

# UNLOCKING SOUTH KOREA'S DIGITAL POTENTIAL:

## THE ECONOMIC OPPORTUNITIES OF DIGITAL TRANSFORMATION AND GOOGLE'S CONTRIBUTION

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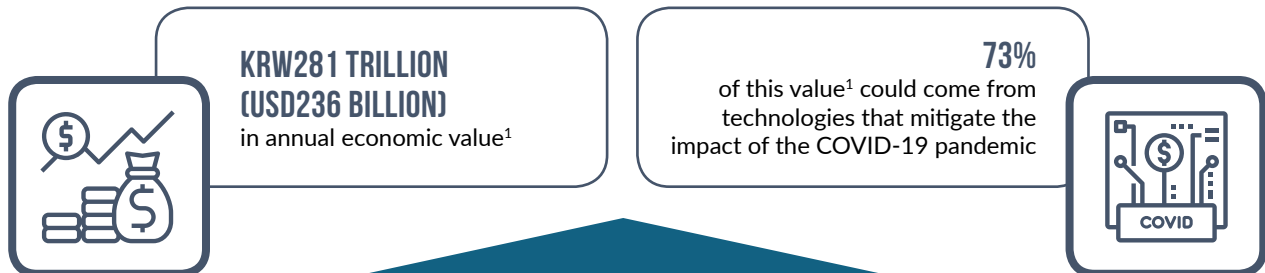
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# UNLOCKING SOUTH KOREA'S DIGITAL POTENTIAL



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



## THREE PILLARS OF ACTION

**NURTURE THE LOCAL TECHNOLOGY ECOSYSTEM**



**1**

**FOSTER ADOPTION OF CUTTING-EDGE TECHNOLOGIES LIKE AI AND CLOUD COMPUTING**



**2**

**FACILITATE ACCESS TO DIGITAL EXPORT OPPORTUNITIES**



**3**

## EXAMPLES OF GOOGLE'S CONTRIBUTIONS TO EACH PILLAR

### "GOOGLE FOR STARTUPS CAMPUS"

provides a collaborative space for South Korean startups and supports developer communities

### GOOGLE CLOUD

provides reliable and scalable infrastructure, allowing companies to deploy cutting-edge technologies at lower cost

### Google's "CHANGGOO PROGRAM"

supports mobile app and game developers in their growth and internationalization efforts by collaborating with the Ministry of SMEs & Startups

## GOOGLE'S BROADER ECONOMIC BENEFITS



### BUSINESSES

Google supports **KRW10.5 TRILLION (USD8.8 BILLION)** in annual benefits to businesses in South Korea<sup>2</sup>



### CONSUMERS

Google supports **KRW11.9 TRILLION (USD10 BILLION)** in annual benefits to consumers in South Korea<sup>2</sup>



### SOCIETY

Google's "CAMPUS FOR MOMS" program provides access to mentorship and technical training for female entrepreneurs in South Korea

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 as at time of research in 2020.

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



# EXECUTIVE SUMMARY

**South Korea has been a longstanding global leader in technology and innovation.** South Korea is home to world-leading electronics and information and communications technology (ICT) companies such as Samsung, Hyundai Motor, LG Corporation, SK and KT. The country also boasts world-class ICT infrastructure – for instance, it has one of the world's fastest Internet speeds, and is the first country globally to implement 5G mobile networks nationwide.<sup>1</sup> Moreover, the country was ranked 25th out of 141 economies on the availability of digital skills among its working population in the World Economic Forum's "Global Competitiveness Index 2019".<sup>2</sup> ICT has also been integrated at all levels of the education system in South Korea – students are utilizing wireless Internet, electronic blackboards, virtual reality devices to adopt computational thinking in tackling challenging problems.<sup>3</sup>

**However, the country faces several challenges to maintaining this status.** In 2020, South Korea's top rank as the world's "Most Innovative Nation" on the Bloomberg Innovation Index was overtaken by another country (Germany), for the first time in six years.<sup>4</sup> Its global status as a world technology leader is threatened by several factors. One is the growing digital divide between large conglomerates

and small and medium-sized enterprises (SMEs). While technology-driven research and development (R&D) is the lifeblood of large conglomerates such as Samsung and LG, SMEs exhibit lower technology innovation and adoption rates. For example, there is a gap in the adoption rates of large versus small and medium-sized companies in advanced digital technologies such as radio frequency identification (RFID) and big data.<sup>5</sup> While more than half of large firms in South Korea are estimated to have adopted cloud computing technologies, only about 20 percent of small firms do.<sup>6</sup> According to an Organisation for Economic Co-operation and Development (OECD) study, the uneven diffusion of digital technologies is attributed to the lack of awareness of the potential of digital transformation in improving productivity and reducing costs, as well as uneven access to digitally skilled workers.<sup>7</sup>

**Digital technologies can help enhance South Korea's economic recovery from the COVID-19 crisis in the short and medium term, while addressing productivity challenges in the long term.** The COVID-19 pandemic has laid bare the importance of harnessing digital technologies for business resilience. With social distancing requirements bringing about massive disruption to long-established business models

1. Sources include: OECD (2020), "Promoting the diffusion of technology to boost productivity and well-being". Available at: <https://www.oecd-ilibrary.org/sites/0002659e-en/index.html?itemId=/content/component/0002659e-en>; ITU News (2018), "How the Republic of Korea became a world ICT leader". Available at: <https://news.itu.int/republic-korea-leader-information-communication-technologies/>

2. World Economic Forum (2019), Global competitiveness index. Available at: [http://www3.weforum.org/docs/WEF\\_TheGlobalCompetitivenessReport2019.pdf](http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf)

3. ITU News (2018), "How the Republic of Korea became a world ICT leader". Available at: <https://news.itu.int/republic-korea-leader-information-communication-technologies/>

4. Michelle Jamrisko and Wei Lu (2020), "Germany breaks Korea's six-year streak as most innovative nation". Bloomberg. Available at: <https://www.bloomberg.com/news/articles/2020-01-18/germany-breaks-korea-s-six-year-streak-as-most-innovative-nation>

5. Sources include: OECD (2020), Economic Surveys: Korea. Available at: <https://www.oecd.org/economy/surveys/korea-2020-OECD-economic-survey-overview.pdf>; Ecoscope (2020), "Korea: Roadmap to narrow digital gaps". Available at: <https://oecdscopescope.blog/2020/08/11/korea-roadmap-to-narrow-digital-gaps/>

6. OECD (2020), "Promoting the diffusion of technology to boost productivity and well-being". Available at: <https://www.oecd-ilibrary.org/sites/0002659e-en/index.html?itemId=/content/component/0002659e-en#section-d1e9476>

7. Ecoscope (2020), "Korea: Roadmap to narrow digital gaps". Available at: <https://oecdscopescope.blog/2020/08/11/korea-roadmap-to-narrow-digital-gaps/>



(particularly those requiring in-person transactions and physical manned operations), the country experienced its sharpest quarterly gross domestic product (GDP) decline in June 2020.<sup>8</sup> This has necessitated many firms to build resilience by leveraging digital technologies such as cloud computing and the Internet of Things (IoT) to facilitate remote work, automate operations, and improve the remote coordination of supply chains. In recognition of the significant economic prospects presented by digital technologies, the South Korean Government announced the “Digital New Deal” stimulus package as one of its key strategies to combat the COVID-19 pandemic. This will involve the deployment of nationwide fifth generation (5G) infrastructure, promote industrial convergence between 5G and Artificial Intelligence (AI), as well as advance the adoption of cloud computing technologies in the government services sector to spur economic recovery.<sup>9</sup> In the long term, digital technologies can help reverse recent declines in the nation’s labor productivity rates. With one of the longest working hours among the OECD countries – about 300 hours longer than

the average annual working hours, the country’s labor productivity (on a per worker basis) is 20 percent lower than the OECD average.<sup>10</sup> Digital technologies can serve to augment efficiency in the workplace by equipping workers with the tools to automate repetitive and menial tasks, allowing them to focus their time on higher-order work.

**However, there is a gap in the knowledge base of how digital technologies can benefit South Korea’s economy – particularly its traditional, non-tech sectors.** Despite comprehensive research on the economic impact of the technology sector, there is limited research on the economic value of different technologies across other sectors, particularly in traditional sectors such as infrastructure and agriculture. Research to date has also tended to focus on specific technological applications such as the Internet and AI.<sup>11</sup>

**This report finds that, if leveraged fully in the economy, digital technologies could create an annual economic value of KRW281 trillion (USD236 billion)**

8. Bank of Korea (2020), “Real Gross Domestic Product: 2nd Quarter of 2020 (Advance Estimate)”.

Available at: <http://www.bok.or.kr/eng/bbs/E0000634/view.do?nttlid=10059416&menuNo=400069&pageIndex=8>

9. Troy Stangarone (2020), “South Korea’s Digital New Deal”. The Diplomat. Available at: <https://thediplomat.com/2020/06/south-koreas-digital-new-deal/>

10. Sources include: OECD (2020), Economic Surveys: Korea. Available at: <https://www.oecd.org/economy/surveys/korea-2020-OECD-economic-survey-overview.pdf>; Ecoscope (2020), “Korea: Roadmap to narrow digital gaps”. Available at: <https://oecdecoscope.blog/2020/08/11/korea-roadmap-to-narrow-digital-gaps/>

11. Other research has estimated that the Internet is estimated to contribute a GDP impact of about KRW247 trillion (USD209 billion) annually in 2019, and that AI technologies could generate an economic impact of KRW455 trillion (USD389 billion) by 2030. Sources include: Korea Internet Business Association (2017), 파급효과 분석 연구. (“Analysis of ripple effect on the digital economy”) Available at: <http://www.kinnet.net/cfile1/3beaf6d5-7e8f-4f0a-8b85-004e6be45524.pdf>; Shin & Kim (2019), Korean government announces National AI Strategy to bolster the economy & improve living standards by 2030. Available at: <https://www.shinkim.com/attachment/16054>





**by 2030.**<sup>12</sup> To put this in perspective, this is equivalent to about 13 percent of South Korea's GDP in 2020.<sup>13</sup>

The key messages of this report include:

- **Eight key technologies hold transformative potential for businesses and workers in South Korea.** These include mobile Internet; cloud computing; big data; AI; financial technology (fintech); the IoT and remote sensing; advanced robotics; and additive manufacturing. By allowing for new business models, revenue streams, productivity savings and GDP increments, these technologies could create significant economic value for both businesses and the government in South Korea.
- **If leveraged fully, digital transformation can unlock KRW281 trillion (USD236 billion) worth of economic value in South Korea by 2030.** By generating productivity gains, revenue boosts, cost savings and GDP increments, digital technologies can reap up to KRW281 trillion (USD236 billion) worth of economic value annually in South Korea by 2030. The largest projected beneficiaries are the consumer, retail and hospitality, manufacturing, and government sectors.
- **Digital adoption is also crucial for the country to gain resilience during the COVID-19 crisis and in the post-pandemic future.** By allowing businesses to engage customers digitally, and minimize logistical bottlenecks amidst supply chain disruptions, technologies can help businesses manage the severe economic impacts of COVID-19. It is estimated that a substantial 73 percent of South Korea's digital opportunity – worth KRW206 trillion (USD172 billion) – could be derived from such technology applications.<sup>14</sup>
- **Three pillars of action are required for South Korea to fully capture its digital opportunity.** While South Korea is already making significant progress in some of these areas, there is scope for

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

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

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



the country to push further on some policy agenda. The three pillars include:

- First, it is crucial that the country *nurtures the local technology ecosystem*. Although R&D investment in South Korea is among the highest among OECD economies, these tend to be concentrated in large companies. The government could promote domestic innovation among small firms by fostering their partnerships with global technology companies. This could allow such firms to better connect to global innovation networks, and gain access to cutting-edge technologies and digital platforms. The Singapore Government's multi-faceted approach to promoting an innovation-centered business culture through a combination of global-local tech partnerships, strong IT infrastructure, and robust Intellectual Property (IP) frameworks offers an international best practice in this regard.
- Second, there is scope to further *foster the adoption of cutting-edge technologies like AI and cloud computing* by local enterprises. The South Korean Government has a strong focus on industry-academia partnerships to nurture homegrown high-tech industries (e.g., the partnership between Samsung and leading academic institutions to develop new energy sources). To support the deployment of emerging technologies across sectors, the country has also unveiled multiple policy initiatives such as the “National Strategy for Artificial Intelligence” and the “Digital New Deal” stimulus package to combat the COVID-19 pandemic. The country could go further to support technology adoption by traditional sectors through sector-specific tech adoption roadmaps and strategies (e.g., New Zealand's “Industry Strategy”), and at the same time, provide skilling opportunities for the workforce to capture digital opportunities from new technologies (e.g., Sweden's “Competence Center for AI Development”).
- Third, it is important to ensure that businesses in South Korea are provided adequate *access to digital export opportunities*. The South Korean Government has been active in establishing digital platforms such as the “u-Trade Hub 2.0” platform which leverages big data analytics and AI technologies to allow companies to manage all trading processes (e.g., tracking overseas shipments, cross-border contract signing, customs clearances, managing online distribution) efficiently. At the same time, South Korea has been actively promoting its exports online by hosting online exhibitions (e.g., “K-Content Expo” and “Korea Sale Fiesta”) to market local products while creating avenues for local businesses to meet foreign buyers through online conferences. To nurture “global-ready” businesses, particularly for micro, small and medium-sized enterprises (MSMEs) which tend to face larger barriers to exporting overseas, the South Korean Government can consider providing further capacity-building support such as improving access to information resources to educate Korean enterprises and introducing incentives for businesses to expand globally. In New Zealand, Callaghan Innovation, the country's innovation agency, provides end-to-end support for companies ranging from tax incentives to subsidies for digital adoption and knowledge sharing. For businesses to tap on regional and global digital trade opportunities, South Korea can consider participating in international trade agreements such as the recently signed “Digital Economy Partnership Agreement” between New Zealand, Singapore and Chile – a new trade agreement aimed at helping MSMEs take advantage of opportunities from digital trade.



- **Through both its programs and products, Google is making a significant contribution to advancing South Korea's digital transformation journey.** The company has been building strong partnerships with domestic tech firms, such as Hyundai Motor Group, and supporting local tech startups through initiatives such as "Google for Startups" to promote the growth of the digital economy. Through Google Cloud, Google has supported local businesses in using digital tools to deliver innovative products and services in a cost-efficient manner. At the same time, Google is preparing the next generation of workers in utilizing emerging technologies through programs such as the "Digital and Media Literacy Education" program to increase digital literacy among junior high school students and "Google for Education" summits that look into increasing the use of virtual reality (VR) and augmented reality (AR) in classrooms. Collaborating with the South Korean Government (Ministry of SMEs & Startups), Google has also been a key partner of the "ChangGoo Program" which promotes the development of South Korea's mobile app exports.
- **Google's products also deliver wider benefits to businesses, consumers and the broader society in South Korea.** Businesses and consumers in South Korea are estimated to derive annual economic benefits from these products worth **KRW10.5 trillion (USD8.8 billion)** and **KRW11.9 trillion (USD10 billion)**, respectively.<sup>15</sup> These products include Google Search, Google Ads, AdSense, Google Play, 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. Beyond the KRW10.5 trillion (USD8.8 billion) business benefits, the Android operating system provides cost savings for both South Korean Original Equipment Manufacturers (OEMs) and app developers. South Korean OEMs are saving one-off development costs and achieving additional annual savings through simplified operating system maintenance and upgrading. Taken together, the total savings to South Korean OEMs are estimated to be over KRW3 trillion (USD2.5 billion). The vast adoption of free-to-use open-source operating systems, such as Android, allows app developers to cut development time and therefore, costs. This implies cost savings of approximately KRW280 billion (USD234 million) saved for over 36,000 South Korean apps.<sup>16</sup> 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 delivers benefits to the broader society by extending digital skilling opportunities to female entrepreneurs, facilitating the recovery of underserved communities which were affected during the pandemic, and supporting not-for-profit organizations in protecting the environment.

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

16. Note that the cost and time savings from both South Korea OEMs and app developers are not included in the business benefits figure of KRW10.5 trillion (USD8.8 billion).



# **SIZING THE PRIZE — THE ECONOMIC OPPORTUNITY OF DIGITAL TRANSFORMATION IN SOUTH KOREA**



Digital transformation is not just about the technology sector – it affects every sector in South Korea. Neglecting the impact of digital technology on traditional sectors like infrastructure and agriculture would risk overlooking the full transformative impact of technologies. If leveraged fully, digital transformation can create up to KRW281 trillion (USD236 billion) worth of economic value annually in South Korea by 2030. This is equivalent to about 13 percent of the country's GDP in 2020. The largest projected beneficiary of digital transformation in South Korea is its consumer, retail and hospitality sector, which is estimated to account for about 20 percent of the total economic value.

Digital adoption is also crucial for the country to gain resilience during the COVID-19 crisis and in the post-pandemic future. By supporting businesses in engaging customers and transacting with them digitally, resuming business 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 73 percent of South Korea's digital opportunity – at KRW206 trillion (USD172 billion) – could be derived from technology applications that help businesses and workers manage the economic impacts of COVID-19.

# “SIZING THE PRIZE”

## THE ECONOMIC VALUE OF DIGITAL TRANSFORMATION

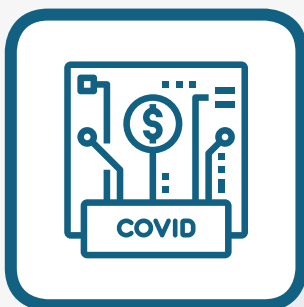


IF LEVERAGED FULLY,  
DIGITAL TRANSFORMATION CAN CREATE AN  
IMPACT OF UP TO...



**KRW281 TRILLION  
(USD236 BILLION)**

in annual economic value<sup>1</sup>



**73%**

of this value<sup>1</sup> could come from technologies  
that help mitigate the economic impacts of the  
COVID-19 pandemic

**... IN SOUTH KOREA BY 2030**

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

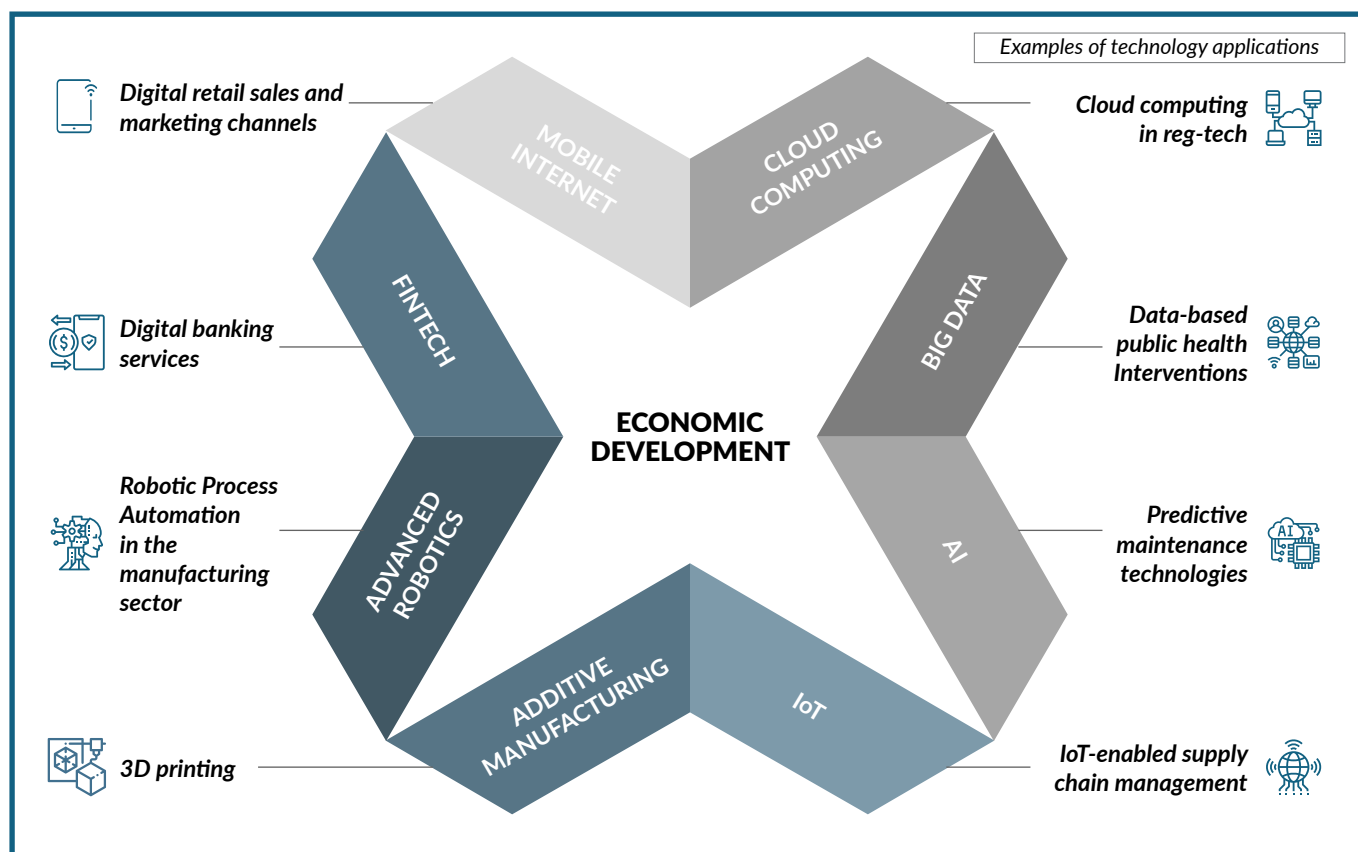
# 1.1 DIGITAL TRANSFORMATION CAN UNLOCK UP TO KRW281 TRILLION (USD236 BILLION) WORTH OF ECONOMIC VALUE IN 2030

Digital technologies can unlock significant economic value in South Korea. 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 South Korea. 40 technology

applications – each mapping to one of the eight technologies – were then identified across ten industry sectors. To assess the economic potential of digital transformation in South Korea, 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





## EXHIBIT 2:

## 40 DIGITAL TECHNOLOGY APPLICATIONS ACROSS 10 SECTORS WERE IDENTIFIED TO SIZE SOUTH KOREA'S ECONOMIC OPPORTUNITY FROM DIGITAL TRANSFORMATION

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

## BOX 1.

# EIGHT KEY TECHNOLOGIES WITH TRANSFORMATIVE POTENTIAL FOR SOUTH KOREA

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.<sup>17</sup> 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 South Korea has already driven the adoption of new business models such as the app economy, over-the-top (OTT) services and mobile-commerce (or “m-commerce”), there are several mobile Internet-enabled applications that have yet to see full adoption in the country. These include the use of mobile telehealth applications in the health sector, and the use of smartphone-based government e-services to streamline the delivery of public services.
- **Cloud computing.** Referring to the delivery of information technology (IT) resources over the Internet, cloud computing technologies allow individuals and entities to access technology services such as enhanced computing power, data storage and management tools on an as-needed basis. Buying, owning, and maintaining physical data centers and servers can be cost-prohibitive particularly for MSMEs. In addition, public cloud hosting boosts productivity by providing tailored productivity tools, enabling improved security and making resources available on an on-demand basis. Cloud computing has also become essential for leveraging other technologies such as AI and machine learning.
- **Big data.** Big data, and the analysis of it, refers to the ability to 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 what people do.<sup>18</sup> Examples of AI applications include virtual assistants, autonomous vehicles and speech recognition tools.
- **Financial technology (Fintech).** Sometimes referred to as Digital Financial Services (DFS), fintech has been instrumental in boosting the financial services sector through facilitating deposits, payments and providing individuals with access to more advanced financial products such as loans, savings and investments. Moreover, by allowing for cashless payments, fintech has also been responsible for driving greater growth in other sectors (e.g., consumer, retail and hospitality).

