

UNLOCKING THAILAND'S DIGITAL POTENTIAL:

THE ECONOMIC OPPORTUNITIES OF DIGITAL TRANSFORMATION AND GOOGLE'S CONTRIBUTION

NOVEMBER 2021

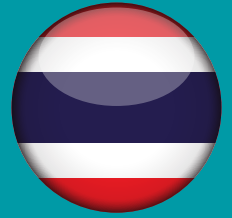




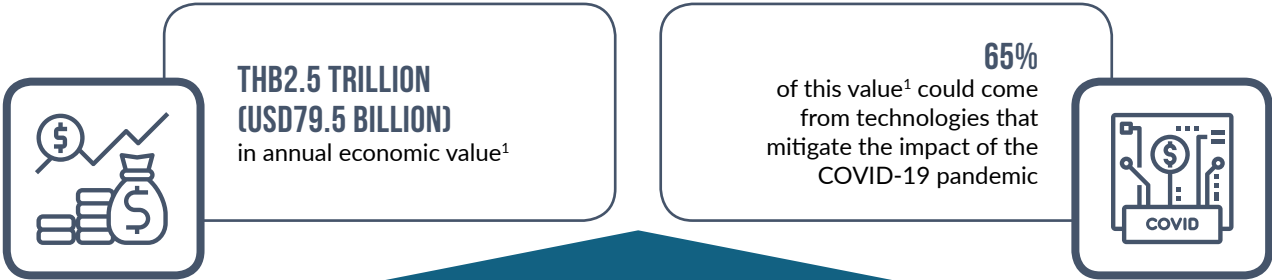
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UNLOCKING THAILAND'S DIGITAL POTENTIAL



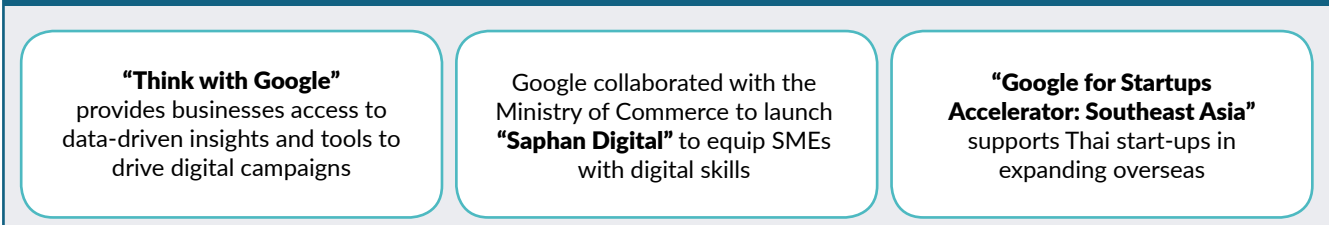
BY 2030, IF LEVERAGED FULLY, DIGITAL TRANSFORMATION CAN CREATE UP TO...



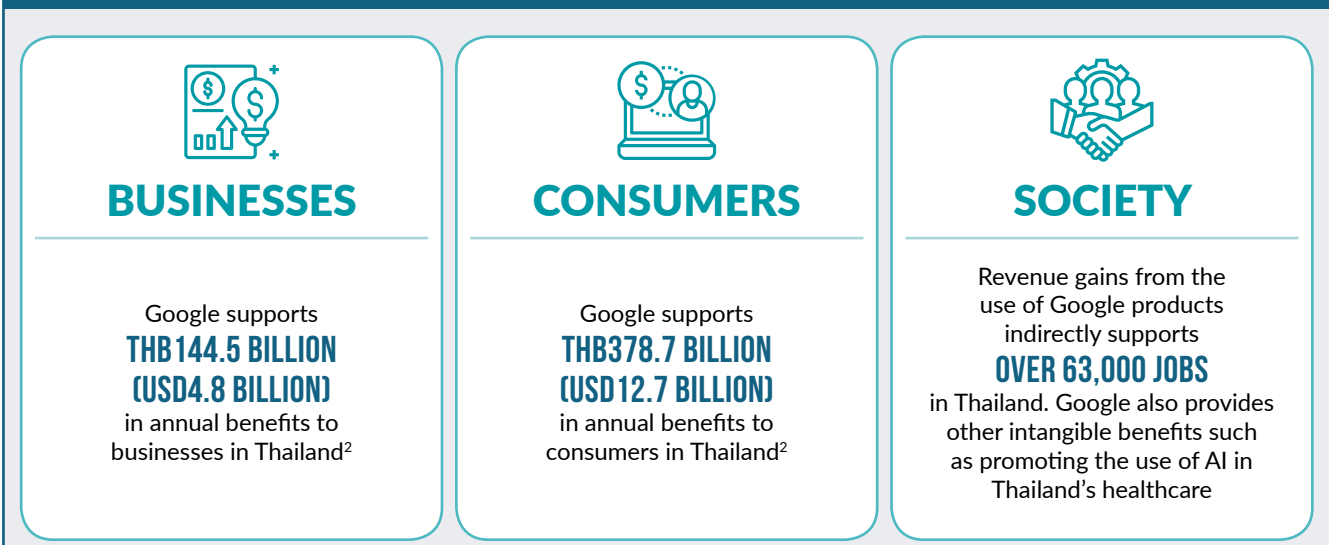
THREE PILLARS OF ACTION



EXAMPLES OF GOOGLE'S CONTRIBUTIONS TO EACH PILLAR



GOOGLE'S BROADER ECONOMIC BENEFITS



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

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

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

EXECUTIVE SUMMARY

Thailand's digital economy has grown significantly in recent years and is well-positioned for further growth. In 2020, the European Center for Digital Competitiveness ranked Thailand as the second most digitally competitive country, based on the progress made in developing its ecosystem and the shifting mindset towards digitization in the East Asia and the Pacific region.¹ The Thailand Board of Investment estimated that the country's digital economy² is poised for greater growth and is expected to contribute about 25 percent of Thailand's gross domestic product (GDP) by 2027, up from 17 percent in 2018.³ Propelled by the increasing Internet usage and growth in e-commerce,

recent research by Google and Temasek has found that Thailand's Internet economy was worth USD18 billion in 2020, and could grow further at 25 percent annually to reach USD53 billion by 2025.⁴ The government has also identified the country's digital economy as one of the key levers of economic growth; its "Thailand 4.0" strategy aims to transform the country into an innovation and knowledge-based digital hub in Southeast Asia.⁵

However, the country faces several barriers to unlocking its full digital transformation potential.

Despite the significant growth opportunity for Thailand's digital economy, the country faces several challenges in



1. European Center for Digital Competitiveness (2020), Digital Riser Report 2020.

Available at: https://digital-competitiveness.eu/wp-content/uploads/ESCP03_Digital-Riser-Ranking_2020-09-14-1.pdf

2. The Thailand Board of Investment defines the digital economy as the adoption of digital technologies to improve overall efficiency and achieve economic growth. Thailand Board of Investment (2020), Thailand Digital Industry: Current situation and supporting measures.

Available at: https://www.boi.go.th/upload/content/Thailand%20Digital%20Industry_%20Current%20Situation%20and%20Supporting%20Measures.pdf

3. Thailand Board of Investment (2020), Thailand Digital Industry: Current situation and supporting measures.

Available at: https://www.boi.go.th/upload/content/Thailand%20Digital%20Industry_%20Current%20Situation%20and%20Supporting%20Measures.pdf

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

Available at: https://storage.googleapis.com/gweb-economy-sea.appspot.com/assets/pdf/Thailand-e-Economy_SEA_2020_Country_Insights.pdf

5. Open Gov (2019), "Pushing forward Thailand 4.0". Available at: <https://opengovasia.com/pushing-forward-thailand-4-0/>



realizing its full potential. These include a digital talent gap and relatively slow adoption of digital solutions by businesses. A 2020 study comparing digital adoption rates by businesses across countries found that only 33 percent of businesses in Thailand were embracing digital transformation and planning to invest for the future, as compared to the global average of 59 percent.⁶ The study attributed this to the lack of digital skills and technological know-how.⁷ The low digital adoption rate of businesses in Thailand has also been attributed to a shortage of tech graduates and the perceived high cost of investing in technology infrastructure such as fifth generation (5G) networks.⁸

Digital transformation can help enhance Thailand's economic recovery from the COVID-19 crisis, while boosting the long-term competitiveness of its businesses. A study has found that, globally, the pandemic has effectively pushed forward the digital revolution by five years,⁹ providing an opportunity for Thailand to ride the next digital wave. Digital transformation will be important to boost its economic recovery efforts and enhance the long-term resilience of businesses for the post-pandemic future.

This report finds that, if leveraged fully in the economy, by 2030, digital technologies could create an annual economic value of THB2.5 trillion (USD79.5 billion).¹⁰

To put this in perspective, this is equivalent to about 16 percent of Thailand's GDP in 2020.¹¹

The key messages of this report include:

- **Eight key technologies hold transformative potential for businesses and workers in Thailand.** 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. By allowing the creation of new business models and productivity savings, these technologies could create significant economic value for Thailand.
- **If leveraged fully, digital transformation can unlock THB2.5 trillion (USD79.5 billion) worth of economic value in Thailand by 2030.** By generating productivity gains, revenue boosts, cost savings and GDP increments, digital technologies can

6. Deloitte (2020), *The Thailand Digital Transformation Survey Report 2020*.

Available at: <https://www2.deloitte.com/content/dam/Deloitte/th/Documents/technology/th-tech-the-thailand-digital-transformation-report.pdf>

7. Deloitte (2020), *The Thailand Digital Transformation Survey Report 2020*.

Available at: <https://www2.deloitte.com/content/dam/Deloitte/th/Documents/technology/th-tech-the-thailand-digital-transformation-report.pdf>

8. 5G is a 5th generation mobile network that is expected to offer faster data download and upload speeds compared to its predecessors. *The Business Times*, Singapore (2019), "Thailand's internet economy 'healthy' but lags in digital adoption."

Available at: <https://www.business-times.com.sg/asean-business/news/thailands-internet-economy-healthy-but-lags-in-digital-adoption>

9. McKinsey & Company (2020), *The Next Normal: The recovery will be digital*.

Available at: <https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/How%20six%20companies%20are%20using%20technology%20and%20data%20to%20transform%20themselves/The-next-normal-the-recovery-will-be-digital.pdf>

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

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



reap up to THB2.5 trillion (USD79.5 billion) worth of economic value annually in Thailand by 2030. The largest projected beneficiaries are the consumer, retail and hospitality; manufacturing; government; infrastructure; and education and training sectors.

- **Of the total economic opportunity from digital technologies, about 40 percent is likely to be concentrated in Greater Bangkok.** Although Greater Bangkok (i.e., Bangkok and vicinities, including Samut Prakan, Pathum Thani, Samut Sakhon, Nakhon Pathom and Nonthaburi) constitutes only slightly more than one percent of Thailand's overall land area, 40 percent of the projected digital opportunity could go to this largely urbanized region in 2030 – suggesting a geographic digital divide that is important to bridge.¹²
- **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, resume business operations, and address logistical bottlenecks, technology can help businesses manage the severe economic impacts of COVID-19. It is estimated that a substantial 65 percent of Thailand's digital opportunity – worth THB1.6 trillion (USD51.7 billion) – could be derived from technology applications.¹³
- **Three pillars of action are required for Thailand to fully capture its digital opportunity.** While Thailand is already making significant progress in some of these areas, there is scope for the country to push further on some policy agendas, with a particular focus on small and medium-sized enterprises (SMEs) and on regions which are lagging in digital adoption. These pillars include:
 - First, it is crucial to have strong policy support to **lower the barriers to digital adoption faced by businesses**. The government has identified 12 new growth industries and provided various tax incentives, including 13 years of tax breaks for research and development (R&D) projects and the adoption of technologies

12. Knoema (2012), "Samut Sakhon Province". Available at: <https://knoema.com/atlas/Thailand/Samut-Sakhon-Province>

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

such as biotechnology, nanotechnology, advanced material technology and digital technology. To address the rural-urban digital divide, the government launched the “Net Pracharat” program to expand Thailand’s national broadband network coverage to over 74,000 villages. The country could go further to provide financial and advisory support for SMEs lacking in digital expertise to accelerate their digital transformation journey and promote the adoption of emerging technologies like Artificial Intelligence (AI) in the country.

- Second, there is scope to further *enhance digital skills training and education* in Thailand. The Department of Skill Development and Digital Economy Promotion Agency has collaborated with the private sector to develop online digital skills training programs, such as “Digital Skill” which offers online data science, IoT and cybersecurity courses for working professionals. The country also has a strong focus on nurturing digital competencies starting from a young age, through the introduction of online computer science and programming lessons in curriculums. To close the gap between

the curriculum in educational institutions and industry needs, industry-institute collaborations should be facilitated to ensure that curriculums are regularly updated to reflect the emerging skill needs (i.e., big data analytics and AI). This includes equipping students with work-ready skills and qualifications to meet the needs of the industry. Given the current shortage of workers literate in the required digital skills, it becomes critical for Thailand to develop support programs incentivizing firms and individuals to continue upskilling in these highly-demanded digital skills.

- Third, Thailand should continue to *develop a conducive environment for digital trade*. For businesses in Thailand to fully harness the export opportunities afforded by digital technologies and channels, Thailand joined the “ASEAN Single Window”,¹⁴ a regional initiative that aims to expedite cargo clearance and enable the electronic exchange of trade documents. In addition, to streamline administrative procedures for exporting, the government launched the “National Digital Trade Platform” (NDTP). With the rise of cross-border electronic



14. ASEAN refers to the Association of Southeast Asian Nations. It is an economic union comprising ten member states, including Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam. ASEAN aims to accelerate the economic growth, social progress and cultural development in the region through joint endeavors.

transactions, safeguarding personal data and consumer rights is essential to enable seamless cross-border data flows. To this end, the country has developed clear guidelines on data privacy and protection issues in relation to cross-border data flows. In May 2019, the country also established its first comprehensive regulatory framework which provides such guidance based on the internationally recognized European Union's "General Data Protection Regulations" (GDPR). Beyond these efforts, the government can go further to encourage more local businesses to participate in digital trade through subsidies for digital adoption and developing knowledge sharing platforms. Through these measures, businesses in Thailand, particularly SMEs, can become more "global-ready", and at the same time, discover and leverage opportunities to export overseas. In addition, the Thai Government can extend its current agriculture export promotion campaign to a long-term initiative that promotes local products and services on online export marketing platforms. However, there is room for Thailand to deepen its digital economy collaborations beyond the ASEAN initiatives. The country could launch negotiations with like-minded trade partners and participate in multilateral digital trade agreements to establish digital trade rules, develop international frameworks to foster interoperability. One example is the "Digital Economy Partnership Agreement" signed between Singapore, New Zealand and Chile to facilitate cross-border data flows.

- **Through its programs and products, Google is making a significant contribution to advancing Thailand's digital transformation journey.** By introducing infrastructure such as Google Cloud and online digital marketing resources such as "Think with Google", Google enables businesses to adopt advanced

digital tools and leverage data-driven insights to improve their services. Through programs such as "Saphan Digital" and "Skillshop", Google is supporting the development of a digitally skilled workforce. "Google for Startups Accelerator: Southeast Asia" enables start-ups in Thailand to access its global network of industry partners to expand internationally. By establishing the "Framework for Responsible Data Protection Regulation", Google is promoting the protection and privacy of data and information to facilitate cross-border data flows.

Google's products also deliver wider benefits to businesses, consumers and the broader society in Thailand.

Businesses and consumers in Thailand are estimated to derive total annual economic benefits from these products worth **THB144.5 billion (USD4.8 billion)** and **THB378.7 billion (USD12.7 billion)**, respectively.¹⁵ 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 experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic contributions to businesses and individuals, Google also supports benefits to the wider society in Thailand. By enabling businesses to unlock new revenue streams and expand their businesses through the use of Google Ads, AdSense, and YouTube, Google indirectly supports over 63,000 jobs in Thailand.¹⁶ The Android operating system also supports more than 58,000 jobs in Thailand's economy.¹⁷ Furthermore, Google also delivers intangible benefits through its programs and initiatives, such as extending digital skilling opportunities to underserved communities, promoting the use of AI in healthcare, safe Internet use, as well as arts and culture in Thailand.

15. Based on AlphaBeta analysis. See Appendix B for details on the methodology.

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

17. Based on AlphaBeta analysis. See Appendix B for details on the methodology.



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

Digital transformation can unleash tremendous economic benefits for Thailand. It is not just important for the technology sector – neglecting the impact of digital technology on 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 THB2.5 trillion (USD79.5 billion) worth of economic value annually by 2030. This is equivalent to about 16 percent of the country's GDP in 2020. The largest economic beneficiary of digital transformation in Thailand is its consumer, retail and hospitality sector, which is estimated to account for about 21 percent of the total economic value.

Digital adoption is also crucial for the country to gain resilience during the COVID-19 crisis and in the post-pandemic future. By supporting businesses in engaging customers and transacting with them digitally, resuming operations, and minimizing logistical bottlenecks, technology applications can help businesses and workers manage the economic ramifications of the COVID-19 pandemic. It is estimated that a substantial 65 percent of Thailand's digital opportunity – at THB1.6 trillion (USD51.7 billion) – could be derived from technology applications that help businesses and workers manage the economic impacts of COVID-19.

Although Greater Bangkok (i.e., Bangkok and vicinities, including Samut Prakan, Pathum Thani, Samut Sakhon, Nakhon Pathom and Nonthaburi) constitutes only slightly more than one percent of Thailand's overall land area, 40 percent of the projected digital opportunity could go to this region in 2030. This reflects a geographic digital divide that is important to bridge.



“SIZING THE PRIZE”

THE ECONOMIC VALUE OF DIGITAL TRANSFORMATION

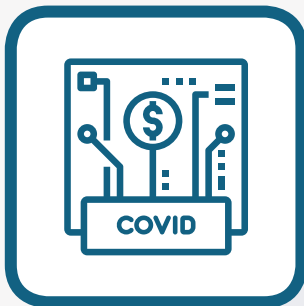


IF LEVERAGED FULLY,
DIGITAL TRANSFORMATION CAN CREATE AN
IMPACT OF UP TO...



**THB2.5 TRILLION
(USD79.5 BILLION)**

in annual economic value¹



65%

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

... IN THAILAND BY 2030

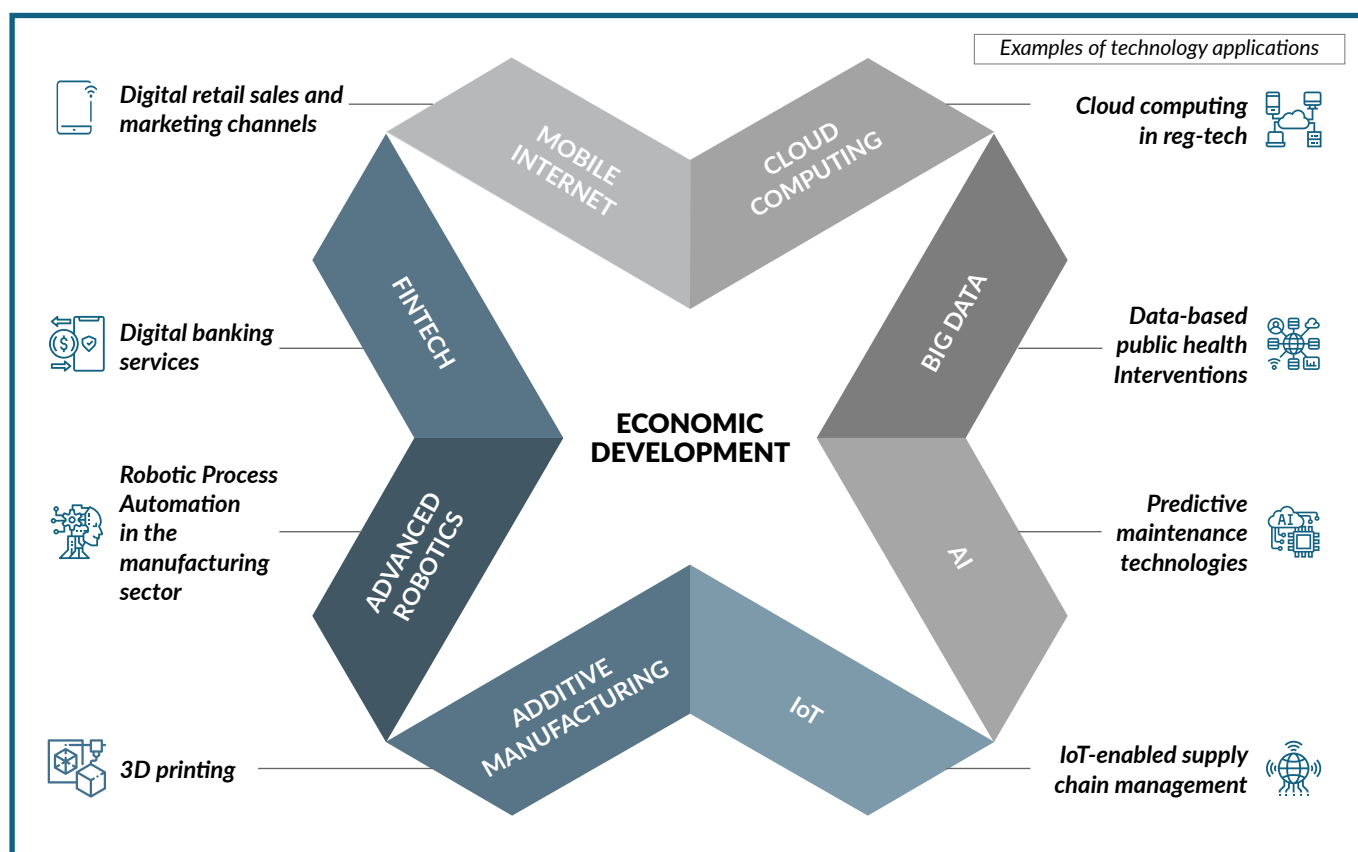
1. Economic value refers to GDP increments, productivity gains, cost savings, time savings, increased revenues, increased wages and increased tax collection. Note: Estimates are based on AlphaBeta analysis using a range of original and third-party sources. See report's Appendix for methodology.

1.1 DIGITAL TRANSFORMATION CAN UNLOCK UP TO THB2.5 TRILLION (USD79.5 BILLION) WORTH OF ECONOMIC VALUE IN 2030

Digital technologies can unlock significant economic value in Thailand. In particular, eight key technologies hold transformative potential for the country (Exhibit 1). Box 1 shows an overview of these technologies, and the potential each has for creating productivity boosts for businesses and workers in Thailand. 40 technology

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

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



BOX 1.

EIGHT KEY TECHNOLOGIES WITH TRANSFORMATIVE POTENTIAL FOR THAILAND

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.¹⁸ 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 Thailand 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 its full potential 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 centers and servers can be cost-prohibitive particularly for SMEs. In addition, public cloud hosting boosts productivity by providing tailored productivity tools, enabling improved security and making resources available on an on-demand basis. Cloud computing has also become essential for leveraging other technologies such as AI and machine learning.
- **Big data.** Big data, and the analysis of it, refers to the ability to analyze 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 analyze customer preferences more effectively to increase customer satisfaction. With the information derived from analytics, businesses can also design targeted programs 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 people.¹⁹ 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,

18. 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://alphabetabeta.com/our-research/the-digital-sprinters-capturing-a-us34-trillion-through-innovative-public-policy/>
19. Microsoft (2018), *The future computed*. Available at: https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf



Fintech has also been responsible for driving greater growth in other sectors (e.g., consumer, retail and hospitality).



























































- **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.²⁰ IoT has a number of applications across sectors with significant economic potential: the health and wellbeing of users can be monitored and maintained by wearable devices, thereby lowering public health expenditure; energy consumption can be monitored and optimized in buildings; equipment use can be enhanced; and health and safety performance of factories can be improved.

- **Advanced robotics.** While simple robots have increasingly been a staple of factory floors in many economies like Thailand, 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.²¹ 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, enabling producers to rapidly adjust to changing customer needs.
- **Additive manufacturing.** This relates to technologies that build 3D objects by adding layer upon layer of material. There is a range of potential benefits, such as the ability to handle complex, low-volume components where rapid turnaround is critical.²²

20. 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
21. Boston Consulting Group (2019), *Advanced robotics in the factory of the future*. Available at: <https://www.bcg.com/publications/2019/advanced-robotics-factory-future>
22. Sharp (2019), “Is additive manufacturing the right choice for your electronic assembly?” JJS Manufacturing Blog. Available at: <https://blog.jjsmanufacturing.com/additive-manufacturing-electronic-assembly>

EXHIBIT 2:

40 DIGITAL TECHNOLOGY APPLICATIONS ACROSS 10 SECTORS WERE IDENTIFIED TO SIZE THAILAND’S ECONOMIC OPPORTUNITY FROM DIGITAL TRANSFORMATION

Agriculture & food 	Consumer, retail & hospitality 	Education & training 	Financial services 
<ul style="list-style-type: none">  Precision farming technologies  IoT-enabled supply chain management  Food safety technologies 	<ul style="list-style-type: none">  Digital retail sales and marketing channels  IoT-enabled inventory management  Automation & AI customer service in hotels  Data analytics on travel patterns  Online F&B delivery channels 	<ul style="list-style-type: none">  E-career centers and digital jobs platforms  Personalized learning  Online retraining programs 	<ul style="list-style-type: none">  Big data analytics  Reg tech  Digital banking services
Government 	Health 	Infrastructure 	Manufacturing 
<ul style="list-style-type: none">  E-services  Cloud computing  E-procurement  Geographic Info. System enabled tax collection  Data analytics for government transfer payments 	<ul style="list-style-type: none">  Remote patient monitoring  Telehealth applications  Data-based public health Interventions  Detection of counterfeit pharmaceutical drugs  Smart medical devices  Electronic medical records 	<ul style="list-style-type: none">  Smart grids  5D BIM & project management technologies  Predictive maintenance technologies  Smart buildings 	<ul style="list-style-type: none">  Big data analytics  Additive manufacturing  IoT-enabled supply chain management  Automation & robotics
Resources 	Transport services 	<p>Key technologies:</p> <ul style="list-style-type: none"> <li style="width: 50%;"> Mobile Internet <li style="width: 50%;"> Fintech <li style="width: 50%;"> Advanced robotics <li style="width: 50%;"> Additive manufacturing <li style="width: 50%;"> Cloud computing <li style="width: 50%;"> Big Data <li style="width: 50%;"> AI <li style="width: 50%;"> IoT 	
<ul style="list-style-type: none">  Smart exploration and automation in mining operations  Predictive safety technologies  Predictive maintenance technologies 	<ul style="list-style-type: none">  Smart roads  Smart ports  Autonomous vehicles  Geospatial services 		

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 THB2.5 trillion (USD79.5 billion) in Thailand by 2030.**²³ This is a substantial value that is equivalent to 16 percent of Thailand's GDP in 2020 (Exhibit 3).

