Carol saw how they had fun creating their games and helping each other out during classes. Through CITC, she noticed that her children have not only become more self-motivated in their learning but were also learning to solve problems independently while developing strong collaboration skills. One of the brothers, Eli, hopes to use his coding skills to help other children appreciate and understand nature and science better, such as learning how to recycle, protect the animals and the environment. After graduating from Scratch level 1, Egan and Eli were offered Science with Code Scholarships (CITCx)¹⁷⁴ to apply their coding knowledge to science topics. Given the financial challenges, Carol appreciates initiatives like CITC that provides an avenue for the brothers to pursue coding education and empowers children to create, solve problems and develop important soft skills.

NURIN HASHA BINTE JUBIR – A CITC VOLUNTEER INSTRUCTOR

Before entering university, Nurin used her spare time to volunteer and fundraise for social services. During the COVID-19 pandemic, she realised the importance of technology and searched for volunteer opportunities to empower children with technology skills. Despite having no prior coding experience, Nurin self-learned the Scratch language through YouTube tutorials and drew inspiration from other coders on the platform to create her own games. In 2021, she joined CITC as a volunteer to teach coding to children. Nurin often encourages her students to imagine and learn independently by giving them an end product and prompting them to think of innovative ways to build their codes and form their own product. As an advocate of creative expression, she sees coding as an effective way to help children develop technical skills through trial and error while giving them the space to express their imagination. She believes that independent and active learning encourages children to think creatively, develop their strengths, and build self-awareness.



Photo Source: <https://www.saturdaykids.com/blog/codeinthecommunity-volunteer-nurin-hasha/>

174. CITCx is an interdisciplinary tech scholarship offered to graduates from CITC with the aim of helping them apply their knowledge in coding to real world topics in Science, Technology, Engineering and Mathematics (STEM). Saturday Kids (2020), "Introducing CITCx: Interdisciplinary Tech Scholarships for Code in the Community graduates". Available at: https://www.saturdaykids.com/blog/citcx-interdisciplinary-tech-scholarships-disadvantaged-kids/?fbclid=IwAR2cDDiDL9lF99gmZwJlI39CkouBqcnPSvzU_GWGec1cmkYwvcuUzVJ4l

the recovery phases of COVID-19.¹⁷⁵ The programme consists of a series of educational and development modules built to aid SMEs and startups as they journey towards and through digitalisation. EMERGE focuses on helping Singapore-based startups and SMEs lay the building blocks of their business and navigate hyper-growth opportunities and challenges related to recovery from the pandemic. At the end of the programme, deserving high-growth startups will have an opportunity to pitch to imminent venture capital investors and enterprise customers for investments and business growth.

Besides supporting businesses, Google contributed over SGD46,000 to support New Hope Community Services (NHCS) efforts in providing food and shelter to over 70 Malaysian workers who were stranded in Singapore when the borders closed at the start of the pandemic.¹⁷⁶ Globally, COVID-19 propagated a mental health crisis of significant proportions. Google supported a local non-governmental organisation, Limitless.sg, to fund almost 1,000 counselling sessions for at-risk youth amid the deterioration of youth mental health as a result of multiple COVID-19 restrictions. Google also supported the Ministry of Health Office for Healthcare Transformation (MOHT) in a YouTube creator-led campaign to raise awareness of their mental health hotline, mindline.sg, and to encourage help-seeking behaviour.¹⁷⁷

GOOGLE SUPPORTS THE LGBTQ+ COMMUNITY DURING THE COVID-19 CRISIS

As part of the company's ongoing commitment to diversity, equity and inclusion, the **T Project**, a social service support group for the transgender community in

Singapore, was one of the 70 organisations worldwide that received a total of USD1.2 million funding from Google.org.¹⁷⁸ Amid the heightened health, social and economic risks that disproportionately impacted LGBTQ+ communities during the pandemic, these funds were channelled towards distributing food rations and medical supplies, such as surgical masks, personal thermometers and hand sanitisers, and providing refuge for transgender women amid rising unemployment due to the pandemic. The grant was also used to assist beneficiaries in subsidising the hefty costs of mental health treatment and hormone therapy medication.

GOOGLE CHAMPIONS ENVIRONMENTAL SUSTAINABILITY

In 2020, Google announced its commitment to operate with carbon-free energy for 24 hours, seven days a week in all its data centres and campuses worldwide by 2030.¹⁷⁹ To this end, the company will invest in reliable carbon-free energy and apply AI to optimise its electricity demand and forecasting. These efforts are projected to help create 12,000 jobs globally by 2025 and accelerate the availability of clean energy in communities worldwide. Following its first renewable energy deal in Asia to purchase energy generated from a ten-megawatt solar installation in Taiwan's Tainan City, Google inked a second renewable energy deal in Singapore in 2020. The company entered a partnership with Sembcorp, an energy and urban development group that currently has over 360 megawatts of solar project capacity in Singapore, to pay for energy generated from solar panels installed on 500 public housing flats across Singapore which will be used for its local operations.¹⁸⁰

175. TIE Singapore (2021), "EMERGE". Available at: <https://singapore.tie.org/emerge/> and Google, "Youth Business International (YBI): Supporting underserved business owners through challenging times". Available at: <https://www.grow.google/intl/uk/story/youth-business-international-ybi-supporting-underserved-business-owners-through-challenging-times>

176. The Online Citizen (2020), "Singapore churches form 'Home Away from Home'; collaborate with NHCS to provide shelter for stranded Malaysian workers". Available at: <https://www.theonlinecitizen.com/2020/03/20/spore-churches-form-home-away-from-home-collaborate-with-nhcs-to-provide-shelter-for-stranded-malayan-workers/>

177. MediCorp (2020), "YouTube, MediCorp's Bloomr.SG, and top Singapore YouTube creators join hands for launch of video series to support mental health awareness". Available at: <https://www.mediocorp.sg/en/corporate/mediocorp-in-the-news/media-releases/youtube-mediocorp-bloomr-sg-mental-health-wellbeing-series-13822154>

178. Google The Keyword (2020), "Providing Google.org support to LGBTQ+ organizations worldwide". Available at: <https://blog.google/outreach-initiatives/google-org/pride-2020-grantees/>

179. Google The Keyword (2020), "Our third decade of climate action: Realizing a carbon-free future". Available at: <https://blog.google/outreach-initiatives/sustainability/our-third-decade-climate-action-realizing-carbon-free-future>

180. ZDNet (2020), "Sembcorp, Google sign deal to tap Singapore's solar energy". Available at: <https://www.zdnet.com/article/sembcorp-google-sign-deal-to-tap-singapores-solar-energy/#:~:text=Google%20will%20pay%20for%20power.Sembcorp%20Power%20and%20Sembcorp%20Solar,> and Sembcorp (2021), "Sembcorp Grows Renewable Energy Portfolio with 82 Megawatt-Peak of Solar Project Wins". Available at: <https://www.sembcorp.com/en/media/media-releases/energy/2021/march/sembcorp-grows-renewable-energy-portfolio-with-82-megawatt-peak-of-solar-project-wins/>

CONCLUDING REMARKS



A combination of modern physical and digital infrastructure, a strong digital talent base, and robust Intellectual Property (IP) regulations have propelled Singapore to become the destination of choice for technology and innovation businesses today. However, the country currently faces several barriers to unlocking the full benefits of digital transformation such as the limited adoption of advanced digital technologies and gaps in increasingly critical digital skill sets. While the government has extended several measures to assist businesses in accessing innovative solutions and accelerating the deployment of digital innovation, Singapore could go further in facilitating digital adoption among SMEs, digitally upskilling the nation and positioning the country as a regional hub for digital trade. The COVID-19 pandemic, in particular, has further amplified the importance of digital transformation in supporting the country to “build back better” and boost long-term economic resilience. Google has been instrumental in unlocking Singapore’s digital potential and supporting the country in its economic recovery efforts. For instance, the company has introduced skills training programmes and helpful tools to ensure everyone stays safe, informed and connected during the pandemic. With the close cooperation between public and private stakeholders like Google, Singapore can realise the full productivity benefits of digital transformation and unlock an annual economic value of SGD65.3 billion (USD47.4 billion) by 2030.



APPENDIX: METHODOLOGY

A: SIZING THE ECONOMIC VALUE OF DIGITAL TECHNOLOGIES

This document provides the detailed methodology, assumptions and sources of information to quantify the future 2030 potential economic impact of digital technologies for Singapore in 2030.



APPENDIX A1: OVERALL APPROACH

A four-step methodology was used to understand the potential economic impact created by digital technologies in 2030 (Exhibit A1).

STEP 1: IDENTIFY DIGITAL TECHNOLOGIES

Several existing research reports on current and emerging digital technologies were reviewed to identify the most relevant technologies to focus on for this analysis in terms of their potential economic impact. There was a large body of research by academics, development practitioners, non-for-profits as well as the private and public sector on the interaction between technologies and economic development. In 2013, McKinsey Global Institute identified 12 disruptive trends that would transform life, business and the global economy.¹⁸¹ Of these trends, seven were considered digital in nature: mobile Internet; automation of knowledge; IoT which was often combined with geospatial and satellite technology (e.g., remote sensing); cloud technology; advanced robotics; autonomous and near autonomous vehicles; and additive manufacturing (more commonly known as 3D printing).

Since 2013, several technologies have been added to this list due to potentially transformational economic and social impact. For example, the UK-based international

development network, Bond, noted rapid changes in the technologies shaping international development between 2016 and 2019. Emerging technologies included big data, financial technology (FinTech), machine learning and even blockchain. These technologies were in no way mutually exclusive and the line between what constituted a different technology versus an application of a technology could be blurred. For example, AI utilised big data which often relied on cloud computing technology to provide the storage and computational horsepower to run machine learning algorithms and other analytics. Similarly, autonomous vehicles contained a multitude of sensors, many of which were Internet-enabled i.e., IoT. Exhibit 1 in Chapter 1 provides an overview of eight key digital technologies with significant implications for economic development.