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

18. Microsoft (2018), The future computed. Available at: [https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed\\_2.8.18.pdf](https://blogs.microsoft.com/wp-content/uploads/2018/02/The-Future-Computed_2.8.18.pdf)



## BOX 1 (CONT'D).

# EIGHT KEY TECHNOLOGIES WITH TRANSFORMATIVE POTENTIAL FOR SOUTH KOREA

- **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.<sup>19</sup> IoT has a number of applications across sectors with significant economic potential: wearable devices can help monitor and maintain health and wellbeing thereby lowering public health expenditure; energy consumption can be monitored and optimized in buildings; equipment use can be enhanced; and the health and safety performance of factories improved.
- **Advanced robotics.** While simple robots have increasingly been a staple of factory floors in mature economies like South Korea, 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.<sup>20</sup> These improvements permit faster setup, reconfiguration, as well as more efficient and stable operations. For instance, in the manufacturing sector, advanced robotics can increase productivity and flexibility in both the factory and the supply chain, and enable producers to rapidly adjust to changing customer needs.
- **Additive manufacturing.** This relates to technologies that build 3D objects by adding layer upon layer of material. There is a range of potential benefits, such as ability to handle complex, low-volume components where rapid turnaround is critical.<sup>21</sup>



19. McKinsey Global Institute (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](https://digitalchallengers.mckinsey.com/files/McKinsey%20CEE%20report_The%20Rise%20of%20Digital%20Challengers.pdf)

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

21. Sharp (2019), "Is additive manufacturing the right choice for your electronic assembly?" JJS Manufacturing Blog. Available at: <https://blog.jjsmanufacturing.com/additive-manufacturing-electronic-assembly>

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 KRW281 trillion (USD236 billion) in South Korea by 2030.**<sup>22</sup> This is a substantial value that is equivalent to 13 percent of South Korea's GDP in 2020 (Exhibit 3).

The **consumer, retail and hospitality sector is projected to be technology's largest economic beneficiary in South Korea.** This sector is estimated to be able to gain annual economic benefits of up to KRW56.1 trillion (USD47 billion) in 2030 – amounting to about 20 percent of the country's total digital opportunity.<sup>23</sup> Other top sector beneficiaries include government (KRW49.1 trillion or USD41.1 billion), manufacturing (KRW42.9 trillion or USD36 billion), health (KRW39.7 trillion or USD33.3 billion), and education and training (KRW34.5 trillion or USD28.9 billion).<sup>24</sup>

The key opportunities posed by digital adoption in these sectors are as follows:

- **Consumer, retail and hospitality.** There is vast scope for businesses in this sector to benefit from digital technologies. In the retail industry, the productivity gains experienced by businesses from marketing and selling goods through digital channels are estimated to range from six to 15 percent.<sup>25</sup> These arise as a result of being able to reduce manpower requirements, harness inventory efficiencies and cutting real estate costs (e.g., rental of shop space).<sup>26</sup> Besides minimizing human contact, digital technologies such as

AI-powered robots hold tremendous productivity potential in the food and beverage (F&B) industry. For example, the telecommunications company, KT Corp, introduced an AI-powered robot food server that is capable of serving food to four tables at once, thereby freeing up time for waiters to tend to non-routine customer needs, improving service quality.<sup>27</sup> In the tourism and hospitality industry, technology applications can also drive greater productivity. In hotels, AI-driven conversational interfaces can facilitate quicker check-in and check-out procedures (a study found that AI could reduce the time needed for this by up to 70 percent),<sup>28</sup> and allow staff to focus on providing more personalized customer service.<sup>29</sup> Such customized service has been found to be one of the most important drivers of customer loyalty, and it is estimated that AI-enabled services can allow for hotel revenues to increase by ten percent by freeing up more time for hospitality staff to focus on high-impact and high-value customer interactions.<sup>30</sup> Finally, big data analytics offer the tourism industry a significant boost in marketing and service delivery. By drawing upon data about consumer preferences and running analytics on them, tourism companies stand to improve their revenues through targeted product development based on individual customer preferences. A global study reflected that tour companies experienced a revenue uplift of six to ten percent from integrating proprietary data to create personalized tourist experiences.<sup>31</sup>

- **Government.** Government agencies in South Korea can tap on a range of digital technologies

22. 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.

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

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

25. 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>

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. Business Korea (2020), "KT Corp. unveils AI-based smart robot food server". Available at: <http://www.businesskorea.co.kr/news/articleView.html?idxno=52092>

28. 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>

29. Ministry of Business, Innovation and Employment (2018), Artificial Intelligence: Shaping a future New Zealand.

Available at: <https://www.mbie.govt.nz/dmsdocument/5754-artificial-intelligence-shaping-a-future-new-zealand-pdf>

30. 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>

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

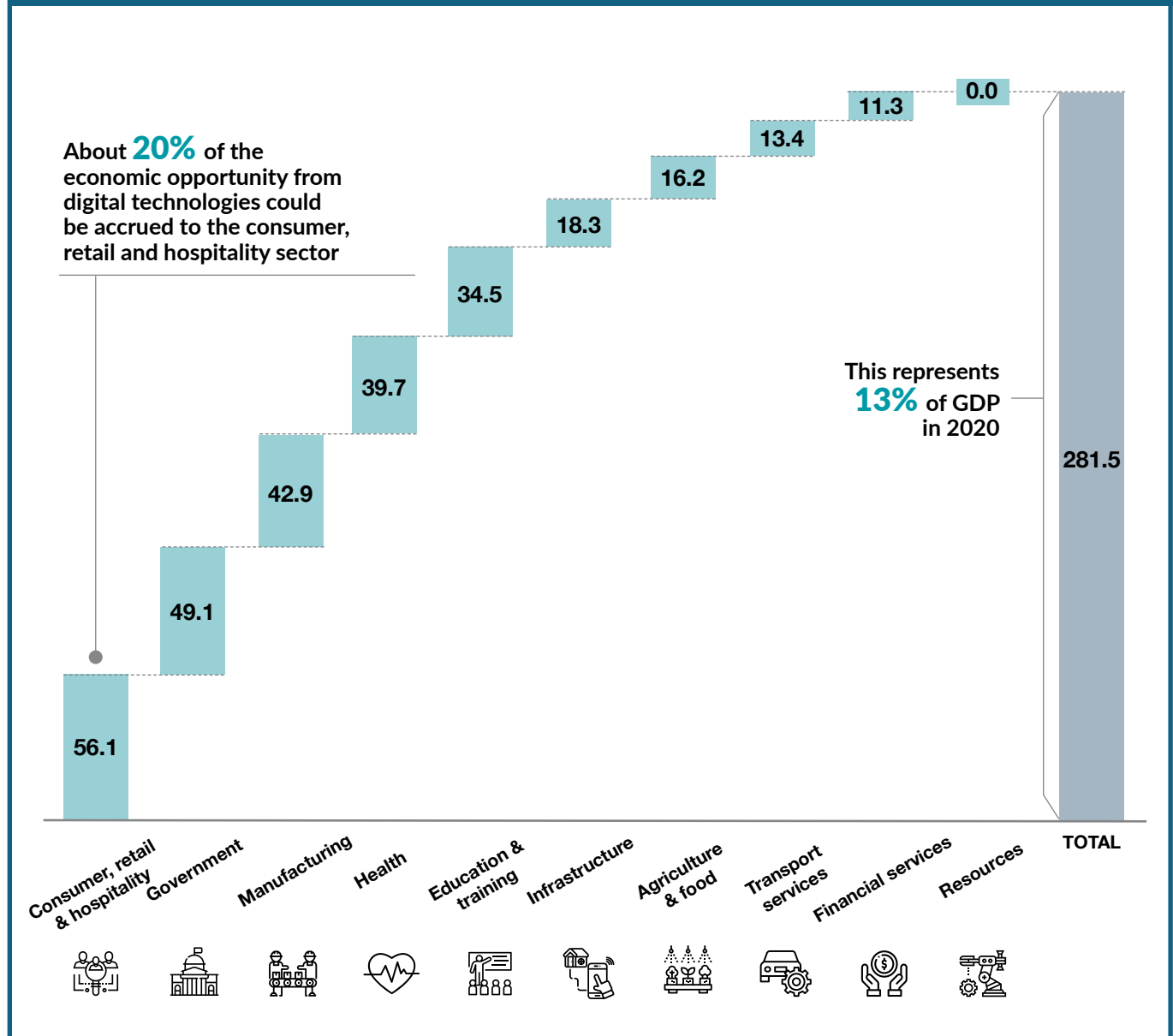
Available at: <https://www.bcg.com/publications/2020/bionic-revenue-management-travel-tourism>



## EXHIBIT 3:

# BY 2030, DIGITAL TECHNOLOGIES COULD SUPPORT UP TO KRW281 TRILLION (USD236 BILLION) OF ANNUAL ECONOMIC IMPACT IN SOUTH KOREA

POTENTIAL ANNUAL ECONOMIC VALUE FROM DIGITAL TECHNOLOGIES, BY SECTOR<sup>1</sup>  
KRW TRILLION, 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

to enhance service delivery and cost efficiency. Digitizing administrative processes offer significant cost savings potential, with studies reflecting that these can reduce the costs of administrative activities by 15 to 20 percent.<sup>32</sup> Already, the country is one of the global leaders in this area – a study by the United Nations reflects that South Korea leads globally on the provision of e-government services.<sup>33</sup> Another important technology application in the government sector is the use of cloud computing, which can help agencies significantly reduce IT hardware and equipment costs through the delivery of on-demand IT resources over the Internet, instead of purchasing, owning and maintaining physical data centers and servers. Again, South Korea is relatively advanced in this regard; the Korean National Information Resources Service is responsible for migrating government services into Google Cloud and manages 1,230 digital government services to facilitate interdepartmental information sharing and optimize resource utilization.<sup>34</sup> However, the country can go further to leverage other technologies to enhance its public sector. Big data analytics, for example, allow government agencies to analyze the vast amounts of data collected across a range of public service areas, in order to make more accurate predictions and intelligent decisions about public service delivery and even strategic policy areas. Potential big data applications in the public sector include reducing improper payments, increasing revenue from tax compliance, and improving policy outcomes and tracking. In particular, the South Korean Government can draw on best practices in the financial services sector, and use analytics to ensure

payment integrity and minimize fraud. It has in fact been estimated that between five and ten percent of all global government transfers are improper payments, and these have the potential to be significantly reduced through the deployment of big data analytics.<sup>35</sup> The South Korean Government is already relatively advanced in deploying other technologies. By introducing AI-powered facial recognition and QR code pass cards to government employees, the Ministry of Interior and Safety aims to improve the convenience and security of access to government buildings. Instead of having to deploy staff to manually verify the public servant identification cards, the facial recognition terminal can recognize 30,000 unique users and conduct 3,000 matches per second.<sup>36</sup>

- Manufacturing.** There is vast potential for technology applications such as big data analytics, additive manufacturing (more commonly known as 3D printing), IoT-enabled supply chain management, and advanced robotics to boost productivity and value-add in the manufacturing sector. By improving demand forecasting and production planning for customer needs, it has been estimated that the use of big data analytics can bring about a 2.5 to three percent increase in the profit margins of manufacturers.<sup>37</sup> Some companies in South Korea have achieved even more significant gains. Piston Korea, a Korean engine piston manufacturer, experienced a 14 percent improvement in net profits after implementing an integrated system that collects and analyzes real-time data from factory floor activities.<sup>38</sup> Through the use of big data analytics to optimize the mold casting process precisely, the company also achieved a

32. 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](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)

33. United Nations Department of Economic and Social Affairs (2020), E-government survey 2020.

Available at: [https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20\(Full%20Report\).pdf](https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf)

34. United Nations Department of Economic and Social Affairs (2020), E-government survey 2020.

Available at: [https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20\(Full%20Report\).pdf](https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf)

35. McKinsey Center for Government (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>

36. Find Biometrics (2020), "Suprema pushes contactless security solutions in response to COVID-19".

Available at: <https://findbiometrics.com/suprema-pushes-contactless-security-solutions-response-covid-19-070702/>

37. 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>

38. Magnus Wiktorsson, Sang Do Noh, Monica Bellgran, Lars Hanson, Smart Factories: South Korean and Swedish examples on manufacturing settings, Procedia Manufacturing, Volume 25, 2018, Pages 471-478, ISSN 2351-9789, <https://doi.org/10.1016/j.promfg.2018.06.128>

26 percent reduction in the number of physical defects in their products, resulting in significant cost savings. AI and IoT technologies may also be used in “smart factories” to forecast when machinery is likely to experience downtime, and proactively address them before failures occur – an application known as “predictive maintenance”. A survey found that manufacturing businesses in South Korea using predictive maintenance solutions could extend their equipment lifespan by more than 20 percent, and reduce maintenance costs by 15 percent.<sup>39</sup> Based on projections in South Korea’s “Mid- to Long-term Master Plan in preparation for the Intelligent Information Society” (which outlines the government’s vision for cutting-edge technologies such as AI and IoT to be integrated into every aspect of society), predictive maintenance for machinery used in electronics manufacturing can help reduce the cost of maintenance by KRW25 trillion (USD20.9 billion).<sup>40</sup> By enabling rapid, “on-time” and customized manufacturing, additive manufacturing or 3D printing technologies can help businesses in South Korea expand their reach to more customer segments (given the increased level with which products can be customized), as well as improve operational efficiencies. It has been projected that the global economic value brought about by this technology could reach between USD100 billion and USD250 billion by 2025.<sup>41</sup> Technology adoption also poses significant benefits for workers in the sector. By taking over labor-intensive manufacturing tasks, industrial automation and robotics demonstrate significant potential in addressing productivity declines caused by South Korea’s aging and shrinking workforce, in which the share of employees aged over 60 years in the



country (19 percent) is projected to be higher than the OECD average (17 percent).<sup>42</sup> At the same time, workers get to benefit by switching their focus from repetitive tasks to higher-value activities that are likely to command better wages and provide better work satisfaction. In a global survey conducted to measure the impact of automation technologies in the workplace, 92 percent of senior executives reported an improvement in employee satisfaction.<sup>43</sup> Moreover, robots can help to address labor shortages in low-skilled jobs which locals are unwilling to work for, such as laborer roles in the manufacturing, agriculture and fishing industries, which are characterized by low pay and poor working conditions.<sup>44</sup>

39. Mobile World Live (2020), “SKT makes smart factory play”. Available at: <https://www.mobileworldlive.com/featured-content/home-banner/skt-makes-smart-factory-play>

40. Government of the Republic of Korea Interdepartmental Exercise (2017), Mid- to Long-term Master Plan in preparation for the Intelligent Information Society.

Available at: <http://www.msip.go.kr/dynamic/file/afidfile/msse56/1352869/2017/07/20/Master%20Plan%20for%20the%20intelligent%20information%20society.pdf>

41. 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>

42. OECD (2015), Workforce ageing in OECD countries. Available at: <https://www.oecd.org/els/emp/2080254.pdf>

43. Kofax (2019), “The Surprising Truth: Intelligent automation and RPA improve employee satisfaction”.

Available at: <https://www.kofax.com/blog/worker-satisfaction-improves-after-RPA>

44. The Korea Herald (2017), “Korea to accept 56,000 foreign workers in 2018”. Available at: <http://www.koreaherald.com/view.php?ud=20171222000777>

- Health.** Digital technologies can unlock greater productivity in the health sector and achieve better public health outcomes. Rapid advancements in AI technology have allowed for robotic surgeries to be conducted safely and remotely. It has been found that hospitals in South Korea can benefit from an improvement in the accuracy and safety of surgical processes which could save up to KRW55 trillion (USD46.1 billion) in healthcare costs by 2030.<sup>45</sup> Besides improving healthcare outcomes, digital technologies can also help ramp up healthcare capacity rapidly. Remote patient monitoring technologies, for example, allow clinicians to delegate the monitoring of multiple patients to ancillary staff, enabling them to focus more time on critical patient-facing activities such as emergency treatments. By eliminating unnecessary hospitalization for patient observation, the McKinsey Global Institute (MGI) estimates that remote patient monitoring technology could

reduce the cost of treating chronic diseases by ten to 20 percent.<sup>46</sup> Fueled by the growing inclinations of consumers to monitor their own health, advances in smart medical devices such as connected implants, wearables and home health monitoring devices could empower patients to self-manage their health conditions. At the same time, personalized and predictive health care services could help patients to address their health conditions by leveraging data from such technologies. It has been estimated that the use of smart devices could reduce disability-adjusted life years (DALYs)<sup>47</sup> in high-income countries by one percent annually.<sup>48</sup> There is already some evidence of advanced technology adoption in South Korea's health sector. For example, to support the aging population in South Korea, the AI care robot, Dasomi, serves as a companion to the elderly and allows caregivers to monitor the elderly living alone remotely.<sup>49</sup>



45. Government of the Republic of Korea Interdepartmental Exercise (2017), Mid- to Long-term Master Plan in preparation for the Intelligent Information Society. Available at: <http://www.msip.go.kr/dynamic/file/afieldfile/msse56/1352869/2017/07/20/Master%20Plan%20for%20the%20intelligent%20information%20society.pdf>

46. 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>

47. The disability-adjusted life year (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

48. 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>

49. Ministry of Science and ICT (2020), "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&nttSeqNo=9&searchOpt=ALL&searchTxt=>





- Education and training.** Digital technologies do not only hold the promise of enhancing the quality and reach of education, but also facilitate the matching of demand and supply in the job market. Despite the unique learning interests and capacities that students have, most education systems tend to take a “one-size-fits-all” approach to teaching and instruction. A key area in which technology can address this is through digital personalized learning tools, which allow teachers to track students’ mastery of the subject matter, and complement traditional classroom instruction with a customized style, content, sequencing, and pace of instruction to meet the individual education needs of each student. For example, big data and analytics could be used to create personalized study plans to address each student’s weaknesses while identifying programs to grow their strengths.<sup>50</sup> It has been found that by improving learning outcomes and ultimately the supply of skilled labor in the economy, personalized education tools and programs – if implemented nationwide – can boost

the national employment rate in high-income economies by 0.5 percent annually.<sup>51</sup> There is already some evidence of digital adoption in this sector. For example, to address the shortage of English teachers in the country, the Seoul Metropolitan Office of Education recently developed an AI-powered English assistant teacher, which can hold conversations and quiz students in English to gauge their verbal mastery of the language.<sup>52</sup> Outside the education system, e-career centers and digital job platforms are important digital tools that enhance efficiencies and address information asymmetries in the labor market. The multiplier effects generated by an expanding network of jobseekers and employers have enabled digital jobs platforms to gather a wider universe of work opportunities, providing jobseekers with more options and a better understanding of wages they can command. Shorter search times and better job matching through digital platforms are projected to raise employment by 1.8 percent in South Korea by 2030.<sup>53</sup>

50. 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>

51. McKinsey Global Institute (2018), Smart cities: digital solutions for a more livable future. Available at: <https://www.mckinsey.com/~media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/Smart%20cities%20Digital%20solutions%20for%20a%20more%20livable%20future/MGI-Smart-Cities-Full-Report.pdf>

52. Sources include: Ministry of Science and ICT (2020), “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&nttSeqNo=9&searchOpt=ALL&searchTxt=>

The Interpreter (2020), “Why COVID-19 only accelerates South Korea’s AI ambitions”. Available at: <https://www.lowyinstitute.org/the-interpreter/why-covid-19-only-accelerates-south-korea-s-ai-ambitions>

53. McKinsey Global Institute (2015), A labor 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>



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

The COVID-19 pandemic has had a significant impact on South Korea's economy. When the total number of infections in the country crossed the 2,000 mark in February 2020, all inbound flights to South Korea were suspended, and international travelers arriving from Incheon International Airport fell by 97.3 percent in April 2020.<sup>54</sup> In May 2020, the country experienced an unprecedented 46.3 percent decline in exports year-on-year,<sup>55</sup> and its sharpest quarterly decline in GDP since the Global Financial Crisis. While the economy has since achieved a measure of recovery, registering quarterly GDP growth of 1.9 percent in the third quarter of 2020, the overall economic outlook remains bleak, with annual GDP growth in 2020 estimated at -1.9 percent – as compared to two percent in 2019.<sup>56</sup>

This hefty economic impact is largely driven by the disruption to global supply chains and declining household consumption.<sup>57</sup> Ranked 6th among 18 high-income economies on global value chain participation rate by the OECD in 2017, South Korea is heavily reliant on imports for raw materials and intermediate goods, especially from China which accounts for about 30 percent of the nation's imported intermediate goods.<sup>58</sup> When Chinese firms struggled to resume production at normal capacity, key industries such as electronics and automobile manufacturing had to suspend production lines for a few days.<sup>59</sup> At the same time, demand from major trading partners such as the United States and Europe remained muted as lockdown measures led to lower manufacturing activity and global demand. The decrease in steel and oil products

54. Forbes (2020), "COVID-19 hitting South Korea hard as economy contracts and exports tumble".

Available at: <https://www.forbes.com/sites/donaldkirk/2020/05/13/covid-19-hitting-south-korea-hard-as-economy-contracts-and-exports-tumble/?sh=4bc8dc5758fe>

55. Korea Customs Service (2020), "Trade statistics for export/import". Available at: [https://unipass.customs.go.kr/ets/index\\_eng.do](https://unipass.customs.go.kr/ets/index_eng.do)

56. International Monetary Fund (October 2020), "World Economic Outlook Database". Available at: <https://www.imf.org/en/Publications/WEO/weo-database/2020/October>

57. The Global Economy (2020), "South Korea: Exports, percent of GDP". Available at: <https://www.theglobaleconomy.com/South-Korea/exports/>

58. The Korea Herald (2020), "Korea's supply chain vulnerable to coronavirus crisis". Available at: <http://www.koreaherald.com/view.php?ud=20200326000305>

59. The Korea Herald (2020), "Korea's supply chain vulnerable to coronavirus crisis". Available at: <http://www.koreaherald.com/view.php?ud=20200326000305>

shipments led South Korea's exports to decline by over three percent to USD45 billion in October 2020 compared with a year ago.<sup>60</sup>

South Korea's household consumption has also been affected by measures implemented to curb the community spread of COVID-19. In particular, the country's hospitality, retail and F&B industries, which largely comprises traditional, small and medium-sized businesses that account for over 99 percent of businesses in these industries, have been disproportionately impacted.<sup>61</sup> While South Korea was spared from a nationwide lockdown, tight social restrictions and the closure of certain business activities meant consumers largely stayed in their homes and firms implemented work-from-home arrangements. As a result, private consumption fell by over four percent year-on-year in the third quarter of 2020.<sup>62</sup> Amid lower retail footfall and consumption, the apparel business experienced an 85 percent loss in February and March sales in 2020 as compared to a year ago, while offline retail stores suffered over 17 percent year-on-year decrease in sales in March 2020.<sup>63</sup> In addition, falling profit margins threatened the survival of many small businesses. A survey conducted by the Korea Economic Research Institute in March 2020 found that six out of ten small businesses feared that their business would not last for more than half a year if the outbreak were to persist.<sup>64</sup>

Technology adoption will be crucial for businesses and workers to manage the crisis's impacts.

**Of South Korea's total digital opportunity of KRW281 trillion (USD236 billion), a substantial 73 percent – KRW206 trillion (USD172 billion) – could be driven by technologies that help businesses and workers mitigate the economic impacts of COVID-19 (Exhibit 4).**

KRW206 trillion (USD172 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. There are three channels in which such technology applications allow for this (Exhibit 5).