The **consumer, retail and hospitality sector is projected to be technology's largest economic beneficiary in Thailand.** This sector is estimated to be able to gain annual economic benefits of up to THB528 billion (USD16.9 billion) in 2030 – amounting to about 21 percent of the country's total digital opportunity.²⁴ Other top sector beneficiaries include manufacturing (THB443 billion or USD14.2 billion), government (THB365 billion or USD11.7 billion), infrastructure (THB252 billion or USD8.1 billion), and education and training (THB226 billion or USD7.2 billion).²⁵

The key opportunities posed by digital technologies for these sectors are as follows:

- **Consumer, retail and hospitality.** Many retail and food and beverage (F&B) businesses in Thailand are turning to online platforms such as e-commerce marketplaces and mobile applications to digitize their offerings and increase accessibility for customers. In the retail industry, productivity gains from marketing and selling goods through digital channels are estimated to range from six to 15 percent. This is a result of businesses being able to reduce manpower requirements, harness inventory efficiencies, and eliminate real estate costs (e.g., rental of store space).²⁶ In addition, digital technologies could also be used to track customer demand and enable demand forecasting. For example, consumer goods retailer, “7-Eleven”, introduced AI-powered facial recognition technology across all its 11,000 stores

in Thailand to analyze in-store traffic and customer behavior, such as how long a customer lingers at a specific shelf and detecting changes in the emotions of shoppers as they roam around the store.²⁷

- **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 this sector. By improving demand forecasting and production, the use of big data analytics can bring about up to a three percent increase in the profit margins of manufacturers.²⁸ By enabling rapid, “on-time” and customized manufacturing, additive manufacturing technologies (more commonly known as “3D printing”) can enhance the time-to-market and market productivity, as well as increase customer bases. In the automobile manufacturing industry, the use of advanced technologies such as robotics and automation have enabled manufacturers in Thailand to experience increased productivity. For example, automobile parts maker, Thai Summit Gold Press, integrated 180 welding robots into its manufacturing line in 2016.²⁹ Each robot has been able to take up around twice the workload of regular workers, with just three welding robots taking over the tasks of six workers in one of its factory lines.
- **Government.** There is significant scope for the government to improve service delivery and cost efficiency using digital technologies. Such technologies include digitizing government services, cloud computing, and e-procurement. The Thailand Government has already taken steps to adopt some of these technologies. For example, the Department of Agricultural Extension (DOAE) created a digital registry of the nation's farmers

23. 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.

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

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

26. 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>

27. Financial Times (2018), “Thai 7-Eleven stores to adopt facial recognition technology.” Available at: <https://www.ft.com/content/1caa4ee4-2812-11e8-b27e-cc62a39d57a0>

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

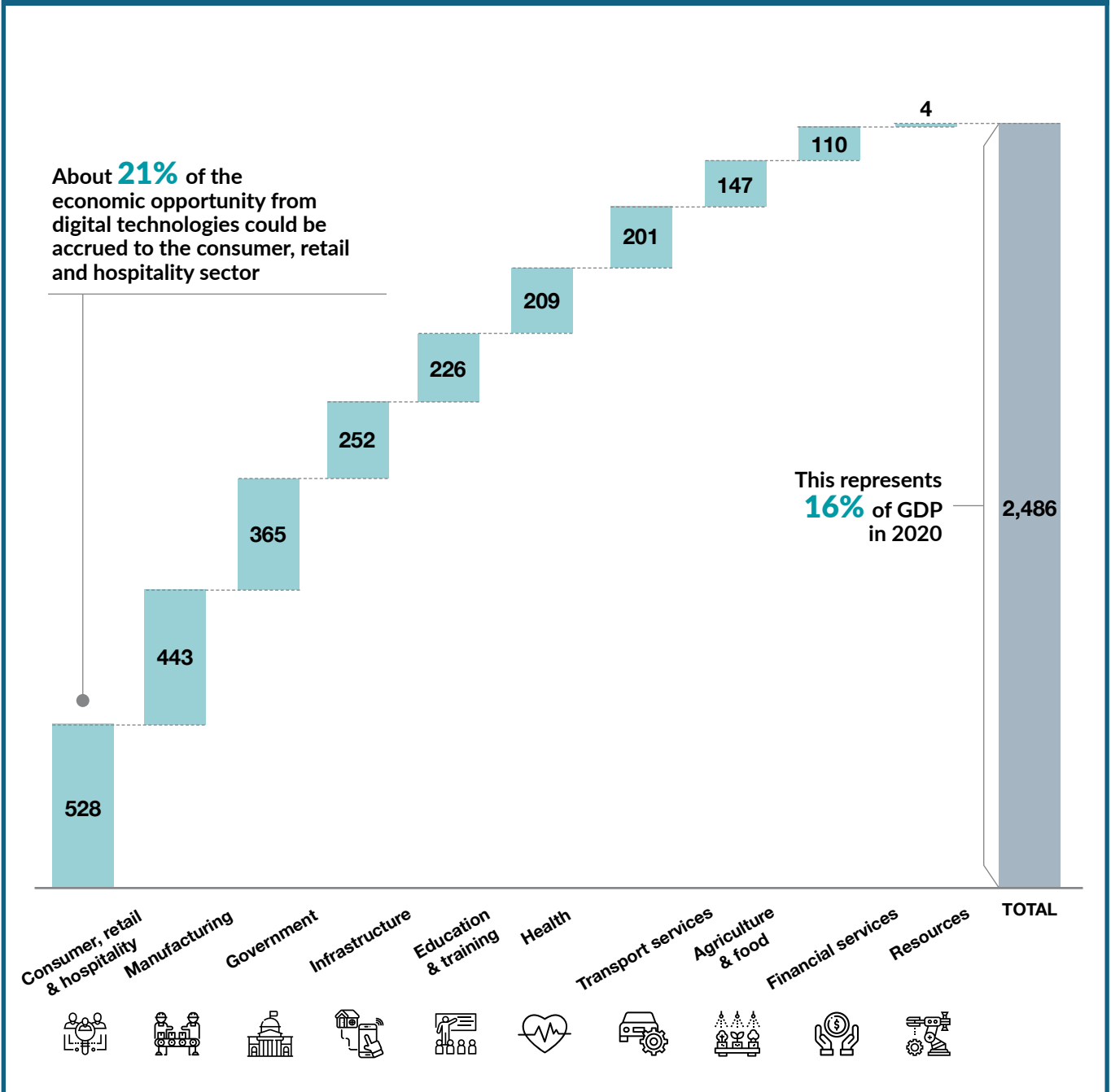
Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation>

29. Nikkei Asia (2016), “Robot makers surf automation wave in Southeast Asia.” Available at: <https://asia.nikkei.com/Business/Robot-makers-surf-automation-wave-in-Southeast-Asia>

EXHIBIT 3:

BY 2030, DIGITAL TECHNOLOGIES COULD SUPPORT UP TO THB2.5 TRILLION (USD79.5 BILLION) OF ANNUAL ECONOMIC IMPACT IN THAILAND

POTENTIAL ANNUAL ECONOMIC VALUE FROM DIGITAL TECHNOLOGIES, BY SECTOR¹
THB BILLIONS, 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

and fields to keep track of crop productivity and efficiency.³⁰ The digital registry also serves as a one-stop platform for farmers to obtain analyses on soil types and suggestions of suitable crops to grow by season. Another important technology application in the government sector is the use of cloud computing, which can significantly reduce IT hardware and equipment costs. The Cabinet of Thailand approved funding for a USD146.6 million state cloud and data center service during the period of 2020 to 2022.³¹ However, the country can go further to leverage on other technologies to enhance its public sector. The automation of procurement procedures through e-procurement, for example, can save governments up to five percent on expenditures and 50 to 80 percent on transaction costs.³²

- **Infrastructure.** Digital technologies, such as Building Information Management (BIM) and predictive maintenance, can generate cost savings and improve precision. Global case studies have shown that due to lower resource requirements, three-dimensional (3D) printing, modular construction, and BIM can reduce construction and demolition waste by 30 percent,³³ 50 percent,³⁴ and 45 percent³⁵ respectively. COVID-19's impact on the construction industry has further reinforced the importance of such technologies. In Thailand, small and medium-sized contractors have been encouraged to improve efficiency and remain competitive by adopting such innovative technologies.³⁶ In addition, the government plans to build an IoT Institute in "Digital Park Thailand", a flagship project under Thailand's

Eastern Economic Corridor (EEC) to create a technology ecosystem. The IoT Institute will include a 5G laboratory, cloud innovation lab, AI design lab and data analytics centers - the first IoT building is expected to cost about THB1.6 billion (USD52.4 million).³⁷ Residential buildings, such as Park Origin Phayathai in Bangkok, have also started to make use of IoT applications, like smart mirrors and home automation.³⁸

- **Education and training.** Not only do digital technologies hold the promise of enhancing the quality and reach of education, they 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 personalized learning tools. For example, eLernity Thailand, a European learning and talent management platform localized for Thailand, delivers gamified and personalized English lessons for K-12 students. Its "English Galaxy" program incorporates immersive augmented reality (AR) and virtual reality (VR) lessons.³⁹ Besides the education system, digital job platforms and e-career centers are important digital tools that enhance efficiencies and address information asymmetries in the labor market. For example, the government launched an online recruitment platform, Thai Mee Ngan Tam (Thais Have Jobs), which features approximately 1.2 million job opportunities across private and public sectors.⁴⁰ As of October 2020, 240,000 people have applied for jobs on the platform.⁴¹

30. OpenGovAsia (2018), "How big data will power the Thai the government." Available at: <https://opengovasia.com/how-big-data-will-power-the-thai-the-government/>

31. W.Media (2020), "Funding approved for a \$146m state cloud and data center in Thailand." Available at: <https://w.media/funding-approved-state-cloud-data-center-thailand/>

32. OECD, E-procurement for good governance and development in Italy, North Africa, and the Middle East. Available at: <https://www.oecd.org/mena/governance/39856250.pdf>

33. Ghaffar, et al (2018), Additive manufacturing technology and its implementation in construction as an eco-innovative solution.

Available at: <https://www.sciencedirect.com/science/article/pii/S0926580517309731>

34. WRAP, Waste Reduction Potential of Offsite Volumetric. Available at: <https://www.howickltd.com/asset/327.pdf>

35. McKinsey & Company (2019), Modular construction: From projects to products.

Available at: <https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/modular-construction-from-projects-to-products>

36. Bangkok Post (2020), "Small contractors told to upgrade." Available at: <https://www.bangkokpost.com/business/1906485>

37. Bangkok Post (2018), "Thailand sets sights on spearheading IoT alliance."

Available at: <https://www.bangkokpost.com/tech/1419099/thailand-sets-sights-on-spearheading-iot-alliance>

38. Asia Property Awards (2019), "Hyper-connected homes elevate art of smart in Thailand and Singapore."

Available at: <https://www.asiapropertyawards.com/en/hyper-connected-homes-elevate-art-of-smart-in-thailand-and-singapore/>

39. Bangkok Post (2017), "The modern classroom." Available at: <https://www.bangkokpost.com/tech/1368835/the-modern-classroom>

40. People Matters (2020), "1.2 million job opportunities to be listed on new Thailand platform."

Available at: <https://www.peoplemattersglobal.com/news/recruitment/12-million-job-opportunities-to-be-listed-on-new-thailand-platform-27113>

41. Bangkok Post (2020), "New world of work." Available at: <https://www.bangkokpost.com/business/2000635/new-world-of-work>

1.2 THAILAND'S DIGITAL OPPORTUNITY IS DISTRIBUTED ACROSS ALL REGIONS

Of Thailand's total digital opportunity, about 40 percent (THB985.3 billion or USD31.5 billion) is likely to be concentrated in Greater Bangkok (i.e., Bangkok and vicinities, including Samut Prakan, Pathum Thani, Samut Sakhon, Nakhon Pathom and Nonthaburi) (Exhibit 4).⁴² This is despite the fact that the Greater Bangkok region makes up only 1.5 percent of the country's total land mass – suggesting a geographical digital divide.⁴³

This finding is not surprising, however, given regional disparities in digitization. This trend has similarly been reflected in other studies. For example, the National Institute of Development Administration in Thailand highlighted the digital divide between the Bangkok metropolitan region and the Northeastern region – the share of households with personal computers (PC) was 57.2 percent in Bangkok, but only 25.9 percent in the Northeastern region in 2018.⁴⁴ Part of this is driven by differences in regional access to digital infrastructure. While the country was ranked as having the fifth-fastest broadband speed in the world, people living in remote rural areas did not have access to electricity, let alone computers and the Internet.⁴⁵ The lack of digital infrastructure to provide Internet service can be attributed to two key reasons. First,

due to the mountainous terrain and low residential density, it is challenging and costly to provide broadband services in rural areas unlike more populous major metropolitan regions, such as Bangkok. Connecting broadband subscribers and the nearest access points in sparsely populated areas require longer communication lines, known as the “last mile” problem, and entail higher labor and construction costs. Given the higher construction costs and low population density in these villages, traditional Internet service models are unsustainable and commercially unviable for telecommunication companies.⁴⁶ Moreover, households in villages generally have lower purchasing power than those in major cities, which makes Internet access unaffordable. Second, people living further away from the cities have limited awareness of the positive impacts of technology on productivity and are not equipped with the requisite skills to take advantage of digital technologies. The World Bank identified wide gaps in access to digital learning resources between rural and urban schools, which became more pronounced during the period of school closures during the COVID-19 pandemic. While 70 percent of students in urban schools have a computer at home, only 45 percent in rural schools reported the same.⁴⁷

42. The 2030 projections made for the distribution of the country's digital opportunity across different regions assume that the level and mix of economic activities in each region remains constant from 2019 to 2030.

43. Knoema (2012), “Samut Sakhon Province”. Available at: <https://knoema.com/atlas/Thailand/Samut-Sakhon-Province>

44. National Institute of Development Administration (2018), Digital Thailand. Available at: <https://so04.tci-thaijo.org/index.php/NCRI/article/download/174278/124821/>

45. Sources include: The Straits Times (2020), “Coronavirus: Thailand to launch nationwide distance learning for students in high-risk areas”. Available at: <https://www.straitstimes.com/asia/se-asia/coronavirus-thailand-to-launch-nationwide-distance-learning-for-students-in-high-risk>; World Population Review (2021), “Internet speeds by country 2021.” Available at: <https://worldpopulationreview.com/country-rankings/internet-speeds-by-country>

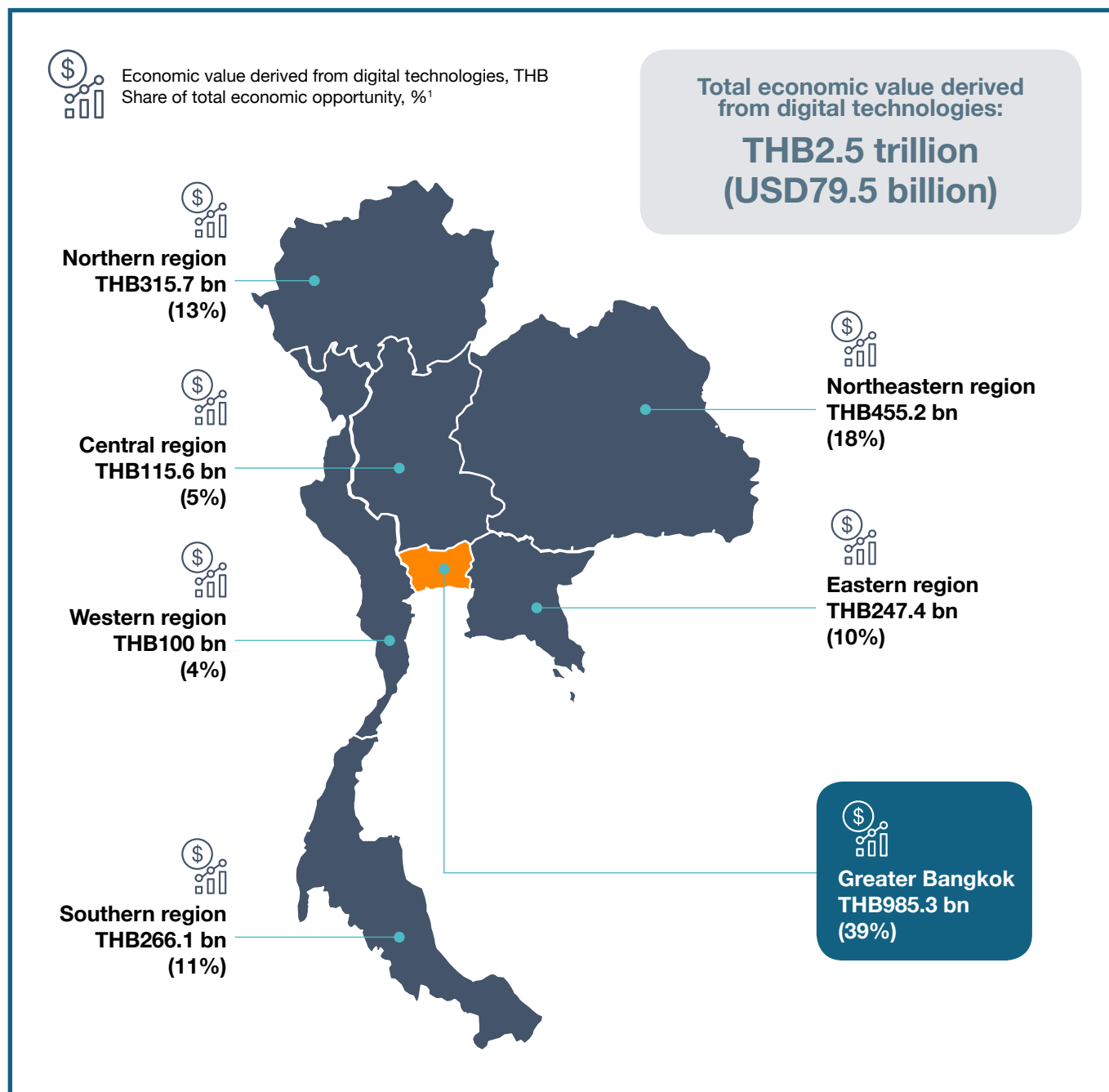
46. International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies (2019), Rural and remote broadband development in Thailand: Enabled by last-mile infrastructure and services. Available at: <https://tuengr.com/V10A/10A13E.pdf>

47. Programme for International Student Assessment (2018), Thailand Country Report.

Available at: <http://documents1.worldbank.org/curated/en/6833311593415205230/pdf/Thailand-Programme-for-International-Student-Assessment-PISA-2018-Country-Report.pdf>

EXHIBIT 4:

ABOUT 40 PERCENT OF THE COUNTRY'S PROJECTED DIGITAL OPPORTUNITY IN 2030 IS CONCENTRATED IN GREATER BANGKOK, REFLECTING A DIGITAL DIVIDE THAT IS IMPORTANT TO BRIDGE



1. Shares are computed using each region's share of GDP and number of businesses from the Office of the National Economic and Social Development Council and the National Statistics Office. See methodology for details.



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

COVID-19 has had a significant impact on Thailand's economy. Social distancing measures and border closures have significantly reduced economic activity in consumer-driven sectors such as tourism and retail trade. Meanwhile, manufacturing output has taken a downturn due to challenges such as shipment delays in raw materials and intermediate products. The GDP contribution from the manufacturing sector declined by 8.3 percent, while the accommodation and food service industries fell by 36.6 percent year-on-year in the fourth quarter of 2020.⁴⁸ The Bank of Thailand estimated that Thailand's economy could contract by 6.6 percent in 2020 while forecasting a slower rebound of 3.2 percent for 2021 (lower than the previous estimate of 5.0 percent).⁴⁹ According to the Asian Development Bank (ADB) COVID-19 Policy Database, measures worth at least USD84 billion have been announced by Thailand to combat the pandemic.⁵⁰ Some of these COVID-19 stimulus packages have

placed a strong focus on digital transformation to aid economic recovery. For example, businesses adopting digital technology in their operations, such as AI, big data analytics or machine learning programs, are eligible for a 50 percent corporate income tax exemption on profits for an additional three years.⁵¹

Technology adoption will be crucial for businesses and workers to manage the crisis's impacts. **Of Thailand's total digital opportunity of THB2.5 trillion (USD79.5 billion), a substantial 65 percent – THB1.6 trillion (USD51.7 billion) – could be driven by technologies that help businesses and workers mitigate the impacts of COVID-19** (Exhibit 5).

This THB1.6 trillion (USD51.7 billion) alludes to the combined value of all technology applications that allow businesses to navigate and even flourish during the pandemic and in the post-COVID future.

48. Office of National Economic and Social Development Council (2021), *Thai Economic Performance in Q4 and 2020 and the Outlook for 2021*.

Available at: https://www.nesdc.go.th/nesdb_en/article_attach/article_file_20210215120612.pdf

49. Thailand Board of Investment, "Economic overview." Available at https://www.boi.go.th/index.php?page=economic_overview

50. ADB COVID-19 Policy Database, <https://covid19policy.adb.org/> (accessed 27 January 2021).

51. ASEAN Briefing (2021), "Thailand Issues New COVID-19 Stimulus Package to Accelerate Investments".

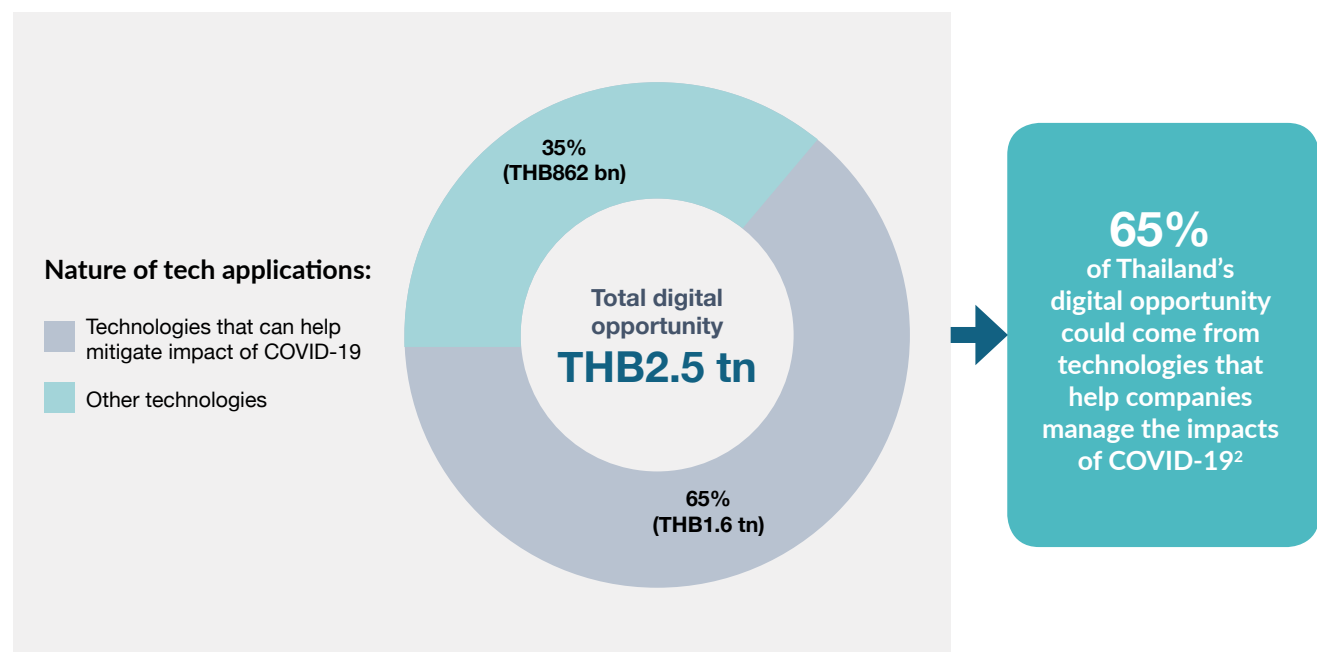
Available at: <https://www.aseanbriefing.com/news/thailand-issues-new-covid-19-stimulus-package-to-accelerate-investments/>



EXHIBIT 5:

OF THE TOTAL DIGITAL OPPORTUNITY, 65% (THB1.6 TRILLION OR USD51.7 BILLION) IS DRIVEN BY TECHNOLOGIES THAT CAN HELP MITIGATE THE IMPACTS OF COVID-19

% OF ECONOMIC VALUE DERIVED FROM DIGITAL TECHNOLOGIES,¹ BY NATURE OF TECHNOLOGY, 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.

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

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis

There are three channels in which such technology applications allow for this (Exhibit 6):

- **Enabling the continuity of business operations amid remote working arrangements.** With precautionary measures implemented at workplaces, the resultant reduction in on-site manpower has decreased operating capacity, while some businesses have switched to remote working arrangements indefinitely. A range of digital technologies allows for business continuity despite these circumstances, by facilitating virtual collaboration among co-workers, and enabling the remote control of physical operations from off-site locations. Examples of relevant technology applications include automation and AI customer service in hotels and remote patient monitoring. Combined, such technology applications are projected to deliver a total annual economic value of THB1,140 billion (USD36.5 billion) if fully adopted by 2030 (Exhibit 6). In the hospitality industry, AI-enabled customer check-ins do not only serve to address health concerns by minimizing human contact, but they can also help boost staff productivity and create greater service value overall. Remote check-ins are estimated to reduce the time taken to verify visitors' particulars by up to 70 percent.⁵² In Thailand, Avani Atrium Bangkok Hotel launched a digital concierge application, which allows guests to check in remotely through their smartphones enroute to the hotel, contact the customer service team via the "live chat" feature, browse menus and order in-room dining.⁵³ At the same time, by freeing their time up from mundane administrative tasks, hotel staff may focus on higher value-add tasks such as addressing more complex customer demands and personalizing customer service. Such applications can be similarly implemented in the health sector – Box 2 highlights an example of how robots were successfully leveraged in Thailand during the COVID-19 crisis.

- **Facilitating customer interactions, transactions and marketing through digital platforms.** Social distancing measures targeted at containing the COVID-19 outbreak have severely restricted customer interactions and transactions for businesses that heavily rely on physical interactions. As customers gravitate towards online marketplaces and services, technologies enable businesses to continue customer interactions and marketing activities online. Examples of relevant technology applications include digital e-commerce platforms in the retail industry, online food and beverage (F&B) delivery services in the hospitality industry, e-career centers and digital jobs platforms in the recruitment industry, and telehealth apps in the health sector. (see Box 3) Combined, such technology applications are projected to deliver a total annual economic value of THB243 billion (USD7.8 billion) if fully adopted by 2030 (Exhibit 6).