STEP 2: ALIGN ON FOCUS SECTORS

To understand the current and potential economic output of these digital technologies, a set of focus sectors have been identified. These sectors were selected based on two steps:

- Clustering industries, at the ISIC 1 digit level, into broader sectors for convenient analysis.¹⁸² This was guided by the individual industry's relevance

181. McKinsey Global Institute (2013), *Disruptive technologies: Advances that will transform life, business, and the global economy*. Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies>

182. These sectors uniquely match to the relevant International Standard Industrial Classification of All Economic Activities (ISIC) with the exception of "Consumer, retail & hospitality", combining ISIC Sector G: Wholesale and retail trade; repair of motor vehicles and motorcycles and Sector I: Accommodation and food service activities; "Infrastructure", which combines ISIC Sectors F: Construction and L: Real estate activities; and "Resources", combining the ISIC Sector B: Mining and quarrying; Sector D: Electricity, gas, steam and air conditioning supply and Sector E: Water supply, sewerage, waste management and remediation activities.

for digital technologies (based on past research quantifying the potential industry benefits of these digital technologies).¹⁸³

- Prioritising the sectors based on their importance for Gross Domestic Product (GDP), proxied by the sector’s share of national GDP. Each selected sector must represent more than 1.5 percent of the national GDP.

The Information and Communication Technology (ICT) industry classification was excluded due to its value-added to the economy being almost entirely driven by technology and most of the value from digital technologies in this sector would have been captured in other sectors as an input to production.

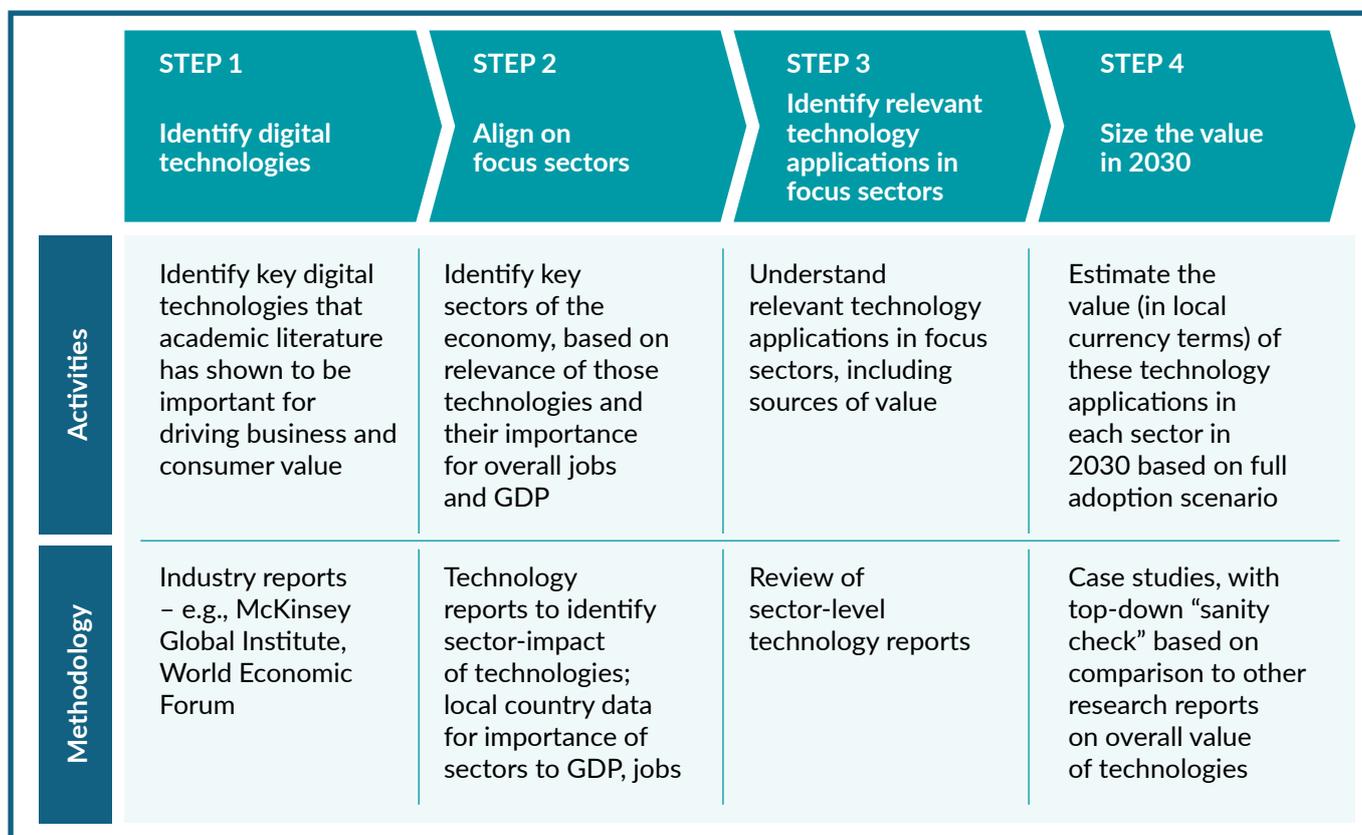
Based on these steps, nine sectors were selected.¹⁸⁴ These sectors consisted of Consumer, retail and hospitality services; Education and training; Financial services; Government; Health; Infrastructure (including utilities such as energy and water); Manufacturing; Professional services; and Transport services.

STEP 3: IDENTIFY RELEVANT TECHNOLOGY APPLICATIONS IN FOCUS SECTORS

Relevant technology applications in the focus sectors and their sources of value (e.g., reduced wastage in production, enhanced consumer offerings) were identified based on a detailed review of the academic literature for each of the eight focus technologies. These technology applications included tangible drivers

EXHIBIT A1:

A FOUR-STEP METHODOLOGY WAS USED TO UNDERSTAND HOW DIGITAL TECHNOLOGIES COULD TRANSFORM ECONOMIC DEVELOPMENT



183. This was based on a range of reports. See for example, McKinsey Global Institute (2014), *Southeast Asia at the crossroads: Three paths to prosperity* (Available at: https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Asia%20Pacific/Three%20paths%20to%20sustained%20economic%20growth%20in%20Southeast%20Asia/McKinsey_Global_Institute%20SE%20Asia_Executive%20summary_November%202014.ashx); and McKinsey Global Institute (2014), *India’s tech opportunity: Transforming work, empowering people* (Available at: <https://www.mckinsey.com/industries/high-tech/our-insights/indias-tech-opportunity-transforming-work-empowering-people>).

184. In Singapore, all nine sectors have fulfilled the criterion in Step 2 except the Government sector which accounts for less than 1.5 percent of the national GDP.

of business value, such as the use of remote patient monitoring to enable hospital-level care in homes using advanced sensors, smart medical devices, and robotics. A list of these technology applications, categorised by sector and key digital technology, is shown in Exhibit 2 in Chapter 1. Several emerging digital technologies such as blockchain were considered but not analysed as they were still in the nascent stages and economic impact estimates were difficult to obtain.

STEP 4: SIZE THE VALUE IN 2030

The value (in local currency terms) of these technology applications in each sector was then quantified in 2030 (based on assessed potential linked to benchmarks).

The **"Full adoption" scenario** was analysed. In this scenario, the country was assumed to achieve full digital adoption (100 percent) in the 40 digital technology applications across ten sectors. This scenario was modelled to frame the maximum achievable opportunity.

A series of international and country-specific case studies were used for each technology application in the sizing. A "sanity check" of the results was then done by comparing the overall sector and economy-wide estimates with other research reports. **These estimates do not represent GDP or market size (revenue), but rather economic impact such as productivity gains, increased revenues and cost savings.**

APPENDIX A2: SPECIFIC APPROACHES, ASSUMPTIONS AND SOURCES

Table 1 summarises the key metrics and sources used commonly across the sizing of the economic opportunities of digital technology applications.

The specific assumptions and sources of information used to size each digital technology application in each sector are shown below. These assumptions were used to estimate the "Full adoption" scenario in 2030.

TABLE 1: KEY METRICS AND SOURCES FOR SIZING ECONOMIC OPPORTUNITIES

METRICS	SOURCE
GDP / GDP per capita	<ul style="list-style-type: none"> World Bank GDP statistics International Monetary Fund (IMF) Real GDP growth estimates Singapore Department of Statistics
Population	<ul style="list-style-type: none"> United Nations Department of Economic and Social Affairs Population datasets
Labour Force	<ul style="list-style-type: none"> International Labour Organisation (ILO) World Bank Labour Force statistics Singapore Department of Statistics
Wage	<ul style="list-style-type: none"> Singapore Department of Statistics
Exchange rates	<ul style="list-style-type: none"> OFX

CONSUMER, RETAIL AND HOSPITALITY

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. DIGITAL RETAIL SALES AND MARKETING CHANNELS		PRODUCTIVITY GAINS
Productivity gains from delivering retail goods through digital channel reducing labour, inventory, and real estate costs	Sized based on productivity gains from delivering goods digitally. McKinsey Global Institute (2013) estimated that productivity gains from selling goods through digital channels ranged from six percent to 15 percent, based on reduced labour requirements, inventory efficiencies and lower real estate costs. Country-level estimate was derived based on domestic e-commerce retail sales and operating costs (assuming constant growth rates).	<ul style="list-style-type: none"> McKinsey Global Institute (2013)¹⁸⁵
2. IOT-ENABLED INVENTORY MANAGEMENT		INCREASED REVENUES
Use of IoT to reduce stock outs	Sized based on increase in revenues from capturing sales potentially lost due to stock outs. McKinsey Global Institute (2013) estimated that four percent of retail sales were lost due to stock outs, and that 35 percent to 40 percent of this value may be recaptured using IoT. Country-level estimate was derived based on domestic retail sales.	<ul style="list-style-type: none"> McKinsey Global Institute (2013)¹⁸⁶
3. AUTOMATION AND AI CUSTOMER SERVICE IN HOTELS		INCREASED REVENUES
Use of AI and automated services for remote check-ins at hotels	Sized based on increased revenues from higher efficiency in hotel verification procedures. Colliers International (2019) estimates that hotel revenues could increase by ten percent through AI. The Vulcan Post reported that each hotel verification procedure typically took ten minutes. The Singapore Tourism Board estimated that the E-visitor Authentication system could eliminate manual processes and reduce check-in time by up to 70 percent. Country-level estimate was derived based on hotel revenue.	<ul style="list-style-type: none"> Colliers International (2018)¹⁸⁷ The Vulcan Post (2018)¹⁸⁸ Singapore Tourism Board (2019)¹⁸⁹
4. DATA ANALYTICS ON TRAVEL PATTERNS		INCREASED REVENUES
Use of big data analytics in predicting consumer behaviour	Sized based on increased revenues from better targeted promotions to tourists. Boston Consulting Group (2020) estimated that brands experienced a revenue uplift of six to ten percent from integrating proprietary data to create personalised experiences. Country-level estimate was derived based on tourism revenue.	<ul style="list-style-type: none"> Boston Consulting Group (2020)¹⁹⁰

185. McKinsey Global Institute (2013), *Disruptive technologies: Advances that will transform life, business, and the global economy*.

Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies>

186. McKinsey Global Institute (2013), *Disruptive technologies: Advances that will transform life, business, and the global economy*.

Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies>

187. Colliers International (2018), "AI and automation to increase hotel revenues by 10%."

Available at: <https://www.hoteliermiddleeast.com/34362-ai-and-automation-to-increase-hotel-revenues-by-10>

188. The Vulcan Post (2018), "No Queues, No Forms: this Spore Startup Lets You Quickly Check To Hotels With A Selfie."

Available at: <https://vulcanpost.com/704429/triip-digital-hotel-check-in-singapore/>

189. Singapore Tourism Board (2019), "Industry-wide initiatives to transform hotels for sustainable growth."

Available at: <https://www.stb.gov.sg/content/stb/en/media-centre/media-releases/industry-wide-initiatives-to-transform-hotels-for-sustainable-growth.html>

190. Boston Consulting Group (2020), "Bionic Revenue Management in Travel and Tourism."

Available at: <https://www.bcg.com/publications/2020/bionic-revenue-management-travel-tourism>

CONSUMER, RETAIL AND HOSPITALITY (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
5. ONLINE F&B DELIVERY SERVICES		INCREASED REVENUES
Use of online delivery service	Sized based on increase in revenues from capturing F&B orders placed online. The Straits Times (2017) reported that restaurants have seen revenues rise by 15 percent after partnering food delivery firms. Country-level estimate was derived based on domestic F&B revenue.	<ul style="list-style-type: none"> The Straits Times (2017)¹⁹¹

EDUCATION AND TRAINING

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. E-CAREER CENTRES AND DIGITAL JOBS PLATFORM		GDP INCREMENTS
Use of online job listing platforms and matching of candidate profiles to available jobs based on algorithms	Sized based on GDP contributions from higher employment rate. McKinsey Global Institute (2015) estimated the impact on employment rates on different countries, stating that these were different for each country, depending on its labour market characteristics, education and income levels and demographic trends. Country-level estimate was derived based on national employment rate, labour force and GDP per capita.	<ul style="list-style-type: none"> McKinsey Global Institute (2015)¹⁹²
2. PERSONALISED LEARNING		GDP INCREMENTS
Use of digital technologies to provide personalised and remote learning opportunities for students	Sized based on increase in GDP from higher employment rate. McKinsey Global Institute (2018) estimated that personalised learning would increase employment rate by 0.5 percent in high-income countries, and 0.9 percent in other countries. Classification of the country's income level was based on the World Bank's definition. Country-level estimate was derived based on national employment rate, labour force and GDP per capita.	<ul style="list-style-type: none"> McKinsey Global Institute (2018)¹⁹³ World Bank¹⁹⁴
3. ONLINE RETRAINING PROGRAMMES		GDP INCREMENTS
Lifelong learning opportunities delivered in digital format helped individuals gain new skills	Sized based on increase in GDP from higher employment rate. McKinsey Global Institute (2018) estimated that online retraining programmes would increase employment rate by 0.1 percent in "high income" countries, and 0.3 percent in "middle-income" countries. Country-level estimate was derived based on national employment rate, labour force and GDP per capita.	<ul style="list-style-type: none"> McKinsey Global Institute (2018)¹⁹⁵ World Bank¹⁹⁶

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FINANCIAL SERVICES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. BIG DATA ANALYTICS		INCREASED REVENUES
Increased lending to SMEs at higher margins due to big data	Sized based on additional revenue generated from increased lending to SMEs at higher margins. McKinsey Global Institute (2014) estimated that lending to SMEs would increase by 16 percent to 33 percent due to big data analytics, with increased margins between 1.4 percent to 1.8 percent. Country-level estimate was derived based on annual total lending to SMEs.	<ul style="list-style-type: none"> McKinsey Global Institute (2014)¹⁹⁷
2. DIGITAL BANKING SERVICES		COST SAVINGS
Use of Internet and mobile technologies to reduce operational and risk costs, and improve service delivery	Sized based on the cost savings from digitisation such as the electronic onboarding of clients, leveraging machine learning and robotics to create operational improvements and the use of public cloud infrastructure to reduce processing capacity. McKinsey Global Institute (2019) estimated that the cost-efficiency in South Korea from digital banking services is 1.5 percent. Country-level cost savings was derived based on domestic banking sector operating costs.	<ul style="list-style-type: none"> McKinsey Global Institute (2017)¹⁹⁸
3. REG TECH		COST SAVINGS
Use of AI and machine learning to automate document review, risk analysis and other repetitive compliance tasks	Sized based on the cost savings in compliance expenditure due to improvement in efficiency brought about by these technologies. Juniper Research (2017) estimated that up to 50 percent of compliance expenditure could be eliminated from adopting these technologies. KPMG (2013) indicated that compliance expenditure contributed to ten percent of banks' operating costs on average. Country-level estimate of efficiency savings was derived based on domestic banking sector costs.	<ul style="list-style-type: none"> Juniper Research (2017)¹⁹⁹ KPMG (2013)²⁰⁰
4. SMART CONTRACTS		COST SAVINGS
Use of AI and machine learning to execute part of the functions of a contract automatically	Sized based on the cost savings in mortgage processing due to improvement in efficiency brought about by these technologies. Capgemini Consulting (2016) estimated that mortgage customers could expect a 11 to 22 percent drop in the total cost of mortgage processing fees charged to them in case smart contracts are adopted. Country-level estimate of mortgage processing costs.	<ul style="list-style-type: none"> Capgemini Consulting (2016)²⁰¹

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FINANCIAL SERVICES (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
5. ROBO ADVISORY SERVICES		COST SAVINGS
Use of robo-advisors to provide automated, algorithm-driven financial planning services based on information from clients	Sized based on the cost savings in fund management. Deloitte (2019) estimated that 27 fund management companies have seen tangible benefits since setting up their Caifu Hao accounts (robo-advisor): they have been able to increase their operational efficiency by 70 percent, while reducing their overall costs by 50 percent. Country-level estimate of cost savings was derived based on operating expenditure by fund managers in the country.	<ul style="list-style-type: none"> Deloitte (2019)²⁰²

GOVERNMENT

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. CLOUD COMPUTING		COST SAVINGS
Use of cloud-based software to reduce costs	Sized based on the estimated savings from cloud computing, specifically in the reduction in hardware costs. InfoWorld (2019) reported that companies experienced between 25 percent to 55 percent cost savings after migrating to the cloud. Country-level estimate was derived based on government ICT expenditure and hardware costs.	<ul style="list-style-type: none"> InfoWorld (2019)²⁰³
2. E-SERVICES		COST SAVINGS
Reduction in operating expenditure from using e-services	Sized based on the reduction in operating expenditure from moving services online, pre-filing of tax forms, data availability and performance dashboards. McKinsey Global Institute (2011) estimated that between 15 percent to 20 percent of operating expenditure was eliminated in Europe after moving to e-services. The study also reported that the addressable base for such a reduction was about 20 percent to 25 percent of government expenditure. Country-level estimate was derived based on government operating expenditure.	<ul style="list-style-type: none"> McKinsey Global Institute (2011)²⁰⁴
3. E-PROCUREMENT		COST SAVINGS
Cost savings from using e-procurement channels	Sized based on the reduction in transaction costs from shifting to e-procurement for government projects. In South Korea, the Public Procurement Service estimated that the government saved USD8 billion in transaction costs annually through reduced labour costs, reduced lead-time and a more streamlined process. Country-level estimate was derived based on public procurement volumes.	<ul style="list-style-type: none"> Public Procurement Service²⁰⁵

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GOVERNMENT (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
4. GEOGRAPHIC INFORMATION SYSTEM ENABLED TAX COLLECTION		INCREASED TAX COLLECTION
Use of big data and location-based information to improve tax collection	Sized based on the increase in tax collected from using big data and GIS-enabled services. In Brazil, the government managed to raise its Federal Tax collection by about 13 percent through adopting big data in audit corporate tax declaration. Country-level estimate was derived based on the country's tax evasion rate as a percentage of GDP relative to Brazil's.	<ul style="list-style-type: none"> Bill & Melinda Gates Foundation and AlphaBeta (2018)²⁰⁶
5. DATA ANALYTICS FOR GOVERNMENT TRANSFER PAYMENTS		COST SAVINGS
Use of data analytics in government transfer payments	Sized based on reduction in costs from using data analytics in determining eligible recipients of government transfer payments. McKinsey & Company estimated that five to ten percent of government transfer payments globally are improper payments that could be addressed by adopting data analytics. Country-level estimate was derived based on the country's GDP.	<ul style="list-style-type: none"> McKinsey & Company (2017)²⁰⁷

HEALTH

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. REMOTE PATIENT MONITORING		COST SAVINGS
Application of remote monitoring systems to improve patient care	Sized based on cost savings to the healthcare system through reduced hospital visits, length of patients' stays and medical procedures. McKinsey Global Institute (2013) estimated that such systems would reduce hospital visits, length of patients' stays and number of procedures relating to chronic diseases, resulting in ten percent to 20 percent savings for the healthcare system. Country-level estimate was derived from the World Bank's estimate of total healthcare spend and the country's share of spending on chronic diseases.	<ul style="list-style-type: none"> McKinsey Global Institute (2013)²⁰⁸ World Bank²⁰⁹
2. TELEHEALTH APPLICATIONS		COST SAVINGS
Use of Internet and mobile technologies for medical consultations	Sized based on cost savings to the healthcare system through reduced doctor visits. Goldman Sachs (2015) estimated that the US healthcare system could save USD100 billion by adopting telehealth. Country-level estimate was derived based on relative national healthcare expenditure.	<ul style="list-style-type: none"> Goldman Sachs (2015)²¹⁰

