

# VIETNAM'S FUTURE DIGITAL ECONOMY TOWARDS 2030 AND 2045

May 2019

SUPPORTED BY



Ministry of Science and  
Technology, Vietnam



## CITATION

Cameron A, Pham T H, Atherton J, Nguyen D H, Nguyen T P, Tran S T, Nguyen T N, Trinh H Y & Hajkowicz S (2019). Vietnam's future digital economy – Towards 2030 and 2045. CSIRO, Brisbane.

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## ACKNOWLEDGEMENTS

A Steering Committee guided the production of this report. Members include Dr Nguyen Duc Hoang and Dr Bui The Duy from Vietnam's Ministry of Science and Technology; Mr Nguyen The Trung from DTT Technology Group; Ms Nguyen Hoang Ha and Ms Duong Hong Loan from Australia's Department of Foreign Affairs and Trade; and Dr Stefan Hajkowicz, Ms Liza Noonan and Mr James Dods from CSIRO.

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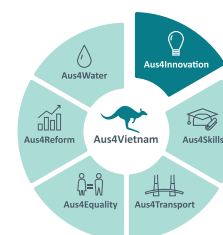
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- Mr Jiri Dusik from the United Nations Development Programme Vietnam.

Comments and input were also provided by Mr Phung Bao Thach, Dr Nguyen Quang Lich, Mr Hoang Xuan Thanh, Mr Trinh Dang Ha, and Mr Nguyen Tuan Anh from the Ministry of Science and Technology; and Mr Dave Dawson and Dr Alex Bratanova from CSIRO's Data61.

Workshops in Vietnam were organised with assistance from Mr Huynh Kim Tuoc and Ms Dang Thi Luan from the Saigon Innovation Hub; Mr Tran Vu Nguyen, Mr Pham Duc Nam Trung, and Ms Ly Phuong Dung from the Danang Business Incubator; Mr Nguyen Thanh Ha and Ms Thi Vu Van Anh from the Vietnam Academy of Social Sciences; and Mr Nguyen Duc Thanh, Ms Vu Thi Thu Hang, Ms Pham Thi Tuyet Mai, and Ms Dang Thi Bich Thao from the Vietnam Institute of Economic and Policy Research.

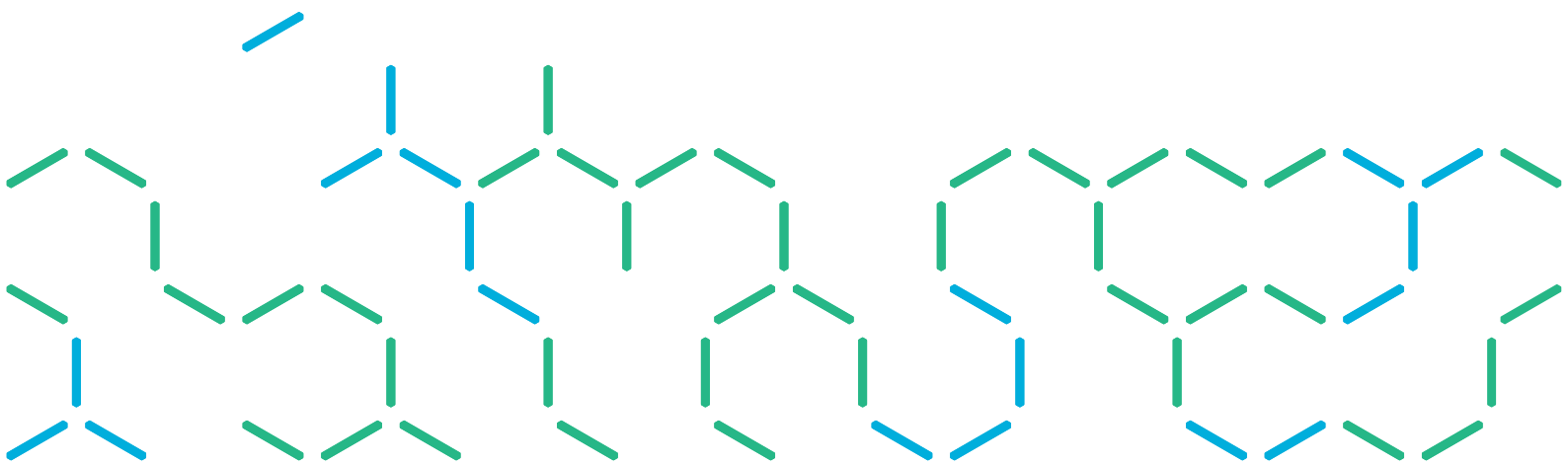
Training was provided to the research team in Vietnam by Dr George Quezada, Dr Stefan Hajkowicz, Dr Kelly Trinh, Mr Dinesh Devaraj, Mr Roy Chamberlain, Mr Dan Bailey and Ms Cathy Pitkin.

This report has been supported by the Australian Department of Foreign Affairs and Trade through the Aus4Innovation program.



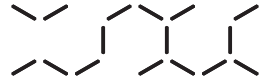
# VIETNAM'S FUTURE DIGITAL ECONOMY TOWARDS 2030 AND 2045

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# FOREWORD



Over the last four decades Vietnam has experienced rapid industrialisation, modernisation and international integration. In the new Vietnam, science, technology and innovation, have a critical role to play in furthering Vietnam's development: improving manufacturing capacity and competitiveness in product value chains, revolutionising business models, and attracting new sources of investment in the information and communications technology (ICT) sector.

Cooperation between Vietnam and Australia has developed strongly over the forty five years since the formal establishment of diplomatic relations in 1973. The relationship today rests on three pillars of cooperation: security, economic and innovation. The Australia-Vietnam Innovation Partnership was launched at the APEC Summit in November 2017 in Da Nang. This partnership has been given life by Aus4Innovation, a AU\$10 million program of cooperation between the Australian Department of Foreign Affairs and Trade and CSIRO and Vietnam's Ministry of Science and Technology on science, technology and innovation.

This report on **Vietnam's Future Digital Economy** represents the first project undertaken under the Aus4Innovation program. CSIRO and the Ministry of

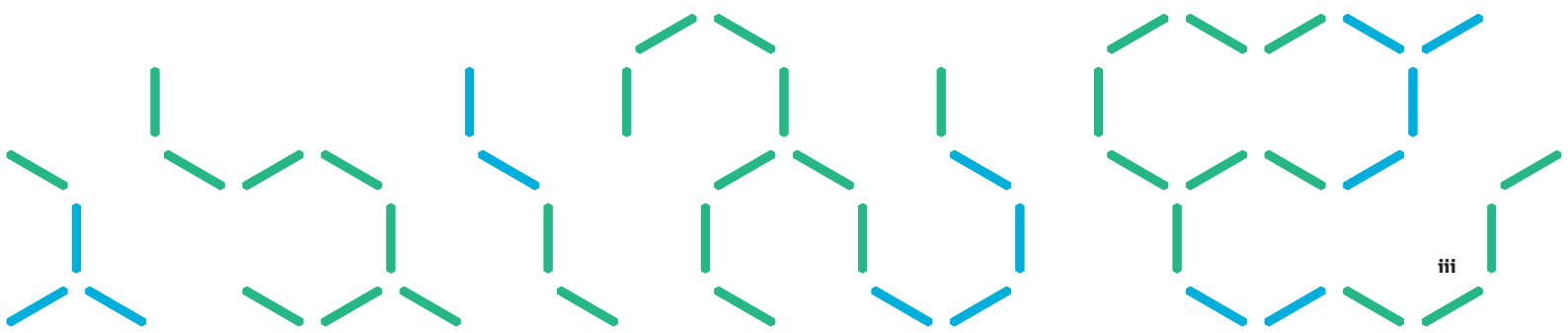
Science and Technology have worked together to deliver this report. Several of the project's early findings were discussed in the thematic workshop on *Industry 4.0 megatrends – identification of impacts and incentives for Vietnam* hosted by the Ministry of Science and Technology on 13 July 2018 under the *Industry 4.0 Summit 2018* organised by the Central Economic Commission and Vietnam Government. The results were greatly appreciated by ministries, sectors and participants. At the launch of Aus4Innovation in January 2019, the project's results were once again presented and acknowledged by international partners and communities such as the World Bank and Asian Development Bank.

We greatly appreciate the collaborative efforts made by both the Ministry of Science and Technology and CSIRO in completing this report. We strongly believe the analysis, findings and recommendations contained in the report will have implications for the development of Vietnam's economy and society over the next 25 years.

On behalf of the Ministry of Science and Technology of Vietnam and the Department of Foreign Affairs and Trade of Australia, we pledge to continue promoting further cooperation in science, technology, research and innovation between our two countries.

**Minister of Ministry of Science and Technology**  
Chu Ngoc Anh

**Department of Foreign Affairs and Trade**  
**Ambassador to Vietnam**  
Craig Chittick



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# GLOSSARY

TERM	DEFINITION
3D printing	Also called additive manufacturing, 3D printing is a method of manufacturing which adds physical materials layer-by-layer until a product is complete. <sup>1</sup>
Artificial Intelligence	“A collection of interrelated technologies used to autonomously solve problems and perform tasks to achieve defined objectives without explicit guidance from a human being.” <sup>2</sup>
Augmented reality	A situation where digital technology is used to overlay the physical ‘real’ world with context-sensitive virtual information in real-time. <sup>3</sup>
Big data analytics	“A new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data, by enabling the high velocity capture, discovery, and/or analysis.” <sup>4</sup>
Cloud computing	Cloud computing allows businesses to access data storage and computing power over the Internet. Cloud services can either be private (where the necessary IT infrastructure is owned and operated by the user or business) or public (where users or businesses pay a fee to an external business to use the cloud).
Cryptocurrency	A type of digital currency that is built with distributed ledger technology (see below for definition of distributed ledger technology) and secured through encryption/cryptographic technology. <sup>5</sup>
Cyber-physical systems	According to the National Institute of Standards and Technology, “cyber-physical systems integrate computation, communication, sensing, and actuation with physical systems to fulfil time-sensitive functions with varying degrees of interaction with the environment, including human interaction.” <sup>6</sup>
Blockchain	A type of distributed ledger technology (see below for definition of distributed ledger technology), where transactions are organised sequentially into groups (‘blocks’) before being added to the ledger (‘chain’). <sup>7</sup> These blocks must be validated by the majority of players before they can join the chain.
Digital currency	According to the World Bank, digital currencies are “digital representations of value that are denominated in their own unit of account, distinct from e-money, which is simply a digital payment mechanism, representing and denominated in fiat money.” <sup>5</sup>
Digital economy	All businesses and services that have a business model based primarily on selling or servicing digital goods and services or their supporting equipment and infrastructure.
Digitalisation	“Encompasses a wide range of new applications of information technology in business models and products that are transforming the economy and social interactions.” <sup>8</sup>
Digital platform	Websites or apps through which an ecosystem of actors (i.e. users, peers, businesses, providers) engage in various activities – where the ecosystem provides strong potential for value creation or capture. <sup>9,10</sup> There are several types of digital platforms, such as marketplace platforms (e.g. Ebay, Amazon), social media (e.g. Facebook, Twitter) and labour market platforms (e.g. freelancer.com, TaskRabbit). <sup>9</sup>
Distributed ledger technology	Digitally stored records of transactions that can be accessed and altered by multiple actors at multiple places at any time. <sup>7</sup>
E-commerce	Sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders. <sup>11</sup>
E-government	The utilization of new information and communication technologies (ICTs) by governments as applied to the full range of government functions. <sup>11</sup>
Gig economy	An economy in which digital platforms are used to connect projects with individual workers or teams of workers. The platforms also facilitate payment between buyers and workers. <sup>12</sup>
Industry 4.0	The next wave of digital and online transformation which will change the structure and dynamics of many industries. These changes will be driven by cutting-edge technologies such as Artificial Intelligence, big data analytics, Internet of Things, sensor networks and cyber-physical systems.
Internet of Things	A network of physical objects which collect data and/or act upon their surrounding environment. As these objects are embedded in a digital network, the objects are able to communicate with each other, as well as other machines and computers. <sup>13</sup>
Megatrend	A deep-set and gradual pattern of change building with increasing momentum to eventually alter the economy. Megatrends occur at the intersection of multiple trends which are more specific to a place and point in time.
Scenarios	Scenarios are plausible, evidence-based narratives about the future at a set point in time.
Sharing economy	The sharing economy refers to a wide range of digital platforms that facilitate the exchange of goods and services between players (e.g. people, businesses) through a range of interaction modalities (e.g. keyboard typing, swiping smartphone screen, scanning a QR code). <sup>14</sup>
Smart cities	A city where digital technological solutions are used to improve the management and efficiency of the urban environment, for the benefit of its habitants and business. <sup>15</sup>
Social media	Online technologies and practices to share content, opinions and information, promote discussion and build relationships. Social media services and tools involve a combination of technology, telecommunications and social interaction. They can use a variety of formats, including text, pictures, audio and video. <sup>16</sup>

TERM	DEFINITION
Strategic foresight	The practice of systematically analysing trends and plausible futures to inform present-day planning and strategy.
Over-the-top services	Online services which can substitute to some degree for traditional media and telecommunications services (including Voice over Internet Protocol, instant messaging and video/music and streaming). <sup>17</sup>
Platform economy	The portion of the economy composed of digital platforms enabling users to share, lend, rent or purchase goods and services. <sup>18</sup>
Virtual Reality	A 3D environment in which a person can become immersed, using a dedicated headset, powered by a computer, game console or a smartphone. The VR experience can be enhanced thanks to 3D audio sounds and by using haptic devices that use sensors to transfer body movement into the virtual space. <sup>19</sup>

# ACRONYMS AND ABBREVIATIONS

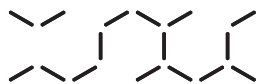
TERM	DEFINITION
AI	Artificial Intelligence
AR	Augmented Reality
ASEAN	Association of South East Asian Nations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAI	Digital Adoption Index
FDI	Foreign Direct Investment
G20	Group of Twenty – including Argentina, Australia, Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom and the United States
GDP	Gross Domestic Product
GSO	General Statistics Office
ICT	Information and Communications Technology
ILO	International Labour Organization
IoT	Internet of Things
IP	Intellectual Property
IT	Information Technology
ITU	International Telecommunications Union
MOST	Ministry of Science and Technology
MPI	Ministry of Planning and Investment
MSME	Micro and small to medium sized enterprises
NGO	Non-Governmental Organisation
OTT	Over-the-top
P2P	Peer-to-peer
PPP	Purchasing Power Parity
R&D	Research and development
STEM	Science, Technology, Engineering and Mathematics
TFP	Total Factor Productivity
US	United States
VR	Virtual Reality



# EXECUTIVE SUMMARY



# EXECUTIVE SUMMARY



The next wave of digital technologies – AI, blockchain, the Internet of Things, and platforms and cloud-based services – has the potential to transform Vietnam into Asia’s next high-performing economy, and to bring up the living standards of all of Vietnam’s citizens over the coming decades.

There is good reason to believe that this transformation will occur: there has been a recent boom in both digital hardware and software exports, Vietnam’s young population is rapidly taking-up new mobile internet services, and the Vietnam Government is implementing wide-reaching Industry 4.0 policies to jump start the modernisation of Vietnam’s major industries and grow new industries.

But to sustain high growth, Vietnam will need to overcome substantial challenges. The population is ageing, climate change and rapid development is straining the environment and food production, and the nation is rapidly urbanising. The workforce needs to upskill especially as jobs are automated across the agriculture and manufacturing sectors. All of these factors will test Vietnam heading into the future but the primary challenge for policy-makers will be to allocate resources efficiently to ensure low debt, as well as inclusive and sustained growth.

The year 2019 signals a new era of policy and strategic direction in Vietnam. This report aims to serve as a strategic decision-making tool for leaders in government and business negotiating the new wave digital innovation and the next phase of economic development.

*Vietnam’s Future Digital Economy: Towards 2045* provides economic modelling for up to the years 2030 and 2045 for four potential scenarios of growth for Vietnam’s digital economy.

With a young and vibrant population, high investment and a location in the heart of high-growth Asian economies, Vietnam has a good chance of surging forward with the new digital tools available, if the transition is managed well.

This transformation will not come without risk, but the larger risk in these times of rapid change, is not transforming at all.

***“Mastering the digital economy creates an opportunity for Vietnam to maintain rapid and sustainable growth through the next phase of development. Strong leadership and institutions will be key in Vietnam’s development across all economic sectors including the private sector. Digital transformation resulting from this strong leadership will unblock bottlenecks to promote further economic development.”***

*Dr Nguyen Van Binh, Politburo Member, Secretary of Party Central Committee, Chairman of the Central Economic Commission*

***“The next 25 years represents a decisive window of opportunity for Vietnam to transition to a more digitalised economy and escape the middle income trap. The success and speed of that transition depends greatly on the profile of the workforce of today, and the workforce is ageing rapidly. Strong national leadership, institutions and policies are needed now to create collective upskilling – across the workforce and society – and enable a successful digital transformation.”***

*Mr Nguyen The Trung, Managing Director, DTT Group*



## Innovative joint project methodology

The **Vietnam’s Future Digital Economy Project** is an innovative joint venture between Vietnam’s Ministry of Science and Technology and CSIRO’s Data61 from Australia. This venture aims to identify significant trends, drivers of change, future scenarios and helpful actions to guide Vietnam’s decision makers through the next wave of digital innovation and industrial transformation.

The first report of the project, *Vietnam Today* (2018), examined the state of Vietnam’s macroeconomy and digital economy in 2018.

The present report, released in 2019, updates this research and examines the state of Vietnam’s economy and digital economy in early 2019 – with a particular focus on Vietnam’s agriculture and manufacturing sectors. The present report also examines the trends that will affect digital economy development in Vietnam up to 2045. The study explores how different rates of digital transformation could create four possible and plausible futures for Vietnam’s digital economy.

The content of this report comes from the people and field experts of Vietnam: those who participated in workshops, interviews and provided data and detailed comment on our analysis.

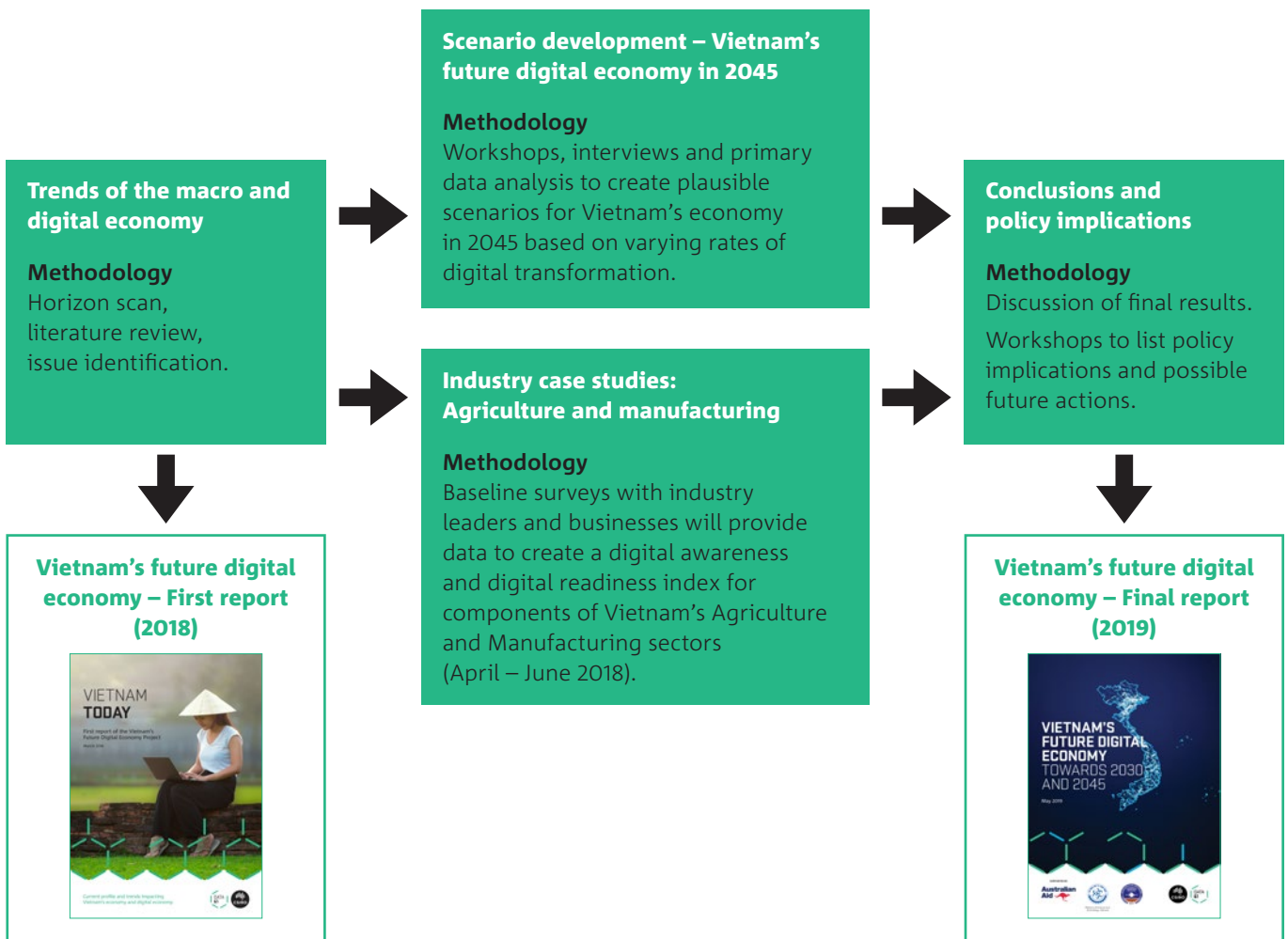


Figure 1 Methodology of the Vietnam’s Future Digital Economy Project

## Megatrends

Seven megatrends are expected to drive the development of Vietnam's future digital economy, leading to the four potential future scenarios described in this report.

1. **Emerging digital technologies:** Emerging digital technologies such as blockchain, Artificial Intelligence, big data analytics and the Internet of Things can leapfrog industry infrastructure upgrades, simplify supply chains and logistics and help businesses operate more efficiently.
2. **A smaller world – internationalisation:** The digital economy can benefit from international integration – by opening Vietnam to new export markets, knowledge and skills transfer, and greater levels of foreign investment.
3. **Increasing need for cybersecurity and privacy:** There is greater need for cybersecurity and privacy as more businesses and consumers engage in the digital economy, and as critical systems such as finance and government are increasingly digitalised.
4. **Modern digital infrastructure:** A strong digital economy requires reliable digital and energy infrastructure – especially for power-intensive technologies such as IoT or AI. New telecommunications networks are also needed to ensure broadband is available to carry the large amounts of digital data needed for new applications.
5. **The push to smart cities:** In a rapidly urbanising and ageing nation, smart cities provide opportunities to use infrastructure and resources more efficiently, as well as reduce waste, pollution and traffic congestion.
6. **Rise of digital skills, services, gigs and the entrepreneur:** Increasing demand for the services sector as well as digital products and services mean there is a need to invest further in higher education, digital skills, entrepreneurial skills and Vietnam's innovation ecosystem. Platforms and the trend away from secure, structured and long-term work is also driving the use of labour and product platforms for income generation and creative avenues for industrial transitions in labour markets.
7. **Changing consumer behaviours – digital tribes, influencers, higher value consumption:** Consumer behaviours are changing as the Asian middle classes emerge and orient to higher-value goods and services, including those from the digital economy. At the same time, higher digital adoption among consumers increases the influence of digital tribes and influencers – both on suppliers and consumer behaviour.

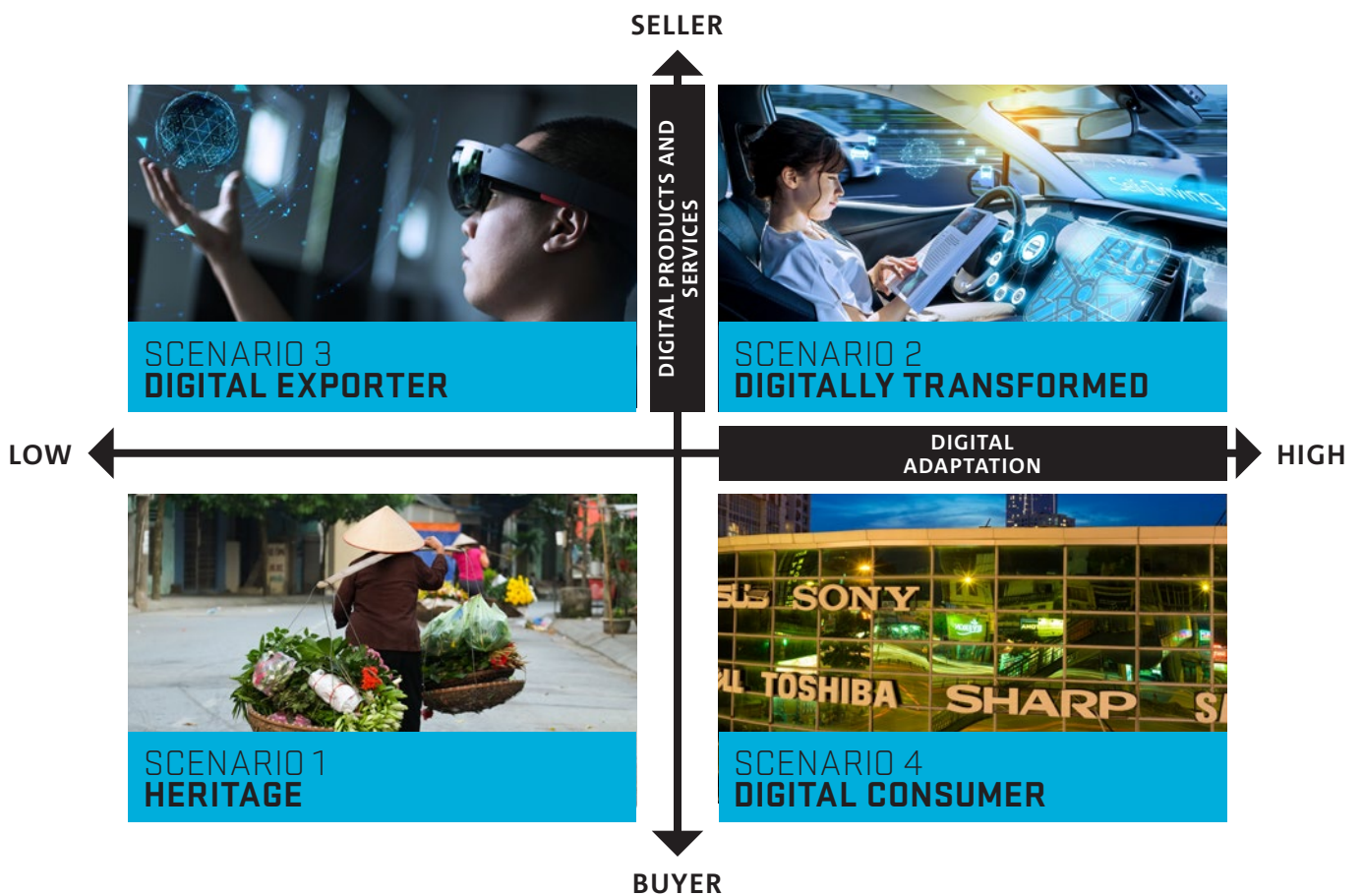


## Scenarios

From these megatrends we have created four future scenarios for Vietnam's digital economy in 2045. These will be determined by a range of external and internal factors, and have been created based along two axes:

- whether or not Vietnam is a net buyer or seller of digital products and services
- level of adaptation to new digital products and services across government, the community and industry.

The scenarios include modelling to estimate levels of job disruption across varying sectors, as well as potential impacts on Gross Domestic Product (GDP).



SCENARIO	EVENTS TO MAKE THIS SCENARIO OCCUR	BENEFITS	PRIMARY RISKS
<b>HERITAGE</b>  <i>Low levels of digital transformation and small ICT industry.</i>	<ul style="list-style-type: none"> <li>• Economic crisis – internal, regional or global</li> <li>• Low investment in digital skills and infrastructure – both energy and telecommunications</li> <li>• Community resistance to change in traditional practices and values</li> </ul>	<ul style="list-style-type: none"> <li>• Low investment and initial debt accumulation</li> <li>• Many people continue to lead a traditional lifestyle</li> <li>• Less risk of cyber attacks due to large remaining cash economy</li> </ul>	<ul style="list-style-type: none"> <li>• Low productivity leading to the loss of economic competitiveness, and increased relative poverty across the population</li> </ul>
<b>DIGITALLY TRANSFORMED</b>  <i>Major digital transformation across all industries and government services. Growth in exports of ICT products and services.</i>	<ul style="list-style-type: none"> <li>• Stable economic conditions – internal and external to Vietnam</li> <li>• High levels of investment in skills, infrastructure and industrial transformation</li> <li>• Broad transformation policies and regulatory reform</li> </ul>	<ul style="list-style-type: none"> <li>• Transformation to a more service-based economy</li> <li>• Increased productivity</li> <li>• Relatively inclusive growth</li> </ul>	<ul style="list-style-type: none"> <li>• Cybersecurity and the threat of nation-wide cyber attacks</li> <li>• Over-borrowing to pay for supporting infrastructure and training leading to a large national debt</li> <li>• Transition issues related to jobs displaced by automation</li> <li>• Inequality (rural-urban)</li> </ul>
<b>DIGITAL EXPORTER</b>  <i>Slow industrial transformation but fast growing pockets of ICT industry. Overseas companies use Vietnam ICT workers due to their low-cost labour.</i>	<ul style="list-style-type: none"> <li>• Low or fluctuating of levels national growth due to varying economic conditions</li> <li>• Limited and targeted investment in skills and infrastructure by government and/or industry</li> <li>• Take-up of the use of global labour market platforms to sell ICT goods and services</li> </ul>	<ul style="list-style-type: none"> <li>• Lower investment requirements than the Transformed Scenario</li> <li>• Export increase in ICT-related sectors</li> <li>• Transitioning slowly to a knowledge-based economy</li> </ul>	<ul style="list-style-type: none"> <li>• Inequality in a two-speed economy</li> <li>• Labour productivity is still low across most of Vietnam and most industries lose competitiveness</li> <li>• Vietnam remains in the middle income trap</li> </ul>
<b>DIGITAL CONSUMER</b>  <i>Broad industrial transformation across Vietnamese industry, but ICT industry has struggled and ICT exports are not a significant component of Vietnam's exports.</i>	<ul style="list-style-type: none"> <li>• Stable economic conditions</li> <li>• Broad investment in digital transformation across industry</li> <li>• Growth and investment in energy and telecommunications infrastructure</li> <li>• Importation of most digital products and services</li> <li>• Greater focus and investment in non-digital sectors such as mining and agriculture</li> </ul>	<ul style="list-style-type: none"> <li>• Inclusive growth and improvements in services</li> <li>• Increased productivity</li> <li>• Leverages Vietnam's traditional market strengths – such as agriculture, mining and tourism</li> </ul>	<ul style="list-style-type: none"> <li>• Cybersecurity with little internal capacity to build secure systems</li> <li>• Lack of adequate human resources to leverage the full impact of digitalisation in most sectors</li> <li>• Reliance on external companies to provide ICT products and services – allowing greater foreign influence in labour and product markets</li> <li>• Over borrowing for infrastructure and industrial transformation leading to large national debt</li> </ul>

Source: Data61 analysis  
Note: GDP measured in real US\$, 2005 prices.



ACCUMULATED ADDITIONAL GDP  
**US\$60.9 billion**  
over 27 years



IMPACT ON ANNUAL GROWTH  
**0.38%**



CURRENT JOBS AT RISK OF TRANSFORMATION OR DISRUPTION  
**18.4%**



ACCUMULATED ADDITIONAL GDP  
**US\$168.6 billion**  
over 27 years



IMPACT ON ANNUAL GROWTH  
**1.1%**



CURRENT JOBS AT RISK OF TRANSFORMATION OR DISRUPTION  
**38.1%**



ACCUMULATED ADDITIONAL GDP  
**US\$66.9 billion**  
over 27 years



IMPACT ON ANNUAL GROWTH  
**0.45%**



CURRENT JOBS AT RISK OF TRANSFORMATION OR DISRUPTION  
**19.1%**



ACCUMULATED ADDITIONAL GDP  
**US\$102.8 billion**  
over 27 years



IMPACT ON ANNUAL GROWTH  
**0.63%**



CURRENT JOBS AT RISK OF TRANSFORMATION OR DISRUPTION  
**28.9%**

## Ways forward

The megatrends identified in this report provide the evidence to imagine change into the future, and the scenarios are designed to help challenge thinking to expand expectations to allow for contingencies to be created.

The Vietnam of 2045 may contain elements described in all scenarios. Visualising the developments and mitigating for risks will ensure the country is stronger and more resilient as it moves through the latest wave of digital innovation.

To mitigate risks and grow the digital economy under all scenarios, a number of actions have been proposed under six broad areas.

The size, focus and distribution of Vietnam’s future digital economy in 2045 will depend on, to some extent, the investment, regulatory and reform decisions that are made today by both the Government and private sector. The country is at a crucial point in economic strategy and development.

By navigating the opportunities, risks and potential outcomes, we are optimistic that Vietnam’s current focus on Industry 4.0, the development of ICT sector, and broader social and economic reform will continue the trend towards a more stable and prosperous Vietnam over the next 25 years.

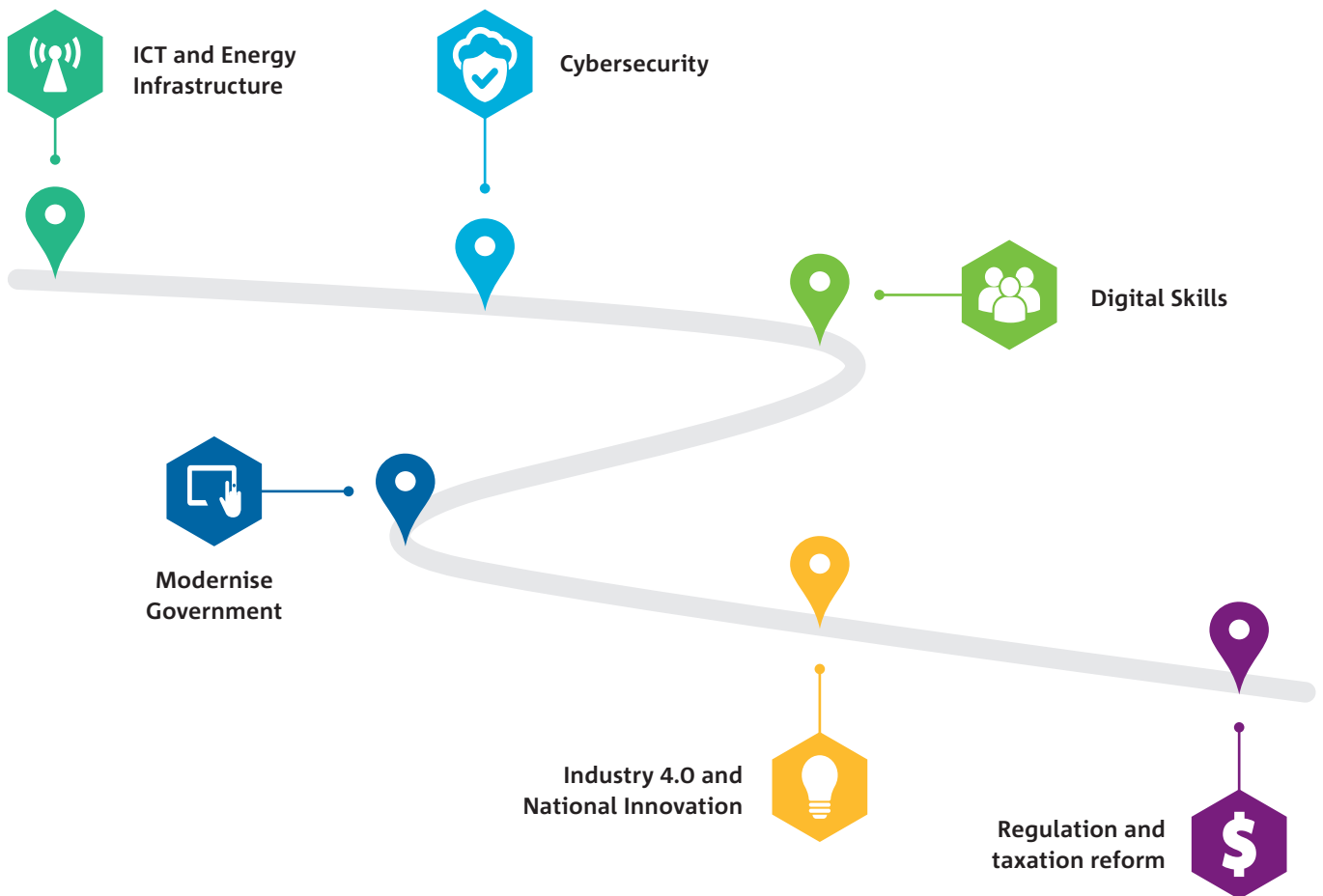


Figure 2 Priority areas for development of Vietnam’s future digital economy

Source: Data61 analysis



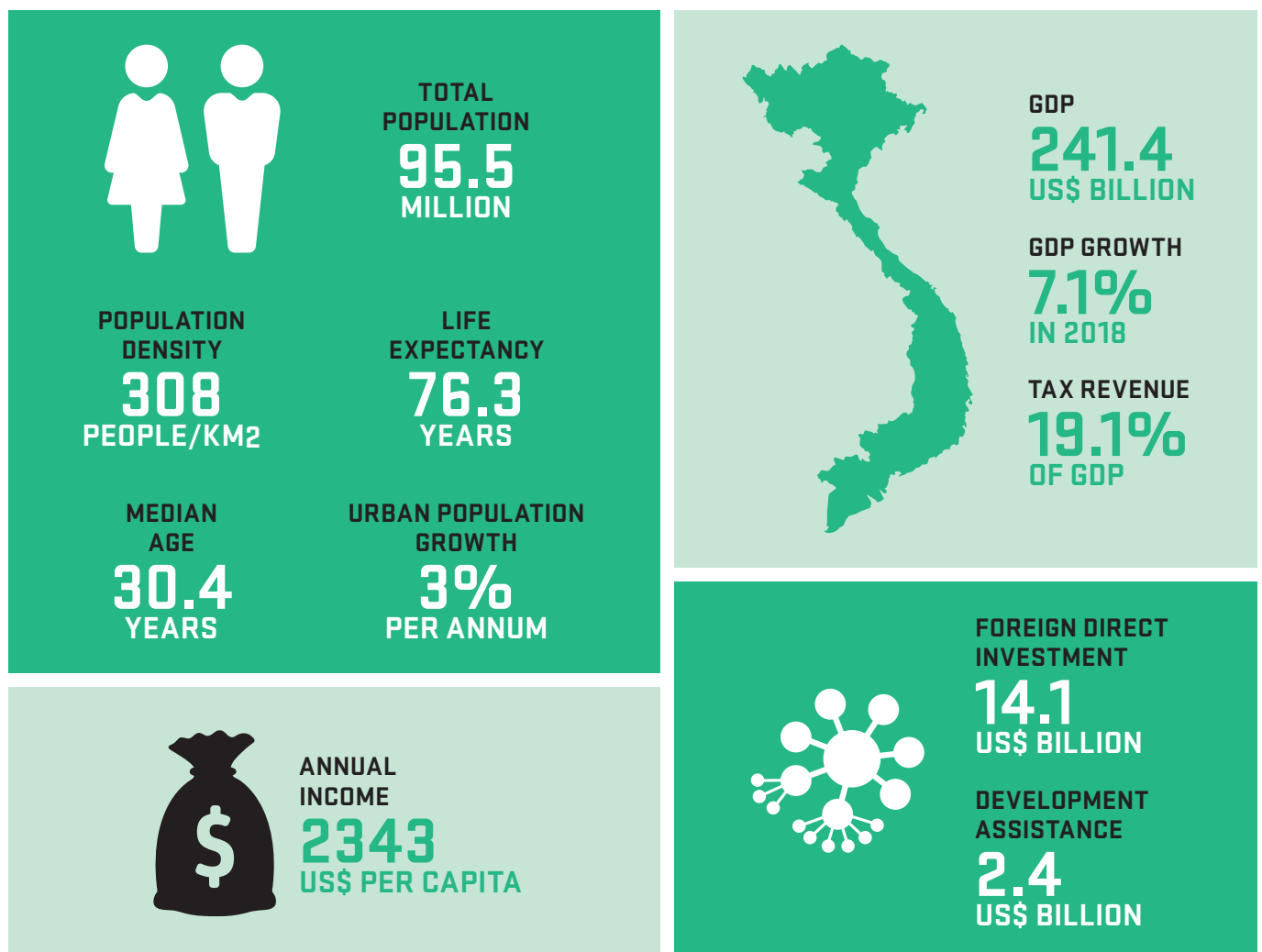
PART I  
**VIETNAM TODAY AND  
THE DIGITAL ECONOMY**

# 1 VIETNAM ECONOMIC OVERVIEW – A DEVELOPMENT SUCCESS STORY

Vietnam’s transformation from one of the world’s poorest countries in the 1980s to middle income status by 2010 is celebrated as an economic success. The economic situation in the 1980s was dire – with the country’s development stalled for over a century due to various wars and the French colonial era. Through peace and unity, Vietnam

was able to determine its own path. In 1986, the Doi Moi reforms opened the economy and attracted high levels of foreign investment into the country. Since the 1990s, Vietnam has seen nearly the world’s fastest GDP and GDP per capita growth rates. This growth has been remarkably inclusive, with millions being lifted out of poverty.

## VIETNAM TODAY: ECONOMY AT A GLANCE



Source: UN World Population Prospects, World Bank Development Indicators, IMF World Economic Outlook database.

## 1.1 Economic trends – From Doi Moi to Vietnam today

In 1986 the Doi Moi reforms gave Vietnam a new direction. The reforms moved the country away from a centralised economy and set it on a path to a liberalised and open market-based economy with high levels of foreign direct investment. The direct impacts of the reforms lifted Vietnam’s GDP by 42% by 1998.<sup>20</sup> Since the 1990s, these reforms have enabled remarkable levels of inclusive growth benefiting all sectors of society.<sup>21</sup>

The nation is also continuing its negotiations for Free Trade Agreements (FTAs). By early 2019, Vietnam had successfully processed 16 FTAs (12 signed and 4 under negotiation), developing trade opportunities with over 60 countries in the world (15 of which belong to the G20). This includes the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), which came into effect in Vietnam in January 2019.

In 2011, Vietnam renewed its commitment to market-led development and modernisation through the *Socio-economic development strategy 2011-2020*. To achieve further investment and market development, the national government is focusing on innovation and promoting skills, improving market institutions and maintaining infrastructure investment.