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

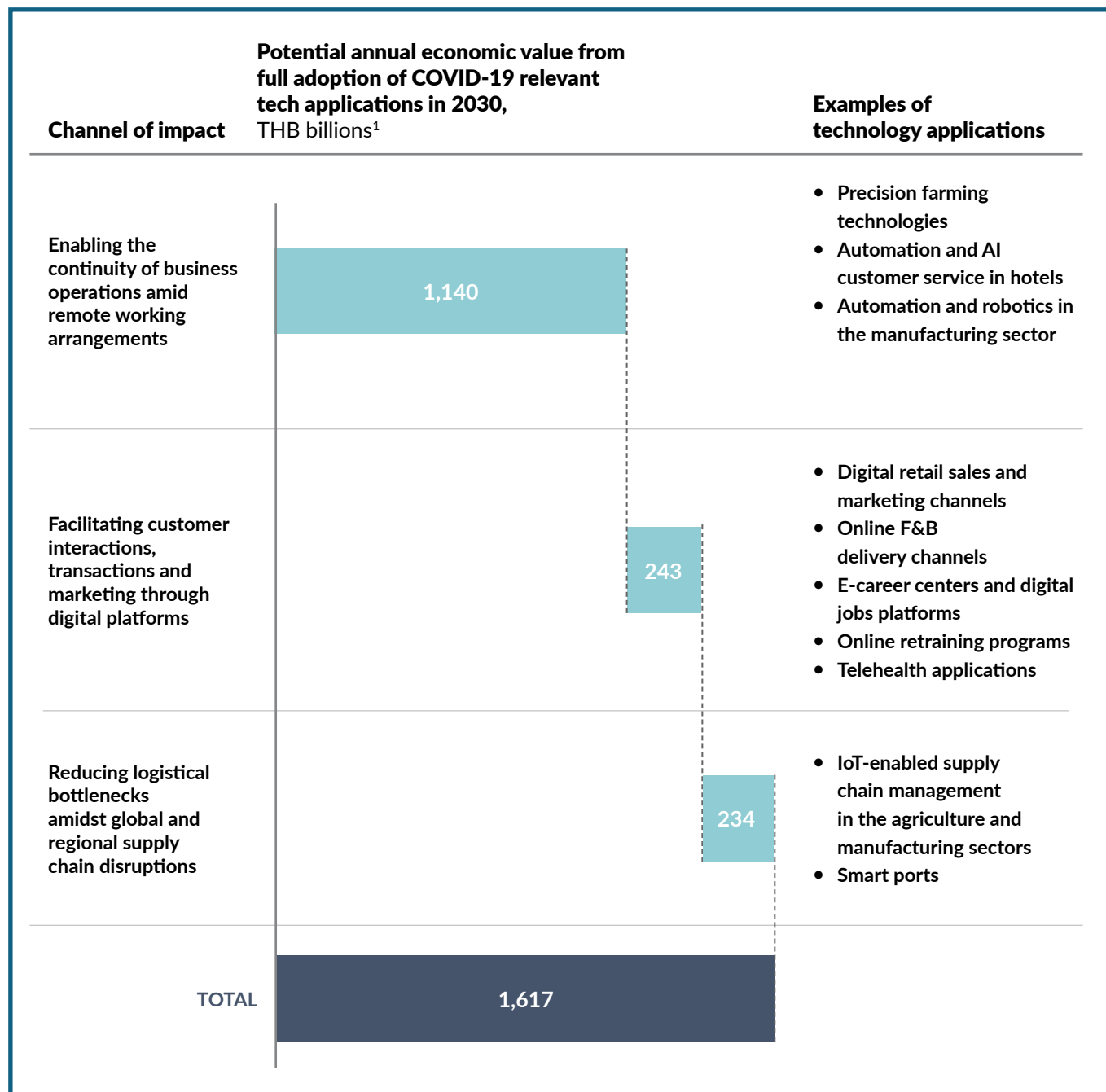
Available at: <https://www.straitstimes.com/singapore/speedier-check-in-process-for-hotels-possible-with-new-automated-facial-recognition-system>

53. Okkami (2020), "Powered by Okkami – Avani Atrium Bangkok Launches Digital Services and Technology".

Available at: <https://www.okkami.com/hospitality-industry-news/powered-by-okkami-avani-atrimum-bangkok-launches-digital-services-and-technology/>

EXHIBIT 6:

TECH APPLICATIONS THAT MITIGATE THE IMPACTS OF COVID-19 CAN GENERATE UP TO THB1.6 TRILLION (USD51.7 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

BOX 2.

HG ROBOTICS: CAPTURING NEW DIGITIZATION OPPORTUNITIES BY EXPANDING INTO NEW USE-CASES DURING THE COVID-19 PANDEMIC

HG Robotics is a local robotics company that provides drone technologies for agriculture, AI-driven security tools, and submarine pipeline inspection.⁵⁴ When the COVID-19 outbreak occurred, the company realized that hospital services could use a boost from robotic integration. HG Robotics partnered with Thai conglomerate Charoen Pokphand Group to design robotic solutions for patient care and improve communications between medical professionals and patients under quarantine.⁵⁵

By using robots in frontline healthcare services, HG Robotics helps medical professionals attend to patients remotely and reduce actual physical contact by up to 70 instances per day. Apart from reducing physical contact, the robots could also support other healthcare services and boost productivity. HG Robotics collaborated with Mi Workspace from Chulalongkorn University's engineering faculty and local engineering company, Obodroid, to develop robots that could deliver food, medical supplies, and send information about the patient's blood pressure, pulse, temperature directly to the doctor.⁵⁶ With its success in the health sector, the company is expanding its services rapidly across hospitals in the region. As of mid-2020, the company had managed to provide its robotic solutions to around 41 hospitals across Thailand, and plans to expand regionally to hospitals in Singapore, the Philippines, and Indonesia.



Photo Source: <https://www.techtalkthai.com/behind-the-scene-of-cu-robocovid-hgrobotics-obodroid/>

54. Bangkok Post (2020), "Robots to the rescue." Available at: <https://www.bangkokpost.com/business/1946496/robots-to-the-rescue>

55. World Economic Forum (2020), "How digitization and innovation can make the post-COVID world a better place."

Available at: <https://www.weforum.org/agenda/2020/08/how-digitization-and-innovation-can-make-the-post-covid-world-a-better-place/>

56. National Thailand (2020), "New robot from Chula to help in battle against Covid-19."

Available at: <https://www.nationthailand.com/edandtech/30385613>

BOX 3. THE IMPORTANCE OF DIGITAL TECHNOLOGIES TO FACILITATE CUSTOMER OR STAKEHOLDER INTERACTIONS DURING THE PANDEMIC

In the **retail** industry, e-commerce platforms serve as marketplaces between buyers and sellers which allow for cross-border exchange of goods and services. For example, Thaitrade.com, an e-commerce portal managed by the country's Department of International Trade Promotion, teamed up with a Singapore-based business-to-business wholesale food platform, OctoRocket, to help selected small businesses in Thailand's food manufacturing and wholesale trade industry export their products.⁵⁷

In the **hospitality** industry, hotels in Thailand such as Centara Hotels & Resorts, Dusit International, and Chatrium Hotels & Residences, which closed temporarily due to the pandemic, created an additional sales channel by listing their food items on popular food delivery platforms, including LineMan, GrabFood, and Foodpanda.⁵⁸



In the **recruitment** industry, online job-matching platforms have been instrumental in addressing unemployment by rapidly matching newly unemployed workers with urgent job openings which would otherwise have flown under the radar. According to McKinsey Global Institute, e-career centers and job-matching platforms could increase employment rates by 1.3 percent in Thailand.⁵⁹ This is particularly important given that the COVID-19 induced global economic slowdown has led to both lay-offs and temporary reductions in working hours, which the International Labour Organization estimated to be equivalent to a loss of 2.2 million full-time jobs.⁶⁰ Over a longer horizon, online retraining programs could also help displaced workers upgrade their skills and regain employment thus contributing to long-term labor productivity.⁶¹

57. Business Times (2020), "New online channel for Thailand's food wholesalers to access region."

Available at: <https://www.businesstimes.com.sg/asean-business/new-online-channel-for-thailands-food-wholesalers-to-access-region>

58. JLL (2020), "Innovative strategies by Thailand's hotel owners to minimize business impact from Covid-19."

Available at: <https://www.jll.co.th/en/views/innovative-strategies-by-thailand-hotel-owners>

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

Available at: <https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/Connecting%20talent%20with%20opportunity%20in%20the%20digital%20age/MGI%20Online%20talent%20A%20labor%20market%20that%20works%20Full%20report%20June%202015.ashx>

60. International Labour Organization (2020), COVID-19 employment and labour market impact in Thailand.

Available at: https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/briefingnote/wcms_747944.pdf

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

Available at: <https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/Connecting%20talent%20with%20opportunity%20in%20the%20digital%20age/MGI%20Online%20talent%20A%20labor%20market%20that%20works%20Full%20report%20June%202015.ashx>



- Reducing logistical bottlenecks amidst global and regional supply chain disruptions induced by the pandemic.** Businesses have had to cope with supply chain disruptions 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. Combined, such technology applications are projected to deliver a total annual economic value of THB234 billion (USD7.5 billion) if fully

adopted by 2030 (Exhibit 6). Embedded in distribution networks, sensor data-driven operations analytics from IoT devices such as the remote reporting of goods' locations allow businesses to optimize transportation and improve their distribution management. The adoption of IoT in manufacturing supply chains could reduce distribution and supply chain operating costs by two to five percent.⁶² IoT also has applications in “smart ports”, where sensor devices can be attached to specific storage containers or to raw materials or products themselves to allow for similar tracking. For example, the Hutchison Ports Thailand, the nation’s largest container terminal operator, introduced autonomous “Qomolo” trucks equipped with online e-tracking services, blockchain and remote-controlled

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



crane-technology to transfer containers between the quay and yard.⁶³

International travel came to a halt as border closures were implemented to tackle the COVID-19 outbreak, which has severely affected the country's tourism industry. As a key driver of Thailand's economy, the travel and tourism sector accounted for nearly 20 percent of its GDP in 2019.⁶⁴ Although the country has been able to contain the community spread of the COVID-19 virus, as long as the borders remain closed, the Tourism Authority of Thailand predicted that the country's tourism revenue will only recover to two-thirds that of pre-pandemic levels in 2022.⁶⁵ The government has already implemented policies to support the sector. In 2020, the Tourism Authority of Thailand launched the

"We Travel Together" program to stimulate domestic tourism by offering subsidies of up to 40 percent for hotel room bookings and air tickets.⁶⁶ As a result, the average occupancy rates in hotels increased from two percent in April 2020 to 34 percent in October 2020.⁶⁷ Moving forward, the government and businesses could leverage the current downtime during the pandemic to accelerate digital transformation in the tourism industry. Digital technologies, such as facial recognition and biometric data, could also support the safe reopening of domestic tourism by minimizing human contact. Box 4 highlights how digital technologies could enhance the country's existing tourism offerings and broaden the reach and appeal of Thailand to domestic and foreign travelers, while facilitating the recovery of the tourism industry when travel resumes.

63. Seatrade Maritime News (2020), "Hutchison Ports Thailand introduces autonomous truck technology".

Available at: <https://www.seatrade-maritime.com/ports-logistics/hutchison-ports-thailand-introduces-autonomous-truck-technology>

64. World Travel & Tourism Council (2019), Thailand 2020 annual research: Key highlights. Available at: <https://wtcc.org/Research/Economic-Impact>

65. Pattaya Mail (2020), "Thailand tourism ends 2020 down 74%; no revival seen until 2022".

Available at: <https://www.pattayamail.com/travel/thailand-tourism-ends-2020-down-74-no-revival-seen-until-2022-338692>

66. The Straits Times (2020), "Thailand halts domestic travel subsidy amid corruption probe".

Available at: <https://www.straitstimes.com/asia/se-asia/thailand-halts-domestic-travel-subsidy-amid-corruption-probe>

67. Sources include: Bank of Thailand (2021), "Tourism indicators". Available at: https://www.bot.or.th/App/BTWS_STAT/statistics/ReportPage.aspx?reportID=875&language=eng

The Straits Times (2020), "Thailand halts domestic travel subsidy amid corruption probe". Available at: <https://www.straitstimes.com/asia/se-asia/thailand-halts-domestic-travel-subsidy-amid-corruption-probe>

BOX 4.

LEVERAGE THE COVID-19 INDUCED DOWNTIME TO ACCELERATE DIGITAL TRANSFORMATION IN THE TOURISM INDUSTRY

Emerging technologies, such as blockchain technology and big data, have enabled tourism operators to gain valuable insights into the customer journey and create a seamless and improved customer experience. Meanwhile, other digital technologies, such as virtual reality, have shed new light on alternatives to traditional tourism offerings. They are likely to become more instrumental to sustaining a steady stream of engagement between tourism operators and home-bound travelers during the pandemic, which could be monetized when travel resumes.

- **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 the personalization of services, security, data analysis, and payments without any human contact point which reduces the risk of the spread of bacteria. 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.⁶⁸
- **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, 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 the responsibility for storing it is shared across the whole network.⁶⁹
- **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.⁷⁰
- **AI and mobile technology.** Shopping for travel accommodation 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 involving multiple devices.⁷¹ AI technologies overlaid with the 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.

68. Revfine (2018), 4 Ways Facial Recognition Can Be Used in the Travel Industry. Available at: <https://www.revfine.com/facial-recognition-travel-industry/>

69. Revfine (2018), How Blockchain Technology is Transforming the Travel Industry. Available at: <https://www.revfine.com/blockchain-technology-travel-industry/>

70. Revfine (2018), How Artificial Intelligence is Changing the Travel Industry. Available at: <https://www.revfine.com/artificial-intelligence-travel-industry/>

71. 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>



- **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 jobs such as waiting on tables, cleaning, and garbage disposal.⁷² Hilton Hotels, for example, has deployed an interactive AI robot named Connie, which uses AI and speech recognition to provide customers with tourist information. The robot gathers data through human interaction, helping to improve the quality of communications as well.⁷³
- **Virtual reality.** Virtual reality allows for sensory experiences that are typically physical in nature to be engaged virtually. This could be used by tourism operators to share experiences and better market to end-consumers. In some

countries such as Thailand and New Zealand, virtual reality technology has been deployed in museums to allow “visitors” to “handle” historical artifacts virtually. For instance, in New Zealand, the Google Cultural Institute partnered with local museums such as the Auckland War Memorial Museum to digitize over 2,000 various artifacts and artworks, featuring them as online exhibits. Each exhibit is tagged to a captivating story about the history of Aotearoa and its people.⁷⁴ In Thailand, Google collaborated with the Art Center in Silpakorn University to create an online exhibition on Google Arts and Culture (see Chapter 3.2). Through immersive virtual reality experiences, tourism operators can continue to engage and pique the interest of “travelers” from the confines of their homes, and keep these destinations top of mind to inspire future travel when borders reopen.

72. 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

73. Hilton (2016), “Hilton and IBM pilot ‘Connie’, the world’s first Watson-enabled hotel concierge”.

Available at: <https://www.wimimy.ai/blog/hilton-and-ibm-pilot-connie-the-worlds-first-watson-enabled-hotel-concierge-robot/>

74. Google Arts & Culture (2020), “Auckland War Memorial Museum Tāmaki Paenga Hira.”

Available at: <https://artsandculture.google.com/partner/auckland-war-memorial-museum>



CAPTURING THE PRIZE — THREE PILLARS OF ACTION

To fully capture the digital opportunity, three pillars of action will be required in Thailand: 1) lower barriers to digital adoption by businesses; 2) enhance digital skills training and education; and 3) develop a conducive environment for digital trade.

The Thai Government has placed a significant emphasis on advancing digital transformation across all three pillars in the country. To lower barriers to digital adoption by businesses, the government has created a favorable policy environment with tax incentives for growth industries and partnered with the private sector and academics to support digitization across sectors. To address the geographical digital divide, the government also launched the “Net Pracharat” program to expand Thailand’s national broadband network coverage to over 74,000 villages. To enhance digital skills training and education, the Department of Skill Development and Digital Economy Promotion Agency have collaborated with the private sector to develop online digital skills training programs, such as “Digital Skill” which offers online data science, IoT and cybersecurity courses for working professionals. Thailand has also nurtured the future workforce in developing digital competencies through online computer science and programming lessons. To continue developing a conducive environment for digital trade, Thailand participated in regional digital trade platforms, such as the “ASEAN Single Window”, and launched the “National Digital Trade Platform” to streamline administrative procedures and promote cross-border data flows.



“CAPTURING THE PRIZE”

THREE PILLARS OF ACTION



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

1

Lower barriers to digital adoption by businesses



2

Enhance digital skills training and education



3

Develop a conducive environment for digital trade



The country has placed significant emphasis in advancing the following areas

- Providing tax incentives to promote growth of new industries
- Partnering with industry to support businesses in digital adoption
- Investing in digital infrastructure for deployment of tech applications
- Addressing shortages in digital talent through partnerships with industry
- Developing digital skills training programs
- Introducing computer science and programming to youths
- Establishing digital platforms to streamline administrative procedures
- Aligning with international standards on cross-border data transfer

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

- Provide resources for SMEs to leverage for digital transformation
- Promote the adoption of emerging technologies
- Ensure responsiveness of tertiary curriculums to emerging skill needs
- Incentivize employees to seek digital upskilling opportunities
- Provide capacity-building support for businesses
- Promote Thai exports via digital platforms
- Participate in multilateral digital trade agreements to promote digital trade

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 provide financial and advisory support for SMEs lacking the digital expertise to accelerate their digital transformation journey. There is also scope for the Thai Government to improve the responsiveness of tertiary curriculums to meet the emerging skill needs through industry-institution collaboration and incentivize employees to seek digital upskilling opportunities. To encourage more local businesses to participate in digital trade and nurture “global-ready” businesses, the government can consider providing more holistic capacity-building support such as offering detailed guidance for businesses to expand globally. There is room for Thailand to deepen its digital economy collaborations with like-minded countries, beyond the ASEAN initiatives, by participating in international digital trade agreements such as the “Digital Economy Partnership Agreement”.

2.1 PILLAR 1: LOW BARRIERS TO DIGITAL ADOPTION BY BUSINESSES

For Thailand to fully capture the economic opportunities afforded by digital technologies, there needs to be strong policy support to lower the barriers to digital adoption for businesses. While companies in Thailand are gradually embracing digital transformation, they still lag their international peers in terms of digital adoption. A study comparing the adoption rate of businesses across countries found that only 33 percent of the respondents in Thailand are gradually embracing digital transformation and planning to invest for the future as compared to the global average of 59 percent.⁷⁵ To encourage and accelerate digital adoption in the country:

- **Providing tax incentives to promote the growth of new industries.** Recognizing digital technology as the country’s next engine of growth, Thailand developed the “Thailand 4.0” economic model and aims to transform itself into the region’s innovation and knowledge-based digital hub. To achieve

“Thailand 4.0”, the government has stepped up efforts to promote 12 new growth industries, referred to as the “S-Curve” industries.⁷⁶ Of the 12, five have been termed as “New S-Curve” industries (referring to emerging industries that could experience significant growth under the right conditions). These comprise: 1) biofuels and biochemicals; 2) digital economy; 3) medical hubs; 4) automation and robotics; and 5) aviation and logistics.⁷⁷ The government provided various tax incentives, including 13 years of tax breaks for research and development (R&D) projects and the adoption of technologies such as biotechnology, nanotechnology, advanced material technology and digital technology, and a 50 percent reduction in corporate income tax for 10 years.⁷⁸ In addition, the Thailand Board of Investment introduced tax and non-tax incentives for projects related to the enhancement of digital technologies,

75. Deloitte (2020), *The Thailand Digital Transformation Survey Report 2020*.

Available at: <https://www2.deloitte.com/content/dam/Deloitte/th/Documents/technology/th-tech-the-thailand-digital-transformation-report.pdf>

76. The 12 targeted S-curve industries are cars; smart electronics; affluent, medical and wellness tourism; agriculture and biotechnology; food; robotics for industry; logistics and aviation; biofuels and biochemicals; digital; medical services; defense; and education development. “S-Curve” describes the process that companies go through as they enter the marketplace and begin to undergo cycles of growth until they reach “critical mass” where a product becomes mainstream and widely adopted. The “S-Curve” industries have been identified to support this process. They are categorized into two groups: “First S-Curve” and “New S-Curve” industries. The “First S-Curve” industries are meant to enhance the competitiveness of the country by leveraging its current strengths in technology innovation, whereas the “New S-Curve” refer to five additional industries developed to accelerate the growth of the country’s new industrial base.

77. Thai Embassy (2021), “Agenda 2: Development of Technology Cluster and Future Industries”.

Available at: <https://thaiembdc.org/agenda-2-development-of-technology-cluster-and-future-industries/>

78. Thailand Board of Investment (2015), *Thailand 4.0 – a new value-based economy*.

Available at: https://www.boi.go.th/upload/content/Thailand,%20Taking%20off%20to%20new%20heights%20@%20belgium_5ab4f8113a385.pdf

software development, digital services and digital infrastructure.⁷⁹ These projects are exempted from paying corporate income tax for up to eight years and smart visa policies have been introduced to attract high-skilled foreign talent and experts in science and technology.

- **Partnering with industry to support businesses in adopting digital tools.**

The Thai Government engages in regular partnerships with the private sector and academics to support businesses in the traditional sectors, such as health and agriculture, in adopting digital tools. For instance, to support technology transfer from research institutes to smallholder farmers (who often experience challenges in technology implementation), the National Science and Technology Department Agency (NSTDA) partnered with the National Electronics and Computer Technology Center (NECTEC) and the tech company, IBM, to launch a smart farming project, “Mitr Phol Modern Farm”.⁸⁰ Mitr Phol, a local sugarcane producer, implemented precision agriculture technologies, including a forecasting model which generates insights up to two weeks in advance such that farmers will be able to proactively plan irrigation, fertilizer application and pesticide spray to tackle potential future threats.⁸¹

- **Investing in digital infrastructure for the deployment of technology applications.**

To address the geographical digital divide, the government launched the “Net Pracharat” (“Village Broadband internet”) program to expand Thailand’s national broadband network coverage to remote areas. Under the “Net Pracharat” program, the Ministry of Digital Economy and Society (MDES) collaborated with the National Broadcasting

Telecommunications Commissions (NBTC) fiber cable network and free public Wi-Fi hotspots were installed in over 74,000 villages.⁸² As of May 2019, 1,671 schools and hospitals were connected to the “Net Pracharat” network and over six million users were connected to the “Net Pracharat” Wi-Fi network.⁸³ MDES also provided training to 1,033 officers who in turn helped raise awareness on the “Net Pracharat” program in their own communities, and trained villagers on Internet fundamentals and how to start an online business. In Baan Nong Klong village, the community launched a tourism campaign on social media by leveraging the high-speed Internet service implemented during the “Net Pracharat” program.⁸⁴ As a result, villagers had the opportunity to sell agricultural goods and products online through their community Facebook page. Thailand also established a digital innovation precinct, “Digital Park Thailand”, in the Eastern Economic Corridor (EEC) to stimulate the country’s digital transformation by attracting global digital players, investors, innovators, start-ups and manufacturers. The park is well-equipped with ultra-high-speed broadband infrastructure, including an international submarine cable station, satellite earth station, and data management center to support the deployment of advanced technologies.⁸⁵

While there are policies to facilitate digital adoption by businesses in Thailand, the top challenges faced by local businesses in embracing digital transformation are the lack of internal and external expertise in implementing technologies as well as a conducive corporate culture that embraces experimentation and promotes coordination across the organization.⁸⁶ The country could go further in the following areas to address these challenges:

79. OpenGov Asia (2019), “Thailand pushing smart agriculture.” Available at: <https://opengovasia.com/thailand-pushing-smart-agriculture/>

80. Huawei (2017), “Insights on digitalization of Thailand industry”.

Available at: <https://www-file.huawei.com/-/media/corporate/pdf/market-trends/thailand-digitalization-whitepaper-en-new.pdf?la=en>

81. Nation Thailand (2019), “Partners aim for SWEET rewards”. Available at: https://www.nationthailand.com/Startup_and_IT/30365479

82. United Nations Economic and Social Commission for Asia and the Pacific (2019), Village Broadband Internet Project (Net Pracharat).

Available at: <https://www.unescap.org/sites/default/files/Village%20Broadband%20Internet%20Project%20%28Net%20Pracharat%29%2C%20MDES%20Thailand.pdf>

83. United Nations Economic and Social Commission for Asia and the Pacific (2019), Village Broadband Internet Project (Net Pracharat).

Available at: <https://www.unescap.org/sites/default/files/Village%20Broadband%20Internet%20Project%20%28Net%20Pracharat%29%2C%20MDES%20Thailand.pdf>

84. Net Pracharat (2019), APT Report on Best Practice of Connectivity. Available at: https://netpracharat.com/Documents/20190805_APT_Netpracharat_V12_Final.pdf

85. Thailand Investment Review (2020), Digital Park Thailand. Available at: <https://www.boj.go.th/upload/content/TIRMarch.pdf>

86. Deloitte (2020), The Thailand Digital Transformation Survey Report 2020.

Available at: <https://www2.deloitte.com/content/dam/Deloitte/th/Documents/technology/th-tech-the-thailand-digital-transformation-report.pdf>

- Provide resources for SMEs to leverage for digital transformation.** Unlike large companies with larger budgets and better access to talent, SMEs tend to have lean resources and are more likely to lag in their digital transformation journeys.⁸⁷ Before the COVID-19 pandemic, SMEs in Thailand cited challenges in obtaining financing due to the lack of collateral and lengthy approval process.⁸⁸ These concerns have become more prevalent during the COVID-19 pandemic, a survey conducted in May 2020 reflected that 85 percent of SMEs in Thailand rated funding support for the adoption of digital technology as the most preferred government initiative.⁸⁹ Thus, SMEs could benefit from receiving support to invest in digital talent and seek the appropriate partnerships, technologies, and expertise that can help address their concerns amid tightening resource constraints. Box 5 illustrates how Singapore supports SMEs by deepening their digital capabilities and connecting them to potential technology partners.
- Promote the adoption of emerging technologies like AI.** Thailand could consider tech-centric strategies to promote the adoption of emerging technologies in the country. While a vast majority of professionals in Thailand recognize the potential of AI in driving the company's next phase of growth, only 26 percent of organizations have developed and fully implemented comprehensive plans to implement AI in their business.⁹⁰ Although the Thai Government promotes the use of AI technology, there is no clear strategy at the national level. The country currently relies on third party tools, such as chatbots, marketing and dialogue systems, but lacks the technical capabilities and talent to apply AI in agriculture, manufacturing and various industries.⁹¹ According to the President of Thailand Tech Startup Association, there is an urgent need for a consolidated national AI strategy. South Korea offers a positive example of how a national AI strategy could be developed and implemented. In December 2019, South Korea launched the "National Strategy for Artificial Intelligence" to harness AI's economic potential and improve citizens' quality of life. The strategy comprises 100 government-wide action tasks under nine strategies in three areas.⁹² These areas are: AI ecosystem (e.g., strengthening data infrastructure), AI utilization (e.g., promote AI adoption across all industries), and people-centered AI (e.g., measures to ensure job security with technological change).⁹³ Beyond the country-wide implementation plan, significant policy focus has also been placed on technology adoption in traditional sectors. In South Korea, the Ministry of Agriculture, Food and Rural Affairs' "Smart Farm Innovation Valley" initiative, for example, sets up job training centers, "smart farms" and testing centers to develop and test farming technologies.⁹⁴



87. Ernst and Young (2019), *Redesigning for the digital economy*.

Available at: https://assets.ey.com/content/dam/ey-sites/ey-com/en_sg/topics/growth/ey-smes-in-southeast-asia-redesigning-for-the-digital-economy.pdf?download

88. Bangkok Post (2021), "Funding Societies, SEA's leading digital financing platform, launches in Thailand to support SMEs".

