UNLOCKING NEW ZEALAND'S DIGITAL POTENTIAL:

THE ECONOMIC OPPORTUNITIES OF DIGITAL TRANSFORMATION AND GOOGLE'S CONTRIBUTION

APRIL 2021

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UNLOCKING NEW ZEALAND'S DIGITAL POTENTIAL

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

NZ$46.6 BILLION
in annual economic value[1]

36%
of this value[1] could come from technologies that mitigate the impact of the COVID-19 pandemic

1 SUPPORT TECHNOLOGY ADOPTION IN KEY INDUSTRIES

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3 PROMOTE DIGITAL EXPORT OPPORTUNITIES

EXAMPLES OF GOOGLE'S CONTRIBUTIONS TO EACH PILLAR

GOOGLE CLOUD
supports the growth of new technology-driven business models for small businesses

Google supports the
"DIGITAL FLUENCY INTENSIVE"
initiative which utilises digital tools to improve learning outcomes in schools with predominantly Māori and Pasifika students

GOOGLE MY BUSINESS
and
GOOGLE ADS
create export opportunities for Kiwi businesses by extending their outreach overseas

GOOGLE'S BROADER ECONOMIC BENEFITS

BUSINESSES

Google supports
NZ$3 BILLION
in annual benefits to businesses in New Zealand[2]

CONSUMERS

Google supports
NZ$3.5 BILLION
in annual benefits to consumers in New Zealand[2]

SOCIETY

Google supports philanthropic organisations, safeguards Internet privacy and security, and promotes cultural diversity in New Zealand

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.
2. Figures are estimated based on the latest available annual data as at time of research in 2020.

EXECUTIVE SUMMARY

Digital transformation has become an imperative in New Zealand. Even before the COVID-19 pandemic, New Zealand's economy had been facing headwinds from disappointing labour productivity growth amidst rising labour costs and an ageing workforce.[1] According to Stats NZ, labour productivity growth fell from an average annual rate of 2.9 in the period between 1997 and 2000, to 1.0 percent in the period between 2008 and 2018.[2] This is around 40 percent lower than top-performing OECD countries, which translates into below average incomes and lower living standards. New Zealand has weathered the COVID-19 crisis well, and the economy is rebounding on the back of policies that have protected businesses and kept unemployment relatively low. However, the COVID-19 crisis has exposed the over-reliance of the New Zealand economy on low-productivity, low-value exports. As we rebuild for the post-pandemic future, digital transformation can no longer be a mere aspiration. It has become an imperative.

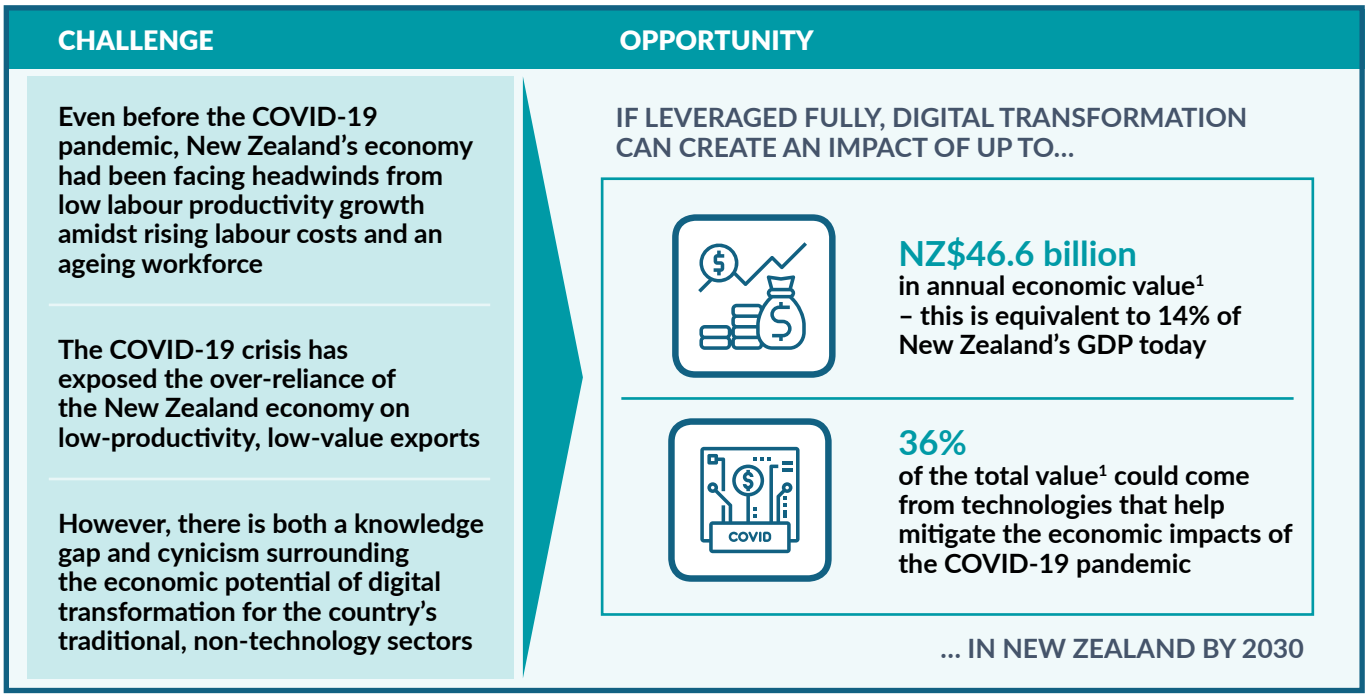
Comprehensive research has been done on the economic contributions of digital technologies in New Zealand. For example, the New Zealand Tech Alliance (NZTech) estimated that the technology sector contributed about NZ$16.2 billion or 8 percent of GDP in 2015, and that five new service sector jobs were created for every new technology sector job.[3] The productivity impacts of specific technologies have also been well researched. Studies by Sapere Research Group estimated that the productivity impact of better use of the Internet by all Kiwi businesses was NZ$34 billion, and that NZ$4.5 billion was the estimated potential gain from better use of data by businesses and government.[4] A study of the productivity benefits from IoT applications estimated a potential net economic benefit of NZ$1.1 billion to NZ$3.3 billion for New Zealand over the next ten years.[5]

However, there is both a knowledge gap and cynicism surrounding the economic potential of digital transformation for New Zealand's traditional, non-technology sectors. Despite comprehensive research on the economic impact of the technology sector, there is limited research on the economic value of different technologies applied in traditional sectors. Moreover, a recent survey showed that by international standards, Kiwis are less positive about the social and economic impact of emerging technologies on the economy.[6] In an industry submission to a government inquiry on this, it was stated that "many New Zealanders

1. New Zealand Productivity Commission (2019), Productivity by the numbers: 2019.
Available at: https://www.productivity.govt.nz/assets/Documents/productivity-by-the-numbers-2019/42ead8d24d/Productivity-by-the-Numbers-2019.pdf
2. New Zealand Productivity Commission (2019), Productivity by the numbers: 2019.
Available at: https://www.productivity.govt.nz/assets/Documents/productivity-by-the-numbers-2019/42ead8d24d/Productivity-by-the-Numbers-2019.pdf
3. NZTech (2016), From tech sector to Digital Nation.
Available at: https://nztech.org.nz/wp-content/uploads/sites/8/2019/02/from-tech-sector-to-digital-nation-2nd-edition-ebook.compressed.pdf
4. Sources include: Sapere Research Group (2014), The value of internet services to New Zealand businesses. Available at: https://srgexpert.com/wp-content/uploads/2017/11/Sapere-Google-INZ-The-value-of-internet-services-to-New-Zealand-Businesses_-_Report-31-March-2014.pdf; Sapere Research Group and Covec (2015), Data driven innovation in New Zealand. Available at: https://srgexpert.com/wp-content/uploads/2017/11/Data_Innovation_Report_WEB.pdf
5. New Zealand IoT Alliance (2020), Accelerating a connected New Zealand.
Available at: https://nztech.org.nz/wp-content/uploads/sites/8/2019/02/Accelerating-a-Connected-New-Zealand-eBOOK.compressed.pdf
6. Productivity Commission (2020), Technological change and the future of work.
Available at: https://www.productivity.govt.nz/assets/Documents/223e187413/At-a-glance_Technological-change-and-future-of-work.pdf

EXHIBIT E1:

THERE IS A NZ$46.6-BILLION ECONOMIC OPPORTUNITY ASSOCIATED WITH DIGITAL TRANSFORMATION IN NEW ZEALAND 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.
SOURCE: AlphaBeta analysis

(both workers and business owners) remain uncertain about both technology itself and about what successful adoption of that technology looks like".[7]

This report finds that, if leveraged fully in the economy, by 2030, digital technologies could create an annual economic value of NZ$46.6 billion.[8] To put this in perspective, NZ$46.6 billion is equivalent to about 14 percent of New Zealand's GDP - or the combined GDP supported by Canterbury and Hawke's Bay.[9] If New Zealand can fully leverage technology, it can deliver higher incomes, better living standards and improved well-being for its people.

The key messages of this report include:

- **Eight key technologies hold transformative potential for businesses and workers in New Zealand.** These include mobile Internet; cloud computing; big data; Artificial Intelligence (AI); financial technology (fintech); the Internet of Things (IoT) and remote sensing; advanced robotics; and additive manufacturing. Mapped to each of the eight technologies, 40 technology applications were then identified across 10 industry sectors in Exhibit E2.[10] By allowing for new business models, revenue streams and productivity savings, these technologies could create significant economic value for both businesses and the government in New Zealand. Workers also receive benefits, with studies showing that by allowing them to focus on more engaging and higher-value work, technology adoption fosters greater job satisfaction, improved wages and enhanced work safety.
- **If leveraged fully, digital transformation can unlock NZ$46.6 billion worth of economic value in New Zealand's non-technology sectors by 2030.**

7. Productivity Commission (2020), Technological change and the future of work.
Available at: https://www.productivity.govt.nz/assets/Documents/223e187413/At-a-glance_Technological-change-and-future-of-work.pdf
8. Economic value refers to GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection.
9. Based on AlphaBeta analysis. See Appendix A for details on the methodology.
10. These ten sectors accounted for 74 percent of New Zealand's combined GDP in 2018. Source: Stats NZ (2020), Available at: http://infoshare.stats.govt.nz/

EXHIBIT E2:

40 DIGITAL TECHNOLOGY APPLICATIONS ACROSS 10 INDUSTRIES WERE IDENTIFIED TO SIZE NEW ZEALAND'S ECONOMIC OPPORTUNITY FROM DIGITAL TRANSFORMATION

Agriculture & food
- Precision farming
- IoT-enabled supply chain management
- Food safety technologies

Consumer, retail & hospitality
- 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

Education & training
- E-career centres and digital jobs platforms
- Personalised learning
- Online retraining programmes

Financial services
- Big data analytics
- Digital banking services
- Reg tech

Government
- Cloud computing
- E-services
- E-procurement
- Geographic Info. System enabled tax collection
- Data analytics for government transfer payments

Health
- Remote patient monitoring
- Telehealth applications
- Data-based public health Interventions
- Detection of counterfeit pharmaceutical drugs
- Smart medical devices
- Electronic medical records

Infrastructure
- Smart grids
- 5D BIM & project management technologies
- Predictive maintenance technologies
- Smart buildings

Manufacturing
- Big data analytics
- Additive manufacturing
- IoT-enabled supply chain management
- Automation & robotics

Transport services
- Smart roads
- Smart ports
- Autonomous vehicles
- Geospatial services

Resources
- Smart exploration and automation in mining operations
- Predictive safety technologies
- Predictive maintenance technologies

Key technologies:

- *Mobile Internet*
- *Advanced robotics*
- *Cloud computing*
- *AI*
- *Fintech*
- *Additive manufacturing*
- *Big Data*
- *IoT*

SOURCE: AlphaBeta analysis

By generating productivity gains, revenue boosts and cost savings, digital technologies can reap up to NZ$46.6 billion worth of economic value annually in New Zealand's non-technology sectors by 2030. The largest projected beneficiaries are the government services, healthcare and manufacturing sectors.

- **Digital adoption can also support higher incomes, as well as higher-quality and safer jobs for Kiwis.** Income improvements can be brought about by technology adoption through increased demand for specialised tech skills such as machine learning, shifts in the type of work performed by workers, economy-wide productivity benefits, as well as additional income-earning opportunities from the sharing economy. At the same time, with the increasing ability of technologies to displace mundane and routine tasks, surveys have shown that employees experience greater job satisfaction as they are able to focus more on meaningful and higher-order work requiring human ingenuity, critical thinking and creativity. Jobs can also be made safer through technologies such as industrial robotics that can perform dangerous physical tasks, which have been shown to reduce workplace injuries.

- **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 minimise logistical bottlenecks amidst supply chain disruptions, technologies can help businesses manage the severe economic impacts of COVID-19. It is estimated that such applications present a combined economic value of NZ$17.1 billion (as a subset of the overall opportunity of NZ$46.6 billion). Beyond expediting short-term economic recovery, advanced technology applications such as increased automation may help address difficulties in access to temporary or seasonal migrant labour (particularly in industries that are reliant on them such as agriculture, hospitality and retail). Increased use of virtual reality technology could support a digital transformation in New Zealand's international tourism industry in the post-pandemic future.

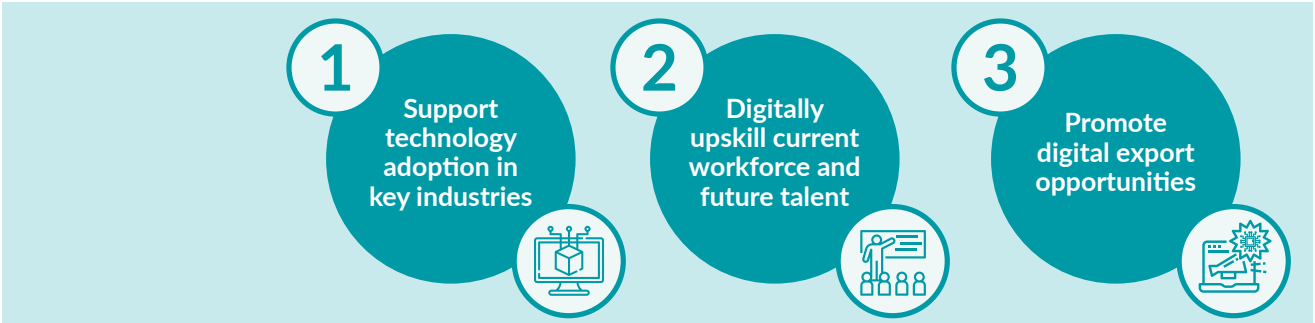
- **Three pillars of action are required for New Zealand to fully capture its digital opportunity.** (Exhibit E3)

  - First, there needs to be ***strong support for technology adoption in key industries.*** While New Zealand has made significant efforts in identifying relevant technologies for adoption in each sector (e.g., through the Ministry of Business Innovation and Employment's "Industry Strategy"), equipping small businesses with digital knowhow (e.g., through the recently announced "Small Business Digital Boost" package), and developing ICT infrastructure to defray the digital setup costs for businesses (e.g., through the "Ultra-Fast Broadband" programme and "Rural Broadband Initiative"), the country could go further to consider a stronger focus on a digitally-enabled "green recovery" process from the COVID-19 pandemic. This could in turn support the development and adoption of digital solutions that bring about more environmentally sustainable outcomes as part of the COVID-19 recovery process. Germany and South Korea's economic stimulus packages, which include a strong focus on technologies that promote clean energy and climate-friendly industries, offer positive international best practices in this regard.

  - Second, there would need to be a ***focus on digitally upskilling the current workforce and future talent.*** The New Zealand Government is making significant investments here, in particular, it is fostering partnerships with industry to identify the digital skills required in each sector and providing support for training in them (e.g., through the "New Zealand Digital Skills Forum" and digital vouchers rendered to small

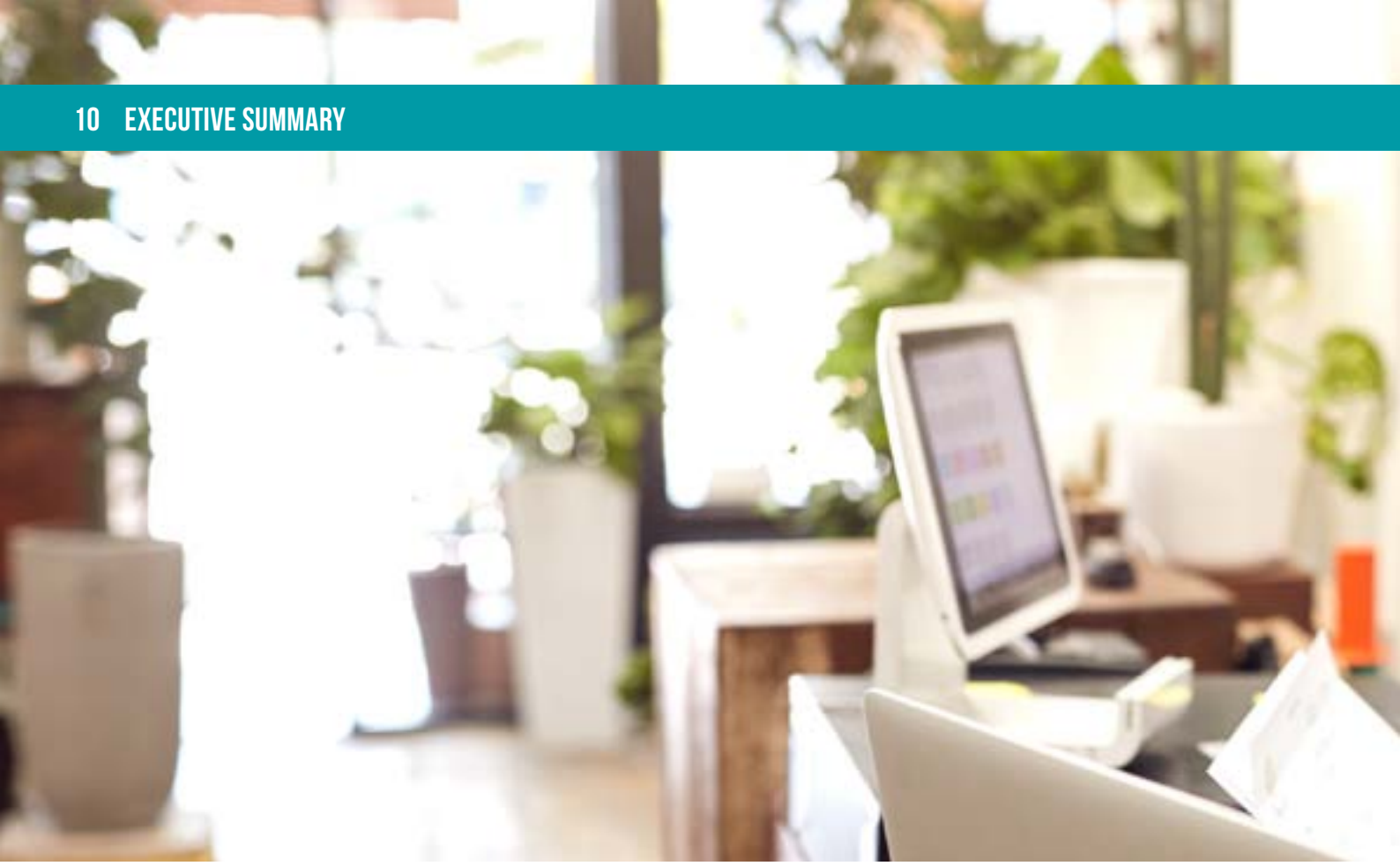
EXHIBIT E3:

THREE PILLARS OF ACTION ARE REQUIRED TO FULLY UNLOCK THE DIGITAL OPPORTUNITY



Significant effort has already been made in the following areas	• Identify techs to be adopted in each sector • Equip small businesses with digital knowhow • Develop ICT infrastructure to lower digital setup costs	• Foster industry-government partnership to identify digital skills required by sector, and provide support for training in them • Embed digital technology in educational curriculums • Promote inclusivity in digital upskilling	• Provide support for businesses to capture digital trade opportunities • Minimise border frictions • Promote open cross-border data flows • Build trust in cross-border digital systems
However there are areas in which New Zealand can further strengthen its approach	• Facilitate digitally enabled "green recovery" efforts from the pandemic	• Ensure that income security policies do not disincentivise digital skilling • Support displaced workers in transitioning into new jobs through digital skills training	• Create stronger international positioning for New Zealand's digital capabilities

SOURCE: AlphaBeta analysis



businesses for training), incorporating technology into educational curriculums (e.g., through the introduction of computational thinking and digital design elements into curriculums), and promoting inclusivity in digital skilling and access particularly for ethnic minorities and people with disabilities (e.g., through its "Digital Inclusion Action Plan"). The country could go further to ensure that income security policies (while important for enhancing social safety nets) do not disincentivise digital skilling efforts, and that workers displaced by the pandemic could be successfully transitioned into new jobs through digital skills programmes.

- Third, it is important to ensure that ***digital export opportunities are enhanced*** for businesses. The New Zealand Government has been active in providing capacity-building support for businesses to tap into overseas markets (e.g., through the "Getting Started Grants" provided by the New Zealand Government agency, Callaghan Innovation, in partnership with the IT industry alliance, NZTech), minimising border frictions and promoting open cross-border data flows in the region (e.g., through the recently signed "Digital Economy Partnership Agreement" with Singapore and Chile). The country can go further to create a stronger international positioning for New Zealand's digital capabilities and companies - though some progress has been achieved here through the government's "New Zealand Story" initiative, international best practices of how countries that have successfully built their reputations as global tech and innovation leaders can be considered. These include increasing government support for research and development (R&D) capacities, fostering industry-academic collaboration to spearhead domestic innovation efforts and promoting collaborations between local start-ups and global technology firms.

- **Through both its programmes and products, Google is making a significant contribution to advancing New Zealand's digital transformation journey.** The company's suite of products and services such as Google Search, YouTube, Google Earth, Google Maps and Google Cloud have not only supported digital offerings of key industries such as retail and tourism, but also delivered transformative impacts that contribute to the growth of New Zealand's digital economy. Google is also supporting the development of digital skills through programmes like the "Google Certification Program", "Digital Fluency Intensive" for teachers, and its partnership with Spark to run workshops to support Kiwi businesses in using digital tools by delivering digital skills training for small and medium-sized enterprises (SMEs) at no cost.[11] Kiwi businesses have also leveraged Google tools like Google Ads to reach foreign markets and explore new export opportunities.

- **Google also delivers wider benefits to Kiwi businesses, consumers and the wider society.** Google's products and services are estimated to bring about total annual business and consumer benefits worth **NZ$3 billion and NZ$3.5 billion**, respectively.[12] These products include Google Search, Google Ads, AdSense, YouTube, Google Play, Google Maps, Google Drive, and Google Docs, 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, on the other hand, experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic contributions to businesses and individuals, Google delivers benefits to the broader society by supporting the country's non-profit sector, enabling safe and secure Internet use, promoting local culture, and reducing carbon emissions.[13]

11. Google New Zealand Blog (2020), "Google and Spark deliver no-cost digital skills training for SMEs". Available at: https://newzealand.googleblog.com/2020/11/google-and-spark-deliver-no-cost.html

12. The Google applications and services included in the analysis of business benefits include Google Search and Ads, AdSense, Google Maps, and Google Play. The Google applications and services included in the analysis of consumer benefits include Google Search, Google Maps, Google Play, Drive, Photos, Docs, and Sheets. Figures are estimated based on the latest available annual data as at time of research in 2020.

13. For further information, please see the forthcoming "Google Social Impact Report" in New Zealand.

SIZING THE PRIZE — THE ECONOMIC OPPORTUNITY OF DIGITAL TRANSFORMATION IN NEW ZEALAND

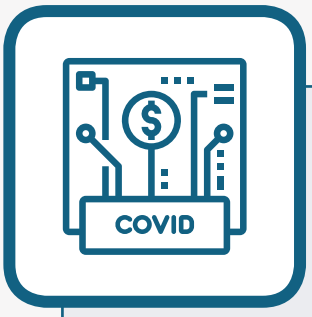
Digital transformation is not just about the technology sector – it affects every sector in New Zealand. Neglecting the impact of digital technology on traditional sectors like infrastructure, tourism, agriculture, retail and banking would risk overlooking the full transformative impact of technologies. If leveraged fully, digital transformation can create up to NZ$46.6 billion worth of economic value annually by 2030. This is equivalent to about 14 percent of the country's GDP in 2019 - or the combined GDP supported by Canterbury and Hawke's Bay. The largest economic beneficiary of digital transformation in New Zealand is its government services sector, which is estimated to account for about 20 percent of the total economic value. Beyond improving economic value and efficiency, digital adoption also has the potential to create better-paying, higher-quality and safer jobs for New Zealanders.

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 and transacting with them digitally, addressing difficulties in accessing temporary or seasonal migrant labour (on which industries such as horticulture production, hospitality and manufacturing are more reliant), and minimising logistical bottlenecks amidst international supply chain disruptions, technology applications can help businesses and workers manage the economic impacts of COVID-19. It is estimated that such applications present a combined economic value of NZ$17.1 billion (as a subset of the overall opportunity of NZ$46.6 billion).

"SIZING THE PRIZE"

THE ECONOMIC VALUE OF DIGITAL TRANSFORMATION

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



NZ$46.6 BILLION
in annual economic value[1]

36%
of this value[1] could come from technologies that help mitigate the economic impacts of the COVID-19 pandemic

... IN NEW ZEALAND BY 2030

1. Economic value refers to GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection.
Note: Based on AlphaBeta estimates. Figures have been rounded.