**Many of the economic trends set by the Doi Moi reforms continue to drive the economy today.**



**Figure 3** Timeline of Vietnam’s achievements from the reunified era to Vietnam today

Adapted from: Green ID Vietnam<sup>22</sup>

## ASTONISHING ECONOMIC GROWTH

The most prominent feature of Vietnam’s economy since the 1990s is its astonishing economic growth. From 2000 to 2015 the country’s average GDP growth was 6.9% per year – nearly the highest average growth rate in the world.<sup>23</sup> In 2018 Vietnam achieved 7.08% GDP growth, the highest since 2011 and far beyond the predicted growth for 2018 (6.8%).<sup>24,25</sup>

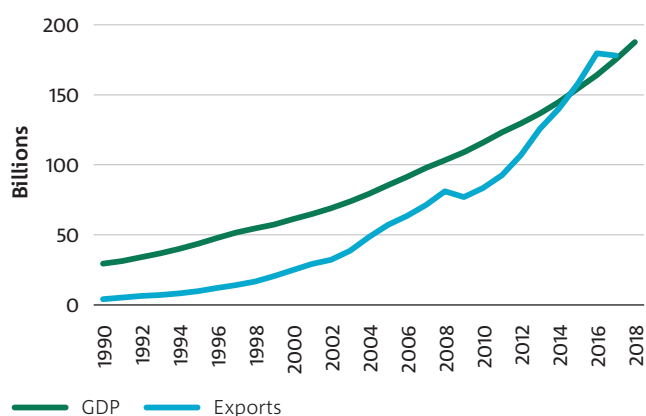


Figure 4 Vietnam GDP and exports (constant 2010 US\$), 1990-2018

Source: World Bank,<sup>26</sup> General Statistics Office,<sup>25</sup> Data61 analysis

## GDP PER CAPITA RAPIDLY RISING FROM A LOW BASE

While Vietnam came close to the world’s highest average annual growth in GDP per capita between 1990 and 2017 (at 6.8%),<sup>26</sup> Vietnam’s GDP per capita remains relatively low. Since Vietnam’s wealth per capita is rising from a low base, the nation has seen almost no progress in catching up to other countries (see Figure 5). In 2018, GDP per capita stood at US\$2,587, an increase of US\$198 from 2017.<sup>25</sup>

## THE NON-STATE SECTOR AND FOREIGN DIRECT INVESTMENT AS AN ENGINE FOR GROWTH

According to the Ministry of Planning and Investment, the non-state sector (including collective, private and household businesses) contributed 41.7% to total GDP in 2017, with goals to contribute 50% by 2020.<sup>27,28</sup> Comparatively, state owned enterprises (SOEs) contributed 28.6% in 2017, and foreign direct investment (FDI) firms contributed 20% in 2018.<sup>27,29</sup>

Recognising the growth potential of private enterprises, the Vietnam government has fully or partially privatised thousands of SOEs since the beginning of the Doi Moi reforms. By 2016, Vietnam had restructured 5,950 SOEs, equitising 4,460 of them. In the 2016-2020 period, the government plans to equitise 240 SOEs. By the end of 2018, however, only 123 SOEs were equitised, showing slower momentum than in the past. The private sector now represents the bulk of the nation’s labour force and over 95% of Vietnam’s more than 560,000 enterprises.<sup>27</sup>

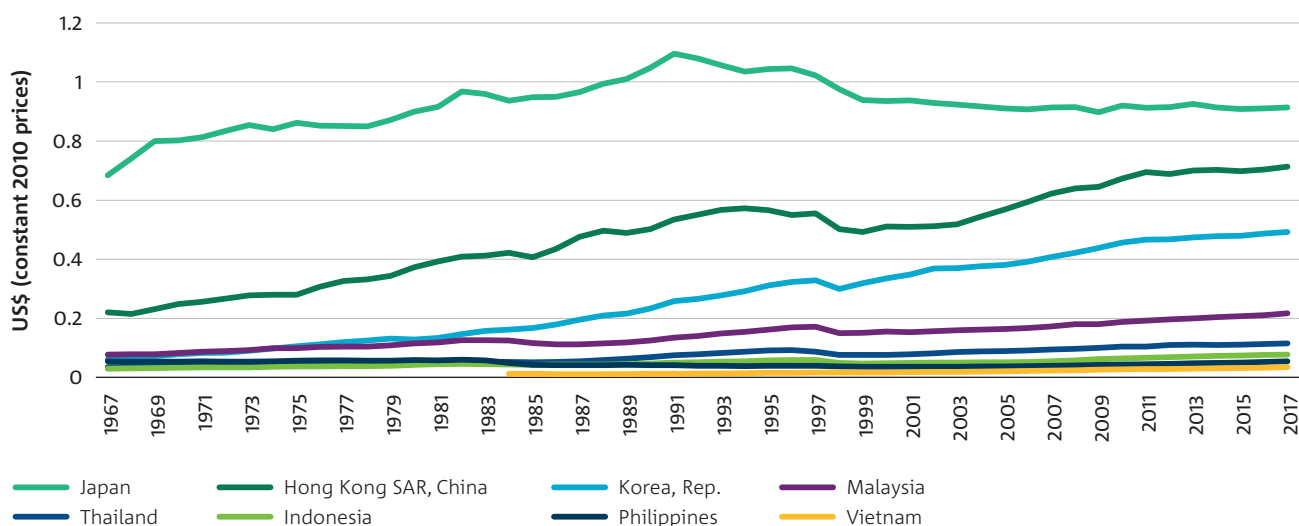
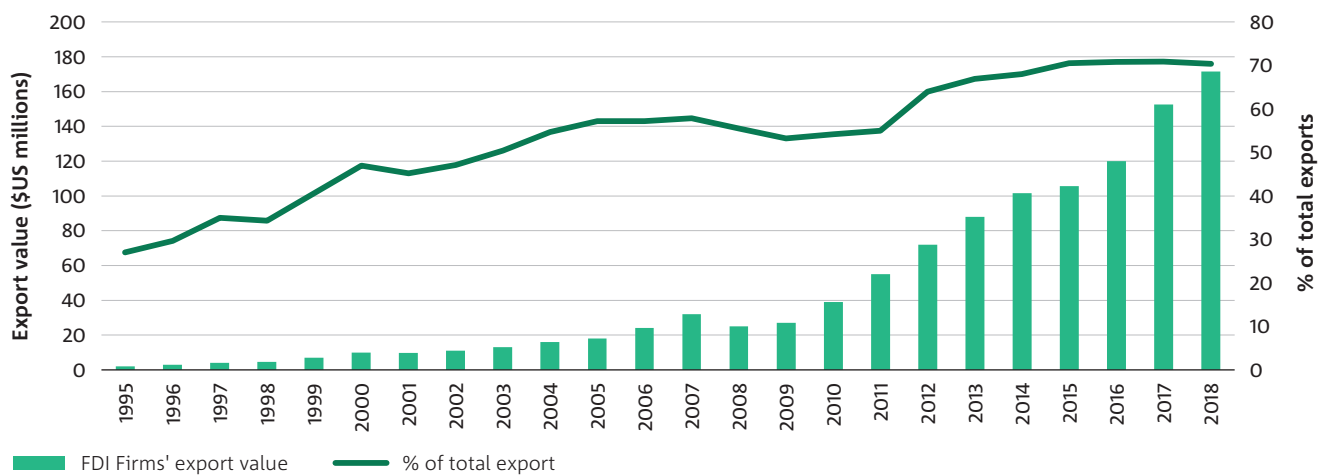


Figure 5 Real GDP per capita relative to US\$ at constant 2010 prices, 1967-2017

Source: World Bank,<sup>26</sup> Data61 analysis





**Figure 6 Foreign-invested firms' export value and proportion of total exports, 1995-2018**

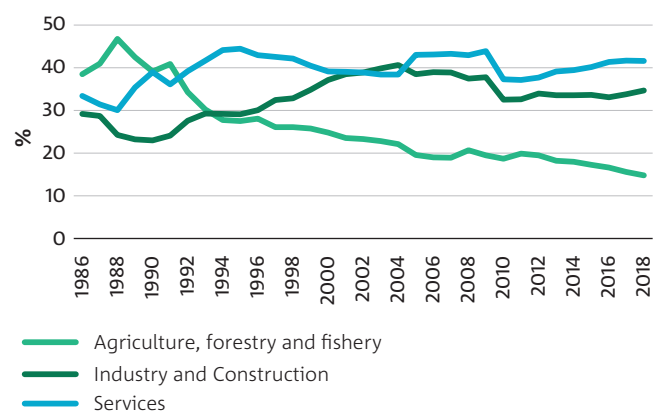
Source: World Bank,<sup>26</sup> Vietnam Customs<sup>32</sup>

FDI is another driver of Vietnam's economy. While FDI is a small component of total GDP, it plays a critical role in attracting capital and expertise to value-added industries in Vietnam. In the last three decades Vietnam disbursed US\$154.5 billion (about 50% of total FDI-registered capital), accounting for approximately 20% of total investment in Vietnamese industry).<sup>30</sup> The mining and quarrying sectors have traditionally been the main beneficiaries of FDI, but now the main beneficiaries are the manufacturing and processing industries.

The attraction of FDI into Vietnam improves the country's overall reputation as a destination for industrial investment and capital. Vietnam is attractive to international investors as an emerging market, and ranks highly on international investment tables.<sup>31</sup> The attraction of FDI is closely linked to increased exports – with 70.4% of total exported goods created by FDI firms in 2017.<sup>32</sup>

### FROM AGRICULTURE TO MANUFACTURING AND SERVICES AS DRIVERS OF GDP

Over the past two decades agricultural production has contributed steadily less as a proportion of GDP, while industry grew over the same period. The services sector is, however, the largest contributor to national output, accounting for over 40% of total GDP.<sup>33</sup> Vietnam aims to improve the combined contribution of industry and services to 85% of total GDP by 2020.<sup>34</sup>



**Figure 7 Value added to Vietnam GDP (%) by economic sector, 1986-2018**

Note: After 2010 the data includes “products/taxes/subsidies on production” as a separate contribution to GDP, which is not represented on this Figure. Therefore values after 2010 do not add to 100%.

Source: General Statistics Office of Vietnam<sup>23</sup>

## THE INCREASING VALUE OF VIETNAM'S EXPORTS AND THE CHEAP LABOUR TRAP

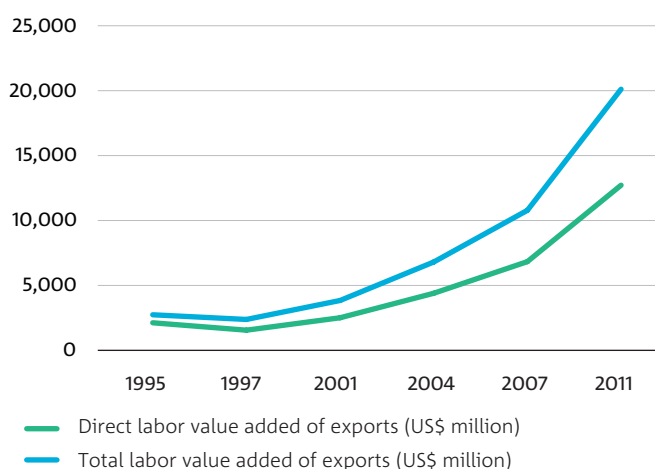
Vietnamese exports have grown rapidly since 1990 (see Figure 4). By 2014 Vietnam had become the 26<sup>th</sup> largest exporter of merchandise in the world.<sup>26</sup> In 2017 imports and exports reached a record US\$425 billion in value, an increase of 21% from 2016.<sup>32</sup>

Exports have created many jobs in Vietnam – both directly and indirectly – as seen in the increase in labour valued-added after 1995 (see Figure 8). However, Vietnam's comparative advantage for exports is mostly based on labour costs. This has created a cheap labour trap, with Vietnam mostly doing outsourced work with little value-added. Furthermore, Vietnam's exports have relied on supporting industries from China, including accessories for advanced technology, garments and footwear. These factors make improving Vietnam's position in global value chains difficult.

## PRODUCTIVITY GAINS – GOOD BUT STALLING AND BEING OUTPACED

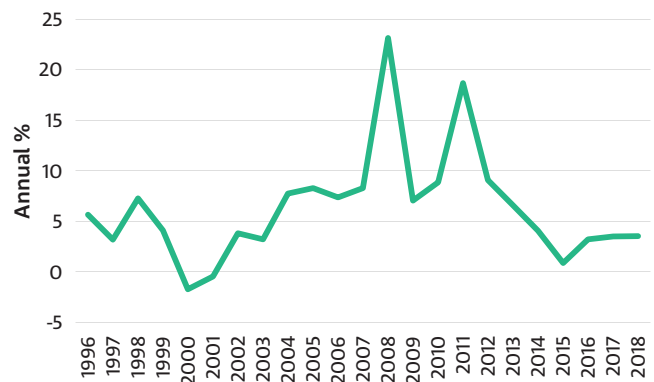
In the past three decades Vietnam has seen the highest labour productivity growth rate among the ASEAN nations.<sup>33</sup> Since 2011 labour productivity has grown on average by 4.7% per year, with a 6% rise in 2017 to US\$3,987 per worker.<sup>33</sup> This high growth has come from a low base however, and overall Vietnam's labour productivity is lower than that of the other ASEAN nations.<sup>26</sup> Moreover, the gap has widened in the past ten years.<sup>26</sup> Productivity will need to grow strongly in the future for Vietnam to remain competitive.

**In the past thirty years Vietnam's economy has also been resilient in the face of threats to macroeconomic stability.**



**Figure 8 Increasing labour value-added of export products in Vietnam, 1995-2011**

Source: World Integrated Trade Solution<sup>35</sup>



**Figure 9 Vietnam inflation, consumer prices (annual %), 1996-2018**

Source: World Bank<sup>26</sup>

## PUBLIC AND PRIVATE DEBT LEVELS RISING

Public and private debt in Vietnam has been growing over the last five years. Public sector debt levels were 61.3% of GDP at the end of 2017, up from 45.8% in 2011.<sup>36</sup> Investing in infrastructure while managing debt will remain a challenge for Vietnam as the economy expands and the population urbanises. Private sector debt is also growing rapidly, with total debt (public and private) reaching 124% of GDP by the end of 2016 – exceeding the ASEAN-5 countries (Malaysia, the Philippines, Singapore, Indonesia and Thailand), other middle income countries and other countries at comparable stages of development.<sup>37</sup>

## CURRENCY DECREASING AGAINST THE US\$, AND INFLATION VOLATILE

The Vietnamese Dong (VND), the currency of Vietnam, has depreciated by approximately 30% against the US dollar (US\$) over the last ten years. This period has also seen wild fluctuations in inflation (measured by the consumer price index). Inflation was above 20% in 2008, and just over 18% in 2011. Inflation has decreased substantially since 2011, and the State Bank of Vietnam and government officials have stated publicly they will use monetary policy to keep inflation below 4% over the coming years.<sup>38,39</sup> Inflation has been managed well since 2015, and reached only 3.5% in 2017.<sup>33</sup>

## 1.2 Vietnam in 2019 – A leading emerging market

Today, Vietnam is considered by some as the world's leading emerging market.<sup>40</sup> The country's development story is still unfolding, however. With aspirations to reach upper-middle income status by 2035,<sup>41</sup> the country is looking to the digital economy to power the next era of growth.

# 2 CONCEPTUALISING

## THE DIGITAL ECONOMY

### 2.1 What is the digital economy?

The 'digital economy' is notoriously hard to define and measure, with definitions from diverse organisations such as the Organisation for Economic Co-operation and Development,<sup>42</sup> G20<sup>43</sup> and the Oxford Dictionary<sup>44</sup> varying in breadth and scope.

This study will adopt a broad definition of the digital economy:

*All businesses and services that have a business model based primarily on selling or servicing digital goods and services or their supporting equipment and infrastructure.*

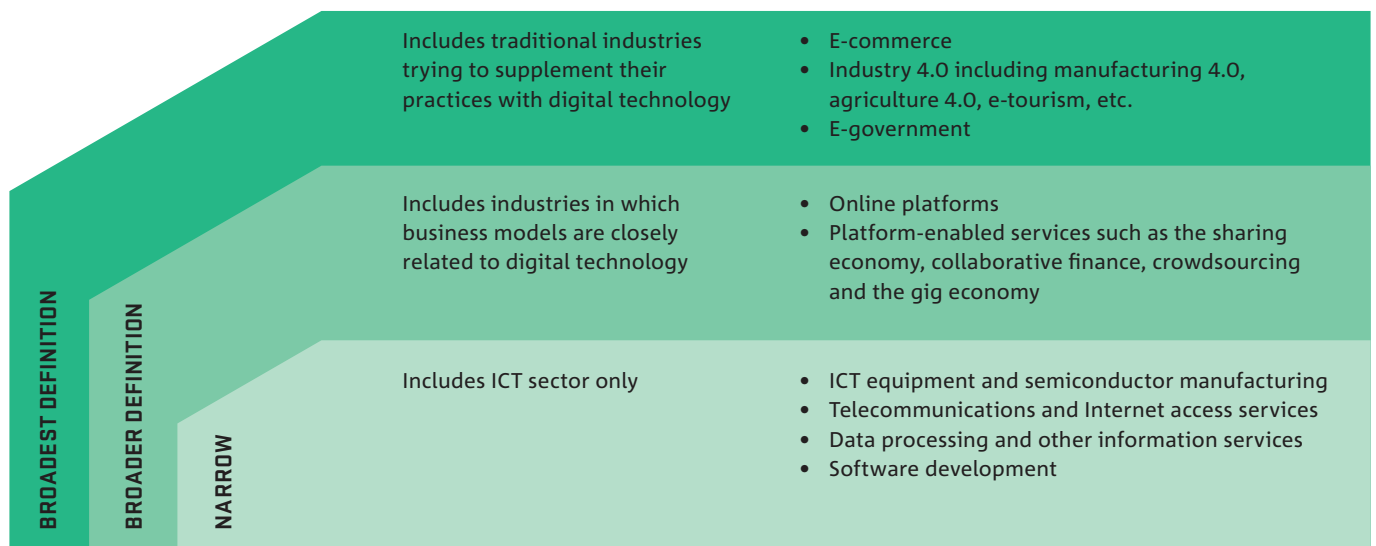
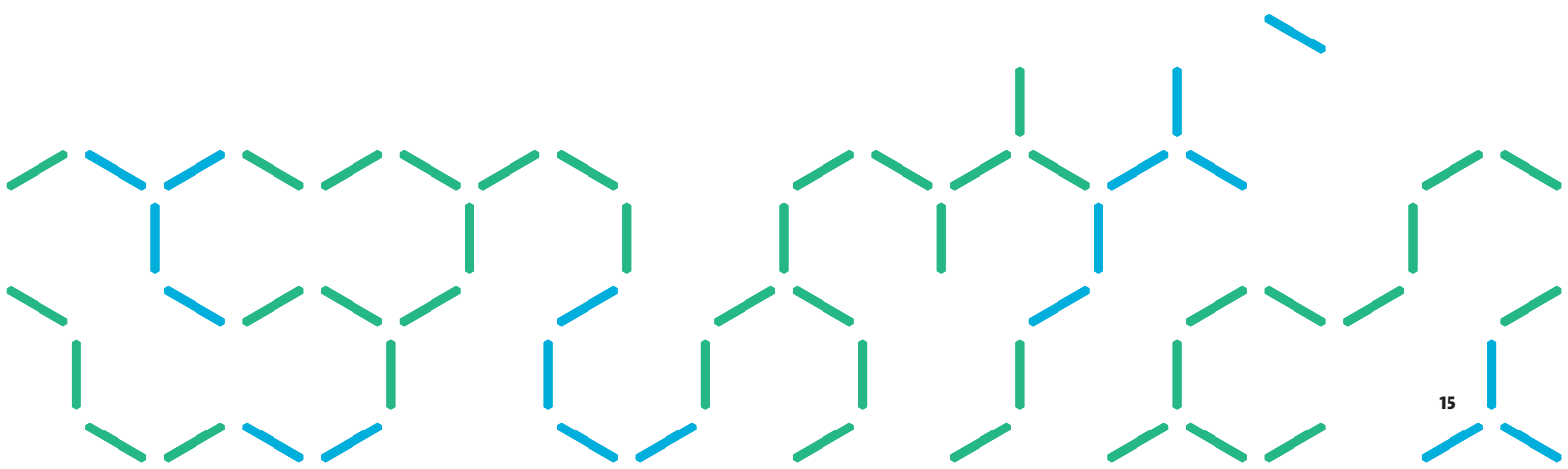


Figure 10 Broadest and narrowest definitions of the digital economy

Adapted from: Buhkt and Heeks<sup>45</sup>



Compared to the traditional economy, there are several novel features of the digital economy:<sup>46,47</sup>

- **Data as the source of value in the digital economy:**  
The increase of digital technologies means that data can now be collected from many sources: from smartphones to millions of sensors in factories, traffic vehicles and individuals. These massive data flows, together with big data analytics, can generate value in all private and public activities.
- **The advance of ICT-related hardware and software:**  
The digital economy is the result of the development of new digital technologies – such as robotics, Internet of Things and digital platforms– that have transformational effects beyond the ICT sector. The transformation cuts across all sectors, from finance to transport, manufacturing, media, education, healthcare and others.
- **New business models that both enable and disrupt businesses:** Businesses models based on digital platforms allow various groups of people to interact, thereby creating network effects and increasing efficiency due to reduced transaction costs. E-commerce, for example, facilitates orders of goods and services that can be delivered through conventional channels or completely electronically. Online advertising is another emerging area where the Internet becomes a medium to deliver precise targeted messages to segmented customers. Meanwhile the sharing economy offers individuals job opportunities and access to underutilised assets and services.
- **New role of consumers:** Digital technology has put consumers on the centre stage. The ability to communicate and share reviews with others not only changes the purchasing experiences of customers, but also significantly affects business reputations. The Internet also empowers consumers with a new way of creating and sharing ideas. Consumers may become a significant new source of innovative ideas for producers.

With these distinct features, the benefits of the digital economy for emerging economies are potentially enormous.

The widespread diffusion of the digital technologies can assist firms optimise processes, reduce transaction costs, transform supply chains, improve productivity and develop new industries. For consumers, the benefits lie in the ability to be connected and access customised and diverse goods and services at competitive prices. Government also benefits from the implementation of e-government, as it provides more efficient alternatives to traditional governance, and new solutions for national problems such as universal healthcare, urban management and climate change. However, economies need to work hard to understand and remove barriers to digital transformation in order for these benefits to be realised at scale.



## Stakeholder interview

**Associate Professor Nguyen Duc Thanh** – President of the Vietnam Institute for Economic and Policy Research (VEPR), University of Economics and Business, Vietnam National University, Hanoi

**The future of Vietnam will be changed dramatically by digital transformation**

### CHANGES IN THE VIETNAMESE POPULATION

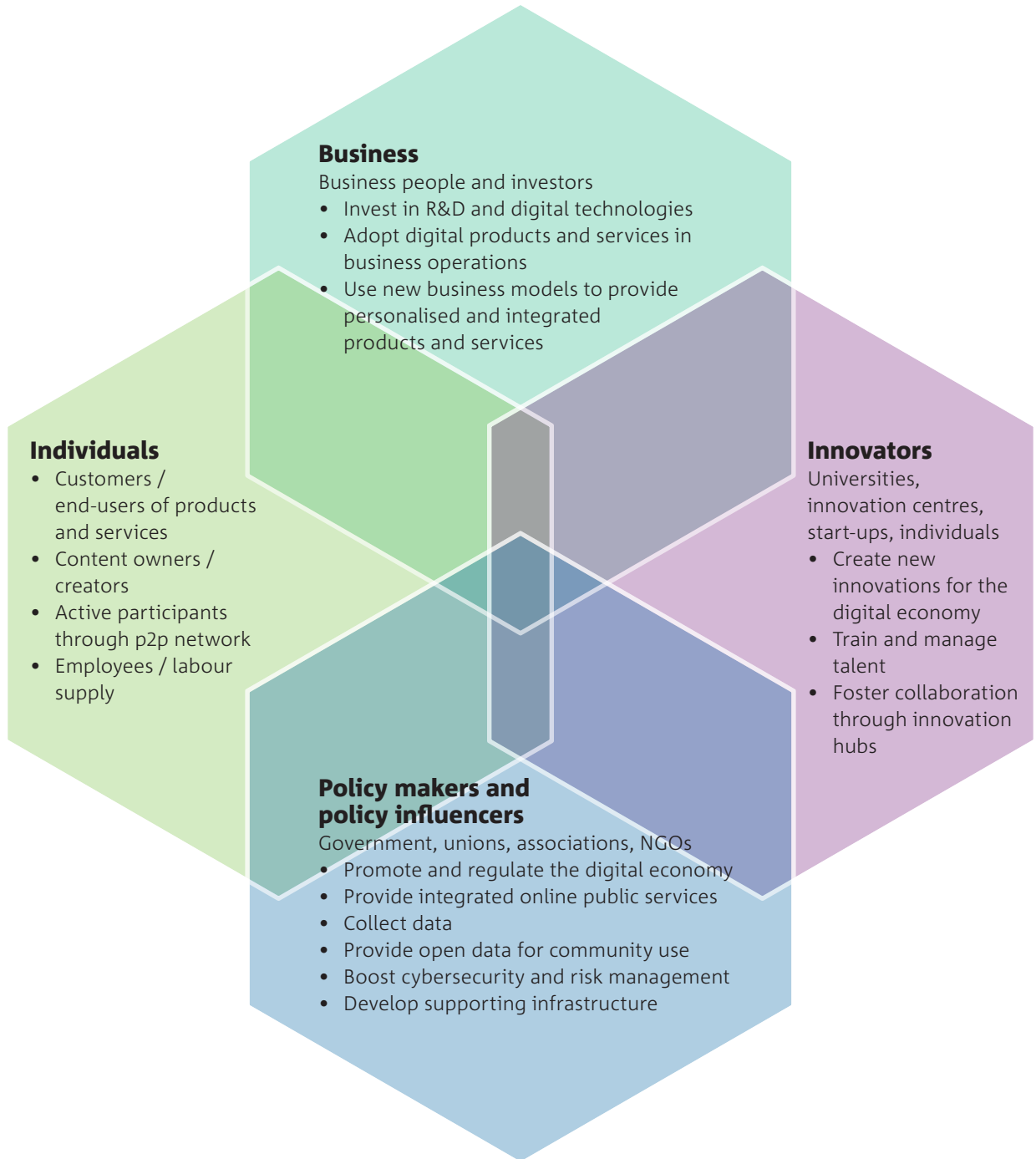
Along with the development of the Internet and social media, the young population of Vietnam will become better informed and well-off – pushing the government toward better governance. The application of digital technology in governance would become an irreversible trend to support the government to manage and respond to this population.

The young population, with different consumption patterns such as the quick adoption of mobile and Internet-based facilities, will create high demand for digital transformation.

### THE INSTITUTIONAL SETTING, EDUCATION AND LANGUAGE COULD HELP VIETNAM CREATE A BREAKTHROUGH IN DIGITAL TRANSFORMATION

Institutional and legal frameworks play important roles in digitalisation. The appropriate policies in copyright, Intellectual Property rights and liberalising the market for scientific research could create breakthroughs for Vietnam in digital development.

English and education are both key to successful integration and digital transformation. Traditional education could be changed by other forms such as online education, home schooling and self-education.



**Figure 11 Digital economy stakeholders**

Source: Data61 analysis

## 2.2 Other definitions related to the digital economy

### DIGITALISATION

According to the International Monetary Fund digitalisation “**encompasses a wide range of new applications of information technology in business models and products that are transforming the economy and social interactions.**”<sup>8</sup> Digitalisation rapidly transforms businesses, particularly as they incorporate data and the Internet into production processes.

### INDUSTRY 4.0

There is a long history of industries, particularly manufacturing, being revolutionised by waves of new technology. In the early 1800s, the First Industrial Revolution started the transition from hand production methods to machine production powered by steam and water engines. The Second Industrial Revolution introduced electricity, assembly lines and mass production to industry. The third wave, or the Digital Revolution, started to harness the power of computers and automation in manufacturing.

Industry 4.0 is the next, and possibly most dramatic, wave of digital and online transformation. It is likely to change the structure and dynamics of many industries through further automation, cyber-physical systems, big data analytics, sensor networks, cloud computing, Artificial Intelligence and the Internet of Things.

Two concepts associated with Industry 4.0 are Manufacturing 4.0 and Agriculture 4.0.

### MANUFACTURING 4.0

The 4.0 factory will have machine-to-machine communication, Artificial Intelligence to enable machines to automatically make routine production decisions, and big data analytics to provide human operators with rich data to inform complex decision making. Analytics can forecast consumer demand, predict machine failures, evaluate production quality in real-time, and help optimise the entire production process.<sup>48</sup>

Operations management within factories will be seamlessly linked to market intelligence and analytics, with greater ability for consumers to order customised low-volume products directly from the factory. Supply chains and distribution can also be assessed, communicated with and adjusted based on varying market conditions and consumer demand. This will result in greater responsiveness, efficiency and agility in getting products to market, and reducing production waste.<sup>49,50</sup>

### AGRICULTURE 4.0

The agriculture sector is set to see radical change through the implementation of Agriculture 4.0, also called ‘smart agriculture’ or ‘precision agriculture.’

Agriculture 4.0 optimises crop inputs based on actual crop needs with the aid of technologies such as GPS, remote sensing networks and the Internet to create cyber-physical systems.<sup>51</sup> These systems can provide real-time intelligence on soil conditions, plant and animal needs, weather conditions, crop yield and market demand. This information can dramatically improve yields, nutritional value, animal welfare and systems waste.<sup>52</sup>

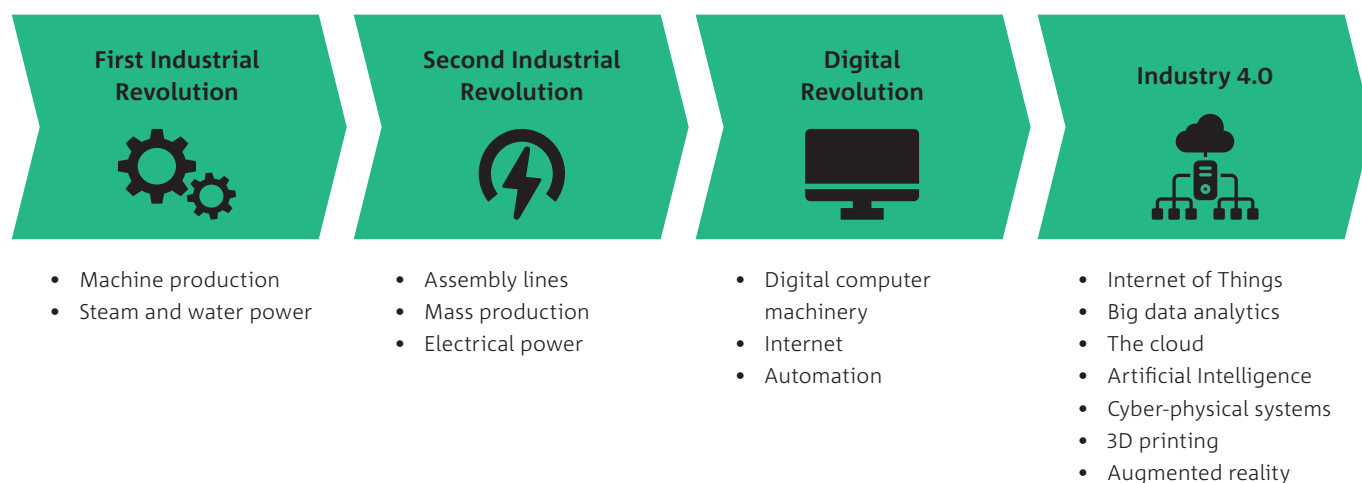


Figure 12 Stages of industrial revolution

Agriculture 4.0 can also harness blockchain distribution networks. Blockchain can provide paddock-to-plate visibility of food available in shops. This can increase consumer trust in Vietnamese produce, and improve value-added components of food – such as nutritional value, geographic sourcing, animal welfare and ‘organic’ attributes.<sup>53,54</sup>

Agriculture 4.0 has begun to be implemented in Vietnam’s rural areas, especially with high value-added products

such as aquaculture, flowers and fruits. For example, in 2016 a wireless sensor network was set up in a Vietnamese fish farm in Dong Thap Province, next to the Mekong River, to control water quality and prevent fish diseases. If implemented more widely, real-time monitoring on fish farms could help cut production losses by 40-50%, equating to a difference in turnover for each farm of at least US\$12,000 every six months.<sup>55</sup> Similar projects are being conducted across the country, with support from government policy and low interest loans.



## Case study

### Data-driven management of diseases on shrimp farms

**The Challenge:** Vietnam is a global leader in shrimp farming. The Ministry for Agriculture and Rural Development has set goals to sustainably grow shrimp farm exports from US\$3.85 billion in 2018 to US\$10 billion by 2025. To achieve this goal Vietnam’s shrimp farmers need to reduce stock losses from the multiple shrimp diseases that currently cost the global industry US\$6 billion per year. Vietnam’s shrimp farmers are working hard to reduce disease losses and their reliance on chemicals, antibiotics and probiotics. The inability to rapidly detect bacterial and viral shrimp diseases, however, poses an ever-present threat to the livelihoods of Vietnam’s shrimp producers and associated national export revenues

**The Solution:** *Shrimp MultiPath* testing, developed at the CSIRO, and commercially available from Genics Pty Ltd, is a high-throughput biotech solution that detects 13 diseases in a single test. This creates unrivalled speed, accuracy and sensitivity in shrimp disease testing. By using this test producers can reduce diseased stocks and maximise sustainable yields. Early and rapid tests also minimise the use of chemical, antibiotic and probiotics.

*Shrimp MultiPath* generates in excess of 600 data points per sample compared to a single data point using current methods. These data are stored in a cloud hosted database that is readily accessible for regional and national level disease surveillance. An essential component of a blockchain based provenance system, *Shrimp MultiPath* delivers enhanced food security via traceable food quality and identification. This will raise the standard of quality assurance globally and give Vietnam a market edge on brand value of exported shrimp product.

**Expected Results:** Lam Dinh, Business Development Director, Viet-Uc Group, has said that: “The data generated by *Shrimp MultiPath* will drive significant commercial benefits to shrimp farming in Vietnam through improved productivity and increased product quality. When fully commercialized and combined with national data analytics and blockchain distribution systems, *Shrimp MultiPath* will help transform our US\$3 billion national shrimp farming industry to the Government value target of US\$10 billion by 2025.”

# 3 THE PREMISE FOR DEVELOPING VIETNAM'S DIGITAL ECONOMY

Along with the promise of Industry 4.0, the broader digital economy has boomed and strengthened the global economy. The digital economy is an opportunity for developing countries, including Vietnam, to shorten their development gap with rich countries. While there are many challenges, Vietnam has many advantages to foster the digital economy.

## 3.1 Benchmarking Vietnam in the international economy

In some areas relevant to the digital economy, Vietnam is leading the world:

- **5G networks** – Vietnam is one of the first countries in the world to trial 5G, with a commercial launch scheduled for 2021.
- **High school student performance** – international rankings place Vietnamese students on par with or above high income nations in science, reading and maths.<sup>56</sup>
- **Affordable Internet** – Vietnam offers the lowest fixed broadband prices (in PPP\$) in the Asia Pacific region.<sup>57</sup>

A regional comparison (between Vietnam, Indonesia, Thailand and the Philippines) of performance in business and innovation, human development, digital infrastructure and digital economy can be found in Table 1. Relative to other nations, Vietnam's strongest areas are high technology exports and performance on the Global Innovation Index.

In many other respects, it appears Thailand is leading the pack. This is consistent with Thailand's income status (upper-middle) which is higher than the three other nations (lower-middle income status).

## 3.2 Policies supporting the digital economy in Vietnam

The Vietnam Government views digital transformation across the broader economy as critical to continued growth and prosperity. At the moment, multiple agencies are charged with supporting and regulating different aspects of the digital economy in Vietnam. The current regulatory framework consists of commercial regulations and decrees issued by various ministries. Currently for telecommunications and ICT industry related issues, the Ministry of Information and Communication is the main agency. Other agencies involved in supporting the digital economy in different areas in Vietnam can be seen in Figure 13.

A single unified agency or ministry may be able to strongly promote, regulate, and implement all activities related to digital economy development. This agency may be able to officially recognise the digital economy's existence in the broader digital economy and create consistency, synchronisation and feasibility in the amendment, formulation and implementation of the policies, programs and plans for the digital economy. The policies should be updated as new Free Trade Agreements are signed and implemented. This will facilitate regional cooperation for digitalisation, innovation, new global value chains and quality FDI. At the same time, creativity, openness and liberalisation should be considered as principles of the digitalisation process, starting from government and diffusing to the whole of society.



Table 1 Benchmarking Vietnam's digital economy with comparable ASEAN nations

	INDICATORS	DATA YEAR	VIETNAM	INDONESIA	THAILAND	PHILIPPINES
Business and Innovation	<b>Ease of Doing Business Index</b> (out of 190 nations) <sup>58</sup> <i>Measures how easily the regulatory environment allows for starting and operating a local firm.</i>	2019	69 <sup>th</sup>	73 <sup>rd</sup>	27 <sup>th</sup>	124 <sup>th</sup>
	<b>Global Competitiveness Report</b> (out of 140 nations) <sup>59</sup> <i>Measures how well productivity is enabled by: the macroeconomic environment, infrastructure, institutions, population health, education, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation.</i>	2018	77 <sup>th</sup>	45 <sup>th</sup>	38 <sup>th</sup>	56 <sup>th</sup>
	<b>Global Innovation Index</b> (out of 126 nations) <sup>60</sup> <i>Measures how well innovation is enabled by a nation's: institutions, human capital, infrastructure, market sophistication and business sophistication. Also measures innovation outputs.</i>	2018	45 <sup>th</sup>	85 <sup>th</sup>	44 <sup>th</sup>	73 <sup>rd</sup>
	<b>Nation Brand Rankings</b> (out of 100 nations; current US\$ billion) <sup>61</sup> <i>Measures the value of a nation's brand.</i>	2018	43 <sup>rd</sup> \$235	16 <sup>th</sup> \$848	31 <sup>st</sup> \$509	29 <sup>th</sup> \$524
	<b>Logistics Performance Index</b> (out of 160 nations) <sup>62</sup> <i>Measures national performance in customs, infrastructure quality and timeliness of shipments.</i>	2018	39 <sup>th</sup>	46 <sup>th</sup>	32 <sup>nd</sup>	60 <sup>th</sup>
Human Resources	<b>Global Talent Competitiveness Index</b> (out of 125 nations) <sup>63</sup> <i>Measures ability to enable, attract, grow, and retain talent. Also measures the level of vocational skills, technical skills and global knowledge skills (i.e. knowledge, problem-solving, creativity).</i>	2019	92 <sup>nd</sup>	67 <sup>th</sup>	66 <sup>th</sup>	58 <sup>th</sup>
	<b>English Language Proficiency Index</b> (out of 88 nations) <sup>64</sup> <i>Measures the English proficiency of people (mostly young adults aged 18+) who are actively studying the English language.</i>	2018	41 <sup>st</sup>	51 <sup>st</sup>	64 <sup>th</sup>	14 <sup>th</sup>
	<b>Workers at High Risk of Job Automation</b> by 2025 (%) <sup>65</sup>	2016	70%	56%	44%	49%
Digital Infrastructure	<b>ICT Development Index</b> (out of 176 nations) <sup>67</sup> <i>Measures ICT access, ICT skills, and ICT adoption.</i>	2017	108 <sup>th</sup>	111 <sup>th</sup>	78 <sup>th</sup>	101 <sup>st</sup>
	<b>Global Cybersecurity Index</b> (out of 193 nations) <sup>66</sup> <i>Measures commitments and progress in cybersecurity across five areas (legal, technical, organisational, capacity building and cooperation).</i>	2017	101 <sup>st</sup>	70 <sup>th</sup>	20 <sup>th</sup>	37 <sup>th</sup>
	<b>Average Download Speeds</b> (out of 200 nations; Mbps) <sup>67</sup>	2018	75 <sup>th</sup> 6.7 Mbps	83 <sup>rd</sup> 5.8 Mbps	40 <sup>th</sup> 17.1 Mbps	89 <sup>th</sup> 5.2 Mbps
	<b>Inclusive Internet Index</b> (out of 86 nations) <sup>68</sup> <i>Measures inclusiveness of the Internet based on infrastructure, affordability, capability (e.g. skills) and relevance of content to users.</i>	2018	43 <sup>rd</sup>	49 <sup>th</sup>	31 <sup>st</sup>	54 <sup>th</sup>
	<b>Population with Internet Access</b> (% of population) <sup>26</sup>	2016	46.5%	32.3%	52.9%	55.5%
	<b>Households with a Computer</b> (% of total households) <sup>69</sup>	2016	20.5%	17.8%	33.9%	20.5%
Digital Economy	<b>Number of Internet Users</b> (millions) <sup>70</sup>	2018	64	132.7	57	67
	<b>E-commerce market size</b> (US\$ billions at 2015 prices) <sup>71</sup>	2015	\$0.8	\$1.3	\$0.9	\$1
	<b>High Technology Exports</b> (current \$US billions) <sup>26</sup>	2016	\$43.6	\$3.9	\$34.7	\$26.1
	<b>E-Government Index</b> (out of 193 nations) <sup>72</sup> <i>Measures e-government development based on three indices: telecommunications infrastructure, human capital and online services.</i>	2018	88 <sup>th</sup>	107 <sup>th</sup>	73 <sup>rd</sup>	75 <sup>th</sup>

Legend: ■ Relatively Ahead, ■ Relatively Behind

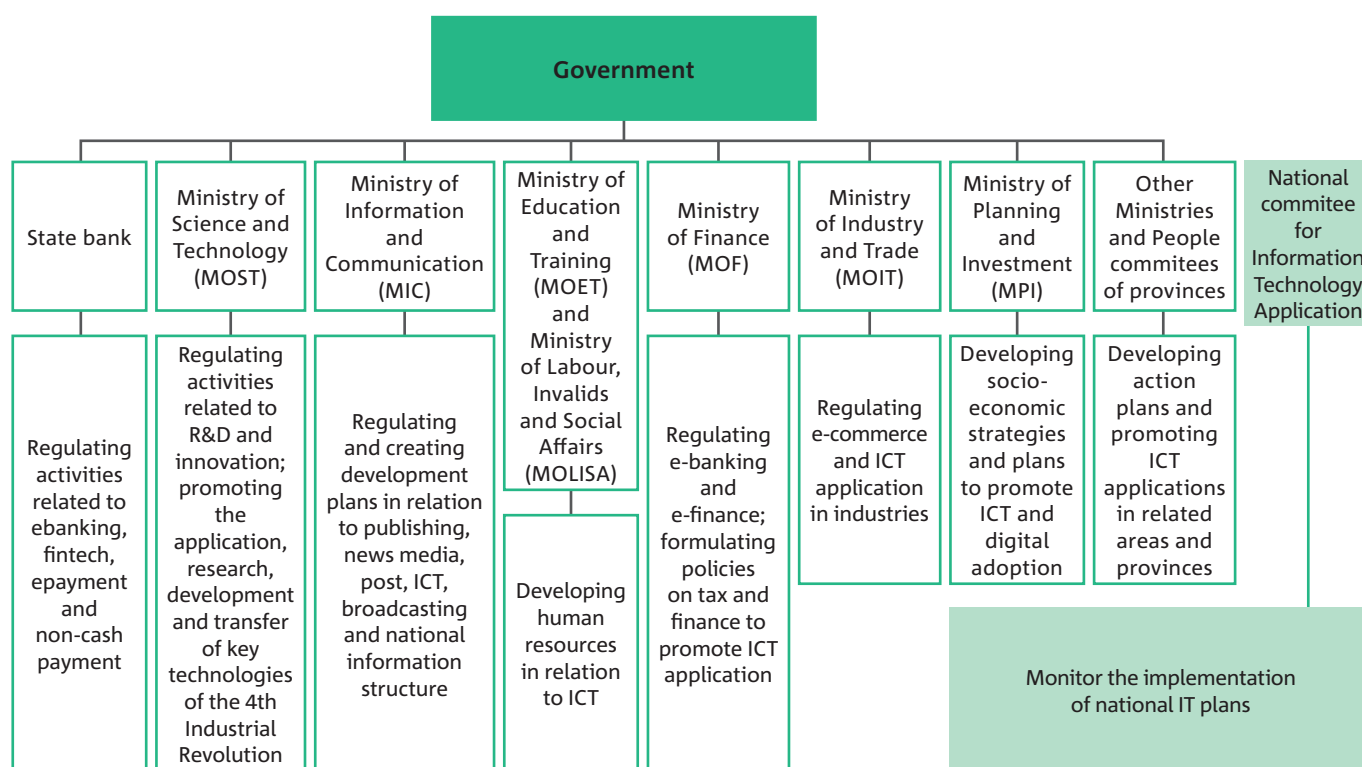


Figure 13 Main regulators of the digital economy in Vietnam

Source: Data61 analysis

Over the years the Vietnam government has implemented a number of laws to regulate the digital economy. Detailed implementation of these laws is guided by decrees and decisions. This regulatory framework is further enhanced by Vietnam's Free Trade Agreements (e.g. AEC, CPTPP) and bilateral agreements such as those with Korea and Japan.

Vietnam's commitment to digitalisation is seen in the number of policies, master plans and directives published over the last 30 years (see Figure 14). The main focus of these is to develop critical infrastructure, build the ICT industry, promote e-commerce and adopt technology as a means of lifting productivity.

The main document guiding the development of digital economy policies and strategies is *Directive 16/CT-TTg*. In this Directive, Prime Minister Nguyen Xuan Phuc instructed the Vietnam Government to further support to technological modernisation of industry by:

- **Focusing on developing new digital infrastructure and networks**
- **Speeding up reform to encourage businesses to adopt new technology** – including implementing e-government across government agencies and reviewing related regulation and services
- **Prioritising the development of the Vietnamese ICT industry** in government policy and reform, and **promoting the take-up of smart technologies across all industries**

- **Building the innovation ecosystem** through further funding for scientific and research infrastructure and institutions, creating international relationships and promoting tech start-ups
- **Building technological skills** through a focus on STEM education and training from early childhood through to adult education
- **Raising awareness at all levels, and in all sectors, of the opportunities and challenges of Industry 4.0**, ensuring all areas of Vietnam's society and industry are prepared for the changes ahead.

## SOME PROMINENT POLICIES OF VIETNAM TOWARD DIGITALISATION INCLUDE:

### Internet infrastructure

**Vietnam is dedicated to providing universal connection coverage across the country.** The first universal service program was implemented between 2005 and 2010 with a total investment of over 5 trillion VND (*Decision No. 74/2006/QD-TTg*). The *Program on the provision of public telecommunications services until 2020* was issued in 2015 and revised in 2018 under *Decision No. 868/QD-TTg*. Under this program, a total of 7.3 trillion VND will be devoted to investing in the development of broadband infrastructure nationwide, with a priority on remote and isolated areas, disadvantaged areas, border areas and islands.