Available at: <https://www.bangkokpost.com/thailand/pr/2068583/funding-societies-seas-leading-digital-financing-platform-launches-in-thailand-to-support-smes>

89. Accenture (2020), *Are you ready to turn today's challenges into opportunities?*

Available at: https://financialservicesblog.accenture.com/wp-content/uploads/2020/09/ASEAN_SME_Transformation_Study_2020.pdf

90. Microsoft (2019), "Microsoft and IDC study underline creativity as most in-demand skill for Thailand's AI-powered future".

Available at: https://news.microsoft.com/th-th/2019/04/04/idc_skillsai_en/

91. Bangkok Post (2019), "Powering up on AI". Available at: <https://www.bangkokpost.com/thailand/special-reports/1614790/powering-up-on-ai>

92. Ministry of Science and ICT, South Korea. *National Strategy for Artificial Intelligence*.

Available at: <https://english.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=10&mPid=9&pageIndex=&bbsSeqNo=46&nntSeqNo=9&searchOpt=ALL&searchTxt=>

93. Ministry of Science and ICT, South Korea. *National Strategy for Artificial Intelligence*.

Available at: <https://english.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=10&mPid=9&pageIndex=&bbsSeqNo=46&nntSeqNo=9&searchOpt=ALL&searchTxt=>

94. Horti Daily (2019), "South Korea to get second Smart Farm Innovation Valley".

Available at: <https://www.hortidaily.com/article/9090841/south-korea-to-get-second-smart-farm-innovation-valley/>

BOX 5.

SMES IN SINGAPORE RECEIVE FINANCIAL AND ADVISORY SUPPORT FOR DIGITAL TRANSFORMATION

To support businesses, particularly SMEs, in shifting online during the pandemic and deepen their digital capabilities, the Singapore government has set aside SGD1 billion (USD745 million) to fund a series of digital transformation schemes.

FUNDING THE COST OF ACQUIRING DIGITAL TALENT

Jointly developed by the Infocomm Media Development Authority (IMDA) and Enterprise Singapore (ESG), the “Digital Leaders Program” supports firms in hiring a core digital team and developing digital capabilities to capture new growth opportunities.⁹⁵ Through the program, companies receive funding support to hire a Chief Technology Officer who will oversee a team of up to five digital talents to help execute digital initiatives for the organization. Companies will also be linked up with ecosystem partners, such as system integrators, technology companies, strategy consultants, and talent search firms to facilitate the recruitment of the digital team, development of digital roadmaps, as well as to support the company’s innovation plans.

PROVIDING ACCESS TO DIGITALIZATION RESOURCES AND ADVISORY

One of the largest hurdles SMEs face in their digital transformation journey is access to talent and skills.⁹⁶ To overcome this hurdle, the “Chief Technology Officer-as-a-Service” (CTOaaS) scheme aims to provide SMEs access to relevant digitalization resources and advisory for free, or at an affordable cost.⁹⁷ Through the scheme, existing digitalization advisory services are consolidated onto a web application that provides a single touchpoint for both digital consultancy and project management services.⁹⁸ This enables SMEs, including home-based sole proprietorships, to tap on professional information technology consultancies and receive end-to-end digital advice to transform their business operations.

FUNDING THE COST OF ADOPTION OF DIGITAL TECHNOLOGIES BY BUSINESSES

The “Emerging Technology Program” incentivizes both SMEs and larger local companies in commercializing their innovations and diffusing technologies.⁹⁹ Through this program, the government will co-fund the costs of trials and adoption of frontier technologies like 5G, AI and blockchain technologies.

95. Infocomm Media Development Authority (2021), “Digital Leaders Programme”. Available at: https://www.imda.gov.sg/programme-listing/Digital-Leaders-Programme?utm_medium=qr&utm_source=infographic&utm_campaign=cos-2021&utm_content=dlp

96. Deloitte (2020), The Thailand Digital Transformation Survey Report 2020. Available at: <https://www2.deloitte.com/content/dam/Deloitte/th/Documents/technology/th-tech-the-thailand-digital-transformation-report.pdf>

97. The New Paper (2021), “New CTO-as-a-Service scheme to help SMEs tap tech expertise”. Available at: <https://www.tnp.sg/news/singapore/new-cto-service-scheme-help-smes-tap-tech-expertise>

98. The Straits Times (2021), “Budget debate: Chief technology officers for hire among Govt’s plans to help businesses digitalise”.

Available at: <https://www.straitstimes.com/singapore/politics/chief-technology-officers-for-hire-among-govts-plans-to-help-businesses>

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

Available at: <https://www.mof.gov.sg/docs/librariesprovider3/budget2021/download/pdf/annexc-1.pdf>

2.2 PILLAR 2: ENHANCE DIGITAL SKILLS TRAINING AND EDUCATION

It is critical to ensure that workers in Thailand are able to use digital technologies to access job opportunities, run businesses and enhance productivity in their work. At the same time, the seeds for a future generation of adaptable and digitally skilled workforce must be planted early to ensure a healthy digital talent pipeline.

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

- Addressing shortages in digital talent through partnerships with industry.** The Department of Skill Development under the Ministry of Labor partnered with the private sector to launch the “Digital Skill Development Academy” (DISDA), a learning institution that provides digital skills training programs and courses for those who are seeking a career in the digital economy.¹⁰⁰ One of the public-private collaborations is with tech company, Huawei, to train and certify 120 ICT instructors and 3,000 participants in topics such as 5G networks over three years.¹⁰¹
- Developing digital skills training programs to upskill the current workforce.** To address the country’s demand for 40,000 digital manpower annually, Thailand’s Digital Economy Promotion Agency (DEPA) has turned to YouTube to equip citizens with digital skills.¹⁰² Its “Thai Skill” channel shares tips for small local businesses, including how to sell products on international e-commerce sites and calculate taxes online. To date, the channel has accumulated over a million views. DEPA has also created an online platform, “Digital Skill”, with local universities and tech companies to offer more than 100 courses on data science, IoT, and cybersecurity. Similarly, the Department of Skill Development launched a mobile app featuring training courses, labor skills standards, e-certificates or diplomas, and information on the “Skills Development Promotion Act”.¹⁰³ With both “Digital Skill” and “Thai Skill” linked to the country’s job matching portal, “JobD2U”, which posts job openings for both digital and non-digital roles, users are able to upskill themselves through these platforms before applying for jobs.
- Introducing computer science and programming to youths.** DEPA partnered with Code.org, a United States-based non-profit organization that delivers computer science lessons in schools, to create a website, Coding Thailand, that teaches children basic coding skills at no cost.¹⁰⁴ DEPA aims to train over 10 million youths in Thailand between 2018 and 2021, and has conducted training for 5,000 schools in its initial phase.¹⁰⁵ The curriculum and resources are also made freely available for teachers and students to use in their online coding education, aligning with the government’s vision to make learning accessible for anyone, anywhere, at any time.¹⁰⁶

100. Bangkok Post (2021), “MOL Launches DISDA to Enhance Digital Workforce”.

Available at: <https://www.bangkokpost.com/thailand/pr/2072555/mol-launches-disda-to-enhance-digital-workforce>

101. Ministry of Labour (2020), “MOL Partners with Huawei to Promote Digital Workforce to Drive Thailand 4.0”.

Available at: <https://www.mol.go.th/en/news/mol-partners-with-huawei-to-promote-digital-workforce-to-drive-thailand-4-0/>

102. GovInsider (2021), “How Thailand is using YouTube to reskill its workforce”.

Available at: <https://govinsider.asia/smart-gov/jakkaniit-kananurak-depa-how-thailand-is-using-youtube-to-reskill-its-workforce/>

103. Bangkok Post (2021), “MOL Launches DISDA to Enhance Digital Workforce”.

Available at: <https://www.bangkokpost.com/thailand/pr/2072555/mol-launches-disda-to-enhance-digital-workforce>

104. GovInsider (2021), “How Thailand is using YouTube to reskill its workforce”.

Available at: <https://govinsider.asia/smart-gov/jakkaniit-kananurak-depa-how-thailand-is-using-youtube-to-reskill-its-workforce/>

105. Sources include: Royal Thai Embassy in Washington D.C. (2018), “Coding kids key to Thailand’s digital future.” Available at: <https://thaiembdc.org/2018/07/02/coding-kids/>

Open Gov (2018), “Coding Thailand to advocate digital technology and computer science among Thai youth.”

Available at: <https://opengovasia.com/coding-thailand-to-advocate-digital-technology-and-computer-science-among-thai-youth/>

106. Digital Economy Promotion Agency (2020), “Coding Thailand: Skills and Knowledge for the future.”

Available at: <https://www.depa.or.th/en/digitalservice/digital-manpower-fund/studying-code-outside-the-classroom>

However, there remain several workforce and skills-related challenges in the country. The World Economic Forum’s “Future of Jobs Report 2020” showed that only about 55 percent of workers in Thailand were literate in the required digital skills for work in the future, including computer skills, basic coding and digital reading.¹⁰⁷ The lack of digital talent in big data, analytics and AI could hinder the country from taking full advantage of the opportunities presented by the digital economy.¹⁰⁸ Additionally, another study found that the education curriculum in public and private tertiary institutions did not reflect the progressive needs of the industry.¹⁰⁹ The country can therefore go further in bridging the digital skills gap and enhancing the digital capabilities of the working population:

- **Ensure responsiveness of tertiary curriculums to emerging skill needs through industry-institution collaboration.** Incorporating digital skill needs into tertiary curriculums is an important approach to ensuring students are equipped with digital skillsets required in future jobs. To ensure that students develop work-ready skills and qualifications that meet the needs of industry, Australia’s national vocational and educational training (VET) curriculums are developed in close consultation with industry. VET training content in the country is developed through a comprehensive framework of industry consultations involving Industry Reference Committees (IRCs), which comprise a range of government-appointed industry leaders from various sectors that come together to provide input on VET packages.¹¹⁰ IRCs are in turn supported by a range of Skills Services Organizations – independent professional service organizations that support IRCs in developing and reviewing training packages. As part of this framework, both small and large technology companies are consulted on VET packages in relation to digital skills.

- **Incentivize employees to seek digital upskilling opportunities.** To address the shortage of digital talent in the existing workforce, it is critical for Thailand to develop a set of support programs offering incentives for both firms and individuals to invest in digital upskilling. Singapore’s “SkillsFuture” initiative provides an international best practice in this regard. The scheme is aimed at providing Singaporeans with the opportunities to develop the right competencies to thrive in a knowledge-based economy.¹¹¹ Under this scheme, Singaporeans are given up to SGD1,500 (USD1,095) in credits to enroll in courses to reskill and upskill themselves. This has helped stimulate increased personal investment by workers in their training, as they tend to be motivated to continue with their selected courses even after the credit limit has been reached. These courses cover various competences, including data literacy, cloud computing, and digital problem-solving. Over a two-year period between 2016 and 2018, more than 285,000 Singaporeans had utilized their “SkillsFuture” Credit.¹¹² In 2019 alone, nearly 500,000 individuals benefited from the initiative’s online and offline courses.¹¹³



107. World Economic Forum (2020), *The Future of Jobs Report 2020*. Available at: http://www3.weforum.org/docs/WFF_Future_of_Jobs_2020.pdf

108. Nation Thailand (2018), “Experts worried about lack of Thai digital skills”. Available at: <https://www.nationthailand.com/national/30343718>

109. Nation Thailand (2016), “Big shortage of qualified technical and skilled workers”. Available at: <https://www.nationthailand.com/national/30299195>

110. Australian Industry and Skills Committee (2020). Available at: <https://www.aisc.net.au/about-aisc>

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

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

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

113. SkillsFuture (2020), “500,000 Individuals and 14,000 Enterprises Benefitted From SkillsFuture Programmes in 2019”

Available at: <https://www.ssg-wsg.gov.sg/news-and-announcements/500-000-individuals-and-14-000-enterprises-benefitted-from-skill.html>

2.3 DEVELOP A CONDUCTIVE ENVIRONMENT FOR DIGITAL TRADE

Finally, for businesses in Thailand to fully harness the economic opportunities afforded by digital technologies, it is important that businesses and organizations are able to maximize the use of digital platforms to export their products and services globally.

Thailand has implemented the following actions in this regard:

- Establishing digital platforms to streamline administrative procedures required for exporting.** As a member of the Association of Southeast Asian Nations (ASEAN), Thailand joined the “ASEAN Single Window”, a regional initiative that aims to expedite cargo clearance and enable the electronic exchange of border trade-related documents among Member States.¹¹⁴ The initiative allows for real-time exchange of e-certificates, such as electronic Phytosanitary Certificate (e-Phyto), electronic Animal Health Certificate (e-AH) and electronic Food Safety Certificate (e-FS) Certificate. To better integrate the country’s trade data with other ASEAN countries, the Thai Government launched the “National Digital Trade Platform” (NDTP) that serves as a central online trading system.¹¹⁵ The platform provides online import-export data, automatic and online documents processing, standardization of documentation, and will also be linked with 36 Thai government agencies that issue licenses and certification for quick processing. The new platform captures the government’s effort to adopt digital technologies into its services, with the NDTP embarking on integrating blockchain technology into its system.

- Aligning with international standards to facilitate cross-border data transfer.** Thailand established its first comprehensive regulatory framework for the protection of personal information based on the internationally recognized European Union’s “General Data Protection Regulations” (GDPR). In particular, the regulatory framework provides guidance on cross-border data transfers by permitting the transfer of personal data provided there are privacy safeguards, that have been approved by the country’s “Personal Data Protection Commission Office”, to protect personal data.¹¹⁶

However, the country faces several obstacles to maximizing its digital trade opportunity, and could consider the following actions:

- Provide capacity-building support for businesses to capture digital trade opportunities.** Beyond developing platforms to streamline administrative procedures associated with trading, the government can consider more wide-ranging support mechanisms. By educating businesses in Thailand, particularly SMEs, on how to be “global-ready”, businesses can discover and leverage opportunities to export overseas. One international best practice can be observed in New Zealand. Callaghan Innovation, a government agency tasked with making New Zealand’s businesses more innovative, is working with NZTech, a group of technology industry associations, to create and nurture a pipeline of local companies to be global-ready. End-to-end support is provided for companies to scale globally in the form of

114. Association of Southeast Asian Nations (2021), “What is the ASEAN Single Window?”. Available at: <https://asw.asean.org/>

115. Nation Thailand (2019) “New digital trading platform to be made part of national agenda.” Available at: <https://www.nationthailand.com/news/30376047>

116. Watson Farley & Williams (2020), “Thailand’s Personal Data Protection Act: a business checklist”. Available at: <https://www.wfw.com/articles/thailands-personal-data-protection-act-a-business-checklist/>



“Getting Started Grants”, “Founder” incubators, tax incentives for R&D efforts, subsidies for digital adoption (“capability vouchers”), and knowledge sharing platforms.¹¹⁷ 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.¹¹⁸

- **Promote Thai exports via digital platforms.**

Although there has been growing optimism among SMEs to leverage the digital economy for growth, the outlook is becoming increasingly challenging for SMEs. Due to border closures amid the COVID-19 pandemic, fruit exports from Thailand have decreased drastically. The Thai Government has therefore partnered with regional e-commerce platforms, such as Lazada, Shopee and Thailandpost, to launch a “Thai Fruits Golden Months” online campaign.¹¹⁹ Over 60 products from 50 farmer groups, community enterprises and cooperatives have since been listed on various platforms.¹²⁰ Thailand could consider

extending the ad-hoc measure to a long-term initiative that promotes local products and services on digital platforms and enables local producers, beyond the agriculture sector, to access international buyers. For instance, South Korea has stepped up the marketing and promotion of Korean products on foreign-e-commerce platforms during “Korea Sale Festa”, the country’s biggest shopping event equivalent to Black Friday that falls in November.¹²¹ For the country to achieve KRW150 trillion in sales and exports from the country’s content industry by 2022, the Korean Creative Content Agency, a government agency that oversees and coordinates the promotion of the country’s content industry, unveiled a three-step plan to promote Korea’s digital content internationally. This includes supporting content creators in digitizing and marketing their content, hosting an online exhibition, “K-Content Expo”, and providing content creators an avenue to exhibit their work and meet buyers through online conferences and meetings on the agency’s content export marketing platform.¹²² During the

117. 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>

118. New Zealand Trade and Enterprise (2020), “Digital commerce”. Available at: <https://www.nzte.govt.nz/page/digital-commerce>

119. International Tropical Fruits Network (2020), “THAILAND: Ministry of Commerce helping fruit farmers sell their products online”.

Available at: <https://www.itfnet.org/v1/2020/05/thailand-ministry-of-commerce-helping-fruit-farmers-sell-their-products-online/>

120. International Tropical Fruits Network (2020), “THAILAND: Ministry of Commerce helping fruit farmers sell their products online”.

Available at: <https://www.itfnet.org/v1/2020/05/thailand-ministry-of-commerce-helping-fruit-farmers-sell-their-products-online/>

121. Pulse (2019), “Korean govt to fully digitize trade procedures by 2021”. Available at: <https://pulsenews.co.kr/view.php?year=2019&no=828606>

122. Sources include: Yonhap News Agency (2019), “S. Korea to spend over 1tln won to nurture content creators”. Available at: <https://en.yna.co.kr/view/AEN20190917006400315>; Korea JoongAng Daily (2020), “Korea aims to maximize its newfound global popularity”.

Available at: <https://koreajoongangdaily.joins.com/2020/07/26/culture/features/Hallyu-content-export/20200726180700511.html>



period of April to July 2020, 131 companies have clinched USD18 million worth of deals through video conferences held with export-related agencies, such as the Korea SMEs and Startups Agency and the Korea International Trade Association.¹²³

- **Participate in multilateral digital trade agreements to promote digital trade and ease cross-border data flows.** With an OECD report highlighting that a 10 percent rise in “bilateral digital connectivity” could improve trade in goods and services by about two and three percent respectively, cross-border data flows are critical for enabling digital exports.¹²⁴ To enhance digital connectivity with its international partners, Thailand could consider participating in multilateral agreements to create a conducive environment for businesses to better tap on the opportunities in the digital economy. An example of such a recently signed agreement is the “Digital Economy Partnership Agreement” (DEPA) signed between Singapore, New Zealand

and Chile, which seeks to promote digital trade and help SMEs overcome the challenges of scale and distance.¹²⁵ The “Digital Economy Partnership Agreement” includes provisions that streamline trading procedures through digitizing trading documentation, and promoting open cross-border data flows with the necessary data safeguards. Through the DEPA, businesses operating in the three signatory countries can transfer information seamlessly across borders, with the assurance that the data is protected by the relevant security mechanisms and requisite regulations.¹²⁶ This provides a conducive environment for data-driven business models such as software-as-a-service and with businesses increasingly reliant on electronic transactions and digital solutions to serve customers regardless of where they are located. In addition, SMEs looking to better understand foreign markets can now access and use open government data to discover new business opportunities and innovate new products and services.

123. The Korea Herald (2020), “Export support for SMEs to center on online realm”. Available at: <http://www.koreaherald.com/view.php?ud=20200914000814>

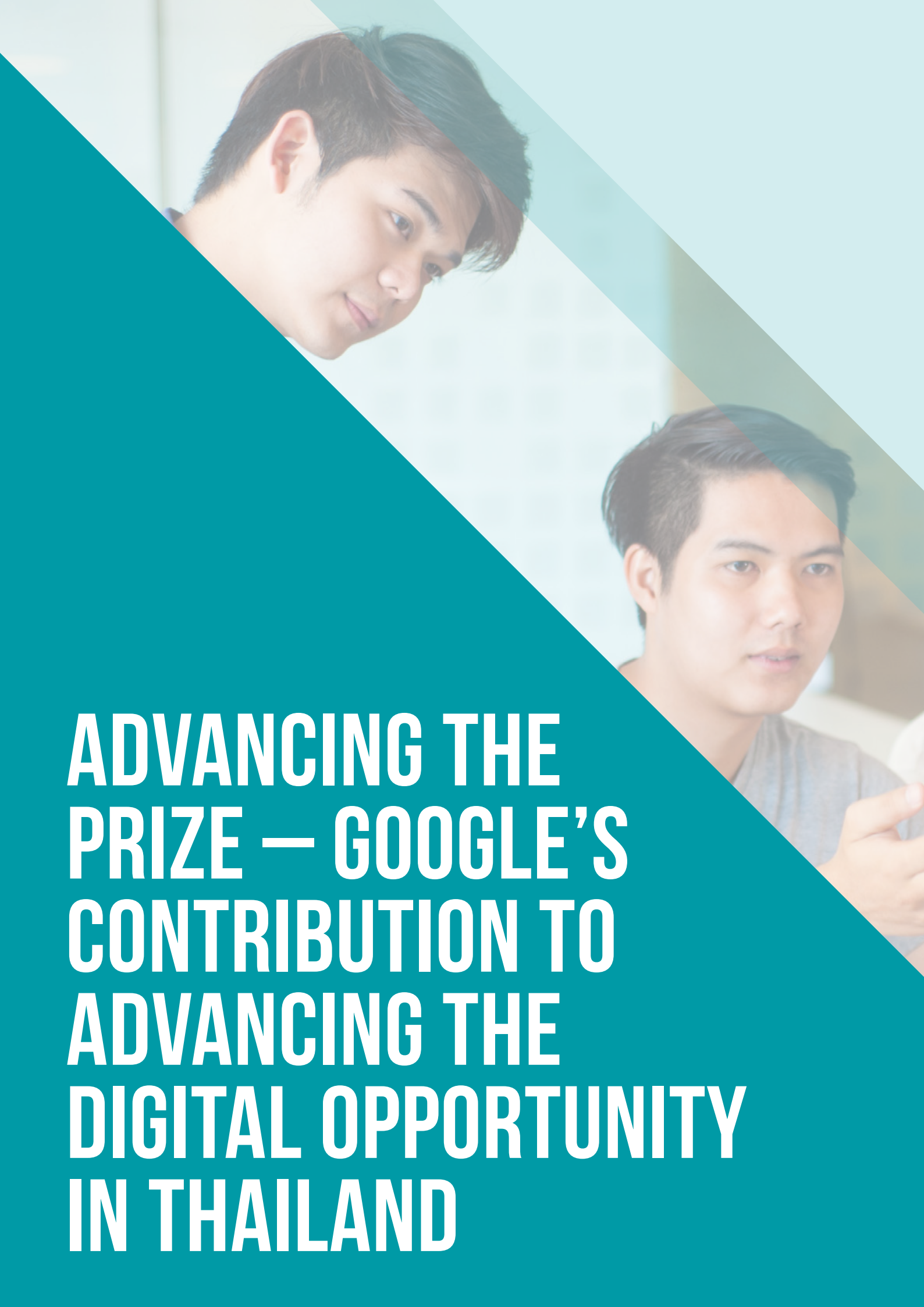
124. OECD (2019), *Trade in the digital era*. Available at: <https://www.oecd.org/going-digital/trade-in-the-digital-era.pdf>

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. 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



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


An important player spearheading digital transformation in Thailand, Google has made significant contributions in each of the three pillars for digital transformation in Thailand outlined in Chapter 2. By introducing infrastructure such as Google Cloud and digital platforms such as “Think with Google”, Google enables businesses to adopt advanced digital tools and leverage data-driven insights to improve their services. Through programs such as “Saphan Digital” and “Skillshop”, Google is supporting the development of a digitally skilled workforce. “Google for Startups Accelerator: Southeast Asia” enables start-ups in Thailand to access its global network of industry partners to expand internationally. By establishing the “Framework for Responsible Data Protection Regulation”, Google is promoting the protection and privacy of data and information to facilitate cross-border data flows.

In addition, Google’s products create various economic benefits for businesses, consumers and the broader society in Thailand. Businesses and consumers in the country were estimated to have derived total annual economic benefits from Google’s products worth THB144.5 billion (USD4.8 billion) and THB378.7 billion (USD12.7 billion), respectively. These products include Google Search, Google Ads, AdSense, YouTube, Google Play, Google Drive, and Google Docs, Sheets and Photos. For businesses, economic benefits come in the form of increased revenue through increased customer outreach and access to new markets, as well as improved productivity through time savings. Consumers experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic


“ADVANCING THE PRIZE”

GOOGLE’S CONTRIBUTION TO THAILAND’S DIGITAL TRANSFORMATION JOURNEY






1
Lower barriers to digital adoption by businesses



2
Enhance digital skills training and education



3
Develop a conducive environment for digital trade

EXAMPLES OF INITIATIVES BY GOOGLE

- **“THINK WITH GOOGLE”** provides businesses access to data-driven insights and tools to drive digital campaigns
- Google collaborated with the Ministry of Commerce to launch **“SAPHAN DIGITAL”** to equip SMEs with digital skills
- **“GOOGLE FOR STARTUPS ACCELERATOR: SOUTHEASTASIA”** supports Thai start-ups in expanding overseas

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

BUSINESSES

Through significant boosts to productivity and customer outreach, Google is estimated to support **THB144.5 billion (USD4.8 billion)** worth of annual benefits for businesses in Thailand¹

CONSUMERS

By helping consumers save time and generating value through their free products, Google is estimated to support **THB378.7 billion (USD12.7 billion)** worth of annual benefits for consumers in Thailand²

SOCIETY

By enabling businesses to unlock new revenue streams and expand their businesses, Google indirectly supports over **63,000 jobs** in Thailand. The Android operating system also supports more than **58,000 jobs** in Thailand’s economy

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

contributions to businesses and individuals, Google also supports benefits to the wider society in Thailand. By enabling businesses to unlock new revenue streams and expand their businesses through the use of Google Ads, AdSense, and YouTube, Google indirectly supports over 63,000 jobs in Thailand. The Android operating system also supports more than 58,000 jobs in Thailand’s economy. Furthermore, Google delivers intangible benefits through its programs and initiatives, such as extending digital skilling opportunities to underserved communities, enabling safe Internet use, promoting health, as well as arts and culture in Thailand.