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HEALTH (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
3. DATA-BASED PUBLIC HEALTH INTERVENTIONS		GDP INCREMENTS
Use of analytics to direct highly targeted health interventions for at-risk populations	Sized based on the economic value of reduced disability-adjusted life years (DALYs) due to timely public health interventions. McKinsey Global Institute (2018) indicated that the most significant and measurable impacts were on maternal and child health, as well as public sanitation and hygiene. It estimated a 0.4 percent reduction in DALYs for "high-income" countries, and 1.5 percent for other countries. Income of countries classified based on the World Bank's definition. Economic value was taken to be this multiplied by GDP per capita, and was estimated based on the proportion of the population suffering from chronic diseases. Country-level estimate was derived based on national population sizes and GDP per capita.	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²¹¹ • UN Population Division (2018)²¹² • World Bank²¹³
4. DETECTION OF COUNTERFEIT PHARMACEUTICAL DRUGS		COST SAVINGS
Use of IoT and advanced analytics to detect counterfeit drugs	Sized based on cost savings from reduced counterfeit pharmaceutical drugs in the country due to higher detection rates. EU IPO (2016) estimated that the annual cost of counterfeit pharmaceutical drugs to Europe's pharmaceutical industry was EUR10 billion. McKinsey Global Institute (2013) assessed that 30 percent to 50 percent of all drugs sold were addressable by this technology, and that its success rate was between 80 percent and 100 percent. Country-level estimate on the national cost of counterfeit drugs was derived based on the country's relative healthcare expenditure.	<ul style="list-style-type: none"> • EU Intellectual Property Office (2016)²¹⁴ • McKinsey Global Institute (2013)²¹⁵
5. SMART MEDICAL DEVICES AND WEARABLES		GDP INCREMENTS
Analysing data across connected implants, smart medical devices and wearables in personalised and predictive care	Sized based on the economic value of reduced disability-adjusted life years (DALYs) due to health improvement measures prompted by data from such devices. McKinsey Global Institute (2018) estimated that smart medical devices reduced DALYs by one percent reduction in high-income countries, and 0.6 percent in other countries. The economic value was taken to be this multiplied by GDP per capita. Classification of the country's income level was based on the World Bank's definition. Country-level estimate was derived based on national population sizes and GDP per capita, and was estimated based on the proportion of the population suffering from chronic diseases.	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²¹⁶ • UN Population Division (2018)²¹⁷ • World Bank²¹⁸

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218. World Bank (2018). Available at: <https://blogs.worldbank.org/opendata/new-country-classifications>

HEALTH (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
6. ELECTRONIC MEDICAL RECORDS		COST SAVINGS
Use of cloud-based electronic medical record systems	Sized based on the cumulative savings (such as saving of physician and nursing time) from adopting electronic health records (EHR). McKinsey Global Institute (2014) estimated that widespread adoption of electronic medical records could increase India's annual economic value by USD3 billion. The global economic impact of HER was estimated based on India's share of the global healthcare expenditure. Country-level estimate was derived based on its relative national healthcare expenditure according to World Bank data and the global EHR market growth rates.	<ul style="list-style-type: none"> • McKinsey Global Institute (2014)²¹⁹ • World Bank²²⁰ • Transparency Market Research²²¹

INFRASTRUCTURE

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. SMART GRIDS		COST SAVINGS
Use of digital communications technology in detecting and optimising electricity networks	Sized based on cost savings from energy savings due to lower consumption and efficiency improvements. The International Herald Tribune (2018) reported that engineers indicated a five to ten percent in energy savings from using smart grids. Country-level estimate was derived based on total electricity consumption. Business and Sustainable Development Commission (2017) estimated that the global average wholesale price of electricity was USD100/Mwh.	<ul style="list-style-type: none"> • The International Herald Tribune (2011)²²² • World Bank²²³ • Business and Sustainable Development Commission (2017)²²⁴
2. 5D BIM AND PROJECT MANAGEMENT TECHNOLOGIES		COST SAVINGS
Use of integrated modelling platforms to simulate construction cost and timeline impacts of decisions in project planning, design, construction, operations, and maintenance	Sized based on cost reductions from improved coordination between different development parameters, as well as the continuous insight provided on project costs. McKinsey Global Institute (2013) estimated that streamlining project delivery could bring about 15 percent savings to infrastructure cost, with 15 percent to 25 percent of these savings coming from 5D BIM technologies. Country-level estimate was derived based on domestic construction sector costs.	<ul style="list-style-type: none"> • McKinsey Global Institute (2013)²²⁵ • Global Infrastructure Outlook²²⁶

219. McKinsey Global Institute (2014), India's technology opportunity: Transforming work, empowering people.

Available at: https://www.mckinsey.com/~/media/mckinsey/industries/technology%20media%20and%20telecommunications/high%20tech/our%20insights/indias%20tech%20opportunity%20transforming%20work%20empowering%20people/mgi%20india%20tech_executive%20summary_december%202014.pdf

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INFRASTRUCTURE (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
3. PREDICTIVE MAINTENANCE TECHNOLOGIES		COST SAVINGS
<p>Using data from sensors to ensure prompt and predictive maintenance, minimising downtime</p>	<p>Sized based on the economic value of benefits from sizable applications including the predictive maintenance of public transit systems and water leakage detection and control. McKinsey Global Institute (2018) estimated a 2.3 percent reduction in average commuting time from predictive transit for “high-income” countries, and 1.4 percent for other countries. On water leakage detection and control, McKinsey Global Institute (2018) estimated a 1.4 percent reduction in water consumption for “high-income” countries, and country-level estimates were used in other countries. Classification of the country’s income level was based on the World Bank’s definition. The Business and Sustainable Development Commission (2017) estimated that the global average price of water was USD0.90/m³. Country-level estimate was derived based on the country’s average commuting time, population, GDP per capita and domestic water consumption.</p>	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²²⁷ • World Bank²²⁸ • UNESCO-IHE (2011)²²⁹ • Business and Sustainable Development Commission (2017)²³⁰
4. SMART BUILDINGS		COST SAVINGS
<p>Use of physical sensor networks, energy storage and data analytics to improve resource efficiency of buildings and reduce energy and water consumption, as well as carbon emissions</p>	<p>Sized based on the economic value of the reduction in greenhouse gas emissions (GHG) and water consumption by building automation systems. McKinsey Global Institute (2018) estimated a 2.9 percent reduction in GHG emissions and a 1.7 percent reduction in water consumption for “high-income” countries. The corresponding figures for other countries were 1.4 percent and 1.1 percent. Classification of the country’s income level was based on the World Bank’s definition. Country-level estimate was derived based on its greenhouse gas emissions and water consumption from buildings. Business and Sustainable Development Commission (2017) estimated that the global average price of water was USD0.90/m³ and GHG price was valued at USD50/ton (a global proxy price equating roughly to the financial incentives needed to achieve carbon emissions consistent with a 2-degree pathway).</p>	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²³¹ • IPCC²³² • World Bank²³³ • Business and Sustainable Development Commission (2017)²³⁴

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MANUFACTURING

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. BIG DATA ANALYTICS		INCREASED REVENUES
Use of big data analytics in demand forecasting and supply planning	Sized based on increase in revenue from more accurate demand-supply matching leading to higher sales. McKinsey Global Institute (2011) estimated a 2.5 percent to three percent increase in profit margin from big data analytics in manufacturing. Country-level estimate was derived based on domestic manufacturing sector GDP.	<ul style="list-style-type: none"> McKinsey Global Institute (2011)²³⁵
2. ADDITIVE MANUFACTURING		PRODUCTIVITY GAINS/COST SAVINGS
Use of dynamic, resource efficient 3D printing and related technologies to enable 'on-time' manufacturing & rapid manufacturing	Sized based on the incremental economic value of faster time-to-market due to quicker prototyping and design adjustments, reduced production time, higher material productivity as well as more efficient sales process due to product customisation. McKinsey & Company (2017) estimated that the global economic value of this technology could reach between USD100 billion and USD250 billion by 2025. Current economic value was calculated based on today's global manufacturing sector GDP, and assuming a constant growth rate for the 2030 forecast. Country-level estimate was derived based on the domestic manufacturing sector GDP as a share of the global figure.	<ul style="list-style-type: none"> McKinsey & Company (2017)²³⁶
3. IOT-ENABLED SUPPLY CHAIN MANAGEMENT		COST SAVINGS
Savings in operating costs from IoT-enabled supply chain management and distribution network management	Sized based on reduction in operating costs from adopting IoT-enabled supply chain management and distribution network management. McKinsey Global Institute (2011) estimated a 2.5 percent to five percent savings in distribution and supply chain operating costs could amount to two percent to six percent of manufacturing sales. Country-level estimate was derived based on domestic manufacturing sector operating costs.	<ul style="list-style-type: none"> McKinsey Global Institute (2011)²³⁷
4. AUTOMATION AND ROBOTICS		PRODUCTIVITY GAINS
Productivity boost from automating mundane and repetitive production tasks	Sized based on productivity boost to manufacturing processes from robots performing mundane and repetitive tasks. McKinsey & Company (2017) estimated that automation and robotics could improve productivity ranging from 0.8 to 1.4 percent of global GDP annually from 2015 to 2065. Country-level estimate was derived based on domestic manufacturing sales.	<ul style="list-style-type: none"> McKinsey & Company (2017)²³⁸