Main Laws								
Law on Telecommunication 2009	Law on Information Technology 2006	Law on Radio Frequency 2009	Law on Cybersecurity 2018	E-transaction 2005	Law on High Technology 2008	Law on Intellectual Property 2005	Law on Technology Transfer 2018	Law on Cybersecurity 2018

Main Decrees and Decisions														
Decision 418/2012/QĐ-TTg on approving the science and technology development plan 2011-2020 with emphasis on digital technologies	Decision 418/2012/QĐ-TTg on approving the science and technology development plan 2011-2020 with emphasis on digital technologies	Decision No.1072/2018/QĐ-TTg, on establishing the national e-government committee	Decision 418/2012/QĐ-TTg on approving the science and technology development plan 2011-2020 with emphasis on digital technologies	Decision No. 16/CT-TTg strengthening the ability to access Industry 4.0	Decree No. 154/2013/ND-CP, on concentrated information technology park	Decree No. 26/2007/ND-CP, detailing the E-transaction Law	Decree No. 71/2007/ND-CP, detailing the Law on Information Technology	Directive No. 16/CT-TTg strengthening the ability to access Industry 4.0	Decree No. 35/2007/ND-CP and No. 27/2007/ND-CP on e-banking and e-finance	Decree No. 52/2013/ND-CP on e-commerce	Decree No. 97/2008/NĐ-CP on internet services and electronic information on the internet	Decision No. 1563/2017/QĐ-TTg, on approving the overall plan for e-commerce development 2016-2020	Resolution No. 1/2019/NQ-CP, on implementing the socio-economic plan and budget estimates for 2019, to issue the National strategy on implementing Industry 4.0; Resolution on improving capacity to approach Industry 4.0 toward 2025; and Solution to develop national human resources to meet the requirements of Industry 4.0	Resolution No. 2/2019/NQ-CP, on improving the business environment and national competitiveness in 2019 toward 2021; to develop the scheme for the National Innovation Center; to develop solutions to master key technologies especially AI; and to deploy the scheme “Developing the Digitalised Knowledge System” and promote e-payment

Main Strategies, Master Plans, Initiatives			
Vietnam post, telecommunications and information technology strategy until 2010 and orientations toward 2020	Master plan on Vietnam’s electronics industry up to 2010, with a vision toward 2020	National planning on development of IT security through 2020	The target program on IT development through 2020, with a vision toward 2025
			The program on development of broadband telecommunications infrastructure through 2020
			Scheme to support the national innovative startup ecosystem through 2025
			Vietnam strategy on ICT development till 2010 and orientations toward 2020

**Figure 14 Update on major regulations relating to the digital economy**  
 Note: A more detailed list of digital regulations can be found in Appendix B.  
 Source: Data61 analysis

The main objective of the program is to provide broadband access to 99% of the communities in Vietnam that have access to electricity. A critical part of this program is the scheduled roll out of 5G services by 2021.<sup>73</sup>

## Human resources and R&D

### **Vietnam aims to enhance the quality of its workforce.**

Between 2005 and 2017, the proportion of state budget spent on education increased from 11% to around 15%.<sup>74</sup> *Directive 16/CT-TTg* also clearly identifies human resources as fundamental to implementing Industry 4.0, setting goals to:

*“Change policies, contents and methods of education and vocational training in order to generate human resources which are able to follow new technological production trends, including the focus on promotion of training in science, technology, engineering and mathematics (STEM), foreign languages, information technology in universal; promote autonomy in higher education and vocational training; pilot regulations on vocational training and higher education applied to some specific fields. Turn population challenges and golden population into an advantage in international integration and international division of labour.”*

*Directive 16* assigned two ministries to building human resources – the Ministry of Education and Training, and the Ministry of Labour, Invalids and Social Affairs. These ministries engage in several activities to build STEM skills. For example, through a public-private partnership with Microsoft, the ministries have increased digital skills training, created a new ICT curriculum, and promoted digital inclusion for rural students and ethnic minorities. More detailed initiatives will be outlined in forthcoming strategies.

As well, 2019 is a milestone for the comprehensive deployment of the scheme *Developing the Digitalised Knowledge System* led by the Ministry of Science and Technology.

## Innovation and the digital ecosystem

Overall, the Vietnam Government has linked increased innovation – including the development of the digital economy – with increasing creativity and experimentation, and a culture of openness and freedom.

### **Vietnam’s policies emphasise research and development (R&D).**

*Decree No. 95/2014/ND-CP*, for example, requires state owned enterprises to invest 3-10% of total revenue for R&D activities.<sup>74</sup> However, Vietnam’s spending on science and technology is still low (0.8% of total national budget in 2017) and is decreasing (the figure was 1% in 2005). Steps will need to be taken to ensure IP can be commercialised and translated into widespread adoption.

**Vietnam also implements various programs to foster the start-up and innovation ecosystem.** These include the National Agency for Technology, Entrepreneurship and Commercialization Development (NATECD), National Technology Innovation Fund (NATIF), Hoalac Hitech Service Centre and the Saigon Silicon City Centre. The country has also decided to build the National Innovation Center and National Start-up Center in which enterprises are put at the centre through *Resolution No. 1&2/2019/ND-CP in improving the country’s business environment and national competitiveness*.

**In addition to enterprise-level initiatives, the Government is also committed to various digitalisation initiatives.** The adoption of digital technologies across industries, including agriculture, healthcare, security and defence is promoted in the *National technology development program up to 2020*.

**Recognising the importance of being a leader in the reform and digitalisation process, the Vietnam Government established a national e-government committee in 2018** (under *Decision No. 1072/2018/QD-TTg*). The committee is responsible for researching and proposing strategies, mechanisms and policies, creating a legal environment to promote the construction and development of e-government, and facilitating the implementation of Industry 4.0.

**Vietnam’s Industry 4.0 policies and actions are being determined by the Ministry of Planning and Investment (MPI) and will be released in early 2019** (see *Resolution No.1&2/2019/NQ-CP* in Figure 14 for a list of relevant actions). Reportedly, MPI modelling estimates the policies and actions under consideration could add 1.3-3.1 million new jobs by 2030, and contribute to strong growth in manufacturing (16%), wholesale and retail (20% or \$9.5 billion), agro-forestry-fishery (12%), supply of electricity, gas, and air conditioning (23%), and finance-banking-insurance (14% or \$3.5 billion).<sup>75</sup>

## Smart cities

**Vietnam is committed to building smart cities.** In 2018, Vietnam joined the *ASEAN Smart Cities Network* and approved the *Sustainable smart city development plan for 2018-2025 and direction until 2030 (Decision No. 950/QD-TTg)*. By 2020, the plan aims to create a legal framework to support sustainable smart city development, as well as build and pilot databases to support urban development. By 2030, the plan aims to “establish the network of smart cities in the North, the Central Vietnam, the South and Mekong Delta, in which Hanoi City, Ho Chi Minh City, Da Nang City and Can Tho City shall be nuclear cities, and establish linkages between smart cities.”

## Cybersecurity

**Cybersecurity in Vietnam operates under two major legal frameworks:** the *Law on Information Security* (Law No. 86/2015/QH13) and the *Law on Cybersecurity* (Law No. 24/2018/QH14). Other relevant regulations are listed in Appendix B.1.3. The cybersecurity law applies to domestic and foreign firms providing services on the telecommunications network or value-added digital services in Vietnam. The firms that collect, exploit, analyse or process personal information and/or data of users in Vietnam are required to establish a branch or a representative office in Vietnam. In addition, the law has articles on data localisation for certain types of data, cybersecurity audits, handling illegal content and protection of children.

**The Vietnam Government also helps ensure cybersecurity through emergency response plans** (*Decision No. 05/2017/QĐ-TTg*). Plans are informed by the National Steering Committee on Information Security, then decided and implemented by the Ministry of Information and Communication. The Ministry implements the plans with help from the *National Cyber Information Security Incident Response Network* – which includes various state agencies (e.g. Vietnam Computer Emergency Response Team), and private firms from a range of relevant sectors (e.g. telecommunications, finance).

## Taxation

**Digitalisation is imposing new challenges for Vietnamese taxation.** These include but are not limited to tax base erosion with new business models such as the sharing economy, the emergence of digital marketplaces and e-commerce platforms and new income sources such as data utilisation. Vietnam, like many other countries, is trying to apply tax to digital transactions. For example, *Official Dispatch 848/BTC-TCT* (issued in 2017) requires foreign companies that provide online reservation services in Vietnam (e.g. Agoda.com, Traveloka.com, Booking.com) to pay income and value-added tax when signing contracts with accommodation establishments in Vietnam (hotels, hostels, etc.). It also requires the establishments to declare and pay taxes on behalf of foreign contractors.

## 3.3 A promising start for the digital economy

Vietnam in 2019 has built a solid foundation for the development of Vietnam's future digital economy. The next chapter will focus on the size and capabilities of the digital economy, and take an in-depth look at the nation's largest industries – agriculture and manufacturing.

## Stakeholder interview

**Dr Vo Tri Thanh** – Chairman of the Vietnam Committee for Pacific Economic Cooperation Council (VNCPEC) – Former Vice President of the Central Institute for Economic Management (CIEM), Ministry of Planning and Investment

**Political will is the most important driver for Vietnam's digital transformation**

### VIETNAM NEEDS TO OVERCOME FIVE BARRIERS TO ENABLE DIGITAL TRANSFORMATION

Vietnam has missed the first three industrial revolutions, for both subjective and objective reasons. The fourth industrial revolution – Industry 4.0 – is a huge chance for Vietnam to make a breakthrough. To succeed, however, there are five barriers that need to be overcome.

The first and most important is **leadership and political will**. These factors will drive whether Industry 4.0 becomes truly embedded in every sector or just a trendy slogan.


Issues related to **Vietnam's legal regulations** are another limitation. Some of the issues are reflected in the difference between how regulations are written versus how they are enforced. As well, regulations often fail to keep up with the rapid rate of digitalisation in society and the economy.

Thirdly, **human resources** are needed at three levels – including consumers in general society for digital adoption, IT workers for digital production, and an elite group for digital leading. The Vietnamese are characterised by 'flexibility,' meaning they easily adopt digital technologies and can work in the field of IT. However Vietnam lacks people that can play the role of 'architect' (those in the elite group) to lead the digital transformation process. Although Vietnamese students gain high achievements, creativity and innovation are not their strengths. Clear evidence of this lies in the fact that most of the recent Vietnamese digital products are platforms applied to different industries, not brand new products.

The **ecosystem for innovation and start-up businesses** is the fourth limitation.

Lastly, the **digital infrastructure** of Vietnam is still at a basic level in terms of data, transmission speeds and similar. Huge investments are needed to create future boosts in digitalisation.





PART II  
**VIETNAM'S CURRENT  
STATUS AND  
POTENTIAL FOR  
DIGITAL ECONOMY  
DEVELOPMENT**

Case studies from the Agriculture  
and Manufacturing Sectors

# 1 DIGITAL TRANSFORMATION

## TRENDS IN VIETNAM

Vietnam's digital economy is growing rapidly. Digital development is transforming multiple economic sectors, from manufacturing and agriculture to trade, payment, transportation, finance and education.

This chapter will provide an overview of the key sectors being transformed by emerging digital technologies. The key sectors discussed include e-commerce, the sharing and platform economy, tourism, logistics, healthcare, fintech, digital content and e-government.

The chapter will then examine the impact of digital technologies on two pillars of Vietnam's economy: agriculture and manufacturing. This includes a discussion of survey data collected from agriculture and manufacturing firms for the *Vietnam's Future Digital Economy Project*. The survey analyses estimate the current level of digital adoption in the two sectors.

Following this, the chapter will describe results from a second survey conducted by the research team. This survey reveals consumer perspectives on key sectors being transformed by digital technologies, including e-commerce, the sharing economy and e-government.

### 1.1 Foundation for digitalisation

#### VIETNAM'S APPETITE FOR DIGITAL IS INCREASING

The adoption of high-speed Internet services, smart devices and mobile phones in Vietnam has been comparatively high since 2003, outstripping adoption in countries such as Pakistan, India and Indonesia. In 2017, more than half of the country had Internet access, compared to around 15% a decade ago.<sup>26</sup> Rural areas still lag behind metropolitan areas, although the provision of satellite and wireless services is now boosting take-up rates in even the most remote provinces.

The adoption of broadband Internet services is also increasing in the business sector. The share of manufacturing and services firms using the Internet for business activities rose to 71% in 2007 and 86% in 2011.<sup>76</sup> Around 500,000 Vietnamese business accounts had been created on Alibaba.com by 2016, and is growing by about 100,000 accounts per year.<sup>77</sup>

Vietnam has the highest number of registered domains in the ASEAN region.<sup>78</sup> In 2017 there were around 422,000 active '.vn' domain names, from a total of nearly 1 million domains registered for ASEAN nations. Vietnam also had also around 16 million allocated IPv4 addresses.<sup>78</sup>

#### WIRELESS RATHER THAN FIXED BROADBAND

Vietnam's Internet use is dominated by mobile phones. From 2006 to 2017, the number of mobile subscriptions increased six-fold. By 2017 Vietnam had 120 million mobile subscriptions. This represents 126% of the total population, with many Vietnamese owning more than one mobile subscription.<sup>79</sup> Over half the mobile phones used in Vietnam are smartphones with Internet access.

### 1.2 ICT – the booming base of Vietnam's digital economy

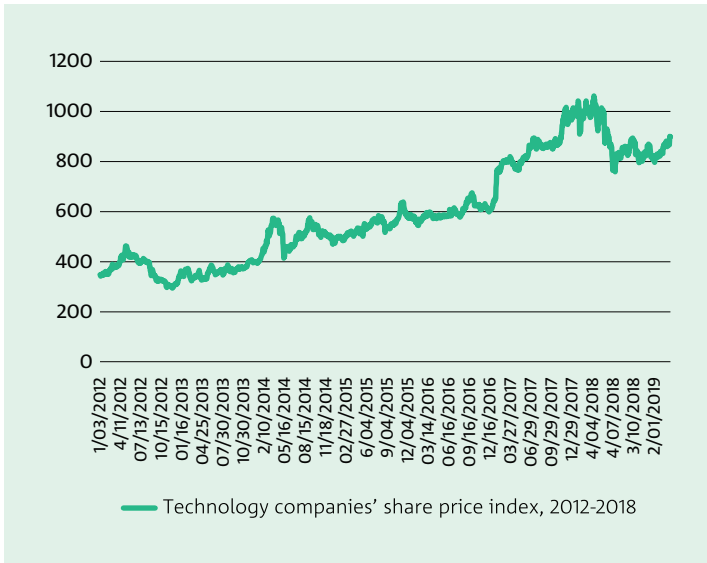
The digital economy is booming in Vietnam. In 2016, *PC Magazine* described the country as South East Asia's Silicon Valley.<sup>80</sup> Emerging sectors and fast-growing sunrise industries in Vietnam include finance technology (fintech), telecommunications, electronics and computer manufacturing, and information and communications technology (ICT) services.

In mid-2018, Vietnam was home to an estimated 30,000 businesses spanning IT hardware, software, digital content and ICT services. The country has a thriving community of software developers and start-ups, developing digital products and services for use within Vietnam as well as undertaking software development offshored from advanced economies.<sup>81</sup> There are also specialist training centres and technology parks for IT programmers and engineers in several locations, including the major cities of Hanoi, Ho Chi Minh City and Da Nang.<sup>82,80</sup>

ICT is one of the fastest-growing sectors in Vietnam. In 2018 the total ICT industry revenue was US\$98.9 billion, 13 times the revenue in 2010 (US\$7.6 billion).<sup>83</sup> The hardware industry is the largest subsector of Vietnam's ICT industry, contributing 89% of total revenue in 2018.



# VIETNAM'S ICT SECTOR AT A GLANCE



**BUSINESSES IN THE ICT SECTOR**  
**30,000**

**EMPLOYED IN IT**  
**955,000**

**IT GRADUATES PER YEAR**  
**80,000**

**IT INDUSTRY REVENUES**  
**\$US 98.9 BILLION**

**TOTAL IT EXPORTS**  
**\$US 83.3 BILLION**

**TARGET TELECOMS INDUSTRY REVENUE IN 2018**  
**\$US 19.74 BILLION**

Source: Ministry of Information and Communications, stockbiz.vn

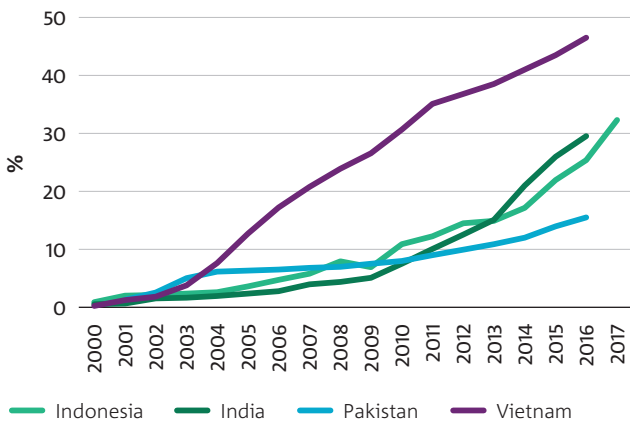


Figure 15 Population using the Internet (%) by country, 2000-2017

Source: World Bank<sup>26</sup>

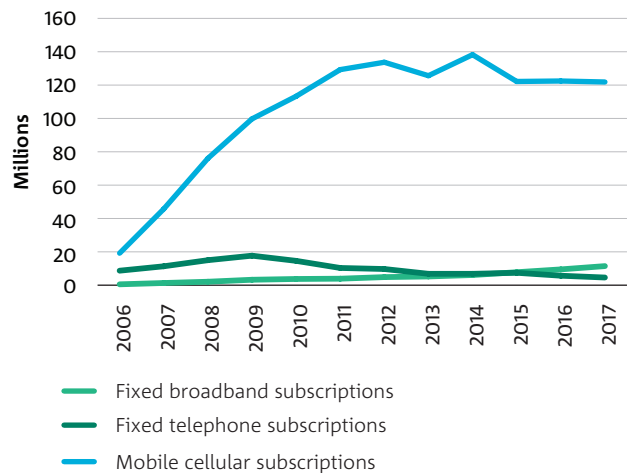


Figure 16 Broadband take-up in Vietnam – number of connections, 2006-2017

Source: World Bank<sup>26</sup>

ICT equipment accounted for around 25% of total exports from Vietnam in 2016, up from less than 10% in 2011.<sup>32</sup> It is now the country's largest export sector, with telephone and broadcasting equipment particularly important.<sup>32</sup> The increase in ICT exports has come from leading Vietnam-located manufacturers such as Samsung, Intel, Dell and LG, who are expanding their businesses and increasing investments in the country.<sup>84,30</sup> Vietnam assembles electrical and electronic products, and increasingly exports sophisticated computing devices. Half of Samsung's high-end S8 and S8 Plus phones and more than 80% of Intel's personal computer central processing units are produced in Vietnam.<sup>40</sup> As a result of foreign investment in ICT manufacturing, Vietnam has surpassed most regional neighbours in high tech exports (see Figure 17).

Local companies in the ICT sector are experiencing remarkable growth also, with share prices increasing more than three-fold since 2012.<sup>85</sup> Larger companies include VC Corporation, Viettel and FPT. See Appendix A for more examples.

The local software industry is growing steadily and starting to attract global attention as a significant regional hub.<sup>80</sup> Local businesses account for the majority of the market, supplying low-cost software products. In mid-2018, a total of 9,500 businesses in Vietnam created digital software for sectors such as finance, telecommunications, smart agriculture and government. In 2016, IT outsourcing services generated around US\$3 billion.<sup>86</sup> Vietnam has overtaken India to be Japan's second-largest software outsourcing destination, behind only China.<sup>87</sup>

**Table 2 ICT industry revenue in Vietnam by sector, US\$ billions**

	2015	2016	2017	2018
Hardware	53	58.8	81.6	88
Software	2.6	3	3.8	4.3
Digital content	0.6	0.7	0.8	0.9
Services	4.5	5	5.4	5.7
Total	60.7	67.7	91.6	98.9

Source: Ministry of Information and Communication

**Table 3 Number of ICT industry enterprises in Vietnam by sector**

	2015	2016	2017	2018 (FIRST 6 MONTHS)
Hardware	2,980	3,404	4,001	4,300
Software	6,143	7,433	8,883	9,500
Digital content	2,339	2,700	3,202	3,500
Services	10,196	10,965	12,338	12,700
Total	21,658	24,501	28,424	30,000

Source: Ministry of Information and Communication

**Table 4 Number of ICT industry employees in Vietnam by sector**

	2015	2016	2017	2018 (FIRST 6 MONTHS)
Hardware	533,003	568,288	677,222	720,000
Software	81,373	97,387	112,004	-
Digital content	44,320	46,647	43,538	45,000
Services	62,888	68,605	64,574	70,000
Total	721,584	780,926	897,338	955,000

Source: Ministry of Information and Communication

### 1.3 Digital content on a roll

#### SOCIAL MEDIA

While television and newspapers maintain their markets, growing mobile device ownership is fuelling demand across the country for digital content and news. There are 240 social networking sites and 63 integrated digital news outlets in Vietnam.<sup>79</sup> Facebook is by far the most popular, with Vietnam ranking as Facebook's 7<sup>th</sup> largest user base with an estimated 58 million active users.<sup>88</sup> The Vietnam Government is promoting the development of local social media networks through initiatives such as *The Digital Vietnamese Knowledge Platform*. This open platform encourages users to develop apps and other software using government data and infrastructure.<sup>89,90</sup>

#### ONLINE ADS

Vietnam's online ad industry is growing rapidly, reaching US\$390 million in revenues in 2016. This is expected to triple by 2020.<sup>91</sup> In 2014, social networks overtook search engines to become the most-used online advertising method for enterprises in Vietnam.<sup>91</sup> Apart from enterprises, most ad patrons are household businesses and individuals selling goods and services online. These groups have contributed the most to the growth of advertising on social networks.

#### OVER-THE-TOP SERVICES

Over-the-top (OTT) services such as Zalo, Skype and Viber are replacing traditional voice and SMS services. Mobile messaging via apps surpassed traditional messaging via SMS in Vietnam in 2012.<sup>84</sup> Major operators including Viettel and VNPT are now shifting to offer their own OTT services, such as Viettel Mocha or Viettalk, to compete.

#### GAMES

Vietnam has become one of the biggest markets for online games in South East Asia. In 2018, Vietnam ranked 25<sup>th</sup> out of 100 countries in total game revenue, with revenues increasing by US\$123 million in 2018 to US\$490 million.<sup>92</sup> The revenue exceeded that of the Philippines and Singapore. VNG, Vietnam's largest provider of online games, is valued at US\$1 billion by market research firms.<sup>93</sup> Most of the growth comes from the mobile games market. Game apps in smartphones increased by 37% in 2016,<sup>94</sup> and as much as 60% of smartphone app revenue in Vietnam comes from games. Flappy Bird, by Vietnam's Nguyen Ha Dong, was the most-downloaded free game in the iOS App store in 2014.<sup>95</sup>

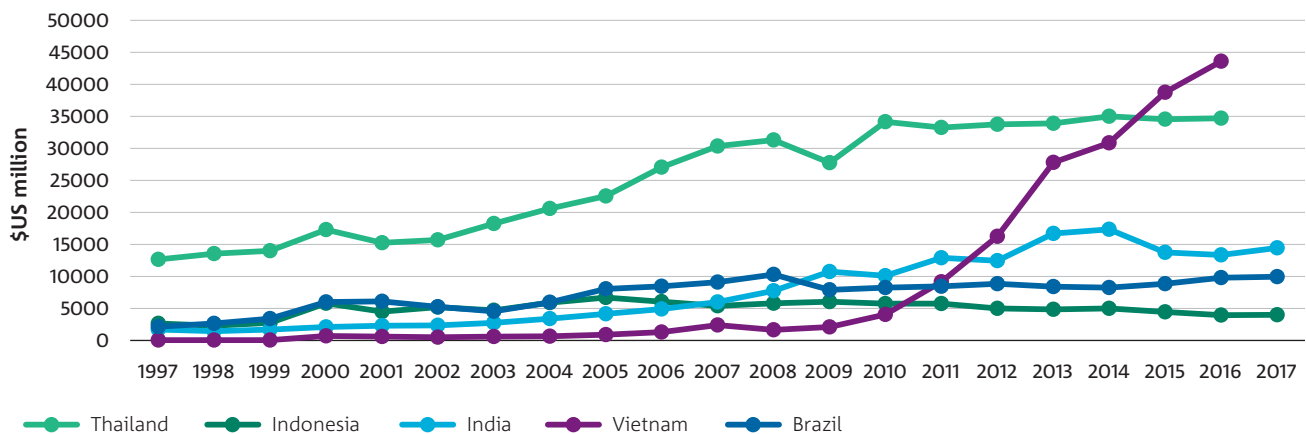


Figure 17 High technology exports across economies (current \$US million) 1997-2017

Source: World Bank<sup>26</sup>

## 1.4 Moving towards digital economy maturity with e-commerce

E-commerce is one of the fastest-growing segments of Vietnam's digital economy. According to the Vietnam E-commerce and Information Technology Agency (VECITA), the nation's e-commerce market is growing by 35% per year – 2.5 times faster, for example, than Japan.<sup>96</sup> Vietnam's online retail revenue reached US\$6.2 billion in 2017, over double that of 2014.<sup>97</sup> By 2020, VECITA predicts the number of online shoppers will increase by 52%, while the Vietnam E-Commerce Association (VECOM) predicts online revenue will reach US\$10 billion.<sup>98,99</sup>

The Internet has become important for information exchange between enterprises, especially for exporting and importing firms. Almost half of Vietnam's businesses own a website (49%) and a third of businesses (32%) have set up relationships with foreign partners through online channels.<sup>100</sup> E-commerce platforms also connect Vietnamese businesses to foreign markets, with around 600 of them exporting on Alibaba and 140 on Amazon (via a partnership with VECOM).<sup>101</sup>

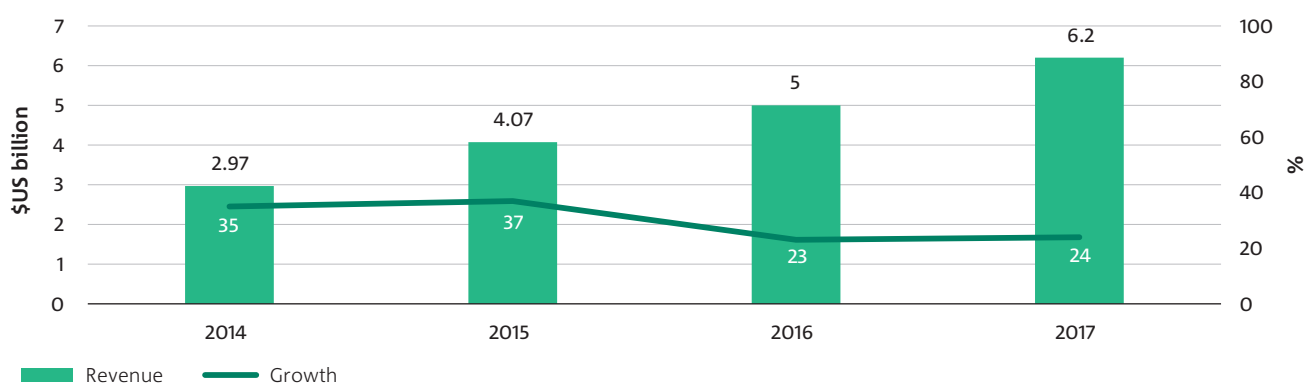
E-commerce within Vietnam and around the world is evolving with the rapid development of mobile payment applications – such as WePay, ApplePay, SamsungPay – and the emergence of global cryptocurrencies that can use digital wallets to allow people to both transfer funds peer-to-peer across the Internet, as well as pay for goods and services locally.

## 1.5 Smart logistics

The logistics sector has grown rapidly along with the e-commerce boom. In recent years logistics enterprises grew on average by 14-16% (US\$40-42 billion) per year.<sup>102</sup> Enterprises operating in the field are transforming from traditional logistics companies to e-commerce logistics companies to cope with competition and new markets.

According to data from the Vietnam Logistics Business Association, the number of enterprises applying technology in their operations increased from 15-20% to 40-50% in recent years.<sup>103</sup> However, more than half of these businesses have not taken on significant technology adoption.<sup>103</sup> This likely contributes to the high cost of logistics operations in Vietnam – 16.8% compared to 12.5% in the Asia Pacific.<sup>103</sup>

A World Bank report on trade logistics in 2016 showed that Vietnam ranked 64<sup>th</sup> out of 160 countries in logistics development.<sup>104</sup> Although there is significant potential here, the competitiveness of this industry is still quite modest compared to other countries in the region, especially in technology adoption.<sup>104</sup> New technologies that have been applied in the global logistics industry are still not commonly used in Vietnam. For example, robotics systems in warehouses have only been applied by two companies in Vietnam, namely German Schenker and Vinamilk in Binh Duong. Major domestic shipping companies are still manually handling goods without using automatic distribution centres. Looking ahead, technologies such as virtual reality or delivery by drones have not yet been announced in any technology deployment plans.<sup>102</sup>



	2015	2016	2017
Estimated number of Internet users involving in e-commerce (million people)	30.30	32.70	33.60
Estimated e-commerce expenditure per person (\$US)	160	170	186
Proportion of BTC e-commerce in total good and service retail (%)	2.80%	3%	3.60%

Figure 18 Vietnam B2C e-commerce landscape

Source: Ministry of Industry and Trade<sup>97</sup>

## 1.6 Smart tourism

Tourism is booming in Vietnam. According to the Vietnam National Administration of Tourism, international visitors, domestic tourists and total revenue soared between 2016 and 2017.<sup>105</sup> In 2017 the tourism industry received 13 million international visitors and 74 million domestic tourists, representing increases of roughly 30% and 20% respectively. In the same year, total direct revenue from tourism reached over US\$23 billion and contributed nearly 7.5% to GDP.

Under Industry 4.0, Vietnam's tourism sector has rapidly changed and increased service quality using the 'smart tourism model.'

According to a survey by the Vietnam National Administration of Tourism, 71% of international tourists to Vietnam in 2017 used online sources to determine their travel destination.<sup>106</sup> In addition, 64% of international tourists booked their trip to Vietnam online.<sup>106</sup> Nearly 100% of Vietnamese enterprises in the tourism sector used websites to introduce their products to consumers, however, only over 50% of domestic enterprises successfully applied online sales and payment methods.<sup>106</sup>

The market share of online hotel bookings in Vietnam has also been high in recent years, accounting for an average of 30-40% of total sales.<sup>106</sup> In this online market, statistics from the Vietnam E-Commerce Association indicate that foreign businesses such as Agoda and Booking.com account represent 80% of these sales, while Vietnamese businesses such as gotadi.com, ivivu.com, chudu24.com and vntrip.vn only occupy a modest part of this market despite some early success as new entrants.<sup>106</sup>

The public transport system also contributes to smart tourism growth. For example, buses with free Wi-Fi have been launched in several cities to enable convenient travel.

## 1.7 Smart health

In 2018 Vietnam's health sector set specific goals to develop the smart health system, with plans to adopt digital technologies in three main pillars: smart disease prevention, smart examination and treatment, and smart medical administration.<sup>107</sup>

One such initiative, the 'healthcare digitalised communication network model,' is a closed network of communication channels in the hospital environment, operated and processed via the Internet. By 2018 the model had been adopted by 40 hospitals and 500 pharmacies.<sup>108</sup> Additionally, the online portal Medihub.vn provides official information on each hospital's services, procedures, regulations, as well as information on diseases and new treatments.

Major hospitals in Vietnam have begun to build and implement a model of Smart Medical Clinics, such as Thu Duc District Hospital in Ho Chi Minh City. People visiting the hospital can now register their medical appointments through a central system that is connected to overall hospital management software. Visitors receive automated ticket numbers and can wait for their appointment with greater comfort and convenience, with several screens around the hospital displaying the order of ticket numbers.

Information management systems are being digitalised. The Ministry of Health is extending its Electronic Medical Records (EMR) plan to its subordinate units over the country after a successful pilot under Circular No. 46/2018/TT-BYT. This EMR system enables medical facilities to record, display and store medical data of each citizen digitally. Vietnam Social Insurance is also actively researching and drafting an electronic health insurance card form. These steps will help Vietnam's health sector save management costs and create conditions for visitors to experience more convenient healthcare.



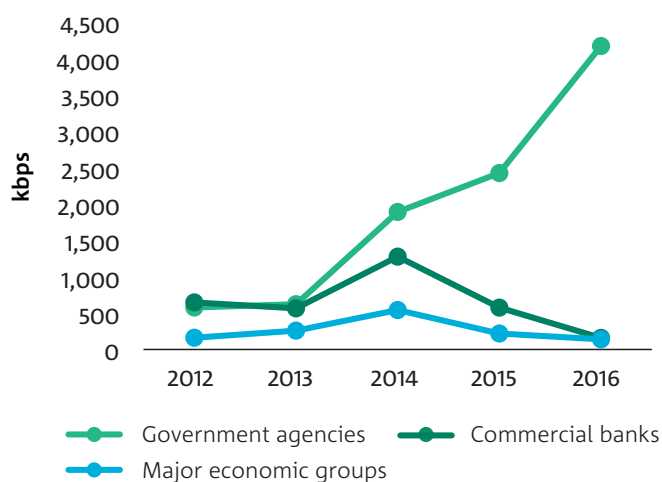
## 1.8 Delivering e-government services

E-government services are spreading rapidly in Vietnam. As in other developing nations, government agencies have typically adopted digital services before many businesses.<sup>109</sup> This is not surprising, as many firms in Vietnam are small and operate informally.

Between 2014 and 2017, Vietnam rose 10 places to rank 88<sup>th</sup> out of 193 countries and territories on the United Nations' E-Government Development Index (EGDI).<sup>110</sup> In 2016, it was among ten countries which made the leap from middle-EGDI to high-EGDI values.<sup>110</sup> As per *Resolution No. 17/NQ-CP*, Vietnam aims to be among the top four ASEAN nations in EGDI performance by 2025.

The main focus of Vietnam's e-government initiatives has been to develop governmental administrative systems in finance, customs and tax management. These efforts seem to be paying off. In a survey by the Ministry of Industry and Trade in 2016, 74% of firms reported using the online public service. Online tax management was the most frequently used public service (88%), followed by online business registration (41%) and customs declarations.

Newer priorities are to develop and support underlying platforms and infrastructure including for IoT and Smart City development, Open Data and Right to Information portals, and inter-agency communication.<sup>112</sup> As set out by *Resolution No. 17/NQ-CP*, by 2020 Vietnam aims to integrate information systems and databases between agencies at all levels of government, with 20% of users authenticated and unified across all systems.



**Figure 19 Internet broadband bandwidth per employee across agencies in Vietnam, 2012-2016**

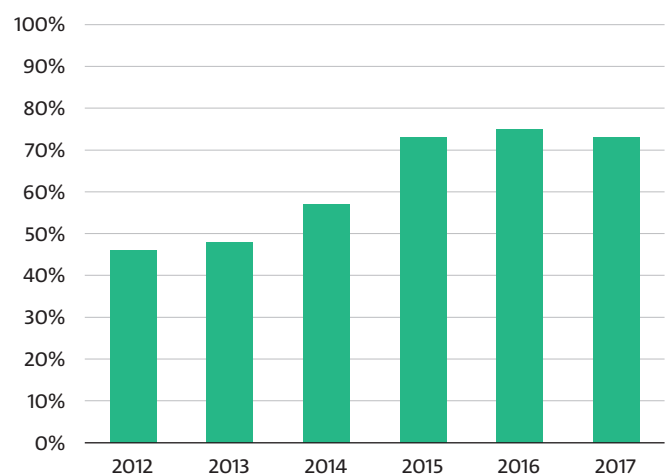
Source: Ministry of Information and Communication and Vietnam Association for Information Processing<sup>82</sup>

## 1.9 Sharing and the platform economy

The sharing economy has been facilitated by cloud computing platforms, the high rate of adoption of smartphones and Vietnamese consumer preferences for low personal asset ownership.

For example, in the last five years, ride-sharing platforms have created competition for traditional taxi businesses. Vietnam was the first country in Asia to attract Uber, and, excluding China, was Uber's fastest-growing market globally in 2015.<sup>113</sup> In 2018, Grab acquired Uber's operations in the ASEAN region, but Go-Jek's entry into Vietnam in September 2018 is set to increase competition. Traditional taxi services are increasingly developing their own platforms and mobile apps to compete. Meanwhile, court proceedings are determining whether ride-sharing platforms will need to follow the same regulations as traditional taxis – which may reduce their competitive edge.

Peer-to-peer lending is growing in Vietnam, with platforms such as Timma, Vaymuon and Mofin offering loans to individuals and Lendbiz offering business loans. Through the Lendbiz service, businesses can apply for up to 1 billion VND (US\$44,000) loans without collateral, and these can be approved within 24 hours. The Lendbiz platform is attractive to investors. Only 500,000 VND (US\$22) is needed to join, and there is the potential to achieve high returns with yearly interest rates up to 20%.<sup>114</sup>



**Figure 20 Business usage of online public services in Vietnam (%)**

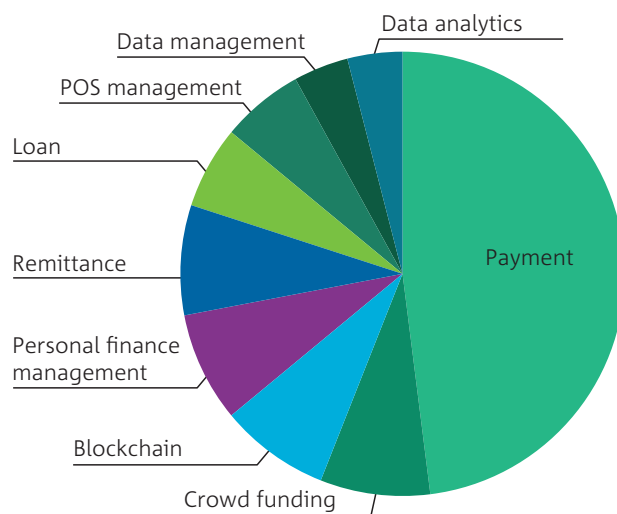
Source: Ministry of Industry and Trade<sup>111</sup>

## 1.10 Financial technology

Digital technologies have given rise to new business models and emerging 'sunrise' industries. Financial technology (fintech) services and products have been among the fastest growing.

Vietnam is a rising star in the global fintech industry.<sup>115</sup> The number of incubators, accelerators and innovation labs in Vietnam is 42 – above Indonesia (20), Malaysia (10) and Thailand (5) and only below Singapore (52).<sup>116</sup> In 2017, Vietnam had 48 fintech firms providing services from payment to remittances and cryptocurrency.<sup>117</sup> The composition of fintech firms is changing, however. Payments still account for a large proportion of fintech start-ups, emerging segments such as insurtech (insurance), wealthtech (wealth) and regtech (regulation) are attracting interest from investors around the world.

At the same time, fintech firms involved with cryptocurrencies are decreasing their presence in Vietnam due to a high level of uncertainty over the use and mining of cryptocurrencies in the nation. Bans have been discussed by government agencies, with varying levels of enforceability. Investment funds and firms have been told to avoid cryptocurrency investments. A ban on cryptocurrency mining equipment has been supported by some ministries. Authorities may need to consider policy options to manage problems associated with cryptocurrency scams that have occurred in the country while also developing strategies to deal with both legal and illegal uses of cryptocurrencies and their role in cross-border currency flows.



**Figure 21 Fintech segments in Vietnam (proportion of fintech companies operating in different areas)**

Source: State Bank of Vietnam<sup>117</sup>



## 2 CASE STUDIES – AWARENESS AND READINESS FOR DIGITAL TRANSFORMATION OF MANUFACTURING AND AGRICULTURE SECTORS

The agriculture and manufacturing sectors were surveyed to provide an in-depth examination of the current state of technology adoption, and the intended speed of future adoption of Industry 4.0 technologies and systems. A separate survey assessed consumer interest in digital products and services.

The agriculture and manufacturing sectors were selected for in-depth examination for the following reasons:

- **They are largest contributors to the overall economy:**

In 2017, the two sectors combined contributed more than 30% of total GDP in Vietnam (see Figure 22). The manufacturing industry has been the driving force for overall national economic growth – growing by more than 14% in 2017 and offsetting the decline in the mining sector that year. The agriculture sector also maintained stable growth at around 2.9% over the last five years, including steady growth in export revenue (around 8% per year) over the same period.<sup>60</sup>

- **There is a high risk of labour displacement through Industry 4.0:**

The agriculture and manufacturing sectors are big employers in the Vietnamese economy, accounting for around 60% of the total labour force (see Figure 22). Industry 4.0 and the introduction of sector-wide automation will create significant labour displacement, especially in routine-task jobs which make up a high proportion of employment in these two sectors. Understanding the challenges of this transition is critical for Vietnam to mitigate labour market impacts of Industry 4.0 policies and the application of newer digital technologies.

- **They are the sectors likely to see the highest gains from Industry 4.0:**

Vietnam’s labour productivity in agriculture and manufacturing ranks very poorly compared to other East Asian nations.<sup>118</sup> Within the Vietnam economy, the agriculture sector performs the most poorly among all the sectors, and manufacturing does not perform much better.<sup>118</sup> Hence, these sectors are where digitisation could have the highest gains for production performance, business operations and productivity.

- **Data constraints:** An examination of the databases of the General Statistics Office showed there is lack of enterprise-level data about digital transformation in the agriculture and manufacturing sectors, whereas this data is relatively available in other industries such as e-commerce, finance, tourism and logistics.



**Figure 22 Contributions of agriculture and manufacturing to Vietnam’s economy (2017)**

Source: General Statistics Office<sup>23</sup>



## 2.1 Manufacturing and agriculture survey methodology

A series of surveys investigated the level of digital awareness and adoption across businesses and consumers in selected manufacturing subsectors and agriculture in Vietnam. In particular, the research team focuses on three modules:

**Survey module 1** assessed the current state of technology use and awareness of Industry 4.0 among enterprises in the manufacturing and agriculture sectors.

This survey aims to answer questions such as: (i) What is the level of awareness of Industry 4.0 within enterprises in selected manufacturing subsectors and agriculture?; (ii) What are the main incentives and barriers for organisations to further adoption of digital technologies associated with Industry 4.0?; (iii) What are key areas and technologies of impact to Vietnamese manufacturing and agriculture?

**Survey module 2** estimated the level of readiness for digital transformation among representative companies in the agriculture and manufacturing sectors. Here, representative companies refer to those which are considered pioneers in digital adoption in selected manufacturing subsectors and agriculture subsectors in Vietnam.

This survey aims to answer: (i) What is the level of digitalisation in representative companies in agriculture and manufacturing Vietnam?; (ii) what is the frontier of digital adoption in selected subsectors in manufacturing and agriculture?

**Survey module 3** broadly gauged consumer demand for digital goods and services in three areas of the digital economy: e-commerce, the sharing economy and e-government.

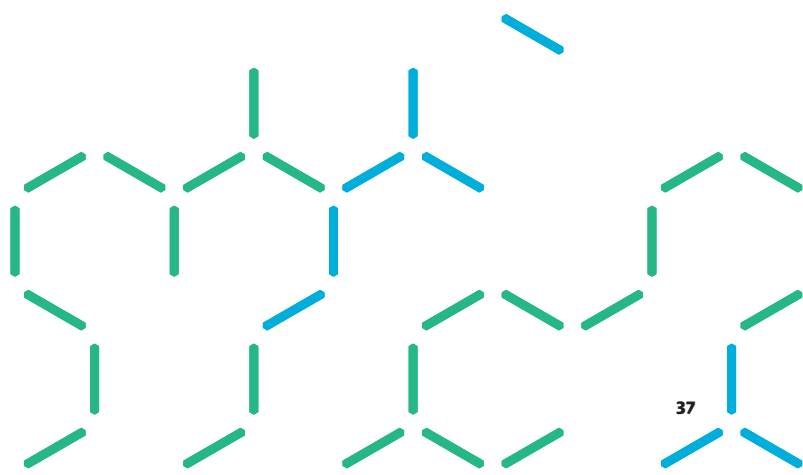
A summary of the survey plans are represented in Figure 23 (See Appendix C for the survey methodology and response rates).

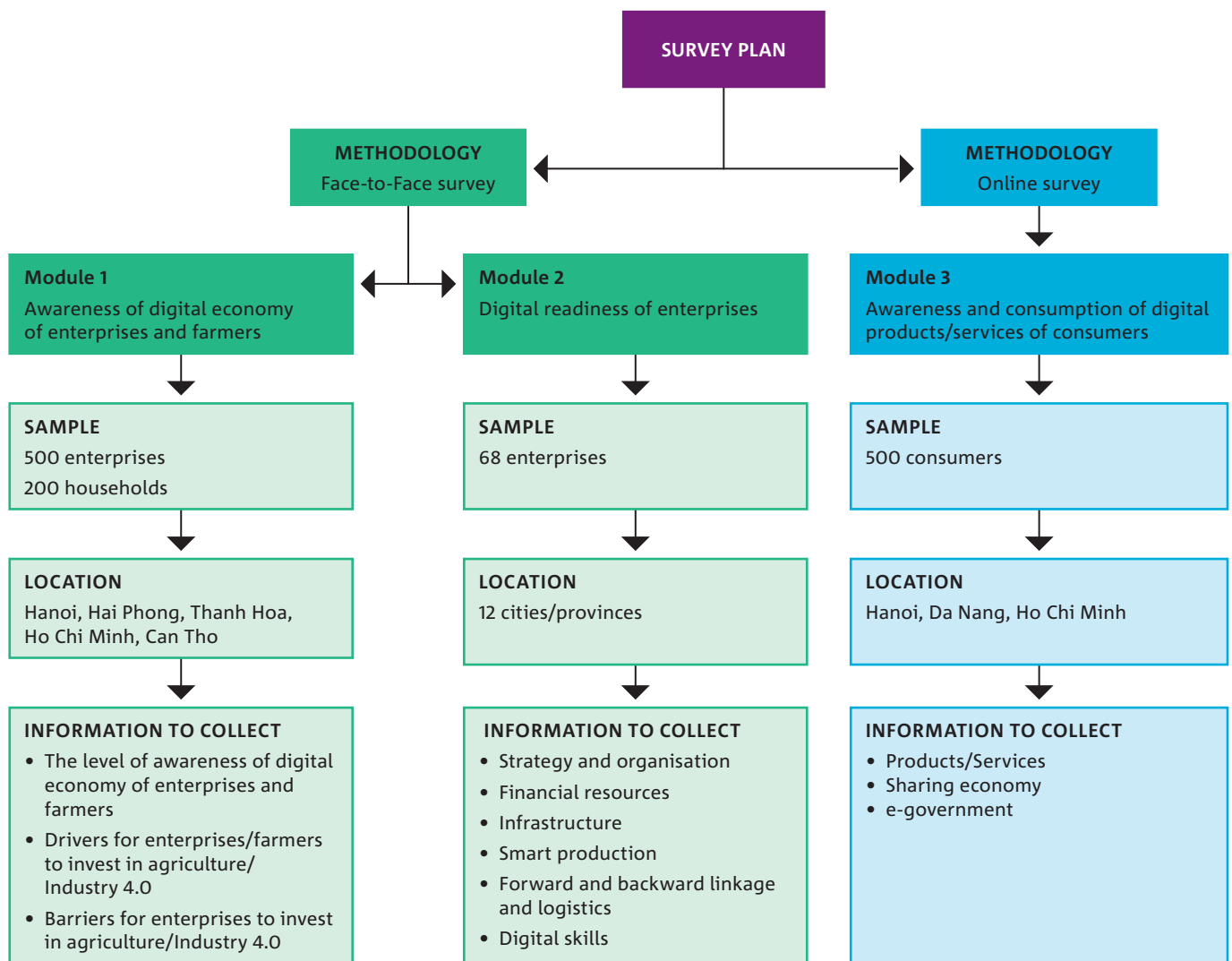
From the results of Module 2, a Digital Adoption Index<sup>a</sup> (DAI) was created to measure representative companies' state-of-development in relation to the application of digital technology in agriculture and manufacturing. Enterprises were assessed across different dimensions such as strategy, financial investment, infrastructure, smart production and logistics. The DAI is then computed by weighting each of these areas to build a synthesized readiness indicator for the entire enterprise.