1.1 DIGITAL TRANSFORMATION CAN UNLOCK UP TO NZ$46.6 BILLION WORTH OF ECONOMIC VALUE BY 2030

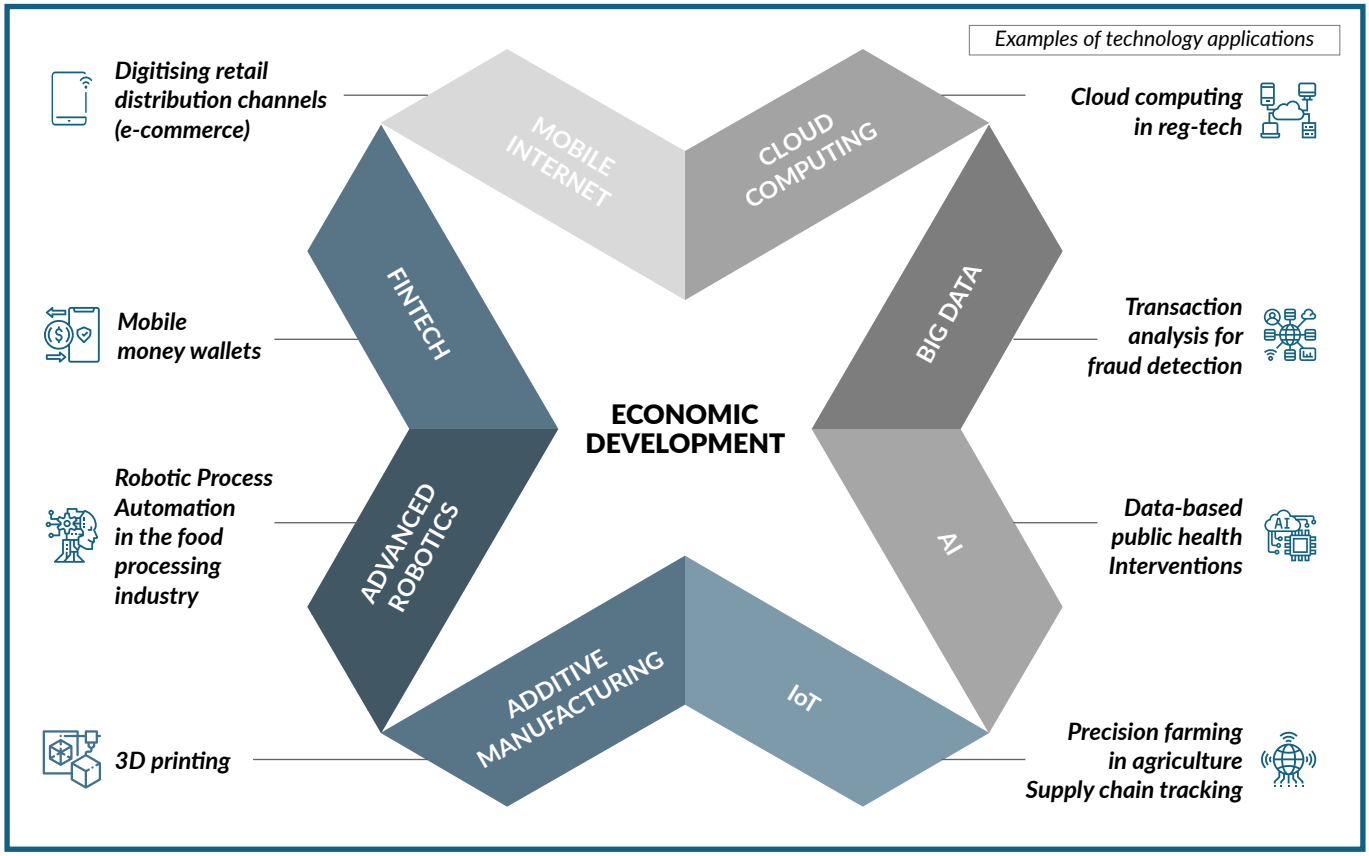
Digital technologies can unlock significant economic value in New Zealand. In particular, eight key technologies hold transformative potential for the country (Exhibit 1). Box 1 shows an overview of these technologies.

Taking into account the combined potential economic value of the 40 technology applications, it is estimated that **digital technologies have the potential to create an annual economic value of NZ$46.6 billion in New Zealand by 2030**.[14] This is a substantial value that is equivalent to 14 percent of New Zealand's GDP in 2019 (Exhibit 2).

Contrary to the conventional notion that services industries are likely to benefit most from digital adoption, **the government services sector is projected to be technology's largest economic beneficiary in**

EXHIBIT 1:

CURRENT RESEARCH REFLECTS EIGHT TRANSFORMATIVE TECHNOLOGIES WITH STRONG ECONOMIC POTENTIAL



14. 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.

BOX 1.
EIGHT KEY TECHNOLOGIES WITH TRANSFORMATIVE POTENTIAL FOR NEW ZEALAND

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.[15] 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 New Zealand 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 health 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 micro, small and medium-sized enterprises (MSMEs). 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, and the analysis of it, 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 that are similar to what people do.[16] 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 investments. Moreover, by allowing for cashless payments, fintech has also been responsible for driving greater growth in other sectors (e.g., retail).

15. 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/
16. Microsoft (2018), The future computed. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf

- **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.[17] 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 New Zealand, the advent of advanced robotics has allowed for an expanding range of tasks that robots can perform. Compared with conventional robots, advanced robots have superior perception, integrability, adaptability, and mobility.[18] 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 are a range of potential benefits, such as ability to handle complex, low-volume components where rapid turnaround is critical.[19]

17. 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
18. Boston Consulting Group (2019), Advanced robotics in the factory of the future.
Available at: https://www.bcg.com/publications/2019/advanced-robotics-factory-future
19. 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

New Zealand. This sector is estimated to be able to gain annual economic benefits of up to NZ$9.5 billion in 2030 – amounting to over 20 percent of the country's total digital opportunity.[20] Other top sector beneficiaries include healthcare (NZ$8.3 billion), manufacturing (NZ$6.3 billion), education and training (NZ$6.1 billion) and consumer, retail and hospitality (NZ$4.5 billion).[21]

The key digital opportunities for businesses and workers in these sectors are as follows:

- **Government services.** The New Zealand Government has a cloud-first strategy, and many workloads have already been moved to cloud operating models. Using this approach, the New Zealand Government has generated significant benefits for the Public Sector and citizens, predominantly in the form of cost savings. Information technology has been moving fast for several years, bringing more powerful and agile computation in the cloud, richer software, better analytics, mobility, and sensors. The rate of innovation in cloud technology has led to the increasing trend in hybrid- and multi-cloud computing. In both cases, cloud technologies provide Governments the ability to better use existing assets and take advantage of newer ways to compute, store, and analyse data. Gartner asserts that 81 percent of organisations are working with two or more public cloud providers.[22] Taking this further, Gartner predicts that "by 2021, over 75 percent of midsize and large organisations will have adopted a multi-cloud and/or hybrid IT strategy."[23] A multi-cloud strategy gives Governments the freedom to use the best possible cloud for each workload whilst reducing the risk of vendor lock-in and driving competition for Government spend. Digitising administrative processes also offer further cost savings potential. For instance, the joint initiative of a trans-Tasman e-invoicing framework with Australia is envisioned to enable quicker processing and payment of invoices, reduce administrative costs and time, and minimise the probability of errors which tends to be higher with manual data entry.[24] Another important technology application in the government services is big data analytics, which allows for more accurate predictions and intelligent decisions to be made by analysing vast amounts of data. While much literature focuses on the transformative benefits of this application to businesses in the private sector, the public sector also stands to gain from predictive and advanced analytics in many areas. These include reducing improper payments, increasing revenue from tax compliance, and improving policy outcomes and tracking. For example, the New Zealand Government can draw on best practices in the financial services sector, using analytics to ensure payment integrity and to reduce fraud. It has in fact been estimated that between 5 and 10 percent of all global government transfers are improper payments, and these have the potential to be significantly reduced through the deployment of big data analytics. With New Zealand's smartphone ownership rate at 95 percent of the population, the government can also leverage mobile technology to pay employee wages and deliver social assistance benefits in a timely and secure fashion.[25]

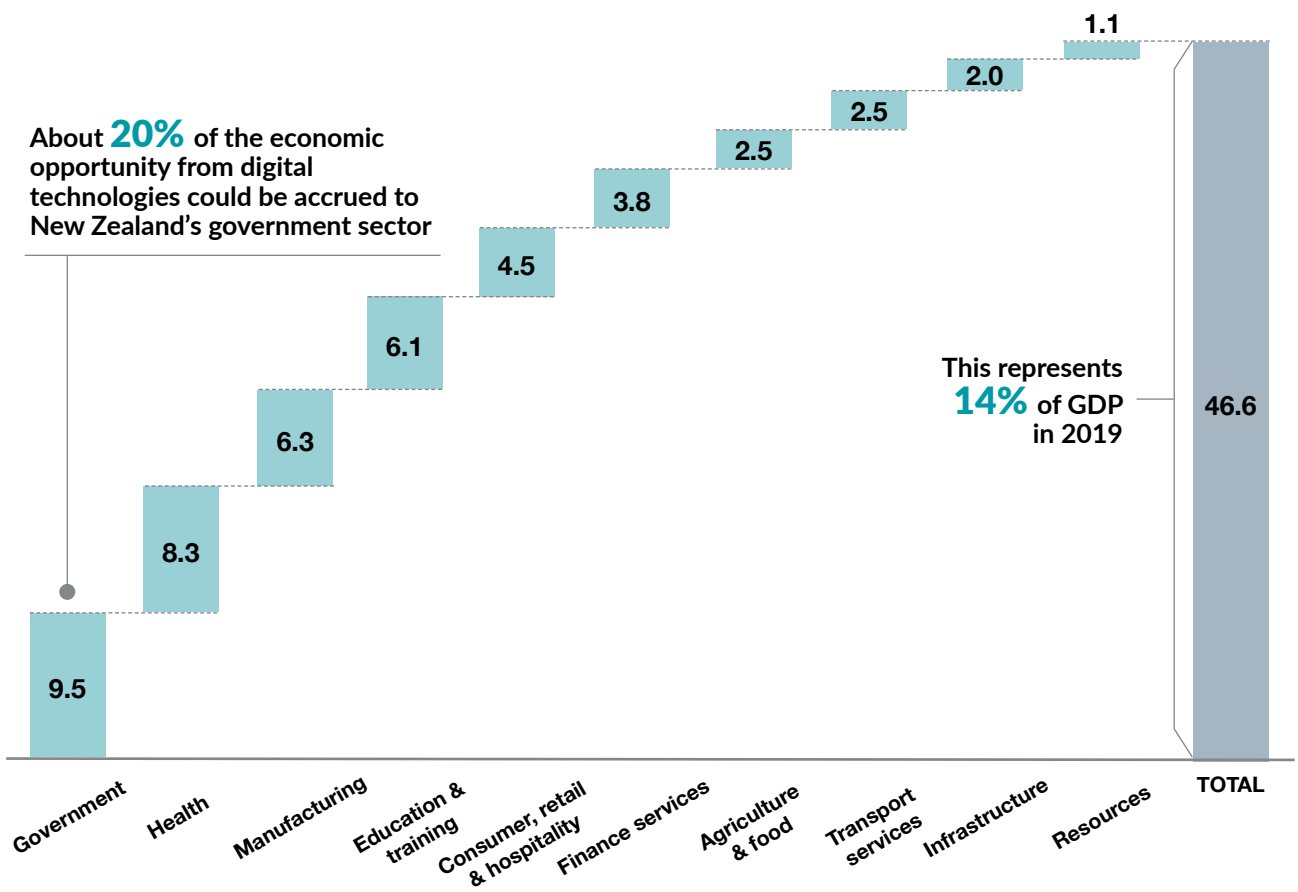
- **Health.** There is vast potential for the public and private healthcare entities to leverage digital technologies for greater productivity and better public health outcomes. Emerging intelligent healthcare services allow standardised

20. Based on AlphaBeta analysis. See Appendix A for details on the methodology.
21. Based on AlphaBeta analysis. See Appendix A for details on the methodology.
22. Gartner (2020), "At Gartner IT infrastructure, operations & cloud strategies conference 2020".
Available at: https://www.gartner.com/en/conferences/apac/infrastructure-operations-cloud-india/featured-topics/cloud
23. Gartner (2020), "At Gartner IT infrastructure, operations & cloud strategies conference 2020".
Available at: https://www.gartner.com/en/conferences/apac/infrastructure-operations-cloud-india/featured-topics/cloud
24. New Zealand Business Number (2019), "First e-invoice paves way for faster, easier, more secure invoicing."
Available at: https://www.nzbn.govt.nz/about-us/news/first-e-invoice-paves-way-for-faster-easier-more-secure-invoicing/
25. Sources include: Datareportal (2020), "Digital 2020: New Zealand." Available at: https://datareportal.com/reports/digital-2020-new-zealand; Mastercard (2018), Building digital liquidity to enable payments at the base of the pyramid. Available at: https://newsroom.mastercard.com/wp-content/uploads/2019/03/Digital-Liquidity-to-Enable-BOP-Payments.final_.pdf

EXHIBIT 2:

BY 2030, DIGITAL TECHNOLOGIES COULD SUPPORT UP TO NZ$46.6 BILLION OF ANNUAL ECONOMIC IMPACT IN NEW ZEALAND

POTENTIAL ANNUAL ECONOMIC VALUE FROM DIGITAL TECHNOLOGIES, BY SECTOR[1]
NZ$ 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 are considered.

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis

data exchange between patients, mobile apps, healthcare providers and partners. Healthcare APIs can help enable building clinical and analytic solutions securely in cloud environments. Indeed, such technologies have been crucial during the COVID-19 pandemic. To ensure New Zealanders have access to the latest updates and health advice from official sources, the government launched the covid19.govt.nz website early on during the pandemic containing information and resources on the evolving outbreak. The Ministry of Health also developed the "NZ COVID Tracer" mobile application that records the places visited by the individual to identify those who may have been exposed to infected individuals, in order to prevent further transmission.[26] Since its implementation, contact tracing enabled the authorities to reach 95 percent of the people who came into contact with infected individuals within three days.[27] Besides curbing the spread of infectious diseases, technologies can help to up healthcare capacity rapidly. Remote patient monitoring, for example, allows clinicians to delegate the monitoring of multiple patients to ancillary staff, enabling them to focus more time on critical patient-facing activities such as emergency treatments. By eliminating unnecessary hospitalisation for patient observation, the McKinsey Global Institute estimates that remote patient monitoring technology could reduce the cost of treating chronic diseases by 10 to 20 percent.[28] Piloted by the rising demand of consumers to monitor their own health, advances in smart medical devices such as connected implants, wearables and home health monitoring devices could empower patients to self-manage their health conditions. Alternatively, a suite of personalised and predictive health care services could emerge to enable patients to address their health conditions leveraging data from such technologies. It has been estimated that the use of smart devices could reduce disability-adjusted life years (DALYs)[29] in high-income countries by 1 percent annually.[30]

- **Manufacturing.** There is vast potential for technology applications such as big data analytics, additive manufacturing, supply chain management and advanced robotics to create economic value in the manufacturing sector. By improving demand forecasting and production planning leading to increased efficiency in meeting customer needs, it has been estimated that the use of big data analytics can bring about a 2.5 to 3 percent increase in the profit margins of manufacturers.[31] By enabling rapid, "on-time" and

26. Ministry of Health (2020), "NZ COVID Tracer app."
Available at: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-resources-and-tools/nz-covid-tracer-app
27. RNZ (2020), "COVID-19: Close contacts not getting into isolation fast enough."
Available at: https://www.rnz.co.nz/news/national/426138/covid-19-close-contacts-not-getting-into-isolation-fast-enough
28. 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
29. The disability-adjusted life year (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.
30. 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-livable-future
31. 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

customised manufacturing, additive manufacturing technologies (more commonly known as "3D printing") enhance the time-to-market, market productivity as well as customer base. It has been projected that the global economic value brought about by this technology could reach between US$100 billion and US$250 billion billion by 2025.[32] By taking over labour-intensive manufacturing tasks, industrial automation and robotics also demonstrate significant potential in addressing New Zealand's ageing and shrinking workforce - the country has among the highest rates of employees aged over 55 years across OECD economies.[33] Individual workers benefit from reduction in time spent on such tasks to focus on higher-value activities that command better wages, and enjoy better work satisfaction. For example, Oasis Engineering collaborated with Callaghan Innovation and Free Flow Partners to use robotics in loading and removing components from factory machines, allowing factory floor workers to work on higher-value tasks. Up from just one previously, five engineers have now been dedicated to product development, and the company is now able to expand its product range to include hydrogen fuel.[34] In addition, it has been found that by automating mundane and repetitive production tasks, industrial robotics could help improve productivity ranging from 0.8 to 1.4 percent of global GDP annually from 2015 to 2065.[35]

- **Education and training.** Digital technologies do not only hold the promise of enhancing the quality and reach of education, but also facilitate the matching of demand and supply in the job market. Despite the unique learning interests and capacities that students have, most education systems tend to take a one-size-fits-all approach to teaching and instruction. A key area in which technology can address this is through digital personalised learning tools, which allow teachers to track students' mastery of the subject matter, and complement traditional classroom instruction with a customised style, content, sequencing and pace of instruction to meet the individual education needs of each student. These include education technology (EdTech) applications and software that use big data and analytics to improve student assessments and create adaptive lessons to ensure students master one concept before they move to more challenging material.[36] The potential extends beyond primary and secondary schools - data can give colleges and universities much greater insight into faculty performance, course progression, and how students

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. New Zealand Work Research Institute (2015), Understanding the needs of New Zealand's ageing workforce.
Available at: https://workresearch.aut.ac.nz/__data/assets/pdf_file/0005/378932/2015-Understanding-Ageing-Workforce-report,-FOW.pdf
34. Callaghan Innovation (2020), "An oasis of innovation as Tauranga manufacturer embraces Industry 4.0."
Available at: https://www.callaghaninnovation.govt.nz/customer-stories/oasis-embraces-industry-40
35. McKinsey & Company (2017), A future that works: Automation, employment, and productivity.
Available at: https://www.mckinsey.com/~/media/mckinsey/featured%20insights/digital%20disruption/harnessing%20automation%20for%20a%20future%20that%20works/a-future-that-works-executive-summary-mgi-january-2017.ashx
36. 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

fare in the labour market after graduation.[37] It has been found that by improving learning outcomes and ultimately the supply of skilled labour in the economy, personalised education tools and programmes - if implemented nationwide - can boost national employment rate in high-income economies by 0.5 percent annually.[38] Outside the education system, digital job platforms and e-career centres are important digital tools that enhance efficiencies and address information asymmetries in the labour market. The multiplier effects generated by an expanding network of jobseekers 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. The ability of such digital platforms to match individuals to suitable job opportunities should not be underestimated; it has been projected that such platforms could match almost 62,000 unemployed individuals to full-time positions annually.[39] This potential is significant particularly given the rise of New Zealand's labour underutilisation rate from 10 to 12 percent against a bleak job market outlook in 2020 – the largest quarterly rise recorded.[40]

- **Consumer, retail and hospitality.** Many Kiwi retail and food and beverage (F&B) businesses are turning to online platforms such as e-commerce marketplaces and mobile applications to digitise their offerings and increase accessibility for customers. In the retail industry, the productivity gains from marketing and selling goods through digital channels have been estimated to range from 6 to 15 percent - these arise as a result of being able to reduce manpower requirements, harness inventory efficiencies and cutting real estate costs (e.g., rental of store space).[41] Especially during the COVID-19 lockdown when restaurants could not receive dine-in customers, many F&B businesses offered contactless takeout and delivery services to allow customers to order food and drinks online. It has been reported that restaurants experience, on average, a 15 percent boost to their revenues after partnering with food delivery companies as a result of being able to reach more customers.[42] In the tourism industry, there is also a range of technology applications that can drive greater productivity. In hotels, AI-driven conversational interfaces can facilitate quicker check-in and check-out procedures (a study found that AI could reduce time needed for this by up to 70 percent),[43] and allow staff to focus on providing more personalised customer service.[44] Such customised service has been found to be one of the most important drivers of customer loyalty, and it is estimated that AI-enabled services can boost hotel revenues by 10 percent.[45] Finally, big data analytics has the potential to offer the tourism industry a significant boost to marketing and service delivery efforts. By drawing upon data about consumer preferences and running analytics on them, tourism companies stand to improve their revenues from more well targeted promotions to prospective customers. A study has reflected that tour companies experienced a revenue uplift of 6 to 10 percent from integrating proprietary data to create personalised tourist experiences.[46]

37. Higher Education (2016), From bricks to clicks - the potential of data and analytics in higher education.
Available at: https://www.policyconnect.org.uk/hec/research/report-bricks-clicks-potential-data-and-analytics-higher-education
38. McKinsey Global Institute (2018), Smart cities: digital solutions for a more livable future.
Available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/Smart%20cities%20Digital%20solutions%20for%20a%20more%20livable%20future/MGI-Smart-Cities-Full-Report.pdf
39. Based on AlphaBeta analysis. See Appendix for more details on the methodology.
40. Stats NZ (2020), "COVID-19 lockdown has widespread effects on labour market."
Available at: https://www.stats.govt.nz/news/covid-19-lockdown-has-widespread-effects-on-labour-market
41. 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
42. The Straits Times (2017), "Delivery sales drive up eateries' revenues." Available at: https://www.straitstimes.com/business/delivery-sales-drive-up-eateries-revenues
43. 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
44. 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
45. 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
46. Boston Consulting Group (2020), "Bionic Revenue Management in Travel and Tourism."
Available at: https://www.bcg.com/publications/2020/bionic-revenue-management-travel-tourism

1.2 DIGITAL ADOPTION CAN ALSO SUPPORT THE CREATION OF BETTER-PAYING, HIGHER-QUALITY AND SAFER JOBS FOR KIWIS

Beyond improving economic value and efficiency, digital adoption also has the potential to create better-paying, higher-quality and safer jobs for New Zealanders. A range of factors associated with technology adoption are likely to drive increased worker incomes in New Zealand:

- **Increased demand for specialised tech skills.** A 2018 study in New Zealand found that increasing demand for specialised digital skills such as machine learning (ML) drove up the median base salary for digital professionals across a variety of sectors by 13 percent in just over six months.[47] These sectors included the financial services (where ML can facilitate fraud detection and credit scoring), public administration (where ML can improve the accuracy of data gathering and processing to enhance the efficiency of government services) and even construction (where ML can be applied to building information modelling tools to aid planning and design prior to physical construction) sectors.