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

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

To **lower barriers to digital adoption by businesses (Pillar 1)**, Google has launched the following efforts in Thailand:

- **Providing SMEs with data-driven insights to leverage for growth.** Unlike large companies with deep pockets to analyze a large volume of marketing data to create hyper-personalized experiences, cash-strapped small businesses do not have the resources to collect such information. Thus, Google created the “Grow with Google” website - a one-stop portal that provides businesses, particularly SMEs, with free digital tools, resources and training courses such as online advertising.¹²⁷ At the same time, “Think with Google” is another website that provides high-level insights, deck-ready statistics and useful tools to explore the latest trends and receive forward-looking perspectives. Particularly for the tourism industry, the increasingly prominent role of digital technology in travel research, planning and booking have emphasized the need for businesses to enhance their online appeal to digitally savvy customers. Through “Think with Google”, businesses can gain access to the latest insights, trends, and best practices for digital marketing and consumer analysis to tide them over the uncertainty. A recent survey by “Think with Google” revealed how consumer sentiment toward travel in the Asia-Pacific region was improving, providing tourist companies in Thailand some indication of economic recovery.¹²⁸ Google is also supporting Thailand’s tourism industry through “Google Trends” which can help the government and tourist companies keep track of consumer sentiment, tourism trends, and make predictions of future development in key destination areas with real-time search data.¹²⁹
- **Introducing cloud infrastructure to support digital business models.** Google’s products have promoted the growth of Thailand’s digital economy by providing the platform for the development of new technology-driven business models and products in the country. Where small businesses struggle to source for capital, Google Cloud democratizes access to specialized technologies such as AI

127. Grow with Google (2021). Available at: https://grow.google/intl/ALL_th/use-tools/

128. Think with Google (2020). “The state of travel in APAC: Identifying trends to prepare for the road ahead.”

Available at: <https://www.thinkwithgoogle.com/int/en-apac/consumer-insights/consumer-trends/state-travel-apac-identifying-trends-prepare-road-ahead/>

129. Google (2021). Google Trends. Available at: <https://trends.google.co.th/trends/?geo=TH>



and machine learning by eliminating fixed costs involved in the usage of such technologies. Businesses can not only train and run machine learning models, but also access sophisticated software for image and language recognition, translation, and other analytical tools. Two local businesses, KBank, a consumer bank which keeps track of around 12 million mobile banking customers, and True Digital, an online streaming provider which handles hundreds of thousands of viewers during live-streaming seasons, have taken advantage of Google Cloud to scale their business.¹³⁰ Google Cloud responds automatically to changes in demand for online traffic entering their servers. When True Digital streams the “World Cup” or “Premier League” games with hundreds of thousands of customers live-streaming at the same time, Google Cloud allows True Digital to scale its service automatically without having to invest in IT infrastructure. During off-peak periods, the company can also save on operating costs without having multiple machines running at the same time. By scaling system allocation from zero to any needed capacity almost instantly and proportionally, True Digital is able to reduce inefficiencies and downtime.

- **Increasing the ease of onboarding on online platforms.** To help SMEs in Thailand set up

their online presence quickly and seamlessly, Google Thailand partnered with Siam Commercial Bank (SCB) in 2018 to provide the bank’s 500,000 SME customers an expedited application process for onboarding onto the Google My Business platform.¹³¹ Google My Business allows SMEs to increase their visibility on both Google Search and Google Maps by creating a free Business Profile online. SMEs applying through SCB’s relationship managers are able to immediately drop a location pin of their business on Google Maps to help potential customers find their physical store. Other essential business information such as the business name, operating hours, or contact details are also found on the company’s Business Profile. Google has also recently introduced the Local Opportunity Finder tool on Google My Business to help small business owners improve their presence on Google Search and Google Maps.¹³² Businesses are provided personalized recommendations to help boost the visibility of their Business Profile online, such as verifying their profiles, responding to customer reviews and adding photos to showcase products and services. In addition, Google also provides training to participating SMEs to learn how to leverage digital marketing through Google’s platforms. This move would allow SMEs to capture more customers via their online presence and thereby increase

130. Bangkok Post (2019). “Google Cloud woos enterprise clientele.” Available at: <https://www.bangkokpost.com/business/1759324/google-cloud-woos-enterprise-clientele>

131. Siam Commercial Bank (2018). “SCB first in Thailand to partner with Google to offer Google My Business to create digital business opportunities for Thai SMEs.” Available at: <https://www.scb.co.th/en/about-us/news/jul-2018/nws-google-business.html>

132. YouTube (2020). “How can I get the most out of my Business Profile on Google?.” Available at: <https://www.youtube.com/watch?v=ixOz7PVE2PO>



sales and provide sustainable growth. For SCB, this would also improve the debt serviceability of SME customers from having increased income to service their loans as businesses become more viable with the help of digital marketing. Box 6 illustrates examples of local SMEs which have effectively utilized Google My Business to create an online presence and thrived with a larger customer base.

To enhance digital skills training and education (Pillar 2), Google is involved in the following:

- **Partnering with the government and industry to nurture a health pipeline of digital talent to support businesses.** Around 1.3 million Thai small businesses, which accounts for over 90 percent of businesses in the country, have been affected by the impact of COVID-19. To support businesses in accessing digital talent, Google collaborated with Thailand’s Ministry of Commerce and industry partners to launch “Saphan Digital” under the “Grow with Google” initiative. Through the program, participants are taught how to use digital tools to help businesses create an online presence and participate in e-commerce. On the other hand, industry partners can gain access to digital talent by connecting with graduates of the program. Graduates are able

to “pair” up with a participating small business or NGO to support the digital transformation journey of these organizations. Examples of organizations that have benefited from this include the Samaritan Association of Thailand and the Steel Metal Company, a local SME. Participants who have successfully completed the program will receive a certification to show that they have developed their newfound set of skills to help them access new income opportunities after the program. Box 7 provides examples of how a local small business was able to pivot his business during the COVID-19 pandemic through the use of digital tools to reach out to new customers.

- **Lowering barriers to digital skills training for business owners.** Co-designed by Google and industry partners, Google launched “Google Primer”, a free mobile application that provides quick, bite-sized lessons on business, marketing, management, and other topics, for business owners to pick up industry relevant digital skills and become digital-ready. The application also showcases successful businesses that have applied their learnings from modules on “Google Primer” to highlight the different ways business owners can upgrade their own line of work.¹³³

133. Your Primer (2021), Available at: <https://www.yourprimer.com/>

BOX 6.

GOOGLE MY BUSINESS HELPS LOCAL SMES TO EXPAND THEIR CUSTOMER BASE AND BOOST SALES

Google's digital tools, such as Google My Business and Google Maps, are instrumental in helping businesses in Thailand go digital to create an online presence and reach out to more customers. By listing their products online, customers can easily discover local businesses by searching their company name, information, operating hours, promotions and keywords.

BAAN TAWAI WOOD CARVING VILLAGE

Known for its community of wood carvers that produces wooden handicrafts with intricate designs in the early 2000s, Baan Tawai found itself competing heavily against many other villages and businesses, with some of its shops being forced to close.¹³⁴ Wasan Dechakan, the President of the village's association of wood carvers, realized word-of-mouth marketing was insufficient to attract tourists to the village as most people search for information on Google. Thus, Dechakan created a free Business profile on Google My Business to put the village on the web. After listing Baan Tawai online, the village received more tourists, which piqued the interests of many villagers. Dechakan started teaching other villagers how to create their Business profiles and upload photos of wood handicrafts to advertise their business. As the villagers' businesses became successful, some have hired more craftsmen from the village to ramp up their production to meet the increasing demand. Over time, the village saw the number of domestic and international tourists doubling since before the adoption of Google My Business, leading to an improvement in the villagers' overall quality of life.

SUDARAT SUKSAENGRAT

Sudarat Suksangrat (สุดารัตน์ สุขแสงรัตน์), who runs a small food shop (Zaap..zodhoak by P'Nhong) in Thailand, has benefitted from using Google tools to thrive during the pandemic.¹³⁵ When the COVID-19 crisis began to hit the country, she became determined to advertise her business online. With the help of Google Maps, she increased the discoverability of her shop by pinning her store onto the local maps, adding pictures of her location and food to attract new customers. This eventually led her to gain a new customer base, with online deliveries forming nearly half of her income. Excited to innovate even further, she sees her foray into the online delivery market as an opportunity to create a ready-to-eat, vacuum packed version of her meals.

134. YouTube (2019). "Google My Business: Baan Tawai Wood Carving Village." Available at: <https://www.youtube.com/watch?v=RTYFK3ldwOM>

135. YouTube (2020). "Google for Thailand: SMEs & Economic Opportunity" Available at: <https://www.youtube.com/watch?v=T6jVa6tNa7U>

BOX 7. SMALL BUSINESS OWNER EXPANDS CUSTOMER BASE AFTER ADOPTING DIGITAL TOOLS INTRODUCED DURING THE “SAPHAN DIGITAL” PROGRAM

Khun Julaprach Petchchang has been selling crispy fish as souvenirs to tourists visiting Chiang Mai for two years.¹³⁶ When the COVID-19 pandemic struck, his business, JCR Trading, was badly affected as international travel came to a standstill and Petchchang lost most of his customers. Petchchang was looking for ways to pivot his business by targeting locals and selling his products online. After attending a hands-on session during the “Saphan Digital” program, Petchchang successfully created a website for his business and developed new products tailored for the domestic market. As JCR Trading undergoes digital transformation, Petchchang is growing his digital toolkit by learning how to use Google Ads to advertise his business online.



Photo Source: <https://www.it24hrs.com/2020/saphan-digital-how-to-register/>

136. Inwshop (2021), Available at: <http://kiavee.inwshop.com/>

- Equipping individuals with industry-relevant digital skills.** Besides supporting businesses and the current workforce, to help individuals and new graduates interested in the tech sector acquire industry-relevant skills, Google launched “Academy Bangkok” in 2018 in partnership with “True Digital Park”, the largest digital innovation hub in Southeast Asia. The space functions as the main training venue for participants of the “Google Ignite” program, a two-month digital marketing training course that prepares Thai university students for future careers in Thai companies for digital-centric roles.¹³⁷ The “Academy Bangkok” also functions as a training facility for other Google-run training programs in areas such as developer skills and cloud computing. The space accommodates cohorts of up to 150 people at a time, providing a conducive environment for digital education. As part of its overall response to the COVID-19 pandemic, Google also ramped up its efforts in “Academy Bangkok” by releasing online courses for graduates and experienced professionals.¹³⁸ Google also

launched the “Grow with Google” initiative in November 2019 to help all Thais have access to digital skills training free-of-charge so that they can participate in the digital economy. Through a series of online digital skilling courses, such as “Skillshop” and “Google Digital Garage”, individuals learn how to utilize digital tools, create an online presence, and engage with a larger audience digitally. For example, Thais are able to learn basic digital marketing skills to enjoy wider employment opportunities or build software development skills to enter new industries. More digitally advanced users can tap onto resources on AI and machine learning to upgrade their technical skill sets. The “Skillshop” program teaches participants how to leverage digital tools such as Google Ads to bring their business online, while “Google Digital Garage” provides participants digital marketing certification. Box 8 shows how these programs have supported individuals, like Thananopawan Rattanatrishi, in their job search by improving their digital skills and employability.



137. True Digital Park (2021), “Google Space.” Available at: https://www.truedigitalpark.com/campus_innovation_space

138. Google (2020), “Being there for Thailand’s small businesses.” Available at: <https://blog.google/around-the-globe/google-asia/being-there-for-thailands-small-businesses/>

BOX 8. GOOGLE'S ONLINE DIGITAL SKILLS PROGRAM EQUIP INDIVIDUALS WITH RELEVANT SKILLS TO LAND JOBS

Google actively supports individuals in their efforts to upskill themselves through online classes and lessons. Thai residents are able to access online programs such as “Skillshop” or “Google Digital Garage” to take up self-paced classes that have a specific focus on digital areas such as Google Ads, Google Ad Manager, or even fundamentals of digital marketing.

Thananopawan Rattanatriri (ชนนพวรรณ รัตนไตรศรี), a digital marketing associate at Crea Co., Ltd., took up the challenge of learning new skills and attended Google’s online digital skills training programs.¹³⁹ After recently graduating from her university in 2020, Rattanatriri was looking for jobs. However, her search appeared to be arduous, with over 50 of her applications not receiving any responses. After being recommended to take up a digital course, Rattanatriri took up “Skillshop” and “Google Digital Garage classes” to upskill herself on basic digital marketing skills. After including her new set of skills into her resume, she successfully found newer employment opportunities popping up, with around 8 to 9 out of 10 of her applications receiving call-backs. With her newfound confidence and relevant skill set, Rattanatriri managed to secure a job at a digital advertising agency as a digital marketing associate.



Photo Source: <https://digitalcontent.com/is-googles-digital-garage-worth-it/blog/>

139. YouTube (2020), "Google for Thailand 2020". Available at: <https://www.youtube.com/watch?v=kqzJ8kmJH6A&t=895s>



To **develop a conducive environment for digital trade (Pillar 3)**, Google has done the following:

- Supporting local start-ups in expanding their global network.** To nurture the growth of local technology start-ups, Google launched the “Google for Startups Accelerator: Southeast Asia” program in Thailand. The program is a three-month online accelerator bootcamp for high potential tech-based start-ups that are solving the region’s challenges in the post-pandemic era.¹⁴⁰ Through the program, start-ups receive tech and business mentorships, opportunities to connect with relevant teams from Google and its network of industry partners and workshops focused on product design, customer acquisition, and leadership development for founders. After attending the

program, Sittisak Wongsomnuk, Chief Executive Officer and Founder of GIZTIX, a local integrated logistics platform which provides real-time matching services to e-commerce businesses, said the program has helped them to determine the direction of their business, improved team management and its online platform.¹⁴¹ GIZTIX has partnered with international delivery service providers, such as DHL and FedEx, and established an extensive logistics network with over 300 registered Thai and foreign shipping firms. The business also received funding from investors in Singapore and the United States to further develop technical features of the platform, including one that will allow users to check cross-border shipping costs and instantly book truck services.¹⁴² Another training program that provides local start-ups international exposure

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

141. Google The Keyword (2020), “Support for Southeast Asian startups tackling big challenges”.

Available at: <https://blog.google/around-the-globe/google-asia/support-southeast-asian-startups/>

142. Nation Thailand (2016). “Giztix out to revolutionise transport, logistics via online platform”.

Available at: https://www.nationthailand.com/business/30294982?utm_source=category&utm_medium=internal_referral



is the “Startup School” program.¹⁴³ Through a series of free, hands-on virtual courses, start-up founders and their teams across Asia Pacific can interact with Googlers, industry leaders and other entrepreneurs from across the globe to discuss a range of topics. These courses aim to introduce start-up founders to digital tools such as Google Ads to support their businesses and equip them with skills, such as digital marketing, product knowledge and business strategy, to advance and scale their start-ups.

- **Promoting protection and privacy of data and information.** Robust privacy safeguards and user controls encourage individuals and businesses to engage in digital trade. As a strong advocate for smart, interoperable and adaptable data protection regulations, Google is supporting Thailand’s efforts

to develop personal data protection legislation by preparing a set of high-level principles on data protection. Governments and businesses can consider adopting Google’s “Framework for Responsible Data Protection Regulation” to protect individuals and communities from harm and misuse of data, while enabling businesses and consumers to benefit from the benefits of innovative services. One of the provisions places a strong emphasis on giving individuals the ability to manage their own personal information that they have provided to an organization, including making the data available for export in a machine-readable format. The framework also promotes global interoperability by encouraging countries to adopt an integrated framework of privacy regulations and cross-border data transfer mechanisms that ensure protections follow the data, not national boundaries.

143. Google for Startups (2021), Available at: <https://campus.co/global/startup-school/>

GOOGLE’S ECONOMIC IMPACT IN THAILAND



BUSINESS BENEFITS

Google supports **THB 144.5 BILLION (USD 4.8 BILLION)** in annual benefits to businesses in Thailand¹



Google Search saves the average Thai employee about **4.7 DAYS PER YEAR** through almost instantaneous access to information online



CONSUMER BENEFITS



Google supports **THB 378.7 BILLION (USD 12.7 BILLION)** in annual benefits to consumers in Thailand²



The average Thai **Google Search** user saves **4.2 DAYS A YEAR** looking for answers, as compared to traditional offline methods



55% of surveyed Thais indicated that their organization has made use of **Google Workspace** tools to facilitate teamwork and coordination while working from home

SOCIETAL BENEFITS



Revenue gains from the use of Google products indirectly supports **over 63,000 jobs** in Thailand. The **Android operating system** also supports **more than 58,000 jobs** in Thailand’s economy



Google partnered with the **Thai Fund Foundation (TFF)** and the **Inter Mountain Peoples’ Education and Culture in Thailand Association (IMPECT)** to provide digital skills training for **40,000** rural micro-entrepreneurs in 20 provinces

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

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

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

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

Google’s applications and services, such as Google Search, Google Ads and Google Maps, bring about various economic benefits in Thailand. This study finds that the annual economic value presented by Google’s applications and platforms is worth THB144.5 billion (USD4.8 billion) for businesses, and THB378.7 billion (USD12.7 billion) for consumers.¹⁴⁴ An overview of the assessed economic benefits of Google products to businesses and consumers in Thailand is provided in Exhibit 7. 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 9 for further details). In addition, Google also supports benefits to the wider society in Thailand. These include indirectly supporting over 63,000 jobs in the economy,¹⁴⁵ while the Android operating software is estimated to support around 58,000 jobs.¹⁴⁶ It also brings intangible benefits to the broader society by extending digital skilling opportunities to underserved communities, promoting the use of AI in healthcare, safe Internet use, as well as arts and culture in Thailand.





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

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

146. Based on AlphaBeta analysis. See Appendix B for details on the methodology.

EXHIBIT 7:

OVERVIEW OF BENEFITS ANNUALLY SUPPORTED BY GOOGLE IN THAILAND



TYPE OF BENEFIT	EASE OF ACCESS TO INFORMATION 	ENTERTAINMENT AND ENRICHMENT 
RELEVANT PRODUCT/S	Google Search	YouTube, Google Play & Android
BUSINESS BENEFITS	<ul style="list-style-type: none"> By allowing for almost instantaneous access to information online, Google Search helps businesses save 4.7 days a year per worker in Thailand 	<ul style="list-style-type: none"> App developers in Thailand earn about THB1 billion (USD34 million) in revenue from both domestic and international markets through the Google Play platform per year Android enables app developers to save up to 25% of development time and target more than 1 billion users worldwide¹
CONSUMER BENEFITS	<ul style="list-style-type: none"> By providing almost instantaneous access to information, the average Google Search user in Thailand saves about 4.2 days looking for answers online each year The total consumer benefits derived from Google Search are estimated at THB86.7 billion (USD2.9 billion) 	<ul style="list-style-type: none"> Consumers can choose from over 3.5 million apps available on the Android ecosystem¹ 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 Thailand are estimated at THB179.7 billion (USD6 billion) annually

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

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

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

SOURCE: AlphaBeta analysis

<p>INCREASED PRODUCTIVITY AND CONVENIENCE</p> 	<p>ADVERTISING BENEFITS</p> 	<p>TOTAL BENEFITS:</p>
<p>Google Maps, Drive, Photos, Docs & Sheets</p>	<p>YouTube, Google Ads & AdSense</p>	
<ul style="list-style-type: none"> The Google My Business (GMB) function in Google Maps allows customers to discover local businesses. Globally, the additional revenue earned by SMEs as a result of GMB has been estimated to be between USD212-250 per year 	<ul style="list-style-type: none"> Google Search and Ads bring about THB134 billion (USD4.5 billion) in net advertising benefits to businesses in Thailand annually² Web publishers and content creators in Thailand earn about THB4.8 billion (USD161 million) in revenue from AdSense and YouTube annually Advertisers in Thailand gain THB4.7 billion (USD157 million) in net advertising benefits annually from displaying advertisements on websites and videos using AdSense and YouTube² 	<p>THB144.5 BILLION (USD4.8 BILLION)</p>
<ul style="list-style-type: none"> The total annual consumer benefits derived from productivity-enhancing tools of Google Maps, Drive, Photos, Docs, and Sheets are estimated at THB112.3 billion (USD3.7 billion) 55% of surveyed Thais indicated that their organization has made use of Google Workspace tools to facilitate teamwork and coordination while working from home 	<p>Nil</p>	<p>THB378.7 BILLION (USD12.7 BILLION)</p>

BOX 9. 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 utilized 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 optimizes their driving and public transport journeys) and Google Search (which increases the efficiency of information gathering) were also measured to derive a measure of the convenience these products bring to them. Appendix B shows a detailed methodological explanation of how the benefit of each product was sized.



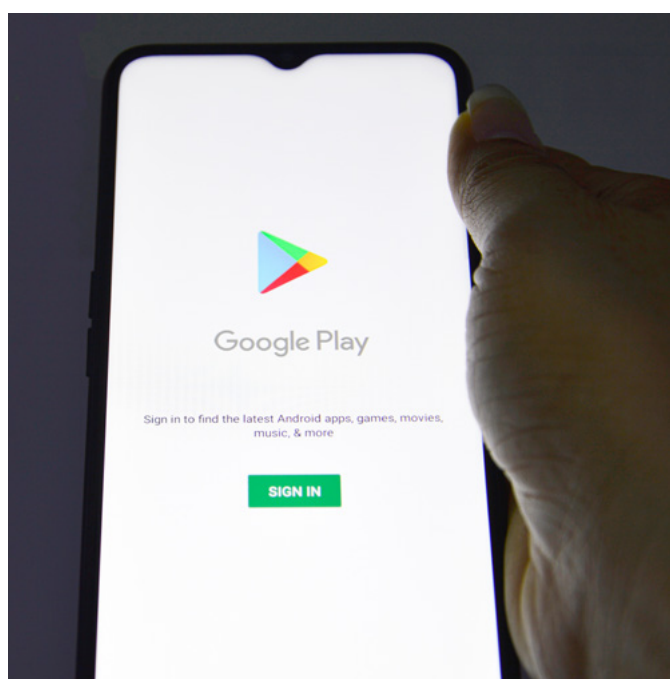
BENEFITS TO BUSINESSES

GOOGLE HELPS BUSINESSES BOOST THEIR REVENUES

Google applications broaden the reach of businesses in Thailand to new customers and markets, allowing them to boost their revenues. Online advertising platforms such as **Google Ads** and **YouTube** allow businesses to conduct targeted advertising, bringing their products and services to the right audiences and growing their customer base. **Google Ads** is estimated to generate THB134 billion (USD4.5 billion) annually in the form of net returns to businesses in Thailand from advertising on Google Search results of relevant keywords.¹⁴⁷ Beyond search advertising, businesses in Thailand 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 THB4.4 billion (USD148 million) annually. Meanwhile, by leveraging the various formats of advertisements enabled by **YouTube**, businesses are

able to receive THB3.6 billion (USD121 million) in net advertising returns annually.¹⁴⁸ Box 10 shows how a local business, which would have not otherwise been able to survive during the pandemic, found an alternative revenue stream online with Google Ads, while Box 11 shows the wider contributions made by Google to support the country during the crisis.

In addition, Google provides new sources of income for content creators in Thailand. By allowing content creators such as online journalists, media sites, bloggers and writers to earn income by hosting advertisements on their sites, **AdSense** is estimated to have helped content creators in Thailand monetize space on their websites, and generate a total annual income of THB3.3 billion (USD112 million). YouTube also benefits video content creators in Thailand who earn revenue through placing advertisements on their videos. This is estimated to bring content creators in Thailand a total of THB1.5 billion (USD49 million) in annual advertising revenue.



Google’s digital product distribution system, **Google Play**, as well as its operating system, **Android**, have resulted in a variety of benefits to app developers in Thailand. App developers were estimated to have earned an annual income of about THB1 billion (USD34 million) from Google Play in both the domestic and global markets.¹⁴⁹ Further, through the Android operating system, app developers in Thailand can readily reach more than 1 billion users globally.¹⁵⁰ 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.¹⁵¹

Exhibit 8 summarizes the estimated business benefits in the form of revenue gains experienced by businesses in Thailand from Google Search and Ads, AdSense, YouTube and Google Play.¹⁵²

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

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

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

150. 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>

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

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

152. 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.

BOX 10. GOOGLE ADS SUPPORTS LOCAL BUSINESSES AFFECTED BY COVID-19 TO GO DIGITAL AND FIND ALTERNATIVE REVENUE STREAMS

Rungroj Satapanakul (รุ่งโรจน์ สถาปนกุล) is the founder of KoalaPrint, a printing service in Thailand. When the COVID-19 outbreak occurred, revenue for his business decreased significantly from hundreds of thousands of Baht a month to zero.¹⁵³ Realizing that this meant having to explore a different business model, he shifted the company's operations online, created an online website and revamped KoalaPrint's image with a fresh and modern look. To direct traffic to their new website, Sathapanikun leveraged Google Ads to target and acquire customers effectively. The results exceeded Sathapanikun's expectations, with sales volume doubling and revenue rising by 20 to 30 percent.

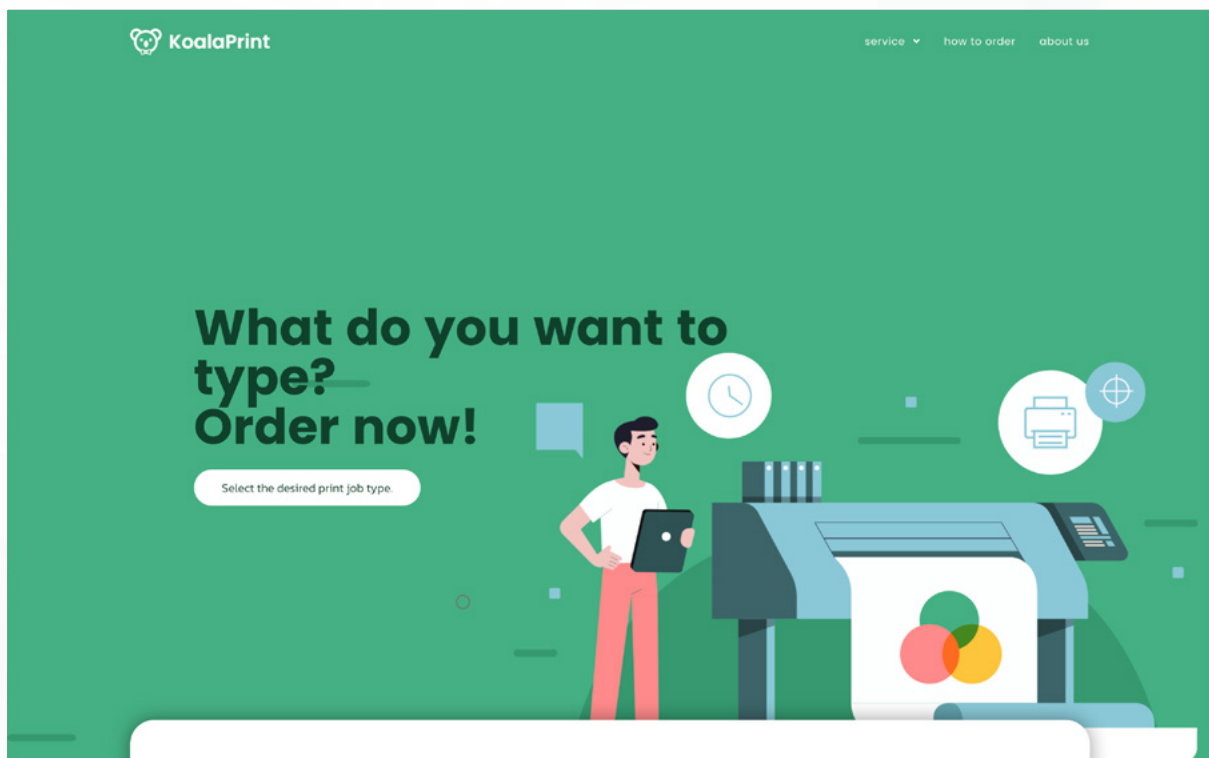


Photo Source: <https://thekoalaprint.com/>

153. YouTube (2020), "Google for Thailand: SMEs & Economic Opportunity" Available at: <https://www.youtube.com/watch?v=T6iVa6tNa7U>

BOX 11.