Similar to the DAI, the Ministry of Industry and Trade (MOIT) conducted a study in 2018 which examined business readiness for Industry 4.0 reforms in Vietnam.<sup>119</sup> The survey found the majority of firms in Vietnam are either at the initial stage of technology adoption or have not applied digital technologies to the production process at all. In particular, 16 out of 17 surveyed sectors were classified as at the initial stages of digital adoption.

The results of MOIT's survey, however, differ from those presented in this chapter because the MOIT survey targeted the average level of digital technology adoption across various industries in Vietnam. Our DAI aims to determine the level of digital adoption across representative businesses – ones that are considered pioneers in digital adoption in selected manufacturing subsectors and agriculture subsectors in Vietnam.

<sup>a</sup> Refer to Appendix C for details on DAI calculation





**Figure 23 Survey methodology on digital awareness, digital transformation readiness and digital consumption**

Source: Ministry of Science and Technology analysis

## 2.2 Manufacturing and agriculture survey results

### INFORMATION TECHNOLOGY ACCESS

The majority of businesses surveyed in the manufacturing and agriculture sectors have applied information technologies in their production. The main applications include everyday business management as well as customer and supplier contact through email and websites. However, the adoption rate is much lower for

agriculture households.<sup>b</sup> Only one in every five agriculture households have access to digital technologies, compared to around 70% for agriculture enterprises and 85% for manufacturing enterprises.

Half of agriculture households state they find Industry 4.0 to be useful to their businesses. This level is comparable to those in material or other manufacturing sectors.

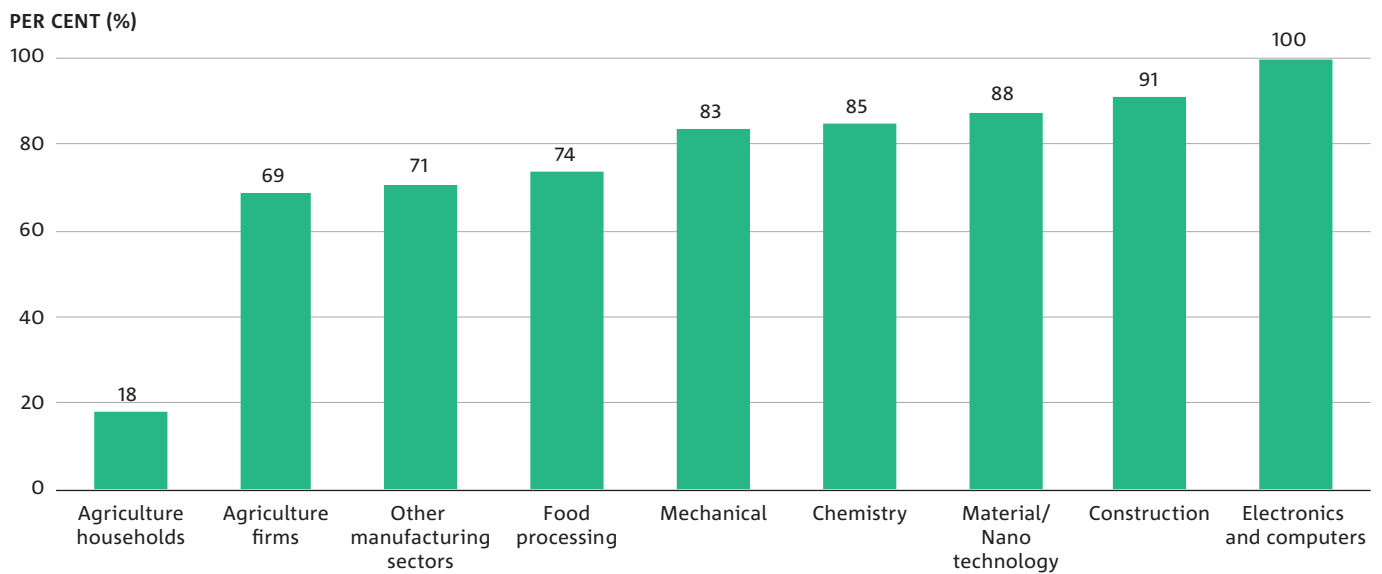


Figure 24 Information technology use across industries

Source: Ministry of Science and Technology analysis

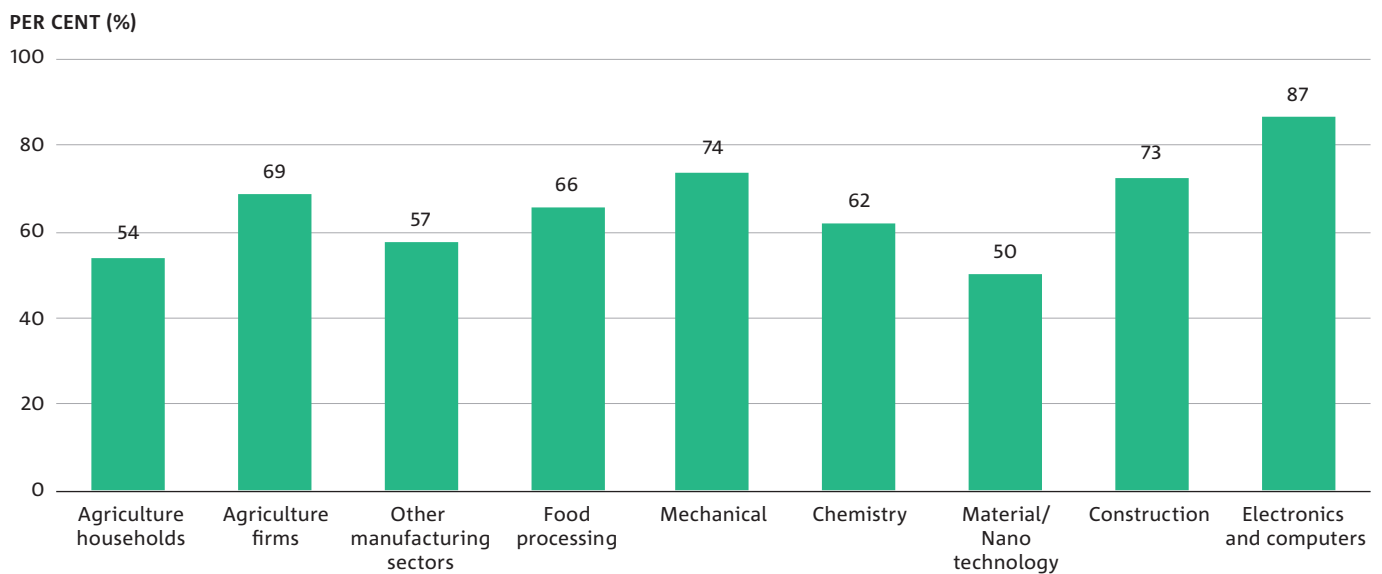


Figure 25 Organisations that find Industry 4.0 important

Source: Ministry of Science and Technology analysis

<sup>b</sup> We use the United Nations definition (as per the *Handbook of Household Surveys*, 1984), where 'agriculture households' are households with at least one member operating a holding (farming household) or when the household head or main income earner is economically active in agriculture.

## REASONS FOR ADOPTING DIGITAL TECHNOLOGIES

The most commonly stated reasons for Vietnamese enterprises to invest in digital technology is to reduce input costs, increase productivity and enhance business management.

Small businesses in agriculture, especially agriculture households, are not motivated to adopt digital technologies for environmental protection and risk management. However, the figure for environmental protection and risk management increases considerably for enterprises that deal with foreign partners.

Export enterprises in both sectors put significantly more weight on risk management and environmental issues compared to companies that only supply the domestic market.

## EMERGING TECHNOLOGY TRENDS

There is wide range of views across sectors and business types on what are the most important technologies to deploy for future business operations and efficiencies.

Agriculture companies and households have different views on the leading technologies for the sector in the future. Larger enterprises expect greater impact from innovations in machinery and equipment and recognise the increasing importance of automation equipment, sensor measurement and data collection. Meanwhile, household enterprises and farmers expect the greatest impact from the technologies that support real-time decision making and address daily management issues.

In manufacturing, since the majority of enterprises are engaged in the assembling and outsourcing stages,

technologies directly related to production are the most appreciated. These include process monitoring and control (56%), robotics (47%) and automation technology (29%). The level of interest in these areas is high across all surveyed sub-sectors and business types.

Technologies associated with research and development, analysis and marketing have received much less attention. Only around 7% and 6% of manufacturing firms appreciate the roles of simulation technology and big data technology respectively.

## CHALLENGES TO GROWTH

Lack of finance and insufficient information were found to be the main barriers to further digitalisation at an enterprise level in Vietnam's manufacturing and agriculture sectors. In particular, unclear economic benefits and uncertain impacts of technology adoption, and prohibitively high investments are the most important challenges for digitalisation in Vietnam, especially for small and medium enterprises.

## VISION AND STRATEGY

Most businesses in the two sectors are relatively new to the concept of Industry 4.0. Most surveyed enterprises have examined options for further digitalisation, but only a negligible proportion have developed detailed plans or allocated funds for digital adoption.

Formal businesses (as opposed to many household enterprises) appear to be better at planning for digital investment. Approximately 35% of formalised agriculture enterprises and about a quarter of manufacturing enterprises plan to invest in Industry 4.0 technologies in the coming year, compared with less than 15% of household businesses.

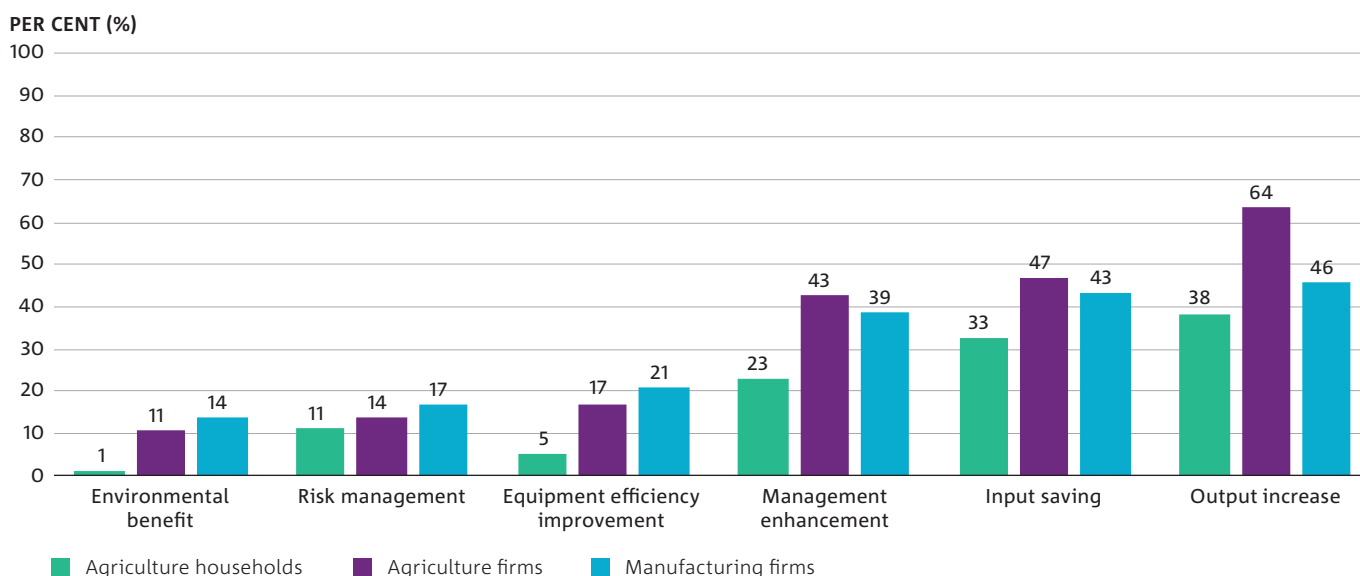
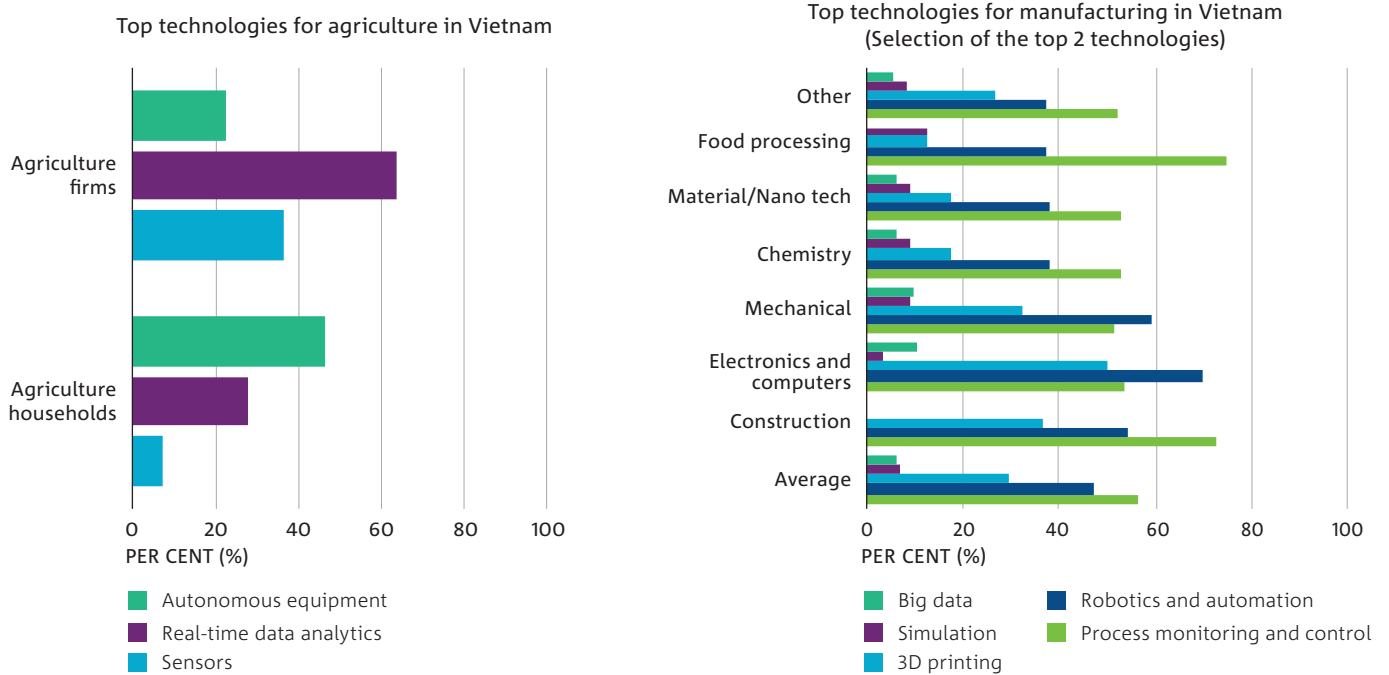


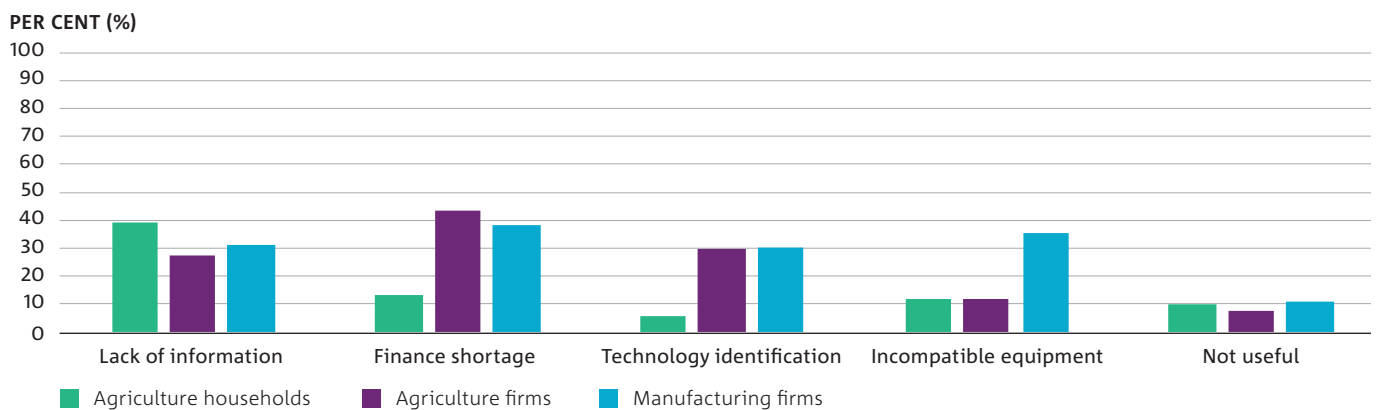
Figure 26 Reasons given as to why enterprises should adopt digital technologies

Source: Ministry of Science and Technology analysis



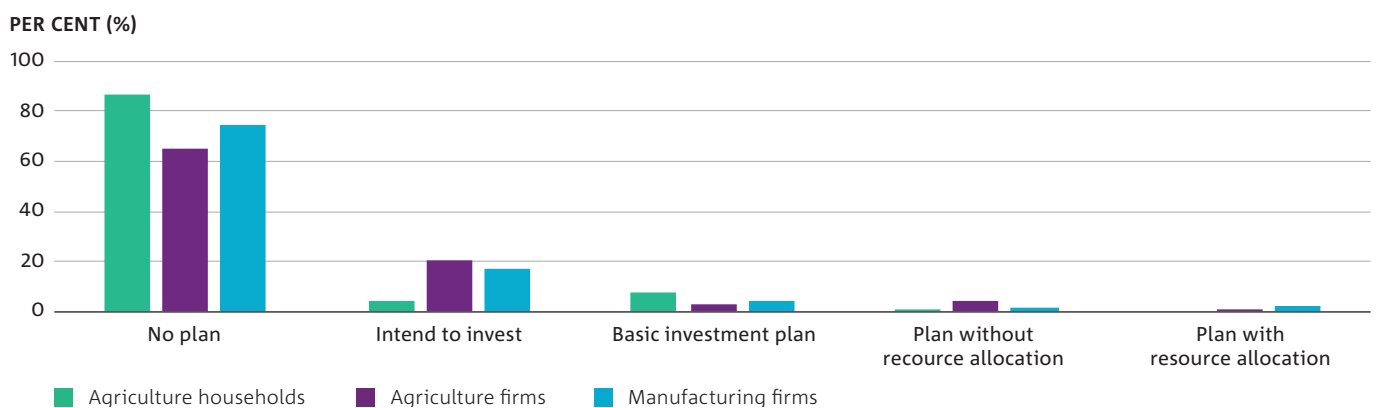
**Figure 27 Important technologies for the manufacturing and agriculture sectors**

Source: Ministry of Science and Technology analysis



**Figure 28 Top challenges to digitalisation in Vietnamese agriculture and manufacturing firms**

Source: Ministry of Science and Technology analysis



**Figure 29 Enterprise plans for digital adoption in the next 12 months**

Source: Ministry of Science and Technology analysis

## SNAPSHOT ON DIGITALISATION OF LEADING COMPANIES

A Digital Adoption Index<sup>c</sup> (DAI) was created to measure leading companies' state-of-development in relation to the application of digital technology in the two sectors (agriculture and manufacturing). Enterprises were assessed on six indicators (including strategy, financial investment, infrastructure, smart production, logistics and human resources). The Digital Adoption Index has been computed by weighting each of these areas to build a synthesised readiness indicator for the entire enterprise.

### Digital Adoption Index results

Overall leading companies in both the manufacturing and agriculture sectors were found to be at the beginner or intermediate level of digital adoption on the DAI.

The DAI assessed six factors contributing to digital adoption within enterprises. *Strategy* and *Finance* were the factors shown to be the largest barriers to digital adoption, while *Infrastructure* and *Forward and backward linkages* were the least significant barriers.

**Infrastructure:** The high value of *Infrastructure* (3.17 and 3.28 for manufacturing and agriculture, respectively) indicates that most companies in the two sectors are focusing on initial business development using basic digital technologies. Benefits are quickly gained from the digitalisation of internal operations and processes. More than 45% of firms believed that their IT systems met the requirements for digitalisation for their business. Companies, however, state they encounter difficulties in regards to cybersecurity and the compatibility of their IT systems and other machines in the production process.

**Forward and backward linkages:** Leading companies have effectively digitalised their logistics operations. More than 60% of companies actively use multiple integrated sale channels such as websites, blogs, forums and social media platforms to reach customers. Around 40% have, to a certain extent, integrated real-time information to the entire value chain such as sale forecasts and warehouse planning and logistics. However, many companies still see more room for improvement; only 30% believe they have achieved a high level of digital integration in logistics.

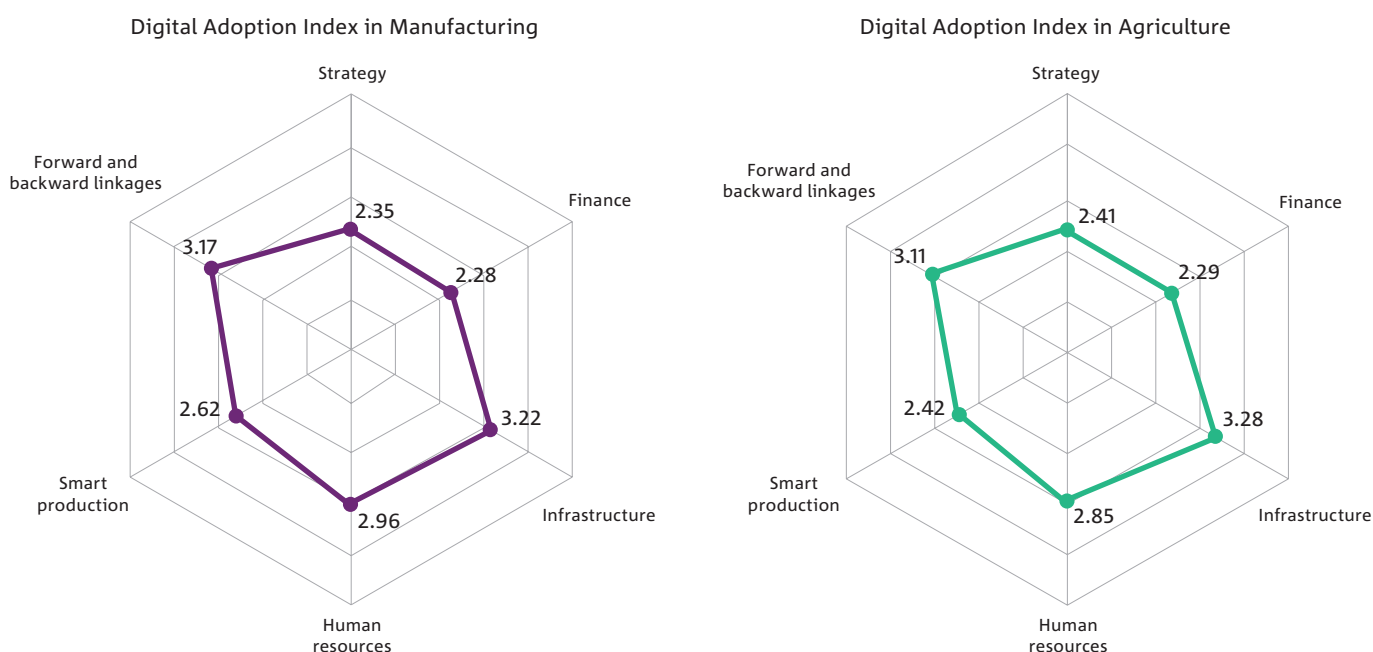


Figure 30 Digital adoption levels across dimensions in Vietnam's leading companies

Note: Adoption level: Level 1 – Outsider; Level 2 – Beginner; Level 3 – Intermediate; Level 4 – Experienced; Level 5 – Pioneer/Expert.

Source: Ministry of Science and Technology analysis

<sup>c</sup> Refer to Appendix C for details on DAI calculation

**Digital skills and capabilities:** Around 40% of enterprises surveyed reported adequate ICT skills to maintain and fully utilise their digital systems. Many enterprises also lack regular practice using ICT software and systems. Approximately 30% state their employees are familiar with, and use collaboration software such as virtual teams on daily basis. However, less than 20% of enterprises stated that they offer regular training or retraining on ICT-related skills for employees.

**Finance:** The largest barrier to digital adoption for the agriculture and manufacturing sectors in Vietnam is finance. Only around 15% of enterprises surveyed reported significant investment in digitalisation in the last year and 18% indicated an intention to invest significantly in the next five years.

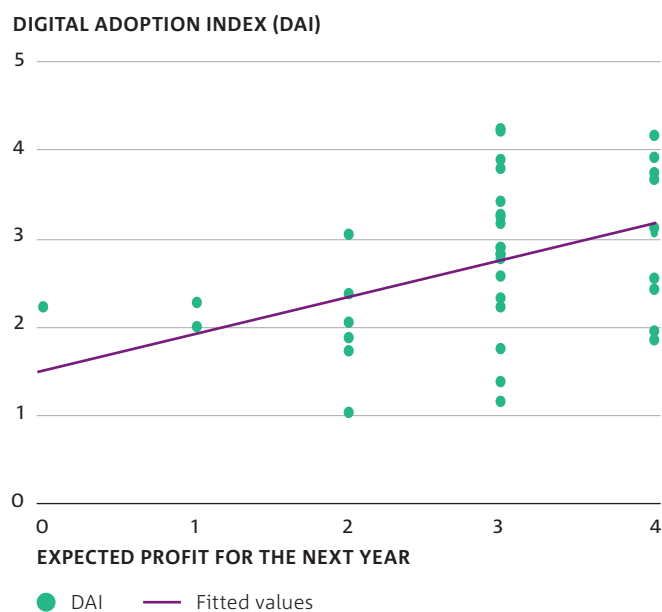
The low investment among leading enterprises may be a result of insufficient available finance and a reluctance to invest in digitisation. Investing in new technology also involves significant uncertainty. Some enterprises state there is a lack of trusted information available on the benefits of investing in new digital systems, and they lack the skills to identify the appropriate technology, especially for the initial phases of systems upgrades.

**Strategy:** The majority of leading enterprises surveyed in the two sectors have managed to incorporate digitalisation in their corporate or business strategy. However, only one in every four companies has created a detailed roadmap or a coordination unit on digitalisation. In addition, around 30% stated the company’s leaders are fully knowledgeable and aware of the importance, workings and implication of Industry 4.0.

**Smart production:** Only 20% of surveyed enterprises stated that interconnected production equipment used in their organisations allow for IT-access, and real-time information on the organisation’s production. Around 30% are applying new technologies such as autonomous production lines, FMS (flexible manufacturing systems), CIM (computer integrated manufacturing) or hydroponics/ indoor farming (growing plants without soils), vertical farming, seawater-farming, precision agriculture.

Only 20% of Vietnamese enterprises in agriculture and manufacturing reported they regularly collect data from all stages of the production process and store it electronically. A smaller proportion (less than 18%) have real-time observation on production processes and have the capability to dynamically respond to changes in demand.

**Digitalisation impact:** To show the impact of digitalisation on financial performance of companies, we also conducted a statistical test on the impact of the digital adoption index on the expected profit of the companies in the next year. The regression analysis uses the sample of 39 manufacturing companies for which we have expected profit values. The result suggests a positive relationship between companies’ digitalisation level measured by the digital adoption index and expectation on future profit. This supports the hypothesis that digitalisation leads to the improvement of productivity and efficiency and thus enables them to save inputs, increase outputs and reach a higher profit margin.



**Figure 31 Profit expectations tend to be higher for firms with a higher Digital Adoption Index**

Source: Ministry of Science and Technology analysis

## 2.3 Consumer views on digitalisation

The following section is devoted to Survey Module 3, which analysed consumer attitudes to digitalisation in three major areas: e-commerce, the sharing economy and e-government.

### E-Commerce

In contrast to the reluctance of the business sector, Vietnamese consumers widely embraced digital engagement. Most respondents (92%) shopped for fashion goods, clothes, footwear and cosmetics online. Meanwhile, online purchases of essential items such as groceries, food and drinks, electronics and refrigerated items were carried out by 60% of survey respondents.

### THE SHARING ECONOMY

About 70-80% of respondents stated they had used the sharing economy in the past 12 months. Respondents assessed a low to medium risk level for buying or selling services on sharing economy apps.

The majority of Vietnamese consumers are familiar with taxi services using mobile apps or websites (91%). The majority of consumers using this type of service highly rated it for saving time and expenses, augmenting income and flexibility.

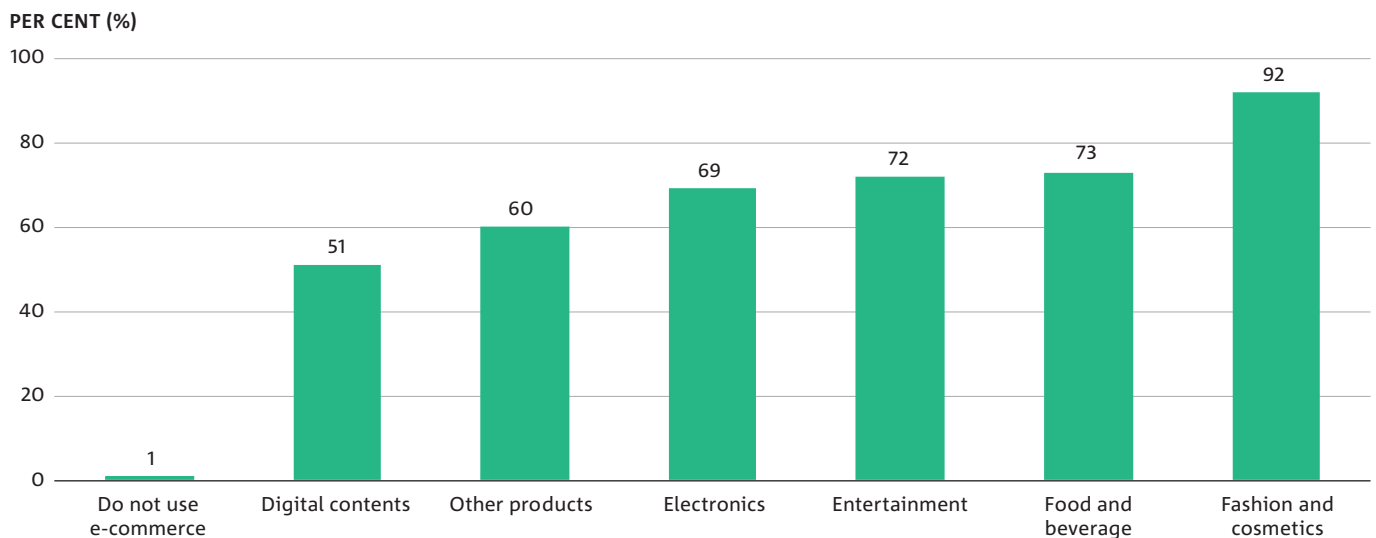


Figure 32 Services purchased over the Internet in the last 12 months

Source: Ministry of Science and Technology analysis

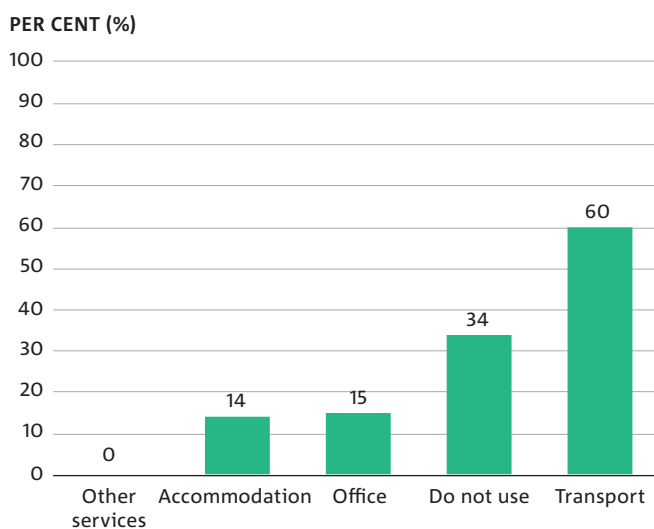


Figure 33 Use of the sharing economy in the last 12 months

Source: Ministry of Science and Technology analysis

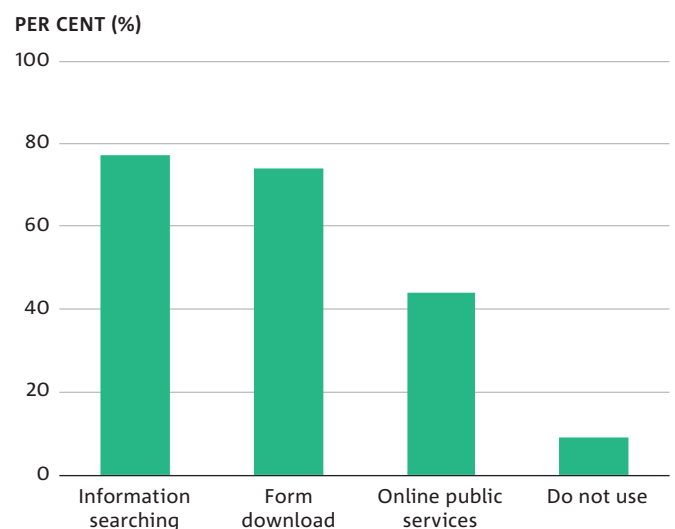


Figure 34 E-government service usage

Source: Ministry of Science and Technology analysis



## E-GOVERNMENT

Citizens' perception of e-government services is relatively positive. The majority of people (60-70%) stated that e-government services help boost the efficiency of public services by reducing processing time and costs, and increasing accountability and transparency. Other benefits of e-government such as empowering civil rights were viewed as less important (less than half of respondents see improving civil rights as an important feature). Respondents who have never used e-government services stated barriers to use included service limitations, a lack of information or instructions on how to use the services, and cybersecurity risks.

## 2.4 Implications for digital development in Vietnam

**Industry 4.0 shows a promising start in Vietnam in the agriculture and manufacturing sectors.** With the exception of agriculture households, the majority of survey respondents had integrated digital technologies into their production processes. The average Digital Adoption Index of agriculture and manufacturing sectors stands at 2.7. Overall, firms showed the highest digital adoption readiness in infrastructure and logistics. However firms were less prepared in terms of finance, strategy and smart production. The Digital Adoption Index shows better-than-expected results considering Vietnam's level of development in agriculture and manufacturing.

**The importance and impact of using digital technologies is recognised across the two sectors.** Incentives to incorporate digital technologies and processes into production for enterprises included productivity improvement through reducing costs, increasing outputs and enhancing business management.

Selling to international markets often requires higher standards of production and record-keeping. Exporting firms have a greater incentive to apply digital technologies to promote environmental benefits and risk management, as part of overall production quality and standards.

**Diverse views on emerging digital technologies.** Different sectors held different views for which digital technologies will have the greatest impact on their business operations. Agriculture enterprises prioritised automation, machinery, sensors and data collection. Meanwhile, household agriculture businesses prioritised technologies to support real-time decision making and daily management issues. In the manufacturing sector, technologies to enable production were prioritised, including process monitoring and control, robots and automation. Very few manufacturing firms were interested in technologies for big data analysis, marketing or research and development.

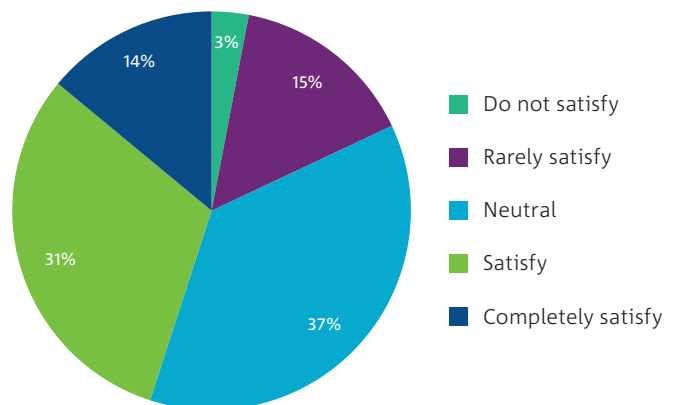


Figure 35 Level of satisfaction with e-government services (% of customers)

Source: Ministry of Science and Technology analysis

**Demand is on the rise.** Vietnamese consumers are embracing digital engagement in all three areas surveyed: e-commerce, the sharing economy and e-government. Digital technologies, and platforms in particular have dramatically changed people's interactions, work and consumer habits. Vietnam's businesses need to understand these universal trends to take advantage of the benefits of the new consumer economy.

## 2.5 Challenges for the digital transformation

Investment in digital technology is still considered high-risk by many enterprises, because the technologies' long-term efficiency has not yet been measured. Moreover, the high cost of implementing Industry 4.0 systems and technologies is prohibitive for many firms and businesses.

Most of the challenges to undertake digital transformation are shared among both industries, including:

- Access to finance, especially among micro and small to medium enterprises (MSMEs)
- Lack of information on new digital technologies and services, especially for household businesses
- Determining which technologies to adopt and adequate technology suppliers
- Available skills and capabilities for implementation and management of Industry 4.0 systems and technologies.

# 3 CONCLUSIONS – THE CURRENT LEVEL OF DIGITAL TRANSFORMATION IN VIETNAM

Vietnam’s economy is changing dramatically through the application of new digital technologies. Some industries in Vietnam are digitalising rapidly, including e-commerce, tourism, digital content and fintech. These industries show high potential for Vietnam’s digital economy in the coming years.

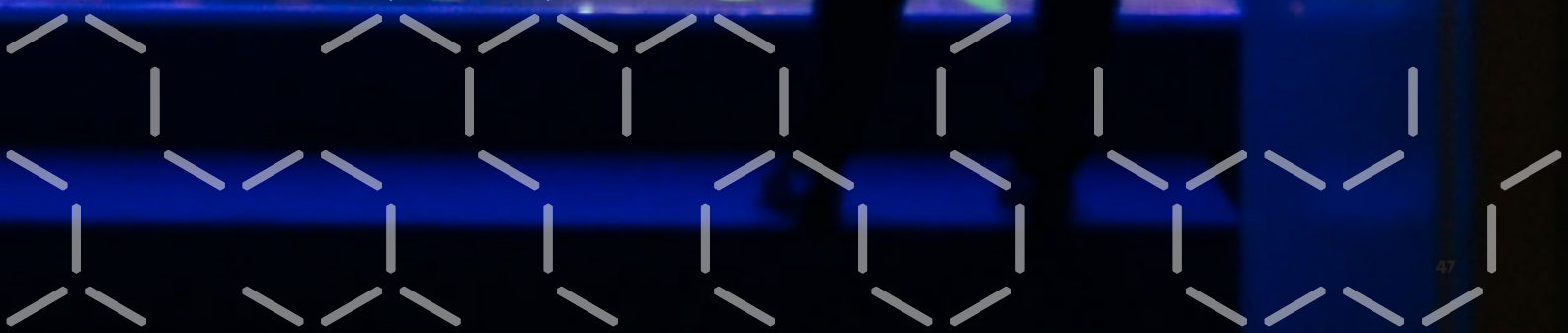
Case studies in the fields of agriculture and manufacturing processing, however, show a moderate level of readiness for digital transformation. While firms in these sectors are well aware of the importance of digital technologies in production, they have trouble adopting new technologies due to financial and technical issues. However, given Vietnam’s context and position in 2019, there remains a high potential return for Vietnam’s digital economy – both in traditional and emerging industries.

The consumer survey results suggest that, as industries transform, Vietnamese consumers are adapting quickly and adopting new products and services of the digital economy. This is beneficial for attracting investment and growing Vietnam’s digital economy.

Overall, this chapter lays the foundation for identifying megatrends affecting Vietnam’s current digital economy, and how they may impact the development of Vietnam’s digital economy in 2045, as described in later chapters of this report.



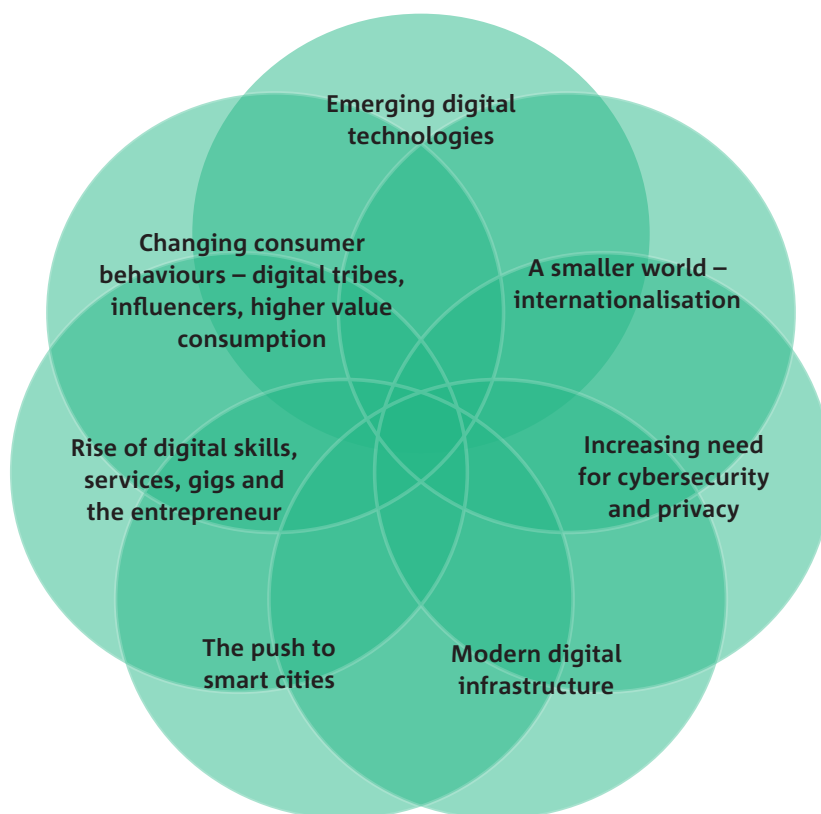
## PART III MEGATRENDS



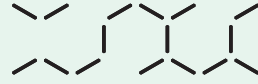
A megatrend is a deep-set and gradual pattern of change building with increasing momentum to change the economy. Megatrends occur at the intersection of multiple trends more specific to a time and place.

The megatrends analysis involved a horizon scanning process which identified economic, technological, social, geopolitical, legal and environmental trends likely to impact Vietnam’s future economy. Individual trends were then qualitatively grouped together into draft megatrends. These were reviewed by digital economy stakeholders via workshops and interviews at Hanoi (82 participants), Ho Chi Minh City (98 participants) and Da Nang (52 participants). Stakeholders included those from various sectors including government, business, start-ups, media, academia and development organisations.

With advice from the digital economy stakeholders in Hanoi, Da Nang and Ho Chi Minh City, the research team identified seven megatrends likely to drive Vietnam’s future digital economy to 2045. The year 2045 was selected to approximate a 25-year span, while aligning with strategic timelines in the public and private sectors.