- **Shifts in the type of tasks performed by workers.** There is growing evidence that by freeing up more time for workers to perform higher value-add tasks, technologies can allow workers to command higher wages in the labour market. Surveys reflect that Kiwi workers who perform cognitive, non-routine tasks command higher wages due to the growing need to add value to what computers can do in a digitalising era. A study in Australia also found that the real wages of low-skill workers could increase by 10 percent if they could reallocate time away from routine and automatable tasks.[48]

- **Economy-wide productivity effects.** By stimulating productivity and quality improvements, technologies enable higher-quality goods and services to be rendered at lower prices. This leads to increased household consumption spending, which in turn increases demand for labour and also wages. Wage improvements could also be traced back to enhanced productivity in the technology sector. The New Zealand Technology Industry Association found that a 4 percent increase in the productivity of the technology sector is associated with a NZ$1.3 billion increase in household consumption spending; this in turn could increase economy-wide real wages by 1.4 percent.[49]

- **Additional income-earning opportunities outside of regular, full-time jobs.** Enabled by technology, the rapid growth of sharing economy platforms in New Zealand has brought about additional income-earning opportunities for Kiwis outside of regular, full-time jobs. The sharing economy relates to direct trade between two users through digital platforms that preclude the need for an intermediary or broker, and as a result often saving both the buyer and seller time and money. Globally, more than 10,000 sharing economy platforms have emerged, and similarly in New Zealand, their popularity has grown.[50] This is particularly significant for

47. AbsoluteIT (2018), Digital remuneration report.
Available at: https://www.absoluteit.co.nz/wp-content/uploads/2018/07/Digital-Remuneration-Report-March-2018-FIN.pdf
48. Hays (2020), Hays jobs report: January to June 2020. Available at: https://www.hays.net.nz/report/HAYS_1378849
49. New Zealand Technology Industry Association (2016), From tech sector to digital nation.
Available at: https://nztech.org.nz/wp-content/uploads/sites/8/2019/02/from-tech-sector-to-digital-nation-2nd-edition-ebook.compressed.pdf
50. Natalia Rimell (2019), "Share and share alike". NZ Herald. Available at: https://www.nzherald.co.nz/business/share-and-share-alike/RL5VZMKYIQWBC33CAEXCEEDYDY/#:~:text=Examples%20of%20businesses%20operating%20in,individuals%20travel%2C%20eat%20and%20work

accommodation-sharing, which refers to short-term accommodation made available via an app or website to people.[51] In the year ending March 2018, it was estimated that the accommodation-sharing activities generated NZ$550 million in gross revenue with 8.8 million guest nights.[52]

Beyond the economic returns to workers, it has been found that technology adoption can also lead to higher-quality work opportunities. As stated by Carolyn Tremain, Chief Executive of the Ministry of Business, Innovation and Employment in relation to AI technologies, "It is likely many jobs will be augmented by the introduction of AI, freeing up employees from the more mundane or rote tasks to allow them to tackle more complex and creative work, enhancing our unique human attributes, such as creativity, critical thinking and collaboration."[53] Such expanded scope for human ingenuity has real implications for improving work quality across different sectors. In the financial services sector, for example, robotic process automation (RPA) adoption goes beyond cost reduction, faster processing speed and better data quality. By having "bots" perform mundane tasks such as checking and recording data, finance team members can switch their attention to more interesting and value-adding work such as developing new mechanisms to mitigate risky loans.[54] Research by AlphaBeta for Australia has additionally shown that automation has the potential to free up one hour per week for managers (who are able to spend less time collecting data and more time on strategic planning) to eight hours per week for teachers (who spend less time on administrative tasks such as recording test scores and more time on one-to-one student engagements).[55]

Workers may also benefit from improved job satisfaction and even workplace safety. A 2019 survey reflected that employees in the Asia Pacific region with access to automation and AI in the workplace are more likely to be satisfied (85 percent) with their work as compared to those without similar access (62 percent).[56] Another survey conducted across 11 countries (United Arab Emirates, Japan, United Kingdom, France, India, Italy, China, Germany, South Korea, Brazil and the US) found that 75 percent of employees believe that AI adoption at work has improved their mental health by allowing them timely access to the information they require to do their jobs (31 percent), automating tasks and

51. Stats NZ (2019), "Accommodation and the sharing economy in New Zealand".
Available at: https://www.stats.govt.nz/experimental/accommodation-and-the-sharing-economy-in-new-zealand
52. Stats NZ (2019), "Accommodation and the sharing economy in New Zealand".
Available at: https://www.stats.govt.nz/experimental/accommodation-and-the-sharing-economy-in-new-zealand
53. AI Forum New Zealand (2019), Artificial Intelligence: Shaping a Future New Zealand.
Available at: https://www.mbie.govt.nz/dmsdocument/5754-artificial-intelligence-shaping-a-future-new-zealand-pdf
54. ACCA (2020), Embracing robotic automation during the evolution of finance.
Available at: https://www.accaglobal.com/content/dam/ACCA_Global/professional-insights/embracing-robotics/Embracing%20robotic%20automation.pdf
55. AlphaBeta and Google (2016), The Automation Advantage. Available at: https://alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
56. Human Resources Director (2019), "What do employees really think of AI?"
Available at: https://www.hcamag.com/nz/specialisation/hr-technology/what-do-employees-really-think-of-ai/180668

decreasing workload to prevent burnout (27 percent), and helping them to prioritise tasks (25 percent).[57] By automating manual and sometimes physically challenging or dangerous tasks, technologies could also help improve workplace safety. A study in Australia shows that in sectors with a high proportion of physical tasks such as construction and manufacturing, workplace injuries could fall by as high as 11 percent as automation eliminates some of the most dangerous physical tasks in the economy.[58]

There is, however, the argument that by displacing work tasks, technologies could put people's jobs at risk. In New Zealand's context, there has been much evidence to the contrary. A study by the New Zealand Tech Alliance in 2016 reflected that the technology sector in fact supports the creation of new jobs in sectors providing ancillary services – on average, five new service sector jobs are created for every new job in New Zealand's tech sector.[59] In addition, new jobs get created when businesses that expand their reach to new markets through digital platforms, or develop new services and products using technology, require increased hiring to meet this additional demand. Box 2 shows an example of how a cruise business in New Zealand underwent a hiring expansion upon digitising its health and safety incident reporting system and augmenting its customer service with an AI-powered customer chatbot.

Further, studies of historical technological revolutions reflect that entirely new occupations could be created due to technological advancements, leading to significant job creation impacts. For instance, it was found that a third of new jobs created in the US over the past 25 years were jobs that did not exist before – in areas including IT development, hardware manufacturing, app creation and IT systems management.[60] Moreover, New Zealand's highly skilled labour force – which registers one of the highest rates of skills and educational attainment globally[61] – is likely to remain resilient to technological change. In addition, a recent survey by the Productivity Commission of 1,001 New Zealanders shows that 93 percent of them agreed that they were sufficiently skilled in the use of digital technologies to do their job.[62]

57. Oracle and Workplace Intelligence (2020), As uncertainty remains, anxiety and stress reach a tipping point at work. Available at: https://www.oracle.com/a/ocom/docs/applications/hcm/2020-hcm-ai-at-work-study.pdf
58. AlphaBeta (2017), The automation advantage. Available at: https://alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf
59. NZTech (2016), From Tech Sector to Digital Nation. Available at: https://nztech.org.nz/wp-content/uploads/sites/8/2019/02/from-tech-sector-to-digital-nation-2nd-edition-ebook.compressed.pdf
60. McKinsey & Company (2017), Technology, jobs and the future of work. Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/technology-jobs-and-the-future-of-work
61. Under the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) in 2014 in which the literacy, numeracy and problem-solving skills of a representative sample of adults were tested, adult New Zealanders' literacy and problem-solving skills (using computers) were among the highest in the world, and their numeracy skills were above the average for the participating 33 countries. Source: OECD. OECD Skills Surveys. Available at: https://www.oecd.org/skills/piaac/
62. New Zealand Productivity Commission (2020), Technological change and the future of work. Available at: https://www.productivity.govt.nz/assets/Documents/0634858491/Final-report_Technological-change-and-the-future-of-work.pdf

BOX 2.
DIGITAL TECHNOLOGIES SPUR THE EXPANSION OF ONE OF THE LARGEST CRUISE OPERATORS IN SOUTH ISLAND

When Black Cat Cruises started in 1985, the tour company accommodated and ferried a few hundred people annually in small canoes and dinghies. However, after replacing its paper-based administration system with a purpose-built digital application, staff could easily log departure, arrival, and vessel incidents in their individual tablets. This has saved administrative costs and reduced delays in resolving outstanding safety-related issues.[63]

In addition, to increase the efficiency of its customer service, Black Cat Cruises launched an AI-powered customer chatbot to allow for the online booking of cruise packages and the facilitation of 500 customer conversations monthly. This is estimated to have alleviated the workload of employees by ten hours monthly, and allowed the company to focus on other areas of the business – especially on improving the customer experience.[64] These changes helped the cruise operator to grow to become one of the most popular in the South Island. For over a decade, the company has been recognised both nationally and internationally with numerous tourism awards - its cruise trips have been ranked as the "Number 1 Wildlife Spotting Activity in New Zealand" (as voted by New Zealanders in a national survey), and the company's akaroa dolphin swim experience was also listed in the Lonely Planet's 2014 guide as one of the "Top 10 Marine Mammal Experiences".[65] Its employee count has grown over the years; it now employs 30 permanent staff, which increases to 50 during the summer vacation period.[66]

Photo Source: https://www.stuff.co.nz/travel/kiwi-traveller/116737165/world-famous-in-new-zealand-akaroas-black-cat-harbour-cruise

63. Ministry of Business, Innovation and Employment (2020), Tourism Case Studies. Available at: https://www.mbie.govt.nz/assets/90642ff7a9/digital-toolkit-case-study-tourism.pdf
64. Yonder (2020), "Yonder chatbot a game-changer for black cat cruises." Available at: https://www.yonderhq.com/case-study/black-cat-cruises-chatbot-answers-immediately-24-7
65. Black Cat Cruises. Available at: https://blackcat.co.nz/
66. Ministry of Business, Innovation and Employment (2020), Tourism Case Studies. Available at: https://www.mbie.govt.nz/assets/90642ff7a9/digital-toolkit-case-study-tourism.pdf

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

Despite having one of the greatest successes globally in curbing the domestic spread of the COVID-19 virus, New Zealand has been pushed by the pandemic into its deepest recession in decades. Following its strict lockdown measures and border closures in early 2020, the country's GDP shrank by 12.2 percent between April and June 2020 – its largest decline on record.[67]

This economic loss is largely driven by the country's strong reliance on tourism and exports, both of which have been heavily impacted by the pandemic. Large-scale travel restrictions introduced to contain the pandemic's spread, coupled with a slump in travel demand, have crippled New Zealand's tourism industry, which contributes both directly and indirectly to a significant 10 percent of overall GDP.[68] At the same time, disruptions to regional and global supply chains have led to a slowdown in global trade – this has heavily impacted New Zealand's goods and services exports which constitute about 28 percent of its GDP.[69]

Technology adoption will be crucial for businesses and workers to manage the crisis's impacts. **Of New Zealand's total digital opportunity of NZ$46.6 billion, NZ$17.1 billion (36 percent)[70] could be driven by technologies that help businesses and workers mitigate the impacts of COVID-19 (Exhibit 3).**

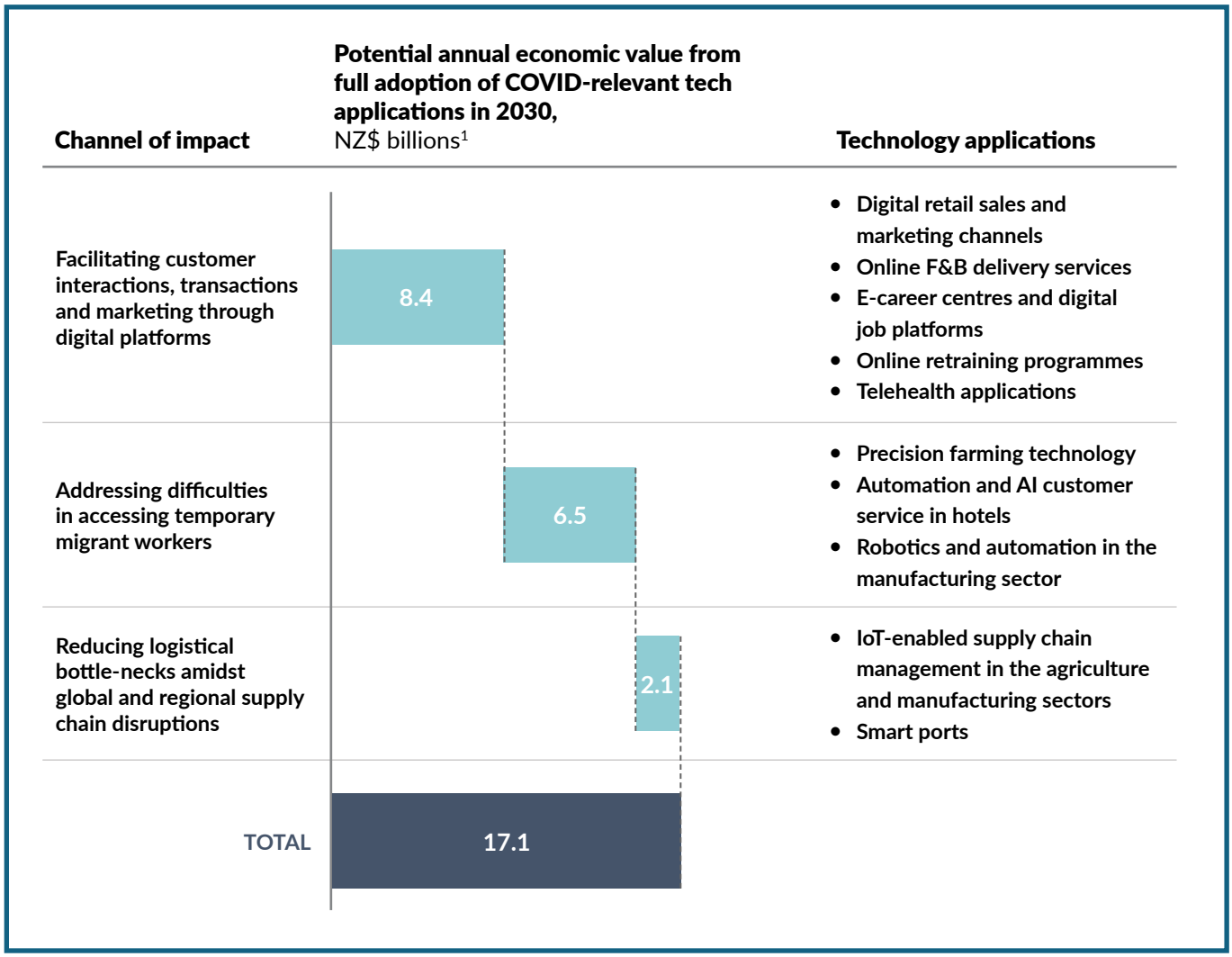
NZ$17.1 billion alludes to the combined value of all technology applications that allow businesses to flourish during the global pandemic and in the post-COVID future.[71] There are three channels in which technology applications can allow for this:

- **Facilitating customer interactions, transactions and marketing through digital platforms.** Although social distancing regulations were eased early on in New Zealand as compared to other countries, physical in-person transactions are unlikely to resume at full scale. These could be driven by lingering safety concerns about such interactions, and permanent changes in consumer behaviour and attitudes towards online marketplaces and services. A recent article by WestPac in New Zealand reflected that the COVID-19 pandemic had introduced a new generation of consumers to online shopping, with many retailers having to adjust their focus away from brick-and-mortar stores towards digital channels.[72] Such channels can enable businesses to scale their digital presence quickly and increase operational efficiency to meet surges in online demand. Examples of relevant technology applications include digital e-commerce platforms in the retail industry, online food and beverage (F&B) delivery services in the hospitality industry, e-career centres and digital

67. Stats NZ (September 2020), "Gross domestic product: June 2020 quarter".
Available at: https://www.stats.govt.nz/information-releases/gross-domestic-product-june-2020-quarter
68. Of the estimated GDP contribution of 10 percent by New Zealand's tourism industry, 6 percent is accounted for by the sector's direct GDP contributions and the remaining 4 percent is accounted for by the indirect value added of industries supporting tourism. See: Tourism New Zealand (2020), "About the tourism industry: data and statistics". Available at: https://www.tourismnewzealand.com/about/about-the-tourism-industy/#:~:text=Tourism%20generated%20a%20direct%20contribution,or%204.0%20percent%20of%20GDP.
69. World Bank – World Integrated Trade Solution (2020), "New Zealand trade statistics". Available at: https://wits.worldbank.org/CountryProfile/en/NZL#:~:text=New%20Zealand%20exports%20of%20goods,percentage%20of%20GDP%20is%2028.27%25.
70. Note that this value refers to the total impact of digital technologies that can help drive resilience during the COVID-19 pandemic if they are fully adopted by industry and government, and does not relate to the impact of any existing recovery plan.
71. Of the 40 technology applications in this study, 22 allow businesses to build resilience during the COVID-19 pandemic through the three specified channels. See Appendix A3 for more details.
72. Westpac New Zealand (2020), "The future of online shopping after COVID-19".
Available at: https://www.westpac.co.nz/rednews/business/the-future-of-online-shopping-after-covid-19/

EXHIBIT 3:

TECH APPLICATIONS THAT HELP BUSINESSES MITIGATE THE IMPACTS OF COVID-19 CAN GENERATE UP TO NZ$17.1 BILLION IN ANNUAL ECONOMIC VALUE BY 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 are considered.

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis

jobs platforms in the recruitment industry, and telehealth apps in the health sector. Telehealth adoption, in particular, scaled rapidly during the lockdown as primary care providers and hospitals were mandated by the government to move 90 and 50 percent of their patient consultations to virtual interactions respectively.[73] This trend is likely to stay even as New Zealand has carefully managed the pandemic response thus far; the government continues to support the use of such applications with the establishment of new provisions to ease the process of providing electronic prescriptions, as well as guidelines for general practitioners on holding remote consultations.[74]

- **Addressing difficulties in accessing temporary migrant labour.** One of the key challenges posed by the pandemic to New Zealand is the impact on the inflows of temporary or seasonal migrant workers. Tight border controls induced by the pandemic have led to a sharp decline in migrant arrivals. Between March and August 2020, there were nearly 111,000 more departures than arrivals, as the number of migrants whose work visas expire outweigh those who are able to gain entry to the country.[75] Several technology applications can help New Zealand businesses in the industries that are particularly reliant on seasonal migrant labour, including agriculture, retail and hospitality mitigate worker shortages and even ramp up productivity in spite of that. Precision farming technologies, for example, allow for the automation of manual farm work activities typically performed by seasonal migrants. Through the deployment of IoT-enabled

73. Roy Chiang (2020), "COVID-19: Acknowledging the need to adopt digital health in New Zealand". Healthcare IT News. Available at: https://www.healthcareitnews.com/news/asia-pacific/covid-19-acknowledging-need-adopt-digital-health-new-zealand
74. Ministry of Health (2020), "Telehealth and online tools". Available at: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-information-health-professionals/telehealth-and-online-tools
75. Lincoln Tan (2020), "Covid 19 coronavirus: Net migrant departures of 111,000 puts economic recovery at risk". NZ Herald. Available at: https://www.nzherald.co.nz/nz/covid-19-coronavirus-net-migrant-departures-of-111000-puts-economic-recovery-at-risk/GI22MAVTKO3I3TR74S763GIOSM/

sensors that continuously monitor soil moisture levels and plant health, watering and fertiliser disbursement may be automated.[76] By helping to reduce labour needs and achieve resource efficiency, it has been estimated that precision farming technologies could bring about NZ$2 billion in annual cost savings if fully adopted in New Zealand. In the hospitality industry, AI-enabled customer check-in and service procedures can help reduce staffing needs often met by seasonal labour. Moreover, AI can also help boost staff productivity and create greater service value overall; by freeing staff up from mundane administrative tasks, they may focus on addressing more complex customer demands or personalising customer service (e.g., customised meal preferences).[77]

- **Reducing logistical bottlenecks amidst global and regional supply chain disruptions induced by pandemic.** Businesses have had to cope with supply chains upheavals when lockdown measures cut the supply of important raw materials and components, and brought delays to the arrival of key components. These disruptions can be 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 agriculture and manufacturing sectors, and "smart ports". IoT devices have revolutionised supply chain management by allowing businesses real-time visibility into where goods are, how they are being stored, and when they can be expected at a specific location. Similarly, in "smart ports", IoT devices can be attached to specific storage containers or to raw materials or products themselves to allow for such tracking. In addition, comprehensive real-time data on cargo schedule and ship positions allow terminal staff to plan anchorage areas and avoid critical berths from being taken out of service by quarantined vessels, reducing bottlenecks and idle time.[78]

Box 3 highlights an example of how a New Zealand firm leveraged digital technologies to weather the negative economic impacts of the measures implemented during the COVID-19 pandemic.

Given the severe impact of the pandemic for New Zealand's international tourism industry - a key economic driver for the country, Box 4 highlights how downtime during the pandemic can be leveraged to support digital transformation for the industry.

76, Meghan Brown (2018), "Smart farming - automated and connected agriculture". Engineering.
Available at: https://www.engineering.com/DesignerEdge/DesignerEdgeArticles/ArticleID/16653/Smart-FarmingAutomated-and-Connected-Agriculture.aspx
77. Based on AlphaBeta analysis. See Appendix A for details on the methodology.
78. 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 3.
KITCHEN MANIA: ONLINE CAMPAIGN BRINGS NEW CUSTOMERS TO LOCAL KITCHEN DESIGNER

Based in Auckland, Kitchen Mania specialises in providing quality kitchen design and installation for contemporary New Zealand homes. Run by a passionate team of designers and specialists, Kitchen Mania prides itself on building kitchens that not only look good but are built to last.

When COVID-19 hit, Kitchen Mania's showrooms had to close and the business had to find alternatives to increase customer reach and boost revenue. Realising the potential to target people looking to redesign their kitchen during the lockdown period, they created an online campaign called "GST Free May" to drive enquiries and kitchen installation bookings by providing discounts. To boost the visibility of its online campaign and drive sales, they turned to Google Search Ads. The results were impressive and the campaign attracted double the number of new customers calling for a kitchen.
In response to social distancing measures, Kitchen Mania has digitised its in-home and showroom consultation services to continue its business operations. By creating an online kitchen design tool, customers can plan and create 3D photo realistic images of their new kitchen with consultants without having to meet physically.[79]

Photo Source: https://yellow.co.nz/y/kitchen-mania-mt-wellington

79. Kitchen Mania (2020), "Kitchen Design Online." Available at: https://www.kitchenmania.co.nz/design-online/

BOX 4.
LEVERAGING COVID-19 TO FACILITATE DIGITAL TRANSFORMATION IN THE TOURISM INDUSTRY

In 2019, international tourism contributed NZ$17.2 billion in spending, or 42 percent of total tourism expenditure.[80] This industry is also traditionally New Zealand's largest export earner, contributing to 21 percent of foreign exchange earnings.[81] However, the COVID-19 pandemic has set this industry back tremendously – international tourist arrivals have declined drastically and is likely to remain low for as long as borders stay closed and an approved vaccine is yet to be made broadly available.

Nevertheless, COVID-19 could give the New Zealand Government the opportunity to accelerate digital transformation in the tourism industry, especially for small and medium sized businesses (SMBs). With 82 percent of travel bookings worldwide being made online or via a smartphone without human interaction in 2018,[82] international tourists are already digitally savvy. Beyond online or mobile applications, technologies can potentially broaden the reach and appeal of New Zealand to tourists worldwide beyond its natural scenic settings – and transform the entire tourism value chain. Some key technologies include:

- **Facial recognition and biometric data.** Facial recognition technology is a form of biometric artificial intelligence, which is able to identify an individual or verify their identity based on facial features. This technology can be used to increase personalisation of services (e.g., a concierge is able to greet the guest by name on arrival), security (e.g., 77 percent of airports and 71 percent of airlines worldwide are planning major programmes or R&D around biometric ID management over the next five years),[83] data analysis, and payments. Financial services company MasterCard has already begun experimenting with a "selfie pay" system, where payments can be confirmed using a smartphone camera, with the image being matched to a database.[84]

- **Blockchain technology.** Blockchain technology refers to a list of public records, also known as a public ledger, wherein transactions between parties are listed or stored. Each record, or referred to as "block," is secured using cryptography. Blockchain can make accessing and storing important information easier and more reliable (e.g., payment information, passport details, baggage information) because responsibility for storing it is shared across the whole network.[85]

- **Big data.** Big data provides a range of benefits in the tourism industry, including being able to use predictive analytics on occupancy and greater insights on customer segments. The international hotel chain, Dorchester Collection, for instance, has used big data and AI technologies to sort through customer feedback from surveys, reviews, and online polls, in order to build a clearer picture of current customer opinion in real-time.[86]

80. New Zealand Institute of Economic Research (2020), Tourism beyond COVID-19. Available at: https://nzier.org.nz/static/media/filer_public/4a/41/4a41290e-d5a7-4af9-988b-284a5f36ed57/nzier_insight_87_-_tourism_beyond_covid-19.pdf
81. Tourism New Zealand (2020), "About the tourism industry". Available at: https://www.tourismnewzealand.com/about/about-the-tourism-industy/#:~:text=Tourism%20is%20our%20biggest%20export,or%204.0%20percent%20of%20GDP .
82. TrekkSoft (2019), Travel Trends Report 2019. Available at: https://www.trekksoft.com/en/resources/ebooks/travel-trends-report-2019
83. SITA (2018), Air Transport IT Insights 2018. Available at: https://www.sita.aero/resources/type/surveys-reports/air-transport-it-insights-2018
84. Revfine (2018), 4 Ways Facial Recognition Can Be Used in the Travel Industry. Available at: https://www.revfine.com/facial-recognition-travel-industry/
85. Revfine (2018), How Blockchain Technology is Transforming the Travel Industry. Available at: https://www.revfine.com/blockchain-technology-travel-industry/
86. Revfine (2018), How Artificial Intelligence is Changing the Travel Industry. Available at: https://www.revfine.com/artificial-intelligence-travel-industry/

- **AI and mobile technology.** Finding travel accommodations can be a protracted and challenging process for most consumers - McKinsey estimates that an average purchase journey for a single hotel room lasts 36 days with 45 touch points, distributed among search engines and the websites of intermediaries and suppliers, and involves multiple devices.[87] AI technologies fused with Internet and mobile technologies could significantly improve the efficiency of the search experience. There has already been widespread adoption of AI technologies for the purposes of powering "chatbots" on social media platforms as well as instant messaging apps. This can help companies respond to consumer demands for faster response times and enable 24/7 access. AI technologies are also supporting conservation projects for eco-tourism. As part of New Zealand's first fenced eco-sanctuary and world-class conservation project, researchers from Victoria University of Wellington used AI algorithms to identify birdcalls, which enabled scientists to discover the location and number of endemic birds.[88]

- **Industry robotics.** While industrial robots are currently focused on heavy manufacturing industries, as the technology evolves and robots become more adaptable, there could be greater investment in robots in service industries like tourism. In tourism, it is highly probable that robots will be able to carry out strenuous and unattractive jobs such as waiting on tables, cleaning, and garbage disposal.[89]

- **Virtual reality.** Virtual reality involves the full immersion in computerised programmes that provide contact in real-time. This could be used by tourism operators to share experiences and better market to end-consumers.

87. McKinsey & Company (2018), How to serve today's digital traveler.
Available at: https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/how-to-serve-todays-digital-traveler
88. Wildlife.ai (2020), "Using machine learning to identify birdsongs".
Available at: https://sites.google.com/wildlife.ai/site/case-studies/birdsong-recognition-with-ai
89. Gül and Gül (2018), The effect of the Fourth Industrial Revolution on tourism. Balikesir University Working Paper Series.
Available at: http://nbuv.gov.ua/j-pdf/evdvnz_2018_2_8.pdf

CAPTURING THE PRIZE — THREE PILLARS OF ACTION

To fully capture the digital opportunity, three pillars of action will be required in New Zealand: 1) Support technology adoption in key industries; 2) Digitally upskill the current workforce and future talent; and 3) Promote digital export opportunities.