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

ENABLING REMOTE WORKING ARRANGEMENTS DURING THE PANDEMIC

Google contributes to the continuity of business functions and operations by providing enabling technologies, such as online video conferences and collaborative tools. As more businesses adjust to work-from-home arrangements during the COVID-19 pandemic, the Google Meet premium video-conferencing software was made available free of charge to all businesses in Thailand. This allowed companies to stay connected and work remotely from anywhere on the globe. In April 2020, Google Meet hosted three billion minutes of video meetings globally and added roughly 3 million new users worldwide daily. The video-conferencing software features a set of security controls to ensure that only intended participants are let into the call.¹⁵⁴ By allowing workers to connect with each other virtually and instantaneously, Google Meet improves productivity by minimizing travel and promoting collaboration.

HELPING STUDENTS LEARN AT HOME

As part of Google's commitment to "Leave no Thais behind" and promote inclusive digital education, Google has integrated Google Workspace for Education (formerly known as G Suite for Education) into Thailand's Digital Education Excellence Platform (DEEP), allowing all public schools in Thailand to access Google's education tools for free when schools were temporarily closed.¹⁵⁵ Google Workspace for Education tools supported distance learning by helping teachers and students stay connected remotely. For example, Google Classroom enables teachers to create virtual classrooms and manage coursework, organize assignments, boost collaboration, and foster better communication by providing students timely feedback on their work. The DEEP platform not only serves as a critical stepping stone towards providing equitable access to a diverse set of curriculums and modules, it also reduces administrative work by digitizing 50 percent of physical documents.¹⁵⁶ The Ministry of Education can effectively monitor the use of school budgets, the use of school resources and the enforcement of school policies on the platform.

154. Google The Keyword (2020), "Google Meet premium video meetings—free for everyone".

Available at: <https://blog.google/products/meet/bringing-google-meet-to-more-people/>

155. Google (2020), "Being there for Thailand's small businesses."

Available at: <https://blog.google/around-the-globe/google-asia/being-there-for-thailands-small-businesses/>

156. Bangkok Post (2020), "Nataphol talks up new 'Deep' platform".

Available at: <https://www.bangkokpost.com/thailand/general/1977755/nataphol-talks-up-new-deep-platform>

EXHIBIT 8:**GOOGLE IS ESTIMATED TO BRING ABOUT THB144.5 BILLION (USD4.8 BILLION) WORTH OF ANNUAL BENEFITS TO BUSINESSES IN THAILAND**

PRODUCT	DESCRIPTION OF BENEFITS	ESTIMATED ANNUAL BENEFITS
Google Search & Ads	Net advertising benefits for businesses ¹	THB134 billion (USD4.5 billion)
AdSense	Net advertising benefits for businesses ¹	THB1.1 billion (USD36 million)
	Income generated by website publishers through AdSense	THB3.3 billion (USD111 million)
YouTube	Net advertising benefits for businesses ¹	THB3.6 billion (USD121 million)
	Advertising revenue earned by YouTube video creators	THB1.5 billion (USD49 million)
Google Play	Income generated by app developers in Thailand from both the domestic and international markets through Google Play	THB1 billion (USD34 million)
TOTAL ANNUAL BUSINESS BENEFITS IN THAILAND:		THB144.5 BILLION (USD4.8 BILLION)

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

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

SOURCE: AlphaBeta analysis

GOOGLE HELPS BUSINESSES INCREASE PRODUCTIVITY AND SAVE TIME

Google helps businesses save time by enhancing employees’ productivity by improving the speed and ease of access to information and research. In particular, **Google Search** minimizes 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 4.7 days annually. **Google Workspace** also plays an integral role in enabling workers to collaborate more easily, particularly during the COVID-19 pandemic. Through features such as Chat and Drive, employees can dynamically create and collaborate on a document with others in a Chat room.

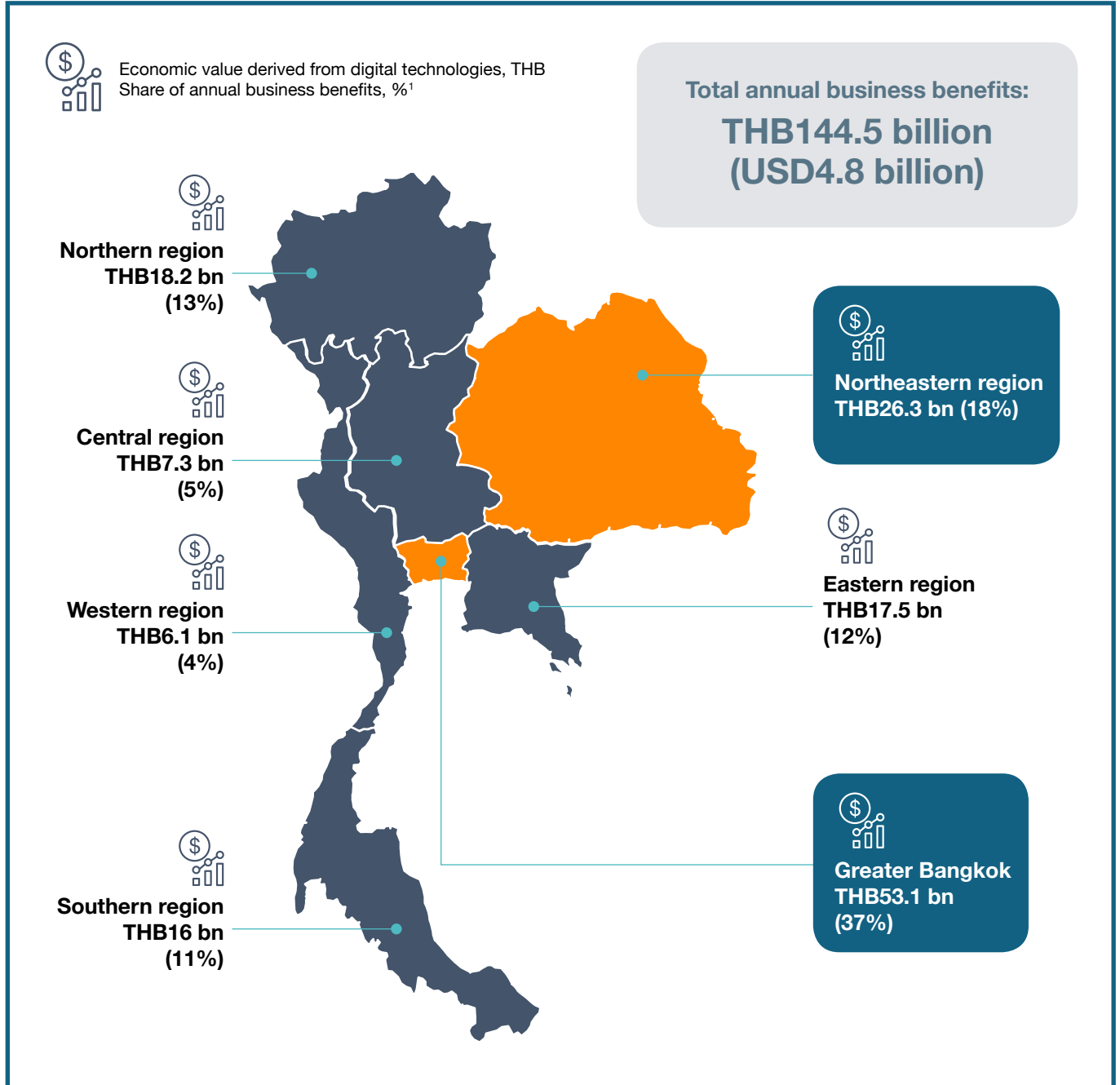
According to AlphaBeta research, about 55 percent of surveyed Thais indicated that their organization has made use of Google Workspace tools to facilitate teamwork and coordination while working from home.

GOOGLE’S BUSINESS BENEFITS ARE DISTRIBUTED ACROSS ALL REGIONS

The benefits of Google’s applications and services in terms of increased revenue and time savings are distributed across all regions in Thailand, but more than half (55 percent) of the benefits are concentrated in Greater Bangkok and the Northeastern region. These benefits range from THB6.1 billion in the Western region to THB53.1 billion in Greater Bangkok. The regional breakdown of Google’s total annual business benefits is shown in Exhibit 9.

EXHIBIT 9:

50% OF THE COUNTRY’S PROJECTED DIGITAL OPPORTUNITY IN 2030 IS FOCUSED ON 2 OF 8 REGIONS, REFLECTING A DIGITAL DIVIDE THAT IS IMPORTANT TO BRIDGE



1. Shares are computed using each region’s share of GDP and number of businesses from the Office of the National Economic and Social development Council and the National Statistics Office. See Appendix B for details on the methodology.

BENEFITS TO CONSUMERS

CONSUMERS IN THAILAND EXPERIENCE TOTAL ANNUAL BENEFITS WORTH THB378.7 BILLION (USD12.7 BILLION)

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 9). 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 to be THB378.7 billion (USD12.7 billion). This value

includes three main categories of benefits provided by Google applications: ease of access to information (Google Search), entertainment and enrichment (YouTube and Google Play), and enhanced productivity and convenience (Google Maps, Drive, Photos, Docs and Sheets). Exhibit 10 shows the breakdown of consumer surplus by category.

GOOGLE ENABLES CONSUMERS BETTER ACCESS TO INFORMATION

Google provides benefits to consumers in Thailand by allowing them to instantly access a vast array of information online. The total annual consumer surplus brought about by Google Search was estimated at

EXHIBIT 10:

GOOGLE IS ESTIMATED TO SUPPORT THB378.7 BILLION (USD12.7 BILLION) WORTH OF ANNUAL CONSUMER SURPLUS IN THAILAND

ESTIMATED ANNUAL CONSUMER SURPLUS OF GOOGLE PRODUCTS IN THAILAND CONSUMER SURPLUS (THB)

TYPE OF BENEFIT	PRODUCT	ANNUAL CONSUMER SURPLUS
Ease of access to information	Google Search	THB86.7 billion (USD2.9 billion)
Enhanced productivity and convenience	Google Maps	THB112.3 billion (USD3.7 billion)
	Google Drive, Photos, Docs and Sheets	
Entertainment and enrichment	Google Play	THB179.7 billion (USD6 billion)
	YouTube	
TOTAL ANNUAL CONSUMER SURPLUS:		THB378.7 BILLION (USD12.7 BILLION)

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

THB86.7 billion (USD2.9 billion) (Exhibit 10). Based on an international study showing that a search for a piece of information that takes 21 minutes in the library takes only seven minutes online, it is estimated that **Google Search** saves consumers in Thailand an average of 4.2 days per year.¹⁵⁷ According to AlphaBeta research, over 40 percent of Google Search users in Thailand say they use online search engines to conduct research for self-enrichment, such as learning new skills.¹⁵⁸

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

Google Maps brings about productivity in the public transport and driving journeys of Thai citizens through the service’s wayfinding and navigation feature, which optimizes these trips using real-time data such as public transport arrival times and road traffic conditions. By displaying business listings on the map, users are able to conveniently locate, discover and obtain the most complete and up-to-date information about local businesses. According to AlphaBeta research, over 50 percent of respondents in Thailand have tried to locate restaurants and over 20 percent found offices of business partners and/or clients by using Google Maps.¹⁵⁹

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 consumers in Thailand. These services enable them to manage files, folders, music and photos on the fly – without having to retrieve the information from a piece of hardware.

The total annual consumer benefits derived from productivity-enhancing tools of Google Maps,

Drive, Photos, Docs, and Sheets are estimated at THB112.3 billion (USD3.7 billion).

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 50 percent of YouTube users in Thailand say they use online video services to learn advanced digital skills such as coding, software programming, and mobile application and website development.¹⁶⁰

Google Play and **Android** have also brought a variety of benefits to consumers in Thailand. For example, Android enables consumers to choose from over 3.5 million apps available on the Android ecosystem.¹⁶¹ 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 THB179.7 billion (USD6 billion) to consumers in Thailand annually.¹⁶²

CONSUMER SURPLUS BENEFITS ARE DISTRIBUTED ACROSS ALL REGIONS

The consumer benefits brought about by Google’s services are distributed across all regions, but more than half (51 percent) of the benefits are concentrated in Greater Bangkok. These benefits are estimated to range from THB7.4 billion in the Western region to THB194.2 billion in Greater Bangkok. Exhibit 11 shows the regional breakdown of the total annual consumer surplus realized by consumers in Thailand.

157. 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>

158. Google/AlphaBeta Economic Impact Report survey, n = 505. Percent represents use of online search engines to conduct research for self-enrichment amongst Thais for whom Google Search is their most frequently used online search engine.

159. Google/AlphaBeta Economic Impact Report survey, n = 505. Percent represents use of online maps services to locate businesses amongst Thais for whom Google Maps is their most frequently used online maps service.

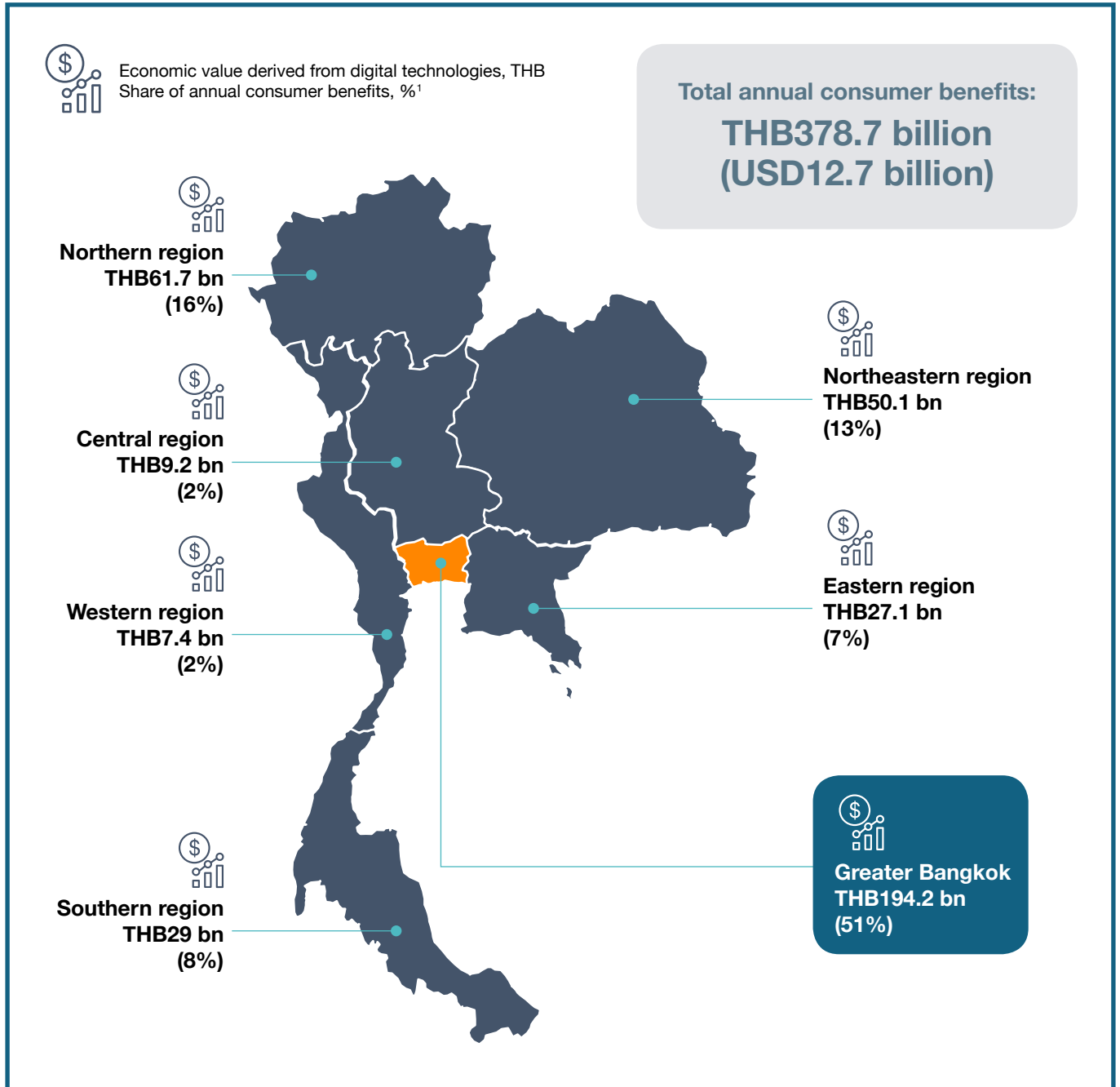
160. Google/AlphaBeta Economic Impact Report survey, n = 505. Percent represents use of online video services to learn advanced digital skills amongst Thais for whom YouTube is their most frequently used online video service.

161. 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/>

162. Google/AlphaBeta Economic Impact Report survey, n = 505. The total consumer surplus represents the economic benefits to consumers in Thailand from using Google Play. See more details in Appendix B for the methodology.

EXHIBIT 11:

MORE THAN HALF OF GOOGLE’S CONSUMER BENEFITS ARE CONCENTRATED WITHIN GREATER BANGKOK



1. Shares are computed using results from a consumer survey conducted in February 2021 with 505 Internet users in Thailand. See Appendix B for details on the methodology.

JOB CREATION AND OTHER BENEFITS TO BROADER SOCIETY

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

GOOGLE INDIRECTLY SUPPORTS JOBS IN THAILAND

At a broader level, Google has facilitated job creation in the economy through its products. Through Google Ads, AdSense and YouTube, Google indirectly supports the creation of **over 63,000 jobs** in Thailand.¹⁶³ These jobs are created through the use of Google products that lead to businesses expanding their customer bases and increasing revenue.¹⁶⁴ For instance, businesses that expand their reach to new markets through advertising via Google Ads, AdSense and YouTube would require increased manpower to meet this additional demand.



Through the Android operating system, It was estimated that **over 58,000** people in Thailand were employed in jobs that were linked to Android in 2020.¹⁶⁵ This includes more than an estimated 19,000 people in Thailand who were employed directly in Android app development jobs. In addition to this direct employment, Android generates employment through indirect jobs (non-tech-related jobs within the app economy), as well as spillover jobs (jobs created outside of the app industry, such as firms supplying app developers with products and services).

GOOGLE EXTENDS DIGITAL SKILLING OPPORTUNITIES TO UNDERSERVED COMMUNITIES

Google’s philanthropic arm, Google.org, has supported The Asia Foundation with a USD3.3 million grant to launch the “Go Digital ASEAN” program. Endorsed by the ASEAN Coordinating Committee on SMEs, the program aims to equip SMEs and underemployed youth, particularly those in rural and isolated areas, with crucial digital skills and tools.¹⁶⁶ Through this grant, The Asia Foundation is working with the Thai Fund Foundation (TFF) and the Inter Mountain Peoples’ Education and Culture in Thailand Association (IMPECT) to provide digital skills training for 2,000 local volunteer trainers in 20 provinces who will go on to share their knowledge with 40,000 micro-entrepreneurs in remote communities.

GOOGLE ENSURES SAFE AND SECURE INTERNET USE

Google helps parents to create a safe online environment for children by developing family-friendly online safety tools such as “YouTube Kids”, “Family Link”, and “Teacher Approved” apps on Google Play. Through “YouTube Kids”, kids can explore YouTube and watch their favorite shows in a contained environment that makes it easier for parents and caregivers to

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

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

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

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

Available at: <https://asiafoundation.org/wp-content/uploads/2020/06/Factsheet-Go-Digital-ASEAN-as-of-19-June-2020.pdf>

guide their journey. Families can also visit the “Google Safety Centre” to learn tips on how to keep the family safe online. In addition, Google Play launched a Kids tab filled with “Teacher approved” apps that are both enriching and entertaining.¹⁶⁷ Apps that have been rated by teachers and meet quality standards receive a “Teacher approved” badge to help parents determine if the app is right for their child.

As part of Google's broader commitment to ensure all Thais have equal opportunities to access digital technology under the theme “Leave No Thai Behind”, Google launched the “Be Internet Awesome” program in 2020. The program is designed for children to learn about the fundamentals of digital citizenship and security so that they can navigate the Internet confidently and safely.¹⁶⁸ In partnership with the Ministry of Education, the Foundation of Thai Suprateacher (FTST) and the Office of the Basic Education Commission (OBEC), Google organized a roadshow event at Phayathai School in Bangkok. The event provided 150 educators training on the “Be Internet Awesome” curriculum and how to utilize lesson plans online to conduct classroom activities for students.¹⁶⁹ Moreover, the curriculum received approval from the Ministry of Education to fulfil sections of the national syllabus.¹⁷⁰

GOOGLE SUPPORTS AI-RELATED RESEARCH TO TACKLE HUMANITARIAN CHALLENGES

Besides improving the productivity of businesses and consumers through digital technology, Google supports researchers in utilizing AI to tackle healthcare issues. In Thailand, over 4.5 million are diagnosed with diabetes annually, with one out of three having

diabetic retinopathy contributing to the loss of sight. However, the country only has 1,500 ophthalmologists. To address the healthcare needs of the population, Google conducted a first-of-its-kind clinical research program, in partnership with the Rajavithi Hospital, to introduce an AI system that detects diabetic retinopathy in screening programs.¹⁷¹ By scanning retinal images of patients, the AI technology is able to detect and diagnose diabetic retinopathy almost immediately. While trained practitioners could only analyze a few hundred photographs a day, the AI system can read an unlimited number of images at a high accuracy rate of 95 percent. This helps detect retinopathy more efficiently and allows patients to receive timely medical intervention to avoid blindness.

GOOGLE PROMOTES THAI ARTS AND CULTURE

Google is committed to preserving the rich cultural heritage of Thailand and has worked with several local partners to bring the country's historical artifacts to an international audience and boost tourism. During the COVID-19 outbreak when travel restrictions were imposed, the Google Arts and Culture platform allowed museums to digitize their artifacts and artworks and feature them as online exhibits. This has been instrumental in sustaining a steady stream of engagement to promote Thai culture and heritage and boost awareness internationally. “Hidden Fruits”, for example, is an online exhibition that provides panoramic views of famous murals on the Google Arts and Culture platform through a partnership with the Art Center in Silpakorn University.¹⁷² In total, Google has collaborated with 15 partners and online exhibitors to showcase local artworks online for visitors across the globe to view.

167. Google The Keyword (2020), “Find high-quality apps for kids on Google Play”. Available at: <https://blog.google/products/google-play/teacher-approved-apps/>

168. Google (2021), “Be Internet Awesome.” Available at: https://beinternetawesome.withgoogle.com/th_th/

169. Thailand Today (2020), “Safe and creative use of digital technology promoted.”

Available at: <https://www.thailandtoday.co/14/02/2020/safe-and-creative-use-of-digital-technology-promoted/>

170. Be Internet Awesome (2019), Smart, Alert, Strong, Kind, Brave.

Available at: https://storage.googleapis.com/gweb-interland.appspot.com/th-all/hub/pdfs/th_Google%20Brand_1267216_BIA_US_Curriculum_v2_15May2018_updated_2.pdf

171. YouTube (2019), “AI for Social Good: Detecting Diabetic Retinopathy.” Available at: <https://www.youtube.com/watch?v=Tt7gwWQ9z58>

172. Google (2021), “Hidden Fruits.” Available at: <https://artsandculture.google.com/exhibit/hidden-fruits/bgKSx0au9Rx3LA>



APPENDIX: METHODOLOGY

A: SIZING THE ECONOMIC VALUE OF DIGITAL TECHNOLOGIES

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



APPENDIX A1: OVERALL APPROACH

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

STEP 1: IDENTIFY DIGITAL TECHNOLOGIES

Several existing research reports on current and emerging digital technologies were reviewed to identify the most relevant technologies to focus on for this analysis in terms of their potential economic impact. There was a large body of research by academics, development practitioners, non-for-profits as well as the private and public sector on the interaction between technologies and economic development. In 2013, McKinsey Global Institute identified 12 disruptive trends that would transform life, business and the global economy.¹⁷³ Of these trends, seven were considered digital in nature: mobile Internet; automation of knowledge; IoT which was often combined with geospatial and satellite technology (e.g., remote sensing); cloud technology; advanced robotics; autonomous and near autonomous vehicles; and additive manufacturing (more commonly known as 3D printing).

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

international development network, Bond, noted rapid changes in the technologies shaping international development between 2016 and 2019. Emerging technologies included big data, financial technology (Fintech), machine learning and even blockchain. These technologies were in no way mutually exclusive and the line between what constituted a different technology versus an application of a technology could be blurred. For example, AI utilized 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.¹⁷⁴

173. 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>

174. 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.

This was guided by the individual industry’s relevance for digital technologies (based on past research quantifying the potential industry benefits of these digital technologies).¹⁷⁵

- Prioritizing 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.

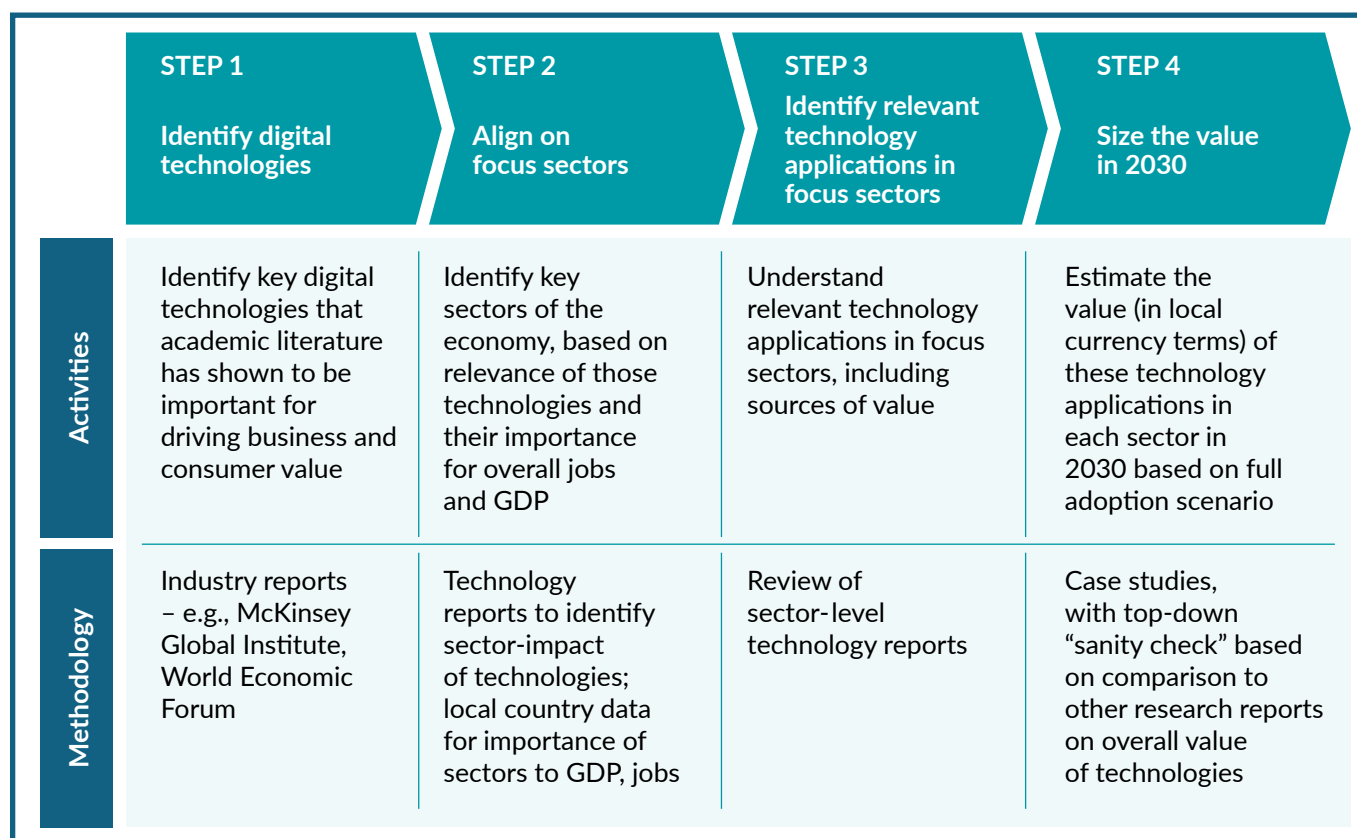
Based on these steps, ten sectors were selected.¹⁷⁶ These sectors consisted of Agriculture and food (including food manufacturing); Consumer, retail and hospitality services; Education and training; Financial services; Government; Health; Infrastructure (including utilities such as energy and water); Manufacturing; Transport services; and Resources (including mining and oil & gas).