- Enabling the continuity of business operations amid remote working arrangements.** With precautionary measures implemented at workplaces to safeguard workers' safety, the resultant reduction in on-site manpower has decreased operating capacity for many businesses, while some businesses have switched to remote working arrangements indefinitely. A range of digital technologies allows for business continuity in these circumstances by facilitating virtual collaboration among co-workers, and automating production processes and the remote control of physical operations from off-site locations. Examples of relevant technology applications include automation and AI customer service in hotels, remote patient monitoring and robotics and automation in the manufacturing sector. Combined, such technology applications are projected to deliver a total annual economic value of KRW121.6 trillion (USD102 billion) if fully adopted by 2030 (Exhibit 5). During the COVID-19 pandemic when social distancing regulations were enforced, many F&B businesses had limited seating capacity and offered contactless takeout and delivery services to allow customers to order food and drinks online. It has been reported that restaurants experience, on average, a 15 percent boost to their revenues after opening online food delivery services.<sup>65</sup> In the hospitality industry, to ensure the safe recovery of tourism activities after the pandemic, AI-enabled customer check-in

60. Ministry of Trade, Industry and Energy (2020), "October exports in Korea decrease 3.6% to \$45.0 billion". Available at: [https://english.motie.go.kr/en/pc/pressreleases/bbs/bbsView.do?bbs\\_seq\\_n=810&bbs\\_cd\\_n=2&currentPage=9&search\\_key\\_n=&search\\_val\\_v=&cate\\_n=](https://english.motie.go.kr/en/pc/pressreleases/bbs/bbsView.do?bbs_seq_n=810&bbs_cd_n=2&currentPage=9&search_key_n=&search_val_v=&cate_n=)

61. Korea Ministry of SMEs and Startups (2020), "Statistics". Available at: <https://www.mss.go.kr/site/eng/02/20202000000002019110610.jsp>

62. Focus Economics (2020), "Consumption in Korea". Available at: <https://www.focus-economics.com/country-indicator/korea/consumption>

63. Sources include: Yonhap News Agency (2020), "Retail sales suffer sharp decline in March as virus hits offline stores". Available at: <https://en.yna.co.kr/view/AEN20200428000800320>; Pulse News (2020), "Small businesses in South Korea feel pinch amid COVID-19 shutdown". Available at: <https://pulsenews.co.kr/view.php?year=2020&no=342060>

64. Pulse News (2020), "Small businesses in South Korea feel pinch amid COVID-19 shutdown". Available at: <https://pulsenews.co.kr/view.php?year=2020&no=342060>

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



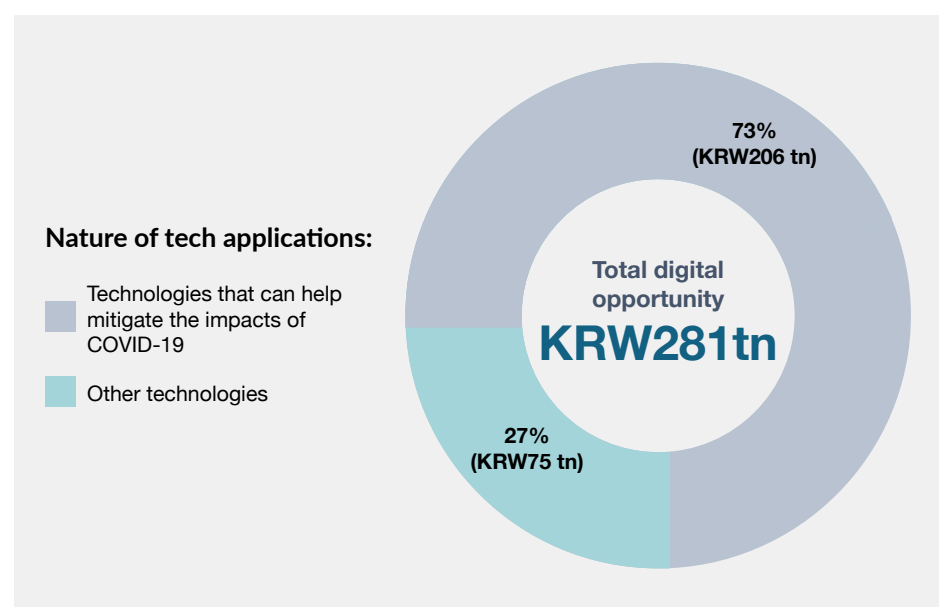
and service procedures do not only serve to address health and safety concerns by minimizing human contact, but can also help boost staff productivity and create greater service value overall. Remote check-ins, such as the “E-Visitor Authentication” (EVA) in Singapore which uses facial recognition technology, are estimated to reduce the time taken to verify visitors’ particulars by up to 70 percent.<sup>66</sup> At the same time, by freeing their time up from mundane administrative tasks, on-site staff may focus on higher value-add tasks such as addressing more complex customer demands or personalizing customer service.

- **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 retail sales and marketing channels in the retail industry, online F&B delivery services in the

#### EXHIBIT 4:

**OF THE TOTAL DIGITAL OPPORTUNITY OF KRW281 TRILLION (USD236 BILLION), 73% IS DRIVEN BY TECHNOLOGIES THAT CAN HELP COMPANIES MITIGATE THE IMPACTS OF COVID-19**

**% OF ECONOMIC VALUE DERIVED FROM DIGITAL TECHNOLOGIES,<sup>1</sup> BY NATURE OF TECHNOLOGY, 2030**



**73%**  
of South Korea's digital opportunity could come from technologies that help companies manage the impacts of COVID-19<sup>2</sup>

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.

SOURCE: AlphaBeta analysis

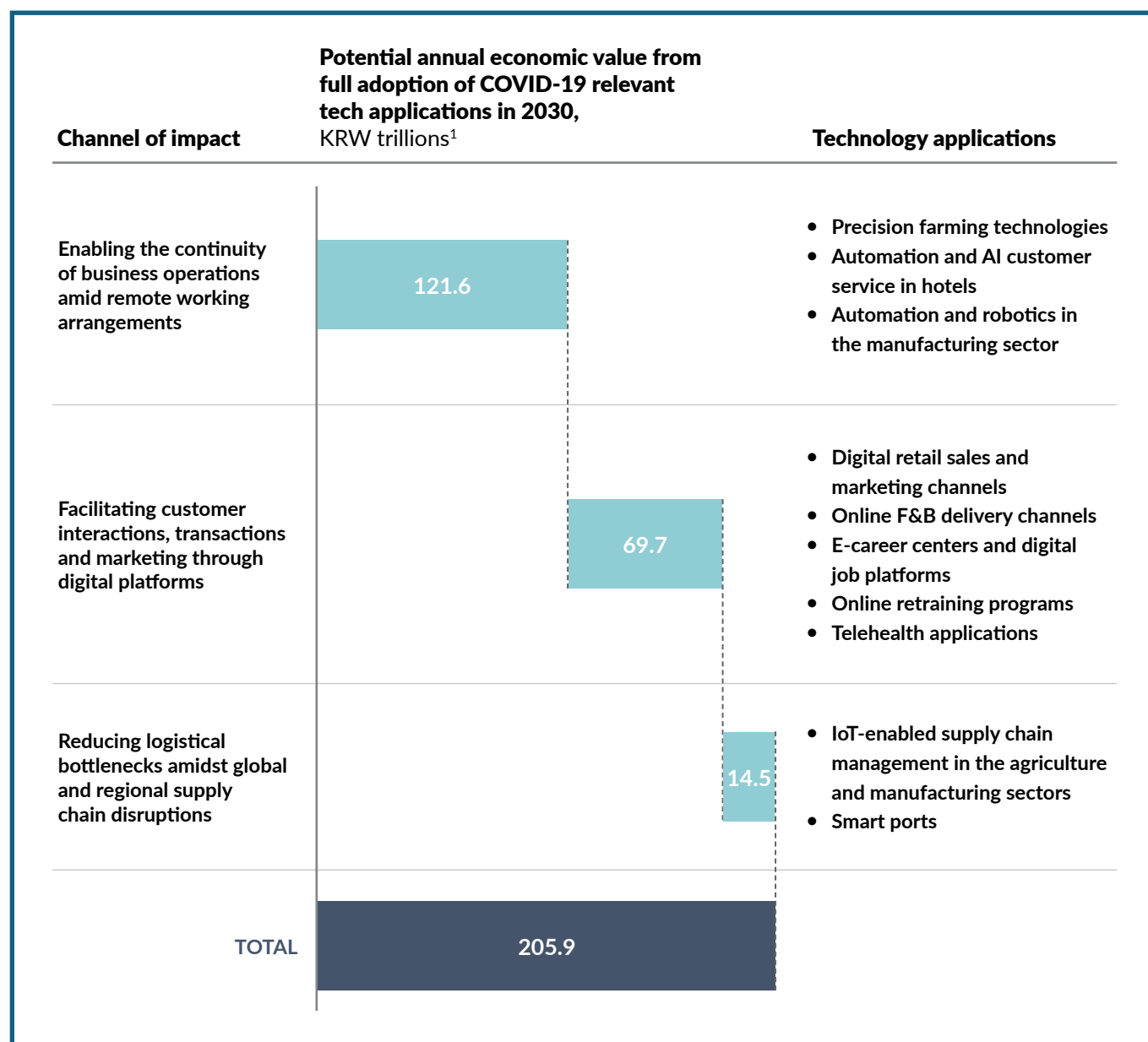
66. The Straits Times (2019), “Faster check-in at Singapore hotels with new automated facial recognition system”.

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



## EXHIBIT 5:

# TECH APPLICATIONS THAT HELP BUSINESSES MITIGATE THE IMPACTS OF COVID-19 CAN GENERATE UP TO KRW206 TRILLION (USD172 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

hospitality industry, e-career centers and digital jobs platforms in the recruitment industry, and telehealth applications in the health sector. Combined, such technology applications are projected to deliver a total annual economic value of KRW69.7 trillion (USD58.4 billion) if fully adopted by 2030 (Exhibit 5). In a short amount of time, brick-and-mortar businesses have had to move online – in fact, a study in the country reflects that online sales in the country soared over 38 percent in March 2020 while sales at physical stores declined by 19 percent.<sup>67</sup> Box 2 shows an example of how one of South Korea's key retail conglomerates, Lotte, has successfully converted its brick-and-mortar stores into online platforms to cater to the growing consumer demand for online products and services during the pandemic.

- **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 KRW14.5 trillion (USD12.2 billion) if fully adopted by 2030 (Exhibit 5). Embedded in distribution networks, sensor data-driven operations analytics from IoT devices, such as remote reporting of position, allow businesses to optimize transportation and improve their distribution management. The adoption of IoT in manufacturing supply chains is estimated to reduce distribution and supply chain operating costs by 2.5 to five percent.<sup>68</sup> Similarly, in “smart ports”, IoT devices can be attached to specific storage containers or to raw materials or products themselves to allow for such tracking. In addition, comprehensive real-time data on cargo schedule and ship positions allow terminal staff to plan anchorage areas and avoid critical berths from being taken out of service by quarantined vessels, reducing bottlenecks and idle time.<sup>69</sup>

In addition, digital technologies can boost the export capabilities of firms in South Korea during and after the pandemic. This is an important competitive edge to maintain, especially since exports account for more than half of the total revenue earned by SMEs in South Korea in 2019.<sup>70</sup> The tremendous impact that online channels can bring to the country's export landscape is reflected by the finding in a study of how firms in South Korea experienced a 400 percent increase in exports on average, after making their products available on the platforms of overseas online retailers.<sup>71</sup> Box 3 shows examples of how digital technologies have provided an important medium of exchange for SMEs in South Korea to export their products and services while engaging stakeholders overseas during the pandemic.

67. Inside Retail (2020), “South Korean online sales surged during COVID-19”. Available at: <https://insideretail.asia/2020/06/01/south-korean-online-sales-surged-during-covid-19/>

68. 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](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)

69. World Ports Sustainability Program (2020), WPSP COVID-19 guidance documents for Ports.

Available at: [https://safety4sea.com/wp-content/uploads/2020/05/WPSP-COVID-19-Guidance-document-for-ports-2020\\_05.pdf](https://safety4sea.com/wp-content/uploads/2020/05/WPSP-COVID-19-Guidance-document-for-ports-2020_05.pdf)

70. FedEx (2019), “SMEs, the driving force of the Korean economy”. Available at: <https://fedexbusinessinsights.com/smes-the-driving-force-of-the-korean-economy/>

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

## BOX 2.

# LOTTE: HOW A TRADITIONAL BRICK-AND-MORTAR BUSINESS SUCCESSFULLY PIVOTED TO AN ONLINE BUSINESS DURING THE PANDEMIC

Before the pandemic, Lotte, one of the country's largest retail conglomerates, mainly sold its products through brick-and-mortar stores including departmental stores and large discount stores. In 2019, the company saw a 64 percent decline in profits from five years ago amid stiff competition from fast-emerging e-commerce platforms.<sup>72</sup> When the COVID-19 pandemic hit South Korea in early 2020, Lotte's sales were further impacted, and the company was forced to close and convert 20 percent of its 200 physical stores. To revitalize sales, the company doubled down on an extensive online strategy.

The company launched an integrated online e-commerce site, "Lotte On", which combines all its previously brick-and-mortar-only convenience stores, pharmacies, departmental stores, supermarket and electronics businesses into an all-in-one platform. Through this platform, the business hopes to achieve KRW20 trillion (USD16.8 billion) in e-commerce sales in 2023.<sup>73</sup> Powered by AI, the e-commerce website offers product recommendation services by integrating and analyzing sales data for 20 million of its products from both online and offline channels for over 39 million customers.<sup>74</sup>

To further entice online customers, "Lotte Duty Free", the duty-free division of the retail conglomerate, launched a series of online discounts for luxury products such as Balenciaga and Valentino that were made available to all consumers.<sup>75</sup> This campaign led to the largest boost in sales experienced by "Lotte Duty Free" in years – of 49 percent year-on-year to KRW1.4 trillion (USD1.2 billion) in the first half of 2020.<sup>76</sup>



To capitalize on the rapid growth in demand for basic necessities and groceries during the pandemic, Lotte partnered with a local online grocery delivery platform, to deliver groceries from Lotte mart stores to customers within 60 to 90 minutes after ordering.<sup>77</sup> As a result, the number of orders received by physical stores increased from 400 to 1,000 per day.<sup>78</sup>

72. Nikkei Asia (2020), "South Korea's Lotte converting physical stores into online bases".

Available at: <https://asia.nikkei.com/Business/Retail/South-Korea-s-Lotte-converting-physical-stores-into-online-bases>

73. Nikkei Asia (2020), "Lotte offers 1-hour delivery in South Korea with e-tail relaunch". Available at: <https://asia.nikkei.com/Business/Companies/Lotte-offers-1-hour-delivery-in-South-Korea-with-e-tail-relaunch>; Nikkei Asia (2020), "South Korea's Lotte converting physical stores into online bases". Available at: <https://asia.nikkei.com/Business/Retail/South-Korea-s-Lotte-converting-physical-stores-into-online-bases>

74. Nikkei Asia (2020), "Lotte offers 1-hour delivery in South Korea with e-tail relaunch".

Available at: <https://asia.nikkei.com/Business/Companies/Lotte-offers-1-hour-delivery-in-South-Korea-with-e-tail-relaunch>

75. The Moodie Davitt report (2020), "Lotte Duty Free announces series of luxury brand online discount events".

Available at: <https://www.moodiedavittreport.com/lotte-duty-free-announces-series-of-luxury-brand-online-discount-events/>

76. Retail News (2020), "Lotte Duty Free online sales up". Available at: <https://www.retailnews.asia/lotte-duty-free-online-sales-down/>

77. Nikkei Asia (2020), "Lotte offers 1-hour delivery in South Korea with e-tail relaunch".

Available at: <https://asia.nikkei.com/Business/Companies/Lotte-offers-1-hour-delivery-in-South-Korea-with-e-tail-relaunch>

78. Nikkei Asia (2020), "South Korea's Lotte converting physical stores into online bases".

Available at: <https://asia.nikkei.com/Business/Retail/South-Korea-s-Lotte-converting-physical-stores-into-online-bases>



## BOX 3.

# DIGITAL TECHNOLOGIES CONNECT BUSINESSES TO INTERNATIONAL CONSUMERS AND FACILITATE THE DIGITAL EXCHANGE OF GOODS AND SERVICES

South Korea's businesses have benefited from the use of digital technologies to conduct sales and business operations in foreign markets. By matching buyers to sellers in different countries with a few clicks, digital technologies have driven down the cost of cross-border communications and transactions, enabling SMEs to participate in export opportunities. This box identifies two key channels in which digital technologies have supported SMEs in South Korea to export their goods and services.

### FACILITATING SALES IN FOREIGN MARKETS

Digital technologies have allowed businesses to reach foreign markets in a cost-efficient manner and capture emerging demand during the COVID-19 pandemic. Increased time spent cleaning, cooking and working at home has led to a global boom in demand for home appliances such as microwave ovens and electric skillets. Appliance businesses in South Korea have profited significantly from this trend via digital platforms. For example, Homeplus, a South Korean homeware chain, saw sales of dishwashers and dish dryers increase by 36-fold in April 2020 as compared to a year earlier.<sup>79</sup> Similarly, after launching its products on Qoo10, a Southeast Asian e-commerce platform, another local home appliance business saw its exports increase by more than 8.7 times in July 2020 during the nationwide online K-Sale ("Korean Donghaeng Sale").<sup>80</sup> Traditional markets also benefited from selling their products at K-Sale – "Champon Soy Sauce Shrimp" from Buan traditional market and "Clam Ramen" from Gochang traditional market were sold out during the online sale.<sup>81</sup>

### CONNECTING WITH STAKEHOLDERS DIGITALLY

Digital tools ranging from simple Internet search engines to more sophisticated cloud computing technologies can also allow enterprises to operate with ease across geographies by connecting with consumers, suppliers and investors across the globe. For example, with over two billion monthly visitors, YouTube provides a platform for advertisers to gain global exposure to targeted audiences at a low cost.<sup>82</sup> Box 10 in Chapter 3.1 provides an example of how a recruiting platform uses YouTube advertisements to match job opportunities to job seekers across borders.



79. The Korea Herald (2020), "COVID-19 changes home appliances consumption trend". Available at: <http://www.koreaherald.com/view.php?ud=20200517000170>

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

81. Ministry of SMEs and Startups (2020), "This time a mini-concert, second 'Donghaeng' of K-Popo and K-Sale". Available at: <https://www.mss.go.kr/site/eng/ex/bbs/View.do?cidx=244&bidx=1021624&parentSeq=1021624>

82. Oberlo (2021), "10 YouTube stats every marketer should know in 2021". Available at: <https://sg.oberlo.com/blog/youtube-statistics>





# **CAPTURING THE PRIZE — THREE PILLARS OF ACTION**

To fully capture the digital opportunity, three pillars of action will be required in South Korea: 1) Nurture the local technology ecosystem; 2) Foster the adoption of cutting-edge technologies like AI and cloud computing; and 3) Facilitate access to digital export opportunities.

Businesses in South Korea have benefited from significant strides made across all three pillars. With one of the highest R&D investments across OECD countries, the country receives strong government financial and regulatory support to **nurture the local technology ecosystem**. To **foster the adoption of cutting-edge technologies like AI and cloud computing**, the South Korean Government has a strong focus on industry-academia partnerships to nurture homegrown high-tech industries and unveiled multiple policy initiatives such as the “National Strategy for Artificial Intelligence” and the “Digital New Deal” stimulus package. As a trade-dependent country, South Korea also places a strong emphasis on **facilitating access to digital export opportunities** for businesses in South Korea. Digital platforms such as “u-Trade Hub 2.0” and “K-Content Expo” create avenues for local businesses to meet foreign buyers and manage online distribution efficiently.

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 adopt Singapore’s multi-dimensional approach in fostering partnerships between global and local technology companies to promote innovation among small firms. In addition, the South Korean Government should consider creating sector-specific technology adoption roadmaps

# “CAPTURING THE PRIZE”

## THREE PILLARS OF ACTION



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

1

Nurture the local technology ecosystem



2

Foster adoption of cutting-edge technologies like AI and cloud computing



3

Facilitate access to digital export opportunities



Significant effort has already been made in the following areas

- Strong government financial support and programs for start-ups
- Removal of barriers to developing and commercializing domestic innovations
- High R&D intensity and a traditionally strong focus on industry-research partnership
- Strong policy support for deployment of emerging technologies across sectors
- Establishment of digital platforms to streamline administrative procedures required for exporting
- Promotion of Korean exports via digital platforms

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

- Foster partnerships between global and local technology companies
- Create sector-specific programs to catalyze deep tech adoption by traditional sectors
- Provide adequate skilling opportunities in cutting-edge technologies like AI
- Provide capacity-building support for businesses to capture digital trade opportunities
- Participate in international digital trade agreements to promote digital trade in the region

like New Zealand's "Industry Strategy" to support technology adoption in traditional sectors. To enhance digital opportunities and nurture "global-ready" businesses, the South Korean Government can consider providing more holistic capacity-building support such as introducing tax incentives for businesses to expand globally and participating in international digital trade agreements such as the "Digital Economy Partnership Agreement".

## 2.1 PILLAR 1: NURTURE THE LOCAL TECHNOLOGY ECOSYSTEM

For South Korea to fully capture the economic opportunities afforded by digital technologies, there needs to be strong policy support for the growth of the local technology ecosystem. With Seoul home to over 8,700 start-ups, 85 accelerators and ten unicorns,<sup>83</sup> South Korea hosts one of the largest domestic start-up and tech ecosystems in the world.<sup>84</sup> This has been in large part driven by supportive government policy, particularly in the following areas:

- Strong government financial support and programs for start-ups.** South Korea has the highest government backing per capita of start-ups in the world – in 2015, the government provided USD4 billion to start-ups in the country, and made a further pledge in 2017 of over USD9 billion in venture capital. In addition, the government has rolled out several programs to support foreign entrepreneurs looking to do business in South Korea.<sup>85</sup> A key program is the "K-Startup Grand Challenge" organized by the country's National IT Industry Promotion Agency (NIPA). Since 2016, 41 start-ups have successfully incorporated in South Korea through this program.<sup>86</sup>
- Removal of barriers to developing and commercializing domestic innovations.** The South Korean Government has a strong policy stance to expand the administrative and financial incentives for companies with source technology, as well as banks that approve loans based on intangible intellectual assets.<sup>87</sup> Such policies effectively expand financing options for, and reduce the costs of developing and commercializing innovations, and include discounts on Intellectual Property (IP) fees and patent applications. For example, in 2019, the Korean Intellectual Property Office (KIPO) and the Financial Services Commission jointly unveiled a plan to expand the volume of IP-backed financing to KRW2 trillion (USD1.7 billion) by 2022.<sup>88</sup> The government has also committed to expanding low-interest IP-backed loans so that small- and medium-sized enterprises (SMEs) could save up to KRW60 billion (USD50.2 million) in interest.<sup>89</sup> At the same time, start-ups in the country are offered a 70 percent fee reduction when requesting a preferential examination for a patent application (which allows for such applications to be expedited).<sup>90</sup>

83. A "unicorn" refers to a privately held start-up company valued at over USD1 billion.

84. Andrea Hak (2020), "Seoul's start-up and tech ecosystem is world class - here's what you need to know". Entrepreneur. Available at: <https://thenextweb.com/entrepreneur/2020/06/29/seouls-start-up-and-tech-ecosystem-is-world-class-heres-what-you-need-to-know/>

85. Amy Guttman (2018), "South Korea triples its financial commitment to startups". Forbes. Available at: <https://www.forbes.com/sites/amyguttman/2018/02/28/south-korea-triples-its-financial-commitment-to-startups/?sh=250335f455fc>

86. Mabel Fu (undated), "Why South Korea should be on the radar of German startups". German Accelerator. Available at: <https://www.germanaccelerator.com/blog/why-south-korea-should-be-on-the-radar-of-german-startups/#:~:text=South%20Korea's%20startup%20ecosystem%20has,per%20capita%20in%20the%20world.>

87. Companies with source technology refer to companies with IP rights to technologies and innovation.

88. Bae Hyunjung (2019), "S. Korea expands benefits for IP-backed financing". Available at: <http://www.koreaherald.com/view.php?ud=20191229000128>

89. Bae Hyunjung (2019), "S. Korea expands benefits for IP-backed financing". Available at: <http://www.koreaherald.com/view.php?ud=20191229000128>

90. Bae Hyunjung (2019), "S. Korea expands benefits for IP-backed financing". Available at: <http://www.koreaherald.com/view.php?ud=20191229000128>



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

- **Foster partnerships between global and local technology companies.** Although R&D investment in South Korea is among the highest across OECD economies, this is chiefly driven by a number of large manufacturing conglomerates, and the country's overall share of innovative small firms is lower than several other OECD economies (at 50 percent versus over 60 percent in Australia and Germany).<sup>91</sup> It has also been found that South Korea is not as well integrated

into global innovation networks as its OECD peers – with levels of international co-authorship and co-patenting among the lowest in the OECD. It is therefore important that the country pursues policies that help firms better connect to global innovation networks, and in particular, catalyze partnerships between global and local technology firms.<sup>92</sup> Singapore – a country that has been described as a “miniature Silicon Valley”, and which plays host to the world's top 80 technology companies – has a vibrant domestic technology industry that is in large part fueled by the strong presence of global technology corporations. Box 4 reflects three key drivers behind its success.