Kiwi businesses have benefited from significant strides made across all three pillars. The government has developed a strong mandate to ***drive technology adoption in key industries*** through its recently launched "Industry Strategy", which aims to increase the uptake of digital technologies in priority industries. To ***digitally upskill New Zealand's current workforce and future talents***, the government has a strong focus on digitally upskilling the current workforce through policies such as the recently announced "Small Business Digital Capability" package which includes a strong digital skills component, and the introduction of introduced tech education as a core component to national curriculums in 2019. As a trade-dependent country, New Zealand also has a strong focus on ***promoting digital export and trading opportunities*** through its participation in the Digital Economic Partnership Agreement (DEPA) and the Single Economic Market (SEM) agenda with Australia.

To go further to fully adopt digital technologies and expedite the digital-led recovery from the impacts of the COVID-19 pandemic, it is recommended that the country explore opportunities for a "green recovery" through embedding a stronger focus in economic stimulus packages on funding for clean energy and the development or adoption of climate-friendly technologies across sectors, invest in digital reskilling programmes that translate into high-value job opportunities, and further enhance digital trade opportunities for Kiwi businesses.

"CAPTURING THE PRIZE"
THREE PILLARS OF ACTION

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

1. Support technology adoption in key industries
2. Digitally upskill current workforce and future talent
3. Promote digital export opportunities

Significant effort has already been made in the following areas

- Identify techs to be adopted in each sector
- Equip small businesses with digital knowhow
- Develop ICT infrastructure to lower digital setup costs
- Foster industry-government partnership to identify digital skills required by sector, and provide support for training in them
- Embed digital technology in educational curriculums
- Promote inclusivity in digital upskilling
- Provide support for businesses to capture digital trade opportunities
- Minimise border frictions
- Promote open cross-border data flows
- Build trust in cross-border digital systems

However there are areas in which New Zealand can further strengthen its approach

- Facilitate digitally enabled "green recovery" efforts from the pandemic
- Ensure that income security policies do not disincentivise digital skilling
- Support displaced workers in transitioning into new jobs through digital skills training
- Create stronger international positioning for New Zealand's digital capabilities

2.1 PILLAR 1: SUPPORT TECHNOLOGY ADOPTION IN KEY INDUSTRIES

To harness the productivity benefits of digital transformation and build economic resilience in the COVID-19 crisis, it is crucial that key industry sectors in New Zealand have access to the digital tools and knowhow required to leverage technology in their day-to-day operations.

New Zealand has already made significant efforts in the following areas:

- **Identify relevant technologies to be adopted in each sector.** In June 2019, the Ministry of Business, Innovation and Employment (MBIE) partnered with the New Zealand Tech Alliance (NZTech), a group of technology industry associations, to launch the "Industry Strategy" which aims to educate and encourage businesses in a range of sectors to adopt technologies, innovate and enhance productivity.[90] At the core of this strategy are the "Industry Transformation Plans", which identify opportunities to lift productivity and growth in key sectors which include construction, food and beverage, agriculture, digital technology and forestry and wood processing.[91]

- **Equip small businesses with digital knowhow and capacities.** New Zealand already has a strong focus in this area, particularly in light of COVID-19. In September 2020, the government announced a NZ$10 million "Small Business Digital Capability" package aimed at supporting the digitisation efforts of small businesses, and an additional NZ$5 million to help tourism-related small businesses. Key initiatives under this programme include platforms for small businesses to share their experiences and lessons learnt from digital adoption, digital skills training for small business owners, and a central repository that brings together the most relevant digital tools, technologies, products and services for businesses.[92]

- **Develop ICT infrastructure to lower digital setup costs for businesses.** Greater ICT connectivity for Kiwi businesses has also been supported through the increased rollout of fibre-to-the-premises "Ultra-Fast Broadband" (UFB) programme and "Rural Broadband Initiative" (RBI), thereby lowering the digital setup costs by businesses.[93] Research has shown that these investments have supported increased digital adoption in the country.[94]

While there is already a comprehensive range of policies to facilitate digital adoption by Kiwi businesses, the country could go further in the following area:

- **Facilitate digitally enabled "green recovery" efforts from the pandemic.** As a recent survey in New Zealand demonstrates, a "green recovery" process from the COVID-19 pandemic is supported

90. Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan. Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan

91. Sources include: Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan. Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan; Ministry of Business, Innovation and Employment (2019), From the Knowledge Wave to the Digital Age. Available at: https://www.mbie.govt.nz/dmsdocument/5866-growing-innovative-industries-in-new-zealand-from-the-knowledge-wave-to-the-digital-age

92. Ministry of Business, Innovation and Employment (2020), "Digital Boost". Available at: https://www.mbie.govt.nz/business-and-employment/business/support-for-business/digital-boost/

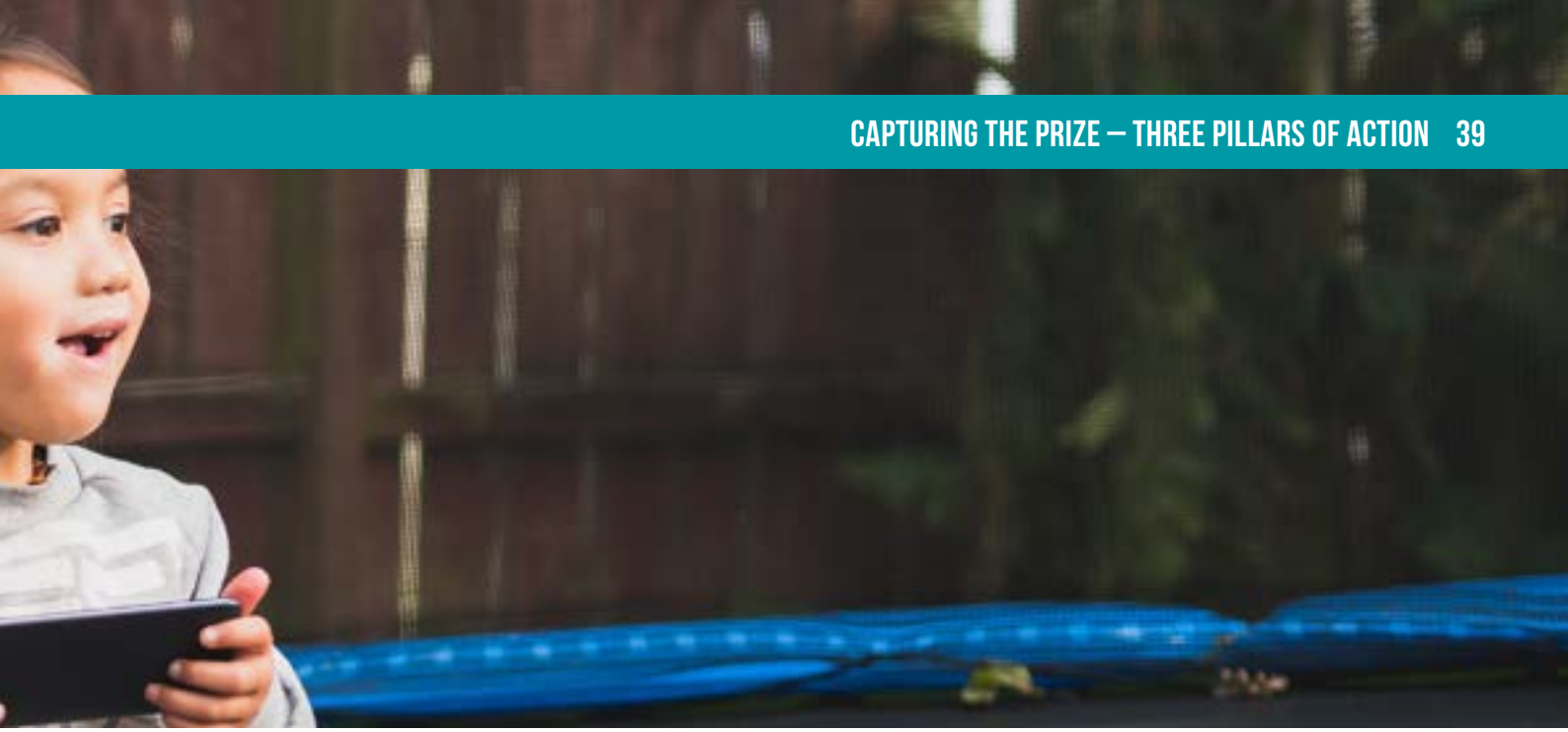
93. Ministry of Business, Innovation and Employment (2017), The business growth agenda: Building a Digital Nation. Available at: https://www.mbie.govt.nz/assets/247943bfa5/building-a-digital-nation-bga.pdf

94. A study by Fabling and Grimes (2016) showed that the diffusion of ultrafast broadband in New Zealand firms has led to complementary organisational investments that entail the adoption of digital technologies. See: Richard Fabling and Arthur Grimes (2016), Picking up speed: does ultrafast broadband increase firm productivity? Available at: http://motu-www.motu.org.nz/wpapers/16_22.pdf

95. Jamie Morton (2020), "Seven in 10 Kiwis want a green COVID-19 recovery – survey". NZ Herald. Available at: https://www.nzherald.co.nz/nz/seven-in-10-kiwis-want-a-green-covid-19-recovery-survey/L2A4KL6EWYMLNFHKALO43LPN54/

by seven in 10 Kiwis.[95] However, while the government has announced the intent to spend more than one billion dollars to create about 11,000 new "nature jobs" (referring to jobs in environmental work such as staff for biodiversity projects and nature ambassadors), concern has been expressed over the lack of emphasis on climate change.[96] Triggering a "green recovery" process could also support the development and adoption of digital solutions that bring about more environmentally sustainable outcomes. For instance, it has been estimated that smart grid technologies can allow for energy savings of between 5 to 10 percent nationwide.[97] IoT-enabled water leakage detection and control technologies can also help bring about a 1.4 percent decrease in national water consumption in high-income countries.[98] There are several promising practices currently being implemented in other countries that New Zealand could consider. Germany, for example, has taken steps towards facilitating this "green recovery" process by structuring economic recovery packages with a climate-friendly focus. The country's €130 billion stimulus included funding for the development of new and emerging technologies to address climate change such as hydrogen technology and electric vehicles.[99] This entails subsidies for electric vehicles, funding for the proposed installation of low-carbon energy and heating systems to improve building energy efficiency, as well as for state-of-the-art hydrogen infrastructure to decarbonise manufacturing. South Korea's COVID-19 response package includes the "Green New Deal", which entails large-scale investments in renewable energy and the creation of a Regional Energy Transition Centre to support workers' transition away from pandemic-affected sectors such as hospitality towards "green jobs" in the renewables industry.[100] Similarly, France's economic recovery plan includes a strong focus to reduce vehicle emissions through the deployment of electric charging stations. The French government's US$8.9-billion stimulus support to the transport services sector includes more than US$390 million in green R&D across vehicle manufacturer supply chains.[101] The New Zealand Government could reference such practices to facilitate a stronger focus on climate-resilient growth after the pandemic.

96. Eleanor Ainge Roy (2020), "New Zealand budget: $1bn for 'nature jobs' but dismay at lack of climate action". The Guardian. Available at: https://www.theguardian.com/world/2020/may/14/new-zealand-budget-1bn-for-nature-jobs-but-dismay-at-lack-of-climate-action
97. Smart Energy Consumer Collaborative. Available at: http://www.whatissmartgrid.org/faqs/what-are-the-benefits-of-the-smart-grid
98. McKinsey Global Institute (2018), Smart cities: Digital solutions for a more liveable future. A vailable at: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/smart-cities-digital-solutions-for-a-more-livable-future
99. Asian Development Bank (2020), Green financing strategies for post-COVID-19 economic recovery in Southeast Asia. Available at: https://www.adb.org/sites/default/files/publication/639141/green-finance-post-covid-19-southeast-asia.pdf
100. International Institute for Sustainable Development (2020), South Korean government launches plan for a Green New Deal. Available at: https://www.iisd.org/sustainable-recovery/news/south-korean-government-launches-plan-for-a-green-new-deal/
101. Asian Development Bank (2020), Green finance strategies for post-COVID-19 economic recovery in Southeast Asia. Available at: https://www.adb.org/sites/default/files/publication/639141/green-finance-post-covid-19-southeast-asia.pdf



2.2 PILLAR 2: DIGITALLY UPSKILL THE CURRENT WORKFORCE AND FUTURE TALENT

It is critical to ensure that New Zealanders are able to use digital technologies to access job opportunities, run businesses and enhance productivity in their work.[102] The opportunities to access digital skills training should be rendered available to all segments of the society, including typically underserved communities such as Māori, Pasifka and people in rural and regional New Zealand. 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.

New Zealand is already advancing this goal of building digital talent through the following action areas:

- **Foster industry-government partnership to identify digital skills required by sector, and provide support for training in them.** The "New Zealand Digital Skills Forum" is a coalition of industry associations and government organisations who work together to identify and tackle issues and opportunities relating to the access and development of skills for the digital technology sector.[103] With a strong focus on ensuring a sustainable talent pipeline, the Forum also maps the future skill requirements in the sector to identify the specific skill gaps that are likely to emerge, so that these can be addressed early.[104] The NZ$10-million "Small Business Digital Capability" package (mentioned under Pillar 1) includes provision for digital skills training vouchers for small business owners.[105] Under this programme, industry specialists are appointed by the government to provide workshops to small businesses on pandemic-proof skills like strategic digital marketing, Search Engine Optimisation (SEO), and online advertising tools.

102. Such a vision for New Zealand as a "Digital Nation" was also laid out in the Business Growth Agenda by the New Zealand Government. See: Ministry of Business, Innovation and Employment (2017), The Business Growth Agenda: Building a Digital Nation. Available at: https://www.mbie.govt.nz/assets/247943bfa5/building-a-digital-nation-bga.pdf

103. New Zealand Digital Skills Forum (2020). Available at: https://www.digitalskillsforum.nz/the-forum/about/

104. New Zealand Digital Skills Forum (2020). Available at: https://www.digitalskillsforum.nz/the-forum/about/

105. Ministry of Business, Innovation and Employment (2020), "Boosting small business digital capability". Available at: https://www.business.govt.nz/news/boosting-small-business-digital-capability/

- **Embed digital technology in educational curriculums.** Digital technology was formalised as part of the national educational curriculum in 2019, when the Ministry of Education (MOE) introduced "computational thinking for digital technologies" and "designing for digital outcomes" into curriculums.[106] Further, as part of the country's Review of Vocational Education, six interim Establishment Boards (iEBs) were established to create new Workforce Development Councils (WDCs) to maintain a strategic purview of future skill needs of industries. These Councils will set standards, develop qualifications, and help shape the curriculum of vocational education to meet emerging digital and technical skill needs in all sectors.[107]

- **Promote inclusivity in digital upskilling and access.** Through its "Digital Inclusion Action Plan", New Zealand seeks to bridge the access of underserved communities such as ethnic minorities and people with disabilities to digital devices, broadband connection and digital content.[108] The country's "Rural Broadband Initiative" (RBI) has also provided its 630,000 rural citizens with access to high-speed broadband.[109]

However, there are several workforce and skills-related challenges in the country. As most have already been well researched and documented by government, industry and academia,[110] two recommendations are highlighted here:

- **Ensure that income security policies do not disincentivise digital skilling.** To encourage labour market dynamism and support potentially displaced workers in light of technological change, the New Zealand Government is looking to adopt policies that promote income security over job security – known as "flexicurity".[111] Policies under consideration include introducing portable individual redundancy accounts, mandating unemployment insurance, and making changes to benefits and tax credits. While this would help address a gap that New Zealand currently has vis-à-vis other mature economies (besides Australia, it is the only OECD economy without a mandated unemployment insurance scheme), one concern with such approaches is they could drive a "wedge" between the labour costs faced by employers and the net wage received by workers, with the possible effect that firms get incentivised to favour work arrangements outside of regular employment such as outsourcing and contracting short-term staff.[112] While New Zealand currently has the lowest tax wedge in OECD countries,[113] it is important that this implication is considered as income security policies are formulated as not only might this threaten opportunities for stable employment in the country, it may also weaken the incentives for employers to invest in long-term digital skills training programmes for employees. Displaced workers may also be discouraged from labour market participation and investing in their own skill development journeys if the adjustments

106. Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan: Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan
107. Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan: Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan
108. New Zealand Government (2020), "Digital Inclusion Action Plan 2020-2021". Available at: https://www.digital.govt.nz/dmsdocument/174~digital-inclusion-action-plan-20202021/html,-communities-and-the-wider-digital-inclusion-system#digital-inclusion,-more-than-getting-a-device-and-internet-connection
109. Centre for Public Impact (2020), "New Zealand's Rural Broadband Initiative (RBI)". Available at: https://www.centreforpublicimpact.org/case-study/rural-broadband-initiative-in-new-zealand/
110. Sources include: Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan: Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan; Productivity Commission (2020), Technological change and the future of work. Available at: https://www.productivity.govt.nz/assets/Documents/223e187413/At-a-glance_Technological-change-and-future-of-work.pdf; New Zealand Digital Skills Forum (2019), Digital skills for a Digital Nation. Available at: https://www.digitalskillsforum.nz/wp-content/uploads/2018/01/digital-skills-for-a-digital-nation-online.pdf
111. Productivity Commission (2020), Technological change and the future of work. Available at: https://www.productivity.govt.nz/assets/Documents/223e187413/At-a-glance_Technological-change-and-future-of-work.pdf
112. Productivity Commission (2020), Technological change and the future of work. Available at: https://www.productivity.govt.nz/assets/Documents/223e187413/At-a-glance_Technological-change-and-future-of-work.pdf
113. OECD Data (2020), "Tax wedge". Available at: https://data.oecd.org/tax/tax-wedge.htm

to the benefit and tax credit policies lead to higher marginal tax rates.[114] It is therefore important that the design of such policies eliminate these perverse incentives that risk undoing the benefits of deep investments made in digital skilling and employment by the country.

- **Support displaced workers in transitioning into new jobs through digital skills programmes.** It is crucial that investments in digital skills programmes translate into tangible job opportunities for Kiwi workers, particularly with COVID-19. Several government initiatives have been developed to address the pandemic's employment impacts. For example, the NZ$1.6-billion "Trades and Apprenticeships Training Package" announced in July 2020 includes free vocational training for displaced workers for two years in the areas of construction, agriculture, manufacturing, community health, counselling and care work.[115] Under the "Keep New Zealand Working" programme, the Ministry of Social Development (MSD) ramped up its online recruitment tool to help job seekers connect to job opportunities.[116] However, although a vast array of literature has shown that digital skills will become even more important with COVID-19 as digitised business models and ways of working become the norm,[117] digital skills training remains an untapped avenue to ensure that displaced workers obtain the skills they require to seek employment during and after the pandemic. This also builds upon pre-pandemic concerns by Kiwi industry of a lack of skills in emerging technology fields such as AI.[118] Singapore's AI skilling courses for individuals affected by the pandemic is a positive example that could be considered in New Zealand (see Box 5).

114. Productivity Commission (2020), Technological change and the future of work. Available at: https://www.productivity.govt.nz/assets/Documents/223e187413/At-a-glance_Technological-change-and-future-of-work.pdf
115. Ministry of Education (2020), "Trades and Apprenticeships Training Package". Available at: https://www.education.govt.nz/our-work/publications/budget-2020/trades-and-apprenticeships-training-package/
116. Ministry of Social Development (2020), Available at: https://www.jobs-during-covid.workandincome.govt.nz/jobs
117. Sources include: McKinsey & Company (2020), "To emerge stronger from the COVID-19 crisis, companies should start reskilling their workforces now". Available at: https://www.mckinsey.com/business-functions/organisation/our-insights/to-emerge-stronger-from-the-covid-19-crisis-companies-should-start-reskilling-their-workforces-now; Oliver Wyman (2020), "Digital skills to fight COVID-19". Available at: https://www.oliverwyman.com/our-expertise/insights/2020/apr/digital-skills-to-fight-covid-19.html; Gartner (2020), "Use COVID-19 downtime to upskill for digital". Available at: https://www.oliverwyman.com/our-expertise/insights/2020/apr/digital-skills-to-fight-covid-19.html
118. Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan. Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan

BOX 5.
AI SINGAPORE: AI TRAINING PROGRAMMES THAT TRANSLATE INTO JOB OPPORTUNITIES

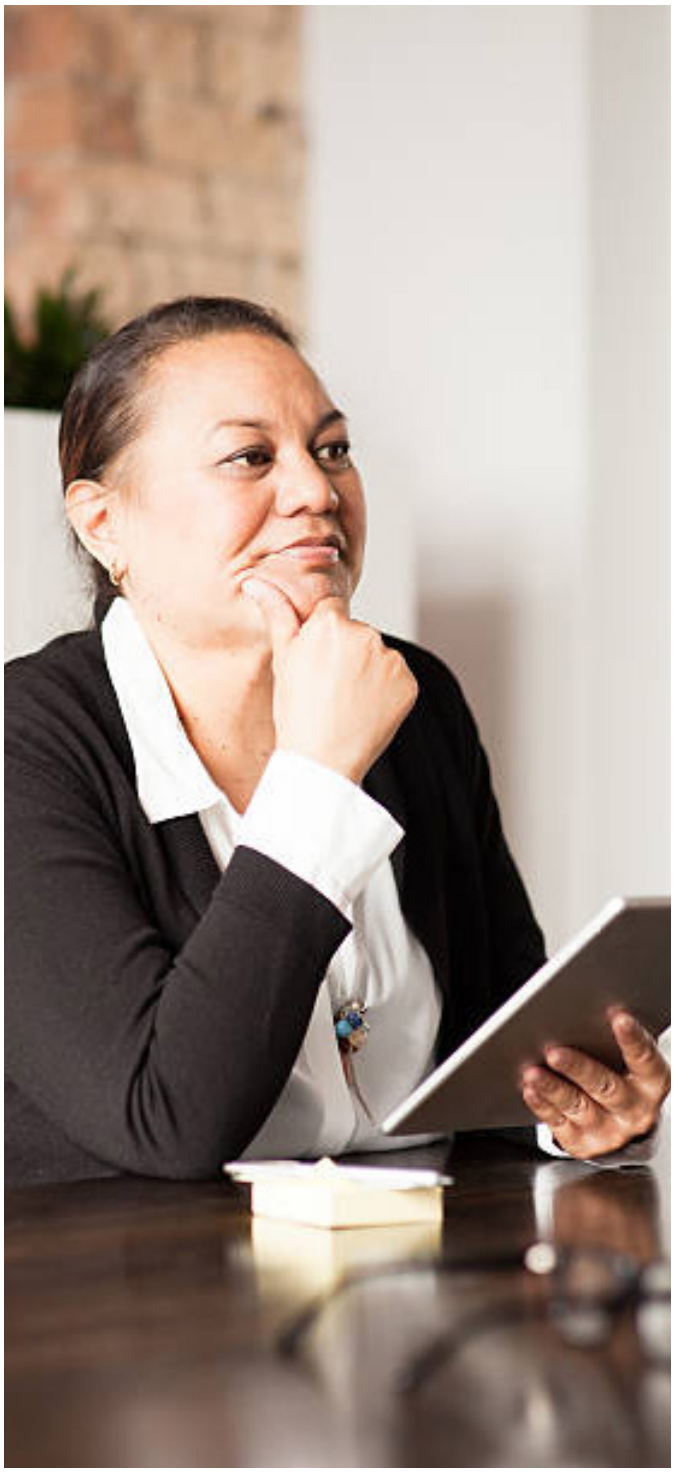
To prepare jobseekers in seizing opportunities in the digital economy during the pandemic, AI Singapore (AISG) has unveiled a series of training programmes to provide up to 2,800 individuals the opportunity to upskill and reskill in various digital technologies, and enhance their career prospects in AI-related roles.

One of these programmes is "AI Data Apprenticeship", which comprises both coursework and practicum components to train participants in data curation for AI solutions.[119] Over a two-month period of coursework, participants will deepen not only their theoretical knowledge of AI and machine learning, but also their software engineering skills to deploy models in real life situations. As participants progress to the practicum component, they will be applying their new knowledge and immersing in a hands-on experience on real-world industry projects sponsored by local companies. The project-based collaboration with industry partners provides an opportunity for companies to assess suitable candidates for hiring while participants gain wider exposure to job opportunities in the growing sector. In the previous batches of similar programmes, some graduates from the programme successfully took on jobs with their project sponsor companies to continue building on the solutions that they initiated during the programme.[120]

Photo Source: https://www.aisingapore.org/2019/02/aiap-batch-1-graduation/

119. AI Singapore (2020), "AI Data Apprenticeship Programme." Available at: https://www.aisingapore.org/industryinnovation/aidp/
120. AI Singapore (2020), "AIAP Batch 4 Graduates." Available at: https://www.aisingapore.org/2020/06/aiap-batch-4-graduates/#more-310687

2.3 PILLAR 3: PROMOTE DIGITAL EXPORT OPPORTUNITIES



Finally, for a small and geographically isolated country like New Zealand, it is important that businesses and organisations are able to maximise digital platforms for export opportunities.