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PROFESSIONAL SERVICES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. CLOUD-BASED FILE MANAGEMENT SERVICES		PRODUCTIVITY GAINS / COST SAVINGS
Use of cloud computing technology to store and organise data virtually	Sized based on estimated cost savings from reduced bandwidth costs. ITProToday (2020) estimated that a consulting firm has been able to cut bandwidth costs by 66 percent after migrating to the cloud. Country-level estimate was derived based on the IT expenditure in the sector.	<ul style="list-style-type: none"> ITProToday (2020)²³⁹
2. DATA VISUALISATION AND ANALYTICS DASHBOARDS		PRODUCTIVITY GAINS/COST SAVINGS
Use of data visualisation and analytics dashboards to visualise complex business problem in a way that allows customers, suppliers and operations teams to make decisions based on data insights	Sized based on the estimated productivity impacts from using data visualisation dashboards, such as Tableau. Tableau (2020) estimated that an outsourcing and consulting group streamlined reporting by ten hours per week and increased operational productivity by 25 percent. Country-level estimate was derived based on the operating expenditure in the sector.	<ul style="list-style-type: none"> Tableau (2020)²⁴⁰
3. NATURAL LANGUAGE PROCESSING		TIME SAVINGS
Use of natural language processing to streamline the research process by directing researchers to specific phrases that appear in lengthy court decisions and researchers can quickly decide which cases are relevant	Sized based on the time savings from using natural language processing in legal research. National Legal Research Group (2018) estimated that attorneys using AI-powered legal research platform finished research projects on average 24.5 percent faster than attorneys using traditional legal research. Country-level estimate was derived based on the average hourly wage of a legal researcher in the country and employment size.	<ul style="list-style-type: none"> National Legal Research Group (2018)²⁴¹
4. AUTOMATED BILLING PROCESSES AND MULTI-CURRENCY CONVERSION		TIME SAVINGS
Building compliance rules into automated billing processes and multi-currency conversions streamline financial calculations and run reports instantaneously	Sized based on the time savings from automated billing processes and multi-currency conversion. NetSuite (2020) estimated that automating billing processes and multi-currency conversions have helped companies to reduce staff time spent on billings by as much as 60 percent. Country-level estimate was derived based on the average hourly wage of an accountant in the country and employment size.	<ul style="list-style-type: none"> NetSuite (2020)²⁴²

239. ITProToday (2020), "ClearSky's Cloud Storage Passes Myers-Briggs' Data Management Test".

Available at: <https://www.itprotoday.com/cloud-storage/clearskys-cloud-storage-passes-myers-briggs-data-management-test>

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Available at: <https://www.tableau.com/solutions/customer/kellyocgr-delivers-insight-billions-dollars-labor-spend>

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Available at: <https://www.netsuite.com/portal/customer-testimonials/cornerstone-ondemand-software.shtml>

TRANSPORT SERVICES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. SMART ROADS		TIME SAVINGS
Use of real-time public transit information, intelligent traffic signals and real-time road navigation to reduce commuting time	Sized based on the economic value of real-time public transit information, intelligent traffic signals and real-time road navigation. McKinsey Global Institute (2018) estimated a 2.2 percent reduction in average commuting time for “high-income” countries, and 5.5 percent for other countries. Classification of the country’s income level was based on the World Bank’s definition. Country-level estimate was derived based on the average commuting time, population and GDP per capita.	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²⁴³ • World Bank²⁴⁴
2. SMART PORTS		COST SAVINGS
Use of IoT to enhance port efficiency	Sized based on cost savings from reduced logistics costs due to IoT-enabled data collection and monitoring, as well as intelligent decision-making capabilities. Accenture and SIPG (2016) estimated 3.6 percent savings in logistics costs from building smart ports. Country-level estimate was derived based on logistics sector costs (based on indicated percentages of the country’s GDP).	<ul style="list-style-type: none"> • Accenture and SIPG (2016)²⁴⁵ • Council of Supply Chain Management Professionals (2013)²⁴⁶ • World Bank (2016)²⁴⁷
3. AUTONOMOUS VEHICLES		COST SAVINGS
Use of AI and sensors to increase fuel efficiency	Sized based on the projected gains in fuel efficiency, compared to conventional vehicles. McKinsey Global Institute (2013) estimated that autonomous cars could travel more closely together, reducing air resistance and improving fuel efficiency by 15 percent to 20 percent. Country-level estimate was derived based on the number of cars, projected number of autonomous vehicles, annual fuel requirement, and cost of fuel.	<ul style="list-style-type: none"> • McKinsey Global Institute (2013)²⁴⁸
4. GEOSPATIAL SERVICES		PRODUCTIVITY GAINS/COST SAVINGS
Productivity impact of using location-based information	Sized based on estimated productivity impact geospatial services in the transport sector (land, sea and air). AlphaBeta (2017) estimated that geospatial services could improve productivity of land, sea and air transport by 2.5 percent to five percent. These benefits include reduced logistics costs, improved network design and management. Country-level estimate was derived based on the size of the land, sea and air transport sector.	<ul style="list-style-type: none"> • AlphaBeta (2017)²⁴⁹

243. McKinsey Global Institute (2018), *Smart cities: Digital solutions for a more liveable future*.

Available at: <https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/smart-cities-digital-solutions-for-a-more-liveable-future>

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245. Accenture and Shanghai International Port Group (2016), *Connected ports: Driving future trade*.

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246. Council of Supply Chain Management Professionals (2013), *State of logistics report*.

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247. World Bank (2016), *Logistics performance index: Ranking by countries*. Available at: <https://lpi.worldbank.org/international/global>

248. McKinsey Global Institute (2013), *Disruptive technologies: Advances that will transform life, business and the global economy*.

Available at: <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/disruptive-technologies>

249. AlphaBeta (2017), *The Economic Impact of Geospatial Services: How Consumers, Businesses And Society Benefit from Location-Based Information*.

Available at: https://www.alphabeta.com/wp-content/uploads/2017/09/GeoSpatial-Report_Sept-2017.pdf

APPENDIX A3: ECONOMIC IMPACT OF COVID-19 RELEVANT TECHNOLOGY APPLICATIONS

To estimate the economic value of technology applications that could help businesses and organisations manage the economic impact of COVID-19, all the technology applications were assessed for their relevance to COVID-19 and the value from those relevant to COVID-19 was estimated.

Of the 40 technology applications, 23 were assessed to have the potential to manage the economic impacts of the pandemic in Singapore's context, through three channels. These are:

- Facilitate customer interactions, transactions and

marketing through digital platforms;

- Enable the continuity of business operations amid remote working arrangements, and
- Reduce logistical bottlenecks amidst global and regional supply chain disruptions induced by the pandemic.

Exhibit A2 shows the list of these 23 COVID-relevant technology applications, grouped by their respective sectors and the specific channel through which they deliver COVID-relevant impact.



EXHIBIT A2:**OF THE 40 APPLICATIONS, 23 HAVE THE POTENTIAL TO ALLOW BUSINESSES TO THRIVE DESPITE THE COVID-19 PANDEMIC THROUGH THREE KEY CHANNELS**

CHANNEL	SECTOR	COVID-19 RELEVANT TECHNOLOGY APPLICATION/S
Facilitate customer interactions, transactions and marketing through digital platforms	Consumer, retail and hospitality	1. Digital retail sales and marketing channels 2. Online F&B delivery channels
	Professional services	3. Automated billing processes and multi-currency conversions
	Education and training	4. E-career centres and digital jobs platforms 5. Online retraining programmes
	Financial services	6. Digital banking services 7. Robo advisory services
	Health	7. Telehealth applications
Enabling the continuity of business operations amid remote working arrangements	Consumer, retail and hospitality	9. IoT-enabled inventory management 10. Automation and AI customer service in hotels
	Financial services	11. Smart contracts
	Professional services	12. Cloud-based file management services
	Government	13. Government e-services 14. E-procurement
	Health	15. Remote patient monitoring 16. Smart medical devices and wearables
	Infrastructure	17. Smart grids 18. 5D BIM and project management technologies 19. Predictive maintenance technologies
	Manufacturing	20. Big data analytics 21. Automation and robotics
Reduce logistical bottlenecks amidst global and regional supply chain disruptions induced by pandemic	Manufacturing	22. IoT-enabled supply chain management (manufacturing)
	Transport services	23. Smart ports

SOURCE: AlphaBeta analysis

B: SIZING GOOGLE'S ECONOMIC IMPACT IN SINGAPORE

To estimate the **business benefits**, the economic value generated by businesses that used Google's products was calculated. These are in the form of increased revenue (through increased customer outreach and access to new markets), as well as improved productivity (through time savings). The Google products included in this analysis of business benefits include Google Search, Google Ads, YouTube, AdSense, and Google Play.

To estimate **societal benefits**, the resultant revenue gains experienced by Singapore's businesses from the use of Google Ads, AdSense, and YouTube were then used to calculate the job creation benefits indirectly supported by Google.

Estimating the **consumer benefits** supported by Google is a challenging task. This is because individuals typically do not have to pay for the Google products that they use. There are several established methodologies for estimating the benefits of free services, including

consumer surplus based on the consumer's willingness to pay (how much an individual values a Google product). Primary data used in the analysis was collected from a consumer survey of 521 Internet users in Singapore. This sample size is statistically significant based on Singapore's online population, at a 95 percent confidence level (the level typically adopted by researchers). The survey was conducted online, which was deemed suitable given the intention to survey Internet users. The sample was also checked for its representativeness of Singapore's Internet population based on demographic variables including age, income level, and the geographical location of respondents. In addition to the consumer survey, this research also leveraged big data gathering methods such as that used to determine the amount of time saved by using Google Maps for driving and public transport, as well as third-party sources. The Google products included in this analysis of consumer benefits include Google Search, Google Play, YouTube, Google Drive, Photos, Docs, and Sheets.