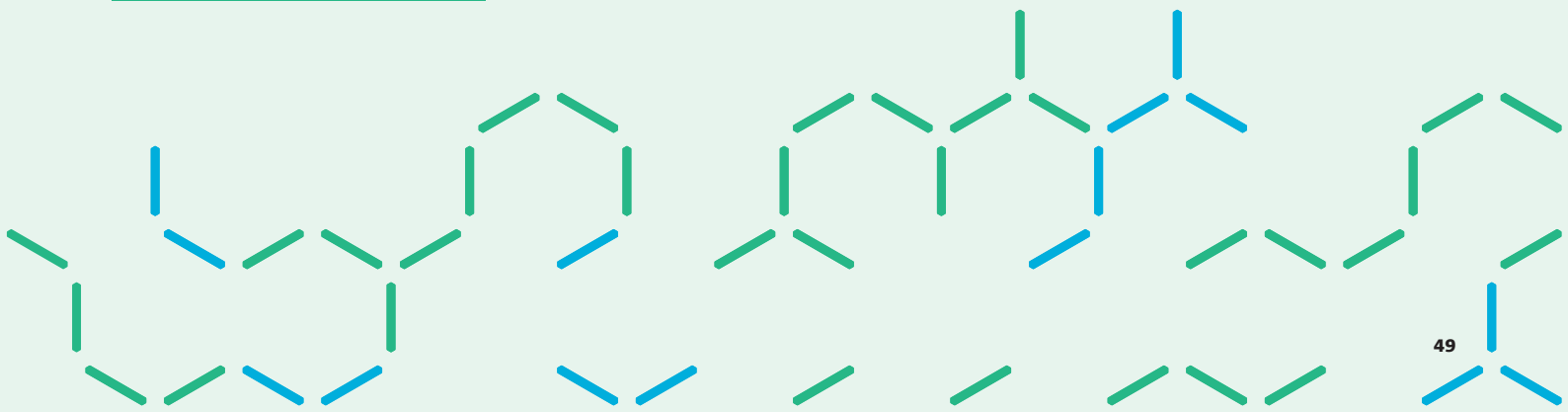
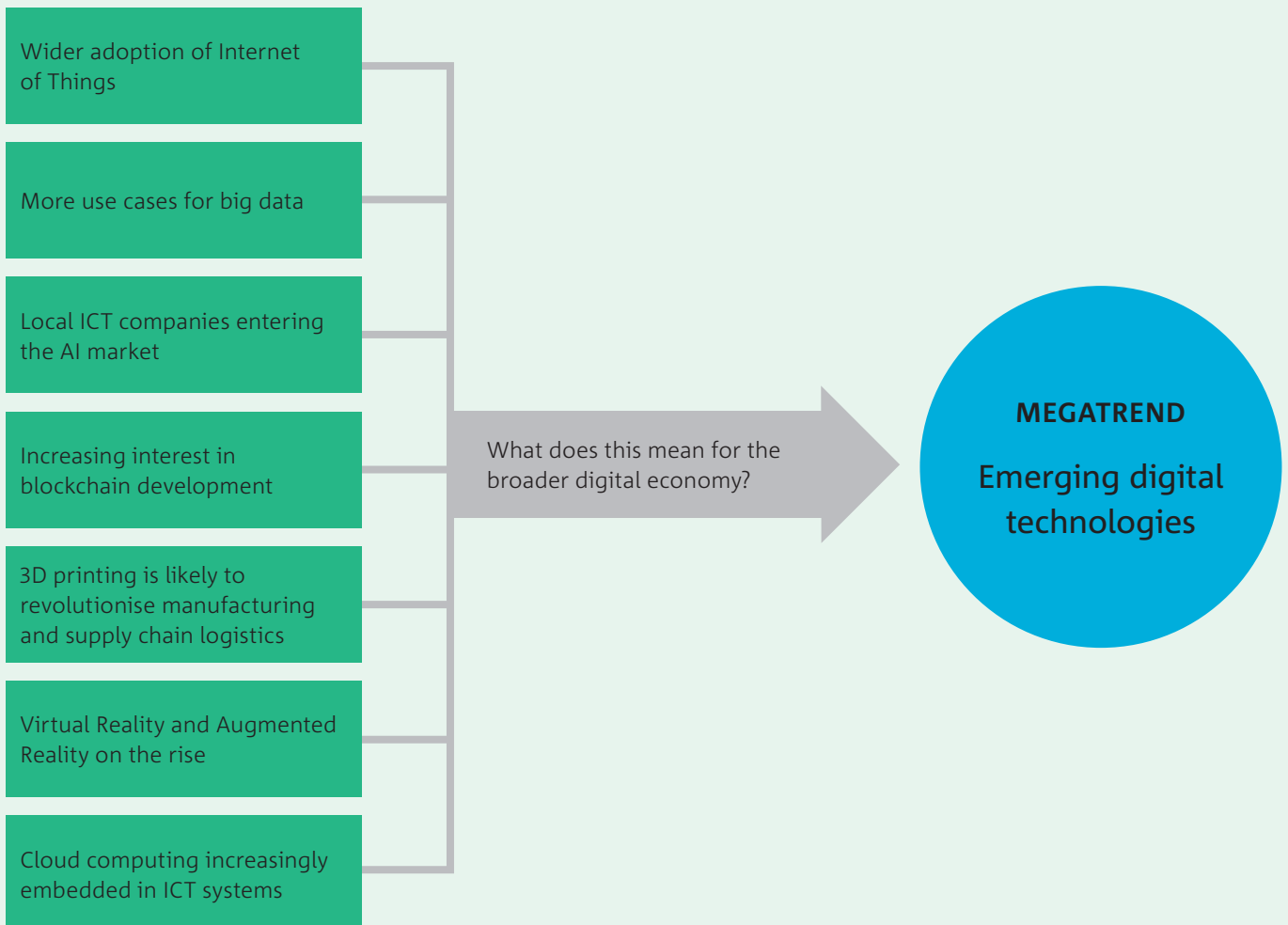


# EMERGING DIGITAL TECHNOLOGIES



Emerging digital technologies such as blockchain, Artificial Intelligence, big data analytics and the Internet of Things can leapfrog industry infrastructure upgrades, simplify supply chains and logistics, and help businesses operate more efficiently.

## RELEVANT MICRO TRENDS










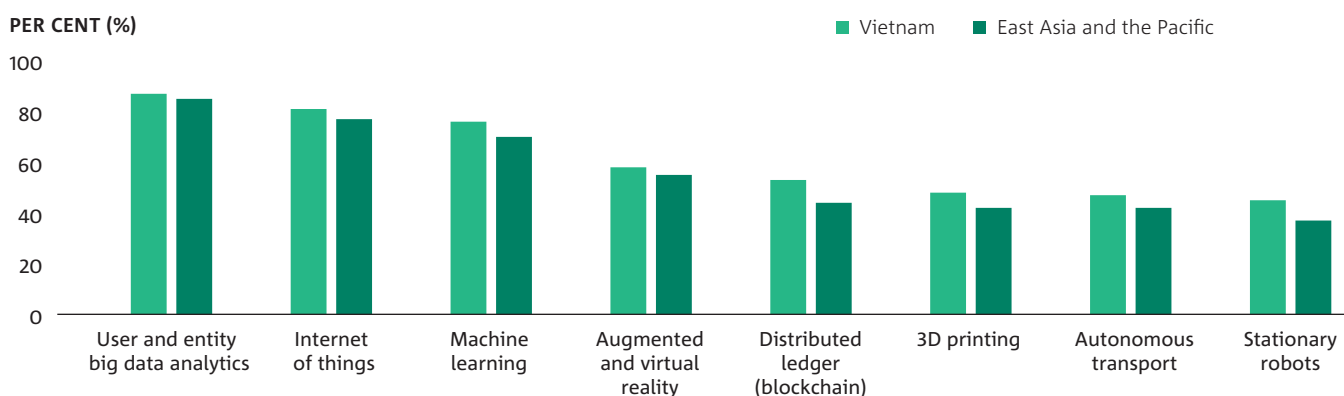
## Institutional environment

The main regulatory frameworks on digital technologies are the *Law on High Technologies* (Law No. 21/2008/QH12), the *Law on Information Technology* (Law No. 67/2006/QH11) and the *Law on technology transfer* (Law No. 07/2017/QH14).

Uptake of emerging digital technologies in Vietnam is largely driven by Industry 4.0 policies (for a description of relevant policies see Part I, 3.2) and general digitalisation strategies (for a list see Appendix B.1.6).

**Table 5 Emerging digital technologies and their applications**

EMERGING DIGITAL TECHNOLOGY	WHAT IT DOES AND HOW IT'S USED
 <p><b>Internet of Things</b> – including sensors, networks, drones and automated vehicles</p>	<p>Environmental monitoring and remote automation on smart farms, smart cities, autonomous vehicles, drones, remotely operated mines and defence systems.</p> <p>These are often integrated into advanced GPS or geospatial systems. Requires supportive wireless broadband networks and cloud services. Can create cyber-physical systems – used to monitor plant, animal or environmental systems or human health through sensors and wearable technology.</p>
 <p><b>Big data analytics</b></p>	<p>Customised services and profiling, security assessments, large systems modelling such as environmental and weather systems, markets, transport systems, consumer behaviour, health and genetic research. Can produce predictive analytics to anticipate behaviour, weather or maintenance for infrastructure for example.</p>
 <p><b>AI, machine learning robotics</b></p>	<p>Systems and robotics that can self-correct and adjust to changing environments, respond to a variety of circumstances or queries, and build on previous data inputs. Applications may include natural language processing and voice recognition, robotics including automated vehicles and factories, and health, transport and business services.</p>
 <p><b>Blockchain technologies</b></p>	<p>Distributed ledgers and third party trust networks that have been used to create digital ‘crypto’ currencies – such as Bitcoin. They also have widespread applications in food and mining provenance, voting systems, payment networks, social networks, smart contracts, and trading platforms.</p>
 <p><b>Virtual and Augmented Reality</b></p>	<p>Visual overlays to enhance performance, create games (such as Pokémon Go), or allow visualisation of new structures. Applications are found in medicine, training and development, entertainment, mining, real estate, tourism and in vehicles, eyewear and ‘smart’ homes.</p>
 <p><b>3D printing</b></p>	<p>A new way to manufacture products that adds physical materials layer-by-layer until a product’s shape matches a digital design. 3D printing is ideal for prototyping because it is highly customisable, on-demand and has lower cost per unit in limited production runs. Other applications include medicine, textiles, aerospace and motor vehicles.</p>
 <p><b>The cloud</b></p>	<p>Provides a simple way to deliver computing services on demand over the Internet. This is an enabler for digital applications such as video streaming services, social networking, digital storage and on-demand backups, application testing and development and, most importantly, big data analytics and Internet of Things.</p>



**Figure 36 Share of large companies (%) adopting emerging digital technologies in Vietnam and East Asia/the Pacific**

Note: This data only represents digital adoption within large companies (in terms of revenue and/or number of employees), not small or medium sized businesses.

Source: World Economic Forum<sup>120</sup>

## Significant trends

- **Wider adoption of Internet of Things (IoT):** Around 75% of global Internet connections by the year 2020 are expected to come from machine-to-machine devices connected via short-range wireless.<sup>121</sup> In 2016, 4G LTE wireless networks began being deployed across Vietnam, with plans to cover over 95% of the population by 2020.<sup>122</sup> These mobile wireless services can also support low-power wide area networks essential for IoT services. Vietnamese telecommunications and IT companies like Viettel, VNPT, FPT and CMC are investing in IoT, with IoT smart city infrastructure being trialled since 2008.<sup>123</sup> Foreign firms – such as CISCO, Bosch and the Sumitomo Corporation – are also investing heavily in Vietnam smart city projects, along with foreign governments from Japan, Singapore, the Netherlands, Sweden and Germany.<sup>124</sup> The Australian Government, with the Asian Development Bank and Mekong Business Initiative, held the Smart City Innovation Challenge to source solutions to Vietnam’s urban challenges from global innovators.<sup>125</sup> The Vietnam Government itself has directed significant funding to smart city projects – especially in Da Nang, Ho Chi Minh City and Hanoi.<sup>126,127</sup> To improve local innovation and IoT technology, Hoa Lac Hi-Tech Park opened in 2016 to support IoT start-ups. Since 2016 Saigon Hi-Tech Park in Ho Chi Minh City have hosted several IoT start-up competitions and incubation programs, supporting over 40 IoT start-ups by 2017.<sup>128,129</sup> Large local firms – Vinamilk and Cau Dat Farm – are automating many of their processing facilities with sensor networks and IoT logistics.<sup>123,130</sup>
- **More use cases for big data:** Digital data from phones, tablets, wearables, apps, platforms, search engines, websites, sensor networks, cameras and satellite images are creating a tsunami of data for analysis and data ‘mashing.’ In 2016, there were an estimated 17.6 billion data-collecting devices connected to the Internet worldwide. By 2025, this is likely to jump to 80 billion.<sup>131</sup> This creates the need for data analytics and feeds into more complex applications – many of which involve Artificial Intelligence. Increasingly, businesses will exploit opportunities to monetise data and analytics, or use data insights to create organisational efficiencies, predictive customer services or expanded markets. Global big data revenues are expected to increase by 14% compound annual growth per year, and quadruple from US\$18.3 billion in 2013 to US\$88.5 billion in 2025.<sup>132</sup> As the market matures, this growth is expected to decline to a degree.<sup>132</sup>
- **Local ICT companies entering the Artificial Intelligence (AI) market:** AI and automated systems have shown breath-taking advances in recent years. Computers and robotics are now solving complex problems using self-generated strategies. Their ability to solve problems without human assistance – explicit rules, instructions or guidance – is core to the technology’s future growth.

The next decade will see major advances in sensory systems, machine learning, predictive analytics and AI generally. Growth forecasts for the global AI market vary widely due to contrary definitions of AI. But most forecast that the sector will grow rapidly and quickly infiltrate business processes. Some predict the global AI market will be worth US\$61.6 billion in 2020, and up to US\$8.3 trillion (GVA) globally by 2035.<sup>133</sup> Vietnam ICT company CMC states much of the AI technology developed in other countries cannot be used in Vietnam due to differing management structures, policies and ways of doing business. So there is high demand for locally-developed software.<sup>134</sup> CMC are developing AI for the Vietnamese market but they are not the only ones. In 2017, IT company FPT launched an AI conversational platform which developers can integrate with their own apps or smart devices.<sup>135</sup> By 2018, the platform generated 4.8 years of speech and converted 2.5 billion characters.<sup>136</sup>

- **Increasing interest in blockchain development:** The global blockchain market is predicted to grow up to 58.4% per year to reach US\$10.6 billion by 2023.<sup>137,138</sup> Much of that growth is expected to come from the Asia Pacific.<sup>138</sup> Recent events and initiatives in Vietnam like the Blockchain and FinTech Challenge (May 2018), Vietnam Blockchain Week (March 2018) and Vietnam Blockchain Club (established in 2017 and currently boasting around 3000 members on social media) indicate a promising start for technology development and uptake. A number of blockchain pilots are being delivered in Vietnam for food provenance and remittance.<sup>139-144</sup> *Forbes* magazine suggests Vietnam will soon become South East Asia’s innovation hub for blockchain development.<sup>145</sup>
- **Virtual Reality (VR) and Augmented Reality (AR) on the rise:** Driven on the back of rapidly rising smartphone ownership, VR and AR development is predicted to soar globally, particularly in the health, training, digital games and tourism sectors. Predictions suggest the global market for AR/VR will reach US\$94.4 billion by 2023, with the Asia Pacific being the primary centre of growth.<sup>146,147</sup> Leading technology companies in Vietnam such as FPT, Viettel and VNG showcased VR travel and entertainment at conferences in 2017 and 2018.<sup>148-150</sup> The Ho Chi Minh City campus of the Royal Melbourne Institute of Technology (RMIT) is running courses on AR/VR development.<sup>151</sup>
- **3D printing is likely to revolutionise manufacturing and supply chain logistics:** Additive manufacturing (or 3D printing) is an emerging Industry 4.0 technology. For now, global adoption of this technology is mainly limited to prototyping.<sup>152</sup> Vietnam itself is ranked as a third-wave adopter.<sup>153</sup> However, widespread adoption in the next two decades could drastically speed up production, trim and globalise supply chains (since

products can be designed anywhere but printed locally), reduce waste and automate manufacturing jobs. As 3D printing becomes cheaper and faster, business leaders across ASEAN nations expect it to eventually become a primary driver of the manufacturing industry – perhaps as soon as 2025.<sup>154</sup> Frost & Sullivan forecasts that by 2025, 3D printing revenue to the Asia Pacific will grow to US\$5.6 billion.<sup>152</sup>

- **Cloud computing increasingly embedded in ICT systems:** Global revenues from public cloud computing services is forecasted by analyst firm Gartner to increase from US\$175.8 billion to US\$278.3 billion between 2018 and 2021.<sup>155</sup> Vietnam is relatively behind other nations in cloud computing adoption – with the nation ranking last out of 24 nations in readiness for adoption and growth of cloud computing services.<sup>156</sup> Reasons for this included the legal and regulatory environment, level of cybersecurity and a lack of Intellectual Property rights which therefore impede cloud research and development. Other barriers to adoption include budgeting restraints and a lack of awareness about benefits of the technology.<sup>157</sup> However overall cloud computing adoption is increasing in Vietnam. According to the Lee Kuan Yew School of Public Policy, Vietnam revenue on cloud services grew 64.4% between 2010 and 2016 – a faster rate than those of Thailand, the Philippines and Indonesia.<sup>157</sup> Adopters of the technology in Vietnam cite a number of benefits of the cloud, including increases in agility, scalability, competitiveness, profitability and customer satisfaction.<sup>157</sup>

## Opportunities

Technologies can increase productivity, access to new business models and new markets, consumer trust and industrial growth.

- Higher productivity, especially labour productivity, across all sectors including public services.<sup>158,159</sup>
- Transition the economy into new business models and new markets, with less and less time and financial investment required as digital technologies are further developed.<sup>159</sup> This will be particularly helpful for digitalising micro and small to medium businesses in the nation.
- Greater transparency and trust in public and private sector organisations.<sup>160</sup>
- Opportunity to leapfrog industrial phases and transition from manual to automated processes.<sup>160</sup>

## Risks

Digital technology could raise risks related to jobs, skills and discrimination.

- **Job automation:** Up to 38.1% of Vietnam’s current jobs can be transformed or displaced due to automation by 2045.<sup>d</sup> A more moderate estimate suggests around 15% of total jobs in Vietnam will be automated by 2033.<sup>161</sup>
- **Skills shortages:** For example, Vietnam is projected to be short 500,000 data scientists, and up to 1 million ICT workers by 2020.<sup>83,162</sup>
- **Unfair algorithms:** AI can create opacity and discrimination in life-affecting judgements and processes. For example, facial recognition software used for policing is sometimes inaccurate and more likely to falsely identify people, or proxies for discrimination can be used to assess financial loans, education admissions, insurance or other life-affecting processes, and could potentially discriminate against certain social groups.<sup>163-165</sup>
- **Digitalisation could deepen inequality:** A 2016 World Bank report shows that digital technologies deliver fewer benefits to the poor, and higher potential benefits for those who are not poor.<sup>166</sup>

## Implications for the development of Vietnam’s Future Digital Economy

The listed digital technologies are key areas for Vietnam’s future digital economy, underpinning smart city and Industry 4.0 initiatives. Within Industry 4.0, for example, big data and IoT will help Vietnam sustain its competitive advantage by providing valuable information to operators and improving demand forecasting, production planning, provenance and logistics. This will improve productivity, customer service, increase profit margins, maximise efficiency and reduce human error.

These technologies also introduce new opportunities for business – with the ability to increase productivity through digitalisation, and scale up business with less financial investment required. Smaller businesses have a lot to gain through digitalisation, however widespread digitalisation of smaller businesses is likely to require concerted efforts to build digital skills, awareness of the benefits, as well as access to finance and/or financial incentives.

d Data61 analysis. See Appendix D for methodology, and Part IV for more detailed results.



Care also needs to be taken with digitalisation since it can deepen inequality.<sup>166</sup> Growth in Vietnam's emerging middle class, for example, could be stifled by digital disruption from automation – especially for low-skill workers. People with only primary school education are 3.1 times more likely than tertiary graduates to be employed in a job at high risk of automation.<sup>154</sup> To achieve inclusive growth, economic and social prosperity of citizens needs to come

first – through upskilling and regulations to protect digital workers. To support both inclusive growth and widespread digitalisation, the digital economy requires a supportive ecosystem – a healthy competitive environment for businesses, institutions for citizen empowerment and an education system to equip users with skills to benefit from the digital economy.



## Case study

### Blockchain: increasing consumer trust in dragon fruit exports

**The Challenge:** As the middle classes rise across Asia,<sup>167</sup> more consumers want to verify their food is safe and ethically produced.<sup>168</sup> However, micro to medium enterprises struggle to give this information to consumers and foreign regulators in a provable way.<sup>169</sup> Through better regulation, new technology and trust systems, Vietnam can dramatically increase the value of its food exports – particularly in boutique products.

Ethitrade launched in 2017 after its pioneers won an international hackathon to help small and medium enterprises build their online identity and trading reputation.

Following this success, The Asia Foundation and Australia's Department of Foreign Affairs and Trade engaged the team to use blockchain to build the reputation of dragon fruit exported from Vietnam.

This is a key export according to the General Department of Vietnam Customs – selling nearly US\$430 million in the first quarter of 2018.<sup>170</sup>

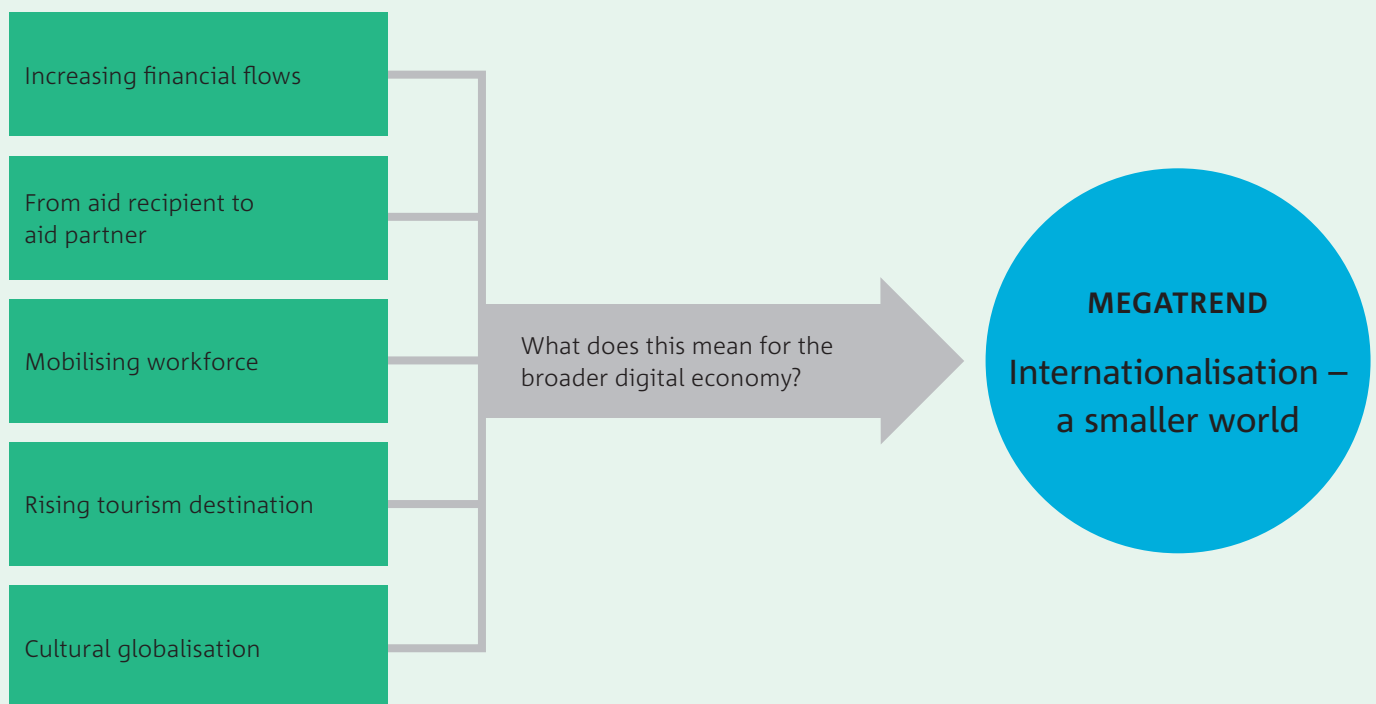
**The Solution:** A blockchain-based food provenance platform is being piloted for the dragon fruit supply chain from Vietnam to Australia. From farm to plate, workers along the supply chain enter transactions and upload certifications onto the blockchain via a mobile phone. Consumers in Australia can scan a QR code to view the dragon fruit's journey.

**Expected results:** The system could empower farmers in micro to medium enterprises to enter global trade and become internationally reputable. Farmers of other crops could also benefit in the future, since the system is expected to scale easily to other food products.

# A SMALLER WORLD - INTERNATIONALISATION

The digital economy can benefit from international integration – by opening Vietnam to new export markets, knowledge and skills transfer, and greater levels of foreign investment.

## RELEVANT MICRO TRENDS



## Institutional environment

**Trade openness:** By early 2019 Vietnam had signed 16 free trade agreements, with 12 in effect and 4 under negotiation. Among those in effect is the *Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP)*, which covers 13.5% of global GDP. Trade is likely to be further boosted by regulations which permit foreign payments (i.e. US, Chinese, Japanese and European currencies) along Vietnam-China border areas (*Circular No. 19/2018/TT-NHNN*).

**Foreign direct investment (FDI):** While economic reforms since 1986 have generously increased FDI into Vietnam,<sup>26</sup> analysts warn more reform is needed to maintain FDI in the longer term.<sup>84</sup> The Vietnam Government is preparing the next set of FDI reforms, which will be outlined in documents such as the *Socio-economic development strategy 2021-2030 (2021)*. For these documents, the Government is considering a significant shift from trying to attract as much FDI as possible to increasing the value gained from FDI in terms of knowledge and technology transfer.

**Cooperation:** Vietnam has formed *strategic partnerships* with several nations, including the United Kingdom, India,

Australia, Japan, Malaysia and the Philippines. Vietnam is also working towards the *ASEAN Community Vision 2025*, a roadmap for unity and well-being in the region. Many smaller-scale cooperation programs operate in Vietnam, such as the Mekong Business Initiative and Finland-Vietnam Innovative Program. Vietnam will continue its multilateral relations, and improve the quality and efficiency of strategic cooperation.

**Workforce mobility:** Migration policy in Vietnam encourages locals to work abroad on fixed term contracts, through the *Law on Vietnamese working abroad under labour contracts (Law No. 72/2006/QH11)* and its implementation under *Decree No. 126/2007/ND-CP*. Migration policy is also geared to attract high-skilled labour into Vietnam, especially returning Vietnamese.

**Tourism:** Tourism in Vietnam operates under the *Law on tourism (Law No. 09/2017/QH14)*, with ambitious national targets set out in *Resolution No. 08-NQ/TW*. To meet these targets, the government is building new airports, opening new international flight paths, investing in human resource development, promoting Vietnam's brand-value, along with a range of other activities.



Figure 37 Foreign direct investment in select ASEAN nations, net inflows (current US\$), 2000-2017

Source: World Bank,<sup>26</sup> Data61 analysis

## Significant trends

- **Increasing financial flows:** In 2017 Vietnam's trade openness ratio (exports plus imports as a percentage of GDP) was 200%, ranked 5<sup>th</sup> among 264 economies.<sup>26</sup> New Free Trade Agreements (FTAs) are likely to shift Vietnam's private sector to a different export and import structure in line with the FTAs. FDI into Vietnam has grown each year since 2011, rising to US\$14.1 billion in 2017.<sup>26</sup> Financial flows also come from family and friends, with remittances into Vietnam growing ten-fold between 2000 and 2017 to US\$13.8 billion.<sup>171</sup>
- **From aid recipient to aid partner:** Official development assistance (ODA) has contributed to Vietnam's success in lowering poverty and improving infrastructure.<sup>172</sup> Once Vietnam reached middle income status, however, the nation changed from being an aid recipient to an aid partner.<sup>172</sup> ODA peaked in 2011 at US\$6.9 billion and lowered to US\$2.8 billion by 2015.<sup>172</sup> ODA will continue to decline and new loans will have higher interest and less favourable terms.<sup>172</sup> Therefore, Vietnam will have to more efficiently target their investments of ODA.
- **Mobilising workforce:** The country's overall net migration rate is nearly zero, indicating equal levels of imported and exported labour.<sup>173</sup> The Ministry of Labour, Invalids and Social Affairs reports that 134,750 Vietnamese workers were sent abroad in 2017 – an increase from 80,320 in 2012.<sup>174</sup> These overseas experiences are thought to reduce local unemployment, upskill workers and supply firms in Vietnam with higher-skilled labour as workers return. Reports suggest in practice, however, there is difficulty connecting returning workers with firms, despite the demand for higher-skilled labour.<sup>175</sup>
- **Rising tourism destination:** Rising middle classes in Asia, along with Vietnam's natural beauty, has led to a booming tourism industry in Vietnam. Vietnam saw a predicted 9 million international tourists in 2018, and the nation is expected to see 13.7 million visitors in 2028.<sup>176</sup>
- **Cultural globalisation:** Global influence on culture is rising as more people engage with foreign cultures online.<sup>177</sup> With 58 million active Facebook users in 2017, Vietnam is ranked as Facebook's 7<sup>th</sup> largest user base.<sup>88</sup> An example of a culture change linked with internationalisation is an increase in consumerist values. Urban Vietnamese hold positive opinions about imported music and imported culture, especially cultural products imported online.<sup>177,178</sup> Shopping and consumption habits may continue to change as more foreign companies set up in Vietnam to accommodate the rising middle class. An influx of foreign business chains has already begun. For example, Japan's 7-Eleven expanded into Ho Chi Minh in 2017, opening 13 stores by August 2018.<sup>179</sup> Scholars have argued that language itself is changing in Vietnam – with English on track to

one day become an official language.<sup>180</sup> English may become common and sometimes even preferred among Vietnamese locals – for example in technical domains and as slang interspersed in Vietnamese speech. While some cultural characteristics of Vietnam are changing, traditional Confucian values – such as collectivism, harmony and respect of social roles and hierarchy – are likely to remain embedded in Vietnamese culture, even if their intensity lessens somewhat.<sup>181</sup>

## Opportunities

International integration provides opportunities to generate capital, exports and knowledge transfers.

- Increased capital into Vietnam through FDI, official development assistance, loans via Fintech platforms, venture capital—especially venture capital from China.<sup>159,172</sup>
- Increased exports/new markets,<sup>159</sup> including for tourism.
- More knowledge and technology transfer/jobs and skills—these are especially beneficial for developing digital skills and international-level entrepreneurial and innovative skills.<sup>159</sup>

## Risks

International integration could grow risks linked to global instability, tax, international companies and talent drain.

- **Vulnerable to global economic destabilisation:** Shocks are being felt from US and retaliatory trade tariffs. If the tariffs proceed, the IMF projects that global output will reduce by 0.5% by 2020.<sup>182</sup> While in the short-run Vietnam has benefitted by the relocation of manufacturing into Vietnam, it is unclear what the long-term effects will be.
- **Meeting increasing regulatory standards:** To be able to export to international markets, exported products need to comply with new regulations set out in newer Free Trade Agreements, and meet the high standards of international economies.
- **Exploitation and dominance by international companies:** Large international companies operating in Vietnam could avoid social and environmental obligations.<sup>183</sup> These companies also make it more difficult for local companies to join the value chain.<sup>160</sup> Local companies may not be able to compete if imported digital goods and services flood the market.
- **Movement of labour – local talent drained and demand filled by foreign workers:** Many skilled workers are migrating overseas,<sup>184</sup> worsening local skills shortages. Skills demands may remain unfilled, or may be filled by skilled international workers if the local education system remains unable to sufficiently upskill the local population.

## Implications for the development of Vietnam's Future Digital Economy

Digitalisation can facilitate trade. Conducting business online, for example, can reduce costs, especially for micro and small to medium enterprises (MSMEs). Vietnam can use digital platforms to stimulate international exports. Online platforms also reduce search costs. ICT products themselves have become a major part of Vietnam's export structure. Vietnam has the potential to become a leading production hub for ICT products such as electronic components and communication equipment. However, online competition from other Asian countries could hinder or depreciate Vietnam's digital services exports,<sup>185</sup> and prevent Vietnam from attracting talent and venture capital to develop the digital economy.

Fostering investment is critical to developing the digital economy, either through financing ICT infrastructure, energy infrastructure or skill transfer. Vietnam can

stimulate technology transfer through exchanging expertise (e.g. satellite technology). Assuming a supportive regulatory environment, the digital economy can source investment through the Fintech sector's remittance, P2P lending and crowdfunding services. These services could have high impact for growing local home businesses. A track record of productivity increases through the deployment of digital technology will also attract more FDI, creating a virtuous cycle.<sup>40</sup>

Vietnam's labour migration strategy could be adjusted to increase the value of Vietnamese workers experiences abroad. There could be, for example, more emphasis on creating skills building experiences in areas such as English, digital skills and creativity. As well, workers abroad would benefit greatly with programs to reintegrate them with the Vietnamese economy when they return.

### Case study

#### A credit scoring system to deliver finance access for all

**The Challenge:** Credit scores have only been calculated for 10% of the emerging markets population. Many customers are unable to receive credit ratings due to a lack of credit history or bank payment history. But in a predominantly cash-driven economy, unless people have already attained a bank loan they are unlikely to have credit or bank payment history. This leads to a 'chicken or the egg' dilemma, making finance inaccessible to billions of potential customers within emerging markets. With middle classes rising across Asia, these potential customers are a highly promising market.

**The Solution:** Trusting Social is a fintech AI company founded in 2013 in the United States by Nguyen Nguyen – a Vietnamese native aiming for financial inclusion for all. The company targets a market of three billion "invisible unbanked customers" from emerging economies.

By applying smart algorithms, advanced credit modelling, big data and machine learning, Trusting Social calculates credit scores of individuals using social, web and mobile data. To dispel concerns about information security, the company protects customer privacy through encrypted and anonymised data exchange. This means all information transferred between banks, telecommunications operators and Trusting Social are anonymous.

**Results:** Trusting Social was the winner of the Future of Money and Technology Startup Competition in 2014, and was among the top 10 fintech start-ups in the United States presenting at the Innotrube Start-up Showcase New York in 2014.



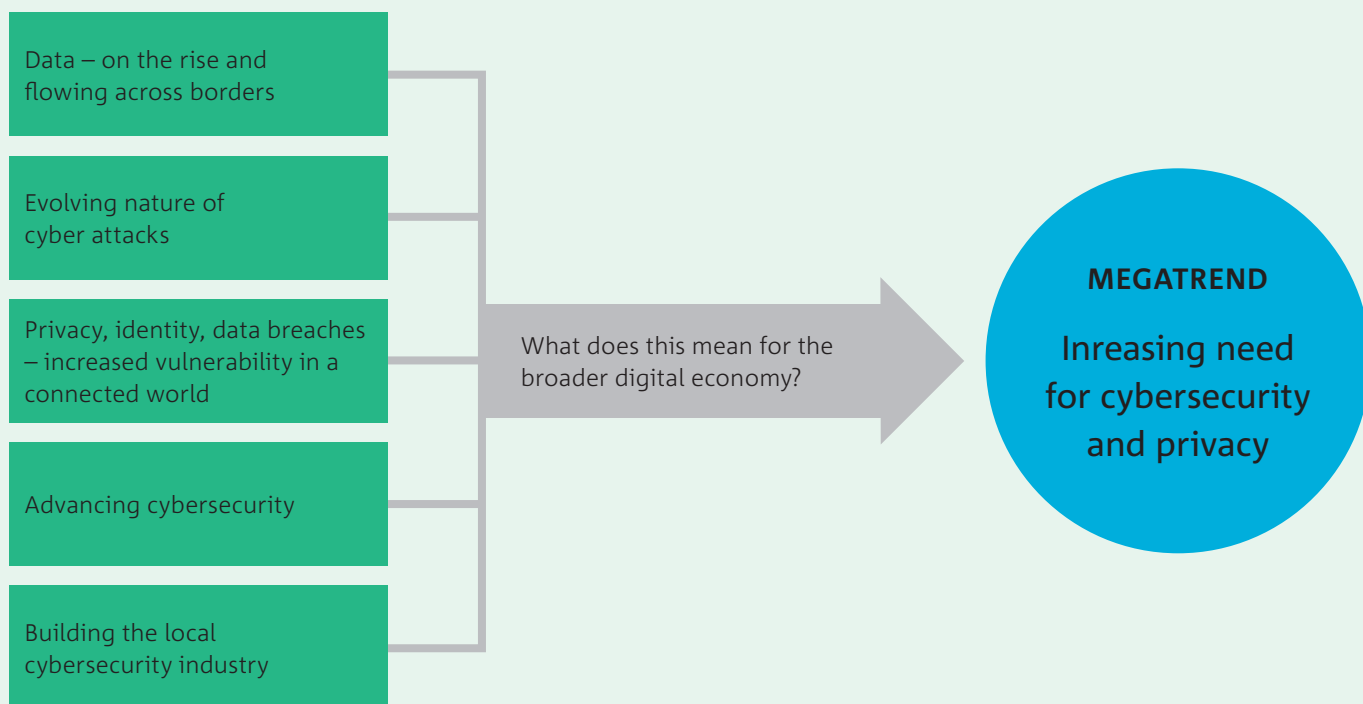
Trusting Social's credit scoring solution unpacks a market need largely untapped by traditional credit systems. The platform hopes to offer seamless credit accessibility for an additional 40% of the population. The people who used to be "invisible" can now become "visible."

Trusting Social is also building a digital marketplace for global credit that connects lenders and borrowers – including individuals and businesses. This platform aims to give lending and underwriting a completely digital and predictable workflow, enabling a launch pad for the next generation of credit products. As well, financial products and services delivered via the platform can be easily tailored to customers based on big data customer analysis.

# INCREASING NEED FOR CYBERSECURITY AND PRIVACY

There is greater need for cybersecurity and privacy as more businesses and consumers engage in the digital economy, and as critical systems such as finance and government are increasingly digitalised.

## RELEVANT MICRO TRENDS



## Institutional environment

A number of regulations support cybersecurity in Vietnam, which help secure the economy, national security and the privacy of citizens.

**Cybersecurity:** See Part I, 3.2 for a description of the institutional environment related to cybersecurity.

**Privacy:** Rather than having a unified law on privacy, protections are scattered across regulations. Both the *Constitution (2013)* and the *Civil Code (Law No. 91/2015/QH13)* list citizens’ right to private lives, personal secrets and family secrets. The main law related to privacy is the *Law on Protection of Consumers’ Rights (Law No. 59/2010/QH12)*. Here, private sector firms must notify users about personal data collection, and gain user consent before using the data or sharing it with third parties. User data is required to be kept secure and confidential, except where requested by state agencies. As well, the *Law on Information Technology (Law No. 67/2006/QH11)* requires collectors of user data (including agencies, organisations and individuals) to only use the data for proper uses. “Proper uses” are unclearly defined, however. Newer protections are listed in *Decree No. 27/2018/ND-CP*, which requires that social networking sites have a

user agreement, and lets users decide if their personal information can be collected or transferred. Enforcement of these regulations appears to be weak, however. According to the Ministry of Justice, it is rare for privacy infringement claims to reach Vietnamese courts.<sup>186</sup>

### Current state of cybersecurity in Vietnam and the Asia Pacific

Cybersecurity in Vietnam and across the Asia Pacific is below the world average. In 2016, Asia Pacific companies took nearly twice as long (1.7 times longer) as the global median to detect cybersecurity breaches.<sup>187</sup> A 2015 survey by ESET indicated that 78% of Internet users in Asia do not have any formal cybersecurity education.<sup>188</sup> Low capability makes the region vulnerable to cyber attacks, especially Vietnam. In the 2017 Global Cybersecurity Index, Vietnam ranked 101 out of 193 nations.<sup>66</sup> As well, in 2016 the proportion of computers affected by dangerous viruses in Vietnam was 63.2%, three times the global average.<sup>189</sup>

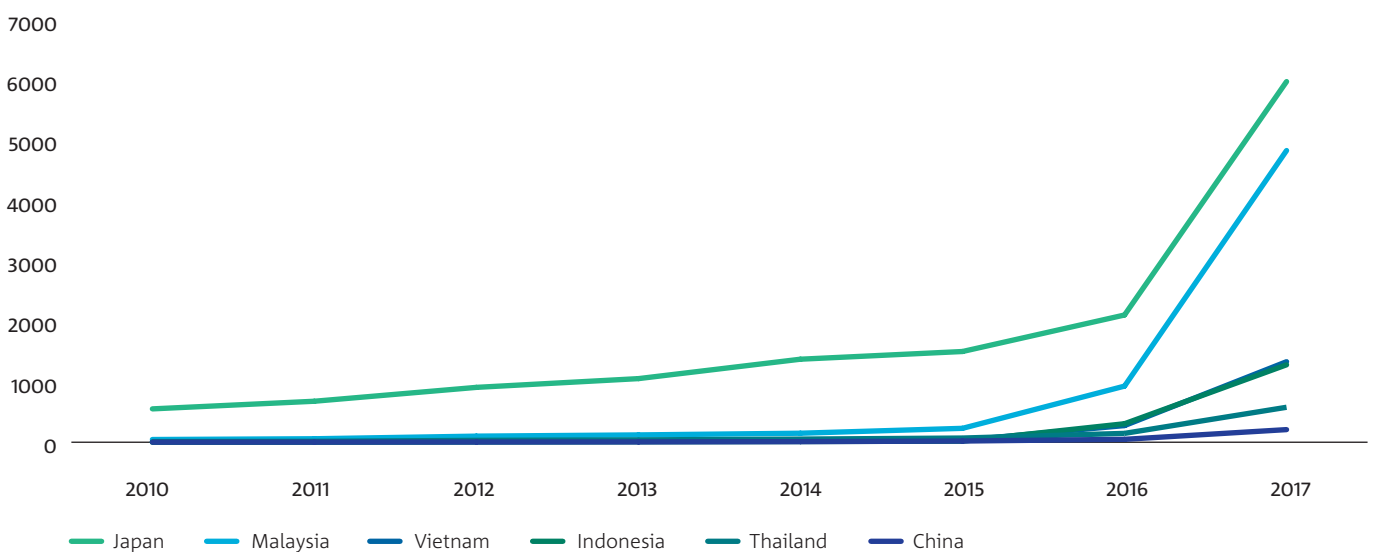


Figure 38 Secure Internet servers per 1 million people in select Asia Pacific countries

Source: World Bank<sup>26</sup>

## Significant trends

- **Data – on the rise and flowing across borders:** Between 2005 and 2014, global data flows increased by a factor of 45.<sup>190</sup> This increases vulnerability, especially as more people and more critical systems (e.g. smart city infrastructure, defence and banking) go online. As global data flows increase, cyber attacks or breaches anywhere in the world could compromise Vietnamese data.
- **Evolving nature of cyber attacks:** According to the BKAV Corporation – an IT company and network security experts – the cost of cyber attacks in Vietnam increased by 15% to US\$540 million between 2016 and 2017.<sup>191</sup> Increasingly cyber attacks on businesses are targeting multiple technologies at once.<sup>192</sup> BKAV analysis suggests IoT devices are especially vulnerable. For example, over three quarters of IP cameras (used for surveillance) in Vietnam used default accounts and passwords set by manufacturers.<sup>191</sup> Cryptocurrency-related attacks are another emerging threat.<sup>191</sup> While a number of cryptocurrency-related activities was made illegal in Vietnam in 2018, cryptocurrency will likely continue to be requested in ransomware attacks and mined covertly via malware infecting Internet browsers, websites and devices.
- **Privacy, identity, data breaches – increased vulnerability in a connected world:** In a 2018 CISCO report, over 40% of firms in Vietnam reported a US\$10 million cost to their business due to data breaches.<sup>192</sup> ATKearney estimates data breaches will cost ASEAN's top 1,000 businesses US\$750 billion between 2017 and 2025.<sup>193</sup> The *Law on Cybersecurity (2018)* – which requires foreign firms to store Vietnamese user data within Vietnam – has also raised concerns over data privacy.<sup>194</sup>
- **Advancing cybersecurity:** In Vietnam and across the Asia Pacific, the number of secure digital servers is growing exponentially (see Figure 38). Between 2015 and 2016, the Vietnam Information Security Index – which measures training/awareness, policy, investment, organisation, technological solutions and management solutions related to cybersecurity – improved by 13.5% to 59.9%. Further improvements came in 2017 when Domain Name System Security Extensions (DNSSEC) were deployed on .vn websites.<sup>195</sup> DNSSEC helps ensure users access websites as intended rather than being hijacked to harmful websites. After DNSSEC was installed, the portion of computers in Vietnam detecting threats (via Windows antivirus) halved compared to the year prior – from 45.9% to 21.2%.<sup>196,197</sup> Between 2015 and 2025, cybersecurity spending in Vietnam is forecast to increase from US\$67 to US\$327 million.<sup>193</sup>

- **Building the local cybersecurity industry:** Cybersecurity training programs are becoming increasingly available with the opening of 10 national cybersecurity training centres and new elective courses in tertiary education centres. Local companies have successfully serviced the Vietnamese market, including BKAV Corporation and CMC which sell antivirus software for the home, business and smartphones. As well, in 2018 nine Vietnamese companies were registered to provide public digital signature verification services.

## Opportunities

Privacy and cybersecurity help set up the nation for digitalisation, and capability can be improved through emerging technologies, regional cooperation and e-learning platforms.

- Increased uptake of digital goods and services – especially antivirus software (particularly for mobile and IoT security), e-government and digital banking.<sup>193,198,199</sup>
- Continued opportunities for Vietnam's local cybersecurity businesses.<sup>200</sup>
- Cybersecurity to ensure trust in platform technology and boost the digital economy.<sup>193,199</sup>
- AI can boost cybersecurity by automating the search, detection and removal of threats.<sup>193</sup>
- Regional cooperation and e-learning platforms to boost cybersecurity skills and capability.<sup>193</sup>

## Risks

Vietnam may not attract enough talent to fulfil their cybersecurity needs, leaving Vietnamese businesses and consumers vulnerable to attacks and overseas competition.

- **Higher vulnerability with globally integrated data:** As countries increasingly digitalise and integrate with other nations, data also becomes more globally integrated. While there are data localisation requirements associated with the *Law on Cybersecurity (2018)*, foreign firms are able to store their own copies of Vietnamese user data outside of Vietnam. Cyber attacks on foreign nations may still compromise Vietnamese data.<sup>193</sup>
- **Threats to national security and economic growth:** Without adequate cybersecurity, Vietnam risks losing sensitive data from government, businesses and consumers. This could threaten national security by exposing vulnerabilities in critical systems such as government, energy, healthcare, and traffic and water networks.<sup>201</sup> Breaches and cyber attacks are also expensive – including costs from fraud, ransomware,



IT security staff (to prevent, identify and repair threats) and revenue loss.<sup>193</sup> Risks increase as digital technologies are increasingly adopted.

- **Lower consumer trust:** Breaches threaten consumer privacy, identity and trust, which could lower adoption of Vietnamese digital goods and services.<sup>202</sup>
- **Loss of international competitiveness:** Many skilled Vietnamese workers are moving overseas,<sup>184</sup> so Vietnam may not be able to retain and attract the cybersecurity talent necessary for digital transformation.<sup>193</sup> Consumers and international investors may look to products and services from other economies due a perceived lack of security in Vietnam.

## Implications for the development of Vietnam's Future Digital Economy

Cybersecurity and privacy are critical to every digital economy. An enabling regulatory environment in these areas is seen as critical to the adoption of technologies such as cloud computing, where leading nations protect data while also enabling data flows across borders.<sup>156</sup> Furthermore, without adequate cybersecurity capability, businesses are reluctant to digitally transform.<sup>203</sup> If digitally-enabled businesses do not believe their data is secure, they may relocate operations to other countries or forgo expansion into Vietnam entirely. Similarly, consumers from international markets may not adopt made-in-Vietnam digital goods and services. In Vietnam – a country with an outstanding appetite for digital technology – concerned consumers may also opt to use foreign-owned digital goods and services. Vietnam's digital economy requires a strong privacy base, preferably under a unified privacy law, and heavy government investment in cybersecurity.