New Zealand has implemented the following actions:

- **Provide capacity-building support for businesses to capture digital trade opportunities.** The New Zealand Government agency, Callaghan Innovation, has been working with NZTech, a group of technology industry associations, to create and nurture a pipeline of Kiwi companies to be global-ready. End-to-end support is provided for companies to scale globally in the form of "Getting Started Grants", "Founder" incubators, tax incentives for research and development (R&D) efforts, subsidies for digital adoption ("capability vouchers"), and knowledge sharing platforms.[121] The government agency, New Zealand Trade and Enterprise (NZTE), also recently launched "myNZTE", a free online platform offering businesses detailed guidance on leveraging digital trade platforms.[122]

- **Minimise border frictions and facilitate interoperability.** Cross-border trade would be greatly enhanced by reducing the need for local registration, removing disclosure requirements of key intellectual property, and minimising unnecessary procedures and duties. In addition, there is a strong evidence base around the potential gains from reducing harmful, trade-distorting non-tariff barriers; past research has estimated that the potential cost of Asia-Pacific Economic Cooperation (APEC) economies' non-tariff measures to Kiwi

121. Ministry of Business, Innovation and Employment (2020), Digital technologies Industry Transformation Plan. Progress update for industry. Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan
122. New Zealand Trade and Enterprise (2020), "Digital commerce". Available at: https://www.nzte.govt.nz/page/digital-commerce

exporters was NZ$8.4 billion per year.[123] To capture the potential gains from a seamless trans-Tasman (a term signifying an interrelationship between Australia and New Zealand) business environment, New Zealand and Australia have collaborated on advancing the "Single Economic Agenda" on multiple fronts, such as streamlining border processing, harmonising regulatory requirements and organising joint trade promotion efforts.[124] Additionally, New Zealand recently signed the "Digital Economy Partnership Agreement" (DEPA) with Singapore and Chile to promote interoperability in digital trade and help MSMEs overcome the challenges of scale and distance.[125] For example, e-certificates for animal products exchanged through the agreement's "International Connectivity System" will reduce time for document transit and cargo clearance, resulting in lower operating costs for exporters.

- **Promote open cross-border data flows.** With an OECD report highlighting that a ten percent rise in "bilateral digital connectivity" could improve trade in goods and services by about 2 and 3 percent respectively, cross-border data flows are critical for enabling digital exports.[126] There is a considerable opportunity to improve transparency on data management requirements across the Asia Pacific region and to identify areas to enhance performance. Through the DEPA, businesses operating in the three signatory countries are able to 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, MSMEs looking to better understand foreign markets can now access and use open government data to discover new business opportunities and innovate new products and services.[127]

123. New Zealand Institute of Economic Research (2016), Report for Export New Zealand – the benefits of trade. Available at: https://www.bec.org.nz/__data/assets/pdf_file/0018/128025/Benefits-of-Trade.pdf
124. New Zealand Foreign Affairs & Trade (2020), "Single Economic Market." Available at: https://www.mfat.govt.nz/en/countries-and-regions/australia/new-zealand-high-commission/single-economic-market/
125. Beehive.gov.nz (2020), "NZ concludes digital economy trade talks with Singapore and Chile." Available at: https://www.beehive.govt.nz/release/nz-concludes-digital-economy-trade-talks-singapore-and-chile
126. OECD (2019), Trade in the digital era. Available at: https://www.oecd.org/going-digital/trade-in-the-digital-era.pdf
127. Ministry of Trade and Industry Singapore (2020), "Digital Economy Partnership Agreement." Available at: https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements/The-Digital-Economy-Partnership-Agreement

- **Build trust in cross-border digital systems.** As digital systems for the exchange of digital goods and services span borders and need to be interoperable across countries, it is important that governments build trust in such systems so that enterprises may confidently enter export markets. This involves aligning laws and regulations with international frameworks through DEPA to protect consumers against fraudulent, misleading or deceptive conduct when engaging in online commercial activities and adopting ethical AI governance frameworks to harness AI in a responsible manner.[128] To support greater participation in trade by women, Māori and rural communities, DEPA also provides a channel for signatories to share best practices and develop joint programmes such as the "Digital SME Dialogue" to promote information sharing and exchange.[129]

While New Zealand has made significant efforts to promote digital trading opportunities for its industry, there is scope for further action in the following area:

- **Create stronger international positioning for New Zealand's digital capabilities.** Several studies and interviews with technology leaders in the country have reflected that a key barrier preventing Kiwi companies from gaining stronger momentum internationally is the lack of international visibility of the country's status as a "world class digital nation".[130] The government is cognisant of this and established the "New Zealand Story" (NZ Story) initiative as a platform to boost the country's export economy by broadening the international perspective about New Zealand.[131] In 2018, NZTE and NZTech created the "UpStarters" campaign to provide a unified voice for the tech sector to engage offshore.[132] While these initiatives have been warmly received by industry, there is still a perception by industry that its messaging has not fully reached its intended audience.[133] Box 6 shows related international best practice approaches from South Korea and Singapore, both of which are widely acknowledged as tech and innovation centres in the region and globally.

128. 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

129. 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

130. NZTech (2016), From Tech Sector to Digital Nation.
Available at: https://nztech.org.nz/wp-content/uploads/sites/8/2019/02/from-tech-sector-to-digital-nation-2nd-edition-ebook.compressed.pdf

131. New Zealand Story (2020). Available at: https://www.nzstory.govt.nz/

132. NZTech (2018), "Launch of NZ tech and innovation story Upstarters".
Available at: https://nztech.org.nz/2018/05/20/launch-of-nz-tech-and-innovation-story-upstarters/

133. Ministry of Business, Innovation and Employment (2020), Digital Technologies Industry Transformation Plan. Progress update for industry.
Available at: https://www.mbie.govt.nz/dmsdocument/11638-digital-technologies-industry-transformation-plan

BOX 6.
SOUTH KOREA AND SINGAPORE: HOW BOTH COUNTRIES BUILT THEIR REPUTATIONS AS GLOBAL TECH AND INNOVATION LEADERS

Ranked among the world's top ten most innovative economies under the World Intellectual Property Organization's Global Innovation Index 2020,[134] Singapore and South Korea both offer interesting insights on how their governments have nurtured and promoted their status as technology and innovation hubs in the region and globally.

SOUTH KOREA: STRONG GOVERNMENT SUPPORT FOR R&D AND INDUSTRY-RESEARCH COLLABORATION

South Korea's position as one of the world's most innovative nations has been often attributed to the country's outstanding performance in R&D intensity - which reflects both R&D investment made by government and industry, and the number of researchers working in and between both sectors. For example, data on the industry-academia movements of individuals from 71 countries show that South Korea registered the greatest share of researchers who moved from industry to academia in 2017 to 2019.[135] This high R&D intensity has emerged from a historically "top-down" innovation system which promotes close collaboration between government, industry and the academic community. These are evident from the government's establishment of research institutes to nurture industry capabilities such as the Korea Institute of Science and Technology (KIST) in 1966, a dedicated ministry to oversee all tech and innovation efforts (the Ministry of Science and Technology) a year later, and an evergreen focus to nurture homegrown high-tech industries (from semiconductor design and manufacture in the 1990s to biotechnology, AI and cybersecurity today).[136] A case in point of a company that has benefited from strong government support and research collaborations to achieve global innovator status is Samsung. As South Korea's largest chaebol (a large family-owned business conglomerate), the company is one of the world's leaders in the design and manufacture of tablets, smartphones and computer chips. With support from the government, it has collaborated with leading academic institutions such as Sungkyunkwan University in Seoul on electrochemistry research - this partnership was one of its most productive, leading the company to develop new energy sources for its products such as lithium-ion batteries.[137] Other partnerships include Seoul National University, and the Korea Advanced Institute of Science and Technology.

134. World Intellectual Property Organization, Cornell SC Johnson College of Business, INSEAD (2020), Global Innovation Index 2020. Available at: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf
135. League of Scholars. Available at: https://www.leagueofscholars.com/
136. Leigh Dayton (2020), "How South Korea made itself a global innovation leader". Nature. Available at: https://www.nature.com/articles/d41586-020-01466-7
137. Leigh Dayton (2020), "How South Korea made itself a global innovation leader". Nature. Available at: https://www.nature.com/articles/d41586-020-01466-7

SINGAPORE: A MULTI-DIMENSIONAL APPROACH TO CEMENTING ITS STATUS AS A "MINIATURE SILICON VALLEY"

Once a sleepy fishing village, the island city-state has emerged as a prosperous technology hub in the heart of Southeast Asia - it has even been described by Hewlett Packard Enterprise's former CEO Meg Whitman as a "miniature Silicon Valley".[138] Today, 80 of the top 100 tech firms in the world have a presence in Singapore.[139] This success has often been attributed to four key drivers - all of which are bolstered by strong government support. Firstly, an ***innovation-centred business culture*** in which global enterprises and start-ups frequently collaborate on projects are the reasons why global tech multinationals are keen to locate in the country. Such collaborations are frequently scaled by Singapore's government, which supports through the development of "regulatory sandbox" environments that encourage live testing of new technologies, marketing the associated programmes to a variety of industry sectors, and at times even providing discounts on rent where real estate space is required.

Secondly, ***modern IT infrastructure*** has rendered a "plug-and-play" business environment in which tech companies can hit the ground running almost immediately. Supported by state-of-the-art digital infrastructure which is constantly evolving to deliver the best performance (e.g., nationwide 5G networks will be ready by 2025), the country was ranked first in digital infrastructure in the Economist Intelligence Unit's Asian Digital Transformation Index.[140] Thirdly, the government's commitment to a ***strong Intellectual Property (IP) regulatory framework*** gives companies confidence that their R&D investments will stay protected, averting any concerns that opportunistic firms could make a quick profit by replicating another company's innovations. The World Economic Forum's Global Competitiveness Report in 2019 ranks the country second globally and top in Asia on IP rights protection.[141] Finally, the presence of a highly skilled talent pool has been a key driver of Singapore's status as an incubator for tech companies. This has been made possible through a range of supportive government policies from embedding a strong focus on tech skills early on in K-12 curriculums (i,e. primary), through to subsidising and availing a suite of digital skills courses to the current workforce.

138. Jonathan Vanian (2017), "Hewlett Packard Enterprise bets that Singapore will be a 'miniature Silicon Valley'". Fortune.
Available at: https://fortune.com/2017/05/09/hewlett-packard-enterprise-singapore-silicon-valley/
139. Economic Development Board, Singapore (2018), "Singapore flexes it standing as Asia's technology capital".
Available at: https://www.edb.gov.sg/en/news-and-events/insights/innovation/singapore-flexes-its-standing-as-asias-technology-capital.html
140. Economist Intelligence Unit (2018), The Asian Digital Transformation Index 2018.
Available at: http://connectedfuture.economist.com/article/asian-digital-transformation-index-2018/
141. World Economic Forum (2019), The Global Competitiveness REport 2019.
Available at: http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf

ADVANCING THE PRIZE — GOOGLE'S CONTRIBUTION TO ADVANCING THE DIGITAL OPPORTUNITY IN NEW ZEALAND

An important player spearheading digital transformation in New Zealand, Google has made significant contributions in each of the three pillars for digital transformation in New Zealand outlined in Chapter 2. Through its programmes, products and services, Google has delivered strong impacts for digital transformation across various industry sectors in New Zealand. Through digital skills programmes like "Digital Fluency Intensive", Google is supporting the government and empowering local communities in building a digitally skilled workforce. Through Google tools such as Google Ads and Google Translate, small businesses in New Zealand have also successfully reached overseas markets and accessed new export opportunities.

In addition, Google's products create various economic benefits for business, consumers and the wider society in New Zealand. Google's products and services are estimated to bring about total annual business and consumer benefits worth NZ$3 billion and NZ$3.5 billion, respectively. These products include Google Search, Google Ads, AdSense, YouTube, Google Play, Google Maps, 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, on the other hand, experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic contributions to businesses and individuals, Google delivers benefits to the broader society by supporting the country's non-profit sector, enabling safe and secure Internet use, promoting cultural diversity, and reducing carbon emissions.

"ADVANCING THE PRIZE"

GOOGLE'S CONTRIBUTION TO NEW ZEALAND'S DIGITAL TRANSFORMATION JOURNEY

1 Support technology adoption in key industries

2 Digitally upskill current workforce and future talent

3 Promote digital export opportunities

EXAMPLES OF INITIATIVES BY GOOGLE

- **GOOGLE CLOUD** supports the growth of new technology-driven business models using AI and machine learning
- Google supports the **"DIGITAL FLUENCY INTENSIVE"** initiative which utilises digital tools to improve learning outcomes in schools with predominantly Māori and Pasifika students
- **GOOGLE MY BUSINESS** and **GOOGLE ADS** create export opportunities for Kiwi businesses by extending their outreach overseas

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

BUSINESSES

Through significant boosts to productivity and customer outreach, Google is estimated to support **NZ$3 billion** worth of annual benefits to businesses in New Zealand[1]

CONSUMERS

By helping consumers save time and generating value through their free products, Google is estimated to support **NZ$3.5 billion** worth of annual benefits to consumers in New Zealand[2]

SOCIETY

By supporting various segments of the society such as non-profits, social enterprises and underserved populations, Google has uplifted the country's overall digital economy

1. Business benefits refer to the estimated economic impact from the following products: Google Search; Google Ads; AdSense; YouTube; Google Play; Android and Google Maps.
2. Consumer benefits refer to the estimated economic impact from the following products: Google Search; Google Maps; 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 for detailed methodology. Figures are estimated based on the latest available annual data as at time of research in 2020.

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

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

Google's suite of products and services **support technology adoption in key industries**, such as tourism and retail. Recognising the increasingly prominent role of digital technology in travel research, planning and booking, Tourism New Zealand, the government agency responsible for marketing New Zealand as a tourist destination, leveraged Google Search and Ads to promote the country's tourism industry online through its award-winning "100% Pure New Zealand" campaign.[142] In an experiment to measure the impact of Google Ads on tourist visits, Tourism New Zealand found that its advertisements promoted via Google Ads drove 11 percent more tourist visits as compared to their other advertisements, and that these incremental visits delivered 12 times higher return on advertisement expenditure based on average visitor spend.[143]

During the COVID-19 outbreak when travel restrictions were imposed, Google's products such as Google Earth and Maps also shed new light on alternatives to traditional tourism offerings. Besides serving as a go-to navigation and discovery tool for travellers to plan trips, Google Maps is now instrumental in sustaining a steady stream of engagement and conversation between tourism operators and home-bound travellers. Box 7 shows an example of how digital tools like Augmented Reality (AR) and Virtual Reality (VR) have not only recreated a virtual version of physical tours, but also augmented the experience by allowing tourists to handle precious historical artifacts virtually.

Besides reinventing traditional industries, Google's products have promoted the growth of New Zealand's digital economy by supporting the development of new technology-driven business models and products in the country. These range from mobile games and virtual assistants to e-commerce platforms and IoT solutions. Box 8 shows how local Kiwi businesses benefit from Google Cloud by augmenting their existing offerings with new features and creating new business opportunities. In addition, Google has also collaborated on research to advance thinking on how businesses can optimise the use of digital tools to improve their bottom line. The company worked with Boston Consulting Group on a study in 2018 that outlined a practical roadmap for companies to attain digital marketing maturity.[144] This included six factors: deriving connected digital insights; deploying automation and integrated technologies; developing actionable measurement frameworks; forming strategic partnerships; cultivating specialist skills; and fostering an agile teaming and "fail-fast" culture.

To **digitally upskill New Zealand's current workforce and future talent**, Google has established partnerships with the government and tertiary institutions to identify skill gaps in the workforce, and launched training initiatives to develop a healthy pipeline of digital talent. As a "Gold" sponsor, Google supported the "New Zealand Digital Skills Hui" event which brought together a coalition of industry associations, government and

142. Think with Google (2019), "Experiment: How Tourism New Zealand measured the incremental impact of display ads on tourist visits." Available at: https://www.thinkwithgoogle.com/intl/en-apac/marketing-strategies/search/experiment-how-tourism-new-zealand-measured-incremental-impact-display-ads-tourist-visits/
143. Think with Google (2019), "Experiment: How Tourism New Zealand measured the incremental impact of display ads on tourist visits." Available at: https://www.thinkwithgoogle.com/intl/en-apac/marketing-strategies/search/experiment-how-tourism-new-zealand-measured-incremental-impact-display-ads-tourist-visits/
144. Google (2018), "How digital marketing maturity helps you personalise marketing at scale". Available at: https://www.thinkwithgoogle.com/intl/en-145/marketing-strategies/app-and-mobile/how-digital-marketing-maturity-helps-you-personalise-marketing-scale/

BOX 7.
GOOGLE EARTH AND MAPS BRING NEW ZEALAND'S LANDMARKS TO INTERNATIONAL AUDIENCES

In collaboration with the Department of Conservation and other local partners, Google Earth and Maps have brought the country's nature and culture to global audiences through virtual tours. Home-bound travellers can now explore the habitats of critically endangered parrot, Kākāpō, on New Zealand's remote Whenua Hou and Anchor Islands without adding undue stresses on the environment. Digital travellers are also guided on the virtual tour with high-quality video narration by Sir David Attenborough, a world-class critically acclaimed naturalist, about Kākāpō and their protected island habitats. Among the hundreds of landmarks including Fox Glacier, Punakaiki Rocks and the Church of the Good Shepherd which have been launched on Street View, Google Maps has also captured the country's wild beauty on its natural trails in Great Walks.[145] The appeal of digital tools to tech-savvy travellers is evidenced from Google Maps recording over 25 percent increase in international visitors since the inception of these trails. The 360-degree panoramas and virtual tours on Google Earth and Maps have provided a refreshing take on travelling.

Besides outdoor Street View, the versatile Google Maps function creates indoor directories based on building floor plans. The Google Cultural Institute has partnered with local museums in New Zealand, including the Auckland War Memorial Museum, to digitise over 2,000 various artifacts and artworks and featured them as online exhibits on its Google Arts and Culture platform. Each exhibit is tagged to a captivating story about the history of Aotearoa and its people. In addition, Google Arts and Culture have partnered with CyArk, a non-profit organisation, to create a digital exhibition of Waitangi Treaty Grounds - the historic meeting place of the Māori chiefs and the British Crown.[146] Through exhilarating and immersive virtual reality experiences, tourism operators can continue to engage and pique the interest of "travellers" from the confines of their homes, and keep these destinations top of mind to inspire future travel when borders reopen.

Photo Source: https://artsandculture.google.com/exhibit/a-living-memorial/YwKit0BP3b-iLA

145. Department of Conservation (2020), "Great Walks."
Available at: https://www.doc.govt.nz/parks-and-recreation/things-to-do/walking-and-tramping/great-walks/
146. Google Arts & Culture (2020), "Auckland War Memorial Museum Tāmaki Paenga Hira."
Available at: https://artsandculture.google.com/partner/auckland-war-memorial-museum

BOX 8.
GOOGLE CLOUD - SUPPORTING THE GROWTH OF DIGITAL BUSINESS MODELS IN NEW ZEALAND

Where small businesses struggle to source for capital, Google Cloud democratises access to specialised technologies such as AI and machine learning by eliminating fixed costs involved in the usage of such technologies. Businesses can access not only "Tensor Processing Units" that train and run machine learning models, but also sophisticated software for image and language recognition, translation, and other analytic tools that unlock the value of their data, reduce costs and provide world-leading products and services to customers globally. For example, The Warehouse Group, one of the largest retailing groups in New Zealand, launched a "Snap and Shop" feature on its mobile application using Google Cloud's neural network AI technology.[147] This feature allows customers to take photos of their desired items on their smartphones and instantly match them with thousands of available products on its catalogue to compare prices. Without having to devote additional resources to infrastructure and expertise, The Warehouse Group relied on pre-built machine learning models and application programming interfaces (APIs) to develop the solution within the capabilities of its existing staff.[148]

Photo Source: https://channellife.co.nz/story/warehouses-mobile-app-now-uses-ai-help-snap-and-shop

In a similar vein, Aider.ai is a locally developed AI assistant for small businesses built on Google Cloud Platform. The assistant uses natural language processing to answer verbal requests by business owners enquiring about their sales, bills, inventory or any other business data via their smartphones. When Aider planned to enter the North American market after gaining traction in its home market, the company was able to leverage the Google Cloud Platform to scale its services automatically without having to invest in IT infrastructure. Following its foray into foreign markets, Aider has gained significant recognition from being the first New Zealand company selected by Mastercard's Elite Start Path programme, which boasts a prestigious Fintech network.[149]

147. The Warehouse Group (2018), "The Warehouse leaps into the AI future with Google."
Available at: https://www.thewarehousegroup.co.nz/news-updates/warehouse/warehouse-leaps-ai-future-google
148. The Warehouse Group (2018), "The Warehouse leaps into the AI future with Google."
Available at: https://www.thewarehousegroup.co.nz/news-updates/warehouse/warehouse-leaps-ai-future-google
149. Aider.ai (2019), "Media Release: Aider first New Zealand company to be selected for elite global start-up programme."
Available at: https://www.aider.ai/blog/media-release-aider-first-new-zealand-company-to-be-selected-for-elite-global-start-up-programme/

non-governmental organisations to identify key issues and shape priorities in strengthening the digital skills ecosystem.[150] Insights from the forum include the growing demand for digital skills is not being matched by sufficient local digital talent, and the need to promote greater inclusiveness in the access to digital skills training opportunities.[151]

In response to these skill needs, Google has launched programmes to upskill the current workforce. For example, digital marketers in New Zealand who enrol in the company's "Programmatic Academy" programme undergo comprehensive training in basic areas ranging from "Media Planning" and "Buying" through to advanced courses like "Data Integration" and "Dynamic Creative". In the first six months of 2019, 50 participants from creative and media agencies benefited from learning how to develop more targeted digital advertising campaigns through a better understanding of buyers' needs.[152] In addition, the "Google Certification Program" trains and certifies individuals in job-ready and high-demand digital skills such as digital marketing. Certified individuals from this scheme are given the opportunity to connect with top national employers at the "Google Career Summit", with over 100 individuals having been employed through this event.[153] In addition, Google partnered with Spark to run workshops that support Kiwi businesses in using digital tools by delivering digital skills training for SMEs at no cost. Under this programme, SMEs can access free classes on how to shift their business online, reach out to new customers and safeguard their online business against cyberattacks.[154]

To nurture future digital talent, Google has introduced tools such as Google Cloud and Google for Education to improve the online delivery of education services. A key example is Google's partnership with the Ministry

of Education to provide all state and state-integrated schools with Chrome Education licences, allowing teachers to teach customised online lessons that are synchronised across multiple Chromebook devices from a single cloud-based console.[155] Schools registered with Chrome Education licences can purchase Chromebook laptops which allow students to benefit from personalised learning experiences with the flexibility to learn at their own pace. At the same time, teachers

150. Digital Skills Forum (2019), "Digital Skills Hui 2019." Available at: https://www.digitalskillsforum.nz/digital-skills-hui-2019/#:~:text=The%20New%20Zealand%20Digital%20Skills,for%20our%20digital%20technology%20sector.
151. Digital Skills Forum (2019), "Digital Skills Hui 2019."Available at: https://www.digitalskillsforum.nz/digital-skills-hui-2019/#:~:text=The%20New%20Zealand%20Digital%20Skills,for%20our%20digital%20technology%20sector.
152. Think with Google (2019), "About the Google Digital Academy."
Available at: https://www.thinkwithgoogle.com/intl/en-gb/future-of-marketing/digital-transformation/about-gda/
153. Grow with Google (2020), "Google Career Certificates." Available at: https://grow.google/certificates/
154. Google in New Zealand (2020), "Google and Spark deliver no-cost digital skills training for SMEs."
Available at: https://newzealand.googleblog.com/2020/11/google-and-spark-deliver-no-cost.html
155. Ministry of Education (2020), "Google Software for schools." Available at: https://www.education.govt.nz/school/digital-technology/software/google/

are able to efficiently tailor the curriculum to students' interests and learning needs.[156] When the pandemic worsened and lockdown measures were imposed in New Zealand, Google for Education was used to ensure that education activities could continue online despite school closures. This tool allowed students and teachers in over 1,000 schools in the country to freely access a complete set of digital tools for communication and collaboration to navigate distance learning.[157]

Google's initiatives also aim to prepare the future workforce to cope with the evolving demands of the digital economy. Under its "CS (Computer Science) First Curriculum" initiative, Google has not only introduced students to computer science, but also provided free tools and resources for teachers to teach computer science. Teachers also benefit from computer science programmes designed by local research institutions, universities and educational non-profits that are funded by Google's "Educator Professional Development Grants". Through the "Digital Technologies Curriculum", teachers can improve their effectiveness in integrating computer science and computational thinking into their lessons.[158]

Google has also provided resources for graduates looking to pursue a career in the tech industry. For example, every high school in New Zealand received copies of "Careers With Code" guides from Google and sponsored tickets to career events organised by Blackbird, a venture capital firm with a portfolio of over 70 companies, which exposed students to the entrepreneurial scene. As a champion of creative workplace culture, Google has also been supporting the creative economy in New Zealand through its platforms. The number of YouTube channels in New Zealand with over 100,000 subscribers grew by 50 percent from 150 in December 2019 to 226 in November 2020.[159] In response to the growing interest in YouTube influencers, Google kicked off a series of "YouTube Creator Workshops" in the country to nurture budding local talent through creating YouTube content and building communities online.[160]

Google is also committed to extending digital skilling opportunities to underserved communities in the country. The company organised a series of diversity-themed events such as "Diversify Digital" which reached out to over 50 Kiwi media professionals to promote diversity in the tech industry, particularly among women, Māori and Pasifika people. The event created greater awareness among participants on the importance of minority representation in the workplace. Box 9 shows an example of how Google's "Digital Fluency Intensive" initiative has not only highlighted the influence of digital technologies in building diversity, equity and inclusion capabilities for teachers, but also enhanced pathways to tech careers for students in local communities.

To **promote digital export opportunities**, Google products such as Google My Business and Google Ads help Kiwi businesses create an online presence that allows them to easily reach overseas markets and audiences. Box 10 shows an example of how Google Ads has uplifted a homegrown business by accessing a wider international market and was a key contributor to its growth in becoming a global exporter. In addition, Google services have enabled small businesses to overcome language barriers and connect with new export opportunities. By allowing for the instantaneous translation of electronic trade documents such as Bills of Lading and Certificates of Origin, AI in Google Translate enables exporters to overcome language barriers and create new export opportunities for even the smallest businesses.