91. OECD (2017), Digitalisation: An enabling force for the next production revolution in Korea. Available at: <https://www.oecd-ilibrary.org/docserver/9789264285545-en.pdf?expires=1608283882&id=id&accname=guest&checksum=3EC1D0EF356CF8D5460A83594516B1BC>

92. OECD (2017), Digitalisation: An enabling force for the next production revolution in Korea. Available at: <https://www.oecd-ilibrary.org/docserver/9789264285545-en.pdf?expires=1608283882&id=id&accname=guest&checksum=3EC1D0EF356CF8D5460A83594516B1BC>



## BOX 4.

# SINGAPORE: A MULTI-DIMENSIONAL APPROACH TOWARDS CEMENTING ITS STATUS AS A “MINIATURE SILICON VALLEY”

Once a sleepy fishing village, the island city-state of Singapore has emerged as a prosperous technology hub in the heart of Southeast Asia. It has even been described by Hewlett Packard Enterprise’s former CEO Meg Whitman as a “miniature Silicon Valley”.<sup>93</sup> Much of this success has been fueled by a strong and growing partnership between global technology companies and local firms – with 80 of the world’s top 100 technology firms having a presence in the country.<sup>94</sup> This strong partnership has often been attributed to three key drivers – all of which are bolstered by strong government support.



Firstly, **an innovation-centered business culture** in which global enterprises and start-ups frequently collaborate on projects are the reasons why global tech multinationals are keen to locate in the country. Such collaborations are frequently scaled by Singapore’s government, which supports through the development of regulatory sandbox environments. To encourage the live testing of new technologies, the government markets the associated programs to a variety of industries, and at times even providing discounts on rent where real estate space is required.

Secondly, **modern IT infrastructure** has rendered a “plug-and-play” business environment in which tech companies can hit the ground running almost immediately. Supported by state-of-the-art digital infrastructure which is constantly evolving to deliver the best performance (e.g., nationwide 5G networks will be ready by 2025), the country was ranked first in digital infrastructure in the Economist Intelligence Unit’s Asian Digital Transformation Index.<sup>95</sup>

Thirdly, the government’s commitment to a **strong Intellectual Property (IP) regulatory framework** gives companies confidence that their R&D investments will stay protected, averting any concerns that opportunistic firms could make a quick profit by replicating another company’s innovations. The World Economic Forum’s Global Competitiveness Report in 2019 ranks the country second globally and top in Asia on IP rights protection.<sup>96</sup> Finally, the presence of a highly skilled talent pool has been a key driver of Singapore’s status as an incubator for tech companies. This has been made possible through a range of supportive government policies from embedding a strong focus on tech skills early on in K-12 curriculums, to subsidizing and availing a suite of digital skills courses to the current workforce.

93. Jonathan Vanian (2017), “Hewlett Packard Enterprise bets that Singapore will be a ‘miniature Silicon Valley’”. Fortune. Available at: <https://fortune.com/2017/05/09/hewlett-packard-enterprise-singapore-silicon-valley/>

94. Economic Development Board, Singapore (2018), “Singapore flexes its standing as Asia’s technology capital”. Available at: <https://www.edb.gov.sg/en/news-and-events/insights/innovation/singapore-flexes-its-standing-as-asias-technology-capital.html>

95. Economist Intelligence Unit (2018), The Asian Digital Transformation Index 2018. Available at: <http://connectedfuture.economist.com/article/asian-digital-transformation-index-2018/>

96. World Economic Forum (2019), The Global Competitiveness Report 2019. Available at: [http://www3.weforum.org/docs/WEF\\_TheGlobalCompetitivenessReport2019.pdf](http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf)





## 2.2 PILLAR 2: LEVERAGE CUTTING-EDGE TECHNOLOGIES LIKE AI AND CLOUD COMPUTING FOR INNOVATION

To unlock the full benefits of digital transformation, South Korea must continue to promote an environment that is conducive to innovation, and pursue policies that facilitate the deployment of cutting-edge technologies such as AI and cloud computing.

The country is already making significant efforts through the following areas:

- High R&D intensity and a traditionally strong focus on industry-research partnership.** South Korea's position as one of the world's most innovative nations has been often attributed to the country's outstanding performance in "R&D intensity" – which reflects both R&D investment made by government and industry, and the number of researchers working in both sectors. For example, data on the industry-academia movements of individuals from 71 countries show that South Korea registered the greatest

share of researchers who moved from industry to academia between 2017 and 2019.<sup>97</sup> This high R&D intensity has emerged from a historically "top-down" innovation system that promotes close collaboration between government, industry, and the academic community. These are evident from the government's establishment of research institutes to nurture industry capabilities such as the Korea Institute of Science and Technology (KIST) in 1966, a dedicated ministry to oversee all tech and innovation efforts (the Ministry of Science and Technology) a year later, and an evergreen focus to nurture homegrown high-tech industries (from semiconductor design and manufacture in the 1990s to biotechnology, AI and cybersecurity today).<sup>98</sup> A case in point of a company that has benefited from strong government support and research collaborations to achieve global innovator status is Samsung. As South Korea's largest chaebol (a large family-owned business conglomerate),

97. League of Scholars. Available at: <https://www.leagueofscholars.com/>

98. Leigh Dayton (2020), "How South Korea made itself a global innovation leader". Nature. Available at: <https://www.nature.com/articles/d41586-020-01466-7>

the company is one of the world's leaders in the design and manufacture of tablets, smartphones, and computer chips. With support from the government, it has collaborated with leading academic institutions such as Sungkyunkwan University in Seoul on electrochemistry research - this partnership was one of its most productive, leading the company to develop new energy sources for its products such as lithium-ion batteries.<sup>99</sup> Other partnerships include Seoul National University (SNU) and the Korea Advanced Institute of Science and Technology (KAIST).

- **Strong policy support for deployment of emerging technologies across sectors.** The country announced a “National Strategy for Artificial Intelligence” in December 2019. To leverage AI to achieve international digital competitiveness (in particular rising from its current 10th global ranking under IMD's Digital Competitiveness Index to become 3rd), harness AI's economic potential (estimated at up to KRW465 trillion won by 2030), and improve citizens' quality of life (to be ranked among the top ten OECD countries on this metric), this strategy comprises 100 government-wide action tasks under nine strategies in three areas.<sup>100</sup> 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).<sup>101</sup> Moreover, South Korea has demonstrated one of the most digitally-focused stimulus responses to the COVID-19 pandemic globally. Its KRW-58 trillion (USD-52.3 billion) “Digital New Deal” stimulus package includes a plan to deploy 5G infrastructure nationwide, promote industrial convergence between 5G and AI, as well as advance the adoption of cloud computing technologies in the government sector.<sup>102</sup> Significant policy focus has also been placed on technology adoption in traditional sectors. Besides the “National Strategy for AI” which includes measures to promote AI adoption in such sectors, the government has also developed sector-specific policies. 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.<sup>103</sup>

While there is already a comprehensive range of policies to promote an innovation-oriented environment, the country could go further in the following areas:

- **Create sector-specific programs to catalyze deep tech adoption in traditional sectors.** Although

99. Leigh Dayton (2020), “How South Korea made itself a global innovation leader”. Nature. Available at: <https://www.nature.com/articles/d41586-020-01466-7>

100. 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&nttSeqNo=9&searchOpt=ALL&searchTxt=>

101. 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&nttSeqNo=9&searchOpt=ALL&searchTxt=>

102. Troy Stangarone (2020), “South Korea's Digital New Deal”. The Diplomat. Available at: <https://thediplomat.com/2020/06/south-koreas-digital-new-deal/>

103. 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/>



there is a strong policy focus in the country to support technology adoption across sectors, current evidence shows that firms in South Korea still lag their OECD peers on the deployment of emerging technologies. While firms in South Korea are among the OECD leaders on broadband connectivity (at over 99 percent for both small and large firms), only 60 percent have a website (versus over 90 percent in Nordic countries like Sweden and Finland), only 36 percent use enterprise planning software (versus 56 percent in Germany), and only 13 percent use cloud computing services (versus 57 percent in Finland).<sup>104</sup> To address this, more emphasis could be placed on providing companies in non-technology sectors with the support to adopt digital technologies. An international best practice worth considering in South Korea is New Zealand's "Industry Strategy", which aims to lift firm productivity through a series of enablers that facilitate digital adoption in selected sectors (Box 5).

- **Provide adequate skilling opportunities in cutting-edge technologies like AI.** A range of international skills benchmarking reports reflects that South Korea lags several peer economies on the quality and quantity of digital skills in its workforce. For example, in the World Economic Forum's "2019

Global Competitiveness Index", South Korea was ranked 25th out of 141 countries on the indicator "digital skills of the current workforce", behind other high-income Asian economies including Singapore, Taiwan, and Hong Kong.<sup>105</sup> In addition, the OECD's 2019 "Program for the International Assessment of Adult Competencies" (PIAAC) survey reflected that less than 37 percent of individuals aged 16-65 in South Korea have a good level of literacy and numeracy skills – which have been demonstrated to determine how well individuals adapt to and manage new digital technologies.<sup>106</sup> This is low as compared to peer OECD economies such as Japan (60 percent) and Sweden (50 percent).<sup>107</sup> To address these gaps, there is scope for the South Korean Government to invest in digital skills training for workers, particularly in cutting-edge technologies like AI. Two international best practices in this area that could be considered for application in South Korea are Sweden's "Competence Center for AI Development" and Singapore's "AI Singapore Talent Development Pathway" – both entail government-academia-industry collaboration to develop national AI training bases for the workforce.<sup>108</sup> Beyond developing AI specialists, both policy examples contain a strong focus on providing AI training to professionals across all levels of digital literacy and sectors.

104. OECD (2017), Digitalisation: An enabling force for the next production revolution in Korea.

Available at: <https://www.oecd-ilibrary.org/docserver/9789264285545-en.pdf?expires=1608283882&id=id&accname=guest&checksum=3EC1D0EF356CF8D5460A83594516B1BC>

105. World Economic Forum (2019), Global Competitiveness Index 2019. Available at: [http://www3.weforum.org/docs/WEF\\_GlobalCompetitivenessReport2019.pdf](http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport2019.pdf)

106. Sources include: OECD (2020), "OECD skills surveys: PIAAC". Available at: <https://www.oecd.org/skills/piaac/>; OECD (2019), OECD Skills Outlook 2019: Thriving in a digital world - how does Korea compare? Available at: <https://www.oecd.org/korea/Skills-Outlook-Korea-EN.pdf>

107. OECD (2020), "OECD skills surveys: PIAAC". Available at: <https://www.oecd.org/skills/piaac/>

108. Sources include: AI Singapore (2020), "Learning Pathway". Available at: <https://www.aisingapore.org/ai-certification/>; AI Competence for Sweden. Available at: <https://ai-competence.se/en/>

## BOX 5. NEW ZEALAND'S DIGITAL TECHNOLOGY INDUSTRY TRANSFORMATION PLANS TRANSFORM TRADITIONAL INDUSTRIES



In June 2019, the Ministry of Business, Innovation and Employment (MBIE) partnered with the New Zealand Tech Alliance (NZTech), a group of technology industry associations, to launch the “Industry Strategy” which aims to educate and encourage businesses in a range of sectors to adopt technologies, innovate and enhance productivity. At the core of this strategy are the “Industry Transformation Plans” (ITPs), which identify opportunities to lift productivity and growth in key industries which include construction, food and beverage, agriculture, digital technology, and forestry and wood processing.<sup>109</sup>

In one of the priority industries, agriculture, a cross-agency taskforce has been formed in the government with the mandate to design and coordinate an agritech ITP. The plan first identified obstacles and constraints that have held back growth in the agritech industry. Subsequently, an action plan was drawn up to create multiple workstreams that addressed each challenge. One of the workstreams includes connecting local agritech firms with global leaders in agritech, like the Netherlands which is home to multiple agriculture innovation hubs. To fully exploit agritech research ideas into finished products and services, the taskforce partnered with the country’s innovation agency, Callaghan Innovation, to accelerate commercialization and spinouts from research institute IPs through on-farm technology prototyping.<sup>110</sup>

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

110. Ministry of Business, Innovation and Employment (2020), Agritech Industry Transformation Plan. Available at: <https://www.mbie.govt.nz/dmsdocument/11572-growing-innovative-industries-in-new-zealand-agritech-industry-transformation-plan-july-2020-pdf>

## 2.3 PILLAR 3: FACILITATE ACCESS TO DIGITAL EXPORT OPPORTUNITIES

Finally, for businesses in South Korea 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.

South Korea has implemented the following actions in this regard:

- **Establishment of digital platforms to streamline administrative procedures required for exporting.**

To boost outbound shipments, the South Korean Government is developing a digital platform to support export procedures such as contracts, customs clearance, and logistics.<sup>111</sup> This move was prompted by a prolonged decline in South Korea's export value over ten months in 2019, as a result of weakening semiconductor prices (which account for a substantial 20 percent of the country's total exports) and the United States-China trade war (that impacted South Korea's exports of intermediate goods to China – which constitutes a bulk of its exports to the country).<sup>112</sup> Leveraging big data analytics and AI technologies, this digital trade platform, known as “u-Trade Hub 2.0”, will allow companies to more efficiently manage all processes related to overseas shipments from procurement, contract signing, customs clearance to managing online distribution.<sup>114</sup> This platform is envisioned to save exporters more than 90 percent in time and cost spent on administrative procedures involved in exporting.<sup>114</sup> In addition, the Korea International

Trade Association (KITA.ORG) is working with local banks to launch a blockchain-based foreign exchange transaction platform, which will allow exporters to conduct foreign exchange trades without having to undergo the current process of submitting 17 handwritten documents.<sup>115</sup>

- **Promotion of South Korean exports via digital platforms.** The government has a strong focus on promoting South Korean products overseas by riding on the global popularity of Korean pop culture. In particular, it has stepped up the marketing and promotion of Korean products on foreign e-commerce platforms during “Korea Sale Fiesta”, the country's biggest annual shopping sales event (equivalent to the United States' “Black Friday”).<sup>116</sup> Targeting for the country to achieve KRW150 trillion (USD126 billion) in sales and exports from the country's content industry by 2022, the Korean Creative Content Agency (KOCCA), a governmental 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.<sup>117</sup> During the period of April to July 2020, 131 companies in South Korea clinched

111. Yonhap News Agency (2019), “S. Korea to promote digital export platform”. Available at: <https://en.yna.co.kr/view/AEN20191014001500320>

112. Sources include: Yonhap News Agency (2019), “S. Korea to promote digital export platform”. Available at: <https://en.yna.co.kr/view/AEN20191014001500320>; The Korea Herald (2020), “Semiconductors again top list of S. Korea's export items in 2019”. Available at: <http://www.koreaherald.com/view.php?ud=20200128000651>; Jung Min-hee (2019), “U.S.-China trade war seriously affecting South Korean industries”. Business Korea. Available at: <http://www.businesskorea.co.kr/news/articleView.html?idxno=32500>

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

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

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

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

117. Sources include: Yonhap News Agency (2019), “S. Korea to spend over 1trn won to nurture content creators”. Available at: <https://en.yna.co.kr/view/AEN20190917006451315>; 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>



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.<sup>118</sup>

A United States National Trade Estimate study in 2020 identified South Korea's restriction on geo-location data as a key barrier to digital trade. By restricting the export of location-based data, this has created a competitive disadvantage for international suppliers that incorporate services such as traffic updates and navigation into their products. In addition, restrictions on cross-border use of cloud computing for the financial services sector pose a serious impediment to the competitiveness of foreign cloud computing service providers in the South Korean market.<sup>119</sup> Therefore, there is scope for the country to go further to promote digital export opportunities in the following areas:

- **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 that educate and inform Korean enterprises, particularly MSMEs, on how to be "global-ready", and discover and leverage opportunities to export overseas. One international best practice can be observed in New Zealand, in which a New Zealand government agency tasked with making Kiwi businesses more innovative, Callaghan Innovation, is working with NZTech, a group of technology industry associations, to create and nurture a pipeline of Kiwi companies to be global-ready. End-to-end support is provided for companies to scale globally in the form of "Getting Started Grants", "Founder" incubators,



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

119. Office of the United States Trade Representative (2020), "Fact sheet on the 2020 National Trade Estimate: Strong, Binding Rules to Advance Digital Trade".

Available at: <https://ustr.gov/about-us/policy-offices/press-office/fact-sheets/2020/march/fact-sheet-2020-national-trade-estimate-strong-binding-rules-advance-digital-trade#:~:text=Korea's%20Restrictions%20on%20Cross%20Border,that%20maintains%20such%20a%20restriction>





tax incentives for R&D efforts, subsidies for digital adoption (“capability vouchers”), and knowledge sharing platforms.<sup>120</sup> 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.<sup>121</sup>

- **Participate in international digital trade agreements to promote digital trade in the region.**

Cross-border trade would be greatly enhanced by reducing the need for local registration, removing disclosure requirements of key intellectual property, and minimizing unnecessary procedures and duties. In addition, there is a strong evidence base around the potential gains from reducing harmful, trade-distorting non-tariff barriers; past research has estimated that the potential cost of data localization requirements and related data privacy and security laws that discriminate against foreign suppliers could amount to about

0.4 percent of South Korea’s GDP.<sup>122</sup> While South Korea has kicked off negotiations with Singapore towards a digital trade deal, the country can participate in international agreements to lower barriers on digital trade and create a conducive environment for cross-border trade in the region.<sup>123</sup> An example of such a recently signed agreement is the “Digital Economy Partnership Agreement” (DEPA) signed between Singapore, New Zealand and Chile – a new trade agreement aimed at helping MSMEs take advantage of opportunities from digital trade.<sup>124</sup> This agreement has allowed for the following ways in which digital trade to flourish:

- **Streamline trading procedures.** For instance, e-certificates for animal products exchanged through the agreement’s “International Connectivity System” will reduce the time for document transit and cargo clearance, resulting in lower operating costs for exporters.

120. 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>

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

122. Bauer, Lee-Makiyama, Marel, Verschelde (2014), The costs of data localisation: Friendly fire on economic recovery. Available at: [https://www.aicasia.org/wp-content/uploads/2017/06/OCC32014\\_1.pdf](https://www.aicasia.org/wp-content/uploads/2017/06/OCC32014_1.pdf)

123. The Korea Herald (2020), “S. Korea, Singapore begin talks on digital trade deal”. Available at: <http://www.koreaherald.com/view.php?ud=20200622000837>

124. Beehive.govt.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>



- **Promote open cross-border data flows with the necessary data safeguards.** With an OECD report highlighting that a ten percent rise in “bilateral digital connectivity” could improve trade in goods and services by about two and three percent respectively, cross-border data flows are critical for enabling digital exports.<sup>125</sup> There is a considerable opportunity to improve transparency on data management requirements across the Asia Pacific region and to identify areas to enhance performance. Through the DEPA, businesses operating in the three signatory countries are able to transfer information seamlessly across borders, with the assurance that the data is protected by the relevant security mechanisms and requisite regulations. This provides a conducive environment for data-driven business models such as software-as-a-service and with businesses increasingly reliant on electronic transactions and digital solutions to serve

customers regardless of where they are located. In addition, MSMEs looking to better understand foreign markets can now access and use open government data to discover new business opportunities and innovate new products and services.<sup>126</sup>

- **Build trust in cross-border digital systems.** As digital systems for the exchange of digital goods and services span borders and need to be interoperable across countries, it is important that governments build trust in such systems so that enterprises may confidently enter export markets. This involves aligning laws and regulations with international frameworks through an agreement such as the DEPA to protect consumers against fraudulent, misleading, or deceptive conduct when engaging in online commercial activities and adopting ethical AI governance frameworks to harness AI responsibly.<sup>127</sup>

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

126. Ministry of Trade and Industry Singapore (2020), “Digital Economy Partnership Agreement.”

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

127. 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>

A close-up photograph of a woman with dark hair looking down. The image is overlaid with semi-transparent digital graphics, including a world map, a bar chart, and various data points and lines, suggesting a focus on technology and data. A large teal diagonal shape covers the bottom left portion of the image, serving as a background for the text.

# **ADVANCING THE PRIZE — GOOGLE'S CONTRIBUTION TO ADVANCING THE DIGITAL OPPORTUNITY IN SOUTH KOREA**



An important player spearheading digital transformation in South Korea, Google has made significant contributions in each of the three pillars for digital transformation. The company has been building strong partnerships with domestic tech firms, such as Hyundai Motor Group, and supporting local tech startups through initiatives such as “Google for Startups” to promote the growth of the digital economy. Through Google Cloud, Google has supported local businesses in using digital tools to deliver innovative products and services in a cost-efficient manner. At the same time, Google is preparing the next generation of workers in utilizing emerging technologies through programs such as the “Digital and Media Literacy Education” program to increase digital literacy among junior high school students. Collaborating with the South Korean Government (Ministry of SMEs & Startups), Google has also been a key partner of the “ChangGoo Program” which promotes the development of South Korea’s mobile app exports.

In addition, Google’s products create various economic benefits for businesses, consumers and the broader society in South Korea. Businesses and consumers in the country are estimated to derive annual economic benefits from Google’s products worth KRW10.5 trillion (USD8.8 billion) and KRW11.9 trillion (USD10 billion), respectively. These products include Google Search and Ads, AdSense, 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. Beyond the KRW10.5 trillion (USD8.8 billion) business benefits,



# “ADVANCING THE PRIZE”

## GOOGLE'S CONTRIBUTION TO SOUTH KOREA'S DIGITAL TRANSFORMATION JOURNEY



Nurture the local technology ecosystem

1



Foster adoption of cutting-edge technologies like AI and cloud computing

2



Facilitate access to digital export opportunities

3

### EXAMPLES OF INITIATIVES BY GOOGLE

- “**GOOGLE FOR STARTUPS CAMPUS**” provides a collaborative space for South Korean startups and supports developer communities
- **GOOGLE CLOUD** provides reliable and scalable infrastructure, allowing companies to deploy cutting-edge technologies at lower cost
- Google's “**CHANGGOO PROGRAM**” supports mobile app and game developers in their growth and internationalization efforts by collaborating with the Ministry of SMEs & Startups

### GOOGLE ALSO DELIVERS WIDER BENEFITS TO BUSINESSES, CONSUMERS AND SOCIETY IN SOUTH KOREA

#### BUSINESSES

Through significant boosts to productivity and customer outreach, Google is estimated to support **KRW10.5 trillion (USD8.8 billion)** worth of annual benefits for businesses in South Korea<sup>1</sup>

#### CONSUMERS

By helping consumers save time and generating value through their free products, Google is estimated to support **KRW11.9 trillion (USD10 billion)** worth of annual benefits for consumers in South Korea<sup>2</sup>

#### SOCIETY

Google partnered with not-for-profit organization, **Our Sea of East Asia Network**, to protect the marine environment and its “**Campus for Moms**” program supports local female entrepreneurs

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

2. Consumer benefits refer to the estimated economic impact from the following products: Google Search; Google Drive; Docs, Sheets and Photos; and 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 as at time of research in 2020.

the Android operating system provides cost savings for both South Korean Original Equipment Manufacturers (OEMs) and app developers. South Korean OEMs are saving one-off development costs and achieving additional annual savings through simplified operating system maintenance and upgrading. Taken together, the total savings to South Korean OEMs are estimated to be over KRW3 trillion (USD2.5 billion). The vast adoption of free-to-use open-source operating systems, such as Android, allows app developers to cut development time and therefore, costs. This implies cost savings of approximately KRW280 billion (USD234 million) saved for over 36,000 South Korean apps.<sup>128</sup> Consumers, on the other hand, experience greater convenience, access to information, and more avenues for learning and skills development opportunities. Beyond its economic contributions to businesses and individuals, Google delivers benefits to the broader society by extending digital skilling opportunities to female entrepreneurs, supporting local not-for-profit organizations in serving underserved communities and protecting the environment in South Korea.