In a globally integrated and digitally oriented world, Vietnam can become vulnerable to cyber attacks even with lower digital adoption than other countries. Therefore, a regional and even worldwide focus is needed to sufficiently develop cybersecurity policy. In particular, ASEAN and other blocs can foster regional cooperation through information sharing, unified adoption of standards and a regional training strategy.<sup>193</sup>

In Vietnam, e-government services, healthcare, manufacturing (especially big data and IoT technology), banking, fintech and larger businesses have the most to gain by better protecting their data. But cybersecurity is also critical for the informal sector and MSMEs.<sup>193</sup> Most data breaches occur due to human error,<sup>204</sup> so smaller businesses – with fewer resources and less digital literacy – may be the most vulnerable. Vietnam will need to build cybersecurity capability at all levels of business.

## Stakeholder interview

**Dr Dang Minh Tuan** – Head of Blockchain Research Center – Post and Telecommunication Institute of Technology – Ministry of Information and Communication

**Every one, every business and every government needs to be well prepared, and able to ensure cybersecurity**

### DRIVERS OF THE DIGITAL ECONOMY

Besides classifying trends on undeniable emerging digital technologies based on technologies such as blockchain, big data, AI, and AR-VR, from an economic point of view, the current major and fundamental forces that dramatically drive the Vietnamese economy are the mobile economy and platform economy. Under these new economies, it is not only a single, separated technology but an integration and mixture of different high technologies. The nature of the socio-economy has been entirely changed by those new technologies and new business models. Firstly, the mobility element with the Internet available at anytime, anywhere provides convenient accessibility to users of information and services. People's behaviour, relationships and production methods have been changed accordingly. The existing traditional economies are challenged with new competition, urging the creation of new types of work, jobs and industries as a result.

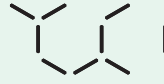
### THE GREATEST OPPORTUNITY OF THE DIGITAL ECONOMY

In this era, the largest opportunity that digital technologies present is the amount of investment able to be saved on infrastructure or facilities, and the amount of time able to be saved in the process. Starting only from a single great idea, digital technologies can help earn higher margins, creating big leaps and huge impacts for the country.

### THE GREATEST RISK OF THE DIGITAL ECONOMY

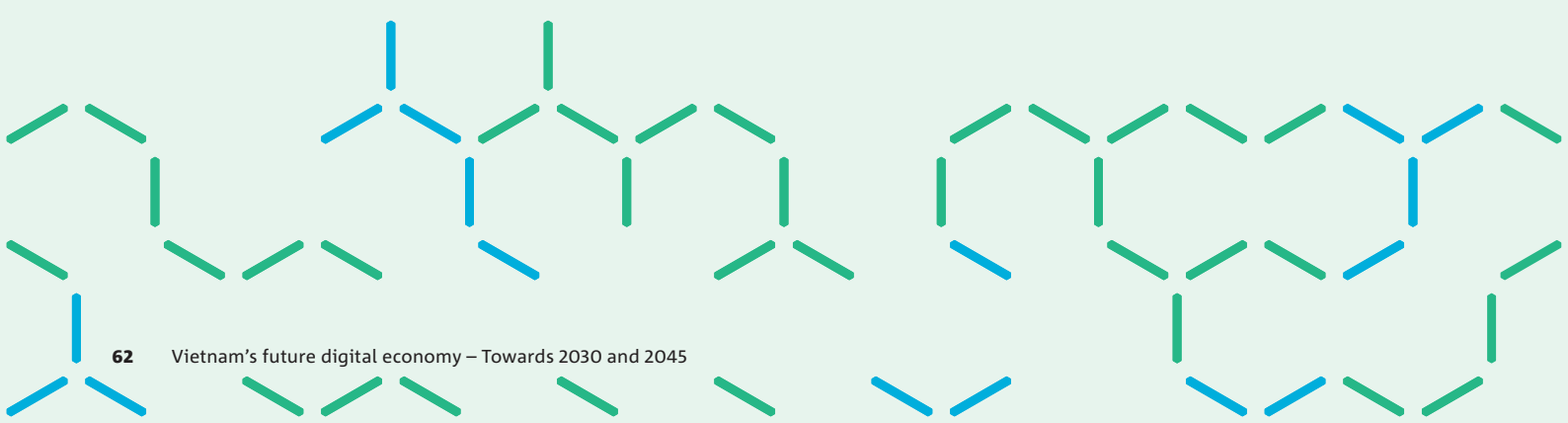
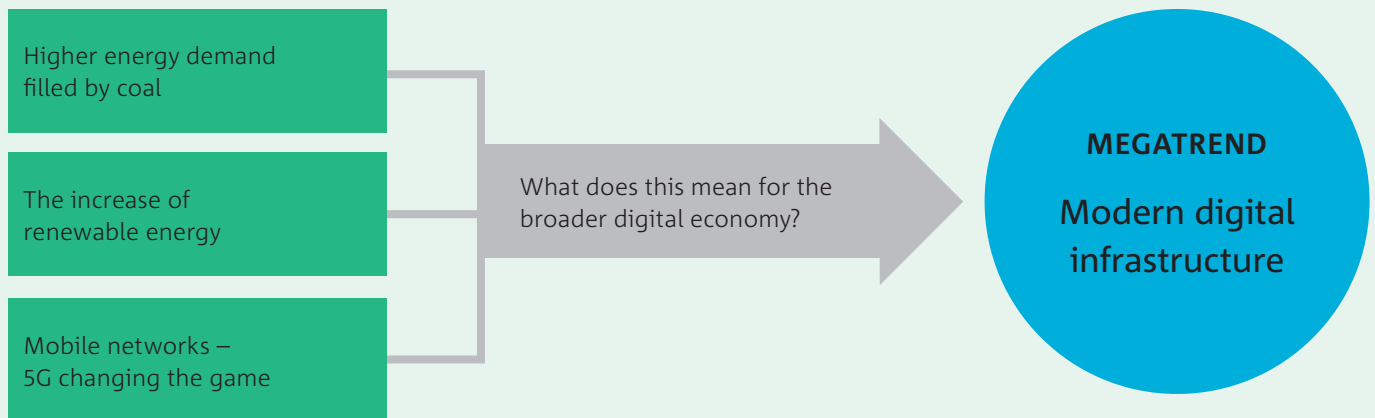
As the world is inter-connected through the Internet, there is also an increasing dependence on technology. Severe cyber attacks could happen – coming from anywhere, anytime and their sensitivity and scope is not only region-wide but global. The scale, level and frequency of impacts can be unpredictable and uncontrolled, making every stakeholder or player more vulnerable. Every individual, every business and every government, therefore, needs to be well prepared, and able to ensure cybersecurity.

# MODERN DIGITAL INFRASTRUCTURE



A strong digital economy requires reliable digital and energy infrastructure – especially for power-intensive technologies such as IoT or AI. New telecommunications networks are also needed to ensure broadband is available to carry the large amounts of digital data needed for new applications.

## RELEVANT MICRO TRENDS



## Institutional environment

Vietnam is upgrading its infrastructure to better support the digital economy and the needs of citizens. Three areas being upgraded are the Internet, satellite and energy infrastructure.

**Internet infrastructure:** In general, the regulator of the telecommunications sector is the Authority of Telecommunications under the Ministry of Information and Communications. Internet infrastructure in Vietnam operates under two major legal frameworks: the *Law on Telecommunications (Law No. 41/2009/QH12)* and the *Law on Radio Frequency (Law No. 42/2009/QH12)*. This framework is supported by *Decree No. 25/2011/ND-CP on the implementation of the Law on Telecommunications*, which was later amended by *Decree No. 81/2016/ND-CP* and *Decree No. 49/2017/ND-CP*. Another supporting regulation is *Decree No. 72/2013/ND-CP on the management, provision and use of Internet services and online information*.

Future developments in Vietnam’s Internet infrastructure aim to deliver universal access to high-speed Internet, including through 5G (see Part I, 3.2 for a more detailed update).

**Satellite technology:** Satellite technology development is led by the *Strategy for research and application of space technology to 2020 (issued in 2006)*, with assistance from the Vietnam National Space Center, the Vietnam Academy of Science and Technology, and the Ministry of Science and

Technology. By early 2019, Vietnam had launched several satellites – two of which were made in Vietnam. These satellites deliver Internet access to remote areas, as well as monitor climate change, natural disasters, agriculture, marine areas and urban development.

**Energy to power the digital economy:** The energy sector in Vietnam acts in accordance with the Electricity Regulatory Authority’s competitive electricity market, which aims to promote fair competition across the electricity sector. The competitive electricity market is being integrated across the whole electricity supply chain – first piloted with generators in 2012, then piloted with wholesalers in 2015, and scheduled to be piloted with retailers in 2021.

To meet energy demand out into the future, a number of actions is being implemented from the *National power development master plan (2011-2020)*. This rise in demand is likely to require more private investment in energy infrastructure, as the state’s major energy enterprises currently lack the finance to increase capacity from existing infrastructure.<sup>205</sup>

The master plan also sets goals for renewable energy to make up 10% of the energy mix by 2030. To meet this goal, analysts have estimated the nation needs to secure US\$10 billion investment per year until 2030.<sup>206</sup> The Government has introduced a number of investment incentives such as feed-in tariffs to attract investment.

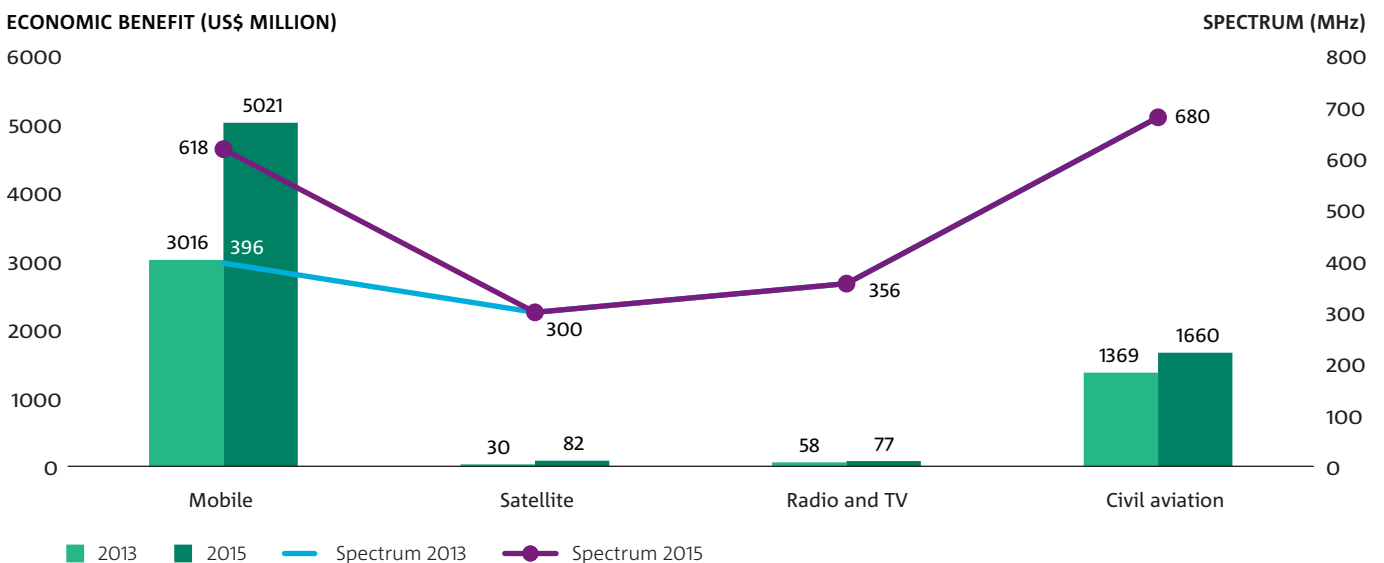


Figure 39 Economic benefit generated from spectrum based sectors, 2013-2015

Source: Vietnam National University and Economic Research Institute of Post and Telecommunication<sup>207</sup>

## Significant trends

- **Higher energy demand filled by coal:** Urbanisation and middle class consumption will continue to drive energy demand across the Asia Pacific, potentially reducing energy exports and international energy security.<sup>208</sup> With local energy resources depleting, Vietnam itself became a net energy importer in 2015.<sup>205,209</sup> Forecasts suggest imports will comprise 58.5% of Vietnam's primary energy supply by 2035.<sup>209</sup> The Ministry of Industry and Trade forecasts energy demand will increase by up to 72% by 2025, from 54 to about 90 million tonnes of oil equivalent.<sup>209</sup> The economy will likely become dependent on coal, especially since plans for nuclear power were halted in 2016.<sup>41,209</sup>
- **The increase of renewable energy:** Government investment incentives appear to have successfully boosted renewable energy investment in Vietnam – with investments in 2018 alone aiming to contribute a total 10,000MW.<sup>210</sup> As of early 2019, the most significant solar system resulting from these investments is the Srepok 1 and Quang Minh Solar Power Plant Complex in Dak Lak province. This US\$141.9 million solar system officially opened in March 2019 and is the first to be completely constructed by local Vietnamese industry.
- **Mobile networks – 5G changing the game:** Mobile subscriptions in Vietnam have grown by 2 million per year since 2012, and millions of new services are predicted to come online over the next decade.<sup>211</sup> This growth coincides with leaps in economic benefit generated by the mobile spectrum (see Figure 39). Although, expanding Internet of Things technology is likely to create more traffic and congestion on the mobile spectrum. Despite improved Internet coverage, a substantial gap remains in access to mobile broadband services between remote rural or mountainous areas and urban areas.<sup>212</sup> However, it is highly likely that most Internet-connected people in the future in Vietnam will be connected through mobile devices alone. With Vietnam implementing 5G networks by 2020, many areas may not need to install costly fibre-to-the-premises infrastructure. The 5G networks will also enable a new generation of IoT technologies – supporting advanced manufacturing and smart city infrastructure.

## Opportunities

Improved digital infrastructure will support smart cities and Industry 4.0. At the same time, energy security can be fostered by renewable energy and efficient use of resources.

- 5G to support connected healthcare, smart cities, autonomous vehicles, industrial IoT and fixed wireless connections.<sup>213</sup>
- Growth in renewable energy, energy storage technology and P2P energy sharing platforms.<sup>40</sup>
- Better monitoring and more efficient use of resources through big data and sensor networks (including electricity via smart grids).<sup>160</sup>

## Risks

Maintaining energy security and digital infrastructure is a key challenge for Vietnam's future digital economy.

- **Low energy security:** Energy infrastructure and imports may not be able to keep pace with energy demand, making it less reliable.<sup>208</sup>
- **Climate change and pollution:** High-carbon energy sources, and increased energy demand caused by a growing digital economy, could contribute to climate change and pollution.<sup>214</sup>
- **Infrastructural damage:** Rising sea levels could submerge Internet and energy while more frequent severe weather events will test the resilience of and flexibility of energy and communications infrastructure.<sup>215</sup>

## Implications for the development of Vietnam's Future Digital Economy

Upgrading, maintaining and building new backbone Internet infrastructure will be critical to ensure reliable Internet connections for Vietnam's future digital economy. The introduction of 5G brings new opportunities for the digital economy. The faster speeds of 5G enable a new generation of IoT, with priority areas for Vietnam in connected healthcare, smart cities, autonomous vehicles, smart manufacturing and Internet network coverage.<sup>213</sup>

New energy infrastructure will be critical to support consumer digital adoption and digitalisation of business and government. Increasing demand can be partly met by renewable energy, which can improve energy security and distribution while shifting away from coal. To foster renewable energy development several barriers need to be overcome – such as a lack of capital from international investors, high costs for technology investment, low returns from current investment incentives, lack of skilled labour, underdeveloped supporting industries and a complex regulatory framework.<sup>206</sup> At the same time, renewables can introduce new challenges such as waste management (preferably through recycling batteries and solar panels), and a need to upgrade the energy grid to cope with variable energy supplies.

Digitalisation can foster energy efficiency and increase energy grid compatibility with variable renewable energy systems. 'Smart grids' can analyse sensor data to anticipate energy needs by location, and therefore more reliably distribute energy. Data analytics in manufacturing can make production more efficient and less wasteful, decreasing energy use per unit. Peer-to-peer energy sharing apps – sharing both renewable energy and energy storage – may encourage technology uptake and provide clean energy. Cloud computing can also increase energy efficiency, as data centres can better optimise performance with energy use, and incorporate renewable energy and energy storage devices. However, older data centres may not be energy efficient – so upgrading hardware will be important to reduce digital economy energy consumption in the long run.

## Stakeholder interview

**Professor Tran Thuc** – Vice President of the Vietnam Panel for Climate Change, and former Director of the Institute of Hydrology and Meteorology Science and Climate Change

### Challenges related to climate change can become opportunities to drive digital development

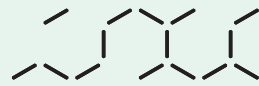
#### DATA-DRIVEN OPPORTUNITIES TO BOOST SUSTAINABILITY

New technologies and data collection is helping transform the economy and environment in Vietnam. For example, renewable energy – in the form of wind and solar energy – is being promoted in Ninh Thuan and Binh Thuan provinces. A private company has also invested in rain gauge stations and is selling their real-time rainfall data back to the State to assist in the operation of hydropower stations. There are a lot of opportunities to collect and use data to assist the transition to a cleaner and more sustainable economy.

#### CHALLENGES FOR DIGITAL TRANSFORMATION

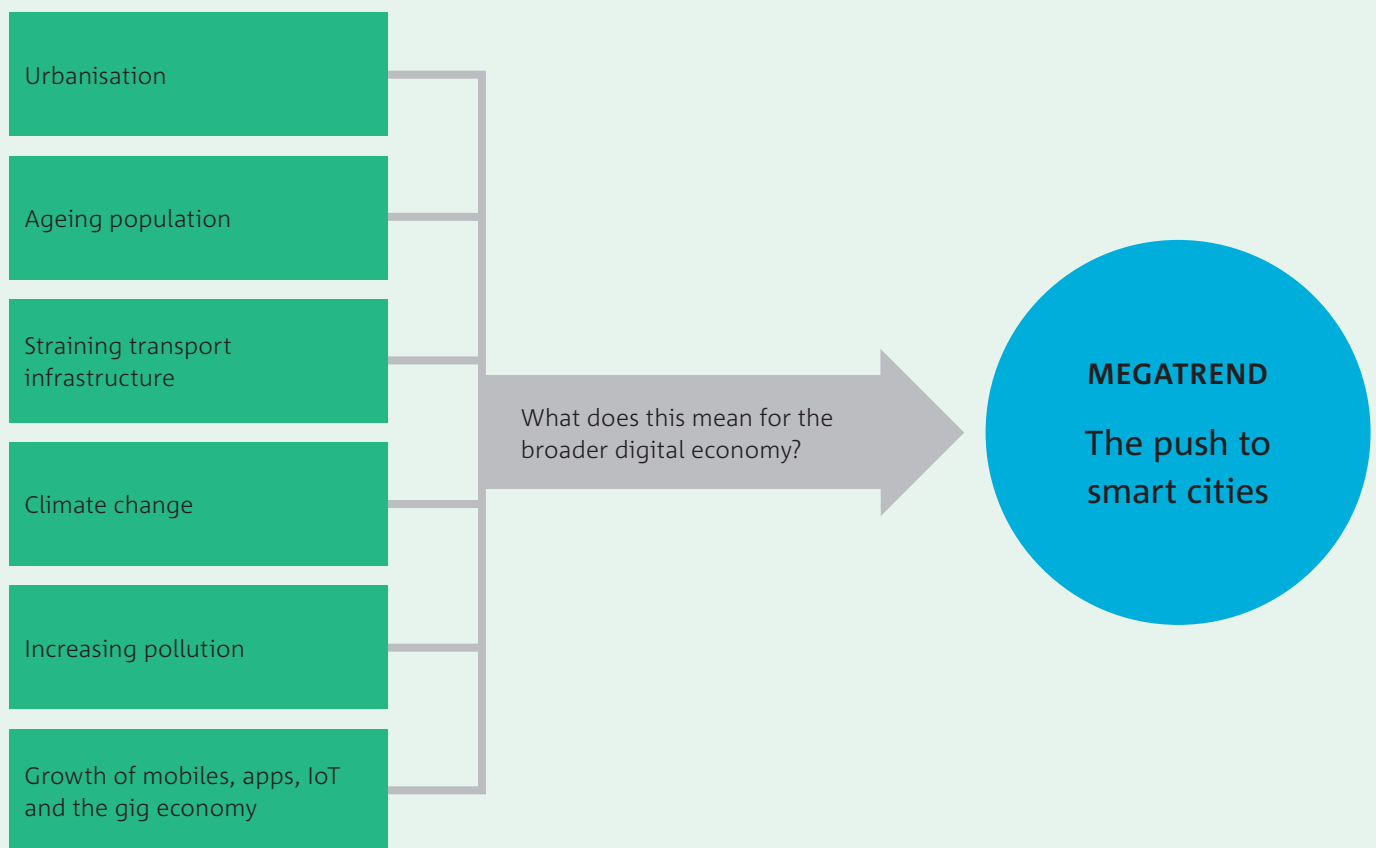
There are also significant barriers to digitalisation for sustainability. The State and citizens therein need to prioritise the environment and leverage their investment in sustainability. This can be promoted through better communication of environmental issues, challenges and costs. There is also a lack of finance for the infrastructure needed to cope with natural disasters and sea-level rises. Better private sector engagement and investment would boost the existing level of public sector investment. Public sector organisations that administer and control provincial infrastructure need to build its capacity to implement change and innovate with new digital technologies. This can be achieved through more training, and greater levels of international cooperation and technology-transfer. There are also issues with environmental law enforcement. These laws can only be adequately enforced when there is much better coordination between ministries and agencies at all levels.

# THE PUSH TO SMART CITIES



In a rapidly urbanising and ageing nation, smart cities provide opportunities to use infrastructure and resources more efficiently, as well as reduce waste, pollution and traffic congestion.

## RELEVANT MICRO TRENDS



## Institutional environment

Vietnam is looking to smart cities to meet the challenges of urbanisation and sustainability.

**Urbanisation:** Urban policy in Vietnam is centred around the *2009 adjustment of orientation master plan to develop Vietnam’s urban system until 2025 with a vision to 2050 (Decision No. 445/QD-TTg)*. Vietnam has issued numerous laws, plans and policies on urban development, but they are mostly uncoordinated with one another. According to the OECD, the lack of coherence has contributed to large amounts of ad hoc urban development at the local level.<sup>216</sup> At the same time, a new legislative framework on urban development management is under discussion by the Ministry of Construction. The new framework could strengthen coordination and implementation of urban policy and help address the issues of urbanisation.

**Sustainable development:** Vietnam is committed to meeting the *United Nations 2030 Agenda*. The nation’s action plan for the 2030 agenda outlines 17 Sustainable Development Goals (SDGs) and 115 targets to meet by 2030. The SDGs include goals such as improving health, education, water quality, energy (in cleanliness and affordability), climate action and environmental preservation. These goals are well-integrated into the *Socio-economic development strategy 2011-2020* and the *Socio-economic development plan 2016-2020*. Individual SDGs are also targeted in numerous laws, policies and plans across ministries, agencies and provinces.<sup>217</sup>

**Smart cities:** See Part I, 3.2 for a description of Vietnam’s smart city policies.

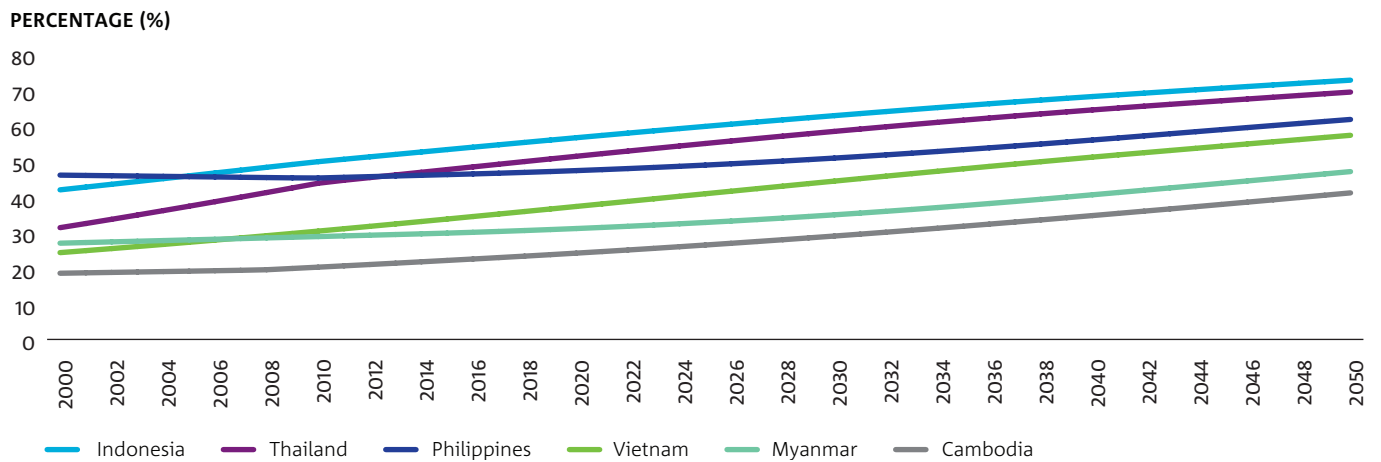


Figure 40 Forecasted proportion (%) of population living in urban areas in select ASEAN countries, 2000-2050

Source: UN Department of Economic and Social Affairs<sup>218</sup>

## Significant trends

- **Urbanisation:** In 2016, about a third of the Vietnamese population lived in urban areas.<sup>218</sup> By 2045 this is predicted to jump to nearly 55% of the population, through rural-urban migration and the development of rural areas into urban areas.<sup>218</sup> Larger cities are urbanising especially quickly, with cities such as Hanoi, Ho Chi Minh City and Hai Phong growing on average 5.5% per year between 2004 and 2013.<sup>216</sup> This rapid urbanisation will need large investments in infrastructure – a forecasted US\$565 billion between 2019 and 2040.<sup>219</sup> If current investment trends continue, investment will not meet demand, especially for transport and water infrastructure.<sup>219</sup> The spending gap is forecast to grow to US\$106 billion by 2040.<sup>219</sup> These limited resources mean the government is likely to prioritise strategic and cost-efficient infrastructure, including smart city infrastructure.
- **Ageing population:** Vietnam has a comparatively young population but the population growth rate is falling and the population is ageing rapidly.<sup>26,110</sup> The World Bank has identified Vietnam as one of the world's fastest-ageing societies.<sup>41</sup> As the proportion of the population over 65 years increases, the proportion of working-age people in the population will decrease, and costs associated with age and healthcare will grow. These new challenges may increase smart city infrastructure for healthcare.
- **Straining transport infrastructure:** Traffic congestion in Ho Chi Minh City and Hanoi is higher than in other Asian cities.<sup>220</sup> This is because of Vietnam's less developed transport infrastructure, high growth in vehicle ownership and low availability and use of public transport.<sup>216</sup> Traffic congestion impacts liveability through increased traffic accidents, poorer daily-time use for citizens, as well as air, water and noise pollution. Smart city infrastructure may help address these issues.
- **Climate change:** In the coming decades, climate change is predicted to increase temperatures, sea levels, soil and water salinity, and the frequency of extreme

weather events.<sup>37,221</sup> Since the Vietnamese population and farming land is generally located near the sea or the river deltas, urban development will need to take extra measures to prevent flooding and minimise damage from extreme weather (e.g. through prediction and warning services).

- **Increasing pollution:** Poor transport, energy and waste infrastructure has led to high levels of water, soil and air pollution.<sup>37,221</sup> This negatively impacts liveability and health. By 2030 Vietnam is projected to experience Asia's second highest mortality rate due to air pollution (19,220 premature deaths per year).<sup>222</sup> Smart city infrastructure for environmental sustainability can help counter these issues.
- **Growth of mobiles, apps, IoT and the gig economy:** Consumer demand for digital products and services in Vietnam is very high and growing quickly.<sup>223</sup> By servicing this demand, the private sector is already influencing how cities operate. For example, gig economy smartphone apps such as Grab are creating employment opportunities and changing city traffic flows.<sup>220</sup>

## Opportunities

Smart city infrastructure can help address problems associated with urbanisation, climate change, pollution and changing demographics.

- Smart city infrastructure to help urban environments cater for larger populations – particularly to reduce traffic congestion and pollution, as well as optimise energy use and healthcare.<sup>160</sup>
- E-government services to be made more efficient and convenient by assigning unique codes to citizens, which they can use across all public services (e.g. ID, social insurance, pensions).
- Increasing interest from the private ICT sector presents an opportunity for public-private partnerships for smart city infrastructure.



## Risks

Smart city infrastructure could be targeted in cyber attacks, could prove ineffective, or be damaged by climate change.

- **Cybersecurity:** As more critical systems (e.g. defence, health, banking) go online, there is greater risk from data breaches and cyber attacks.<sup>193</sup>
- **Smart cities a zero-sum game:** Smart cities may lead to higher energy use that may lead to a zero-sum game for environmental sustainability. Mismanagement of e-waste (e.g. batteries from millions of Internet of Things sensors) could also harm the environment. Urban infrastructure may also be unable to keep pace with rapid urbanisation.<sup>216</sup>
- **Infrastructural damage:** Rising sea levels could submerge homes and smart city infrastructure especially in Vietnam's three largest cities which are all on low-lying river deltas.<sup>215,224</sup>

## Implications for the development of Vietnam's Future Digital Economy

Smart city infrastructure can be financed by the private ICT sector, or international private investors through platforms such as the G20 Global Infrastructure Hub.

Smart cities can help ensure economic growth and urbanisation occurs with low emissions and resource demand. IoT sensors can help measure environmental impacts, predict ecological disorders, create early warning systems and optimise resource management. VR-AR can visualise urban plans, healthcare (e.g. 3D X-rays) and street navigation.<sup>225</sup> The sharing economy can limit pressure on resources and associated negative externalities in their production. The efficiencies created by smart city infrastructure could deliver more value per dollar spent than traditional infrastructure, lowering the infrastructure spending gap. Together, these developments are likely to improve air quality, reduce emissions and increase city-wide efficiencies.



### Stakeholder Interview

**Ms Trinh Thu Nga** – Director of Center for Population, Labour and Employment Studies – Institute of Labour Science and Social Affairs – Ministry of Labour, Invalids and Social Affairs

**Satellite smart cities are a solution to Vietnam's rapid urbanisation**

#### THE OPPORTUNITIES AND RISKS OF URBANISATION

More investment from businesses will be attracted into newly urbanised areas as the infrastructure and socio-economic status of those areas develop. More jobs in the formal sector will be created, bringing decent and sustainable employment opportunities for local labour. On the other hand, as cities attract a huge amount of labour – especially high-skilled labour – unqualified and unskilled labour will be rejected from the formal sector. They will either become unemployed or work for seasonal and manual jobs. Both the overall unemployment rate and employment in the informal sector, therefore, will increase.

#### REDUCING THE STRAIN OF URBANISATION

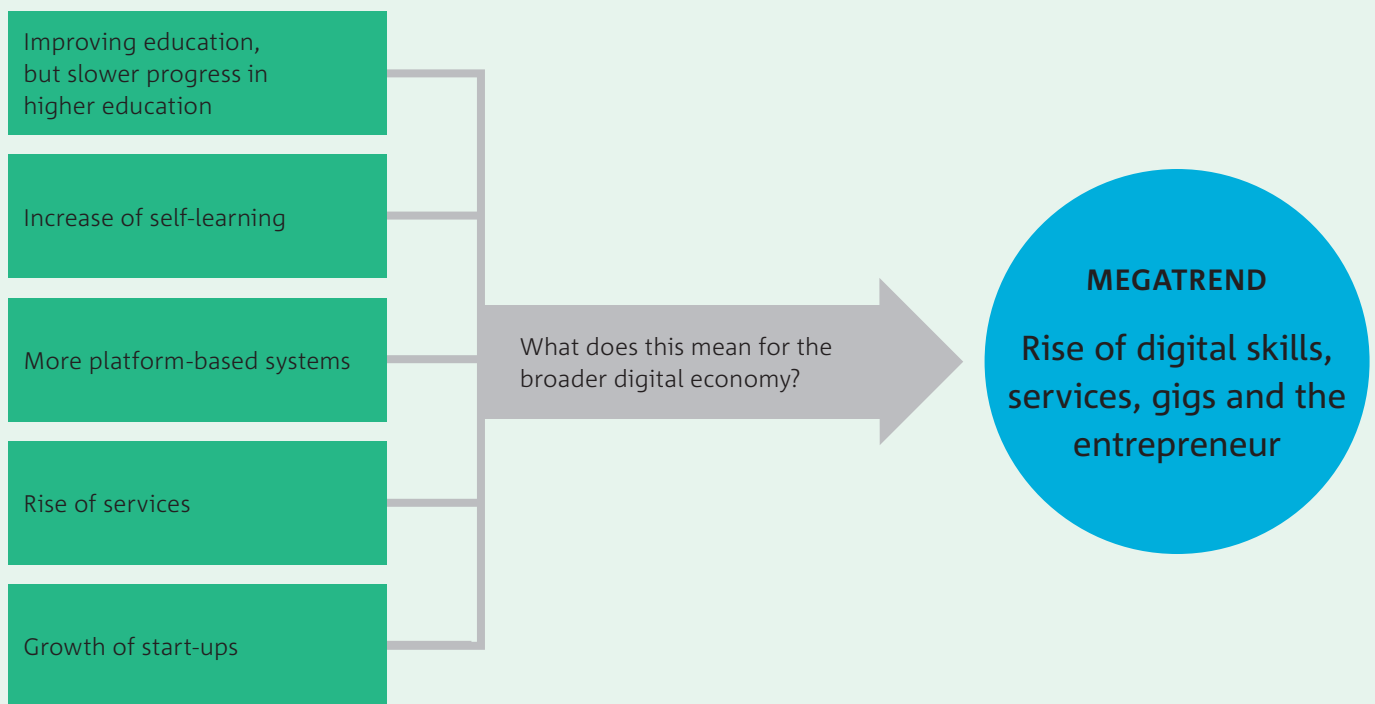
Digitalisation can help address the incoming pressures and problems of urbanisation. For example, there is an opportunity for digital technology in citizen management, by assigning a unique code for each individual which they can use for public services including but not limited to identification, social insurance and the pension system. In addition, public services can be upgraded to the next level by using digital technology to provide convenient and smooth transactions to citizens on-the-spot or from a distance.

The trend of developing satellite cities will deliver more benefits than building more high-rise apartment buildings in existing cities. With investment on infrastructure, especially public transport, the satellite cities will attract people to live and work there, or work from home and access services – including public services – from home. This will help reduce congestion and population density in the main cities. Green or eco cities with eco-architecture and smart-technology systems will be widely promoted in those satellite cities in the time to come.

# RISE OF DIGITAL SKILLS, SERVICES, GIGS AND THE ENTREPRENEUR

Increasing demand for the services sector as well as digital products and services mean there is a need to invest further in higher education, digital skills, entrepreneurial skills and Vietnam's innovation ecosystem. Platforms and the trend away from secure, structured and long-term work is also driving the use of labour and product platforms for income generation and creative avenues for industrial transitions in labour markets.

## RELEVANT MICRO TRENDS

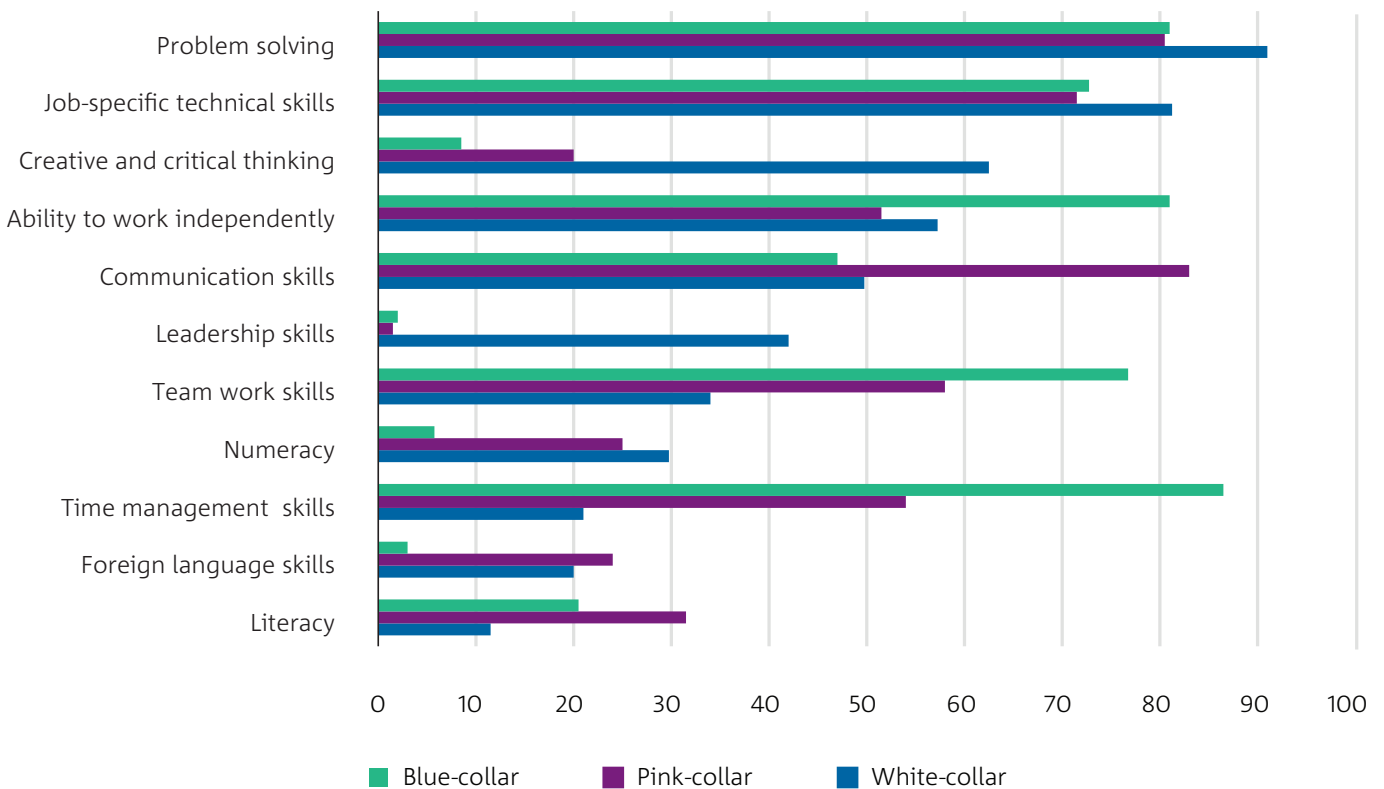


## Institutional environment

Vietnam has a wide range of strategies and policies to support start-ups, the innovation ecosystem and digital skills. These can be reviewed in Part I, 3.2.

**Platform economy:** Vietnam does not have a unified regulatory framework for the platform economy. This means that many platform-based businesses have launched in Vietnam without a clear regulatory environment. Policymakers are challenged to keep up with the entry of new platform-based business models –

classifying them under existing regulatory frameworks or creating new ones. For example, e-commerce platforms comply with regulations set out in *Decree No. 52/2013/ND-CP on e-commerce*. New regulations on other platforms will be introduced in 2019. For example, drafts of a new decree replacing *Decree No. 86/2014/ND-CP on business and conditions for transportation business by auto* suggests ride hailing apps will become legally recognised as taxi firms. Also, the State Bank of Vietnam is reportedly creating a regulatory framework for P2P lending.<sup>226</sup>



**Figure 41 Importance of job skills as ranked by employers (% of firms ranking skill in top 5)**

Source: Vietnam STEP Employer Survey 2011,<sup>227</sup> Data61 analysis

Note: White-collar includes managers, professionals, technicians and clerical support workers. Pink collar includes services and sales workers. Blue collar includes skilled agricultural workers, craft and trade workers, plant and machine operators, and workers in elementary occupations (highly routine and low-skill work).

## Significant trends

- **Improving education, but slower progress in higher education:** Vietnam has seen rapid growth in the number of VET institutions, improved literacy rates, improved teacher-student ratios, and higher student enrolments due to reforms such as the *Higher Education Reform Agenda (2005-2020)*.<sup>228,229</sup> Future reforms are likely to continue this progress in education. However, progress has been slow in higher education and is likely to continue to be a critical challenge for Vietnam. Low tertiary education quality has led to, despite high demand for high-skills, more tertiary graduates working in secondary level jobs or lower (15.4% in 2012 vs. 22.2% in 2017).<sup>174</sup> There are also large digital skills shortages – for example Vietnam is projected to be short 500,000 data scientists by 2020.<sup>162</sup>
- **Increase of self-learning:** Several e-learning platforms have launched in Vietnam in recent years. For example, HocMai – and an e-learning website for school students – launched in 2007 and gained 3 million users by 2018.<sup>230</sup> At the same time, the number of practical learners at community learning centres grew from 6.3 million to 10 million between 2006 and 2015.<sup>231,232</sup>
- **More platform-based systems:** The platform economy is reshaping labour patterns, global markets and supply chains.<sup>233</sup> Platform-based business models – including those that sell goods and services (e.g. Amazon, eBay, Alibaba), transport (e.g. Grab), accommodation (e.g. Airbnb, TravelMob, HomeAway, Expedia.com), and labour and services (e.g. Freelancer, UpWork, TaskRabbit, Triip.me) – have upset established business models and provided new avenues of income for many people with under-utilised assets or availability for work. The World Economic Forum estimates that globally platforms will generate US\$10 trillion benefit for businesses and society between 2016 and 2025.<sup>234</sup> These platforms are also increasing the outsourcing of work from many high income countries to low and middle income countries, particularly those with higher-skilled workers.<sup>235</sup> Work outsourced to Asian nations predominantly involves software development and work involving creative media and multimedia.<sup>235</sup> Asia-based users of freelancer platforms are mostly located in India and the Philippines.<sup>236</sup> However Vietnam, Indonesia, China and Malaysia are competing for third place.<sup>236</sup>
- **Rise of services:** From 1988 to 2018 the GDP share of services increased from 29.7% to 40.9%.<sup>23</sup> As the demand for services increases, there will be more opportunities for sharing economy platforms, gig economy workers and ICT services.
- **Growth of start-ups:** Vietnam's start-up scene is growing – up from 400 start-ups in 2012 to 3,000 in 2017.<sup>237</sup> A growing local entrepreneurial scene makes it more likely that Vietnam will digitalise and reap the benefits of digitalisation, rather than the benefits being taken by foreign businesses. Business confidence

appears to be relatively high for start-ups and other small businesses. About 90% of micro and small to medium enterprises in Vietnam expected their business grow in 2018.<sup>238</sup> This was 20% higher than the Asia Pacific average. This is promising for Vietnam's digital economy, given that start-ups are a driver of digital technology development.

## Opportunities

New skills – including digital, services and entrepreneurial skills – allow Vietnam to build and strengthen expertise for the digital economy.

- Greater flexibility in determining Vietnam's own digital pathways.<sup>158</sup>
- E-learning and cooperation from international teaching agencies and universities can help upskill the population, especially in high-demand areas currently lacking in the workforce.<sup>239</sup>
- Digital skills to enable growth in Industry 4.0 and smart agriculture.<sup>160</sup>
- A shift to service-based industries will be facilitated by larger urban environments able to cater for better training facilities and large organisations.<sup>239</sup>

## Risks

The labour force may not be able to adequately upskill for the digital economy, and MSMEs may be vulnerable due to an under-regulated gig economy and an underdeveloped innovation system.

- **Low accessibility of education:** Rural students may have lower employment and life outcomes, because of limited access to digital skills education, as well as less resources from their families which prevent them from being accepted into tertiary education.<sup>240</sup>
- **Irrelevant skills:** Several training institutions report a mismatch between curricula and skills required in the workplace.<sup>227,241</sup> While employers believe technical skills can be easily taught in vocational training, they are concerned that interpersonal skills, teamwork skills and creativity are underdeveloped in the Vietnamese workforce and difficult to train in adult workers.<sup>239</sup>
- **Digital disruption could outpace upskilling:** With an unskilled workforce mainly working jobs at high-risk of automation,<sup>154,242</sup> Vietnam will see millions of job transitions in the next two decades.
- **Gig economy – unregulated:** The gig economy has risks including unregulated minimum wage and worker protections, and possibly policy interference by multinational corporations who can control significant labour markets and distribution channels.<sup>185</sup>
- **Entrepreneurialism restricted by an underdeveloped innovation system:** One issue is there is a lack of venture capital funds to support start-ups.<sup>41</sup> Those who can access finance are reluctant to patent their ideas due to a concern their ideas will be stolen rather than protected.<sup>41</sup>

## Implications for the development of Vietnam's Future Digital Economy

To enable digital growth into the fourth industrial revolution, employers in Vietnam are looking for a mix of high quality cognitive, behavioural and technical skills.<sup>239</sup> An expansion of STEM subjects and core skills – such as interpersonal skills, creativity, critical thinking and teamwork skills – in primary and secondary education will help create the future generation of digital economy workers.

Big data analytics and forecasts on job markets, created in collaboration with both businesses and tertiary education providers, can help universities tailor to industry needs. Sharing this data among all training institutions in Vietnam would increase the benefits of such a project, perhaps leading to positive systemic change.

With adequate Internet infrastructure and digital literacy, e-learning can build skills at scale, speed and across

regions. Implemented well, online courses can be just as effective as traditional courses.<sup>243</sup> As well, e-learning allows quality universities – local and overseas – to open more enrolments to Vietnamese students. Mobile-based platforms could make education even more accessible, as they can run on 4G or 5G without a desktop computer. Additionally, labour platforms can connect Vietnamese students with international work experience and thus equip the future workforce with more relevant skills.