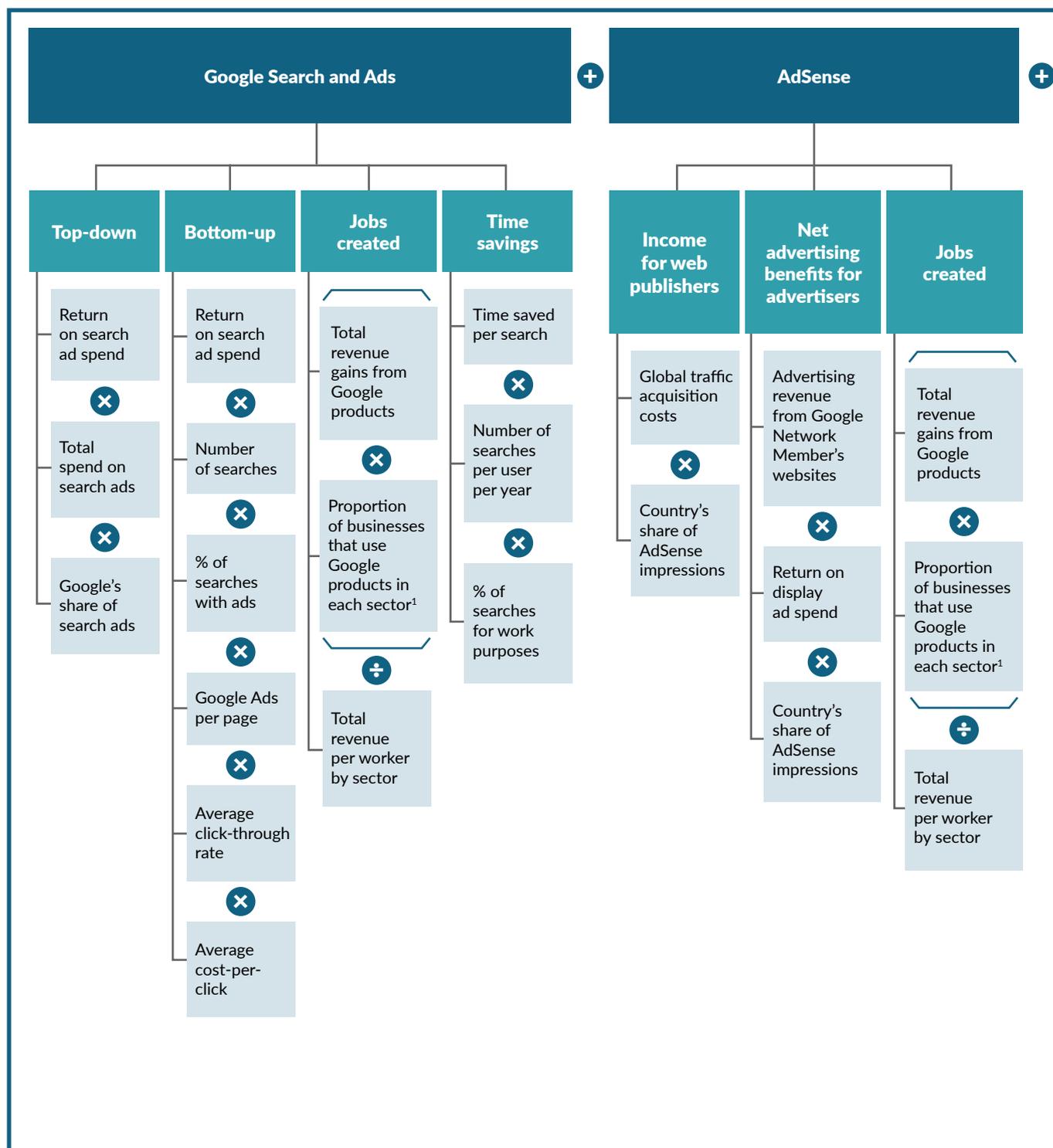
BUSINESS AND JOB CREATION BENEFITS

The business benefits supported by Google include the gross revenue, income or savings generated by businesses using Google products. These benefits do not include the flow-on economic effects generated, such as further purchases from their suppliers or the economic activity generated by the employees of these businesses who spend their wages in the broader economy. These benefits also do not account for activity that may have been displaced by Google, nor attempt to estimate the incremental impact of Google on the Singapore economy beyond what would be the case if Google did not exist but other companies like it did. Exhibit B1 summarises the methodology used for sizing the business and job creation benefits of Google's products.

GOOGLE SEARCH AND ADS

The business benefits of Google Search and Ads were estimated using two methods – a top-down approach and a bottom-up approach. The top-down approach estimated the total size of the search advertising segment in the country and the proportion of this space that Google represents. The bottom-up approach estimated the number of Google searches conducted in the country, the proportion of searches with advertisements, the number of advertisements per search, the average click-through rate (CTR), and the average cost-per-click (CPC).

EXHIBIT B1: METHODOLOGY FOR SIZING BUSINESS AND JOB CREATION BENEFITS FROM GOOGLE



1. In the absence of such publicly available data, this was proxied based on the proportion of businesses that use a website in Singapore. This data is available from Infocomm Media Development Authority (2017), Annual survey on infocomm usage by enterprises for 2017.

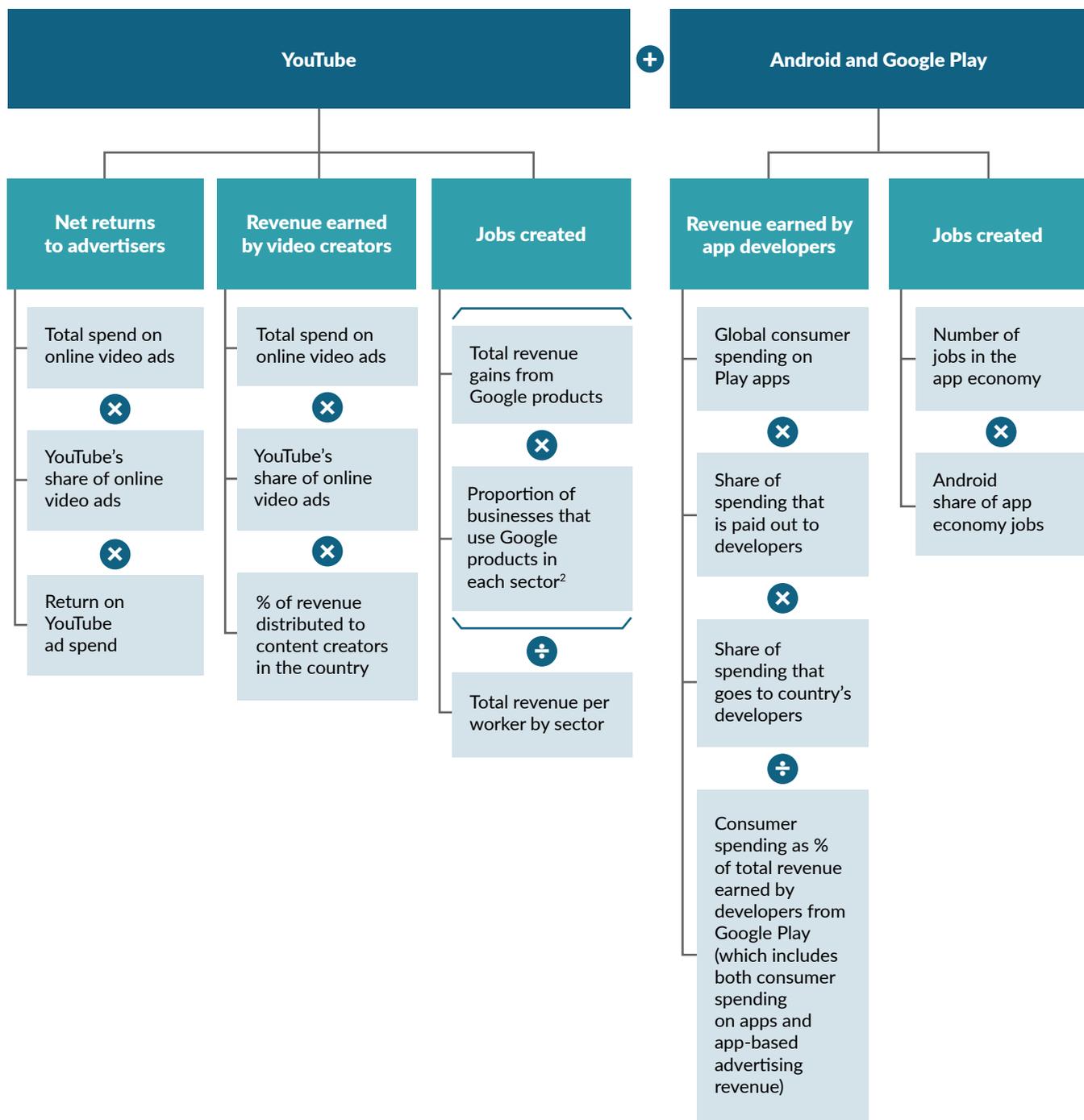
Available at: <https://www.imda.gov.sg/-/media/imda/Files/Industry-Development/Fact-and-Figures/Infocomm-Usage-Business/IU2017-Public-Report.pdf?la=en>

2. In the absence of such publicly available data, this was proxied based on the proportion of businesses that use a social media account in each sector in Hong Kong, which has a similar economic development level as Singapore. This data is available from Census and Statistics Department Hong Kong SAR (2019), Report on the survey on information technology usage and penetration in the business sector for 2019.

Available at: https://www.censtatd.gov.hk/en/data/stat_report/product/B1110005/att/B11100052019BE19B100.pdf

Note: This report's methodology for measuring Google's economic impact is consistent with the methodology used in the Google Economic and Social Impact South Korea and New Zealand 2021 reports.

SOURCE: AlphaBeta analysis



To estimate the income generated by businesses paying for online advertising through Google a return on investment (ROI) ratio range of 3.4 – 8 was applied, and both estimates were reported.²⁵⁰ This ROI ratio was developed from a few assumptions:

- Using a large sample of proprietary data, Hal Varian, Google’s Chief Economist, estimated that businesses received USD2 in revenue for every USD1 spent on advertising. This finding was published in the American Economic Review in 2009.
- Businesses also receive free clicks because of unpaid Google Search. Using research published in the International Journal of Internet Marketing and Advertising in 2009 by Jansen and Spink, the Google US Economic Impact Study assumed that businesses receive five clicks for every click on a paid advertisement.
- Unpaid clicks are not considered as commercially valuable, so the US Economic Impact Study assumed their value at 70 percent of paid clicks.
- Because of these assumptions, an ROI ratio of eight was estimated. This ROI ratio was taken as an upper bound. To derive a lower bound, we built on the academic findings detailed in the Google UK Economic Impact Study to set a lower bound of 3.4.