## 3.1 GOOGLE CONTRIBUTES TO EACH OF THE THREE PILLARS OF DIGITAL TRANSFORMATION IN SOUTH KOREA

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

To **nurture the local technology ecosystem (Pillar 1)**, Google has done the following:

- **Foster partnerships with local technology companies to support the development of innovative solutions.** Google has been building strong partnerships with domestic technology firms in their digital innovation efforts. One key industry partnership forged was with a local car manufacturer, Hyundai Motor, in 2018. As part of the partnership, Google launched Android Auto, an in-car infotainment service in Hyundai vehicles that provides information on road hazards to increase safety and entertainment options to improve

the driving experience.<sup>129</sup> In 2020, Kia Motors, a subsidiary under the Hyundai Motor Group, also leveraged Google Cloud to develop an AI-based digital car manual that catalogs different features within the car on a smartphone application. By using a smartphone camera to capture images of different parts of the car, customers are able to view the name and functions of each part, and even troubleshoot using the app. This is made possible by Google Cloud's AI-based image recognition technology which identifies in-car switch symbols accurately from any angle and instantly displays a video introducing the detailed functions of the symbol.<sup>130</sup> The innovative digital car manual was also awarded the grand prize under the "Intelligent Application" category at the "2020 Spring Conference of the Korea Intelligent Information System Society".<sup>131</sup>

128. Note that the cost and time savings from both South Korea OEMs and app developers are not included in the business benefits figure of KRW10.5 trillion (USD8.8 billion).

129. Pulse News (2018), "Google to launch in-car infotainment service in Korea in partnership with Hyundai Motor".

Available at: <https://pulsenews.co.kr/view.php?year=2018&no=437266>

130. Hyundai Motor Group (2020), "Kia Motors partners with Google Cloud to develop AI-based Owner's Manual app".

Available at: <https://news.hyundaimotorgroup.com/MediaCenter/News/Press-Releases/Kia-Motors-partners-with-Google-Cloud-to-develop-AI-based-Owner-s-Manual-app>

131. Hyundai Motor Group (2020), "Kia Motors partners with Google Cloud to develop AI-based Owner's Manual app".

Available at: <https://news.hyundaimotorgroup.com/MediaCenter/News/Press-Releases/Kia-Motors-partners-with-Google-Cloud-to-develop-AI-based-Owner-s-Manual-app>

- **Provide resources and community support for budding entrepreneurs.** Besides partnering with local businesses, Google has also provided resources and created developer communities to support local entrepreneurs. To enable local tech businesses to grow and scale rapidly, Google has dedicated a space known as “Google for Startups Campus” whereby start-ups can receive training and mentorship. As part of the “Google for Startups” program, Google launched “Startup School” – a series of free, hands-on virtual courses, covering a range of topics from digital marketing to business strategy, for start-up founders and their teams around the world. During the COVID-19 pandemic, the alumni of “Google for Startups” hosted a virtual event to share their tips for working from home and provide advice on dealing with stress for South Korean founders.<sup>132</sup> Google is also a strong supporter of South Korea's largest AI community, “TensorFlow User Group”, as well as 15 “Google Developer Groups” across the country where developers learn, connect and innovate using Google's technologies. Other community groups supported by Google include “Machine Learning Study Jams” and “Cloud Study Jams” which provide e-learning content and hands-on learning of Google tools while building communities and networks for developers in the country. Together, it is estimated that over 50,000 developers in South Korea will benefit from the “Study Jams” by 2023.
- **Invest in network infrastructure.** Besides uplifting local tech businesses directly, Google has also made significant investments of more than USD2 billion in network infrastructure to help improve the capacity of network services in the Asia Pacific (APAC) region, including South Korea.<sup>133</sup> These investments are crucial in providing the underlying infrastructure layer for business to deliver their products and

services through the Internet and thus, boosting the country's overall economic activity and digital connectivity. Box 6 shows the impact of Google's network infrastructure investments on businesses in South Korea.

To **promote the use of cutting-edge technologies like AI and cloud computing for innovation (Pillar 2)**, Google has launched the following efforts in South Korea:

- **Facilitate the growth of new business models through tools like Google Cloud.** By leveraging on Google's products and services such as Google Cloud, new technology-driven business models and products can be created. These range from mobile games and virtual assistants to e-commerce platforms and IoT solutions. Where small businesses struggle to source for capital, Google Cloud democratizes access to specialized technologies such as AI and machine learning by eliminating the fixed costs involved in the adoption of such technologies, particularly for start-ups and MSMEs seeking to maximize productivity and access new revenue streams on lean budgets.<sup>134</sup> Businesses may access Google Cloud's open-source machine learning platform, TensorFlow (which trains and runs machine learning models), and other sophisticated software for image and language recognition, translation, and other analytic tools that unlock the value of their data, reduce costs and provide world-leading products and services to customers globally. Box 7 shows how local businesses have benefited from using Google Cloud to launch new services and scale up rapidly across different countries in tandem with the expansion of the business.
- **Organize accelerator programs to develop the local gaming industry.** To help home-grown

132. Google The Keyword (2020), “Five years of Google for Startups in Korea”. Available at: <https://blog.google/around-the-globe/google-asia/five-years-google-startups-korea/>

133. Analysys Mason (2020), Economic impact of Google's APAC network infrastructure. Available at: <https://www.analysismason.com/consulting-redirect/reports/impact-of-google-network-APAC-2020/>

134. Sources include: Boston Consulting Group (2019), Ascent to the Cloud: How Six Key APAC Economies Can Lift-off. Available at: <https://www.bcg.com/publications/2019/economic-impact-public-cloud-apac/default.aspx>; Deloitte (2018), Economic and social impacts of Google Cloud. Available at: [https://www2.deloitte.com/content/dam/Deloitte/es/Documents/tecnologia/Deloitte\\_ES\\_tecnologia\\_economic-and-social-impacts-of-google-cloud.pdf](https://www2.deloitte.com/content/dam/Deloitte/es/Documents/tecnologia/Deloitte_ES_tecnologia_economic-and-social-impacts-of-google-cloud.pdf)





## BOX 6. GOOGLE'S NETWORK INFRASTRUCTURE INVESTMENTS IN SOUTH KOREA

By improving the capacity of network services, investments in network infrastructure such as edge infrastructure allow local Internet service providers to better manage higher Internet traffic and enable faster data transfers. These, in turn, allow them to deliver innovative services such as cloud services, video conferencing, and gaming. Google's infrastructure investments in the APAC region have contributed to higher download speeds in South Korea, which are now more than twice that of less well-connected economies. A recent study found that by allowing for increased business activity through higher rates of Internet use, Google's investments in network, submarine cables, and edge infrastructure in APAC collectively contributed a total USD23 billion to South Korea's GDP cumulatively from 2010 to 2019, and are expected to contribute an additional USD16 billion from 2020 to 2024. The study also found that Google's network infrastructure investment spurred job creation through two channels: direct job creation in the construction and telecommunications industries, and indirect job creation facilitated by the improvement of broadband connectivity (especially in the ICT, financial services, and manufacturing sectors). The same study estimated that a total of 33,000 jobs were created in South Korea as a result of Google's network investments in APAC in 2019.<sup>142</sup>



142. Analysys Mason (2020), Economic impact of Google's APAC network infrastructure - Focus on South Korea. Available at: <https://www.analysismason.com/consulting-redirect/reports/impact-of-google-network-APAC-2020/>

## BOX 7.

# GOOGLE CLOUD: PROVIDING RELIABLE AND SCALABLE INFRASTRUCTURE TO ALLOW LOCAL INNOVATORS TO DEVELOP CUTTING-EDGE TECH APPLICATIONS

### MATHPRESSO: PROVIDING EQUITABLE ACCESS TO EDUCATIONAL OPPORTUNITIES USING TENSORFLOW

Mathpresso is an educational technology start-up that aims to provide equal access to educational opportunities for students in South Korea where the education system is highly competitive and reliant on private education. Its flagship application, Qanda, allows students to ask questions and search for solutions just by taking photos. This is enabled by machine learning technologies that recognize letters, equations, and graphs in images.

By leveraging Google Cloud's open-source machine learning platform, TensorFlow, the team behind Mathpresso was able to launch the first version of their AI search service in three months. The platform also helped them to effectively manage image data and improve search performance. Mathpresso has raised USD21 million in funding to date and is currently used by one-third of students in South Korea. The company has also expanded its user base internationally to more than 50 countries.

### NETMARBLE: UTILIZING GOOGLE CLOUD PLATFORM TO BECOME ONE OF THE FASTEST-GROWING MOBILE GAMING DEVELOPERS IN ASIA

Netmarble is a South Korea-based mobile game developer who began using Google Cloud back in 2017. After the business migrated to the cloud platform, Netmarble was able to leverage tools and services available on the platform. This includes data analytics and machine learning that support game development across multiple markets, manage the business infrastructure and spread business intelligence throughout the organization to continuously improve its operations. Due to the reliable and scalable cloud infrastructure from Google, the company was able to grow and internationalize cost-efficiently without the hefty investments typically required to enter foreign markets. This led to the gaming developer eventually attaining its status as one of the largest mobile gaming companies in the world. The Head of Netmarble AI Revolution Center once remarked, "The public cloud aligns with our vision for innovation and is as committed as we are to building better player services with advanced artificial intelligence and reliable, scalable cloud infrastructure."<sup>143</sup>



Photo Source: <http://m.koreaherald.com/view.php?ud=20190207000354>

143. Analysys Mason (2020), Economic impact of Google's APAC network infrastructure - Focus on South Korea. Available at: <https://www.analysismason.com/consulting-redirect/reports/impact-of-google-network-APAC-2020/>



Ads, Google is enabling local firms to broaden horizons and reach potential customers overseas. Box 8 illustrates an example of how a medical technology start-up could share its innovative solution with stroke patients around the globe and support their recovery by leveraging Google Ads and Google Analytics tool.

- **Promote the development of South Korean mobile app exports in the region and globally.**

Through Google Play, developers in South Korea are able to leverage the platform to create mobile applications that can be distributed globally. In addition, Google partnered with the Ministry of SMEs and Startups and the Korea Institute of Startup and Entrepreneurship Development to launch a start-up accelerator program in 2019 known as the “ChangGoo Program”. Through this program, local start-ups receive professional one-to-one consultations focusing on the development of mobile games and app quality, monetization, and support their internationalization efforts. At the end of the program, start-ups get connected with global and local venture capitalists and game publishers to showcase their innovations on “Demo Day”. In 2019, a total of 100 mobile game and app start-ups participated in the “ChangGoo Program” and 26 developers expanded to global markets after graduating from the program. Developers who have attended the “ChangGoo Program” saw their revenues increase by 54 percent while teams have expanded by 45 percent. For example, founded in February 2016 by Minu Kim, Sticky Hands is an indie game studio that specializes in “Solitaire” game types and its game title, Solitaire Farm Village, was ranked among the top three in the 2019 edition of the program. With the program’s holistic growth support, including one-on-one consultations, global boot camps, and marketing campaigns,



the developer achieved a 174 percent growth in revenue and the team doubled in size after completing the program. Moreover, Sticky Hands successfully expanded to global markets such as Japan and the United States. Another startup, CatchitPlay, which develops educational mobile applications focusing on language learning has also gained huge success after graduating from the “ChangGoo Program”. Through gamification, the app creates a virtual world that rewards users with points to unlock advanced services and generates revenue through subscription and in-app purchases. By connecting with investors and gaining publicity during the program, CatchitPlay raised USD3 million in its Series A funding from venture capitalists and expanded to the Japanese market.

## BOX 8.

# MEDICAL TECHNOLOGY START-UP LEVERAGES GOOGLE ADS AND GOOGLE ANALYTICS TOOL TO EXPAND INTERNATIONALLY

Hoyoung Ban was never able to share the joy of graduation with his father, who died after suffering a stroke while he was completing his undergraduate studies at the Korea Advanced Institute of Science and Technology (KAIST). Not long after this, two of Ban's uncles suffered strokes; they survived, but as a result of not completing rehabilitation therapy due to the prohibitively high costs, did not recover completely.

For Ban, these experiences sparked a personal interest in stroke rehabilitation algorithms and robotics. Together with his friends, Young Choi and Scott Kim, Ban co-founded Neofect, a medical technology startup that attempts to make the process of post-stroke paralysis rehabilitation more interesting and affordable.<sup>144</sup> This entailed providing gamified rehabilitation solutions for stroke recovery – the trio developed a patented glove-like device and combined this with online games to provide fun and accessible physiotherapy. The actions of the game would be tailored to help patients regain and improve movement and strength.



Photo Source: <https://www.neofect.com/us/blog/portable-home-therapy-for-stroke-rehab>

After creating the innovative glove-like device, the team wanted to promote it globally but did not know where to begin and how to find an advertising agency with a sizable marketing budget and global outreach. When Ban got to know about Google Ads, the team realized that they could run advertising campaigns online effectively with a minimal budget which was extremely helpful for the cash-strapped company. Based in South Korea, Neofect managed to establish a strong presence in 30 markets worldwide by leveraging Google Ads to promote their products.

Neofect also used Google Analytics, a Google Ads-linked tool that collects data on website visits and visitor behavior that is then used to identify audiences that had displayed a high level of engagement with the website's content. Based on these insights, advertisements related to Neofect products were displayed to targeted groups of people with whom these products were most likely to resonate with. By running targeted Google Ads using Google Analytics, the cost per conversion was reduced by 28 percent and the company's sales surged.<sup>145</sup> The company also received testimonials from stroke patients across the globe who have recovered after using Neofect products and regained autonomy.<sup>146</sup>

Due to its winning combination of a strong product and customer interest, the company went public in 2018 and recently won the 2019 "MedTech Breakthrough Award", an international award that recognizes top companies in the health and medical technology industry, for the second year in a row.

144. YouTube (2020), "네오펙트 반호영 대표의 이야기 - Google for KR". Available at: <https://www.youtube.com/watch?v=vAdoECxkHsU&feature=youtu.be>

145. YouTube (2020), "네오펙트 반호영 대표의 이야기 - Google for KR". Available at: <https://www.youtube.com/watch?v=vAdoECxkHsU&feature=youtu.be>

146. YouTube (2020), "네오펙트 반호영 대표의 이야기 - Google for KR". Available at: <https://www.youtube.com/watch?v=vAdoECxkHsU&feature=youtu.be>



# GOOGLE'S ECONOMIC IMPACT IN SOUTH KOREA



## BUSINESS BENEFITS

Google supports  
**KRW 10.5 TRILLION  
(USD 8.8 BILLION)**  
in annual benefits to businesses  
in South Korea<sup>1</sup>



**Google Search** saves the average  
employee in South Korea about  
**117 HOURS PER YEAR**  
through almost instantaneous  
access to information online

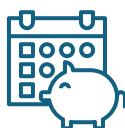


## CONSUMER BENEFITS

Google supports  
**KRW 11.9 TRILLION  
(USD 10 BILLION)**  
in annual benefits to consumers  
in South Korea<sup>2</sup>



**Google Search** user in  
South Korea saves  
**6 DAYS A YEAR**  
looking for answers, as  
compared to traditional  
offline methods



**Android** enables consumers  
to choose from  
**OVER 3.5 MILLION**  
apps available on the  
Android ecosystem<sup>3</sup>



## SOCIETAL BENEFITS



Google.org supported Youth Business International with a **KRW 2.9 trillion (USD 2.5 million)** grant to launch the **"Rapid Response and Recovery"** program across the APAC region including South Korea to support business owners from underserved communities such as youths, women and refugees, who were affected by the economic downturn during the COVID-19 pandemic



Google partnered with not-for-profit organization, **Our Sea of East Asia Network**, to protect the marine environment and its **"Campus for Moms"** program supports local female entrepreneurs

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

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

3. 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/>

Note: All data is based on AlphaBeta analysis using a range of original and third party sources. See Appendix in report for detailed methodology. Figures are estimated based on the latest available annual data as at time of research in 2020.

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

Google's applications and services, such as Google Search and AdSense bring about substantial economic benefits in South Korea. This study finds that the annual economic value of these benefits is estimated at KRW10.5 trillion (USD8.8 billion) for businesses and KRW11.9 trillion (USD10 billion) for consumers.<sup>147</sup> An overview of the assessed economic benefits of Google products to businesses and consumers in South Korea is provided in Exhibit 6. In addition, the Android operating system provides cost savings of over KRW3 trillion (USD2.5 billion) for South Korean Original

Equipment Manufacturers (OEMs) and approximately KRW280 billion (USD234 million) for South Korean app developers.<sup>148</sup> 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 brings intangible benefits to the broader society by extending digital skilling opportunities to female entrepreneurs, supporting local not-for-profit organizations in serving underserved communities, and protecting the environment in South Korea.

### BENEFITS TO BUSINESSES

#### GOOGLE HELPS BUSINESSES BOOST THEIR REVENUES

Google applications broaden the reach of businesses in South Korea 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 KRW6.6 trillion (USD5.5 billion) annually in the form of net returns to businesses in South Korea from advertising on Google Search results of relevant keywords.<sup>149</sup> Beyond search advertising, businesses in South Korea 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 KRW111 billion (USD93 million) per year. Meanwhile, by

leveraging the various formats of advertisements enabled by **YouTube**, local businesses managed to expand internationally (see Box 10).

In addition, Google provides new sources of income for content creators in South Korea. By allowing content creators such as online journalists, media sites, bloggers and writers to earn income by hosting advertisements on their sites, **AdSense** is estimated to help content creators in South Korea monetize space on their websites, and generate a total income of KRW342 billion (USD287 million) annually. **YouTube** also benefits video content creators in South Korea who earn revenue through placing advertisements on their videos. Box 11 illustrates an example of how YouTube videos provide a rich knowledge resource for niche topics, such as gluten-intolerance, and enable enterprising content creators to capitalize on this platform to build a ground-up business with a community of followers.

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

148. Note that the cost and time savings from both South Korea OEMs and app developers are not included in the business benefits figure of KRW10.5 trillion (USD8.8 billion).

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

## EXHIBIT 6:

## BUSINESS AND CONSUMER BENEFITS SUPPORTED BY GOOGLE IN SOUTH KOREA

TYPE OF BENEFIT	EASE OF ACCESS TO INFORMATION 	ENTERTAINMENT AND ENRICHMENT 
RELEVANT PRODUCT/S	Google Search	Google Play & Android
BUSINESS BENEFITS	<ul style="list-style-type: none"> <li>By allowing for almost instantaneous access to information online, Google Search helps businesses save <b>4.9 days</b> or <b>117 hours</b> a year per worker</li> </ul>	<ul style="list-style-type: none"> <li>App developers in South Korea earn about <b>KRW3.5 trillion (USD2.9 billion)</b> in revenue from both domestic and international markets through the Google Play platform per year</li> <li>Android enables app developers to save over <b>22%</b> of development time and target more than <b>1 billion</b> users worldwide<sup>1</sup></li> </ul>
CONSUMER BENEFITS	<ul style="list-style-type: none"> <li>By providing almost instantaneous access to information, the average Google Search user in South Korea saves about <b>6 days</b> looking for answers online each year</li> <li>The total annual consumer benefits derived from Google Search are estimated at <b>KRW4.2 trillion (USD3.5 billion)</b></li> </ul>	<ul style="list-style-type: none"> <li>Consumers can choose from over <b>3.5 million</b> apps available on the Android ecosystem<sup>2</sup></li> <li>By gaining access to a range of digital entertainment options through Google Play, the consumer surplus benefits to consumers in South Korea are estimated at <b>KRW5.1 trillion (USD4.3 billion)</b> annually</li> </ul>

1. AlphaBeta (2018), "AlphaBeta research brief: The estimated economic impact from Android across five Asian markets". Available at: <https://www.alphabeta.com/wp-content/uploads/2017/08/180820-Android-Economic-Impact.pdf>



2. 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/>

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

Note: Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis



<p><b>INCREASED PRODUCTIVITY AND CONVENIENCE</b></p> 	<p><b>ADVERTISING BENEFITS</b></p> 	<p><b>TOTAL BENEFITS:</b></p>
<p><b>Google Drive, Photos, Docs &amp; Sheets</b></p>	<p><b>Google Ads, AdSense</b></p>	
<ul style="list-style-type: none"> <li>Productivity tools in Google Drive, Photos, Docs, and Sheets enable for greater efficiencies in day-to-day work tasks. For example, Drive allows businesses to store all of their documents in one place that can be readily accessed by multiple employees and devices</li> </ul>	<ul style="list-style-type: none"> <li>Google Search and Ads bring about <b>KRW6.6 trillion (USD5.5 billion)</b> in net advertising benefits annually to businesses in South Korea<sup>3</sup></li> <li>Advertisers in South Korea gain about <b>KRW111 billion (USD93 million)</b> in net advertising benefits through displaying advertisements on websites using AdSense annually<sup>3</sup></li> <li>Web publishers and content creators earn about <b>KRW342 billion (USD287 million)</b> in revenue from AdSense annually</li> </ul>	<p><b>KRW10.5 TRILLION (USD8.8 BILLION)</b></p>
<ul style="list-style-type: none"> <li>The total consumer benefits derived from productivity-enhancing tools of Google Drive, Photos, Docs, and Sheets are estimated at <b>KRW2.5 trillion (USD2.1 billion)</b> annually</li> </ul>	<p>Nil</p>	<p><b>KRW11.9 TRILLION (USD10 BILLION)</b></p>

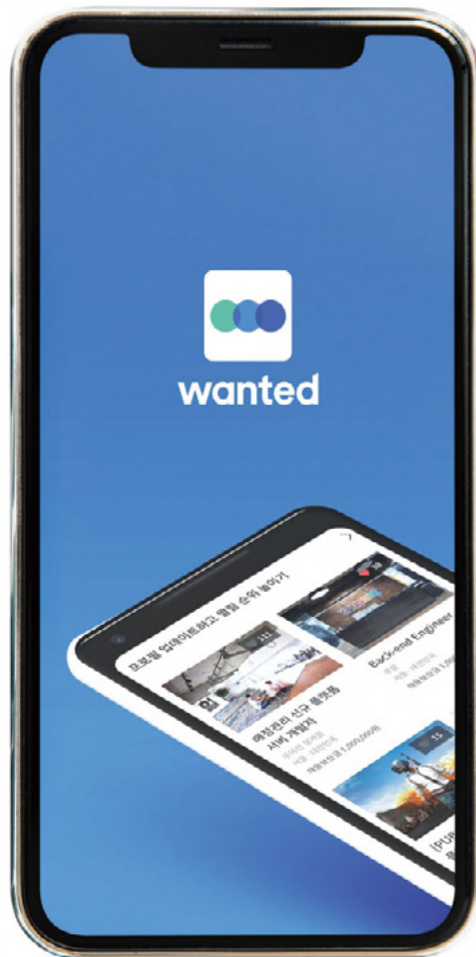
## BOX 9.