156. Google for Education (2017), "Bombay school chooses G Suite and Chromebooks, learning outcomes Improve."
Available at: http://services.google.com/fh/files/misc/final_bombay_casestudy.pdf
157. Classroom Help (2020), "Supporting schools during COVID-19 with advanced Hangouts Meet features and training."
Available at: https://support.google.com/edu/classroom/thread/32576916?hl=en
158. Google in New Zealand (2019), "Computer science grants for New Zealand educators."
Available at: https://newzealand.googleblog.com/2019/05/computer-science-grants-for-new-zealand.html
159. Social Blade (2020), "Top 250 YouTubers in New Zealand sorted by subscribers." Available at: https://socialblade.com/youtube/top/country/nz/mostsubscribed
160. Google in New Zealand (2019), "YouTube Creator Workshops kick off in Manukau."
Available at: https://newzealand.googleblog.com/2019/10/youtube-creator-workshops-kick-off-in.html

BOX 9.
"DIGITAL FLUENCY INTENSIVE" INITIATIVE EMPOWERS TEACHERS WITH DIGITAL SKILLS TO UPLIFT UNDERSERVED SEGMENTS OF THE POPULATION

Google is a long-term supporter of the Manaiakalani Education Trust, which applies technology to help improve student achievement in low decile schools (which refer to schools with more students living in poorer communities). Since 2018, Google has been partnering with the Manaiakalani Digital Teaching Academy, as part of the Manaiakalani Education Trust, to deliver 1,600 days of training to graduate teachers across New Zealand under the "Digital Fluency Intensive" programme. The Manaiakalani Education Trust was formed in 2011 to deliver education programmes in school clusters within Auckland's oldest state housing community, Glen Innes, Pt England and Panmure, where 95 percent of its students were of Māori and Pasifika ethnic origin. To empower teachers in utilising digital technology in classrooms, the Manaiakalani Digital Teaching Academy was established with the support of Google, the Innovation Partnership, and the University of Auckland.[161]

Photo Source: https://idealog.co.nz/tech/2016/11/2016-new-zealand-innovation-awards-excellence-social-innovation-innovation-education-training-development-manaiakalani-education-trust

With eight in ten New Zealand school principals who believe that digital technologies positively impact student achievement, Google sponsored training for teachers on a broad range of digital tools and applications that could be integrated into existing classroom pedagogy for more effective teaching, planning, assessment and professional learning.[162] Through a year of training, teachers explored ways to maximise value from utilising some of the foundational Google for Education tools both in the classroom and in their professional day-to-day lives. Within three years, students taught by graduate teachers at Manaiakalani Education Trust have shown accelerated achievement outcomes by progressing twice faster than expected in a school year when compared with the national average. In addition, collaborative, coding, creativity and technical skills gleaned in the classroom also helped students thrive in the future workforce. Such training programmes also prepared students and teachers for remote learning during the pandemic – over 100 schools working with the Manaiakalani Education Trust have successfully shifted their teaching online.[163]

161. Beehive.govt.nz (2013), "Manaiakalani Digital Teaching Academy launch."
Available at: https://www.beehive.govt.nz/speech/manaiakalani-digital-teaching-academy-launch
162. Google in New Zealand (2019), "Helping Kiwi teachers learn digital skills through the Manaiakalani Education Trust."
Available at: https://newzealand.googleblog.com/2019/11/helping-kiwi-teachers-learn-digital.html
163. Google in New Zealand (2019), "Helping Kiwi Teachers Learn Digital Skills through the Manaiakalani Education Trust."
Available at: https://newzealand.googleblog.com/2019/11/helping-kiwi-teachers-learn-digital.html

BOX 10.
ETHIQUE'S DREAM GOES GLOBAL WITH GOOGLE ADS

Frustrated with the amount of packaging and water waste produced by the personal care industry, Brianne West decided to try her hand at recreating a commonly used product that created minimal waste. A science undergraduate student at the time, Brianne started experimenting with creating solid shampoo from her kitchen in Christchurch.[164] After a year of iterating and refining her product, Brianne finally came up with a super concentrated shampoo bar that worked. Together with her mum, Janette, Brianne created small one-kg batches of shampoo bars and sold them online through a website. Soon after she started selling her products, demand for them quickly rose – much to her amazement. This initial success spurred Brianne to sell her eco-friendly shampoo to a wider global audience through online advertising.

In 2015, she formally established the company, Ethique, and using Google My Business, she created a free Business Profile and leveraged Google Ads to make it easy for customers to find her business when searching for eco-friendly beauty products. These tools provided a cost-efficient method for the small business to reach out to an international base of environmentally conscious customers searching for eco-friendly beauty products. Almost immediately after making use of these tools, Ethique received its first international order which validated the global potential of her products. In 2016, her story was picked up by Forbes, Huffington Post and tagged by celebrities such as Britney Spears and Ashton Kutcher, which increased Ethique's reputation and placed her brand in the spotlight.

Fast forward to today, Ethique continues to leverage Google Ads to promote over 40 products in sixteen countries across the world. At the same time, the business has successfully achieved what Brianne had always set out to do - it has prevented almost one million plastic bottles from ending up in landfills and oceans, and aims to prevent a further 50 million plastic bottles from doing so by 2025.

Photo Source: https://www.beautyindependent.com/ethique-leading-plastic-free-beauty-movement/

164. Ethique (2020), "The journey of Ethique." Available at: https://ethiqueworld.com/pages/journey

GOOGLE'S ECONOMIC IMPACT IN NEW ZEALAND

GOOGLE'S WIDER BENEFITS TO BUSINESSES, CONSUMERS AND SOCIETY

BUSINESS BENEFITS

Google supports
NZ$3 BILLION
in annual benefits to businesses in New Zealand[1]

Google Search saves the average Kiwi employee about
2.4 DAYS PER YEAR
through almost instantaneous access to information online

CONSUMER BENEFITS

Google supports
OVER NZ$3.5 BILLION
in annual benefits to consumers in New Zealand[2]

40%
of **Google Search** users in New Zealand use the tool for self-enrichment (e.g., to gain new knowledge)

According to AlphaBeta research,
OVER 20%
of **YouTube** users in New Zealand say they use online video services to learn advanced digital skills[3]

Google Maps reduces driving times by close to
4.1 HOURS,
and also shaves off roughly
4.5 HOURS
of commute time on public buses and trains per year

SOCIETAL BENEFITS

In 2020, Google contributed
NZ$1.4 BILLION
in Ad Grants, together with Google Search, and generated a minimum of NZ$10.3 billion in economic value for non-profit organisations addressing critical challenges around the globe.[4]

Google Maps saves between
30,400-40,300 TONNES
of CO2 from vehicle emissions annually, equivalent to the emissions of
6,600-8,700 PASSENGER CARS

1. Business benefits refer to the estimated economic impact from the following products: Google Search; Google Ads; AdSense; YouTube; Google Play; Android and Google Maps.
2. Consumer benefits refer to the estimated economic impact from the following products: Google Search; Google Maps; Google Drive; Docs, Sheets and Photos; Youtube; Google Play.
3. Google/AlphaBeta Economic Impact Report survey, n = 538. Percent represents use of online video services to learn advanced digital skills amongst New Zealanders for whom YouTube is their most frequently used online video service.
4. The economic impact of Ad Grants is the total economic value created in the form of actions, such as volunteer cultivation and other grantee goals. This excludes the immense social value created when non-profits invest these resources into their communities across the globe: providing basic necessities such as food, water, and shelter, training individuals to pursue sustainable work opportunities, connecting people in crisis to the resources that they need, fighting against societal inequities, and so much more. For further information, please see the forthcoming "Google New Zealand Community Engagement Report".
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 as at time of research in 2020.

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

Google's applications and services, such as Google Search, bring about substantial economic benefits in New Zealand. This study finds that the annual economic value presented by Google's applications and platforms are worth NZ$3 billion for businesses, and over NZ$3.5 billion for consumers.[165] An overview of the assessed economic benefits of Google products to Kiwi businesses and consumers is provided in Exhibit 4.

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 11 for further details). In addition, Google brings intangible benefits to the broader society by supporting the country's non-profit sector, enabling safe and secure Internet use, promoting the local culture, and reducing carbon emissions.

BENEFITS TO BUSINESSES

GOOGLE HELPS BUSINESSES BOOST THEIR REVENUES

Google applications broaden the reach of New Zealand businesses to new customers and markets. 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 NZ$2.7 billion in the form of net returns to New Zealand businesses from advertising on Google Search results of relevant keywords per year.[166] Beyond search advertising, New Zealand 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 NZ$14.6 million annually. Meanwhile, by leveraging the various formats of advertisements enabled by **YouTube**, businesses are estimated to achieve NZ$151 million in net advertising returns annually.[167]

Box 12 illustrates how local SMEs were able to expand their customer outreach and increase revenue through Google Ads during the COVID-19 pandemic (refer to Box 3 in Chapter 1.3 for more examples), while Box 13 shows the wider contributions made by Google to supporting the country during this crisis.

In addition, Google provides new sources of income for content creators in New Zealand. 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 help content creators in New Zealand monetise space on their websites, and generate a total annual income of over NZ$45 million. **YouTube** also benefits New Zealand video content creators who earn revenue through placing advertisements on their videos. This is estimated to bring Kiwi content creators a total of NZ$61.5 million in annual advertising revenue. Box 14 shows examples of how YouTube supports local content creators and expands their outreach to global audiences.

165. 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.
166. This refers to the increase in revenues and sales that can be directly attributed to advertising minus the related advertising expenditure.
167. This refers to the increase in revenues and sales that can be directly attributed to advertising minus the related advertising expenditure.

EXHIBIT 4:

BUSINESS AND CONSUMER BENEFITS SUPPORTED BY GOOGLE IN NEW ZEALAND

TYPE OF BENEFIT	EASE OF ACCESS TO INFORMATION	ENTERTAINMENT AND ENRICHMENT
RELEVANT PRODUCT/S	**Google Search**	**YouTube, Google Play & Android**
BUSINESS BENEFITS	• By allowing almost instantaneous access to online information, Google Search saves the average Kiwi employee about **2.4 days** per year	• App developers in New Zealand earn about **NZ$30.7 million** in annual revenue from both the domestic and international markets through the Google Play platform • Video creators on YouTube earn **NZ$61.5 million** in advertising revenue annually • Android enables app developers to save up to **25%** of development time and target more than **1 billion** users worldwide[1]
CONSUMER BENEFITS	• Google Search saves consumers about **4.9 days** seeking information online every year • **40%** of Google Search users use the tool for self-enrichment (e.g., to gain new knowledge) • The total annual consumer benefits derived from Google Search are estimated at **NZ$906 million**	• According to AlphaBeta research, over **20%** of YouTube users in New Zealand say they use online video services to learn advanced digital skills[3] • 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 New Zealand are estimated at **NZ1.4 billion** annually

1. 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

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

3. Google/AlphaBeta Economic Impact Report survey, n = 538. Percent represents use of online video services to learn advanced digital skills amongst New Zealanders for whom YouTube is their most frequently used online video service.

4. The economic impact of Ad Grants is the total economic value created in the form of actions, such as volunteer cultivation and other grantee goals. This excludes the immense social value created when non-profits invest these resources into their communities across the globe: providing basic necessities such as food, water, and shelter, training individuals to pursue sustainable work opportunities, connecting people in crisis to the resources that they need, fighting against societal inequities, and so much more. For further information, please see the forthcoming "Google New Zealand Community Engagement Report".

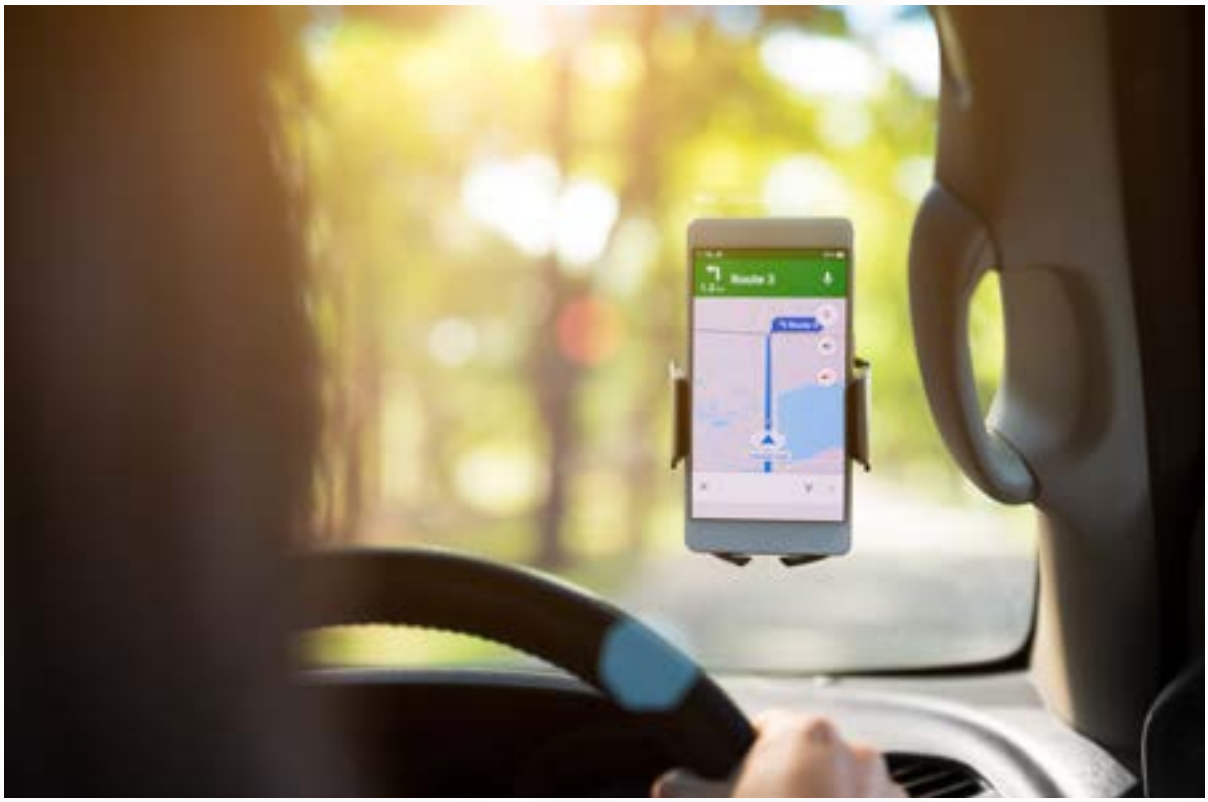
Note: Figures are estimated based on the latest available annual data as at time of research in 2020.

SOURCE: AlphaBeta analysis

	INCREASED PRODUCTIVITY AND CONVENIENCE	ADVERTISING BENEFITS	TOTAL BENEFITS:
	Google Maps, Drive, Photos, Docs & Sheets	**Google Ads, AdSense, YouTube**	
	• Uploading a Business Profile on Google helps Kiwi businesses gain access to customers both in their vicinity (through the Google My Business feature which leverages Google Maps), as well as in overseas markets • Productivity tools in Google Drive, Photos, Docs, and Sheets enable for greater efficiencies in day-to-day work tasks. For example, Docs and Sheets allow for real-time collaboration between team members on the same documents. Drive also allows businesses to store all of their documents in one place that can be readily accessed by multiple employees and devices	• Google Search and Ads bring about **NZ$2.7 billion** in net advertising benefits to businesses in New Zealand annually[2] • Advertisers in New Zealand gain **NZ$165 million** in net advertising benefits annually through displaying advertisements on websites and videos using AdSense and YouTube[2] • Web publishers earn about **NZ$45 million** in revenue from AdSense annually • In 2020, Google contributed **NZ$1.4 billion** in Ad Grants, together with Google Search, and generated a minimum of NZ$10.3 billion in economic value for non-profit organisations addressing critical challenges around the globe[4]	**NZ$3 BILLION**
	• Google Maps helps consumers save over **4.5 hours** on public transport trips per year • Drivers spend **4.1 hours** less on the roads per year by using Google Maps to optimise their driving journeys • The total consumer benefits derived from productivity-enhancing tools of Google Maps, Drive, Photos, Docs, and Sheets are estimated at **NZ$1.2 billion** annually	Nil	**NZ$3.5 BILLION**

BOX 11.
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 A2 shows a detailed methodological explanation of how the benefit of each product was sized.



BOX 12.
GOOGLE ADS HELPED LOCAL SMES IMPROVE CUSTOMER OUTREACH AND REVENUE DURING COVID-19

TRILOGY

Founded by two sisters in 2002 looking for a solution to their sensitive skin problems, Trilogy is a Kiwi company that seeks to create safe and effective beauty products. As soon as they discovered the powerful benefits of rosehip skin oil, the sisters pioneered the use of this and other natural ingredients to develop skincare solutions.

The business had traditionally relied on multiple channels to distribute their products, including pharmacies, retailers, and online sales. However, as foot traffic to pharmacies and retailers declined during the COVID-19 pandemic, Trilogy's revenue was severely affected.

To get the business back on track, Trilogy improved their advertising strategy and boosted online sales using Google Search Ads. By restructuring their Ad campaigns and regularly optimising their performance to align with their growth priorities, Trilogy managed to achieve a 93 percent increase in conversions from ad views to sales as compared to before the pandemic started.

Photo Source: https://www.trilogyproducts.com/pages/our-story

BOX 13.
GOOGLE'S CONTRIBUTIONS TO GOVERNMENT, BUSINESSES AND STUDENTS DURING THE COVID-19 PANDEMIC

SAFEGUARDING PUBLIC HEALTH AND ENABLING EFFICIENT INFORMATION DELIVERY

Google's advertising tools have proven to be particularly helpful during the COVID-19 pandemic not only to businesses, but also the government. In 2020, Google contributed NZ$1.4 billion in Ad Grants, together with Google Search, and generated a minimum of NZ$10.3 billion in economic value for non-profit organisations addressing critical challenges around the globe.[168] Part of this was used to support the Government's pandemic-related communication, which was so effective that on the first day of the lockdown, those ads recorded the third highest click-through rate in the world. This was an absolute number (not per capita) and meant that New Zealanders easily found their way to the Government's official website - covid19.govt.nz.

In addition, Google has been working closely with the Ministry of Health to ensure that citizens can easily access important public health announcements (e.g., updates on the number of infected cases, lockdown policy changes). To stem the proliferation of misinformation during the pandemic, Google staff also worked hard to actively take down YouTube videos featuring misleading information.[169] Google also played an instrumental role in tracking the movements of infected individuals to help curb the spread of the virus. By using aggregated, anonymised data from **Google Maps**, Google published **COVID-19 Community Mobility Reports** to chart movement trends. The Government has used this information as part of their Weekly Economic Updates.[170]

ENABLING REMOTE WORKING ARRANGEMENTS DURING THE PANDEMIC

As more businesses adjust to work-from-home arrangements during the COVID-19 pandemic, the **Google Meet** video-conferencing software's advanced capabilities (i.e., allowing for larger meetings of up to 250 participants per call) was

168. The economic impact of Ad Grants is the total economic value created in the form of actions, such as volunteer cultivation and other grantee goals. This excludes the immense social value created when non-profits invest these resources into their communities across the globe: providing basic necessities such as food, water, and shelter, training individuals to pursue sustainable work opportunities, connecting people in crisis to the resources that they need, fighting against societal inequities, and so much more. For further information, please see the forthcoming "Google New Zealand Community Engagement Report".
169. Google in New Zealand (2020), "How we're responding to COVID-19."
Available at: https://newzealand.googleblog.com/2020/04/how-were-responding-to-covid-19.html
170. Weekly Economic Update - 30 October 2020, Treasury, New Zealand.
Available at: https://www.treasury.govt.nz/publications/weu/weekly-economic-update-30-october-2020-html
171. Google Cloud (2020), "Helping businesses and schools stay connected in response to coronavirus."
Available at: https://cloud.google.com/blog/products/g-suite/helping-businesses-and-schools-stay-connected-in-response-to-coronavirus

made available free of charge to all Kiwi businesses that use Google Workspace. This allowed companies to stay connected and work remotely from anywhere on the globe.[171]

SUPPORTING BUSINESS CONTINUITY

Besides its free Google Ads for small businesses, Google also added new features to its suite of products and services to facilitate businesses in capturing new sources of revenue that emerged during the COVID-19 pandemic. With increasing consumer demand for food delivery and takeout, businesses which created Business Profiles on **Google My Business** have the option of adding dining attributes such as "curbside pickup", "no-contact delivery" and "dine-in" on their profile.[172] This greatly enhanced the ease with which customers could order food while minimising physical contact, while enabling businesses to continue operating while abiding by social distancing measures. Google also launched a new website, **Google for Small Business**, in New Zealand to provide small businesses with resources, tools and timely information on COVID-19. This includes guidance on keeping customers informed of changes in business operations, using digital tools like **Google Search** to explore online retail, and leveraging online collaboration tools such as **Google Drive** for remote work.[173]

HELPING STUDENTS LEARN AT HOME

Over 1,000 schools in NZ use **Google for Education** - a free range of productivity tools that can be used from any device. Many students also use Chromebooks as their device and **Google Meet** to connect teachers over video calls. **Google Classroom** allows teachers to create, distribute, collaborate and grade assignments virtually. To help students learn from home under lockdown, Google created new distance learning resources for them and their teachers. This included a collection of training materials, an expanded **YouTube Learning Hub**, a series of blog posts and webinars, as well as tips and best practices. Google also hosted regular webinars for teachers to join to provide support in their move to distance learning, especially around the effective use of the range of tools available to them.

172. Google for Small Business (2020), "Helping your business through COVID-19."
Available at: https://smallbusiness.withgoogle.com/intl/en_nz/news/resources-for-smbs-impacted-by-coronavirus/#!/
173. Google for Small Business (2020), "Helping your business through COVID-19."
Available at: https://smallbusiness.withgoogle.com/intl/en_nz/news/resources-for-smbs-impacted-by-coronavirus/#!/

BOX 14.
YOUTUBE PROVIDES LOCAL CONTENT CREATORS WITH A GLOBAL REACH

BRYCE LANGSTON

Bryce Langston, who is passionate about small space design, created the “Living Big in a Tiny House” YouTube channel to share his experiences and stories about living in tiny homes, alternative dwellings, and eco-friendly living. Despite targeting a niche market, his videos have been watched almost 80 million times since he started uploading them in 2013. By 2020, “Living Big in a Tiny House” reached 3.7 million subscribers globally. Bryce now works on his channel full-time with his partner, travelling around the world and creating new content to grow his audience.

TOYBOX

Toybox, a boutique production studio based in Auckland, is the creator of the animated series "Sherwood". Inspired by the legend of Robin Hood, the series follows 14-year-old Robin and her friends’ battles with the wealthy "Upper City" in their efforts to overcome inequality and to fight for justice. It also seeks to inspire young women and girls on their role in technology by showing how Robin uses technology and code to battle the "Sheriff of Sherwood". Through YouTube, the locally developed and animated story has generated over 35 million views globally.[174]

Photo Source: https://www.rnz.co.nz/national/programmes/saturday/audio/2018670640/bryce-langston-the-beauty-of-tiny-houses

174. ToyBox (2020). Available at: https://www.toybox.co.nz/project/sherwood/

Google's digital product distribution system, **Google Play**, as well as operating system, **Android**, have resulted in a variety of benefits to Kiwi app developers. App developers are estimated to earn an annual return of over NZ$30.7 million from both the domestic and international markets through the Google Play platform. Further, through the Android operating system, app developers in New Zealand can readily reach more than one billion users globally.[175] 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.[176]

Exhibit 5 summarises the estimated business benefits in the form of revenue gains experienced by New Zealand businesses from Google Search and Ads, AdSense, YouTube and Google Play annually.[177]

GOOGLE HELPS BUSINESSES INCREASE PRODUCTIVITY AND SAVE TIME

Google helps businesses save time by enhancing employees' productivity through 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 2.4 days annually.

EXHIBIT 5:
GOOGLE IS ESTIMATED TO BRING ABOUT NZ$3 BILLION WORTH OF ANNUAL BENEFITS TO BUSINESSES IN NEW ZEALAND

PRODUCT	DESCRIPTION OF BENEFITS	ESTIMATED ANNUAL BENEFITS
Google Search and Ads	Net advertising benefits for businesses[1]	NZ$2.7 billion
AdSense	Net advertising benefits for businesses[1]	NZ$14.6 million
	Income generated by website publishers through AdSense	NZ$45 million
YouTube	Net advertising benefits for businesses[1]	NZ$151 million
	Advertising revenue earned by YouTube video creators	NZ$61.5 million
Google Play	Income generated by app developers in New Zealand from both the domestic and international markets through Google Play	NZ$30.7 million
	TOTAL ANNUAL BUSINESS BENEFITS IN NEW ZEALAND:	**NZ$3 BILLION**

1. Net advertising benefits refer to additional revenue earned from advertising less the advertising cost.
SOURCE: AlphaBeta analysis

175. 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
176. 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
177. 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.

BENEFITS TO CONSUMERS

CONSUMERS IN NEW ZEALAND EXPERIENCE TOTAL ANNUAL BENEFITS WORTH NZ$3.5 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 11). 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 NZ$3.5 billion per year. 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 6 shows the breakdown of consumer surplus by category.

GOOGLE ENABLES CONSUMERS BETTER ACCESS TO INFORMATION

Google provides benefits to New Zealand consumers by allowing them to instantly access a vast array of information online. The total consumer surplus brought about by **Google Search** is estimated at NZ$906 million per year (Exhibit 6). Based on an international study showing that a search for a piece of information that takes 21 minutes in the library takes only 7 minutes online, it is estimated that Google Search saves New Zealand consumers an average of 4.9 days per year (Exhibit 7).[178]

By providing free access to information and learning resources, Google Search also helps Kiwis acquire new knowledge and skills. An estimated 40 percent of Google Search users in New Zealand use it for self-enrichment (e.g., seeking new knowledge, developing new skills).