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.

EXHIBIT A1:

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



175. 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%20Global%20Institute%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>).

176. In Thailand, all ten sectors have fulfilled the criterion in Step 2.

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, categorized by sector and key digital technology, is shown in Exhibit 2 in Chapter 1. Several emerging digital technologies such as blockchain were considered but not analyzed 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 analyzed. 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 modeled 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 summarizes the key metrics and sources used commonly across the sizing of the economic opportunities of digital technology applications.

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

TABLE 1: KEY METRICS AND SOURCES FOR SIZING ECONOMIC OPPORTUNITIES

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

AGRICULTURE AND FOOD

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. PRECISION FARMING TECHNOLOGIES		PRODUCTIVITY GAINS/COST SAVINGS
Data-driven optimization 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. Thailand Development Research Institute (2017) found that two years after implementing precision agriculture, local farmers were able to increase their yields by 27 percent. 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.	<ul style="list-style-type: none"> Thailand Development Research Institute (2017)¹⁷⁷ World Bank¹⁷⁸
2. 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 10 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.	<ul style="list-style-type: none"> McKinsey Global Institute (2014)¹⁷⁹ Food and Land Use Coalition¹⁸⁰
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. PricewaterhouseCoopers (2015) estimated the global cost of food fraud, proxied by lost sales due to adverse health consequences, to be between USD30 billion to USD40 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.	<ul style="list-style-type: none"> Fast Company (2017)¹⁸¹ PricewaterhouseCoopers (2015)¹⁸² Food and Agriculture Organisation of the United Nations¹⁸³

177. Thailand Development Research Institute (2017). Agriculture 4.0: Obstacles and how to break through. Available at: <https://tdri.or.th/en/2017/06/agriculture-4-0-obstacles-break/>

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

179. McKinsey Global Institute (2014). Three paths to sustained economic growth in Southeast Asia.

Available at: <https://www.mckinsey.com/featured-insights/asia-pacific/three-paths-to-sustained-economic-growth-in-southeast-asia>

180. 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>

181. 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>

182. PricewaterhouseCoopers (2015). Food fraud vulnerability assessment. Available at: <https://www.pwc.com/sg/en/industries/assets/food-fraud-vulnerability-assessment.pdf>

183. Food and Agriculture Organisation of the United Nations (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 labor, 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 labor requirements, inventory efficiencies and lower real estate costs. Country-level estimate was derived based on domestic e-commerce retail sales and operating costs (assuming constant growth rates).	<ul style="list-style-type: none"> McKinsey Global Institute (2013)¹⁸⁴
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 4 percent of retail sales were lost due to stock outs, and that 35 percent to 40 percent of this value may be recaptured using IoT. Country-level estimate was derived based on domestic retail sales.	<ul style="list-style-type: none"> McKinsey Global Institute (2013)¹⁸⁵
3. AUTOMATION AND AI CUSTOMER SERVICE IN HOTELS		INCREASED REVENUES
Use of AI and automated services for remote check-ins at hotels	Sized based on increased revenues from higher efficiency in hotel verification procedures. Colliers International (2019) estimates that hotel revenues could increase by ten percent through AI. The Vulcan Post reported that each hotel verification procedure typically took ten minutes. The Singapore Tourism Board estimated that the E-visitor Authentication system could eliminate manual processes and reduce check-in time by up to 70 percent. Country-level estimate was derived based on hotel revenue.	<ul style="list-style-type: none"> Colliers International (2018)¹⁸⁶ The Vulcan Post (2018)¹⁸⁷ Singapore Tourism Board (2019)¹⁸⁸
4. DATA ANALYTICS ON TRAVEL PATTERNS		INCREASED REVENUES
Use of big data analytics in predicting consumer behavior	Sized based on increased revenues from better targeted promotions to tourists. Boston Consulting Group (2020) estimated that brands experienced a revenue uplift of 6 to 10 percent from integrating proprietary data to create personalized experiences. Country-level estimate was derived based on tourism revenue.	<ul style="list-style-type: none"> Boston Consulting Group (2020)¹⁸⁹

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

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186. 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>

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

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

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

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

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

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

CONSUMER, RETAIL AND HOSPITALITY (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
5. ONLINE F&B DELIVERY SERVICES		INCREASED REVENUES
Use of online delivery service	Sized based on increase in revenues from capturing F&B orders placed online. The Straits Times (2017) reported that restaurants have seen revenues rise by 15 percent after partnering food delivery firms. Country-level estimate was derived based on domestic F&B revenue.	<ul style="list-style-type: none"> The Straits Times (2017)¹⁹⁰

EDUCATION AND TRAINING

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. E-CAREER CENTERS AND DIGITAL JOBS PLATFORM		GDP INCREMENTS
Use of online job listing platforms and matching of candidate profiles to available jobs based on algorithms	Sized based on GDP contributions from higher employment rate. McKinsey Global Institute (2015) estimated the impact on employment rates on different countries, stating that these were different for each country, depending on its labor market characteristics, education and income levels and demographic trends. Country-level estimate was derived based on national employment rate, labor force and GDP per capita.	<ul style="list-style-type: none"> McKinsey Global Institute (2015)¹⁹¹
2. PERSONALIZED LEARNING		GDP INCREMENTS
Use of digital technologies to provide personalized and remote learning opportunities for students	Sized based on increase in GDP from higher employment rate. McKinsey Global Institute (2018) estimated that personalized 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, labor force and GDP per capita.	<ul style="list-style-type: none"> McKinsey Global Institute (2018)¹⁹² World Bank¹⁹³
3. ONLINE RETRAINING PROGRAMS		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 programs 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, labor force and GDP per capita.	<ul style="list-style-type: none"> McKinsey Global Institute (2018)¹⁹⁴ World Bank¹⁹⁵

190. The Straits Times (2017), "Delivery sales drive up eateries' revenues." Available at: <https://www.straitstimes.com/business/delivery-sales-drive-up-eateries-revenues>

191. 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>

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

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

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

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

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

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

FINANCIAL SERVICES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. BIG DATA ANALYTICS		INCREASED REVENUES
Increased lending to small and medium-sized enterprises (SMEs) at higher margins due to big data	Sized based on additional revenue generated from increased lending to SMEs at higher margins. McKinsey Global Institute (2014) estimated that lending to SMEs would increase by 16 percent to 33 percent due to big data analytics, with increased margins between 1.4 percent to 1.8 percent. Country-level estimate was derived based on annual total lending to SMEs.	<ul style="list-style-type: none"> McKinsey Global Institute (2014)¹⁹⁶
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 digitization such as the electronic onboarding of clients, leveraging machine learning and robotics to create operational improvements and the use of public cloud infrastructure to reduce processing capacity. McKinsey Global Institute (2019) estimated that the cost-efficiency in South Korea from digital banking services is 1.5 percent. Country-level cost savings was derived based on domestic banking sector operating costs.	<ul style="list-style-type: none"> McKinsey Global Institute (2019)¹⁹⁷
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 10 percent of banks' operating costs on average. Country-level estimate of efficiency savings was derived based on domestic banking sector costs.	<ul style="list-style-type: none"> Juniper Research (2017)¹⁹⁸ KPMG (2013)¹⁹⁹

196. 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>

197. McKinsey Global Institute (2019), *Bracing for consolidation: The quest for scale*. Available at: <https://www.mckinsey.com/~/media/McKinsey/Industries/Financial%20Services/Our%20Insights/Bracing%20for%20consolidation%20in%20Asia%20Pacific%20banking%20The%20quest%20for%20scale/Asia-Pacific-Banking-Review-2019-vF.pdf>

198. Juniper Research (2017), *How Reg Tech can save banks billions*.

Available at: <https://www.juniperresearch.com/document-library/white-papers/how-regtech-can-save-banks-billions>

199. 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. InfoWorld (2019) reported that companies experienced between 25 percent to 55 percent cost savings after migrating to the cloud. Country-level estimate was derived based on government ICT expenditure and hardware costs.	<ul style="list-style-type: none"> • InfoWorld (2019)²⁰⁰
2. E-SERVICES		COST SAVINGS
Reduction in operating expenditure from using e-services	Sized based on the reduction in operating expenditure from moving services online, pre-filing of tax forms, data availability and performance dashboards. McKinsey Global Institute (2011) estimated that between 15 percent to 20 percent of operating expenditure was eliminated in Europe after moving to e-services. The study also reported that the addressable base for such a reduction was about 20 percent to 25 percent of government expenditure. Country-level estimate was derived based on government operating expenditure.	<ul style="list-style-type: none"> • McKinsey Global Institute (2011)²⁰¹
3. E-PROCUREMENT		COST SAVINGS
Cost savings from using e-procurement channels	Sized based on the reduction in transaction costs from shifting to e-procurement for government projects. In South Korea, the Public Procurement Service estimated that the government saved USD8 billion in transaction costs annually through reduced labor costs, reduced lead-time and a more streamlined process. Country-level estimate was derived based on public procurement volumes.	<ul style="list-style-type: none"> • Public Procurement Service²⁰²
4. GEOGRAPHIC INFORMATION SYSTEM ENABLED TAX COLLECTION		INCREASED TAX COLLECTION
Use of big data and location-based information to improve tax collection	Sized based on the increase in tax collected from using big data and GIS-enabled services. In Brazil, the government managed to raise its Federal Tax collection by about 13 percent through adopting big data in audit corporate tax declaration. Country-level estimate was derived based on the country's tax evasion rate as a percentage of GDP relative to Brazil's.	<ul style="list-style-type: none"> • Bill & Melinda Gates Foundation and AlphaBeta (2018)²⁰³

200. InfoWorld (2019), "Can the cloud save you money? These companies say yes".

Available at: <https://www.infoworld.com/article/3445206/can-the-cloud-save-you-money-these-companies-say-yes.html>

201. 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%20Global%20Institute%20big%20data%20full%20report.pdf>

202. Public Procurement Service (2012), e-Procurement Experience in Korea: Implementation and Impact.

Available at: <https://www.europarl.europa.eu/document/activities/cont/201207/20120710ATT48620/20120710ATT48620EN.pdf>

203. 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 5 to 10 percent of government transfer payments globally are improper payments that could be addressed by adopting data analytics. Country-level estimate was derived based on the country's GDP.	<ul style="list-style-type: none"> McKinsey & Company (2017)²⁰⁴

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 10 percent to 20 percent savings for the healthcare system. Country-level estimate was derived from the World Bank's estimate of total healthcare spend and the country's share of spending on chronic diseases.	<ul style="list-style-type: none"> McKinsey Global Institute (2013)²⁰⁵ World Bank²⁰⁶
2. TELEHEALTH APPLICATIONS		COST SAVINGS
Use of internet and mobile technologies for medical consultations	Sized based on cost savings to the healthcare system through reduced doctor visits. Goldman Sachs (2015) estimated that the US healthcare system could save USD100 billion by adopting telehealth. Country-level estimate was derived based on relative national healthcare expenditure.	<ul style="list-style-type: none"> Goldman Sachs (2015)²⁰⁷

204. 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>

205. 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>

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

207. Goldman Sachs (2015), The digital revolution comes to US healthcare. Available at: https://massdigitalhealth.org/sites/mehi/files/documents/eHealth_Cluster/The%20Digital%20Revolution%20comes%20to%20US%20Healthcare_GoldmanSachs_2015.pdf

HEALTH (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
3. DATA-BASED PUBLIC HEALTH INTERVENTIONS		GDP INCREMENTS
Use of analytics to direct highly targeted health interventions for at-risk populations	Sized based on the economic value of reduced disability-adjusted life years (DALYs) due to timely public health interventions. McKinsey Global Institute (2018) indicated that the most significant and measurable impacts were on maternal and child health, as well as public sanitation and hygiene. It estimated a 0.4 percent reduction in DALYs for "high-income" countries, and 1.5 percent for other countries. Income of countries classified based on the World Bank's definition. Economic value was taken to be this multiplied by GDP per capita, and was estimated based on the proportion of the population suffering from chronic diseases. Country-level estimate was derived based on national population sizes and GDP per capita.	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²⁰⁸ • UN Population Division (2018)²⁰⁹ • World Bank²¹⁰
4. DETECTION OF COUNTERFEIT PHARMACEUTICAL DRUGS		COST SAVINGS
Use of IoT and advanced analytics to detect counterfeit drugs	Sized based on cost savings from reduced counterfeit pharmaceutical drugs in the country due to higher detection rates. EU IPO (2016) estimated that the annual cost of counterfeit pharmaceutical drugs to Europe's pharmaceutical industry was EUR10 billion. McKinsey Global Institute (2013) assessed that 30 percent to 50 percent of all drugs sold were addressable by this technology, and that its success rate was between 80 percent and 100 percent. Country-level estimate on the national cost of counterfeit drugs was derived based on the country's relative healthcare expenditure.	<ul style="list-style-type: none"> • EU Intellectual Property Office (2016)²¹¹ • McKinsey Global Institute (2013)²¹²
5. SMART MEDICAL DEVICES AND WEARABLES		GDP INCREMENTS
Analyzing data across connected implants, smart medical devices and wearables in personalized 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 1 percent reduction in high-income countries, and 0.6 percent in other countries. The economic value was taken to be this multiplied by GDP per capita. Classification of the country's income level was based on the World Bank's definition. Country-level estimate was derived based on national population sizes and GDP per capita, and was estimated based on the proportion of the population suffering from chronic diseases.	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²¹³ • UN Population Division (2018)²¹⁴ • World Bank²¹⁵

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

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

209. UN Population Division (2018). Available at: <https://esa.un.org/unpd/wpp/DataQuery/>

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

211. EU Intellectual Property Office (2016), *The economic cost of IPR infringement in the pharmaceutical industry*.

Available at: <https://euipo.europa.eu/ohimportal/en/web/observatory/ipr-infringement-pharmaceutical-sector>

212. 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>

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

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

214. UN Population Division (2018). Available at: <https://esa.un.org/unpd/wpp/DataQuery/>

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

HEALTH (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
6. ELECTRONIC MEDICAL RECORDS		COST SAVINGS
Use of cloud-based electronic medical record systems	Sized based on the cumulative savings (such as saving of physician and nursing time) from adopting electronic health records (EHR). McKinsey Global Institute (2014) estimated that widespread adoption of electronic medical records could increase India's annual economic value by USD3 billion. The global economic impact of EHR was estimated based on India's share of the global healthcare expenditure. Country-level estimate was derived based on its relative national healthcare expenditure according to World Bank data and the global EHR market growth rates.	<ul style="list-style-type: none"> • McKinsey Global Institute (2014)²¹⁶ • World Bank²¹⁷ • Transparency Market Research²¹⁸

INFRASTRUCTURE

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. SMART GRIDS		COST SAVINGS
Use of digital communications technology in detecting and optimizing electricity networks	Sized based on cost savings from energy savings due to lower consumption and efficiency improvements. The International Herald Tribune (2018) reported that engineers indicated a five to 10 percent in energy savings from using smart grids. Country-level estimate was derived based on total electricity consumption. Business and Sustainable Development Commission (2017) estimated that the global average wholesale price of electricity was USD100/Mwh.	<ul style="list-style-type: none"> • The International Herald Tribune (2011)²¹⁹ • World Bank²²⁰ • Business and Sustainable Development Commission (2017)²²¹
2. 5D BIM AND PROJECT MANAGEMENT TECHNOLOGIES		COST SAVINGS
Use of integrated modeling platforms to simulate construction cost and timeline impacts of decisions in project planning, design, construction, operations, and maintenance	Sized based on cost reductions from improved coordination between different development parameters, as well as the continuous insight provided on project costs. McKinsey Global Institute (2013) estimated that streamlining project delivery could bring about 15 percent savings to infrastructure cost, with 15 percent to 25 percent of these savings coming from 5D BIM technologies. Country-level estimate was derived based on domestic construction sector costs.	<ul style="list-style-type: none"> • McKinsey Global Institute (2013)²²² • Global Infrastructure Outlook²²³

216. 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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218. Transparency Market Research (2018), "Electronic Health Records Market". Available at: <https://www.transparencymarketresearch.com/electronic-health-records-market.html>

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220. World Bank statistics on electric power consumption. Available at: <https://data.worldbank.org/indicator/EG.USE.FLFC.KH.PC>

221. 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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Available at: <https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/infrastructure-productivity>

223. 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
<p>Using data from sensors to ensure prompt and predictive maintenance, minimizing downtime</p>	<p>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 USD0.90/m³. Country-level estimate was derived based on the country’s average commuting time, population, GDP per capita and domestic water consumption.</p>	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²²⁴ • World Bank²²⁵ • UNESCO-IHE (2011)²²⁶ • Business and Sustainable Development Commission (2017)²²⁷
4. SMART BUILDINGS		COST SAVINGS
<p>Use of physical sensor networks, energy storage and data analytics to improve resource efficiency of buildings and reduce energy and water consumption, as well as carbon emissions</p>	<p>Sized based on the economic value of the reduction in greenhouse gas emissions (GHG) and water consumption by building automation systems. McKinsey Global Institute (2018) estimated a 2.9 percent reduction in GHG emissions and a 1.7 percent reduction in water consumption for “high-income” countries. The corresponding figures for other countries were 1.4 percent and 1.1 percent. Classification of the country’s income level was based on the World Bank’s definition. Country-level estimate was derived based on its greenhouse gas emissions and water consumption from buildings. Business and Sustainable Development Commission (2017) estimated that the global average price of water was USD0.90/m³ and GHG price was valued at USD50/ton (a global proxy price equating roughly to the financial incentives needed to achieve carbon emissions consistent with a 2-degree pathway).</p>	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²²⁸ • IPCC²²⁹ • World Bank²³⁰ • Business and Sustainable Development Commission (2017)²³¹

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

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

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

226. UNESCO-IHE (2011), *National Water Footprint Accounts*. Available at: <https://waterfootprint.org/media/downloads/Report50-NationalWaterFootprints-Vol1.pdf>

227. Business and Sustainable Development Commission (2017), *Valuing the SDG prize: Unlocking business opportunities to accelerate sustainable and inclusive growth*.

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

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

229. IPCC estimates on global greenhouse gas emissions. Available at: <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

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

231. 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 3 percent increase in profit margin from big data analytics in manufacturing. Country-level estimate was derived based on domestic manufacturing sector GDP.	<ul style="list-style-type: none"> McKinsey Global Institute (2011)²³²
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 customization. McKinsey & Company (2017) estimated that the global economic value of this technology could reach between USD100 billion and USD250 billion by 2025. Current economic value was calculated based on today's global manufacturing sector GDP, and assuming a constant growth rate for the 2030 forecast. Country-level estimate was derived based on the domestic manufacturing sector GDP as a share of the global figure.	<ul style="list-style-type: none"> McKinsey & Company (2017)²³³
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 5 percent savings in distribution and supply chain operating costs could amount to 2 percent to 6 percent of manufacturing sales. Country-level estimate was derived based on domestic manufacturing sector operating costs.	<ul style="list-style-type: none"> McKinsey Global Institute (2011)²³⁴
4. AUTOMATION AND ROBOTICS		PRODUCTIVITY GAINS
Productivity boost from automating mundane and repetitive production tasks	Sized based on productivity boost to manufacturing processes from robots performing mundane and repetitive tasks. McKinsey & Company (2017) estimated that automation and robotics could improve productivity ranging from 0.8 to 1.4 percent of global GDP annually from 2015 to 2065. Country-level estimate was derived based on domestic manufacturing sales.	<ul style="list-style-type: none"> McKinsey & Company (2017)²³⁵

232. 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>

233. 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>

234. 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>

235. 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>

RESOURCES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. SMART EXPLORATION AND AUTOMATION IN MINING OPERATIONS		
PRODUCTIVITY GAINS / COST SAVINGS		
Use of big data to analyze 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 USD250 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.	<ul style="list-style-type: none"> McKinsey & Company (2015)²³⁶
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 USD15 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.	<ul style="list-style-type: none"> McKinsey & Company (2015)²³⁷
3. PREDICTIVE MAINTENANCE TECHNOLOGIES		
PRODUCTIVITY GAINS/COST SAVINGS		
Use of remote operations centers 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 USD105 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.	<ul style="list-style-type: none"> McKinsey & Company (2015)²³⁸

236. 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>

237. 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>

238. 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>

TRANSPORT SERVICES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
1. SMART ROADS		TIME SAVINGS
Use of real-time public transit information, intelligent traffic signals and real-time road navigation to reduce commuting time	Sized based on the economic value of real-time public transit information, intelligent traffic signals and real-time road navigation. McKinsey Global Institute (2018) estimated a 2.2 percent reduction in average commuting time for “high-income” countries, and 5.5 percent for other countries. Classification of the country’s income level was based on the World Bank’s definition. Country-level estimate was derived based on the average commuting time, population and GDP per capita.	<ul style="list-style-type: none"> • McKinsey Global Institute (2018)²³⁹ • World Bank²⁴⁰
2. SMART PORTS		COST SAVINGS
Use of IoT to enhance port efficiency	Sized based on cost savings from reduced logistics costs due to IoT-enabled data collection and monitoring, as well as intelligent decision-making capabilities. Accenture and SIPG (2016) estimated 3.6 percent savings in logistics costs from building smart ports. Country-level estimate was derived based on logistics sector costs (based on indicated percentages of the country’s GDP).	<ul style="list-style-type: none"> • Accenture and SIPG (2016)²⁴¹ • Council of Supply Chain Management Professionals (2013)²⁴² • World Bank (2016)²⁴³
3. AUTONOMOUS VEHICLES		COST SAVINGS
Use of AI and sensors to increase fuel efficiency	Sized based on the projected gains in fuel efficiency, compared to conventional vehicles. McKinsey Global Institute (2013) estimated that autonomous cars could travel more closely together, reducing air resistance and improving fuel efficiency by 15 percent to 20 percent. Country-level estimate was derived based on the number of cars, projected number of autonomous vehicles, annual fuel requirement, and cost of fuel.	<ul style="list-style-type: none"> • McKinsey Global Institute (2013)²⁴⁴
4. GEOSPATIAL SERVICES		PRODUCTIVITY GAINS/COST SAVINGS
Productivity impact of using location-based information	Sized based on estimated productivity impact geospatial services in the transport sector (land, sea and air). AlphaBeta (2017) estimated that geospatial services could improve productivity of land, sea and air transport by 2.5 percent to 5 percent. These benefits include reduced logistics costs, improved network design and management. Country-level estimate was derived based on the size of the land, sea and air transport sector.	<ul style="list-style-type: none"> • AlphaBeta (2017)²⁴⁵

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

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

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

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

Available at: <https://www.scribd.com/document/461158472/accenture-connected-ports-driving-future-trade-pdf>

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

Available at: <http://www.scdigest.com/assets/newsviews/13-06-20-2.php?cid=7168&ctype=content>

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

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

Available at: <https://www.mckinsey.com/--/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Disruptive%20technologies/McKinsey%20Global%20Institute/Disruptive%20technologies%20Full%20report%20May2013.ashx>

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

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

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

To estimate the economic value of technology applications that could help businesses and organizations 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, 22 were assessed to have the potential to manage the economic impacts of the pandemic in Thailand's context, through three channels. These are:

- Facilitating customer interactions, transactions and marketing through digital platforms
- Enabling the continuity of business operations amid remote working arrangements; and
- Reducing logistical bottlenecks amidst global and regional supply chain disruptions.

Exhibit A2 shows the list of these 22 COVID-19 relevant technology applications, grouped by their respective sectors and the specific channel through which they deliver COVID-19 relevant impact.



EXHIBIT A2:**OF THE 40 APPLICATIONS, 22 HAVE THE POTENTIAL TO ALLOW BUSINESSES TO THRIVE DESPITE THE COVID-19 PANDEMIC THROUGH THREE KEY CHANNELS**

CHANNEL	SECTOR	COVID-19 RELEVANT TECHNOLOGY APPLICATION/S
Facilitating 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 centers and digital jobs platforms 4. Online retraining programs
	Financial services	5. Digital banking services
	Health	6. Telehealth applications
Enabling the continuity of business operations amid remote working arrangements	Agriculture & food	7. Precision farming technologies
	Consumer, retail and hospitality	8. IoT-enabled inventory management 9. Automation and AI customer service in hotels
	Government	10. Government e-services 11. E-procurement
	Health	12. Remote patient monitoring 13. Smart medical devices and wearables
	Infrastructure	14. Smart grids 15. 5D BIM and project management technologies 16. Predictive maintenance technologies
	Manufacturing	17. Big data analytics 18. Automation and robotics
	Resources	19. Smart exploration and automation in mining operations
Reducing logistical bottlenecks amidst global and regional supply chain disruptions	Agriculture & food	20. IoT-enabled supply chain management (food)
	Manufacturing	21. IoT-enabled supply chain management (manufacturing)
	Transport services	22. Smart ports

SOURCE: AlphaBeta analysis

APPENDIX A4: BREAKDOWN OF THAILAND'S DIGITAL OPPORTUNITY BY REGION

Regional splits of the economic opportunity presented by digital technologies in Thailand were determined based on two metrics. The first metric refers to the breakdown of the number of businesses by sector and province, while the second refers to the breakdown of GDP contribution by sector and province. Regional splits of the total digital opportunity were derived based on the average of the two metrics by region. The official administrative and jurisdictional set of seven regions and their corresponding 77 provinces were used, and are as follows:

1. **Greater Bangkok region:** Bangkok Metropolis, Samut Prakan, Pathum Thani, Samut Sakhon, Nakhon Pathom, Nonthaburi)
2. **Central region:** Saraburi, Singburi, Chai Nat, Ang Thong, Lop Buri, Phra Nakhon Sri Ayuthaya
3. **Eastern region:** Chon Buri, Chachoengsao, Rayong, Trat, Chanthaburi, Nakhon Nayok, Prachinburi, Sa Kaeo
4. **Western region:** Ratchaburi, Kanchanaburi, Phachuap Khiri Khan, Phetchaburi, Suphan Buri, Samut Songkhram
5. **Southern region:** Phuket, Surat Thani, Ranong, Phangnga, Krabi, Chumphon, Nakhon Si Thammarat, Songkhla, Satun, Yala, Trang, Narathiwat, Phatthalung, Pattani
6. **Northern region:** Chiang Mai, Lampang, Uttaradit, Mae Hong Son, Chiang Rai, Phrae, Lamphun, Nan, Phayao, Nakhon Sawan, Phitsanulok, Kam Phaeng Phet, Uthai Thani, Sukothai, Tak, Phichit, Phetchabun
7. **Northeastern region:** Khon Kaen, Udon Thani, Loei, Nong Khai, Mukdahan, Nakhon Phanom, Sakon Nakhon, Kalasin, Nakhon Ratchasima, Chaiyaphum, Yasothon, Ubon Ratchathani, Roi Et, Buri Ram, Surin, Maha Sarakham, Si Sa Ket, Nong Bua Lam Phu, Am Nat Chareon, Bueng Kan



Table 2 shows the inputs and sources used for calculating the breakdown of digital opportunity by sector and province.