# 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 Search (which increases the efficiency of information gathering) were also measured to derive a measure of the convenience these products bring to them. Appendix B shows a detailed methodological explanation of how the benefit of each product was sized.



## BOX 10. A RECRUITING PLATFORM USES YOUTUBE ADVERTISEMENTS TO MATCH JOB OPPORTUNITIES TO JOB SEEKERS ACROSS BORDERS



Wanted is Asia's first online referral-based recruiting platform which leverages human relationships and machine learning technology to improve job matching. As a young startup in a highly competitive industry, it was essential for Wanted to rapidly expand its reach and acquire new users in order to grow its customer base. Bokkee Lee, Founder and CEO of Wanted, turned to YouTube advertisements to increase public awareness of the company, as the platform allowed him to gain exposure to targeted audiences at a low cost. The company's video advertisements on YouTube received more than five million views, which in turn led to a 125 percent growth in users.

The company has since managed to secure USD18 million in funding. Today, Wanted is matching more than 800,000 users with over 5,000 companies across South Korea, Singapore, Hong Kong, Japan, and Taiwan.

Photo Source: <https://www.sisajournal.com/news/articleView.html?idxno=200358>



## BOX 11.

# YOUTUBE PROVIDES KNOWLEDGE FOR A GLUTEN-INTOLERANCE INDIVIDUAL TO TURN HER DAILY CHALLENGE INTO A BUSINESS OPPORTUNITY

Song Sung-Rye has always been distant from the food culture as she inherited her father's gluten intolerance. Consuming any food that contains flour, rye or barley would cause her stomachaches or diarrhea and at times, even fainting spells. Unfortunately, most South Korean dishes contain gluten and growing up, she could not eat her own birthday cakes. She resorted to baking her own bread but there were few resources available for her to learn about gluten-free baking until she came across YouTube.<sup>150</sup>

Through YouTube, she started learning from gluten-free baking videos and attempted to develop new gluten-free recipes. Initially, the kitchen turned into a battlefield featuring burnt crust, soggy buns and melting doughs. After practicing multiple times, her baking skills improved, and she was able to come up with a recipe easily. To share her gluten-free baking journey online, Song started posting her recipes on her blog which attracted many followers who were facing similar diet sensitivities.<sup>151</sup> Upon her followers' requests, she started to share her homemade gluten-free bread with followers and the number of requests skyrocketed until she was receiving over 100 orders daily.<sup>152</sup> In response to the overwhelming response, she decided to turn her home baking venture into a gluten-free bakery business, Sunnybread, in Itaewon, central Seoul and provide gluten-intolerant customers with the freedom to eat what people commonly enjoy.



Photo Source: <https://www.creatrip.com/en/blog/6175/Itaewon-Vegan-Bakery-Sunny-Bread>

150. YouTube (2020), "송성례님의 이야기: 식문화에서 소외되었던 그녀가 함께 먹는 즐거움을 찾기까지". Available at: <https://www.youtube.com/watch?v=HwAnD3bXtmE&feature=youtu.be>

151. YouTube (2020), "송성례님의 이야기: 식문화에서 소외되었던 그녀가 함께 먹는 즐거움을 찾기까지". Available at: <https://www.youtube.com/watch?v=HwAnD3bXtmE&feature=youtu.be>

152. YouTube (2020), "송성례님의 이야기: 식문화에서 소외되었던 그녀가 함께 먹는 즐거움을 찾기까지". Available at: <https://www.youtube.com/watch?v=HwAnD3bXtmE&feature=youtu.be>

Google's digital product distribution system, **Google Play**, as well as operating system, **Android**, have resulted in a variety of benefits to South Korean OEMs, app developers, telecommunication operators, payment providers and other businesses. (see Box 12)

Exhibit 7 summarizes the estimated business benefits in the form of revenue gains experienced by businesses in South Korea from Google Search and Ads, AdSense and Google Play annually.



### GOOGLE HELPS BUSINESSES INCREASE PRODUCTIVITY AND SAVE TIME

Google helps businesses save time by enhancing employees' productivity through improving the speed and ease of access to information and research. In particular, **Google Search** 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 117 hours annually.

### GOOGLE SUPPORTS JOBS IN SOUTH KOREA

At a broader level, Google has facilitated job creation in the digital economy through its products and operating system. Through Google Ads as well as AdSense, Google supports the creation of over 54,000 jobs in the wider economy.<sup>153</sup> These jobs are created through the use of Google products that lead to businesses expanding their customer bases and increasing revenue.<sup>154</sup> For instance, businesses that expand their reach to new markets through advertising via Google Ads and AdSense would require increased manpower to meet this additional demand.

Through the Android operating system, It was estimated that over 350,000 people in South Korea were employed in jobs that were linked to Android in 2020.<sup>155</sup> This includes more than an estimated 100,000 South Koreans who are employed directly in Android app development jobs. In addition to this direct employment, Android generates employment through indirect jobs (non-tech-related jobs within the app economy), as well as spillover jobs (jobs created outside of the app industry, such as firms supplying app developers with products and services).

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

154. 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.

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



## BOX 12.

# ANDROID'S ECONOMIC IMPACT IN SOUTH KOREA

### BENEFITS TO OEMS

South Korea is home to some of the world's leading companies in the smart device space, such as Samsung and LG. Over 253 million units of smartphone devices, accounting for roughly 19 percent of global smartphone sales, were made by Samsung alone in 2020.<sup>156</sup> In South Korea, most OEMs utilize Android operating systems in their products. By being able to use Android source code directly rather than having to develop bottom-up operating systems, South Korean OEMs can drastically reduce one-off development costs as well as annual software maintenance costs. It is estimated that free-to-use open-source operating systems such as Android have enabled South Korean OEMs to save more than one million software development days each. The total savings to South Korean OEMs are estimated to be over KRW3 trillion (USD2.5 billion).<sup>157</sup>

### BENEFITS TO APP DEVELOPERS

South Korean app developers are also benefiting from the Android operating system in two ways: 1) Increasing demand for apps; and 2) Reducing the time and cost of app development. Not only has Android driven the global demand for apps, but Google Play also serves as a direct export channel for local developers to tap on the global demand. It is estimated that through Google Play store, app developers in South Korea can readily

reach more than 36 million Android users at home and over one billion users globally across 190 countries and territories.<sup>158</sup> In 2020, app developers in South Korea were estimated to earn a return of KRW3.5 trillion (USD2.9 billion) from both the domestic and international markets through the Google Play platform.<sup>159</sup>

In addition, having an open source and free-to-use operating system is likely to lead to widespread adoption among OEMs. Adopting the same operating system ensures a baseline level of compatibility



156. Gartner (2021), "Gartner Says Worldwide Smartphone Sales Declined 5% in Fourth Quarter of 2020".

Available at: <https://www.gartner.com/en/newsroom/press-releases/2021-02-22-4q20-smartphone-market-share-release>

157. Refer to Appendix B for details on methodology.

158. Sources include: StatCounter (2021), "Mobile Operating System Market Share Republic Of Korea". Available at: <https://gs.statcounter.com/os-market-share/mobile/south-korea>; Statista (2020), "Number of smartphone users in South Korea from 2015 to 2025". Available at: <https://www.statista.com/statistics/467171/forecast-of-smartphone-users-in-south-korea/>; 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>

159. This figure was taken from the App Annie website that requires a paid subscription to access. Source: App Annie (2020), "Downloads & Revenues of Top 300 KR Publishers". Available at: [https://www.google.com/url?q=https://www.appannie.com/intelligence/top-companies?breakdowns%3D\(product\\_id,publisher\\_id,company\\_id,parent\\_company\\_id\)%26granularity%3Dmonthly%26date%3D\(%25272020-01-01%2527%25272020-12-31%2527\)%26country\\_code%3D\(WW\)%26device\\_code%3Dandroid-all%26top\\_companies.tab%3Dest\\_revenue\\_sum%26company\\_hq%3D\(in:!\(KR\)\)%26chart\\_top\\_companies.chart\\_v0\(est\\_revenue\\_sum\)%3D\(aggr:lt,percent:lf,stack:lf,type:column\)%26top\\_companies.chart\\_v0\(est\\_revenue\\_sum\)\\$chart\\_compare\\_facets%3D\(est\\_download\\_sum\)%26est\\_revenue\\_sum\\_order.by%3D\(\(name:est\\_revenue\\_sum,order:desc\)\)&sa=D&source=editors&ust=1616756021137000&usg=AOvVaw0YbyKkHdUOiqPhBjXOLs\\_H](https://www.google.com/url?q=https://www.appannie.com/intelligence/top-companies?breakdowns%3D(product_id,publisher_id,company_id,parent_company_id)%26granularity%3Dmonthly%26date%3D(%25272020-01-01%2527%25272020-12-31%2527)%26country_code%3D(WW)%26device_code%3Dandroid-all%26top_companies.tab%3Dest_revenue_sum%26company_hq%3D(in:!(KR))%26chart_top_companies.chart_v0(est_revenue_sum)%3D(aggr:lt,percent:lf,stack:lf,type:column)%26top_companies.chart_v0(est_revenue_sum)$chart_compare_facets%3D(est_download_sum)%26est_revenue_sum_order.by%3D((name:est_revenue_sum,order:desc))&sa=D&source=editors&ust=1616756021137000&usg=AOvVaw0YbyKkHdUOiqPhBjXOLs_H)





across multiple devices which in turn, can reduce the initial development and launch costs associated with apps developed in a more fragmented ecosystem with several close, proprietary operating systems. Without having to duplicate efforts across multiple platforms, it is estimated that the Android operating system can save app developers over 22 percent in development time, implying over KRW280 billion (USD234 million) in costs saved for more than 36,000 South Korean apps.<sup>160</sup>

## **BENEFITS TO TELECOMMUNICATION OPERATORS AND PAYMENT PROVIDERS**

Besides OEMs and app developers, telecommunication operators have benefitted from three major sources linked to Android, namely: 1) increased demand for smartphones; 2) growth in data traffic; and 3) the creation of new distribution and revenue channels. First, Android has spurred demand for smartphones by lowering the costs of handsets and encouraging innovation globally, which eventually boosted revenues for telecommunication

operators. Second, the increased smartphone penetration has in turn created significant demand for data. Mobile data volumes that originated from Android devices in South Korea grew by more than 50 percent annually between 2011 and 2019 after Android found commercial success in 2010, driving significant data revenues for local telecommunication operators.<sup>161</sup> Finally, telecommunication operators can utilize the free Android Open Source Project (AOSP) software to create their own distribution channel for applications, enabling them to generate new revenue streams. For example, SK Telecom, KT and LG are able to operate their own app store, One Store.<sup>162</sup> Besides creating new distribution channels, Android enables telecommunication operators to access alternative revenue streams by facilitating direct carrier billing and hosting proprietary apps. For businesses and payment providers looking to create payment gateways on mobile applications, the Payment Request API in Android accepts credit cards electronically and allows merchants to collect payment information from customers with minimal integration.<sup>163</sup>

160. Refer to Appendix B for details on methodology.

161. Korea Communications Commission (2019), Annual Report 2019.

Available at: <https://www.kcc.go.kr/user.do?mode=view&page=E02010700&dc=E02010700&boardId=1053&cp=1&boardSeq=49968>

162. Business Korea (2015), "Korean Mobile Carriers Open New Application Store". Available at: <http://www.businesskorea.co.kr/news/articleView.html?idxno=10425>

163. Google Developers (2021) "Introduction to the Payment Request API".

Available at: <https://developers.google.com/web/ilt/pwa/introduction-to-the-payment-request-api>

**EXHIBIT 7:**

## GOOGLE IS ESTIMATED TO BRING ABOUT KRW10.5 TRILLION (USD8.8 BILLION) WORTH OF ANNUAL BENEFITS TO BUSINESSES IN SOUTH KOREA

PRODUCT	DESCRIPTION OF BENEFITS	ESTIMATED ANNUAL BENEFITS
<b>Google Search &amp; Ads</b>	Net advertising benefits for businesses <sup>1</sup>	KRW6.6 trillion (USD5.5 billion)
<b>AdSense</b>	Net advertising benefits for businesses <sup>1</sup>	KRW111 billion (USD93 million)
	Income generated by website publishers through AdSense	KRW342 billion (USD287 million)
<b>Google Play</b>	Income generated by app developers in South Korea from both the domestic and international markets through Google Play <sup>2</sup>	KRW3.5 trillion (USD2.9 billion)
<b>TOTAL ANNUAL BUSINESS BENEFITS IN SOUTH KOREA:</b>		<b>KRW10.5 TRILLION (USD8.8 BILLION)</b>

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

2. This figure was taken from the App Annie website that requires a paid subscription to access. Source: App Annie (2020), "Downloads & Revenues of Top 300 KR Publishers". Available at: [https://www.google.com/url?q=https://www.appannie.com/intelligence/top-companies?breakdowns%3D\(product\\_id,publisher\\_id,company\\_id,parent\\_company\\_id,%26granularity%3Dmonthly%26date%3D\(%25272020-01-01%2527%25272020-12-31%2527\)%26country\\_code%3D\(WW\)%26device\\_code%3Dandroid-all%26top\\_companies.tab%3Dest\\_revenue\\_sum%26company\\_hq%3D\(in%3D\(KR\)\)%26chart\\_top\\_companies.chart.v0\(est\\_revenue\\_sum\)%3D\(aggr:lt,percent:lf,stack:lf,type:column\)%26top\\_companies.chart.v0\(est\\_revenue\\_sum\)%3D\(chart\\_compare\\_facets%3D\(est\\_download\\_sum\)%26est\\_revenue\\_sum\\_order\\_by%3D\(\(name:est\\_revenue\\_sum,order:desc\)\)&sa=D&source=editors&ust=1616756021137000&usg=AOvVaw0YbyKkHdUOiqPhBjXOLs\\_H](https://www.google.com/url?q=https://www.appannie.com/intelligence/top-companies?breakdowns%3D(product_id,publisher_id,company_id,parent_company_id,%26granularity%3Dmonthly%26date%3D(%25272020-01-01%2527%25272020-12-31%2527)%26country_code%3D(WW)%26device_code%3Dandroid-all%26top_companies.tab%3Dest_revenue_sum%26company_hq%3D(in%3D(KR))%26chart_top_companies.chart.v0(est_revenue_sum)%3D(aggr:lt,percent:lf,stack:lf,type:column)%26top_companies.chart.v0(est_revenue_sum)%3D(chart_compare_facets%3D(est_download_sum)%26est_revenue_sum_order_by%3D((name:est_revenue_sum,order:desc))&sa=D&source=editors&ust=1616756021137000&usg=AOvVaw0YbyKkHdUOiqPhBjXOLs_H)

Note: Figures are estimated based on the latest available annual data as at time of research in 2020. Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis





## BENEFITS TO CONSUMERS

### CONSUMERS IN SOUTH KOREA EXPERIENCE TOTAL ANNUAL BENEFITS WORTH KRW11.9 TRILLION (USD10 BILLION) FROM GOOGLE'S SERVICES

The consumer benefits supported by Google are challenging to measure and calculate because individuals typically do not pay for the services. In the absence of price indicators, the economic “willingness to pay” principle was adopted to estimate the value of consumer benefits by asking individuals how much they value specific products (see Box 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 at KRW11.9 trillion (USD10 billion) annually. This value includes three main categories of benefits provided by Google applications: ease of access to information (Google Search), entertainment and enrichment (Google Play), and enhanced productivity and convenience (Google Drive, Photos, Docs and Sheets). Exhibit 8 shows the breakdown of consumer surplus by category.

### GOOGLE ENABLES CONSUMERS BETTER ACCESS TO INFORMATION

Google provides benefits to consumers in South Korea by allowing them to instantly access a vast array of information online. The total consumer surplus brought about by **Google Search** is estimated at KRW4.2 trillion (USD3.6 billion) annually (Exhibit 8). Based on an international study showing that a search for a piece of information that takes 21 minutes in the library takes only seven minutes online, it is estimated that Google Search saves consumers in South Korea an average of 6 days per year.<sup>164</sup>

By providing free access to information and learning resources, Google Search also helps users in South Korea acquire new knowledge and skills. An estimated 29 percent of Google Search users in South Korea use it for self-enrichment (e.g., seeking new knowledge, developing new skills).

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

## EXHIBIT 8:

## GOOGLE IS ESTIMATED TO SUPPORT A TOTAL KRW11.9 TRILLION (USD10 BILLION) WORTH OF ANNUAL CONSUMER SURPLUS IN SOUTH KOREA

ESTIMATED ANNUAL CONSUMER SURPLUS OF GOOGLE PRODUCTS IN SOUTH KOREA  
CONSUMER SURPLUS (KRW)

TYPE OF BENEFIT	PRODUCT	ANNUAL CONSUMER SURPLUS
Ease of access to information	Google Search	KRW4.2 trillion (USD3.5 billion)
Entertainment and enrichment	Google Play	KRW5.1 trillion (USD4.3 billion)
Enhanced productivity and convenience	Google Drive, Photos, Docs and Sheets	KRW2.5 trillion (USD2.1 billion)
TOTAL CONSUMER SURPLUS:		KRW11.9 TRILLION (USD10 BILLION)

Note: Figures are estimated based on the latest available annual data as at time of research in 2020. Numbers may not sum due to rounding.

SOURCE: AlphaBeta analysis

## GOOGLE'S SERVICES IMPROVE PRODUCTIVITY AND CONVENIENCE FOR CONSUMERS IN SOUTH KOREA

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

The total consumer benefits derived from productivity-enhancing tools of Google Drive, Photos, Docs, and Sheets are estimated at KRW2.5 trillion (USD2.1 billion) per year.

## 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).

**Google Play** and **Android** have also brought a variety of benefits to consumers in South Korea. For example, Android enables consumers to choose from over 3.5 million apps available on the Android ecosystem.<sup>165</sup> Meanwhile, Google Play is a convenient platform for consumers to access a range of smartphone applications, as well as digital books, music and films.

According to AlphaBeta research, Google Play is estimated to bring a total annual consumer surplus of KRW5.1 trillion (USD4.3 billion) to consumers in South Korea.<sup>166</sup>

165. 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/>

166. Google/AlphaBeta Economic Impact Report survey, n = 529. The total consumer surplus represents the economic benefits to consumers in South Korea from using Google Play. See more details in Appendix B of the methodology.



## BENEFITS TO THE BROADER SOCIETY

Beyond the benefits to businesses and individuals, Google delivers benefits to the broader society in South Korea that may not accrue directly to a specific company or person. In economics, these are often termed as “spillover benefits”. These benefits might not appear in GDP measures today but consist of other objectives that are important to strengthening South Korea’s economy over time.

### GOOGLE EXTENDS DIGITAL SKILLING OPPORTUNITIES TO FEMALE ENTREPRENEURS

These benefits are a result of the use of Google products or direct initiatives and strategic partnerships Google has engaged in South Korea. Beyond the digital skills programs discussed in Chapter 3.1, the company’s products and programs provide a range of societal benefits through supporting broader human capital development and helping local not-for-profit organizations. Box 13 provides further examples of how Google supported local female entrepreneurs through a program called “Campus for Moms”.

### GOOGLE SUPPORTS UNDERSERVED COMMUNITIES DURING COVID-19

In addition, Google’s philanthropic arm, Google.org, helped several local and regional organizations to support underserved communities in tiding through the COVID-19 pandemic. Supported by a KRW2.9 trillion (USD2.5 million) Google.org grant, Youth Business International launched a “Rapid Response and Recovery” program across 16 ASEAN countries, including South Korea. The program supported small, and medium-sized enterprises (SMEs), particularly business owners from underserved communities such as youths, women and refugees, who were affected by the economic downturn during the COVID-19 pandemic.<sup>167</sup> At the country-level, business owners will be provided with a holistic package of emergency support, including crisis hotlines, targeted advice and signposting, and online training through webinars and mentoring. At the regional level,



regional communities of practice will be developed to support organizations in connecting, learning, innovating and sharing best practices on how to support MSMEs before, during and after the peak of the COVID-19 crisis.

### GOOGLE HELPS PROTECT THE ENVIRONMENT

Google has been seeking partnerships with not-for-profit organizations to support their mission in protecting the environment. As seen in Box 14, by partnering with a not-for-profit, civic group and research institution, Our Sea of East Asia Network (OSEAN), Google harnessed its expertise in digital technologies to improve the efficiency of the organization’s buoy collection and contributed to its efforts in protecting the marine environment.

167. Youth Business International (2020), “COVID-19 Rapid Response and Recovery Programme supported by Google.org”. Available at: <https://www.youthbusiness.org/initiative/covid-19-rapid-response-and-recovery-programme>

## BOX 13.

# CAMPUS FOR MOMS: PROVIDING TRAINING AND MENTORSHIP TO LOCAL FEMALE ENTREPRENEURS

“Campus for Moms” is a program ran by Google where entrepreneurs are brought together in a supportive community and provided with access to mentorship and technical training. In South Korea, a number of female entrepreneurs have benefited from the program. This box provides two examples of how graduates from “Campus for Moms” have managed to grow their business using the knowledge and skills they obtained from the program.

### LEE DA-RANG

Lee Da-rang graduated from “Campus for Moms” with an idea to create an online community that offers training and guidance on parenthood. Through the program, she learned essential skills such as customer outreach, marketing, product development, and investment. Da-rang managed to turn her idea into a successful business, Growing Mom, which attracted more than 40,000 followers on social media. Today, her company employs data management and analysis techniques to provide parents with information in a creative and approachable way.

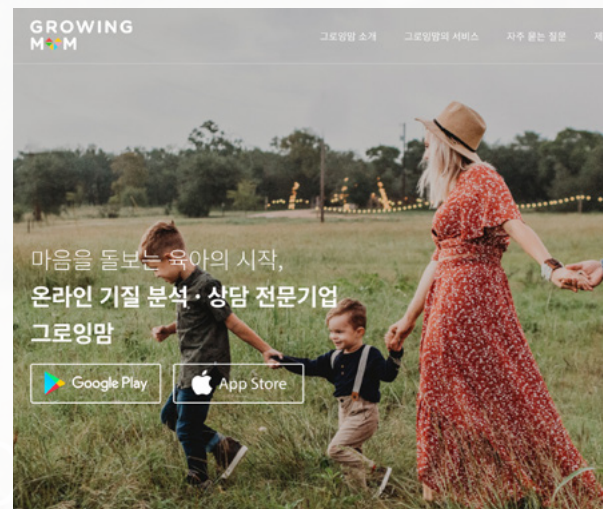


Photo Source: <https://www.growingmom.com/#/main>

### SEOJUNG CHANG

As a working mother, Seojung Chang understands the challenges faced by mothers who are not educational experts and do not have the sufficient time and effort to find out how best to care for their children. In 2017, Seojung established Jaranda, an educational technology startup, that leverages data analysis to provide personalized teaching and babysitting for kids between four to 13.<sup>168</sup> It is Seojung's goal to offer credible childcare services so that working parents do not have to give up on their career for their kids like she once had to. Initially, many parents did not understand the business and starting the business was an uphill challenge.