GOOGLE'S SERVICES IMPROVE PRODUCTIVITY AND CONVENIENCE FOR KIWIS

Google Maps brings about efficiency in the public transport and driving journeys of New Zealand 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. Google Maps helps consumers optimise their public transport journeys and save over 4.5 hours annually on buses and trains. Drivers spend 4.1 hours less on the roads per year by using Google Maps to optimise their driving journeys (Exhibit 7).

Beyond time savings, Google Maps also brings intangible benefits to consumers in New Zealand through features such as Google Street View. Box 15 illustrates how Google Street View reignited the dream of a local photographer diagnosed with agoraphobia, a fear of open spaces.

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 New Zealand 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 consumer benefits derived from productivity-enhancing tools of Google Maps, Drive, Photos, Docs, and Sheets are estimated at NZ$1.2 billion per year.

178. 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

EXHIBIT 6:

GOOGLE IS ESTIMATED TO SUPPORT A TOTAL NZ$3.5 BILLION WORTH OF ANNUAL CONSUMER SURPLUS IN NEW ZEALAND

ESTIMATED ANNUAL CONSUMER SURPLUS OF GOOGLE PRODUCTS IN NEW ZEALAND
CONSUMER SURPLUS (NZ$)

TYPE OF BENEFITS	PRODUCT	ANNUAL CONSUMER SURPLUS
Ease of access to information	Google Search	NZ$906 million
Entertainment and enrichment	YouTube	NZ$1.4 billion
	Google Play	
Enhanced productivity and convenience	Google Maps	NZ$1.2 billion
	Google Drive, Photos, Docs and Sheets	
	TOTAL CONSUMER SURPLUS:	**NZ$3.5 BILLION**

SOURCE: AlphaBeta analysis

EXHIBIT 7:

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

ESTIMATED ANNUAL TIME SAVINGS PROVIDED BY GOOGLE SEARCH AND GOOGLE MAPS TO NEW ZEALAND CONSUMERS
AMOUNT OF TIME SAVED PER YEAR

PRODUCT	TIME SAVINGS PER USER
Google Search	4.9 days per year[1]
Google Maps	4.1 hours per year (driving)
	4.5 hours per year (public transport)

1. These time savings differ from those estimated in the business benefits section, as these relate to savings gained on non-work activities (e.g., using Google Search to find information for leisure purposes).
SOURCE: AlphaBeta analysis

BOX 15.
GOOGLE STREET VIEW ALLOWS AN AGORAPHOBIC PHOTOGRAPHER TO TRAVEL BEHIND THE SCREEN

When Jacqui was diagnosed with agoraphobia – an anxiety disorder characterised by an intense, irrational fear of open spaces, she thought that she would never be able to realise her dream of photographing the world. It was Google Street View that reignited Jacqui's dream by allowing her to travel the back roads of the world and capture arresting moments through screenshots. Encouraged by her family to share them, Jacqui amassed over 50,000 followers on her Instagram account in just a few months.

Through Google Street View, Jacqui has also been able to find her voice and express herself. As she puts it, "Agoraphobia and anxiety limit my ability to travel, so I have found another way to see the world." In the autumn of 2017, Jacqui's work was featured in her first solo gallery show in Manhattan. In a partnership with "Stories For Good", an independent online publication, she is selling limited edition prints to raise money for mental health charities.

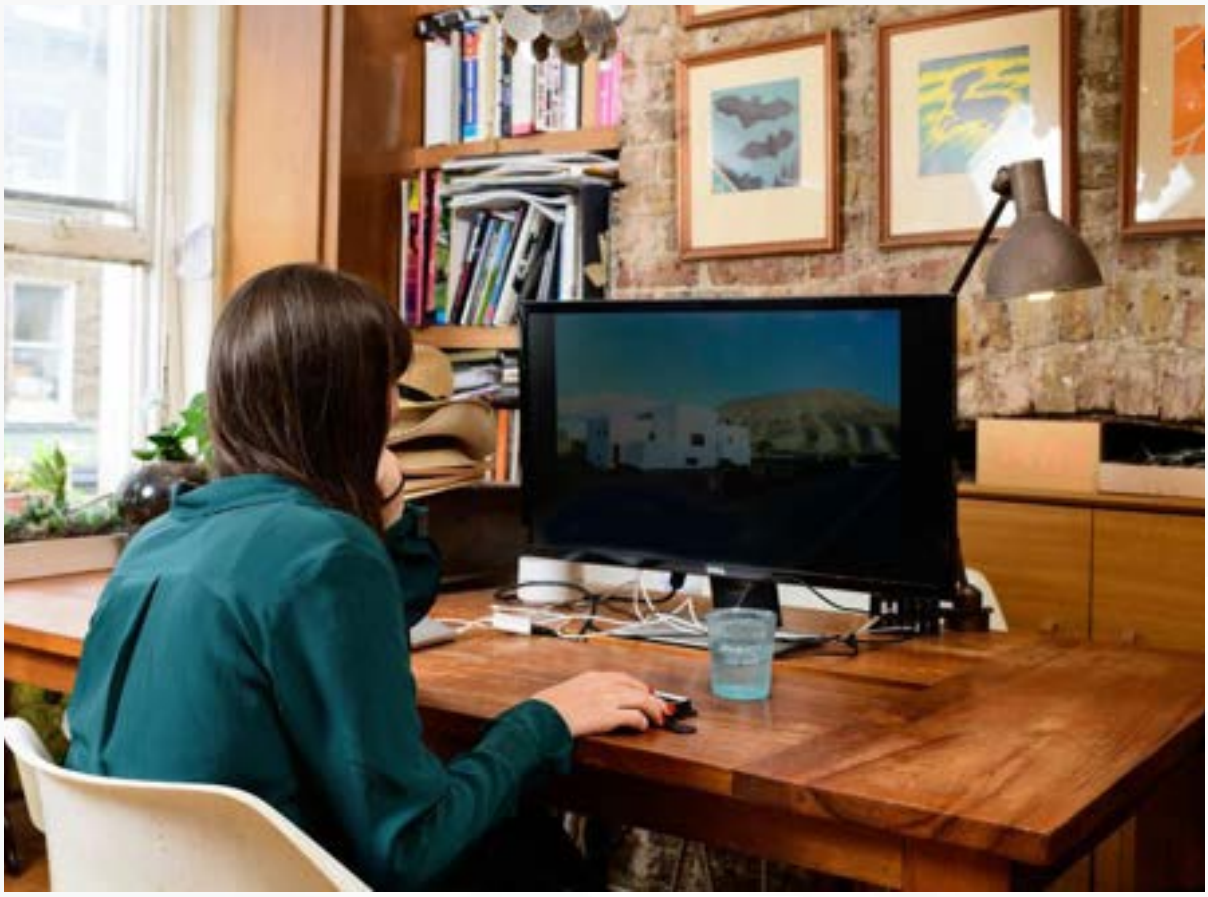


Photo Source: https://www.elle.com/uk/life-and-culture/elle-voices/a23052912/agoraphobic-photographer-instagram-lexus/

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 20 percent of YouTube users in New Zealand say they use online video services to learn advanced digital skills such as coding, software programming, and mobile application and website development.[179]

Google Play and **Android** have also brought a variety of benefits to New Zealand consumers. For example, Android enables consumers to choose from over 3.5 million apps available on the Android ecosystem.[180] 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 NZ$1.4 billion to New Zealanders annually.

BENEFITS TO WIDER SOCIETY

GOOGLE'S CHARITABLE SUPPORT FOR ORGANISATIONS THROUGH IN-KIND ADVERTISING

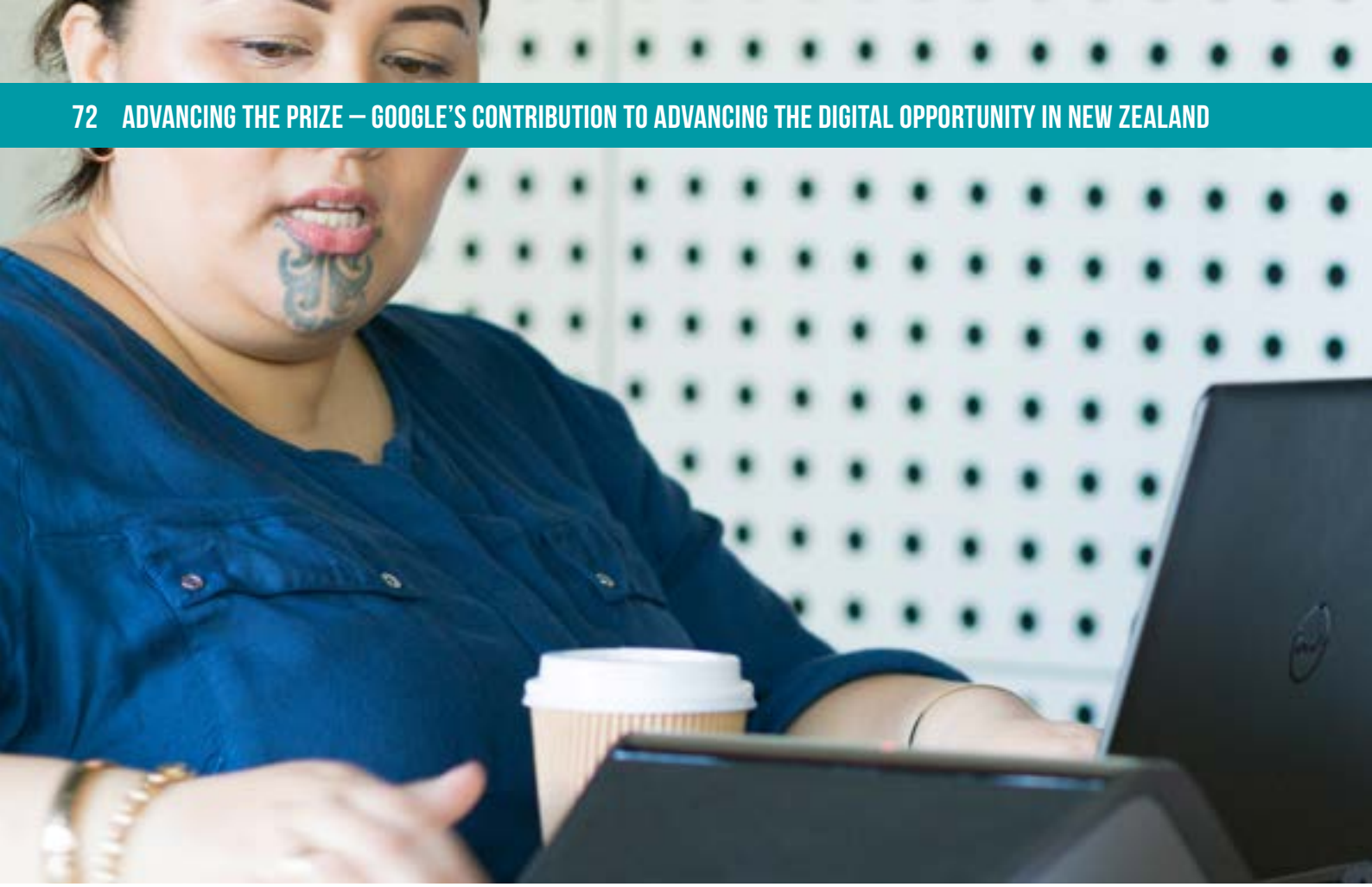
Google supports government, small businesses and organisations in the non-profit sector through **Ad Grants**, a programme that provides in-kind advertising to eligible organisations. In 2020, Google contributed NZ$1.4 billion in Ad Grants, together with Google Search, and generated a minimum of NZ$10.3 billion in economic value for non-profit organisations addressing critical challenges around the globe.[181] The Ad Grants to the government were used to support crisis communication efforts including free COVID-19 information-related advertisements on Google Search pages. These free ads helped ensure that people in New Zealand were directed to covid19.govt.nz. Ad Grants also provided support to help small businesses weather the pandemic (see Box 13). These grants resulted in a 187 percent year-on-year increase in Ad Grants usage, with over 45 million impressions served to Kiwis. Charitable recipients can leverage Google's advertising tools to promote their organisation, recruit volunteers, and attract donors. For example, Kiwis for Kiwi, a charity that supports community-led kiwi conservation efforts, managed to achieve a 105 percent increase in its online website traffic and attracted 12,000 visitors within a month of using Ad Grants.

GOOGLE ENABLES SAFE AND SECURE INTERNET USE

Google ensures the safety and security of its users' information through **Google Account**, a service which allows users to see and manage their personal information, privacy, and security settings, thereby allowing them to safeguard their data, protect their privacy and decide how they want to share their information with Google. In 2019, the company incorporated new privacy updates to its applications, including **Password Check Up**, a service that checks a user's saved passwords if they have been leaked and compromised in breaches, and offers users the option of automatically deleting their activity data on an ongoing basis.[182]

Besides improving safety features on its applications, Google also supports local organisations that provide Internet safety solutions and programmes for New

179. Google/AlphaBeta Economic Impact Report survey, n = 538. Percent represents use of online video services to learn advanced digital skills amongst New Zealanders for whom YouTube is their most frequently used online video service.
180. 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/
181. The economic impact of Ad Grants is the total economic value created in the form of actions, such as volunteer cultivation and other grantee goals. This excludes the immense social value created when non-profits invest these resources into their communities across the globe: providing basic necessities such as food, water, and shelter, training individuals to pursue sustainable work opportunities, connecting people in crisis to the resources that they need, fighting against societal inequities, and so much more. For further information, please see the forthcoming "Google New Zealand Community Engagement Report".
182. Google (2019), "Introducing auto-delete controls for your Location History and activity data".
Available at: https://blog.google/technology/safety-security/automatically-delete-data/



Zealanders. For example, Google sponsored the Allanah and Madeline Foundation to provide "Digital Licence", an interactive online quiz to help children learn about cyber safety. This was made available for all Year Eight and Nine students across New Zealand. Through the programme, students were educated on what to do if they were exposed to unwanted, inappropriate, and offensive content or cyberbullying, as well as the consequences of putting their privacy at risk when interacting online.[183]

GOOGLE PROMOTES KIWI CULTURE AND DIVERSITY

Google's applications and services help local and global audiences learn about New Zealand culture, languages, and histories. For example, Te Reo Māori as a language on **Google Translate** allows Kiwis and visitors to practice and build their knowledge of Māori language while **Google Search** in Te Reo is used by tens of thousands of people every day. Google also supported the development of Kupu App, which uses photo recognition to identify items in pictures and translate them into Māori language in real-time. In 2019, over four million Te Reo words were played within the app.

Through the **Google Street View** feature on Google Maps, cultural attractions such as Māori rock carvings and other sites of significance can be viewed online by global audiences. Visitors can also take virtual tours of a Marae and learn about its interior design as well as its importance to Māori communities using Google Earth.

GOOGLE HELPS REDUCE CARBON FOOTPRINT OF NEW ZEALANDERS

Google Maps helps reduce the carbon footprint of New Zealanders, allowing them to do their part in tackling climate change. By optimising driving trips, **Google Maps** helps to save between 30,400 – 40,300 tonnes of CO2 emissions from vehicles per year (Exhibit 8). The amount of emissions saved is equivalent to the annual emissions from 6,600 – 8,700 passenger cars.

183. Google (2017), "Helping NZ students stay safe online". Available at: https://newzealand.googleblog.com/2017/05/helping-nz-students-stay-safe-online.html

EXHIBIT 8:

BY OPTIMISING TRIPS, GOOGLE MAPS SAVE BETWEEN 30,400-40,300 TONNES OF CO2 EMISSIONS PER YEAR, EQUIVALENT TO EMISSIONS FROM 6,600-8,700 CARS

ESTIMATED CO2 EMISSIONS SAVED FROM USING GOOGLE MAPS IN NEW ZEALAND
TONNES OF CO2 EMISSIONS SAVED AND EQUIVALENT NUMBER OF CARS

PRODUCT	CO2 EMISSIONS SAVED	EQUIVALENT NUMBER OF CARS[1]
Google Maps	30,400 – 40,300 tonnes	6,600 – 8,700 cars

1. Based on assumption of carbon emissions from a typical passenger vehicle of 4.6 tonnes of CO2 emissions per year. Source: US Environmental Protection Agency (2018)
SOURCE: AlphaBeta analysis

APPENDIX: METHODOLOGY

A: SIZING THE ECONOMIC VALUE OF DIGITAL TECHNOLOGIES

This document provides the detailed methodology, and the assumptions and sources of information used to quantify the potential economic impact of digital technologies for New Zealand 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 is 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.[184] Of these trends, eight were considered digital in nature: mobile Internet; financial technology; 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.[185] This

184. 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

185. 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.

was guided by the individual industry's relevance for digital technologies (based on past research quantifying the potential industry benefits of these digital technologies).[186]

- 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, ten sectors were selected.[187] These sectors consisted of Agriculture and food (including food manufacturing); Consumer, retail and hospitality services; Education and training; Financial services; Government; Health; Infrastructure (including utilities such as energy and water); Manufacturing; Transport services; Resources (including mining and oil & gas).

EXHIBIT A1:

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

	STEP 1 Identify digital technologies	STEP 2 Align on focus sectors	STEP 3 Identify relevant technology applications in focus sectors	STEP 4 Size the value in 2030
Activities	Identify key digital technologies that academic literature has shown to be important for driving business and consumer value	Identify key sectors of the economy, based on relevance of those technologies and their importance for overall jobs and GDP	Understand relevant technology applications in focus sectors, including sources of value	Estimate the value (in local currency terms) of these technology applications in each sector in 2030 based on full adoption scenario
Methodology	Industry reports – e.g., McKinsey Global Institute, World Economic Forum	Technology reports to identify sector-impact of technologies; local country data for importance of sectors to GDP, jobs	Review of sector-level technology reports	Case studies, with top-down "sanity check" based on comparison to other research reports on overall value of technologies

186. 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).

187. In New Zealand, all ten sectors have fulfilled the criterion in Step 2.

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 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 E1 in Executive Summary. 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 in the sizing of economic opportunities of digital technology applications across the ten sectors.

The specific assumptions and sources used to size each digital technology application in the "Full adoption" scenario in 2030 are shown below.

TABLE 1: KEY METRICS AND SOURCES FOR SIZING ECONOMIC OPPORTUNITIES

METRICS	SOURCE
GDP / GDP per capita	• World Bank GDP statistics • International Monetary Fund (International Monetary Fund) Real GDP growth estimates • Stats NZ
Population	• United Nations Department of Economic and Social Affairs Population datasets
Labour Force	• International Labour Organisation (ILO) • World Bank Labour Force statistics • Stats NZ
Wage	• Stats NZ
Exchange rates	• OFX

AGRICULTURE AND FOOD

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. PRECISION FARMING TECHNOLOGIES		**PRODUCTIVITY GAINS/COST SAVINGS**
Data-driven optimisation of crop and meat production	Sized based on the productivity gains from increased yield, as well as cost savings from the use of fewer resources in farming. Future Farming (2018) states that Variable Rate Irrigation (VRI) can reduce water usage with a cost savings potential of US$138.05/ha. Country-level estimate was derived based on the effectiveness of the technology within the context of the country's agricultural landscape and its agricultural sector GDP.	• Future Farming (2018)[188] • World Bank[189]
2. IOT-ENABLED SUPPLY CHAIN MANAGEMENT		**INCREASED REVENUES**
IoT technology to help reduce food waste in supply chain	Sized based on the additional revenues from reduced food losses that occur in the supply chain. McKinsey Global Institute (2014) estimated that ten percent to 15 percent of all food waste throughout the supply chain were recoverable from technology-enabled supply chain management. Country-level estimate was derived based on annual food waste from the supply chain which was assumed to grow at constant rates.	• McKinsey Global Institute (2014)[190] • Food and Land Use Coalition[191]
3. FOOD SAFETY TECHNOLOGIES		**COST SAVINGS**
Using sensors, data monitoring and analysis techniques to ensure the biosecurity of food products and predict when concerns may arise	Sized based on cost savings from reduced food contamination losses. Fast Company (2017) reported that improving food traceability via sensing, tracking and data monitoring technologies could improve the percentage of food arriving at the retailers' premises with target freshness, from 30 percent to 90 percent. Pricewaterhouse Coopers (2015) estimated the global cost of food fraud, proxied by lost sales due to adverse health consequences, to be between US$30 billion to US$40 billion a year. Growth in cost of food fraud was derived based on FAO's estimate of global food demand growth. Country-level estimate of food contamination losses was derived based on the relative share of global GDP.	• Fast Company (2017)[192] • Pricewaterhou-se Coopers (2015)[193] • Food and Agriculture Organisation of the United States[194]

188. Future Farming (2018), "Profiting from precision irrigation".
Available at: https://www.futurefarming.com/Smart-farmers/Articles/2018/9/Profiting-from-precision-irrigation-335622E/
189. World Bank (2018). Available at: https://blogs.worldbank.org/opendata/new-country-classifications
190. McKinsey Global Institute (2014), Southeast Asia at the crossroads: Three paths to prosperity.
Available at: https://www.mckinsey.com/featured-insights/asia-pacific/three-paths-to-sustained-economic-growth-in-southeast-asia
191. Food and Land Use Coalition (2019), Reducing Food Loss and Waste.
Available at: https://www.foodandlandusecoalition.org/wp-content/uploads/2019/09/Critical-Transitions-6-Reducing-Food-Loss-and-Waste.pdf
192. Fast Company (2017), "These high-tech sensors track exactly how fresh our produce is so we stop wasting food."
Available at: https://www.fastcompany.com/40424163/these-high-tech-sensors-track-exactly-how-fresh-our-produce-is-so-we-stop-wasting-food
193. Pricewaterhouse Coopers (2015), Food fraud vulnerability assessment.
Available at: https://www.pwc.com/sg/en/industries/assets/food-fraud-vulnerability-assessment.pdf
194. Food and Agriculture Organisation of the United States (2002), "World agriculture 2030: Main findings."
Available at: http://www.fao.org/english/newsroom/news/2002/7833-en.html

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).	• McKinsey Global Institute (2013)[195]
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.	• McKinsey Global Institute (2013)[196]
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.	• Colliers International (2018)[197] • The Vulcan Post (2018)[198] • Singapore Tourism Board (2019)[199]

195. 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
196. 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
197. 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
198. The Vulcan Post (2018), "No Queues, No Forms: this S'pore Startup Lets You Quickly Check To Hotels With A Selfie."
Available at: https://vulcanpost.com/704429/gtriip-digital-hotel-check-in-singapore/
199. 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

CONSUMER, RETAIL AND HOSPITALITY (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
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.	• Boston Consulting Group (2020)[200]
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. Bankwest (2018) estimated that 29 percent of hospitality revenue was attributed to the food and beverage sector. 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 hospitality revenue.	• Bankwest (2018)[201] • The Straits Times (2017)[202]

EDUCATION AND TRAINING

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. E-CAREER CENTRES AND DIGITAL JOBS PLATFORMS		**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.	• McKinsey Global Institute (2015)[203]
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.	• McKinsey Global Institute (2018)[204] • World Bank[205]

200. Boston Consulting Group (2020), "Bionic Revenue Management in Travel and Tourism."
Available at: https://www.bcg.com/publications/2020/bionic-revenue-management-travel-tourism
201. Bankwest (2019), Bankwest Future of Business: Focus on Hospitality.
Available at: https://www.bankwest.com.au/content/dam/bankwest/documents/business/insights/focus-on-hospitality-report-2019.pdf
202. The Straits Times (2017), "Delivery sales drive up eateries' revenues." Available at: https://www.straitstimes.com/business/delivery-sales-drive-up-eateries-revenues
203. 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
204. 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-livable-future
205. World Bank (2018). Available at: https://blogs.worldbank.org/opendata/new-country-classifications

EDUCATION AND TRAINING (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
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.	• McKinsey Global Institute (2018)[206] • World Bank[207]

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.	• McKinsey Global Institute (2014)[208]
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 (2017) estimated that the potential savings from retail banking operational costs and risk costs ranged from 20 percent to 30 percent and ten percent to 30 percent, respectively. Country-level cost savings was derived based on domestic banking sector operating costs.	• McKinsey Global Institute (2017)[209]
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.	• Juniper Research (2017)[210] • KPMG (2013)[211]

206. 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-livable-future
207. World Bank (2018). Available at: https://blogs.worldbank.org/opendata/new-country-classifications
208. McKinsey Global Institute (2014), China's digital transformation: The Internet's impact on productivity and growth.
Available at: https://www.mckinsey.com/industries/high-tech/our-insights/chinas-digital-transformation
209. McKinsey Global Institute (2017), Digital Australia: Seizing opportunities from the fourth industrial revolution.
Available at: https://www.mckinsey.com/featured-insights/asia-pacific/digital-australia-seizing-opportunity-from-the-fourth-industrial-revolution
210. Juniper Research (2017), How Reg Tech can save banks billions.
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211. KPMG (2013), The cost of compliance. Available at: https://home.kpmg.com/content/dam/kpmg/pdf/2014/07/Cost-of-Compliance.pdf

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. Brookings (2010) reported that government agencies experienced between 25 percent to 50 percent cost savings after moving to the cloud. Country-level estimate was derived based on government ICT expenditure and hardware costs.	• Brookings (2010)[212]
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.	• McKinsey Global Institute (2011)[213]
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 US$8 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.	• Public Procurement Service[214]
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.	• Bill & Melinda Gates Foundation and AlphaBeta (2018)[215]