With a large informal sector and young population,<sup>174</sup> Vietnamese workers may adapt well to platform systems. Platform-based business models are likely to facilitate the economic transformation of areas susceptible to job replacement through automation.<sup>244</sup> Platforms are also a new avenue for Vietnam's growing business process outsourcing industry.<sup>40</sup>



### Stakeholder interview

**Dr Le Dong Phuong** – Director of Center for Higher Education Studies – Vietnam Institute of Education Sciences – Ministry of Education and Training

**We will soon lack people who are capable of working in digital economy, not only to create new technology but also to receive and transform knowledge to create new products or services**

### CHALLENGES TO HUMAN RESOURCES FOR THE DIGITAL ECONOMY

One problem across the education system is that it does not help students develop creativity. Passive learning and outdated curricula are still prominent. The education system mainly provides knowledge, with less focus on practice, therefore neglecting student and market demand. In many fields, especially IT, education often lags behind emerging trends. The education system, therefore, cannot produce a person who is aware of technology or has high technology competency. Capability in knowledge acquisition and utilisation at the workplace is still very low. We will soon lack people who are capable of working in the digital economy, not only to create new technology but also to receive and transform knowledge to create new products or services.

### SOLUTIONS FOR BETTER HUMAN RESOURCES

More open education policies should be formed. Since only 5% of the Vietnamese labour force has obtained a higher education degree – compared to 20% in other nations – we should promote higher education in terms of quantity first, then quality as guided by market needs. Higher education, especially in IT, should promote creativity rather than knowledge as it does currently, because the fields of study most relevant to the future

digital economy are still unknown. There should also be requirements or social responsibilities on the private sector to invest in education and employment.

Secondary education should also be changed to increase digital literacy and place more importance on inquiry-based education. This is to create people who can think independently and dare to take risks. Career development should be well provided to help students find their suitable career path based on their potential and interests, and prepare knowledge and skills at younger age – for example in grade 7, 8 and 9.

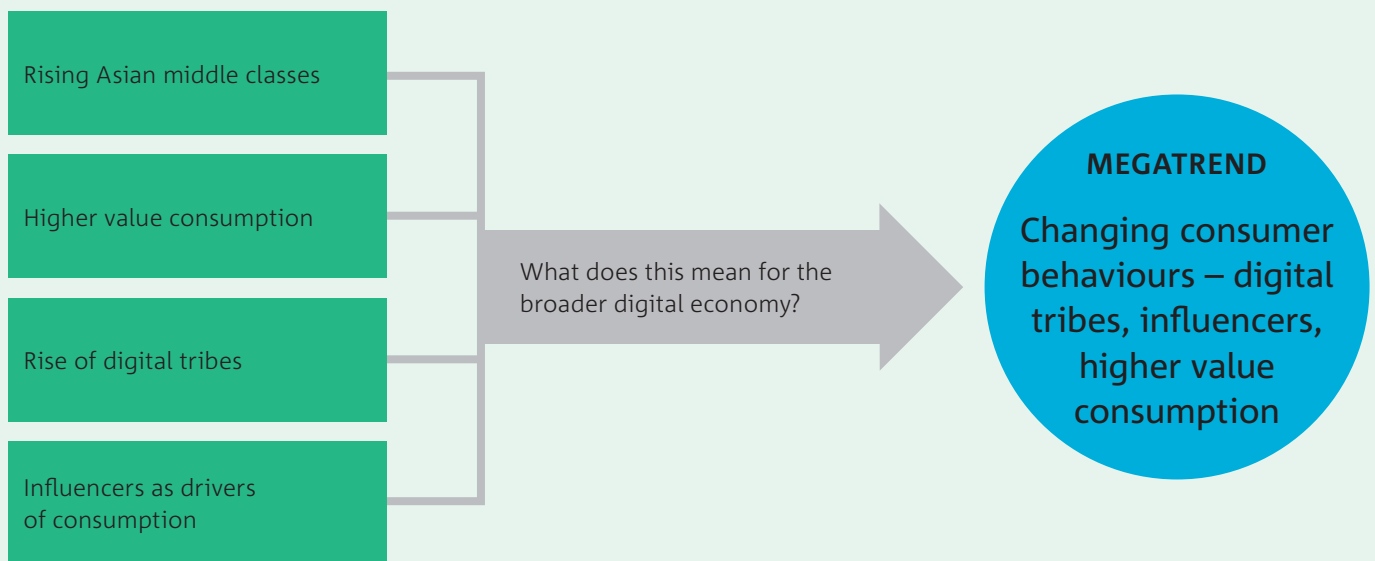
The same approach to education for everyone is no longer suitable in this era; instead individualised and differentiated education should be promoted. Lifelong learning should also be encouraged across society to help the labour force keep up with global changes. Vietnam should recognise and provide education and certifications for learners from different types of education (full-time, part-time, online, offline, onsite, distance learning, or even a mixture of all). By accepting different learning modalities, social learning will be widely promoted.

There should be competitive salary and benefit packages to attract people to teach, work and conduct research in basic sciences such as mathematics and physics. Currently, the workforce in this field is underpaid.

# CHANGING CONSUMER BEHAVIOURS – DIGITAL TRIBES, INFLUENCERS, HIGHER VALUE CONSUMPTION

Consumer behaviours are changing as the Asian middle classes emerge and orient to higher-value goods and services, including those from the digital economy. At the same time, higher digital adoption among consumers increases the influence of digital tribes and influencers – both on suppliers and consumer behaviour.

## RELEVANT MICRO TRENDS



## Institutional environment

In response to emerging preferences of the Asian middle classes, the Vietnam Government has introduced several regulations to improve the quality of products made and/or sold in Vietnam.

**Improving quality within Vietnam:** Within Vietnam, this includes regulations to improve *food safety* (e.g. *Decree No. 15/2018/ND-CP*) and reduce the sale of counterfeit products (e.g. *Decree No. 08/2013/ND-CP*). Several agencies investigate and enforce these regulations, including the police, the Ministry of Industry and Trade and Vietnam Customs.

**Improving local brand-value:** Other initiatives aim to boost the brand value of Vietnamese products to the

domestic and international markets. For example, in 2003 the Ministry of Industry and Trade introduced the *Vietnam Value Program*. This program fosters domestic brands by offering enterprises: corporate branding training, brand consulting, awards for outstanding domestic brands and marketing support for award recipients.

**Meeting international standards:** Another important regulation to Vietnamese exporters is Vietnam's *Law on Foreign Trade Management (Law no. 05/2017/QH14)*, in effect from 2018. This law includes technical and quarantine measures which help Vietnamese exporters meet the strict standards of safety and quality set by international regulators.

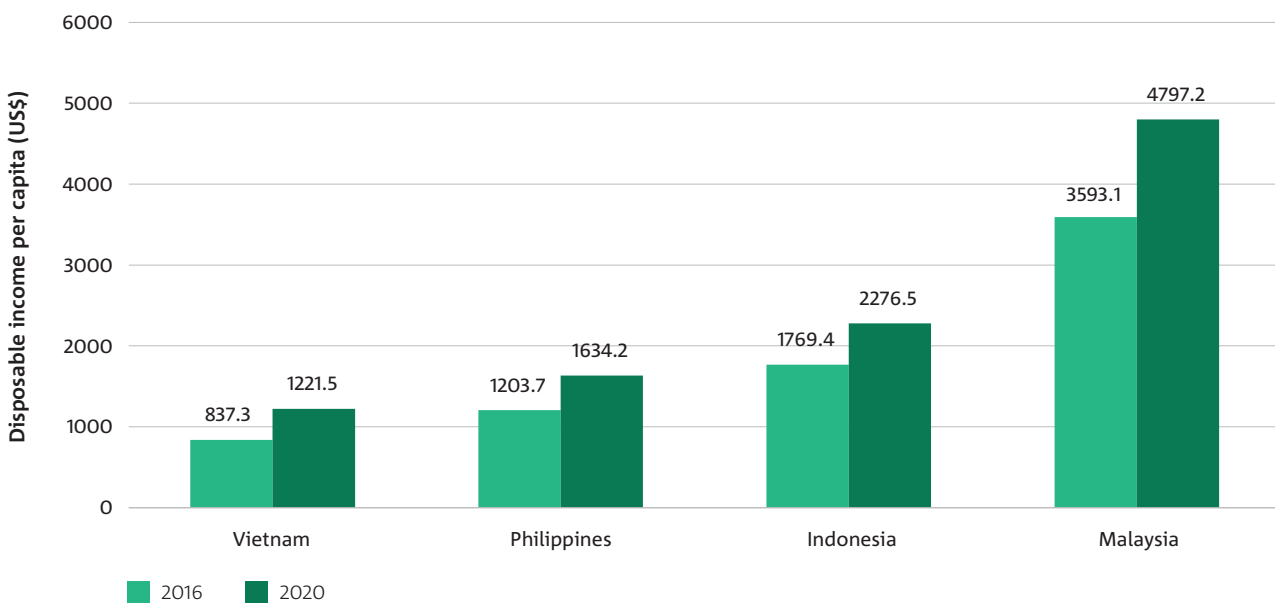


Figure 42 Disposable income projections of the middle class in selected ASEAN countries, US\$ per capita, 2016-2020

Adapted from: PwC<sup>245</sup>

Sources: BMI Research, World Bank

## Significant trends

- **Rising Asian middle classes:** Forecasts to 2030 suggest the global middle class is expanding rapidly, with Asia representing 88% of the next billion new entrants between 2010 and 2020.<sup>167</sup> Within Vietnam, the middle class is forecast to increase from 11% of the population in 2015 to over 50% by 2035.<sup>41</sup> As the middle classes grow in the Asia Pacific, so will their spending – predicted to nearly triple between 2015 and 2030.<sup>167</sup> See Figure 42 for a comparison of projected disposable income per capita to 2020 in selected ASEAN countries.
- **Higher value consumption:** As the middle classes emerge there is greater demand for high-value products. For example, per capita food demand in low and middle income countries is increasingly matching that from high income countries through higher intake of meat, dairy and processed foods.<sup>246</sup> Within Vietnam, high-value consumption is driven by changes in consumer preferences, especially those of the younger urban generation. Emerging preferences among urban Vietnamese include individualisation,<sup>247,248</sup> sustainability,<sup>249,250</sup> as well as prestige and brand value.<sup>251</sup> Higher value consumption will likely push further adoption of digital goods and services.
- **Rise of digital tribes:** Digital tribes are online communities which interact via social media or video games. Youths seem to be driving the rise of digital tribes around the world, especially since they are far more likely to use social media.<sup>252</sup> This is especially true in Vietnam which has a relatively large age divide in social media use (79% of adults aged 18-36 vs. 27% of adults aged 37+).<sup>252</sup> These tribes are also increasingly harnessed in digital marketing campaigns such as Vietnam's 'Share a Coke' campaign in 2014.<sup>253</sup> The campaign's first Facebook ad alone was 'liked' by over 190,000 users and shared by over 1,000 users to their personal networks.<sup>253</sup>
- **Influencers as drivers of consumption:** Influencers are consumers who have reached online celebrity status by growing large audiences on social media.<sup>254</sup> Their large audiences make them a powerful driver of consumer behaviour, now contracted by many of the major international brands and marketing companies.<sup>255</sup> Most of the leading companies (two thirds in a 2018 survey) believe influencer marketing will become more important in the future.<sup>255</sup> Vietnam is developing its local capability – with 44% of the major local brands and marketing companies using influencer marketing according to a 2018 survey.<sup>256</sup> This seems to be impacting local consumer behaviour – for example in an online 2018 survey, 43.3% of young, mainly female adults in Vietnam said they have purchased products due to influencer recommendations.<sup>257</sup>

## Opportunities

Emerging preferences create demand for high-value products and services, and support domestic economic growth and product provenance.

- Increased purchasing power creating new demand from the region, creating larger export markets particularly for high-value foods and tourism in Vietnam.<sup>40,167</sup>
- Less dependence on exports as a driver of growth, due to higher purchasing power in Vietnam.<sup>41</sup>
- Ability to assure consumers of high-value – and therefore increase prices – through blockchain or similar technology for product provenance.<sup>40,249</sup>

## Risks

New middle class preferences are likely to pressure domestic companies to upgrade their brand value, especially as they face more competition from foreign brands.

- **Increased competition:** Since the middle class in Vietnam prefer products from foreign brands,<sup>251</sup> domestic companies may need to adapt to remain competitive.
- **Greater risks from brand mismanagement:** High-value products and services benefit strongly from positive brand value. But this requires careful brand management, especially as consumers are increasingly influenced by digital tribes and influencers.<sup>258</sup>

## Implications for the development of Vietnam's Future Digital Economy

The increase of middle class spending power creates new opportunities for Vietnam's digital economy. This includes increased international and domestic demand for ICT products, digital tourism, and services delivered through digital platforms. To serve emerging preferences for individualisation, products and services can be personalised with the aid of big data and AI.

At the same time, increasing consumer orientation to high-value products heightens expectations for product quality, origin and authenticity. This means consumers with greater spending power are likely to pay more for products that guarantee supply-chain transparency.<sup>249</sup> This can be achieved through blockchain technologies for product provenance, which can assure consumers of authenticity and high-value (e.g. organic farming) in a trustworthy way.



Consumer behaviour is also changing through the influence of digital tribes. This makes digital tribes a critical consideration in marketing campaigns. Exploratory research suggests, for example, that Vietnamese shoppers mainly use word-of-mouth recommendations via social media to inform their purchasing decisions.<sup>259</sup> As digital tribes increasingly drive consumer behaviour,

organisations themselves are prompted to adapt. For example, the consumer-led Facebook group ‘Zero Waste Saigon’ – which started in 2018 and gained over 9,600 members by 2019 – promotes sustainable businesses/products/services. This encourages other businesses to adopt similar practices.



A Vietnamese local and a tourist sharing drinks – a friendly gesture in Northwest Vietnamese culture.

## Case study

### Locally made tours: A travel platform from Ho Chi Minh City to 227 countries

**The opportunity:** After 10 years working as a tour volunteer for international travellers, Ha Lam understood what travellers enjoyed in their visits to Vietnam: interacting with locals, eating local food, walking the path less travelled and being treated as a friend rather than a customer. These are experiences that tourism companies struggle to provide. At the same time, Ha Lam noticed that young Vietnamese locals enjoyed being tour guides as an opportunity to practice the English language. Travellers also enjoyed the tours, even offering generous tips as a thank you.

**The initiative:** With a vision to connect travellers all over the world with locally run tours, Ha Lam and her husband created the Triip.me travel platform in 2013. This travel platform was the first of its kind, later expanding into the global market through web and smartphone apps. The platform is also built on an innovative blockchain system which automatically executes payments between travellers, tour guides

and travel businesses using smart contracts.

The blockchain system also rewards travellers with TriipMiles (a cryptocurrency which can be redeemed for travel booking discounts) if they opt in for travel advertisements and share their data to advertisers on the platform.

**Results:** To live, breathe and experience daily life as a local is a new type of travel experience pioneered by Triip.me – and it promises to become a key trend for tourism in the near future. The platform also creates opportunities for locals to learn English and gain employment. By 2018 Triip.me had a presence in 227 nations with a network of 1.3 million hotels and 6,000 local tour guides. More recently, Triip.me partnered with Booking.com to expand its business into accommodation. The forward-thinking and digitally-enabled nature of the platform suggests a bright future ahead.

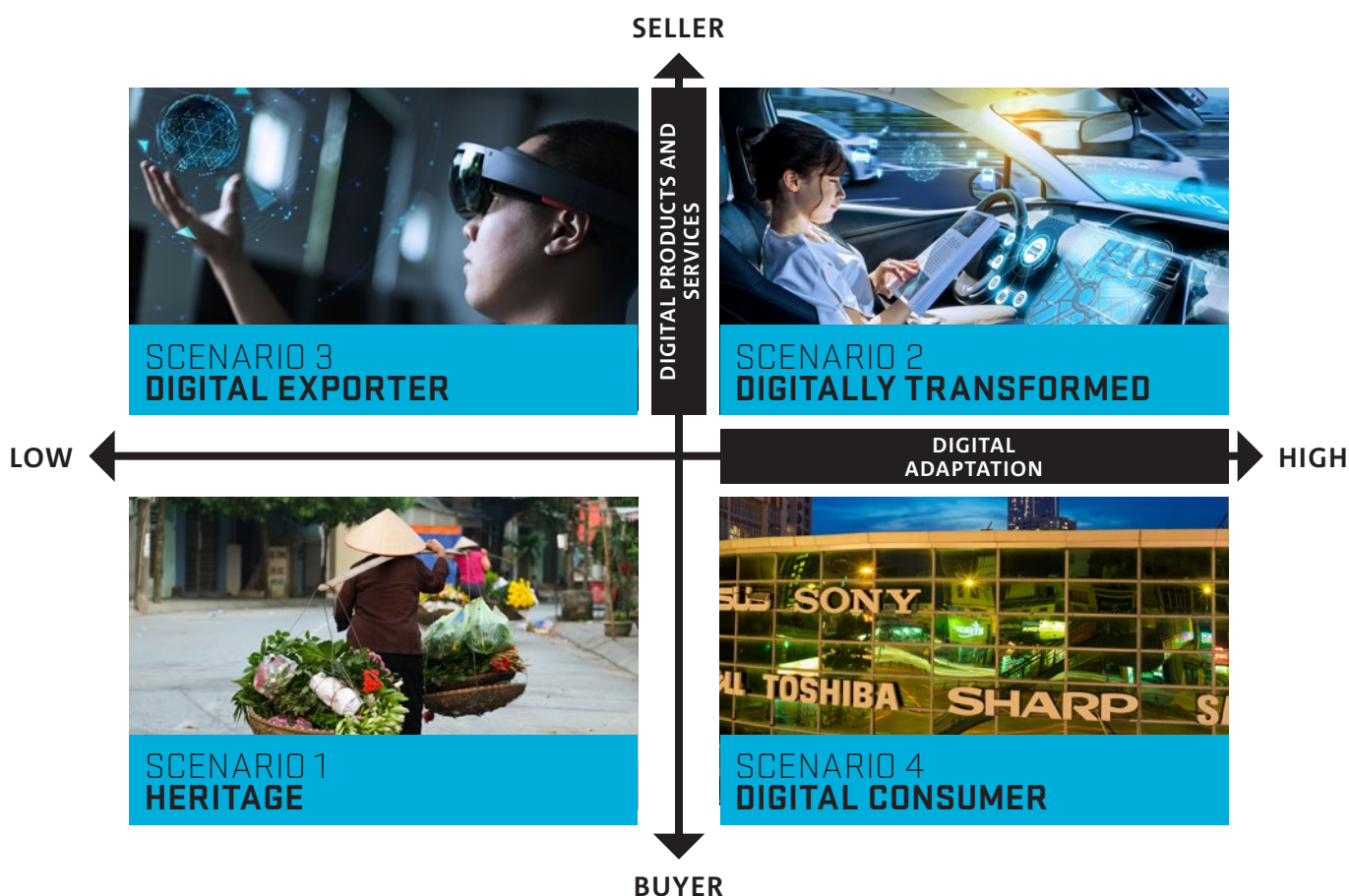




# PART IV SCENARIOS 2045

Scenarios are plausible, evidence-based narratives about the future at a set point in time. They can be identified by extending trends and megatrends into the future, and creating axes of greatest impact and greatest uncertainty.

Based on our analyses and stakeholder feedback in workshops and interviews, the research team have identified four scenarios for Vietnam’s digital economy in 2045.



### How were the scenarios created?

The scenarios were created by analysing the megatrends likely to cause the greatest impact and greatest uncertainty, and forecasting how they might impact Vietnam’s future digital economy. These are placed on an axis (low-high) to create scenario quadrants.

### Vertical axis

Due to Vietnam’s high level of internationalisation, Foreign Direct Investment and the number of trade agreements entered into by Vietnam over the last decade, we considered *Internationalisation* to be the megatrend likely to create the greatest uncertainty for Vietnam’s future digital economy. The axis is affected by external events such a global or regional economic slowdown, currency crises, global commodity prices, domestic inflation rates,

and the economic health and growth rates of Vietnam’s trading partners. The impact of internationalisation on the digital economy is described as whether or not Vietnam becomes a buyer or seller of digital products and services.

We considered that at the lower end of that axis there would be little to no growth in Vietnam’s current digital sector with only minor changes to the proportions of existing exports by sector. The higher end of that axis shows significant growth in the export of digital products and services and Vietnam becoming a leader in digital technology – both for the domestic market and for export.

The extent to which Vietnam becomes a buyer or seller of digital products and services determines the size of Vietnam’s ICT sector and number of digital exports. This axis also indicates the extent to which Vietnam makes the transition from a digital technology adopter, to a producer and developer of digital products and services.

## Horizontal axis

We considered the *Emerging Digital Technologies* to be the megatrend likely to create the greatest impact on Vietnam’s future digital economy. This axis is affected by how emerging digital technologies change Vietnam over the next 25 years, and how they are used and applied around the world. Technologies such as blockchain, Artificial Intelligence, and the Internet of Things will cause productivity changes across industry and governments, and will impact Vietnam’s international competitiveness. The impact of Emerging Digital Technologies on Vietnam’s future digital economy relates to the extent to which Vietnam’s government, industry and community adopts and adapts to the new technology. The level and breadth of digital adoption across Vietnam’s industry, government and community will impact Vietnam’s aims for Industry 4.0, e-government and Smart City applications.

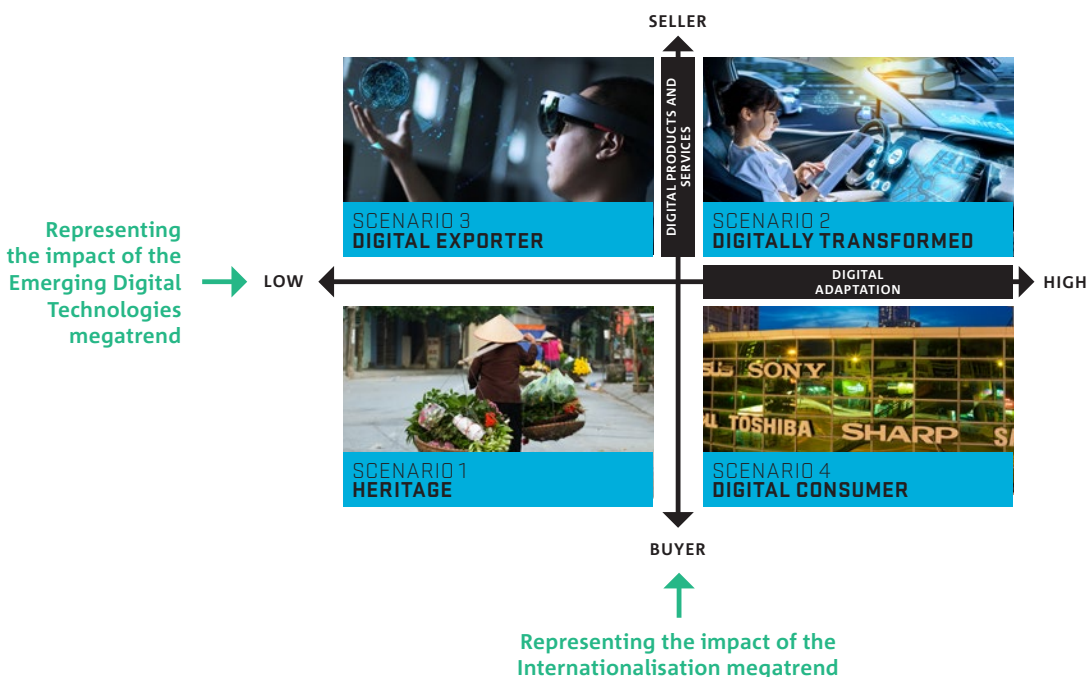
We considered that the lower end of this axes would represent only minor progressive change to Vietnam’s current digital capabilities and adoption of technology. While Vietnam’s adoption of smartphones in the community sector is high, its adoption of digital technologies across industry is currently relatively low, and adaption to digital technologies – through regulation reform and institutional change – has also been reflective of these low levels of investment.

The high end of the digital transformation axis describes transformative digital adoption and adaption across all areas of government, industry and the community. This includes the introduction of smart city technologies, robotics, Artificial Intelligence, blockchain technologies and big data analytics.

The axes chosen also:

1. **Had reasonable historical data.** This was essential to model aspects within each scenario to gain estimates of numbers of jobs disrupted and impacts on GDP.
2. **Were considered relatively independent of each other:** Vietnam’s exports in ICT products and services may grow, for instance, without widespread changes to emerging digital products and services within domestic industries. This is the Digital Exporter scenario, and may result in pockets of ICT expertise across a relatively unmodified and traditional economy.

Adaptation to new digital technologies may also grow without the development of a domestic ICT industry, and an increase in digital exports. This may mean that commodity exports in Vietnam still dominate in 2045, and that ICT products and services used within Vietnam are imported or based in other countries (such as platforms like Facebook and Amazon). Productivity across industries in this scenario would grow, as ICT products sourced from outside of Vietnam would still transform the economy. This is the Digital Consumer Scenario.



3. **Created scenarios that were sufficiently distinct from each other:** this means that there is enough difference in the scenarios for readers of the report to put themselves into four distinctly different futures, and for the differences in the scenarios to be motivating of particular actions, contingencies and change.

4. **Described a future digital economy as opposed to a broader economy:** this report was tasked with describing Vietnam’s future digital economy, and while it can be argued that all economies are now somewhat digital, indicators such as employment growth or productivity growth were not considered as axes because they could occur without digital technologies and would not be descriptive of the digital economy in particular.

SCENARIO	HERITAGE	TRANSFORMED	DIGITAL EXPORTER	DIGITAL CONSUMER
<b>Description</b>	<ul style="list-style-type: none"> <li>Low levels of digital transformation and small ICT industry</li> </ul>	<ul style="list-style-type: none"> <li>High levels of digital transformation across all industries and government services. Growth in exports of ICT products and services.</li> </ul>	<ul style="list-style-type: none"> <li>Slow industrial transformation but fast growing pockets of ICT industry. Overseas companies use Vietnam ICT workers due to their low-cost labour.</li> </ul>	<ul style="list-style-type: none"> <li>Broad industrial transformation across Vietnamese industry, but ICT industry has struggled and ICT exports are not a significant component of Vietnam’s exports</li> </ul>
<b>Events to make this scenario occur</b>	<ul style="list-style-type: none"> <li>Economic crisis – internal, regional or global</li> <li>Low investment in digital skills and infrastructure – both energy and telecommunications</li> <li>Increasing cyber attacks and privacy breaches leading to social distrust of the digital economy</li> </ul>	<ul style="list-style-type: none"> <li>Stable economic conditions – internal and external to Vietnam</li> <li>High levels of investment in skills, infrastructure and industrial transformation</li> <li>Broad transformation policies and regulatory reform</li> </ul>	<ul style="list-style-type: none"> <li>Low or fluctuating national growth due to varying economic conditions</li> <li>Limited and targeted investment in skills and infrastructure by government and/or industry</li> <li>Take-up of the use of global labour market platforms to sell ICT goods and services</li> </ul>	<ul style="list-style-type: none"> <li>Stable economic conditions</li> <li>Broad investment in digital transformation across industry</li> <li>Growth and investment in energy and telecommunications infrastructure</li> <li>Importation of most digital products and services</li> <li>Greater focus and investment in non-digital sectors such as mining and agriculture</li> </ul>
<b>Benefits</b>	<ul style="list-style-type: none"> <li>Low investment and initial debt accumulation</li> <li>Some people continue to lead a ‘low tech’ and ‘back to basics’ lifestyle</li> </ul>	<ul style="list-style-type: none"> <li>Transformation to a more service-based economy</li> <li>Increased productivity</li> <li>Relatively inclusive growth</li> </ul>	<ul style="list-style-type: none"> <li>Lower investment requirements than the Transformed Scenario</li> <li>Exports increase in ICT-related sectors</li> <li>Transitioning slowly to a knowledge-based economy</li> </ul>	<ul style="list-style-type: none"> <li>Inclusive growth and improvements in services</li> <li>Increased productivity</li> <li>Leverages Vietnam’s traditional market strengths – such as agriculture, mining and tourism.</li> </ul>
<b>Primary risks</b>	<ul style="list-style-type: none"> <li>Low productivity leading to the loss of economic competitiveness, and increased relative poverty across the population</li> </ul>	<ul style="list-style-type: none"> <li>Cybersecurity and the threat of nation-wide cyber attacks</li> <li>Over-borrowing to pay for supporting infrastructure and training leading to a large national debt</li> <li>Transition issues related to jobs displaced by automation.</li> <li>Inequality</li> </ul>	<ul style="list-style-type: none"> <li>Inequality in a two-speed economy</li> <li>Labour productivity is still low across most of Vietnam and most industries lose competitiveness</li> <li>Vietnam remains in the middle income trap</li> </ul>	<ul style="list-style-type: none"> <li>Cybersecurity with little internal capacity to build secure systems.</li> <li>Lack of adequate human resources to leverage the full impact of digitalisation in most sectors</li> <li>Reliance on external companies to provide ICT products and services – allowing greater foreign influence in labour and product markets</li> <li>Over borrowing for infrastructure and industrial transformation leading to large national debt</li> </ul>

Source: Data61 analysis

SCENARIOS	ACCUMULATED ADDITIONAL GDP BY 2045	IMPACT ON ANNUAL GROWTH	DESCRIPTION AND ASSUMPTIONS
HERITAGE	\$US 60.9 B	0.38%	<ul style="list-style-type: none"> <li>Labour replacement due to automation is modest in all sectors</li> <li>The impact of digital adoption may contribute approximately US\$61 billion to Vietnam's GDP by 2045</li> </ul>
DIGITAL EXPORTER	\$US 66.9 B	0.45%	<ul style="list-style-type: none"> <li>There are more opportunities for development in the three sectors namely Information, Media and Telecommunications; Professional, Scientific and Technical activities; and Education and Training.* Digital adoption in the other sectors has remained at a similar level to the Heritage Scenario.</li> <li>Vietnam can gain as much as about \$US67 billion by 2045 with digital technology adoption</li> </ul>
DIGITAL CONSUMER	\$US 102.8 B	0.63%	<ul style="list-style-type: none"> <li>Digital adoption in the three sectors (Information, Media and Telecommunications; Professional, Scientific and Technical activities; and Education and Training) has remained at a similar level to the Heritage Scenario. There is wide adoption of digital technologies in other sectors, though at slower rates compared to those of the Digitally Transformed Scenario.</li> <li>Digital adoption is likely to add another \$US103 billion to GDP by 2045</li> </ul>
DIGITALLY TRANSFORMED	\$US 168.6 B	1.1%	<ul style="list-style-type: none"> <li>Digital technologies are well developed and widely adopted at high rates across all sectors</li> <li>Vietnam can see an increase of around \$US169 billion in projected GDP by 2045</li> </ul>

**Figure 43 Impact of digital technology adoption on GDP as described in the scenarios for Vietnam's digital economy in 2045**

\*We assume these sectors are leading and the keys to develop digital technology whereas the other sectors likely adopt the technology.

Source: GSO data, Data61 Analysis

Note: GDP in real US\$, 2005 prices.

SCENARIOS	PROPORTION OF JOBS AT RISK OF TRANSFORMATION DUE TO DIGITAL TECHNOLOGY	DESCRIPTION AND ASSUMPTIONS
HERITAGE	18.4%	<ul style="list-style-type: none"> <li>Labour replacement due to automation is modest in all sectors</li> <li>About 18.4% of the total labour force is at risk of job displacement by 2045</li> </ul>
DIGITAL EXPORTER	19.1%	<ul style="list-style-type: none"> <li>There are more opportunities for development in three sectors: Information, Media and Telecommunications; Professional, Scientific and Technical activities; and Education and Training. Digital adoption in the other sectors are similar level to that in the Heritage Scenario.</li> <li>About 19% of total jobs are at risk by 2045</li> </ul>
DIGITAL CONSUMER	28.9%	<ul style="list-style-type: none"> <li>Digital adoption in three sectors remained at a similar level to that in the Heritage Scenario: Information, Media and Telecommunications; Professional, Scientific and Technical activities; and Education and Training. There is wide adoption of digital technologies in other sectors, though at a slower rates than the Digitally Transformed Scenario.</li> <li>Around 29% of total jobs are at risk</li> </ul>
DIGITALLY TRANSFORMED	38.1%	<ul style="list-style-type: none"> <li>Digital technologies are well developed and widely adopted at high rates in all sectors</li> <li>About 38% of total jobs are at risk</li> </ul>

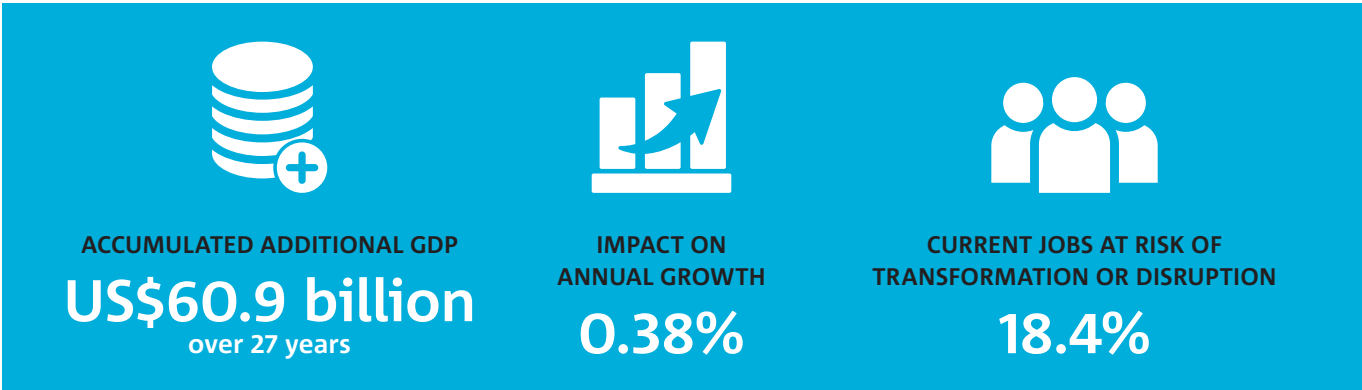
**Figure 44 Impact of digital technology adoption on the labour market, as described in the scenarios for Vietnam's digital economy in 2045**

Source: GSO data and Data61 Analysis

# SCENARIO 1

## HERITAGE

Low digital transformation, stalling productivity, boutique labour intensive, and commodity-based exports.



Note: GDP in real US\$, 2005 prices.



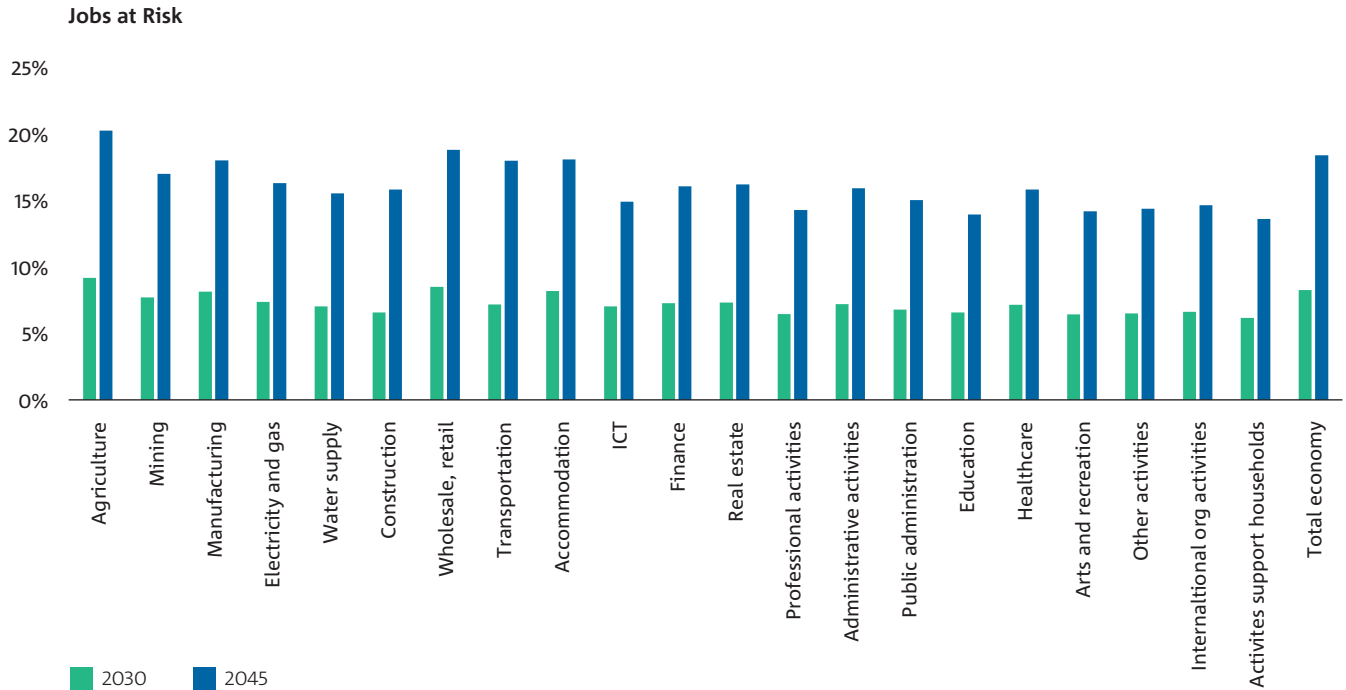


Figure 45 Total impact of digital technology by % on labour markets across industries of Vietnam by 2030 and 2045 – Heritage Scenario

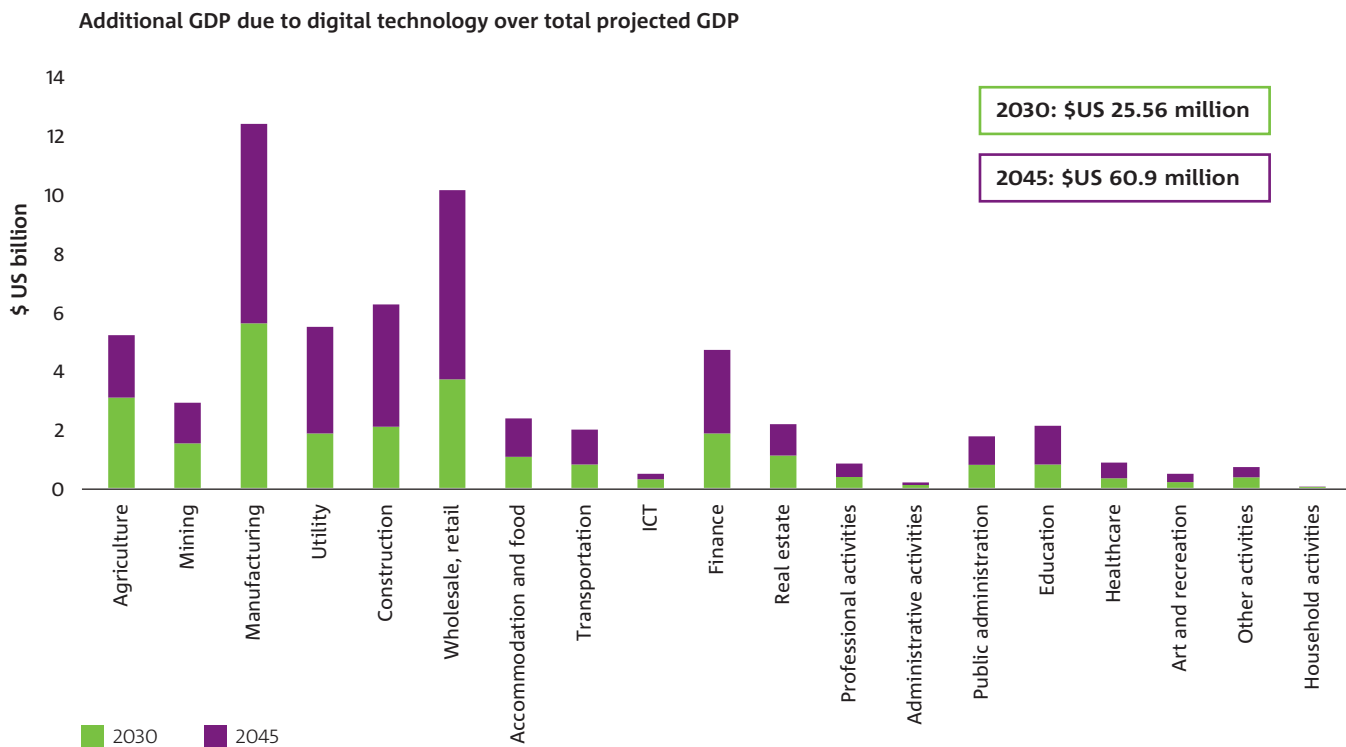


Figure 46 Total impact of digital technology on GDP across industries of Vietnam by 2030 and 2045 – Heritage Scenario

Note: GDP in real US\$, 2005 prices.

## Features of this scenario:

Digital adoption is relatively low and labour productivity has stalled. The economy is still largely reliant on traditional commodities exports (agricultural, fishing and mining products) and a growing tourism sector. There has been low and patchy adoption of ICT products across Vietnam's industry, and no breakthrough global technologies. The ICT industry is based in a few urban centres and struggles to keep highly skilled developers within Vietnam.

Main exports: Tourism, mineral ores, petro-chemicals, and agricultural products.

## Critical developments for Heritage Scenario to occur:

A growth in the price and value of unrefined exports – such as mineral ores, petro-chemicals and agricultural products.

Low investments by government and industry in ICT infrastructure, new energy infrastructure, and digital skills and capabilities.

A lack of regulatory reform in areas such as taxation, business incentives, land use, IP protections, innovation systems, use of digital products and services.

Community resistance to change in traditional practices and values, and an increase in the labour intensive niche production methods – such as artisan products and services.

Possible external economic factors that inhibit the growth and transformation of the Vietnam economy – such as a global or regional economic slowdowns or crises.

Slow transformation within the Vietnam government to e-government services and products.

## How can this scenario occur?

For Vietnam to be in a Heritage Scenario in 2045 there may be new political or economic instability within Vietnam – or larger regional or global economic slowdowns beyond Vietnam. Vietnam's high level of internationalisation makes the country vulnerable to the economic fortunes of other countries. Imprudent allocation of resources, over-spending and debt accumulation, internal political unrest, large natural disasters or widespread corruption could sap momentum from Vietnam's current high levels of growth, and leave Vietnam languishing at the lower end of middle income status for decades to come.<sup>260</sup> Ohno (2013) suggests that Vietnam's economy is already showing signs of falling into the middle income trap with low efficiency in economic investments, falling productivity in the production sector, and recent depreciation of the Vietnamese Dong.

Indonesia's economic history illustrates how, despite significant initial growth, Vietnam could slip into a Heritage Scenario. Following independence in 1945 after the Second World War Indonesia was on a similar growth trajectory to that of South Korea, rated as a high performance Asian economy (HPAE) and growing strongly by reducing government debt, inviting foreign investment, and opening up the foreign exchange. Indonesia became a middle income country in 1993 but was set back by the Asian Financial Crisis in 1996, and structural weaknesses, regional conflicts, natural disasters and corruption in the financial and government sectors meant the country slipped to low income status, and took six years to regain lower middle income status in 2003.<sup>261</sup> Despite being rich in natural resources – particularly oil – Indonesia has not reaped the economic and social benefits of its income, and the country remains in lower-middle income status 16 years later.<sup>261</sup> Indonesia is considered to be one of the countries in the 'middle income trap.'<sup>262</sup>

## Exports – Mining, agriculture and growing tourism

- **Mining and petro-chemicals:** Vietnam holds significant deposits of bauxite, titanium, tungsten, zinc, copper, gold, nickel, manganese and rare-earth minerals, as well as fuel such as coal and crude oil. In the twenty-six years to 2045 commodity prices for mining minerals have risen, and plans to add value to mineral exports have been shelved as it is now more profitable to export the unrefined products to countries with fully-automated processing plants. This has meant that mineral exports have grown as a percentage of GDP. Following a trend that began in the mid-2010s, extraction of minerals from Vietnam has been increasingly difficult due to ageing mines, depleted resources and outdated equipment. Although the prices for ores have risen, mining output has only risen slightly in the last 20 years.<sup>263</sup>
- **Tourism:** 2019-2045 saw Vietnam's tourism sector grow steadily and strongly with the rise of the middle classes across much of South East Asia. Is it now one of Vietnam's larger export earners. Middle class urban-dwelling Chinese and Indian tourists in particular are using Vietnam as a convenient and affordable coastal getaway. Many of Vietnam's tourist businesses are still owner-operated, facilitated by platforms such as Airbnb, HomeAway and HometoGo. These have facilitated the transition of many small communities from agricultural to tourist towns – many of which have developed 'eco-tourist' operations. Larger multinational operators have congregated in beachside locations – many of which are now suffering from high visitation rates, pollution and degradation.<sup>176</sup> Increasing environmental events and currency fluctuations have made the market unreliable, with large year-to-year business fluctuations.
- **Agriculture:** Vietnam's agriculture sector grew steadily from 2019-2045, although it is still labour intensive and reliant on the output from small scale farming. The percentage of the population employed in agriculture has dropped only slightly. The lack of supporting energy and transport infrastructure (roads, rail and ports) means it is still quite inefficient to produce many foods in Vietnam, and this is now a disincentive to investment compared to the highly efficient systems deployed in neighbouring nations. Climate change and resource depletion are now major issues in the sector.

- **Manufacturing:** Vietnam's manufacturing sector has steadily declined – lacking the competitive productivity of factories in neighbouring countries. For a while it looked hopeful that the investment in high tech manufacturing that occurred prior to 2020 would continue, but over time other countries with fully-automated factories, reliable electricity, better infrastructure and low-burden regulation became more attractive.<sup>263</sup> Downturns in the global economy and currency crises also lowered demand for many products in the major consumer markets. Many small factories still exist however, utilising the low-cost labour market, and the existing infrastructure in terms of equipment and buildings.