TABLE 2: INPUTS AND SOURCES FOR CALCULATING THE BREAKDOWN OF DIGITAL OPPORTUNITY BY SECTOR AND PROVINCE

METRIC	SOURCE
Share of businesses by sector in each province	<ul style="list-style-type: none"> National Statistical Office (2016)²⁴⁶
Share of Gross Domestic Product (GDP) by sector for each province	<ul style="list-style-type: none"> Office of the National Economic and Social Development Council (2018), "Gross Regional and Provincial Product Chain Volume Measure 2018 Edition". Available at: https://www.nesdc.go.th/nesdb_en/ewt_w3c/main.php?filename=national_account

246. National Statistical Office (2016), "Number of Establishments by Economic Activity Region and Province Year: 2016". Available at: <http://www.nso.go.th/sites/2014en>

247. Office of the National Economic and Social Development Council (2018), "Gross Regional and Provincial Product Chain Volume Measure 2018 Edition". Available at: https://www.nesdc.go.th/nesdb_en/ewt_w3c/main.php?filename=national_account



B: SIZING GOOGLE'S ECONOMIC IMPACT IN THAILAND

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, YouTube, Google Ads, AdSense, and Google Play.

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

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

of free services, including consumer surplus based on the consumer's willingness to pay (how much an individual values a Google product). Primary data used in the analysis was collected from a consumer survey of 505 Internet users in Thailand. This sample size is statistically significant based on Thailand'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 Thailand's Internet population based on demographic variables including age, income level, and the geographical location of respondents. In addition to the consumer survey, this research also leveraged big data gathering methods such as that used to determine the amount of time saved by using Google Maps for driving and public transport, as well as third-party sources. The Google products included in this analysis of consumer benefits include Google Search, Google Play, YouTube, Google Drive, Photos, Docs, and Sheets.



BUSINESS AND JOB CREATION BENEFITS

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

GOOGLE SEARCH AND ADS

The business benefits of Google Search and Ads were estimated using two methods – a top-down approach and a bottom-up approach. The top-down approach estimated the total size of the search advertising segment in the country and the proportion of this space that Google represents. The bottom-up

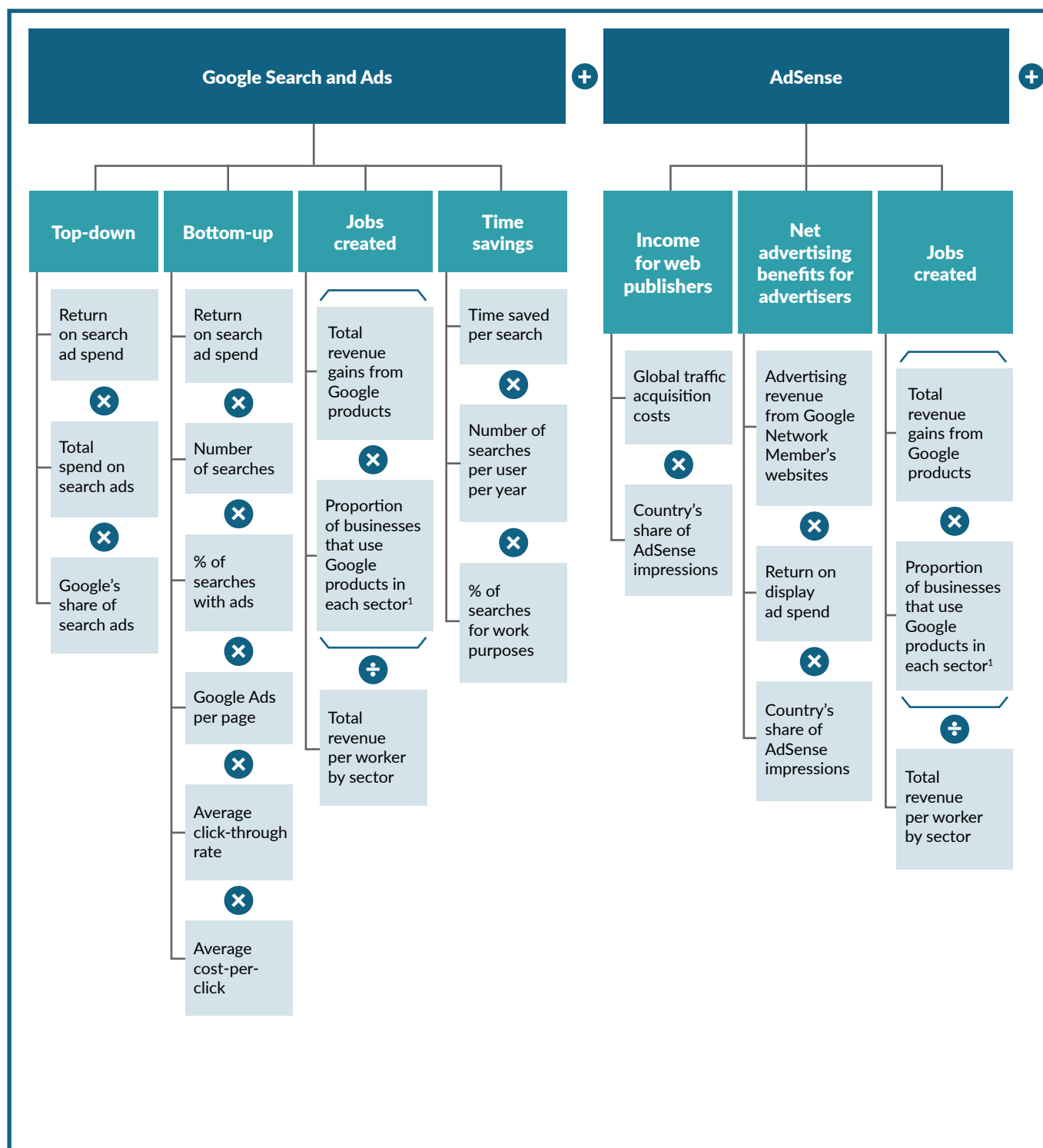
approach estimated the number of Google searches conducted in the country, the proportion of searches with advertisements, the number of advertisements per search, the average click-through rate (CTR), and the average cost-per-click (CPC).

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.²⁴⁸ This ROI ratio was developed from a few assumptions:

- Using a large sample of proprietary data, Hal Varian, Google's Chief Economist, estimated that businesses received USD2 in revenue for every USD1 spent on advertising. This finding was published in the American Economic Review in 2009.
- Businesses also receive free clicks because of unpaid Google Search. Using research published in the International Journal of Internet Marketing and Advertising in 2009 by Jansen and Spink, the Google US Economic Impact Study assumed

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

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

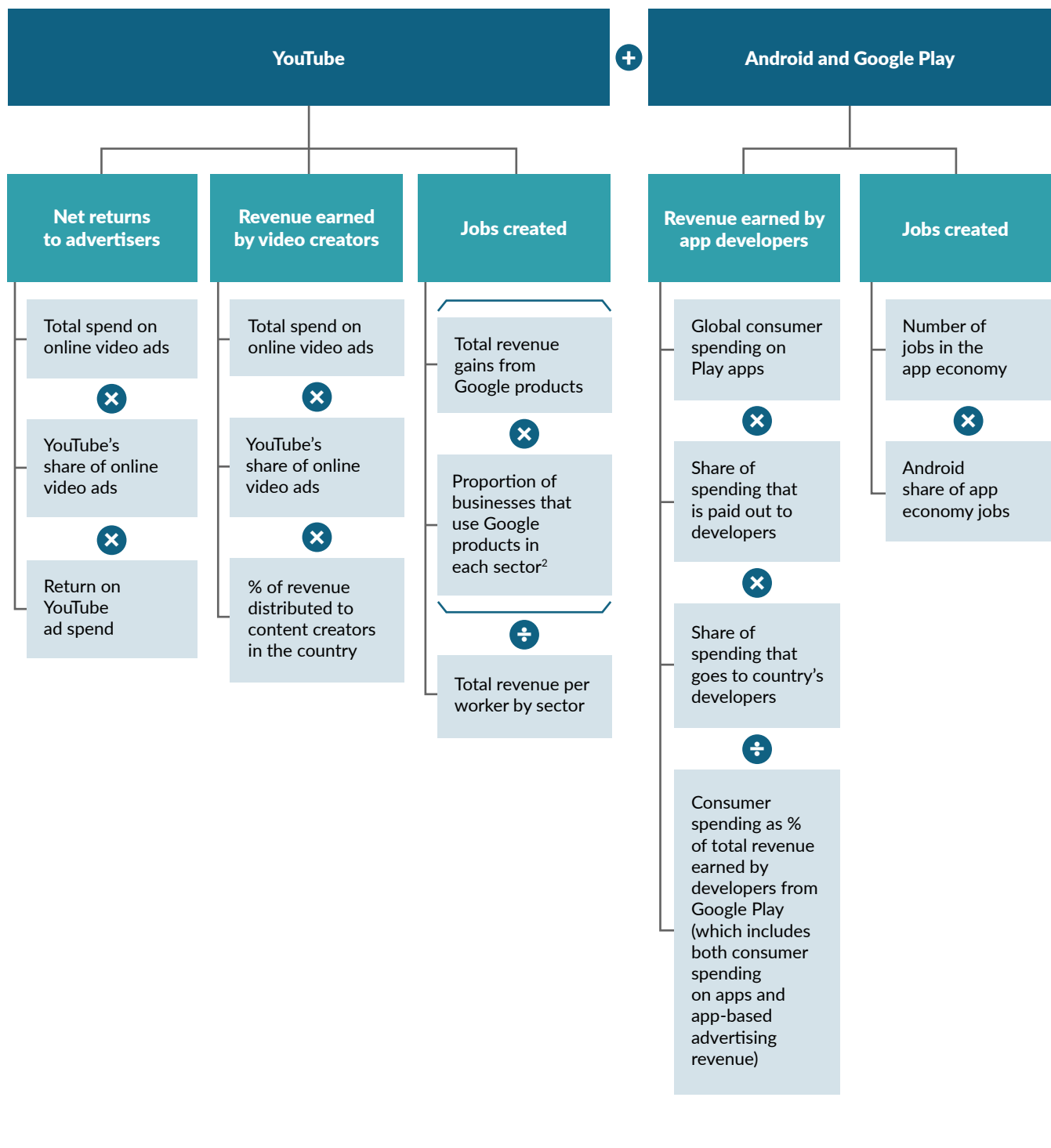


1. In the absence of such publicly available data, this was proxied based on the proportion of businesses that use websites in each sector in Malaysia, which has a similar economic development level as Thailand. This data is available from Department of Statistics Malaysia (2018), "Usage of ICT and e-commerce by establishment". Available at: <https://news.statistics.gov.my/news-portalx/ep/epFreeDownloadContentSearch.seam?cid=385487>

2. In the absence of such publicly available data, this was proxied based on the proportion of businesses that use a social media account in each sector in Malaysia, which has a similar economic development level as Thailand. This data is available from Department of Statistics Malaysia (2018), "Usage of ICT and e-commerce by establishment". Available at: <https://news.statistics.gov.my/news-portalx/ep/epFreeDownloadContentSearch.seam?cid=385487>

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

SOURCE: AlphaBeta analysis



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 3 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.²⁴⁹ 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.²⁵⁰ 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 4 shows the inputs and sources used for estimating the business benefits of AdSense.

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

YOUTUBE

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

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

GOOGLE PLAY

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

Table 7 shows the inputs and sources used for estimating the business benefits of Google Play.

BREAKDOWN OF BUSINESS BENEFITS BY REGION

We estimated the breakdown of Google's business benefits by region through various metrics.

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

250. 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.

These metrics provided very similar approximations for each state's share of benefits; however, some carry more weight for states that have a larger share of output or number of businesses. To minimize the weighting of such metrics, we took an average of the metrics listed in the table below.

Table 8 shows the inputs and sources used for calculating the breakdown of business benefits by region.

JOB CREATION BENEFITS FROM GOOGLE ADS, ADSENSE AND YOUTUBE

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

all sectors. In the absence of publicly available data for the proportion of businesses that use Google's products, this was proxied based on the proportion of businesses that use websites (for Google Ads and AdSense) or social media accounts (for YouTube). The share of businesses using websites and the share of businesses with a social media account were proxied with website usage and social media adoption among businesses in Malaysia, which has a similar economic development level as Thailand. Table 9 shows the inputs and sources used for estimating the job impact from Google Ads, AdSense and YouTube.

EMPLOYMENT IMPACT FROM ANDROID ECOSYSTEM

Our estimate of employment supported by Android is based on the methodology developed by Mandel (2017).²⁵¹ Their approach employs data on job postings from indeed.com to size employment in the app economy (see reference for details). The methodology distinguishes between direct, indirect and spillover jobs within the app economy, each accounting for one-third of total jobs in the app economy.

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

The number of jobs in Thailand's app economy is estimated based on the country's app intensity multiplied by the total number of employed workers in the country. Table 10 shows the inputs and sources used for estimating the number of jobs created through the Android ecosystem.

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TABLE 3: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF GOOGLE SEARCH AND ADS

APPROACH	METRIC	SOURCE
Top down approach	Total market expenditure on search advertising	<ul style="list-style-type: none"> Statista (2020)²⁵²
	Google Search's market share	<ul style="list-style-type: none"> StatCounter (2020)²⁵³
Bottom-up approach	Google Search traffic data	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2020)
	% pages that display advertisements	<ul style="list-style-type: none"> Varian (2009)²⁵⁴, Jansen & Spink (2009)²⁵⁵ Deloitte (2015)²⁵⁶
	Advertisements per page on average	<ul style="list-style-type: none"> Varian (2009)²⁵⁷, Jansen & Spink (2009)²⁵⁸ Deloitte (2015)²⁵⁹
	CTR for Search (Estimate)	<ul style="list-style-type: none"> Word Stream (2019)²⁶⁰ BannerTag (2019)²⁶¹
	Average CPC for Search (Estimate)	<ul style="list-style-type: none"> Word Stream (2018)²⁶² Adstage (2019)²⁶³
Both Methods	ROI ratio Lower and Upper Bound	<ul style="list-style-type: none"> Varian (2009)²⁶⁴, Jansen & Spink (2009)²⁶⁵ Deloitte (2015)²⁶⁶

TABLE 4: 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	<ul style="list-style-type: none"> Alphabet (2019)²⁶⁷
	ROI ratio	<ul style="list-style-type: none"> Gupta et al. (2015)²⁶⁸
Revenue to content creators	Global traffic acquisition costs related to AdSense	<ul style="list-style-type: none"> Alphabet (2019)²⁶⁹
Both estimates	Country share of global impressions on AdSense (Estimate)	<ul style="list-style-type: none"> DoubleClick (2012)²⁷⁰ Internet World Stats (2021)²⁷¹

252. Statista (2020), "Search advertising – Thailand". Available at: <https://www.statista.com/outlook/219/126/search-advertising/thailand>

253. StatCounter (2020), "Search engine market share Thailand". Available at: <https://gs.statcounter.com/search-engine-market-share/all/thailand/#yearly-2019-2019-bar>

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

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

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270. Google DoubleClick (2012), "What's trending in display for publishers?". Available at: <https://www.slideshare.net/RFONNIER/display-business-trends-publisher-edition-google-2012>

271. Internet World Stats (2020), "World Internet Users and 2021 Population Stats". Available at: <https://www.internetworldstats.com/stats6.htm>

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

METRIC	SOURCE
Time saved per search	<ul style="list-style-type: none"> • Varian (2014)²⁷² • Chen et al. (2014)²⁷³
Average daily searches per worker	<ul style="list-style-type: none"> • AlphaBeta Consumer Survey (2021)
% of searches for work purposes	<ul style="list-style-type: none"> • AlphaBeta Consumer Survey (2021)

TABLE 6: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF YOUTUBE

METRIC	SOURCE
Total video advertising spend in country	<ul style="list-style-type: none"> • Statista (2020)²⁷⁴
YouTube's market share	<ul style="list-style-type: none"> • AlphaBeta Consumer Survey (2020)
YouTube ROI ratio	<ul style="list-style-type: none"> • Business Insider (2016)²⁷⁵

TABLE 7: INPUTS AND SOURCES FOR CALCULATING BUSINESS BENEFITS OF GOOGLE PLAY

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

272. Hal Varian (2014), "Economic value of Google" (Presentation).

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TABLE 8: INPUTS AND SOURCES FOR CALCULATING THE BREAKDOWN OF BUSINESS BENEFITS BY REGION

METRIC	SOURCE
Share of GDP for each region	<ul style="list-style-type: none"> Office of the National Economic and Social Development Council (2018)²⁸⁰
Share of businesses in each region	<ul style="list-style-type: none"> National Statistical Office of Thailand (2016)²⁸¹

TABLE 9: INPUTS AND SOURCES FOR CALCULATING JOB IMPACT

APPROACH	METRIC	SOURCE
Revenue per worker by sector	Number of employees in Thailand by sector	<ul style="list-style-type: none"> National Statistical Office (2019)²⁸²
	Total revenue by sector	<ul style="list-style-type: none"> National Statistical Office (2014)²⁸³
Breakdown of business benefits for Google Ads, AdSense and YouTube	Businesses using a website from each sector as % of total	<ul style="list-style-type: none"> Department of Statistics Malaysia (2018)²⁸⁴
	Businesses with a social media account as % of total	<ul style="list-style-type: none"> Department of Statistics Malaysia (2018)²⁸⁵

TABLE 10: INPUTS AND SOURCES FOR CALCULATING ANDROID'S IMPACT ON EMPLOYMENT

ESTIMATION	METRIC	SOURCE
App employment supported by Android	Number of jobs in the app economy	<ul style="list-style-type: none"> AlphaBeta (2017)²⁸⁶ Bank of Thailand (2020)²⁸⁷
	Ratio of direct to indirect and spillover jobs	<ul style="list-style-type: none"> Mandel (2017)²⁸⁸
	Android share of app economy jobs	<ul style="list-style-type: none"> Mandel (2017)²⁸⁹

280. Office of the National Economic and Social Development Council (2018), "Gross Regional and Provincial Product Chain Volume Measure 2018 Edition". Available at: https://www.nesdc.go.th/nesdb_en/ewt_w3c/ewt_dl_link.php?filename=national_account&nid=4317

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

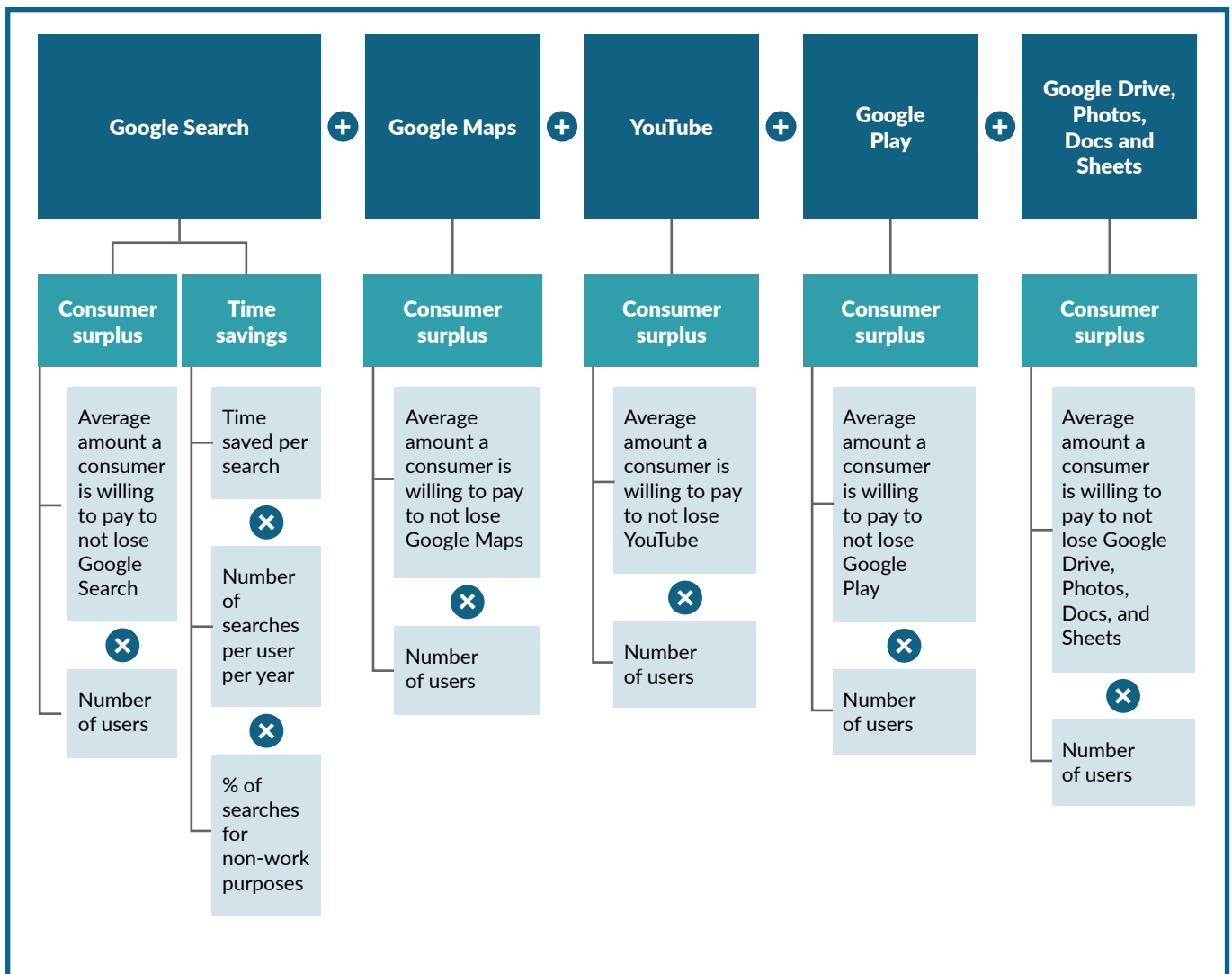
289. Mandel (2018), The App Economy in Vietnam, 2017. Available at: http://www.progressivepolicy.org/wp-content/uploads/2018/01/PPI_VietnamAppEconomy_2018.pdf

CONSUMER BENEFITS

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

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

EXHIBIT B2: METHODOLOGY FOR SIZING CONSUMER BENEFITS FROM GOOGLE



Note: This report’s methodology for measuring Google’s economic impact is consistent with the methodology used in the Google Economic and Social Impact New Zealand 2021 report.
SOURCE: AlphaBeta analysis

GOOGLE SEARCH

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

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

To calculate time savings, we applied time saving estimates from an experiment that measured the time taken to conduct a search online versus a search at the library.²⁹⁰ This study found that a search that takes 21 minutes in the library takes seven 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 the country 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 11 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 favorite online maps service. To calculate the consumer surplus for Google Maps, we multiplied the number of Google Maps users with the average willingness to pay obtained from the consumer survey.

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

GOOGLE PLAY

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

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

GOOGLE DRIVE, PHOTOS, DOCS, AND SHEETS

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

Table 14 shows the inputs and sources used for calculating the consumer benefits of Google Drive, Photos, Docs, and Sheets.

YOUTUBE

We calculated the benefits of YouTube to consumers using willingness to pay, where consumers were asked to value their favorite online video service. Results from the survey of the country's online population were used. 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 specialized statistical software, online marketing, website development, smartphone application development) was also estimated using the consumer survey.

Table 15 shows the inputs and sources used for calculating the consumer benefits of YouTube.

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.

BREAKDOWN OF CONSUMER BENEFITS BY REGION

We estimated the breakdown of Google's consumer benefits by region through three different metrics, namely: 1) the amount that consumers in each region value Google's products per year (WTP); 2) the share

of online population in each region; and 3) the share of Google product users in each region.

Table 16 shows the inputs and sources used for calculating the breakdown of consumer benefits by region.

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

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	Online Population (OP)	<ul style="list-style-type: none"> Internet World Stats (2021)²⁹¹
	Search users as % of OP	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
Time saved per user	Time saved per search	<ul style="list-style-type: none"> Varian (2014)²⁹² Chen et al. (2014)²⁹³
	Average daily searches per user	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
	% of searches for non-work purposes	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)
Share of Search users who have made use of Search for self-enrichment purposes	% of Search users in country who made use of Search for self-enrichment purposes	<ul style="list-style-type: none"> AlphaBeta Consumer Survey (2021)

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

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

291. Internet World Stats (2020), "World Internet Users and 2021 Population Stats". Available at: <https://www.internetworldstats.com/stats6.htm>

292. Hal Varian (2014), "Economic value of Google" (Presentation).

Available at: <http://cdn.oreillystatic.com/en/assets/1/event/57/The%20Economic%20Impact%20of%20Google%20Presentation.pdf>

293. Chen, Y., YoungJoo Jeon, G., & Kim, Y.-M. (2014), "A day without a search engine: an experimental study of online and offline searches". *Experimental Economics*, Vol 17, Issue 4, pp 512-536.

294. Internet World Stats (2020), "World Internet Users and 2021 Population Stats". Available at: <https://www.internetworldstats.com/stats6.htm>

TABLE 13: 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 (2021)
	Online Population (OP)	• Internet World Stats (2021) ²⁹⁵
	Google Play users as % of OP	• AlphaBeta Consumer Survey (2021)

TABLE 14: 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 (2021)
	Online Population (OP)	• Internet World Stats (2021) ²⁹⁶
	Google Drive users as % of OP	• AlphaBeta Consumer Survey (2021)

TABLE 15: 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 (2021)
	Online Population (OP)	• Internet World Stats (2021) ²⁹⁷
	YouTube users as % of OP	• AlphaBeta Consumer Survey (2021)
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 (2021)

TABLE 16: INPUTS AND SOURCES FOR CALCULATING THE BREAKDOWN OF CONSUMER BENEFITS BY REGION

METRIC	SOURCE
Amount that consumers in each region value Google's products per year (WTP)	• AlphaBeta Consumer Survey (2021)
Share of Online population (OP) in each region	• AlphaBeta Consumer Survey (2021)
Number of Google product users as % of OP in each region	• AlphaBeta Consumer Survey (2021)

295. Internet World Stats (2020), "World Internet Users and 2021 Population Stats". Available at: <https://www.internetworldstats.com/stats6.htm>296. Internet World Stats (2020), "World Internet Users and 2021 Population Stats". Available at: <https://www.internetworldstats.com/stats6.htm>297. Internet World Stats (2020), "World Internet Users and 2021 Population Stats". Available at: <https://www.internetworldstats.com/stats6.htm>

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