212. Brookings (2010), "Saving Money Through Cloud Computing". Available at: https://www.brookings.edu/research/saving-money-through-cloud-computing/
213. 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/McKinsey Global Institute_big_data_full_report.ashx
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215. Bill & Melinda Gates Foundation and AlphaBeta (2018), Digital Innovation in Public Financial Management (PFM): Opportunities and implications for low-income countries. Available at: https://www.alphabeta.com/wp-content/uploads/2018/07/pfm-technology-paper-long-version.pdf

GOVERNMENT (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
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.	• McKinsey & Company (2017)[216]

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.	• McKinsey Global Institute (2013)[217] • World Bank[218]
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 US$100 billion by adopting telehealth. Country-level estimate was derived based on relative national healthcare expenditure.	• Goldman Sachs (2015)[219]

216. McKinsey & Company (2017), Government productivity: Unlocking the $3.5 trillion opportunity. Available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/The%20opportunity%20in%20government%20productivity/Government-Productivity-Unlocking-the-3-5-Trillion-Opportunity-Full-report.pdf?shouldIndex=false

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218. World Bank statistics on current health expenditure. Available at: https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS

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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.	• McKinsey Global Institute (2018)[220] • UN Population Division (2018)[221] • World Bank[222]
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 €10 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.	• EU Intellectual Property Office (2016)[223] • McKinsey Global Institute (2013)[224]
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.	• McKinsey Global Institute (2018)[225] • UN Population Division (2018)[226] • World Bank[227]

220. 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-livable-future
221. UN Population Division (2018). Available at: https://esa.un.org/unpd/wpp/DataQuery/
222. World Bank (2018). Available at: https://blogs.worldbank.org/opendata/new-country-classifications
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224. 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
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227. 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 US$3 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.	• McKinsey Global Institute (2014)[228] • World Bank[229] • Transparency Market Research[230]

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. Smart Energy Consumer Collaborative (2018) estimated five to ten percent energy could be saved 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 US$100/Mwh.	• Smart Energy Consumer Collaborative (2018)[231] • World Bank[232] • Business and Sustainable Development Commission (2017)[233]
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.	• McKinsey Global Institute (2013)[234] • Global infrastructure Outlook[235]

228. 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/McKinsey Global Institute%20India%20tech_Executive%20summary_December%202014.ashx
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230. Transparency Market Research (2018), "Electronic Health Records Market". Available at: https://www.transparencymarketresearch.com/electronic-health-records-market.html
231. Smart Energy Consumer Collaborative. Available at: http://www.whatissmartgrid.org/faqs/what-are-the-benefits-of-the-smart-grid
232. World Bank statistics on electric power consumption. Available at: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
233. Business and Sustainable Development Commission (2017), Valuing the SDG prize: Unlocking business opportunities to accelerate sustainable and inclusive growth. Available at: http://businesscommission.org/our-work/valuing-the-sdg-prize-unlocking-business-opportunities-to-accelerate-sustainable-and-inclusive-growth
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235. Global Infrastructure Outlook on forecasting infrastructure investment needs and gaps. Available at: https://outlook.gihub.org/

INFRASTRUCTURE (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
3. PREDICTIVE MAINTENANCE TECHNOLOGIES		**COST SAVINGS**
Using data from sensors to ensure prompt and predictive maintenance, minimizing downtime	Sized based on the economic value of benefits from sizeable 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 US$0.90/m3. Country-level estimate was derived based on the country's average commuting time, population, GDP per capita and domestic water consumption.	• McKinsey Global Institute (2018)[236] • World Bank[237] • UNESCO-IHE (2011)[238] • Business and Sustainable Development Commission (2017)[239]
4. SMART BUILDINGS		**GDP INCREMENTS**
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	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 US$0.90/m3 and GHG price was valued at US$50/ton (a global proxy price equating roughly to the financial incentives needed to achieve carbon emissions consistent with a two-degree pathway).	• McKinsey Global Institute (2018)[240] • IPCC[241] • World Bank[242] • Business and Sustainable Development Commission (2017)[243]

236. 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-livable-future
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243. Business and Sustainable Development Commission (2017), Valuing the SDG prize: Unlocking business opportunities to accelerate sustainable and inclusive growth.

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.	• McKinsey Global Institute (2011)[244]
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 US$100 billion and US$250 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.	• McKinsey & Company (2017)[245]
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.	• McKinsey Global Institute (2011)[246]
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.	• McKinsey & Company (2017)[247]

244. 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
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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.	• McKinsey Global Institute (2018)[248] • World Bank[249]
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).	• Accenture and SIPG (2016)[250] • Council of Supply Chain Management Professionals (2013)[251] • World Bank (2016)[252]
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.	• McKinsey Global Institute (2013)[253]
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 services (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.	• AlphaBeta (2017)[254]

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

RESOURCES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. SMART EXPLORATION AND AUTOMATION IN MINING OPERATIONS		**PRODUCTIVITY GAINS/COST SAVINGS**
Use of big data to analyse geoscience and drilling data to locate probable deposits proactively and efficiently, and automate extraction and transport	Sized based on the potential global economic value of such technologies in mining. McKinsey & Company (2015) estimated big data to generate US$250 billion in economic value, based on an 80 percent adoption rate scenario. Country-level estimate was derived based on the country's relative share of global mining sector GDP, proxied by the country's share of global mineral rents.	• McKinsey & Company (2015)[255]
2. PREDICTIVE SAFETY TECHNOLOGIES		**PRODUCTIVITY GAINS/COST SAVINGS**
Technologies that improve productivity and safety such as wearables with in-built sensors that monitor fatigue, location, atmosphere and vitals, and augmented reality interfaces that improve human-machine interaction	Sized based on the potential global economic value of such technologies in mining. McKinsey & Company (2015) estimated the economic value to be US$15 billion, based on a 100 percent adoption rate scenario. Country-level estimate was derived based on the country's relative share of global mining sector GDP, proxied by the country's share of global mineral rents.	• McKinsey & Company (2015)[256]
3. PREDICTIVE MAINTENANCE TECHNOLOGIES		**PRODUCTIVITY GAINS/COST SAVINGS**
Use of remote operations centres and data-collecting sensors on mining equipment to improve failure anticipation, reduce unscheduled breakdowns and increase equipment life	Sized based on the potential global economic value of such technologies in mining. McKinsey & Company (2015) estimated the economic value to be US$105 billion, based on a 100 percent adoption rate scenario. Country-level estimate was derived based on the relative share of global mining sector GDP, proxied by the country's share of global mineral rents.	• McKinsey & Company (2015)[257]

255. McKinsey & Company (2015), How digital innovation can improve mining productivity.
Available at: https://www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity
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257. McKinsey & Company (2015), How digital innovation can improve mining productivity.
Available at: https://www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity

APPENDIX A3: ECONOMIC IMPACT OF COVID-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, 12 were assessed to have the potential to manage the economic impacts of the pandemic in New Zealand's context, through three channels. These are:

- Facilitate customer interactions, transactions and marketing through digital platforms;
- Address difficulties in accessing temporary or seasonal migrant workers for industry sectors that are heavily reliant on them; and
- Reduce logistical bottlenecks amidst supply chain disruptions induced by pandemic.

Exhibit A2 shows the list of these 12 COVID-relevant technology applications, grouped by their respective sector and the specific channel through which they deliver COVID-relevant impact.

EXHIBIT A2:

OF THE 40 APPLICATIONS, 12 HAVE THE POTENTIAL TO ALLOW BUSINESSES TO THRIVE DESPITE THE COVID-19 PANDEMIC THROUGH THREE CHANNELS

CHANNEL	SECTOR	COVID-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 services
	Education and training	3. E-career centres and digital jobs platforms 4. Online retraining programmes
	Financial services	5. Digital banking services
	Health	6. Telehealth applications
Address difficulties in accessing temporary migrant workers	Agriculture and food	7. Precision farming technologies
	Consumer, retail and hospitality	8. Automation and AI customer service in hotels
	Manufacturing	9. Robotics and automation
Reduce logistical bottlenecks amidst global and regional supply chain disruptions	Agriculture & food	10. IoT-enabled supply chain management (food)
	Manufacturing	11. IoT-enabled supply chain management (manufacturing)
	Transport services	12. Smart ports

SOURCE: AlphaBeta analysis

B: SIZING GOOGLE'S ECONOMIC IMPACT IN NEW ZEALAND

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, AdSense, YouTube, Google Play, and Google Maps.

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 538 Internet users in New Zealand. This sample size is statistically significant based on New Zealand'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 New Zealand'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 Maps, YouTube, Google Play, Google Drive, Photos, Docs, and Sheets.

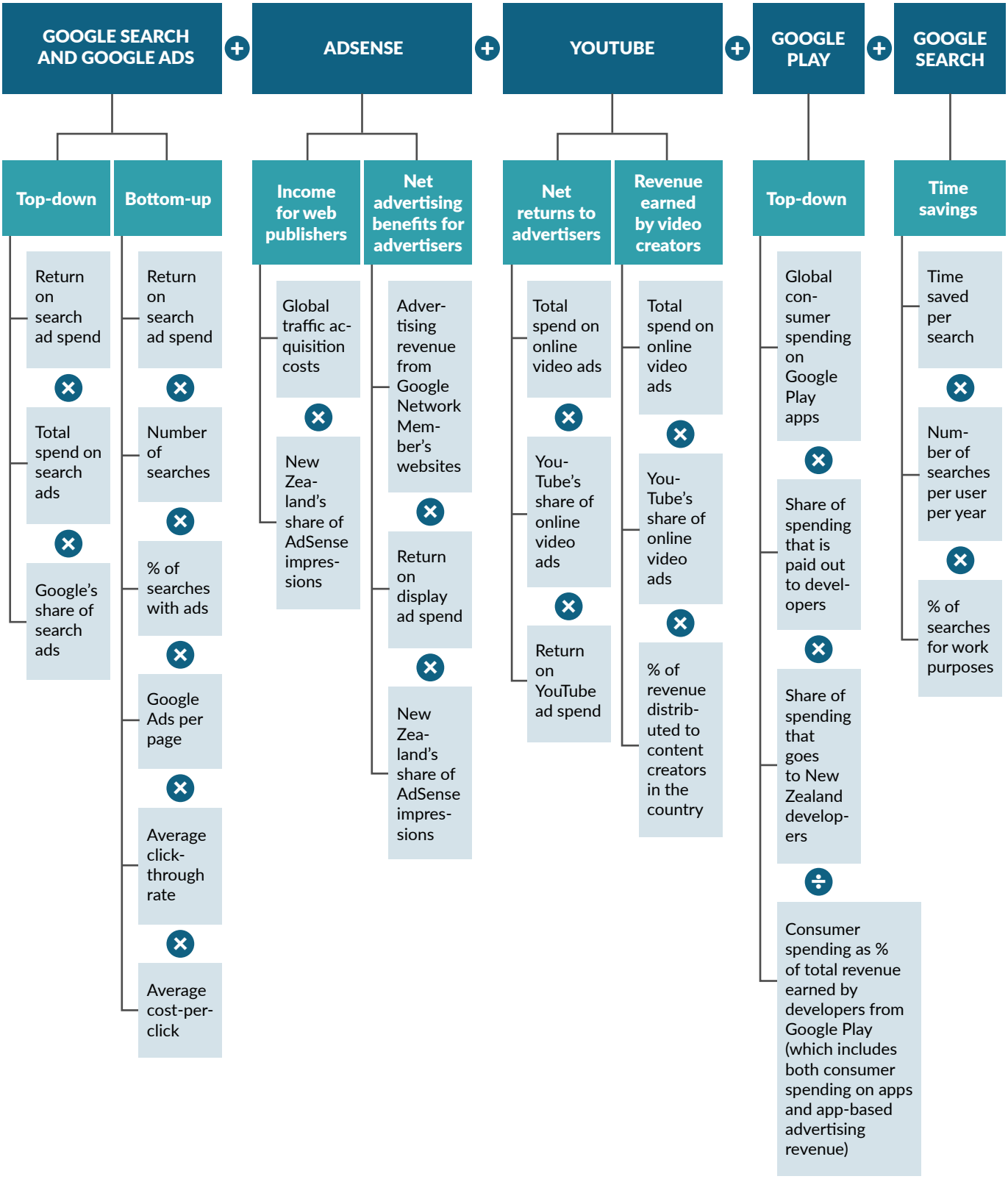
The **societal benefits** supported by Google are challenging to measure as they are difficult to quantify. Hence, we only estimated the environmental impact from using Google Maps in the form of reduced CO2 emissions.

BUSINESS 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 New Zealand economy beyond what would be the case if Google didn't exist but other companies like it did. Exhibit A3 summarises the methodology used for sizing business benefits of Google's products.

EXHIBIT A3:

METHODOLOGY FOR SIZING BUSINESS BENEFITS FROM GOOGLE



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 New Zealand 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).

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.[258] 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 US$2 in revenue for every US$1 spent on advertising. This 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, 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 8 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.[259] 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.[260] 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.

The benefits of YouTube to video content creators were also estimated as the total income earned from placing advertisements on their YouTube videos. The total income earned by the country's video content creators was estimated from YouTube's share of the total video advertising spend in the country, and multiplying the estimate with the share of revenue distributed to video content creators.

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

258. ROI reflects the net advertising benefits that businesses receive from online advertising (i.e. total revenue minus online advertising cost).
259. This refers to the increase in revenues and sales that can be directly attributed to advertising minus the related advertising expenditure.
260. 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.

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

APPROACH	METRIC	SOURCE
Top down approach	Total online search advertising market size	• Statista (2020)[261]
	Google Search's market share	• StatCounter (2020)[262]
Bottom up approach	Search traffic data	• AlphaBeta Consumer Survey (2020)
	% of pages that display advertisements	• Varian (2009)[263], Jansen & Spink (2009)[264] • Deloitte (2015)[265]
	Advertisements per page on average	• Varian (2009)[266], Jansen & Spink (2009)[267] • Deloitte (2015)[268]
	Average CTR for Search (Estimate)	• Word Stream (2019)[269] • BannerTag (2019)[270]
	Average CPC for Search (Estimate)	• Word Stream (2018)[271] • Adstage (2019)[272]
Both Methods	ROI ratio Lower and Upper Bound	• Varian (2009)[273], Jansen & Spink (2009)[274] • Deloitte (2015)[275]

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275. Deloitte (2015), Google's Economic Impact United Kingdom.

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)[276]
	ROI ratio	• Gupta et al. (2015)[277]
Revenue to content creators	Global traffic acquisition costs related to AdSense	• Alphabet (2019)[278]
Both estimates	Country share of global impressions on AdSense (Estimate)	• DoubleClick (2012)[279] • Internet World Stats (2019)[280]

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

METRIC	SOURCE
Total online video advertising spend in country	• Statista (2020)[281]
YouTube's market share	• AlphaBeta Consumer Survey (2020)
YouTube ROI ratio	• Business Insider (2014)[282]
Share of revenue distributed to content creators	• Variety (2013)[283]

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GOOGLE PLAY

We estimated the revenue earned by New Zealand app developers 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 developers, and the share of the spending that went to New Zealand app developers. The revenue from consumer spending earned by New Zealand app developers 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 5 shows the inputs and sources used for estimating the business benefits of Google Play.

GOOGLE SEARCH (TIME SAVINGS)

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

TABLE 5: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF GOOGLE PLAY

METRIC	SOURCE
Global consumer spending on Google Play	• Sensor Tower (2020)[284]
Share of the spending that is paid out to app developers	• Google (2020)[285]
Share of the spending that goes to the country's app developers	• Caribou Digital (2016)[286]
Consumer spending as % of total revenue earned by developers from Google Play (which includes both consumer spending on apps and app-based advertising revenue)	• Appota/AdSota (2017)[287]

TABLE 6: INPUTS AND SOURCES FOR CALCULATING TIME SAVING BENEFITS OF GOOGLE SEARCH

METRIC	SOURCE
Time saved per search	• Varian (2014)[288] • Chen et al. (2014)[289]
Average daily searches per worker	• AlphaBeta Consumer Survey (2020)
% of searches for work purposes	• AlphaBeta Consumer Survey (2020)

284. Sensor Tower (2020), "Consumer Spending in Mobile Apps Grew 17% in 2019 to Exceed NZ$83 Billion Globally". Available at: https://sensortower.com/blog/app-revenue-and-downloads-2019
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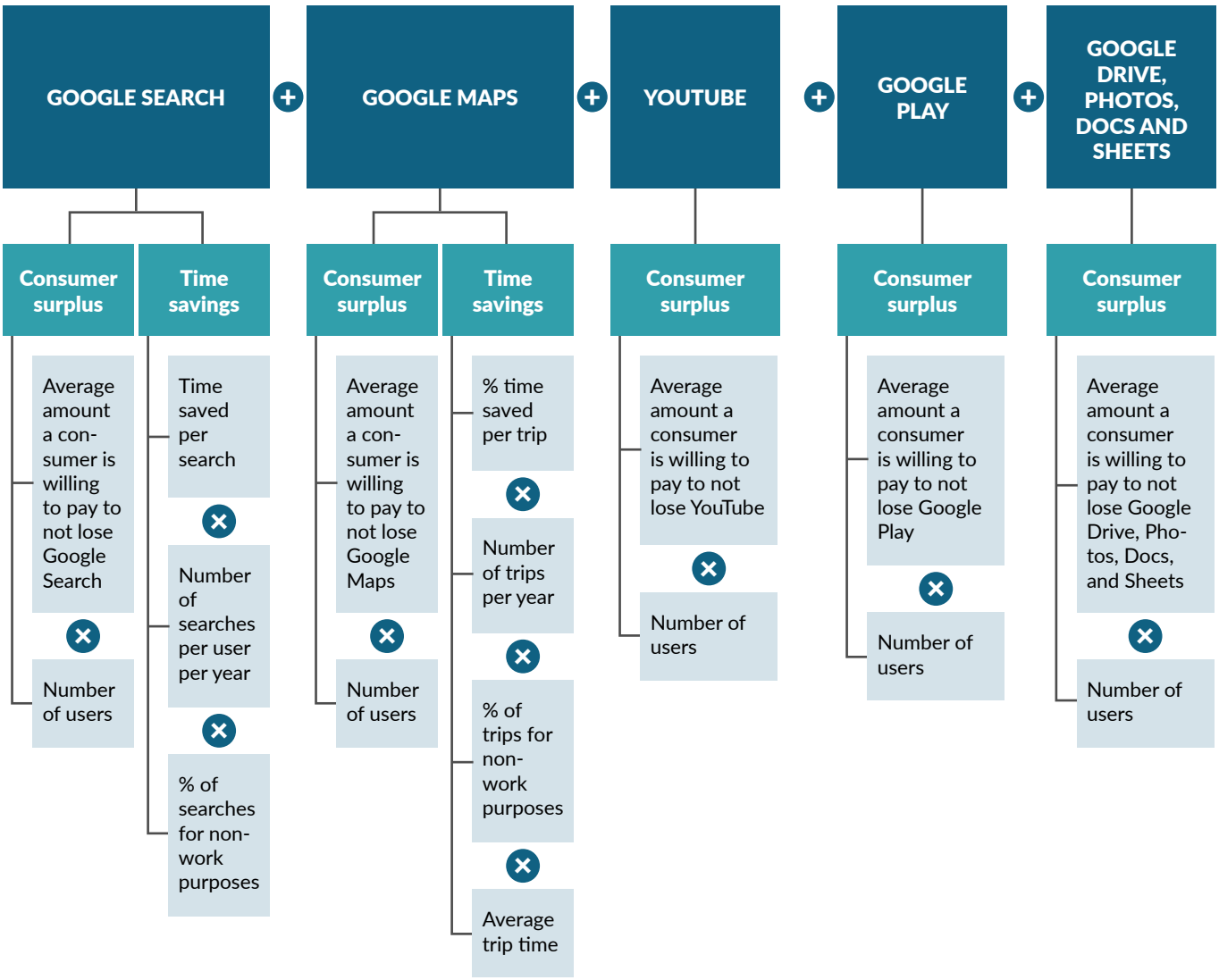
CONSUMER BENEFITS

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 Maps (which optimises their driving and public transport journeys) and Google Search (which increases the efficiency of information gathering). Exhibit A4 summarises the methodology used for sizing consumer surplus and time savings of relevant products.

EXHIBIT A4:
METHODOLOGY FOR SIZING CONSUMER BENEFITS FROM GOOGLE



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.[290] 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 New Zealand 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 7 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. We also estimated the time saved by using Google Maps for driving and public transport trips.

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.

The time saved per user by using Google Maps was estimated using the amount of time saved per trip, the average trip time, and the number of trips conducted for non-work purposes per user. The time saving per trip was obtained from AlphaBeta's traffic crawler analysis of driving and public transport trips in Auckland, Christchurch, and Wellington in 2016.

Table 8 shows the inputs and sources used for calculating the consumer benefits of Google Maps.

YOUTUBE

We calculated the benefits of YouTube to consumers using willingness to pay, where consumers were asked to value their favourite online video service. Results from the survey of New Zealand online population were used.

The share of YouTube users in the country who have made use of YouTube to learn advanced digital skills (e.g., coding and software programming, use of specialised statistical software, online marketing, website development, smartphone application development) was also estimated using the consumer survey.

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

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 New Zealand online population were used.

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

290. Chen et al. (2014) A day without a search engine: an experimental study of online and offline searches. Experimental Economics, Vol 17, Issue 4, pp 512-536.

TABLE 7: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF GOOGLE SEARCH

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019)[291]
	Search users as % of OP	• AlphaBeta Consumer Survey (2020)
Time saved per user	Time saved per search	• Varian (2014)[292] • Chen et al. (2014)[293]
	Average daily searches per user	• AlphaBeta Consumer Survey (2020)
	% of searches for non-work purposes	• AlphaBeta Consumer Survey (2020)
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	• AlphaBeta Consumer Survey (2020)

TABLE 8: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF GOOGLE MAPS

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019)[294]
	Maps users as % of OP	• AlphaBeta Consumer Survey (2020)
Time saved per user by using Google Maps for public transport	% of time saved per trip on average	• AlphaBeta traffic crawler analysis (2016)
	Number of public transport trips using Google Maps per week	• AlphaBeta Consumer Survey (2020)
	% of trips for non-work purposes	• AlphaBeta Consumer Survey (2020)
	Average trip time	• AlphaBeta Consumer Survey (2016)
Time saved per user by using Google Maps for driving	% of time saved per trip on average	• AlphaBeta traffic crawler analysis (2016)
	Number of driving trips using Google Maps per week	• AlphaBeta Consumer Survey (2020)
	% of trips for non-work purposes	• AlphaBeta Consumer Survey (2020)
	Average trip time	• AlphaBeta Consumer Survey (2016)

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294. Internet World Stats (2019). Available at: https://www.internetworldstats.com/stats6.htm

TABLE 9: INPUTS AND SOURCES FOR CALCULATING CONSUMER BENEFITS OF YOUTUBE

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019)[295]
	YouTube users as % of OP	• AlphaBeta Consumer Survey (2020)
Share of YouTube users who have made use of YouTube to learn advanced digital skills	% of YouTube users in country who made use of YouTube to learn advanced digital skills	• AlphaBeta consumer survey (2020)

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

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019)[296]
	Google Play users as % of OP	• AlphaBeta Consumer Survey (2020)

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 New Zealand online population were used.

Table 11 shows the inputs and sources used for calculating the consumer benefits of Google Drive, Photos, Docs, and Sheets.

TABLE 11: 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)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019)[297]
	Users of Drive, Photos, Docs, and Sheets as % of OP	• AlphaBeta Consumer Survey (2020)

295. Internet World Stats (2019). Available at: https://www.internetworldstats.com/stats6.htm
296. Internet World Stats (2019). Available at: https://www.internetworldstats.com/stats6.htm
297. Internet World Stats (2019). Available at: https://www.internetworldstats.com/stats6.htm

SOCIETAL BENEFITS

We estimated the environmental impact of Google Maps in the form of reduced CO2 emissions. This was calculated based on the average distance saved from using Google Maps, the number of Google Maps users for driving, the average vehicle occupancy rate, and the amount of CO2 emissions per kilometre travelled.

Table 12 shows the inputs and sources used for calculating the societal benefits of Google Maps.

TABLE 12: INPUTS AND SOURCES FOR CALCULATING SOCIETAL BENEFITS OF GOOGLE MAPS

ESTIMATION	METRIC	SOURCE
CO2 emissions saved per year	Average distance travelled per year per user (km)	• AlphaBeta Consumer Survey (2017)
	Average percentage of distance saved with Google Maps	• AlphaBeta traffic crawler analysis (2016)
	Number of individuals who used Google Maps for driving	• AlphaBeta Consumer Survey (2020)
	Average vehicle occupancy rate	• NZ Ministry of Transport (2018)[298]
	Average amount of CO2 emissions for cars per km travelled	• NZ Ministry of Transport (2019)[299]
Equivalent number of passenger cars	Average amount of CO2 emissions per passenger car per year	• US Environmental Protection Agency (2018)[300]

298. NZ Ministry of Transport (2018), "RD029 Mean occupancy of light 4-wheeled vehicles by region (people/vehicle)".
Available at: https://www.transport.govt.nz/mot-resources/transport-dashboard/2-road-transport/rd086-vehicle-kilometres-travelled-by-region-billion-km/rd029-mean-occupancy-of-light-4-wheeled-vehicles-by-region-peoplevehicle/
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Important Notice on Contents

This report has been prepared by AlphaBeta for Google. AlphaBeta and Google would like to thank Andrew Sweet, Director of Firecone NZ, for his valuable contribution in peer reviewing the report.

All information in this report is derived or estimated by AlphaBeta analysis using both proprietary and publicly available information. Google has not supplied any additional data, nor does it endorse any estimates made in the report. Where information has been obtained from third-party sources and proprietary research, this is clearly referenced in the footnotes.

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