Seojung came across a “Campus for Moms” program advertisement on social media and joined the program to pitch her startup to venture capitalists where she raised USD2.6 million in funding for her company. During the program, she picked up machine learning skills and learned how to refine the attributes of every child and teacher to provide a more accurate matching service. As of May 2020, Jaranda has made over 32,000 matches and spent over 10,760 hours teaching and babysitting children.<sup>169</sup> The business now has over 23,000 registered instructors and a strong user return rate of 76 percent.<sup>170</sup>

168. YouTube (2020), “자란다 장서정 대표의 이야기 - Google for Korea”. Available at: [https://www.youtube.com/watch?v=CyMaTQkli\\_A&feature=youtu.be](https://www.youtube.com/watch?v=CyMaTQkli_A&feature=youtu.be)

169. YouTube (2020), “자란다 장서정 대표의 이야기 - Google for Korea”. Available at: [https://www.youtube.com/watch?v=CyMaTQkli\\_A&feature=youtu.be](https://www.youtube.com/watch?v=CyMaTQkli_A&feature=youtu.be)

170. YouTube (2020), “자란다 장서정 대표의 이야기 - Google for Korea”. Available at: [https://www.youtube.com/watch?v=CyMaTQkli\\_A&feature=youtu.be](https://www.youtube.com/watch?v=CyMaTQkli_A&feature=youtu.be)



## BOX 14. GOOGLE PARTNERS WITH A NOT-FOR-PROFIT ORGANIZATION TO PROTECT THE MARINE ECOSYSTEM THROUGH ADVANCED TECHNOLOGY

Our Sea of East Asia Network (OSEAN) is a not-for-profit, civic group and research institution established to protect the marine environment from marine litter such as used Styrofoam buoys. On average, 10,000 tons of these used buoys are washed ashore in South Korea every year. Over time, these buoys disintegrate to become microplastics that enter water bodies and get absorbed by marine animals. Eventually, these microplastics enter the human body through seafood consumption.<sup>171</sup> To remove marine litter from the coast lines, the team had to spend long hours trying to identify buoys that were left abandoned. They were urgently in need of a solution that could identify such buoys in a more efficient manner.

When Google decided to support OSEAN's cause, the team was introduced to Auto Machine Learning technology which detects objects based on certain patterns and quantifies them. By taking a picture of the coastline using the smartphone camera, the application can show where buoys are located and the number of buoys within the picture. Instead of counting the buoys manually, users need only capture images using their smartphone, requiring only a tenth of the time needed previously. In 2020, the machine learning technology enabled OSEAN to remove ten percent more buoys.<sup>172</sup>

Moving forward, OSEAN is also exploring the use of drones in capturing these images to further reduce the need for the team to visit the beaches in-person. OSEAN's CEO, Hong Sun-Wook, shared how the application has helped realize her dream of introducing citizen science to the masses: "It is about [enabling] ordinary citizens to participate in the production, analysis and sharing of scientific data that is accessible to everyone."



Photo Source: <http://www.osean.net/main/>

171. YouTube (2020), "오션 홍선욱 대표의 이야기 - Google for Korea".

Available at: <https://www.youtube.com/watch?list=TLGGoTYiFDv3vKlyNTaxMjAyMQ&v=AEF0R41Hy8k&feature=youtu.be>

172. YouTube (2020), "오션 홍선욱 대표의 이야기 - Google for Korea".

Available at: <https://www.youtube.com/watch?list=TLGGoTYiFDv3vKlyNTaxMjAyMQ&v=AEF0R41Hy8k&feature=youtu.be>





# APPENDIX: METHODOLOGY

# A: SIZING THE ECONOMIC VALUE OF DIGITAL TECHNOLOGIES

This document provides the detailed methodology, assumptions and sources of information used to quantify the potential economic impact of digital technologies for South Korea 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.<sup>173</sup> 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.<sup>174</sup> This

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.

was guided by the individual industry's relevance for digital technologies (based on past research quantifying the potential industry benefits of these digital technologies).<sup>175</sup>

- Prioritizing the sectors based on their importance for 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 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.<sup>176</sup>

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; Resources (including mining and oil & gas); Transport services.

## EXHIBIT A1:

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

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

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\\_Global\\_Institute%20SE%20Asia\\_Executive%20summary\\_November%202014.ashx](https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Asia%20Pacific/Three%20paths%20to%20sustained%20economic%20growth%20in%20Southeast%20Asia/McKinsey_Global_Institute%20SE%20Asia_Executive%20summary_November%202014.ashx)); and McKinsey Global Institute (2014), India's tech opportunity: Transforming work, empowering people (Available at: <https://www.mckinsey.com/industries/high-tech/our-insights/indias-tech-opportunity-transforming-work-empowering-people>).

176. In South Korea, all ten sectors have fulfilled the criterion in Step 2 except for the agriculture & food sector which accounts for less than 1.5 percent of the national GDP:



### STEP 3: IDENTIFY RELEVANT TECHNOLOGY APPLICATIONS IN FOCUS SECTORS

Relevant technology applications in the focus sectors and their sources of value (e.g., reduced wastage in production, enhanced consumer offerings) were identified based on a detailed review of the academic literature for each of the eight focus technologies. These technology applications included tangible drivers of business value, such as the use of remote patient monitoring to enable hospital-level care in homes using advanced sensors, smart medical devices, and robotics. A list of these technology applications, 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"> <li>World Bank GDP statistics</li> <li>International Monetary Fund (IMF) Real GDP growth estimates</li> <li>Korean Statistical Information Service</li> </ul>
Population	<ul style="list-style-type: none"> <li>United Nations Department of Economic and Social Affairs Population datasets</li> </ul>
Labour Force	<ul style="list-style-type: none"> <li>International Labour Organization (ILO)</li> <li>World Bank Labor Force statistics</li> <li>Korean Statistical Information Service</li> </ul>
Wage	<ul style="list-style-type: none"> <li>Korean Statistical Information Service</li> </ul>
Exchange rates	<ul style="list-style-type: none"> <li>OFX</li> </ul>

## AGRICULTURE AND FOOD

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. PRECISION FARMING TECHNOLOGIES</b>		<b>PRODUCTIVITY GAINS/COST SAVINGS</b>
<b>Data-driven optimization of crop and meat production</b>	Sized based on the productivity gains from increased yield, as well as cost savings from the use of fewer resources in farming. National Institute of Agricultural Science (2017) found that in a Variable Rate Treatment (VRT) plot, the average yield was 34 percent higher than the control. 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"> <li>National Institute of Agricultural Science (2017)<sup>177</sup></li> <li>World Bank<sup>178</sup></li> </ul>
<b>2. IOT-ENABLED SUPPLY CHAIN MANAGEMENT</b>		<b>INCREASED REVENUES</b>
<b>IoT technology to help reduce food waste in supply chain</b>	Sized based on the additional revenues from reduced food losses that occur in the supply chain. McKinsey Global Institute (2014) estimated that ten percent to 15 percent of all food waste throughout the supply chain were recoverable from technology-enabled supply chain management. Country-level estimate was derived based on annual food waste from the supply chain which was assumed to grow at constant rates.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2014)<sup>179</sup></li> <li>Food and Land Use Coalition<sup>180</sup></li> </ul>
<b>3. FOOD SAFETY TECHNOLOGIES</b>		<b>COST SAVINGS</b>
<b>Using sensors, data monitoring and analysis techniques to ensure the biosecurity of food products and predict when concerns may arise</b>	Sized based on cost savings from reduced food contamination losses. Fast Company (2017) reported that improving food traceability via sensing, tracking and data monitoring technologies could improve the percentage of food arriving at the retailers' premises with target freshness, from 30 percent to 90 percent. Pricewaterhouse Coopers (2015) estimated the global cost of food fraud, proxied by lost sales due to adverse health consequences, to be between 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"> <li>Fast Company (2017)<sup>181</sup></li> <li>Pricewaterhouse Coopers (2015)<sup>182</sup></li> <li>Food and Agriculture Organisation of the United Nations<sup>183</sup></li> </ul>

177. Lee, Jae-Soo, Kim, Kuk-Hwan & Kim, Sang-Cheol (2017). Rice precision farming in Korea. Available at: <https://ap.ftc.org.tw/article/1412>

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

179. McKinsey Global Institute (2014), Southeast Asia at the crossroads: Three paths to prosperity.

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

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. Pricewaterhouse Coopers (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
<b>1. DIGITAL RETAIL SALES AND MARKETING CHANNELS</b>		<b>PRODUCTIVITY GAINS</b>
<b>Productivity gains from delivering retail goods through digital channel reducing labor, inventory, and real estate costs</b>	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"> <li>McKinsey Global Institute (2013)<sup>184</sup></li> </ul>
<b>2. IOT-ENABLED INVENTORY MANAGEMENT</b>		<b>INCREASED REVENUES</b>
<b>Use of IoT to reduce stock outs</b>	Sized based on increase in revenues from capturing sales potentially lost due to stock outs. McKinsey Global Institute (2013) estimated that four percent of retail sales were lost due to stock outs, and that 35 percent to 40 percent of this value may be recaptured using IoT. Country-level estimate was derived based on domestic retail sales.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2013)<sup>185</sup></li> </ul>
<b>3. AUTOMATION AND AI CUSTOMER SERVICE IN HOTELS</b>		<b>INCREASED REVENUES</b>
<b>Use of AI and automated services for remote check-ins at hotels</b>	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"> <li>Colliers International (2018)<sup>186</sup></li> <li>The Vulcan Post (2018)<sup>187</sup></li> <li>Singapore Tourism Board (2019)<sup>188</sup></li> </ul>

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

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 S'pore Startup Lets You Quickly Check To Hotels With A Selfie." Available at: <https://vulcanpost.com/704429/gtrip-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>



## CONSUMER, RETAIL AND HOSPITALITY (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>4. DATA ANALYTICS ON TRAVEL PATTERNS</b>		<b>INCREASED REVENUES</b>
Use of big data analytics in predicting consumer behaviour	Sized based on increased revenues from better targeted promotions to tourists. Boston Consulting Group (2020) estimated that brands experienced a revenue uplift of six to ten percent from integrating proprietary data to create personalized experiences. Country-level estimate was derived based on tourism revenue.	<ul style="list-style-type: none"> <li>Boston Consulting Group (2020)<sup>189</sup></li> </ul>
<b>5. ONLINE F&amp;B DELIVERY CHANNELS</b>		<b>INCREASED REVENUES</b>
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"> <li>The Straits Times (2017)<sup>190</sup></li> </ul>

## EDUCATION AND TRAINING

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. E-CAREER CENTERS AND DIGITAL JOBS PLATFORMS</b>		<b>GDP INCREMENTS</b>
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"> <li>McKinsey Global Institute (2015)<sup>191</sup></li> </ul>
<b>2. PERSONALIZED LEARNING</b>		<b>GDP INCREMENTS</b>
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"> <li>McKinsey Global Institute (2018)<sup>192</sup></li> <li>World Bank<sup>193</sup></li> </ul>

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## EDUCATION AND TRAINING (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>3. ONLINE RETRAINING PROGRAMS</b>		<b>GDP INCREMENTS</b>
<b>Lifelong learning opportunities delivered in digital format helped individuals gain new skills</b>	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"> <li>McKinsey Global Institute (2018)<sup>194</sup></li> <li>World Bank<sup>195</sup></li> </ul>

## FINANCIAL SERVICES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. BIG DATA ANALYTICS</b>		<b>INCREASED REVENUES</b>
<b>Increased lending to small and medium-sized enterprises (SMEs) at higher margins due to big data</b>	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"> <li>McKinsey Global Institute (2014)<sup>196</sup></li> </ul>
<b>2. DIGITAL BANKING SERVICES</b>		<b>COST SAVINGS</b>
<b>Use of Internet and mobile technologies to reduce operational and risk costs, and improve service delivery</b>	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"> <li>McKinsey Global Institute (2017)<sup>197</sup></li> </ul>
<b>3. REG TECH</b>		<b>COST SAVINGS</b>
<b>Use of AI and machine learning to automate document review, risk analysis and other repetitive compliance tasks</b>	Sized based on the cost savings in compliance expenditure due to improvement in efficiency brought about by these technologies. Juniper Research (2017) estimated that up to 50 percent of compliance expenditure could be eliminated from adopting these technologies. KPMG (2013) indicated that compliance expenditure contributed to ten percent of banks' operating costs on average. Country-level estimate of efficiency savings was derived based on domestic banking sector costs.	<ul style="list-style-type: none"> <li>Juniper Research (2017)<sup>198</sup></li> <li>KPMG (2013)<sup>199</sup></li> </ul>

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## GOVERNMENT

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. CLOUD COMPUTING</b>		<b>COST SAVINGS</b>
<b>Use of cloud-based software to reduce costs</b>	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"> <li>• InfoWorld (2019)<sup>200</sup></li> </ul>
<b>2. GOVERNMENT E-SERVICES</b>		<b>COST SAVINGS</b>
<b>Reduction in operating expenditure from using e-services</b>	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"> <li>• McKinsey Global Institute (2011)<sup>201</sup></li> </ul>
<b>3. E-PROCUREMENT</b>		<b>COST SAVINGS</b>
<b>Cost savings from using e-procurement channels</b>	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"> <li>• Public Procurement Service<sup>202</sup></li> </ul>
<b>4. GEOGRAPHIC INFORMATION SYSTEM ENABLED TAX COLLECTION</b>		<b>INCREASED TAX COLLECTION</b>
<b>Use of big data and location-based information to improve tax collection</b>	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"> <li>• Bill &amp; Melinda Gates Foundation and AlphaBeta (2018)<sup>203</sup></li> </ul>

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## GOVERNMENT (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>5. DATA ANALYTICS FOR GOVERNMENT TRANSFER PAYMENTS</b>		<b>COST SAVINGS</b>
<b>Use of data analytics in government transfer payments</b>	Sized based on reduction in costs from using data analytics in determining eligible recipients of government transfer payments. McKinsey & Company estimated that five to ten percent of government transfer payments globally are improper payments that could be addressed by adopting data analytics. Country-level estimate was derived based on the country's GDP.	<ul style="list-style-type: none"> <li>McKinsey &amp; Company (2017)<sup>204</sup></li> </ul>

## HEALTH

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. REMOTE PATIENT MONITORING</b>		<b>COST SAVINGS</b>
<b>Application of remote monitoring systems to improve patient care</b>	Sized based on cost savings to the healthcare system through reduced hospital visits, length of patients' stays and medical procedures. McKinsey Global Institute (2013) estimated that such systems would reduce hospital visits, length of patients' stays and number of procedures relating to chronic diseases, resulting in ten percent to 20 percent savings for the healthcare system. Country-level estimate was derived from the World Bank's estimate of total healthcare spend and the country's share of spending on chronic diseases.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2013)<sup>205</sup></li> <li>World Bank<sup>206</sup></li> </ul>
<b>2. TELEHEALTH APPLICATIONS</b>		<b>COST SAVINGS</b>
<b>Use of Internet and mobile technologies for medical consultations</b>	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"> <li>Goldman Sachs (2015)<sup>207</sup></li> </ul>

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>

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## HEALTH (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>3. DATA-BASED PUBLIC HEALTH INTERVENTIONS</b>		<b>GDP INCREMENTS</b>
<b>Use of analytics to direct highly targeted health interventions for at-risk populations</b>	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"> <li>• McKinsey Global Institute (2018)<sup>208</sup></li> <li>• UN Population Division (2018)<sup>209</sup></li> <li>• World Bank<sup>210</sup></li> </ul>
<b>4. DETECTION OF COUNTERFEIT PHARMACEUTICAL DRUGS</b>		<b>COST SAVINGS</b>
<b>Use of IoT and advanced analytics to detect counterfeit drugs</b>	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"> <li>• EU Intellectual Property Office (2016)<sup>211</sup></li> <li>• McKinsey Global Institute (2013)<sup>212</sup></li> </ul>
<b>5. SMART MEDICAL DEVICES AND WEARABLES</b>		<b>GDP INCREMENTS</b>
<b>Analyzing data across connected implants, smart medical devices and wearables in personalized and predictive care</b>	Sized based on the economic value of reduced disability-adjusted life years (DALYs) due to health improvement measures prompted by data from such devices. McKinsey Global Institute (2018) estimated that smart medical devices reduced DALYs by one percent reduction in high-income countries, and 0.6 percent in other countries. The economic value was taken to be this multiplied by GDP per capita. Classification of the country’s income level was based on the World Bank’s definition. Country-level estimate was derived based on national population sizes and GDP per capita, and was estimated based on the proportion of the population suffering from chronic diseases.	<ul style="list-style-type: none"> <li>• McKinsey Global Institute (2018)<sup>213</sup></li> <li>• UN Population Division (2018)<sup>214</sup></li> <li>• World Bank<sup>215</sup></li> </ul>

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## HEALTH (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>6. ELECTRONIC MEDICAL RECORDS</b>		<b>COST SAVINGS</b>
<b>Use of cloud-based electronic medical record systems</b>	Sized based on the cumulative savings (such as saving of physician and nursing time) from adopting electronic health records (EHR). McKinsey Global Institute (2014) estimated that widespread adoption of electronic medical records could increase India's annual economic value by USD3 billion. The global economic impact of HER was estimated based on India's share of the global healthcare expenditure. Country-level estimate was derived based on its relative national healthcare expenditure according to World Bank data and the global EHR market growth rates.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2014)<sup>216</sup></li> <li>World Bank<sup>217</sup></li> <li>Transparency Market Research<sup>218</sup></li> </ul>

## INFRASTRUCTURE

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. SMART GRIDS</b>		<b>COST SAVINGS</b>
<b>Use of digital communications technology in detecting and optimizing electricity networks</b>	Sized based on cost savings from energy savings due to lower consumption and efficiency improvements. The International Herald Tribune (2018) reported that engineers indicated a five to ten percent in energy savings from using smart grids. Country-level estimate was derived based on total electricity consumption. Business and Sustainable Development Commission (2017) estimated that the global average wholesale price of electricity was USD100/Mwh.	<ul style="list-style-type: none"> <li>The International Herald Tribune (2011)<sup>219</sup></li> <li>World Bank<sup>220</sup></li> <li>Business and Sustainable Development Commission (2017)<sup>221</sup></li> </ul>
<b>2. 5D BIM AND PROJECT MANAGEMENT TECHNOLOGIES</b>		<b>COST SAVINGS</b>
<b>Use of integrated modeling platforms to simulate construction cost and timeline impacts of decisions in project planning, design, construction, operations, and maintenance</b>	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"> <li>McKinsey Global Institute (2013)<sup>222</sup></li> <li>Global Infrastructure Outlook<sup>223</sup></li> </ul>

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## INFRASTRUCTURE (CONT'D)

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>3. PREDICTIVE MAINTENANCE TECHNOLOGIES</b>		<b>COST SAVINGS</b>
Using data from sensors to ensure prompt and predictive maintenance, minimizing downtime	Sized based on the economic value of benefits from sizeable applications including the predictive maintenance of public transit systems and water leakage detection and control. McKinsey Global Institute (2018) estimated a 2.3 percent reduction in average commuting time from predictive transit for “high-income” countries, and 1.4 percent for other countries. On water leakage detection and control, McKinsey Global Institute (2018) estimated a 1.4 percent reduction in water consumption for “high-income” countries, and country-level estimates were used in other countries. Classification of the country’s income level was based on the World Bank’s definition. The Business and Sustainable Development Commission (2017) estimated that the global average price of water was USD0.90/m <sup>3</sup> . Country-level estimate was derived based on the country’s average commuting time, population, GDP per capita and domestic water consumption.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2018)<sup>224</sup></li> <li>World Bank<sup>225</sup></li> <li>UNESCO-IHE (2011)<sup>226</sup></li> <li>Business and Sustainable Development Commission (2017)<sup>227</sup></li> </ul>
<b>4. SMART BUILDINGS</b>		<b>COST SAVINGS</b>
Use of physical sensor networks, energy storage and data analytics to improve resource efficiency of buildings and reduce energy and water consumption, as well as carbon emissions	Sized based on the economic value of the reduction in greenhouse gas emissions (GHG) and water consumption by building automation systems. McKinsey Global Institute (2018) estimated a 2.9 percent reduction in GHG emissions and a 1.7 percent reduction in water consumption for “high-income” countries. The corresponding figures for other countries were 1.4 percent and 1.1 percent. Classification of the country’s income level was based on the World Bank’s definition. Country-level estimate was derived based on its greenhouse gas emissions and water consumption from buildings. Business and Sustainable Development Commission (2017) estimated that the global average price of water was USD0.90/m <sup>3</sup> 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).	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2018)<sup>228</sup></li> <li>IPCC<sup>229</sup></li> <li>World Bank<sup>230</sup></li> <li>Business and Sustainable Development Commission (2017)<sup>231</sup></li> </ul>

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## MANUFACTURING

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. BIG DATA ANALYTICS</b>		<b>INCREASED REVENUES</b>
Use of big data analytics in demand forecasting and supply planning	Sized based on increase in revenue from more accurate demand-supply matching leading to higher sales. McKinsey Global Institute (2011) estimated a 2.5 percent to three percent increase in profit margin from big data analytics in manufacturing. Country-level estimate was derived based on domestic manufacturing sector GDP.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2011)<sup>232</sup></li> </ul>
<b>2. ADDITIVE MANUFACTURING</b>		<b>PRODUCTIVITY GAINS/COST SAVINGS</b>
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"> <li>McKinsey &amp; Company (2017)<sup>233</sup></li> </ul>
<b>3. IOT-ENABLED SUPPLY CHAIN MANAGEMENT</b>		<b>COST SAVINGS</b>
Savings in operating costs from IoT-enabled supply chain management and distribution network management	Sized based on reduction in operating costs from adopting IoT-enabled supply chain management and distribution network management. McKinsey Global Institute (2011) estimated a 2.5 percent to five percent savings in distribution and supply chain operating costs could amount to two percent to six percent of manufacturing sales. Country-level estimate was derived based on domestic manufacturing sector operating costs.	<ul style="list-style-type: none"> <li>McKinsey Global Institute (2011)<sup>234</sup></li> </ul>
<b>4. ROBOTICS AND AUTOMATION</b>		<b>PRODUCTIVITY GAINS</b>
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"> <li>McKinsey &amp; Company (2017)<sup>235</sup></li> </ul>

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## RESOURCES

DESCRIPTION	SIZING ASSUMPTIONS	SOURCE
<b>1. SMART EXPLORATION AND AUTOMATION IN MINING OPERATIONS</b>		<b>PRODUCTIVITY GAINS/COST SAVINGS</b>
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"> <li>McKinsey &amp; Company (2015)<sup>236</sup></li> </ul>
<b>2. PREDICTIVE SAFETY TECHNOLOGIES</b>		<b>PRODUCTIVITY GAINS/COST SAVINGS</b>
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"> <li>McKinsey &amp; Company (2015)<sup>237</sup></li> </ul>
<b>3. PREDICTIVE MAINTENANCE TECHNOLOGIES</b>		<b>PRODUCTIVITY GAINS/COST SAVINGS</b>
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"> <li>McKinsey &amp; Company (2015)<sup>238</sup></li> </ul>

236. McKinsey &amp; Company (2015), How digital innovation can improve mining productivity.

Available at: <https://www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity>

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Available at: <https://www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity>

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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
<b>1. SMART ROADS</b>		<b>TIME SAVINGS</b>
<b>Use of real-time public transit information, intelligent traffic signals and real-time road navigation to reduce commuting time</b>	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"> <li>McKinsey Global Institute (2018)<sup>239</sup></li> <li>World Bank<sup>240</sup></li> </ul>
<b>2. SMART PORTS</b>		<b>COST SAVINGS</b>
<b>Use of IoT to enhance port efficiency</b>	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"> <li>Accenture and SIPG (2016)<sup>241</sup></li> <li>Council of Supply Chain Management Professionals (2013)<sup>242</sup></li> <li>World Bank (2016)<sup>243</sup></li> </ul>
<b>3. AUTONOMOUS VEHICLES</b>		<b>COST SAVINGS</b>
<b>Use of AI and sensors to increase fuel efficiency</b>	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"> <li>McKinsey Global Institute (2013)<sup>244</sup></li> </ul>
<b>4. GEOSPATIAL SERVICES</b>		<b>PRODUCTIVITY GAINS/COST SAVINGS</b>
<b>Productivity impact of using location-based information</b>	Sized based on estimated productivity impact geospatial services in the transport sector (land, sea and air). AlphaBeta (2017) estimated that geospatial services could improve productivity of land, sea and air transport by 2.5 percent to five percent. These benefits include reduced logistics costs, improved network design and management. Country-level estimate was derived based on the size of the land, sea and air transport sector.	<ul style="list-style-type: none"> <li>AlphaBeta (2017)<sup>245</sup></li> </ul>

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>

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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.