Table 2 shows the inputs and sources used for estimating the business benefits of Google Search and Ads.

ADSENSE

The direct business benefits from AdSense were estimated as the net advertising benefits generated by businesses placing advertisements on publisher sites such as websites, blogs, and forums.²⁵¹ We estimated this figure using Google’s published global advertising revenue from Google network’s websites and multiplied this by the country’s share of global AdSense impressions.²⁵² In addition, we applied an ROI ratio that

advertisers earn using display advertising, derived from academic literature.

The benefits of AdSense to content creators were also estimated as the total income that they earn from placing advertisements sourced through Ads next to content on their website. The total income earned by the country’s content creators was estimated from Google’s global payments to website publishers, also known as their traffic acquisition costs, and applying the country’s share of AdSense impressions to estimate the payments specific to the country.

Table 3 shows the inputs and sources used for estimating the business benefits of AdSense.

YOUTUBE

We estimated the direct benefits of YouTube to video advertisers in the country based on the total video advertising spend in the country and YouTube’s share of that market. This estimate was then multiplied with the ROI ratios for YouTube advertisement.

Table 4 shows the inputs and sources used for estimating the business benefits of YouTube.

TIME SAVING BENEFITS OF GOOGLE SEARCH

We estimated the time saving benefits that businesses gained from using Google Search based on the amount of time saved per search, the number of searches conducted per worker, and the share of searches that were conducted for work purposes.

Table 5 shows the inputs and sources used for estimating the time savings benefits of Google Search.

GOOGLE PLAY

We estimated the revenue earned by app developers in the country from consumer spending on Google Play based on global consumer spending on Google Play, the share of the spending that was paid out to app

250. ROI reflects the net advertising benefits that businesses receive from online advertising (i.e. total revenue minus online advertising cost).

251. This refers to the increase in revenues and sales that can be directly attributed to advertising minus the related advertising expenditure.

252. This methodology does not account for price differences across countries due to the lack of availability of reliable data on cost per impression by country.

developers, and the share of the spending that went to the country's app developers. The revenue from consumer spending earned by app developers in the country was scaled up to include advertising revenue to arrive at the total revenue supported by Google Play in the country, using estimates for the distribution of revenue across consumer spending and ads.

Table 6 shows the inputs and sources used for estimating the business benefits of Google Play.

JOB CREATION BENEFITS FROM GOOGLE PRODUCTS

We estimated the number of jobs that are indirectly supported through revenue gains experienced by Singapore's businesses from the use of Google's products for advertising. These include revenue gains from Google Ads, AdSense and YouTube. The underlying principle here is that businesses experience revenue gains as they market their goods and services more effectively through the use of these Google services. As their businesses expand, they will need to hire more employees to support the increased demand. This is a conservative estimate as it does not include "spillover jobs" such as new jobs that are created in the supply chain - e.g., supplier companies that also require to hire more as they sell an increased level of raw materials or component services to these businesses. To estimate the job creation impacts robustly, these were computed at the sectoral level, based on the breakdown of Google-supported revenue gains by sector, and revenue per worker in each sector. The breakdown of these Google-supported revenue gains by sector was estimated based on the average of the following two metrics: 1) share of businesses using websites (to proxy for the use of Google Ads and AdSense) or the share of businesses with a social media account (to proxy for the use of YouTube) by sector; and 2) revenues of businesses in each sector. The total revenue gains supported by Google's advertising products in each sector was then divided by the respective revenue per worker figures for each sector to obtain the number of jobs indirectly supported by Google in each sector. The total number

of jobs indirectly supported by Google in Singapore's economy was taken as a sum of the estimated job creation benefits across all sectors. In the absence of publicly available data for the proportion of businesses that use Google's products, this was proxied based on the proportion of businesses that use websites (for Google Ads and AdSense) or social media accounts (for YouTube). The share of businesses with a social media account was proxied with social media adoption among businesses in Hong Kong, which has a similar economic development level as Singapore.

Table 7 shows the inputs and sources used for estimating the job impact from Google Ads, AdSense and YouTube.

JOB IMPACT FROM ANDROID ECOSYSTEM

Our estimate of employment supported by Android is based on the methodology developed by Mandel (2017).²⁵³ Their approach employs data on job postings from indeed.com to size employment in the app economy (see reference for details). The methodology distinguishes between direct, indirect and spillover jobs within the app economy, each accounting for one-third of total jobs in the app economy.

- **Direct jobs:** These are "tech-related" jobs dedicated to building and maintaining apps, (e.g. app developers)
- **Indirect jobs:** These are "non-tech-related" jobs such as HR, marketing, and sales within app companies
- **Spillover jobs:** These are jobs created outside of the app industry due to spillover effects such as app companies' suppliers

The number of jobs in Singapore's app economy is estimated based on the country's app intensity multiplied by the total number of employed workers in the country. Table 8 shows the inputs and sources used for estimating the number of jobs created through the Android ecosystem.

253. Mandel (2017), *US App Economy*. Available at: https://www.progressivepolicy.org/wp-content/uploads/2017/05/PPI_USAppEconomy.pdf

TABLE 2: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF GOOGLE SEARCH AND ADS

APPROACH	METRIC	SOURCE
Top down approach	Total market expenditure on search advertising	<ul style="list-style-type: none"> Statista (2020)²⁵⁴
	Google Search's market share	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
Bottom-up approach	Google Search traffic data	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	% pages that display advertisements	<ul style="list-style-type: none"> Varian (2009)²⁵⁵, Jansen & Spink (2009)²⁵⁶ Deloitte (2015)²⁵⁷
	Advertisements per page on average	<ul style="list-style-type: none"> Varian (2009)²⁵⁸, Jansen & Spink (2009)²⁵⁹ Deloitte (2015)²⁶⁰
	CTR for Search (Estimate)	<ul style="list-style-type: none"> Word Stream (2019)²⁶¹ BannerTag (2020)²⁶²
	Average CPC for Search (Estimate)	<ul style="list-style-type: none"> Word Stream (2018)²⁶³ Adstage (2020)²⁶⁴
	ROI ratio Lower and Upper Bound	<ul style="list-style-type: none"> Varian (2009)²⁶⁵, Jansen & Spink (2009)²⁶⁶ Deloitte (2015)²⁶⁷

254. Statista (2021), "Search advertising – Singapore". Available at: <https://www.statista.com/outlook/219/124/search-advertising/singapore>

255. Varian, H. R. (2009), "Online Ad Auctions". The American Economic Review, Vol. 99, No. 2, pp. 430-434.

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Available at: <https://pennstate.pure.elsevier.com/en/publications/investigating-customer-click-through-behaviour-with-integrated-sp>

257. Deloitte (2015), Google's Economic Impact United Kingdom. Available at: <https://drive.google.com/file/d/0B9xmiQ1MUCjpNXBJZExHY1NqQIU/view>

258. Varian, H. R. (2009), "Online Ad Auctions". The American Economic Review, Vol. 99, No. 2, pp. 430-434.

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259. Jansen, B. J., & Spink, A. (2009), "Investigating customer click through behaviour with integrated sponsored and non-sponsored results." International Journal of Internet Marketing and Advertising, Vol. 5, No. 1-2, pp. 74-94.

Available at: <https://pennstate.pure.elsevier.com/en/publications/investigating-customer-click-through-behaviour-with-integrated-sp>

260. Deloitte (2015), Google's Economic Impact United Kingdom. Available at: <https://drive.google.com/file/d/0B9xmiQ1MUCjpNXBJZExHY1NqQIU/view>

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Available at: <http://www.wordstream.com/blog/ws/2015/07/06/average-cost-per-click>

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265. Varian, H. R. (2009), "Online Ad Auctions". The American Economic Review, Vol. 99, No. 2, pp. 430-434.

Available at: <https://www.aeaweb.org/articles?id=10.1257/aer.99.2.430>

266. Jansen, B. J., & Spink, A. (2009), "Investigating customer click through behaviour with integrated sponsored and non-sponsored results." International Journal of Internet Marketing and Advertising, Vol. 5, No. 1-2, pp. 74-94.

Available at: <https://pennstate.pure.elsevier.com/en/publications/investigating-customer-click-through-behaviour-with-integrated-sp>

267. Deloitte (2015), Google's Economic Impact United Kingdom. Available at: <https://drive.google.com/file/d/0B9xmiQ1MUCjpNXBJZExHY1NqQIU/view>

TABLE 3: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF ADSENSE

ESTIMATION	METRIC	SOURCE
Net advertising benefits for advertisers	Advertising revenue from Google Network Member's websites	• Alphabet (2019) ²⁶⁸
	ROI ratio	• Gupta et al. (2015) ²⁶⁹
Revenue to content creators	Global traffic acquisition costs related to AdSense	• Alphabet (2019) ²⁷⁰
Both estimates	Country share of global impressions on AdSense (Estimate)	• DoubleClick (2012) ²⁷¹

TABLE 4: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF YOUTUBE

METRIC	SOURCE
Total video advertising spend in country	• Statista (2020) ²⁷²
YouTube's market share	• AlphaBeta Consumer Survey (2021)
YouTube ROI ratio	• Business Insider (2014) ²⁷³

TABLE 5: INPUTS AND SOURCES FOR CALCULATING TIME SAVING BENEFITS OF GOOGLE SEARCH

METRIC	SOURCE
Time saved per search	• Varian (2014) ²⁷⁴ • Chen et al. (2014) ²⁷⁵
Average daily searches per worker	• AlphaBeta Consumer Survey (2021)
% of searches for work purposes	• AlphaBeta Consumer Survey (2021)

268. Alphabet (2019). Form 10-K for fiscal year ended December 31, 2019 - Submission to US SEC.

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TABLE 6: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF GOOGLE PLAY