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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](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 South Korea's context, through three channels. These are:

- Facilitate customer interactions, transactions and

marketing through digital platforms;

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

Exhibit A2 shows the list of these 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
<b>Facilitate customer interactions, transactions and marketing through digital platforms</b>	Consumer, retail and hospitality	1. Digital retail sales and marketing channels 2. Online F&B delivery channels
	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
<b>Enable the continuity of business operations amid remote working arrangements</b>	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. Robotics and automation
	Resources	19. Smart exploration and automation in mining operations
<b>Reduce logistical bottlenecks amidst global and regional supply chain disruptions induced by pandemic</b>	Agriculture & food	20. IoT-enabled supply chain management (food)
	Manufacturing	21. IoT-enabled supply chain management (manufacturing)
	Transport services	22. Smart ports

# B: SIZING GOOGLE'S ECONOMIC IMPACT IN SOUTH KOREA

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

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 value a Google product). Primary data used in the analysis was collected from a consumer survey of 529 Internet users in South Korea. This sample size is statistically significant based on South Korea'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 South Korea's Internet population based on demographic variables including age, income level, and the geographical location of respondents. The Google products included in this analysis of consumer benefits include Google Search, Google Play, Google Drive, Photos, Docs, and Sheets.

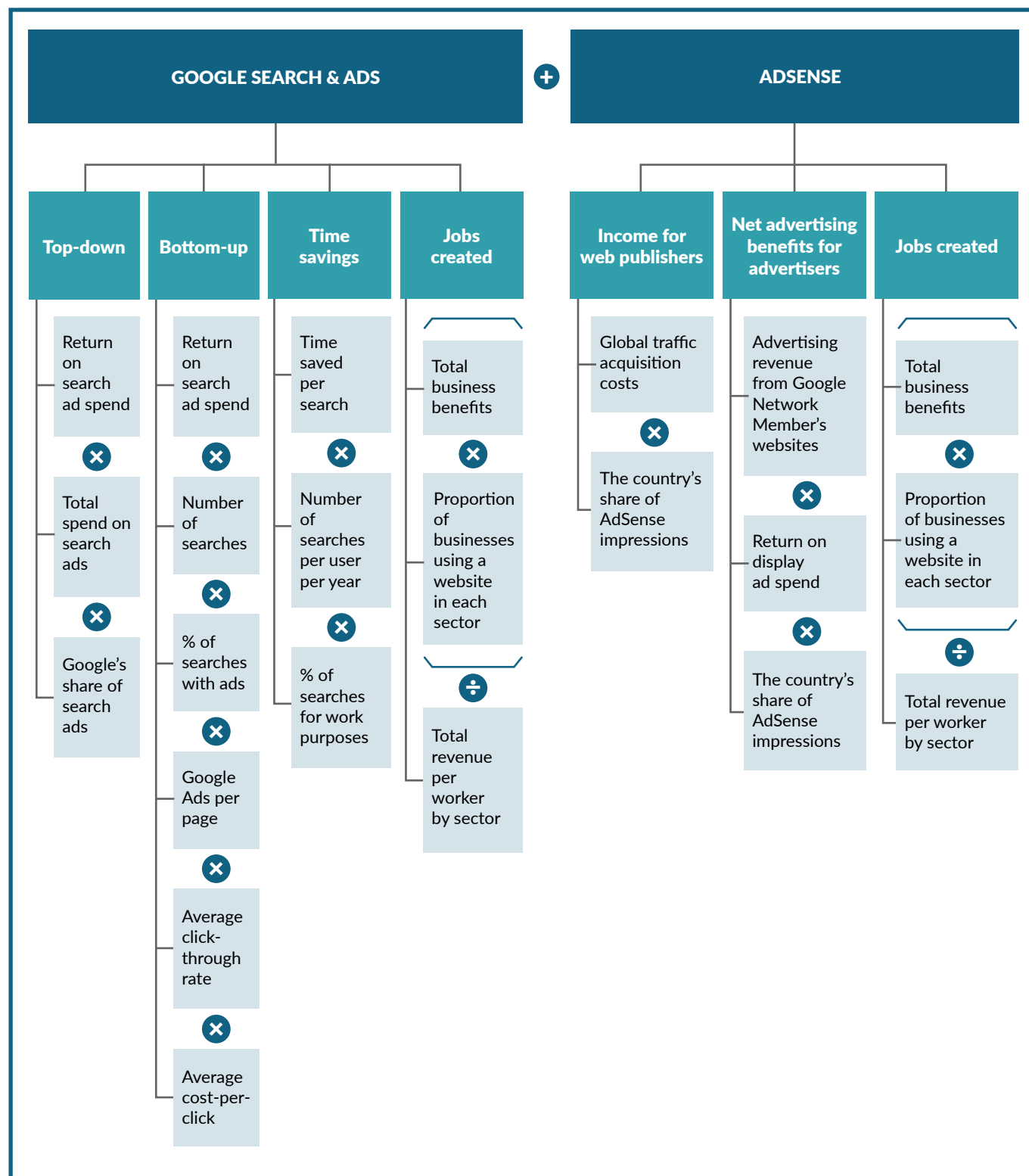
## BUSINESS BENEFITS



The business benefits supported by Google include the gross revenue, income or savings generated by businesses using Google products. These benefits do not include the flow-on economic effects generated, such as further purchases from their suppliers or the economic activity generated by the employees of these businesses who spend their wages in the broader economy. These benefits also do not account for activity that may have been displaced by Google, nor attempt to estimate the incremental impact of Google on the South Korean 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.

## EXHIBIT B1:

## METHODOLOGY FOR SIZING BUSINESS 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 South Korea 2017 report.

SOURCE: AlphaBeta analysis



## 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.<sup>246</sup> This ROI ratio was developed from a few assumptions:

- Using a large sample of proprietary data, Hal Varian, Google's Chief Economist, estimated that businesses received USD2 in revenue for every USD1 spent on advertising. This finding was published in the American Economic Review in 2009.
- Businesses also receive free clicks because of unpaid Google Search. Using research published in the International Journal of Internet Marketing and Advertising in 2009 by Jansen and Spink, the Google US Economic Impact Study assumed that businesses receive five clicks for every click on a paid advertisement.
- Unpaid clicks are not considered as commercially valuable, so the US Economic Impact Study assumed their value at 70 percent of paid clicks.
- Because of these assumptions, an ROI ratio of 8 was estimated. This ROI ratio was taken as an upper bound. To derive a lower bound, we built on the academic findings detailed in the Google

UK Economic Impact Study to set a lower bound of 3.4.

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

## ADSENSE

The direct business benefits from AdSense were estimated as the net advertising benefits generated by businesses placing advertisements on publisher sites such as websites, blogs, and forums.<sup>247</sup> 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.<sup>248</sup> In addition, we applied an ROI ratio that advertisers earn using display advertising, derived from academic literature.

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

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

## TIME SAVINGS BENEFITS OF GOOGLE SEARCH

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

Table 4 shows the inputs and sources used for estimating the time savings benefits of Google Search.

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

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

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

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

APPROACH	METRIC	SOURCE
Top down approach	Total market expenditure on search advertising	<ul style="list-style-type: none"> <li>Statista (2020)<sup>249</sup></li> </ul>
	Google Search's market share	<ul style="list-style-type: none"> <li>AlphaBeta Consumer Survey (2020)</li> </ul>
Bottom-up approach	Google Search traffic data	<ul style="list-style-type: none"> <li>AlphaBeta Consumer Survey (2020)</li> </ul>
	% pages that display advertisements	<ul style="list-style-type: none"> <li>Varian (2009)<sup>250</sup>, Jansen &amp; Spink (2009)<sup>251</sup></li> <li>Deloitte (2015)<sup>252</sup></li> </ul>
	Advertisements per page on average	<ul style="list-style-type: none"> <li>Varian (2009)<sup>253</sup>, Jansen &amp; Spink (2009)<sup>254</sup></li> <li>Deloitte (2015)<sup>255</sup></li> </ul>
	CTR for Search (Estimate)	<ul style="list-style-type: none"> <li>Word Stream (2019)<sup>256</sup></li> <li>BannerTag (2019)<sup>257</sup></li> </ul>
	Average CPC for Search (Estimate)	<ul style="list-style-type: none"> <li>Word Stream (2018)<sup>258</sup></li> <li>Adstage (2019)<sup>259</sup></li> </ul>
Both Methods	ROI ratio Lower and Upper Bound	<ul style="list-style-type: none"> <li>Varian (2009)<sup>260</sup>, Jansen &amp; Spink (2009)<sup>261</sup></li> <li>Deloitte (2015)<sup>262</sup></li> </ul>

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262. Deloitte (2015), Google's Economic Impact United Kingdom. Available at: <https://drive.google.com/file/d/0B9xmjQ1MUCjpNXBJZExHY1NqQIU/view>

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

ESTIMATION	METRIC	SOURCE
Net advertising benefits for advertisers	Advertising revenue from Google Network Member's websites	• Alphabet (2019) <sup>263</sup>
	ROI ratio	• Gupta et al. (2015) <sup>264</sup>
Revenue to content creators	Global traffic acquisition costs related to AdSense	• Alphabet (2019) <sup>265</sup>
Both estimates	Country share of global impressions on AdSense (Estimate)	• DoubleClick (2012) <sup>266</sup>

**TABLE 4: INPUTS AND SOURCES FOR CALCULATING TIME SAVING BENEFITS OF GOOGLE SEARCH**

METRIC	SOURCE
Time saved per search	<ul style="list-style-type: none"> <li>• Varian (2014)<sup>267</sup></li> <li>• Chen et al. (2014)<sup>268</sup></li> </ul>
Average daily searches per worker	• AlphaBeta Consumer Survey (2020)
% of searches for work purposes	• AlphaBeta Consumer Survey (2020)

### VALUE OF ANNUAL TIME SAVINGS TO MANUFACTURERS (OEMS) FROM THE USE OF ANDROID OPERATING SYSTEM

To estimate the value of time savings from Android for OEMs, we multiplied the reduction in development hours required to build and maintain a proprietary software operating system with the average annual salary of a software developer in South Korea.

The time saving has a one-off component of building the operating system, as well as an annual component for maintaining and continuously updating the software. In order to estimate this, we employed the

Basic Constructive Cost Model (COCOMO) which computes the required software development effort as a function of the software program's size. For the one-off component of development efforts, we used the Single Lines of Code (SLOC) in the latest version of the Android Open Source Project (AOSP).<sup>269</sup> We estimated the recurring annual effort component separately using the average annual incremental change in SLOC between modern Linux Kernel distributions (which Android is built upon) from version 3.0.1 to 5.5.<sup>270</sup>

Table 5 shows the inputs and sources used for estimating the time savings benefits to OEMs.

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269. SLOC data obtained from OpenHub - <https://www.openhub.net/p/android>

270. SLOC data obtained from Phoronix - <https://phoronix.com/misc/linux-eoy2019/index.html>

## VALUE OF ANNUAL TIME SAVINGS TO APP DEVELOPERS FROM THE USE OF ANDROID OPERATING SYSTEM

We estimated the benefit to app developers as the value of time savings from not having to port apps across operating systems and instead being able to develop one standalone Android app. In order to obtain the estimates for the parameters used in the calculation we consulted a variety of third party reports and developer surveys, as well as carried out a series of interviews with app developers.

We first estimated the development time requirement for an Android app and a Non-Android app. According to industry consensus, apps can be developed easiest and least time intensive on iOS. In order to keep our estimates conservative, we used the development time requirement for iOS as a proxy for development on all Non-Android operating systems. Further, there is also industry consensus that Android apps take significantly longer to program than iOS apps.<sup>271</sup> We reflected this in our calculations.

In order to compute the incremental time requirement from having to port an existing app to a new operating system, we used the easiest and least labor intensive development technology to build apps across several operating systems, which is hybrid app development.<sup>272</sup> Hybrid app development (for example using HTML5 or CSS) is the most efficient way of making apps work on several operating systems and based on industry studies the incremental time cost per operating system is less than 15 percent of that required for native app development.

To generate an appropriate counterfactual to Android app development, we considered the number of consumers an app developer can reach through Android. We looked at the number of OEMs using Android with a greater than one percent global market share.<sup>273</sup>

We assumed that in the absence of free-to-use open-source operating systems such as Android, each of these OEMs would run its own operating system. Hence, an app would need to be ported to each of them to reach the same audience, in our case, Android provides.

In summary, in order to estimate the time cost saving for free-to-use open-source operating systems such as Android, we compared the developer time required to build a native Android app, to the time requirement of building an iOS app and porting it to ten (eleven minus the initial operating system) additional operating systems, each time incurring the additional cost associated with hybrid development. We used an upper and lower bound on the median app development time based on third party surveys and reports.

Development time savings are multiplied with the national average monthly salary of a software developer to obtain the average per app saving.<sup>274</sup> Per app savings are further multiplied by the average number of apps per publisher listed on dominant app stores, as well as an estimate of the total number of app publishers in the country to obtain the total savings in South Korea.

Table 6 shows the inputs and sources used for estimating the time savings benefits to app developers.

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274. Robert Walters (2020), Salary Survey 2020: South Korea.

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**TABLE 5: INPUTS AND SOURCES FOR CALCULATING TIME SAVING BENEFITS OF ANDROID TO OEMS**

ESTIMATION	METRIC	SOURCE
One-off and annual cost of building and maintaining a proprietary OS	Single lines of code (SLOC) required to build Android Open Source Project (AOSP)	• OpenHub (2016) <sup>275</sup>
	Average incremental annual lines of code from Linux Kernel 3.0.1 to 5.5	• Phoronix (2020) <sup>276</sup>
Basic COCOMO (Organic Project)	Model parameters (SLOC to developer time effort)	• University of Michigan-Dearborn (2016) <sup>277</sup>
	Wrap Rate (Developer/labor costs to overhead costs)	• University of Michigan-Dearborn (2016) <sup>278</sup>
Average annual salary of software developer in country	Average annual salary of junior and senior software developers in the country	• Robert Walters (2020) <sup>279</sup>

**TABLE 6: INPUTS AND SOURCES FOR CALCULATING TIME SAVING BENEFITS OF ANDROID TO APP DEVELOPERS**

ESTIMATION	METRIC	SOURCE
Time savings from developing an app on Android	Median app development time	• Clutch (2017) <sup>280</sup> • Crispy Codes (2016) <sup>281</sup>
	Ratio of Android to iOS apps	• Statista (2021) <sup>282</sup>
	% additional app development time requirement for Android over iOS	• Infinium (2015) <sup>283</sup>
	% additional app development time requirement per additional operating system, hybrid development	• Comentum (2016) <sup>284</sup> • Thorn Technologies (2016) <sup>285</sup>
	Number of Android OEMs in the country with >1% global market share	• AppBrain (2021) <sup>286</sup>
Total benefit to app developers in the country	Average annual salary of country's software developer	• Robert Walters (2020) <sup>287</sup>
	Number of apps published by country's publishers	• 42matters (2021) <sup>288</sup>

275. Synopsys (2016), "Android". Available at: <https://www.openhub.net/p/android>

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### ANNUAL INCREASE IN MOBILE DATA TRAFFIC ORIGINATING FROM ANDROID DEVICES SUPPORTS TELECOMMUNICATION OPERATORS (TELCO)

To estimate the average total data traffic from Android devices, we used the average monthly data volumes per mobile phone subscriber. This figure is then multiplied by the number of smartphone subscribers using Android devices.

Table 7 shows the inputs and sources used for estimating the increase in data traffic originating from Android devices.

### EMPLOYMENT CREATION DUE TO ANDROID ECOSYSTEM

Our estimate of employment supported by Android is based on the methodology developed by Mandel (2012).<sup>289</sup> 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 Human Resources (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 South Korea's app economy is estimated based on the country's app intensity multiplied by the total number of employed workers in the country. We further estimated OEM employment related to Android devices. We calculated the average share of employees in OEMs' Android-related divisions (i.e., LG Electronics: mobile communications, business solutions, home appliance and air solution; Samsung: consumer electronics, IT & mobile communications) as part of total employees for Samsung Electronics and LG Electronics and applied it to the total employees for the two companies in South Korea.

Table 8 shows the inputs and sources used for estimating the number of jobs created through the Android ecosystem.

### JOB IMPACT FROM GOOGLE ADS AND ADSENSE

We estimated the number of jobs that are supported by Google's business benefits (i.e., increased revenue through Google Ads and AdSense) based on the breakdown of business benefits by sector and the revenue per worker in each sector. The breakdown of business benefits by sector was calculated based on the share of businesses using websites (to proxy for the use of Google products). This share was then divided by the respective revenue per worker figures for each sector to obtain the number of jobs created.

Table 9 shows the inputs and sources used for estimating the number of jobs supported by Google Ads and AdSense.

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TABLE 7: INPUTS AND SOURCES FOR CALCULATING DATA TRAFFIC FROM ANDROID DEVICES

ESTIMATION	METRIC	SOURCE
Increase in data traffic originating from Android devices	Average monthly data traffic per user	• Tefficient (2016) <sup>290</sup>
	Number of smartphone subscribers	• Statista (2020) <sup>291</sup>
	Android share of operating system in South Korea	• StatCounter (2021) <sup>292</sup>

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

ESTIMATION	METRIC	SOURCE
App employment supported by Android	Number of jobs in the app economy	• Mandel (2018) <sup>293</sup>
	Ratio of direct to indirect and spillover jobs	• Mandel (2018) <sup>294</sup>
	Android share of app economy jobs	• Mandel (2018) <sup>295</sup>
OEM employment supported by Android	South Korea employment in LG Electronics (mobile communications, business solutions, home appliance and air solution)	• DART (2019) <sup>296</sup>
	South Korea employment in Samsung (consumer electronics, IT & mobile communications)	• Samsung (2019) <sup>297</sup>

TABLE 9: INPUTS AND SOURCES FOR CALCULATING JOB IMPACT

APPROACH	METRIC	SOURCE
Revenue per worker by sector	Number of employees in South Korea by sector	• Korean Statistical Information Service (2019) <sup>298</sup>
	Total revenue by sector	• Korean Statistical Information Service (2019) <sup>299</sup>
Breakdown of business benefits for Google Search and Ads, as well as AdSense	Businesses using a website from each sector as % of total	• Ministry of Science and ICT (2019) <sup>300</sup>

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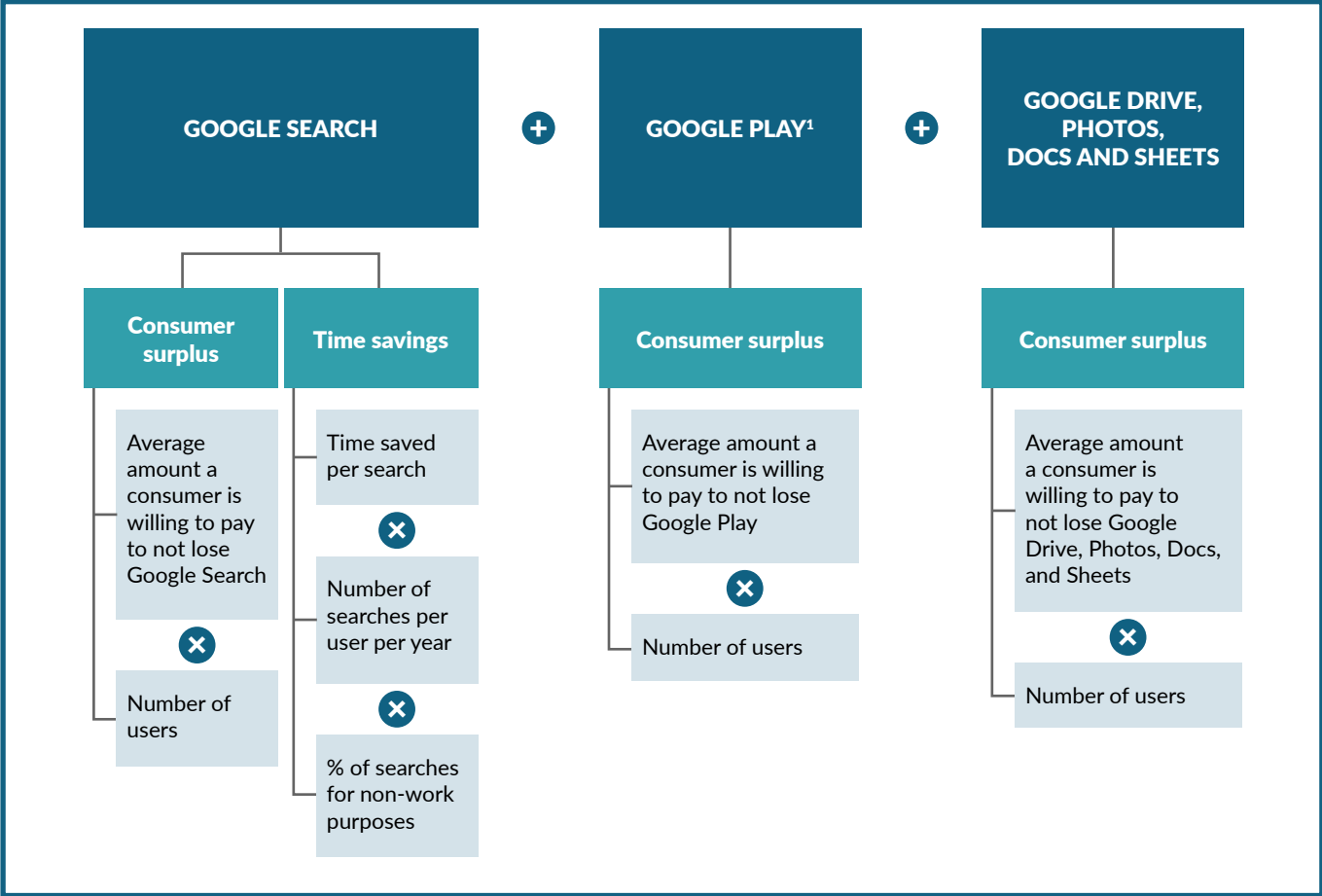
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# CONSUMER BENEFITS

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

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

## EXHIBIT B2: METHODOLOGY FOR SIZING CONSUMER BENEFITS FROM GOOGLE



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



## GOOGLE SEARCH

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

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

To calculate time savings, we applied time saving estimates from an experiment that measured the time taken to conduct a search online versus a search at the library.<sup>301</sup> 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 South Korea 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 10 shows the inputs and sources used for calculating the consumer benefits of Google Search.

## 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 South Korea’s online population were used.

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

## GOOGLE DRIVE, PHOTOS, DOCS, AND SHEETS

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

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

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

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019) <sup>302</sup>
	Search users as % of OP	• AlphaBeta Consumer Survey (2020)
Time saved per user	Time saved per search	• Varian (2014) <sup>303</sup> • Chen et al. (2014) <sup>304</sup>
	Average daily searches per user	• AlphaBeta Consumer Survey (2020)
	% of searches for non-work purposes	• AlphaBeta Consumer Survey (2020)
Share of Search users who have made use of Search for self-enrichment purposes	% of Search users in country who made use of Search for self-enrichment purposes	• AlphaBeta Consumer Survey (2020)

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

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019) <sup>305</sup>
	Google Play users as % of OP	• AlphaBeta Consumer Survey (2020)

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

ESTIMATION	METRIC	SOURCE
Consumer surplus	Amount that consumers value product per year (WTP)	• AlphaBeta Consumer Survey (2020)
	Online Population (OP)	• Internet World Stats (2019) <sup>306</sup>
	Google Drive, Photos, Docs, and Sheets users as % of OP	• AlphaBeta Consumer Survey (2020)

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