METRIC	SOURCE
Global consumer spending on Google Play	<ul style="list-style-type: none"> • Sensor Tower (2020)²⁷⁶
Share of the spending that is paid out to app developers	<ul style="list-style-type: none"> • Google (2020)²⁷⁷
Share of the spending that goes to the country's app developers	<ul style="list-style-type: none"> • Caribou Digital (2016)²⁷⁸
Consumer spending as % of total revenue earned by developers from Google Play (which includes both consumer spending on apps and app-based advertising revenue)	<ul style="list-style-type: none"> • Appota/ AdSota (2017)²⁷⁹

TABLE 7: INPUTS AND SOURCES FOR CALCULATING JOB IMPACT

APPROACH	METRIC	SOURCE
Revenue per worker by sector	Number of employees in Singapore by sector	<ul style="list-style-type: none"> • Ministry of Manpower (2020)²⁸⁰
	Total revenue by sector	<ul style="list-style-type: none"> • Department of Statistics Singapore (2020)²⁸¹
Breakdown of business benefits for Google Search and Ads, AdSense and YouTube	Businesses using a website from each sector as % of total	<ul style="list-style-type: none"> • Infocomm Media Development Authority (2017)²⁸²
	Businesses with a social media account as % of total	<ul style="list-style-type: none"> • Census and Statistics Department Hong Kong SAR (2019)²⁸³

TABLE 8: INPUTS AND SOURCES FOR CALCULATING ANDROID'S IMPACT ON EMPLOYMENT

ESTIMATION	METRIC	SOURCE
App employment supported by Android	Number of jobs in the app economy	<ul style="list-style-type: none"> • AlphaBeta (2017)²⁸⁴ • Ministry of Manpower (2020)²⁸⁵
	Ratio of direct to indirect and spillover jobs	<ul style="list-style-type: none"> • Mandel (2017)²⁸⁶
	Android share of app economy jobs	<ul style="list-style-type: none"> • Mandel (2018)²⁸⁷

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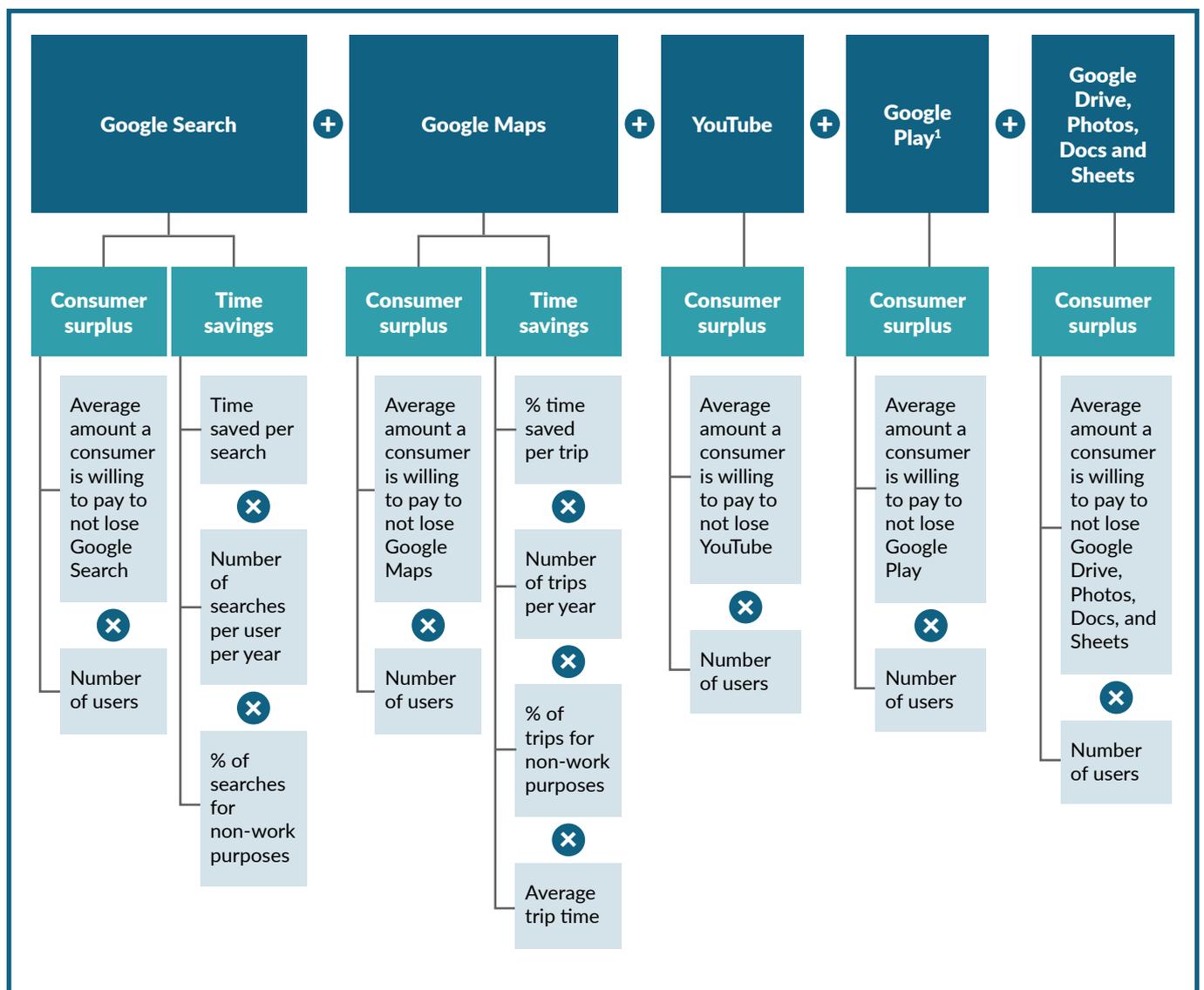
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CONSUMER BENEFITS

The consumer benefits supported by Google are challenging to measure and calculate because individuals typically do not pay for the services. In the absence of price indicators, we adopted the economic “willingness to pay” principle to estimate the value of consumer benefits by asking individuals how much

they value specific products – also known as consumer surplus. We also calculated the time savings accrued to consumers from their use of Google Search (which increases the efficiency of information gathering). Exhibit B2 summarises the methodology used for sizing consumer surplus and time savings of relevant products.

EXHIBIT B2: METHODOLOGY FOR SIZING CONSUMER BENEFITS FROM GOOGLE



1. Consumer benefits of Google Play were previously not sized in the Google Economic and Social Impact Singapore 2017 report.
 Note: This report’s methodology for measuring Google’s economic impact is consistent with the methodology used in the Google Economic and Social Impact Singapore 2017 report.
 SOURCE: AlphaBeta analysis

GOOGLE SEARCH

We estimated the benefits of Google Search to consumers using two metrics: consumer surplus and time savings.

To calculate the consumer surplus for Google Search, we multiplied the number of Google Search users with the average willingness to pay obtained from the consumer survey.

To calculate time savings, we applied time saving estimates from an experiment that measured the time taken to conduct a search online versus a search at the library.²⁸⁸ This study found that a search that takes 21 minutes in the library takes 7 minutes online. After accounting for the fact that people now ask more questions due to the ease of online search, we estimated the time saved across Singapore by using Google Search.

The share of Google Search users in the country who have made use of Google Search for self-enrichment purposes such as learning new skills or acquiring knowledge in a new topic was also estimated using the consumer survey.

Table 9 shows the inputs and sources used for calculating the consumer benefits of Google Search.

GOOGLE MAPS

We sized the benefits of Google Maps to consumers using willingness to pay, where consumers were asked to value their favourite online maps service. To calculate the consumer surplus for Google Maps, we multiplied the number of Google Maps users with the average willingness to pay obtained from the consumer survey.

Table 10 shows the inputs and sources used for calculating the consumer benefits of Google Maps.

GOOGLE PLAY

We calculated the benefits of Google Play to consumers using willingness to pay, where consumers were asked to value their favourite online distribution platform for digital products. Results from the survey of the country's online population were used.

Table 11 shows the inputs and sources used for calculating the consumer benefits of Google Play.

GOOGLE DRIVE, PHOTOS, DOCS, AND SHEETS

We calculated the benefits of Google Drive, Photos, Docs, and Sheets to consumers using willingness to pay, where consumers were asked to value their favourite online cloud-based file storage and document collaboration service. Results from the survey of the country's online population were used.

Table 12 shows the inputs and sources used for calculating the consumer benefits of Google Drive, Photos, Docs, and Sheets.

YOUTUBE

We calculated the benefits of YouTube to consumers using willingness to pay, where consumers were asked to value their favorite online video service. Results from the survey of the country's online population were used.

Table 13 shows the inputs and sources used for calculating the consumer benefits of YouTube.

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TABLE 9: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF GOOGLE SEARCH

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	Online Population (OP)	<ul style="list-style-type: none"> Internet World Stats (2021)²⁸⁹
	Search users as % of OP	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
Time saved per user	Time saved per search	<ul style="list-style-type: none"> Varian (2014)²⁹⁰ Chen et al. (2014)²⁹¹
	Average daily searches per user	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	% of searches for non-work purposes	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
Share of Search users who have made use of Search for self-enrichment purposes	% of Search users in country who made use of Search for self-enrichment purposes	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)

TABLE 10: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF GOOGLE MAPS

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	Online Population (OP)	<ul style="list-style-type: none"> Internet World Stats (2021)²⁹²
	Map users as % of OP	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)

TABLE 11: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF GOOGLE PLAY

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	Online Population (OP)	<ul style="list-style-type: none"> Internet World Stats (2021)²⁹³
	Google Play users as % of OP	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)

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TABLE 12: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF GOOGLE DRIVE, PHOTOS, DOCS, AND SHEETS

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	Online Population (OP)	<ul style="list-style-type: none"> Internet World Stats (2021)²⁹⁴

TABLE 13: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF YOUTUBE

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	Online Population (OP)	<ul style="list-style-type: none"> Internet World Stats (2021)²⁹⁵
	YouTube users as % of OP	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
Share of YouTube users who have made use of YouTube to learn advanced digital skills	% of YouTube users in the country who made use of YouTube to learn advanced digital skills	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)

294. Internet World Stats (2021). Available at: <https://www.internetworldstats.com/stats6.htm>295. Internet World Stats (2021). Available at: <https://www.internetworldstats.com/stats6.htm>

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