## The digital economy and the ICT industry

- **Limited digital economy reform:** There has been a lack of necessary reform in government and industry in relation to new technology and digital disruption. This includes government procurement, taxation, business incentives, IP protection, and reform regarding the ease and security of doing business in Vietnam. The lack of regulatory reform has become a disincentive for both domestic and foreign investment in new ICT products and services.
- **Limited access to government data through Open Data:** A lack of access to Open Data from government and heavy protectionism regarding data sovereignty has deprived the Vietnam ICT and start-up sector of valuable material to create and construct helpful apps and software to help transform Vietnam<sup>264</sup>.
- **Vietnam's ICT industry stalls:** A low skills base has reduced international confidence in Vietnamese ICT firms to produce quality digital goods and systems. While they are able to produce products and services for the local industry, local ICT businesses do not earn enough export income to support more than pockets of expertise in particular urban centres.<sup>265</sup>
- **Restrictions applied to digital platforms:** Distrust in the high levels of data-harvested from these platforms has meant new restrictions have been placed on their use. Local platforms are promoted and this generates, to some degree, good internal interactions.<sup>266,267</sup>

- **Vulnerable to cyber attacks:** There are regular cyber attacks on the country's ICT networks. Banking and other sectors have developed cybersecurity expertise but people are hard to attract, and increasingly that expertise is being sought from external territories.<sup>268</sup>
- **Growing informal economy and use of cash-fiat currency:** Regular data breaches and systems hacking has decreased consumer trust in electronic networks, financial transfers and systems, and the informal economy, and use of cash-fiat currency has grown. This has promoted many smaller, low-tech, local-trade-based vendors.<sup>269</sup>

## Productivity and innovation

- **FDI moving offshore:** Flat labour productivity over this period has meant that some of the larger factories producing high technology goods are moving offshore to take advantage of Industry 4.0 technologies and cheap, reliable and clean sources of power.
- **Job automation:** Factories closing or replacing staff with automated systems in all sectors has created high unemployment – particularly in regional and rural centres and some urban areas, and this has negatively impacted crime, personal safety and the liveability of cities.<sup>154</sup>
- **Low innovation capability:** Relatively low investment in education and innovation means Vietnam still generates low levels of IP and this disadvantages local industry and stifles the generation of breakthrough technologies and new export sectors.<sup>270</sup>
- **Underdeveloped IP system:** Although trust in the systems that register IP in Vietnam have improved, most people are still ignorant of IP registration processes and protections, it is slow, not assured, and the justice system does not regularly enforce IP rights.<sup>270,271</sup>

## Skills and Labour

- **Skills outpaced by demand:** Tertiary education, especially STEM education, has not kept pace with demand for skills in the ICT sector. Many of the more successful enterprises have looked to other countries for both skills and venture capital.<sup>229</sup>
- **Brain drain:** Online education has created avenues for enthusiastic self-learners, but without formal support through a strong national innovation system, many of these students look externally for opportunities to develop their careers and business ideas.<sup>270</sup>

## Urban development

- **More rapid urbanisation:** Decreasing economic opportunities and low levels of government services in rural and remote areas has created a new wave of people moving to the cities. Some medium sized cities are now urbanising at around 7% per year.<sup>272</sup>
- **Underdeveloped infrastructure:** Higher interest on development loans has meant the Government has been unwilling to borrow too heavily for urban infrastructure to accommodate extra people. High-density slums are developing and becoming a more permanent feature on the outskirts of the larger cities. This impacts health and life opportunities of a significant portion of the population.<sup>273</sup>
- **Lower quality of life in urban areas:** Negative externalities – such as air, water and noise pollution and traffic congestion – related to living in the cities has decreased quality of life. There has been some progress in switching to electric vehicles and drones for deliveries, but it has not been fast enough to counter the increase the population, and the use of petrol vehicles is still increasing.
- **Unreliable energy:** Energy use has become a problem, especially in summer months where rising temperatures have increased the use of air conditioners. Blackouts in these months are common, and energy supplies are expensive.<sup>209</sup>

## Environmental impacts

- **Land, air and water degradation:** Lack of effective monitoring and control on environmental pollution and degradation of land, air and water, has meant that although tourism has grown substantially, it has been restricted to a few areas, which are suffering from higher and higher visitation rates. Restrictions on visitor numbers and activities have caused tensions with local communities. Tourism has benefited many smaller operators with the use of platforms, but the largest profits are made by large multinational hotel and development chains.<sup>274</sup>
- **Lower agricultural yields:** Agricultural production has also been constrained by increasing environmental issues related to pollution, salinity, erosion and land degradation. Some harvests have failed with extreme weather events, and natural reserves of fish stocks are in danger of collapsing.
- **Extreme weather, unmitigated:** Climate change and increased frequency of large, unmitigated natural disasters places financial stress on citizens and Vietnam governments at all levels, especially as the two larger sectors – agriculture and tourism – are impacted more widely.<sup>37</sup>

## Priority areas of action for the Heritage Scenario

Investment in digital and energy infrastructure, digital skills, institutional change and regulation reform and development.

## Critical risks for the Heritage Scenario:

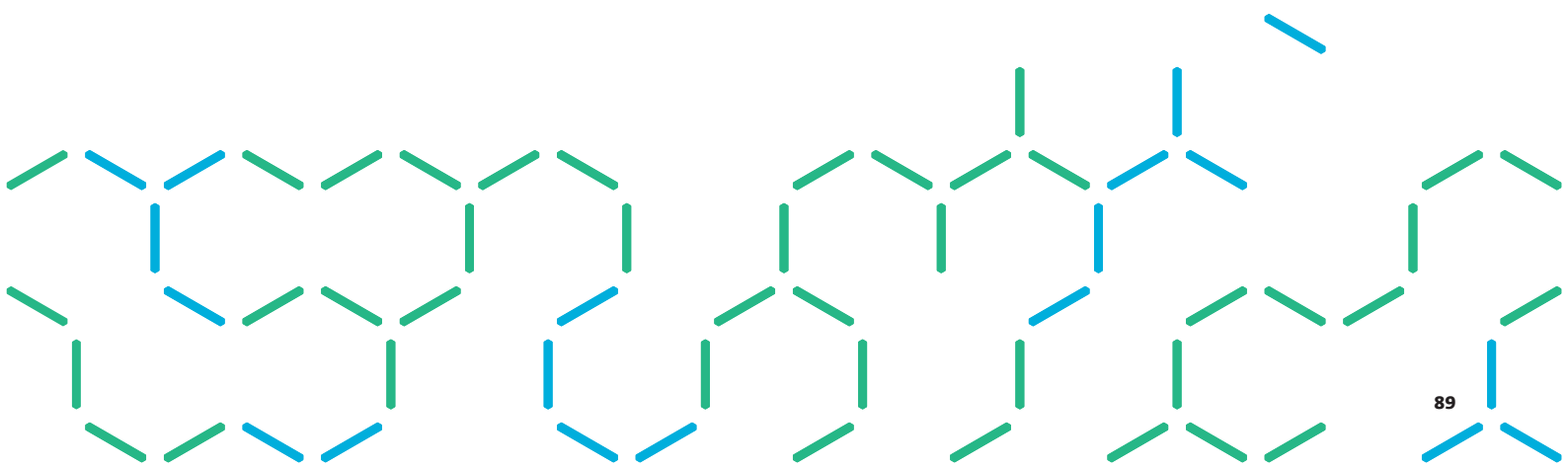
Vietnam would be caught in the middle income trap, and slip in competitiveness compared to other low and middle income countries.

Many Vietnamese people would miss out on the opportunity and freedoms of developing businesses and wealth on global markets.

Vietnam would experience greater impacts from climate change due to lack of monitoring and planning for change. Natural disasters would not be mitigated by digital warning systems or predictive software.

Many natural resources would be depleted as there is still a dependence on commodities, particularly agricultural and mining commodities, and there may be an emerging energy crisis.

Vietnam may lose some of its sovereignty due to data harvesting and control of systems by large multinational firms, and restrictive or completely unprotected IP systems. Vietnam would also not reap the development benefits of using data flows in the ASEAN region.



# SCENARIO 2

## DIGITALLY TRANSFORMED

Digital adoption and ICT industry growth is high, increasing labour productivity across all sectors.



ACCUMULATED ADDITIONAL GDP  
**US\$168.6 billion**  
over 27 years



IMPACT ON  
ANNUAL GROWTH  
**1.1%**



CURRENT JOBS AT RISK OF  
TRANSFORMATION OR DISRUPTION  
**38.1%**

Note: GDP in real US\$, 2005 prices.

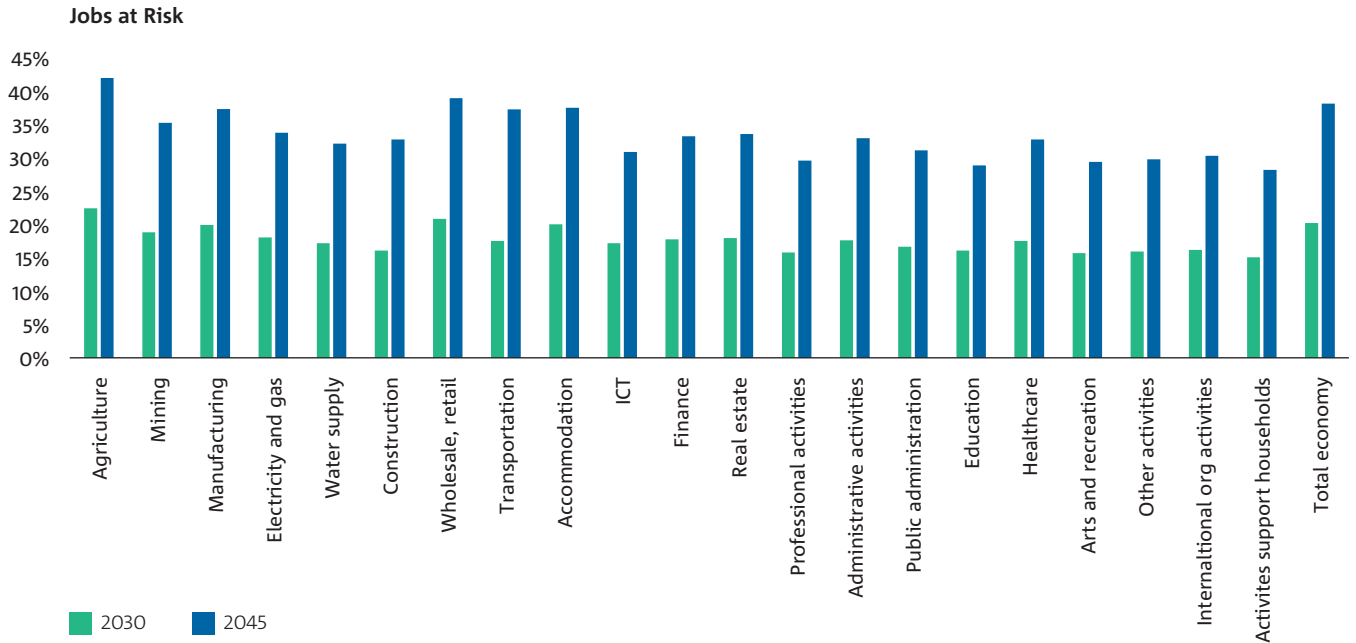


Figure 47 Impact of digital technology by % on labour markets across industries of Vietnam by 2030 and 2045 – Digitally Transformed Scenario

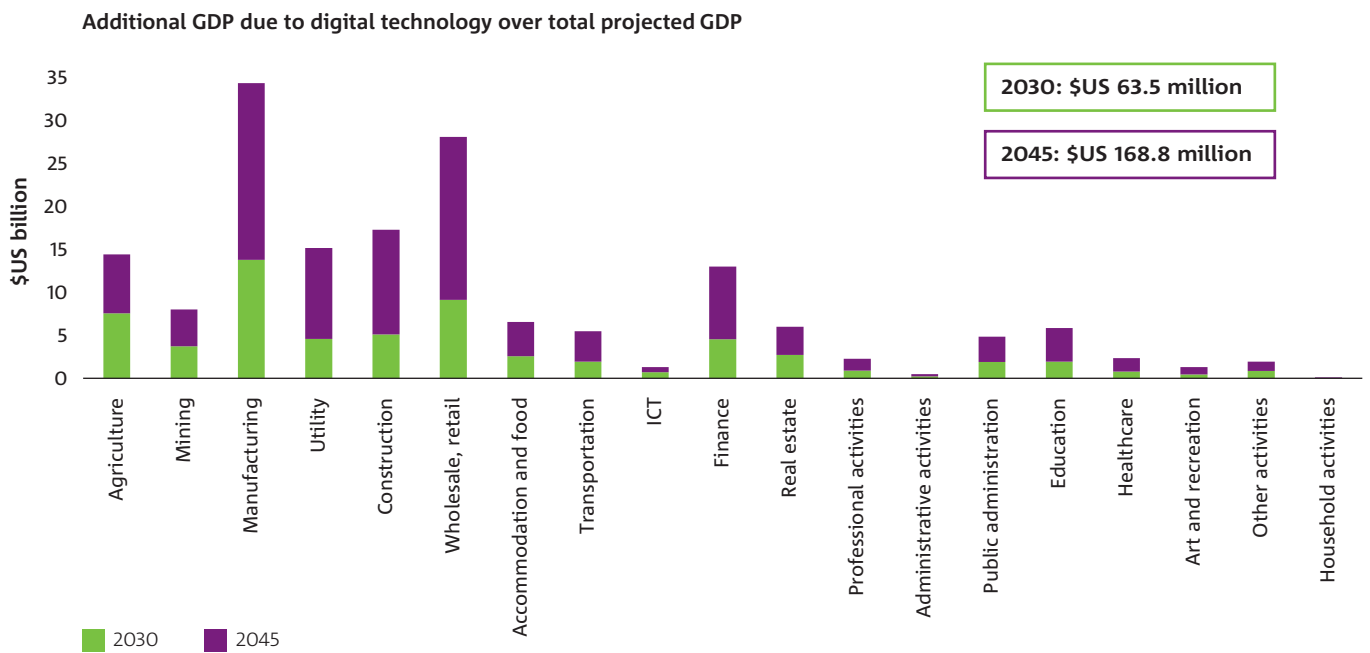


Figure 48 Impact of digital technology on GDP across industries of Vietnam by 2030 and 2045 – Digitally Transformed Scenario  
 Note: GDP in real US\$, 2005 prices.

## Features of the Digitally Transformed Scenario:

Digital adoption is widespread across the population and industrial sectors, resulting in inclusive growth.

Main exports: Knowledge-based services – particularly in design, digital services, agricultural technology and advanced manufacturing, as well as tourism.

**Benefits of the Digitally Transformed Scenario:** higher income and GDP per capita, higher global competitiveness, increased ability to invest in innovation to solve national problems and through smart service provision, increased exports of higher-value products and services.

**Downside to the Digitally Transformed Scenario:** higher education levels will lead to higher wages, and high levels of job disruption. The digitally transformed scenario has the highest level of job disruption of all the scenarios. Countries that have technologically transformed have often had high unemployment rates in certain sectors – such as manufacturing, or in certain age demographics – often either in school leavers, or older workers.

Lower fertility rates resulting from long working hours or higher workforce participation – especially by women – may also lead to a rapidly ageing population, or the need to increase skilled immigration. Allowing in large numbers of foreign workers may threaten cultural cohesiveness.

## Critical developments the Digitally Transformed to occur:

Continuation of global growth, particularly growth in the Asia Pacific region.

Investments in education, new energy sources, a national innovation network and safe and secure communications networks.

Broad regulatory reform in e-government, taxation, business incentives, IP protections and reform, and ease of doing business.

A focus on cybersecurity and the widespread deployment of new trusted networks for IoT.

Building broad proficiency in ICT and STEM skills (from school to the workplace) as well as centres of excellence in ICT growth industries.

Introduction of blockchain-based distribution and other systems such as digital currency for services.

## How can this scenario occur?

For Vietnam to achieve the Digitally Transformed Scenario the country would have to follow a similar economic trajectory to countries such as South Korea or Taiwan. Both of these economies climbed from low income status to high income status over 40 years, or from middle income status to high income status over 10-15 years. Both of these economies have much smaller populations (Taiwan with 23.58 million and South Korea with 51.16 million in 2018), and their economic transitions started roughly 25 years before Vietnam's. The World Bank's Vietnam 2035 documents state that if Vietnam follows a high growth trajectory, it will reach higher middle income status by 2035, and the following decade could see Vietnam reaching high income status. The OECD predicts that current growth patterns suggest Vietnam will not reach high income status before 2058,<sup>159</sup> so rapid transformation would need to occur for Vietnam to reach high income status by 2045. Rapid transformation would need large structural reforms within and across Vietnam, stable economic conditions – both globally and regionally – high investment in infrastructure and broad-based education and industry modernisation programs, investment in the environment and pollution control, increased capital accumulation and good macroeconomic management of spending, debt and inflation.

## Exports

- **Knowledge-intensified:** Vietnam's export industries have transformed and knowledge-intensified. Vietnam is now one of Asia's 'tiger' economies and on the verge of becoming high income status.<sup>275</sup>
- **ICT hub:** Vietnam has become a leader in ICT services, software and goods manufacturing. The country has specialised in growth industries like data privacy, AI, cybersecurity, genomics, and blockchain – and building novel products for domestic and export markets, including through global licencing. A few breakthrough technologies have built export industries in their own right.<sup>276</sup>
- **Education:** Education is becoming a major export industry, as more people are attracted by the success of industry in Vietnam, and Vietnam builds its education and research institutions.<sup>277</sup>
- **High-value agriculture:** Agricultural exports have become higher-value through blockchain provenance systems and better trust in Vietnam-branding. Produce in Vietnam has diversified with new niche markets in luxury food goods. Production value is emphasised over production volume.<sup>32</sup>



- **Tourism remains strong:** Tourism is supported by better infrastructure such as rail to airports, efficient airports and airlines, good communication networks and reliable power. Visas are more widely available and tourist hot-spots are well managed through permit systems and environmental monitoring.<sup>176</sup>

## Digital economy and ICT industry

- **High growth in Vietnam's digital economy:** The digital economy in Vietnam is booming in both supply for internal projects and also as an exporter of ICT products and services.<sup>275,276,278</sup>
- **Rising e-government:** Procurement reform within the Vietnam government has resulted in a surge of competitive government-commissioned work for public sector applications. This has supported Vietnamese start-ups and dramatically cut the costs of the public sector. This has also attracted external interest. This work includes cybersecurity projects, patient admissions systems, education records, drones and sensor networks, analytics, blockchain networks for registries, smart cities and telecommunications works.<sup>279</sup>
- **The start-up sector and ecosystem is vibrant** with a number of start-ups developing into Unicorns; from start-up to scale up and becoming global organisations worth more than US\$1 billion.
- **E-government tenders:** Technology-challenges are now the norm for government-commissioned jobs. These are open competitive tenders for yet-to-be-developed technology to solve specific and general technical and other problems. The intellectual challenge has attracted the best minds from around the world.
- **Privacy and protection:** Vietnam has contributed to South East Asia regional data governance frameworks that protect data sovereignty and citizen privacy through rights and regulations on the use on international platforms, whilst allowing innovation, participation and cross border data flows essential for economic development – particularly in relation to the digital economy. A balance of access rights, and checks and balances, with national authorities has been reached – with the participation of citizens, businesses and security agencies and international bodies.<sup>280</sup>
- **FDI for ICT:** Investment into reforming government process has attracted more FDI. This has been used to leverage further investment in ICT infrastructure and facilities within the country.<sup>29</sup>

- **Job transitions:** Redundancies from government and industry have been supported with 'transition training credits' which provide training for workers in new fields. Skills have improved dramatically.<sup>281</sup> The gig economy, and access to electronic training platforms – from YouTube to free electronic university courses – has also assisted in the development of in-demand skills, such as data analytics, coding, systems engineers, and industrial design.<sup>282</sup>
- **ICT industry peak body and Regulation Reform Panel:** Vietnam's ICT industry works with government's Regulation Reform Panel through a formalised peak body representing both large and small organisations. This body, in conjunction with the Regulation Reform Panel has continuously identified areas of regulation reform needed to keep modernising industry and growing the ICT industry in Vietnam.
- **Leapfrogging technology:** Mechanical systems have been bypassed to full-automated systems. Wired-in systems of broadband have been bypassed with the evolution of 5G wireless networks.<sup>96,283,284</sup>
- **Less cash-fiat currency:** In the 2020s the cash system was reduced, but kept as a backup to crashes in the electronic system. This reduced the informal economy drastically within 10 years of the introduction of electronic payments systems.
- **Digital currency:** Vietnam became one of the first countries in Asia to trial a national blockchain backed digital currency supported by smartphone digital wallets. Monetary flows are now easier to track and tax, taking away some of the burden of regulation on small business.<sup>117,145</sup>

## Productivity and innovation

- **National innovation system:** Investment in a small number of significant high tech parks and a strong national innovation system across significant academic centres has boosted collaboration and joint venture projects, both internally and with other countries.<sup>270</sup>
- **Modernisation has unequal impacts across Vietnam:** some areas in high manufacturing districts are affected by rapid automation and the development of new factories – particularly in garments and footwear – that are fully-automated. Other factory work has been offshored.<sup>285,286</sup>

- **Use of new funding vehicles for infrastructure investment:** Vietnam has taken advantage of a number of new platform-based finance systems to fund many of the smart-city and other infrastructure projects. These have come at low interest costs, and have allowed greater collaboration in design and knowledge.<sup>275</sup>
- **World leader in ICT:** Vietnam is an emerging world leader in a number of technologies – advancing research and preserving the technology in global patents. This has meant the technology can be licenced for use in products, with revenue flowing back into the country to fund further research.<sup>80</sup>
- **IP Protection Balance:** Intellectual Property protections have struck a balance between rewarding the owners and generators of new Intellectual Property through trusted registration and protection systems – now on automated blockchain systems, and the use of creative commons, open source, open data and other licencing systems that allow sharing and distribution of digital assets.<sup>271</sup>
- **Better logistics:** New production and logistics networks have been enabled by widely deployed 5G networks and a new low power wide area network that has stimulated IoT development. Improved logistics at airports and ports have taken advantage of other new facilities in major trading partners and around the South China Sea to increase output and income from regional trade.

## Skills and Labour

- **Brain gain:** Many Vietnamese graduates studying in other countries have been lured back with offers of work, scholarships and positions within newly established research institutions.<sup>277</sup>
- **Broad education policies:** education spending has increased digital literacy across the Vietnamese population – through schools, industry partnerships, blended education programs and industry placements. The working population increases in skills in need – as advised by industry advisory boards to government.
- **Lifelong adult learning courses** are provided in accessible online courses and toolkits and accredited via blockchain systems
- **Training credits:** workers displaced by robotic and AI are provided with retraining credits from their previous employers, and skills in sunrise industries.

## Urban development

- **Clean fuels, clean air:** Petrol vehicles have been phased out ahead of similar cities in neighbouring countries, and Vietnamese cities are now quieter and cleaner. Autonomous electric and hydrogen vehicles are dominant on the roads – with only a few petrol vehicles left. To discourage their use petrol cars are registered at higher rates than newer vehicles. Blue skies have returned permanently to Vietnam’s large cities, which improves public health, and urban liveability.
- **Urban liveability:** A focus on parks and cultural institutions (galleries, museums, wildlife parks, destination points) and has boosted urban liveability. Health and education facilities have been built to be walkable to growing population areas (thus reducing traffic and congestion and improving health). People are now returning from overseas areas.<sup>287</sup>
- **Travel by metro and autonomous vehicles:** New metro systems that were underway in 2019 in the larger cities have taken many vehicles off the roads. Where metro systems are not built autonomous transport systems have decreased private vehicle ownership. People are encouraged not to own their own vehicle but to use more app-facilitated transport, in ‘transport-as-a-service’ systems.<sup>288</sup>
- **Smart cities:** Smart city infrastructure has been installed across the city’s road networks, controlling traffic flows and cutting emissions. Monitoring and number plate tracking helps enforce traffic rules, resulting in safer, more predictable traffic that is easier for planners to control. Smart city infrastructure also monitors crime and collects data on areas of concern.<sup>287</sup>
- **Proactive infrastructure maintenance: sensors and 3D visualisations** of all buildings and infrastructure mean that Vietnam authorities can be proactive in maintaining critical infrastructure in water pipes, roads and bridges. This proactive approach has reduced maintenance costs.<sup>289</sup>
- **Work anywhere:** Better Internet infrastructure has led to more people to working in from home or co-working spaces, rather than physical offices. This also cuts traffic congestion.<sup>290</sup>
- **Drone deliveries:** Drones are now delivering vital supplies for hospitals and emergency services. The increased demand has meant the government has had to restrict their use in city areas.<sup>291</sup>

## Critical risks for the Digitally Transformed Scenario:

Cyber attacks: with universal authentication and essential and smart-city systems now part of the growing IoT, and a far greater proportion of the economy reliant on online networks, Vietnam is more vulnerable to disabling cyber attacks. This includes national security breaches and attacks from foreign state-sponsored organisations, as well as commercial attacks and hacks to release personal and financial data. Cyber attacks have the potential to quickly bring down national systems and the impact on the entire economy.

Distrust in electronic networks due to state and other surveillance, cybercrime and lack of legal and other recourse to financial losses, impacts on property, or invasions of privacy and personal freedoms and safety.

Crime networks and tax-avoidance schemes flourish with the development of encryption technologies and cryptocurrencies that can quickly and anonymously move value from person-to-person, offshore, or fund illegal activities.

Vietnam loses its uniqueness with a loss of cultural diversity in practices, social structures, languages, history and beliefs.

Not everyone reaps the benefits of modernisation of the Vietnam economy, as investment is focused on urban areas, or even greenfield developments. There is a risk of growing inequality, particularly between urban and rural areas.

Automation causes mass unemployment in certain areas, and a need for rapid transformation – particularly in factory towns.

New markets for digital products and services, or alternative sectors such as tourism, do not grow fast enough, and parts of the Vietnamese labour market are excluded from employment opportunities due to low skills, lack of local jobs or lack of ICT equipment and connections.

Over extension of loans and borrowings to modernise industry too rapidly increases public debt to unsustainable levels.

## Environmental impacts

- **Keeping pace with energy demand:** Smart city infrastructure and electric vehicles are increasing demand for electric/grid-based energy. In some cases large loans have been sought to build the required infrastructure, and energy has been imported in the interim years.<sup>292</sup>
- **Shift to renewable and distributed energy networks:** Ambitious renewable energy targets have attracted funding for large renewable energy and battery storage projects. By piloting an array of energy designs and smart-grids Vietnam has become a leader in renewable energy solutions for South East Asia. Vietnam has also decommissioned several older coal-fired power plants, greatly improving carbon emissions and air pollution.<sup>22</sup>
- **Prepared for extreme weather:** Extreme weather events are more frequent but, by modelling and using AI predictive systems to assess the impacts of water flows and surface temperatures, Vietnamese emergency services have built plans to cope with extreme weather events. Extreme weather damage is somewhat mitigated.<sup>293</sup>
- **Salt-tolerant crops:** High salinity in low-lying farms has continued to be a problem, but new species of salt tolerant crops have been introduced to help mitigate the impact.<sup>294</sup>
- **Sustainable agriculture:** The shift to higher-value agriculture has positively impacted farming and agricultural practices. There is lower use of destructive chemicals and bad land practices.<sup>295</sup>
- **Monitoring pollution:** There has been better monitoring and regulation of natural systems through satellite data and sensor networks. This has meant better policing of pollution and dumping.<sup>183,296,297</sup>
- **Monitoring land use:** Satellite monitoring of land-use also means the Vietnam Government can better control vegetation cover, land clearing and agricultural practices, prevent landslides, soil erosion and flash flooding in many areas.<sup>296,298,300</sup>

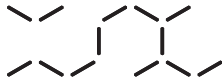
## Priority areas for action in the Digitally Transformed Scenario

Cybersecurity, labour market transformation, regulation and taxation reform, improved rule of law and reduction of systemic corruption, and broad skills programs.

Innovation and investment will be required for infrastructure funding, technology transfer, taxation, international partnerships and government modernisation.

# SCENARIO 3

## DIGITAL EXPORTER



Vietnam’s ICT industry grows on outsourced work from other countries, but internal adoption across industries remains low.



ACCUMULATED ADDITIONAL GDP  
**US\$66.9 billion**  
over 27 years



IMPACT ON ANNUAL GROWTH  
**0.45%**



CURRENT JOBS AT RISK OF TRANSFORMATION OR DISRUPTION  
**19.1%**

Note: GDP in real US\$, 2005 prices.

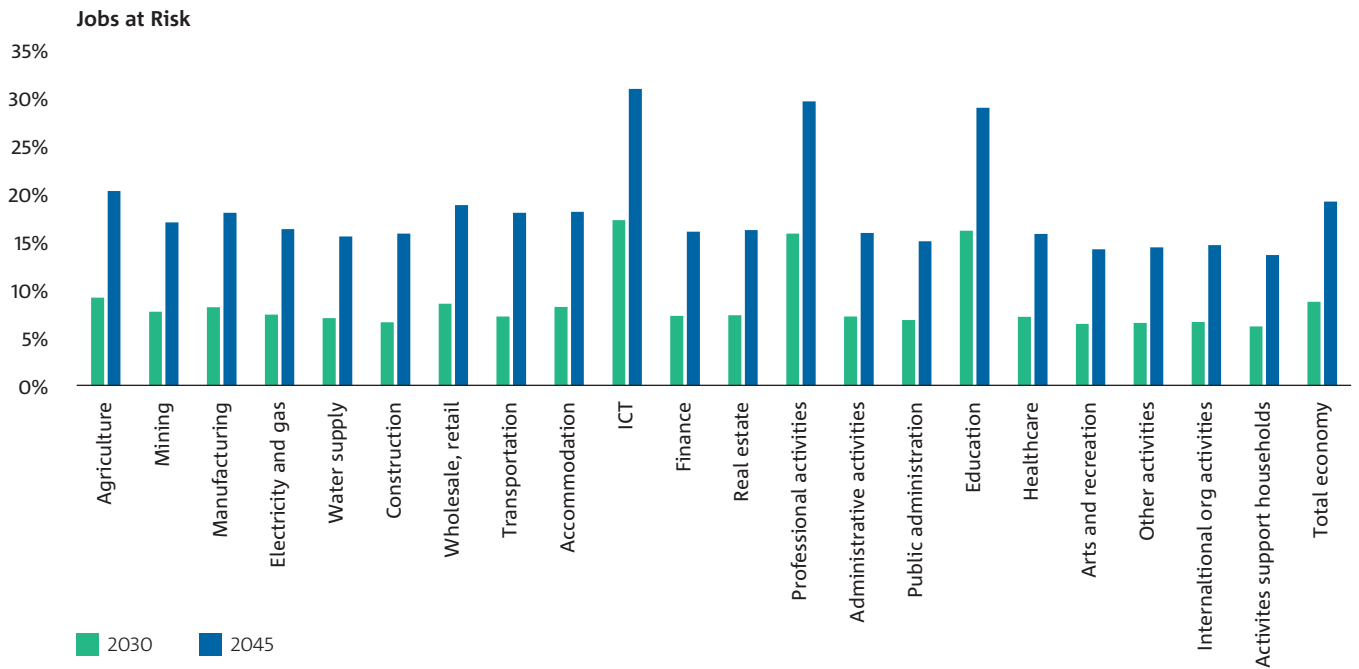


Figure 49 Impact of digital technology on by % on labour markets across industries of Vietnam by 2030 and 2045 – Digital Exporter Scenario

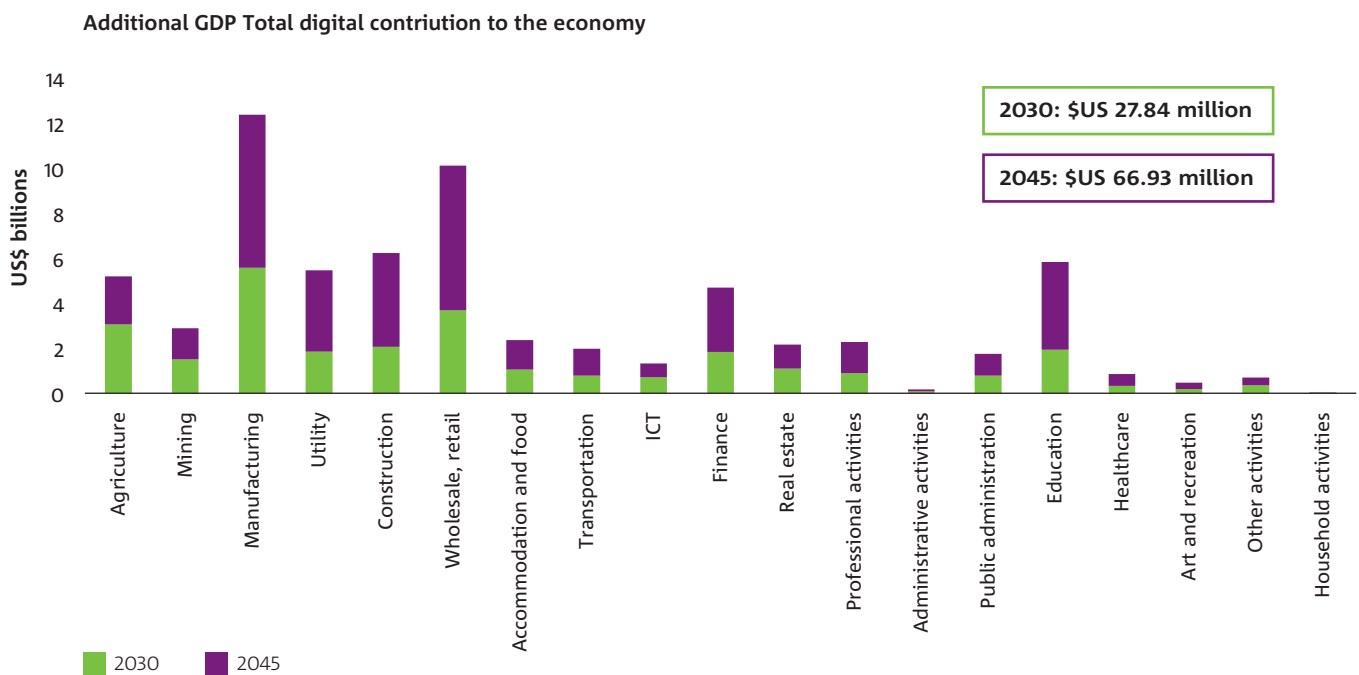


Figure 50 Impact of digital technology on GDP across industries of Vietnam by 2030 and 2045 – Digital Exporter Scenario

Note: GDP in real US\$, 2005 prices.

## Features of the Digital Exporter Scenario:

Digital adoption across all industry sectors is low, but the ICT industry is booming as Vietnam has become a low-cost labour centre for coding and the production of ICT hardware.

Legacy systems and infrastructure, and finance available for investment hold back the broad industrial and societal transformation across Vietnam.

There is growing patchiness of development and increased inequality across Vietnam. Economic growth in Vietnam is no longer inclusive, but largely restricted to a few privileged enclaves in urban centres. This has created a **two-speed economy** – with a few booming urban centres and large areas outside the cities still depending on labour intensive means of production.

Main export sectors: ICT products and services commissioned by external companies, mining and petrol products, agriculture, low-cost tourism.

## Critical developments for the Digital Exporter Scenario to occur:

Investments in reliable energy and ICT infrastructure for critical centres producing ICT hardware and services, but not across the broader industry. Investment – from both government and industry – is very concentrated and focussed.

Take-up of the use of global labour market platforms to sell ICT goods and services.

Structural and regulatory reform across sectors, including government, to prioritise growth in the local ICT industry.

Low availability of finance for transitional investment in industrial infrastructure, equipment, structural change and skills – possibly due to a regional or global financial slowdown.

Inaccessible education across the workforce, particularly in regards to workers needing to transition from unskilled labour to service-driven employment.

Low investments in secure online environments leading to low trust and take-up of e-government services, online financial transactions, and other data platforms.

Cultural pressure to reject new online systems.

Increased use of the informal and cash-driven economy to earn incomes within areas impacted by automation or poorer urban environments.

## How can this scenario occur?

For Vietnam to arrive in the Digital Exporter Scenario, the country would have to focus infrastructure and education spending on the development of the technology sector – particularly those attached to universities, urban centres and greenfield estates, rather than broad-based education and infrastructure policies and programs. Large manufacturers and producers of digital hardware may be attracted through ICT industry incentives and tax breaks. Overseas investment in Vietnam's ICT sector would need to intensify, but focus on using coders, developers and services for low wages and international products. Large manufacturers setting up in Vietnam might actively work to suppress local wages and wage growth. The experience of the growth of India's ICT sector – which grew rapidly and disproportionately to the rest of the Indian economy from the 1990s to the late 2019 – has shown that this can result in a 2-speed economy – where an increasingly wealthy urban elite benefit from global markets while rural citizens without access to improved education are left behind.<sup>301</sup> The growth of India's ICT export sector and the increased wealth of a small sector of the society did not translate into socio-economic benefits for most of India's citizens – around 40% of whom live in rural areas, and international investment in India as a nation has stagnated.<sup>302</sup> This threatens to keep India in the lower-middle income bracket until at least 2047 – where it is predicted to migrate to the upper-middle income bracket – pending significant government reforms and new taxes.

## Exports

- **Booming ICT exports but little reform across other sectors:** ICT hardware manufacturing as well as software and digital content are now a significant proportion of exports,<sup>32</sup> with industrial centres concentrated in urban environments. The agriculture and tourism sectors are also growing, although patchily and periodically disrupted by severe weather events.
- **Increased services and niche exports:** There are increasing exports from services sectors,<sup>23</sup> but these are mostly related to ICT services or related project management,<sup>235</sup> and highly concentrated in urban environments. Some niche exports markets have developed in agriculture and tourism, but they are not high-value.

## Digital economy and ICT industry

- **Still a low-cost labour market:** Most of Vietnam's FDI is still attracted by the relatively low cost labour market, and this is increasingly including work to software developers.<sup>235</sup> There are increasing workshops of Vietnamese coders, developers, systems administrators, call and customer inquiry centres led by large multinational ICT companies, as well as an increase in the factories producing advanced technology products and services – such as phones, computers, electronics and smart-white goods.<sup>32</sup>
- **IT outsourcing:** Like India and Thailand, Vietnam has now built a global reputation as a destination for outsourced coding and software development.<sup>235</sup> Much of this work is relatively unsophisticated and labour intensive – involving design work, platform maintenance and administration, customer responses and media content formulation, but the industry is growing and become more adept at creating new products. The availability of coding piece work from global labour market platforms has allowed some entrepreneurial workers to start their own companies and businesses.<sup>235</sup> Digital services for Chinese, Singaporean, US, British, Japanese, Korean, Australian, NZ and other currencies allows Vietnamese ICT workers to buy more within Vietnam as the Vietnamese Dong has remained comparatively low.
- **ICT manufacturing:** Investment in ICT hardware manufacturing has grown – building off initial investments by Dell, Samsung, and Intel.<sup>84,30</sup> Although there is increasing automation in the production processes, manual labour from cheap workers still powers much of this investment.
- **Unsafe work:** Investment is partly attracted to Vietnam by the lack of health, safety and environmental regulations enforced in other jurisdictions.<sup>185</sup> Workers continue to 'retire at 40' – or lose their paid work in hardware factories when they get older and develop health problems.
- **Online platforms a big source of international ICT work:** Many workers in the ICT software sector have learnt foreign languages and deal with English- and Mandarin-speaking clients via online labour platforms—where they bid for globally outsourced work.<sup>180</sup> Communication skills have become important in understanding and quoting for international clients.
- **Paid in US dollars:** The lack of internal demand and work for ICT skills, and low take-up of technology within Vietnam, has meant that ICT coders and developers do not dedicate time or resources to doing work for Vietnamese Dong, they want to be paid in US dollars, cryptocurrencies, or higher value currencies.

## Productivity and innovation

- **Patchy progress:** Innovation is patchy and less formalised than in the Digitally Transformed Scenario.
- **Low consumer adoption:** Adoption of new technologies has been hampered by fears of rapid change, a lack of regulatory reform, lack of cybersecurity across the telecommunications networks, and low investment in pilots and industry modernisation incentives.<sup>199,303</sup>
- **IP:** Patent protection has improved, but doesn't apply to many ICT products and software code.<sup>41</sup>
- **Uncoordinated innovation system:** A strong national innovation system has not matured, and so innovation projects, foreign aid for innovation and technical developments are opportunistic and un-coordinated—meeting the needs of external players rather than being applied in a coordinated way to achieve Vietnam's goals.<sup>41</sup>
- **Lack of enabling infrastructure:** Low adoption of digital technology and the patchy roll out of 5G and IoT networks have resulted in areas of excellence (such as isolated factories, greenfields estates, co-working centres and academic institutions) contrasting with large areas reliant on older technology and ways of doing business. The lack of reliable and secure telecommunications infrastructure and energy has also hampered further transformation of industry across Vietnam.<sup>213</sup>
- **ICT self-learners:** Pockets of ICT expertise have developed and more and more Vietnamese citizens are self-learning how to use ICT products, platforms and services to generate an income.<sup>231,232</sup> Coding groups are forming in particular areas, and these hold promise for the future.
- **Patchy adoption of blockchain distribution systems:** Some pilots in the use of blockchain systems have turned into structured distribution systems, but access to secure networks and the patchy deployment of IoT infrastructure has hampered their widespread use.<sup>213</sup>
- **Finance becoming less difficult for new ventures:** Attracting finance for new ventures and innovation remains an issue.<sup>41</sup> There has been a slight increase in the availability of venture capital in Vietnam, however, and this has supported a handful of technological breakthroughs and start-up companies who are creating products and services for much larger markets.
- **Skilled workers lured offshore:** Education has improved and the number of unskilled workers in the workforce has significantly declined.<sup>239</sup> This has improved a number of sectors in Vietnam, and increased the services sector, but without broad adoption of new technologies much of this talent is underutilised.

## Skills and Labour

- **Brain gain and brain drain:** while many successful developers are attracted offshore to access better IP protections, larger markets and venture capital, others are attracted back to Vietnam by offers of scholarships and positions in selective research institutions.<sup>277</sup>
- **Industry training from international firms** has been increasingly provided to keep supplying coding and ICT services businesses for export.
- **Local companies also increasing hire and train new coders** and developers to create products for export.
- **Focused education policies:** education spending has been focussed on centres of excellence and a limited number of courses for ICT communities of practice.

## Urban development

- **Rich areas, poor areas:** Cities in Vietnam are growing and becoming more geographically distinct – with areas of greater and lesser wealth, opportunity and education standards becoming entrenched.<sup>304</sup>
- **Growing inequality:** The richer areas within the urban environments have greater opportunity and access to a wider array of jobs and training than poorer areas – which have grown on the outskirts of major metropolitan centres.<sup>304</sup>
- **Education, health, and policing—untransformed:** New schools, hospitals and police facilities are needed to cope with the increased urban populations, and these are built without many of the features of AI and

automation that would make them highly efficient and cheaper to run.<sup>160</sup>

- **More crime:** Areas of high-crime have developed, and these areas have increased their use of the informal economy, even while other areas have reduced it.<sup>174</sup>
- **Limited urban reform:** Autonomous vehicles have not been deployed in any meaningful way – as the necessary and supportive Internet of Things networks have not been successfully launched across all urban areas.<sup>213</sup> There are a few pilots of bus routes between major destination points in Ho Chi Minh City and Hanoi, but these pilots have not translated into broad-scale adoption.
- **Increased congestion:** The limited and disjointed deployment of smart city technology has meant that traffic congestion in cities has increased and much of the development funding available has been used to invest purely in road transport infrastructure (road widenings, new highways and land resumption) to alleviate the congestion.<sup>220</sup>
- **More electric vehicles:** Electric vehicles are increasingly used, but these are merely replacing the older petrol vehicles rather than reducing in number on the roads.<sup>220</sup>
- **Travel by app:** People are increasingly using apps to order transport such as Grab and Uber, but not necessarily giving up on their own scooters and cars.<sup>220</sup> Unlike other countries, however, local transport platforms have not emerged to provide competition.



## Environmental impacts

- **Environment still struggling:** Although systems for environmental monitoring have improved, this has not translated into a high degree of on-the-ground resilience.<sup>160</sup>
- **Infrastructural damage:** Large urban centres are still subject to periodic flooding, high tides and storm surges. These are causing increasing damage and cost – in both human life and infrastructure replacement.<sup>215</sup> Many urban areas are now being deemed un-inhabitable, and people who live there are being requested to move with little assistance. Richer settlements in urban areas have been designed to withstand more natural disasters and have air-conditioning and other features to cope with climate change.
- **Small increase in renewable energy:** Renewable energy is being introduced slowly, and battery and storage facilities built with particular funding from international groups.<sup>305</sup> Most of Vietnam's energy is still derived from coal fired power stations however – either within Vietnam or imported from neighbouring countries, and this impacts on air quality and health outcomes.<sup>41,209</sup>

## Priority areas for action in the Digital Exporter Scenario

Broad skills and education programs across the economy through schools, online learning and adult learning centres

A focus on cheap, affordable technology equipment, software and training for education and industry.

Local support for digital entrepreneurialism and a start-up ecosystems. Promotion of platform-mediated trade for products and services as a transition tool.

Government investment in the local digital industry through contracts for work, technology targets, missions and trade.

## Critical risks for the Digital Exporter Scenario

Inequality and the development of a two-speed economy. There is the risk of distinct areas of advantage and disadvantage developing, causing social instability and the further development of the informal economy.

Lack of investment and the country missing out on the broad productivity gains, market expansion, and market development offered by digital transformation across industries, leaving Vietnam in the middle income trap for most of this century.

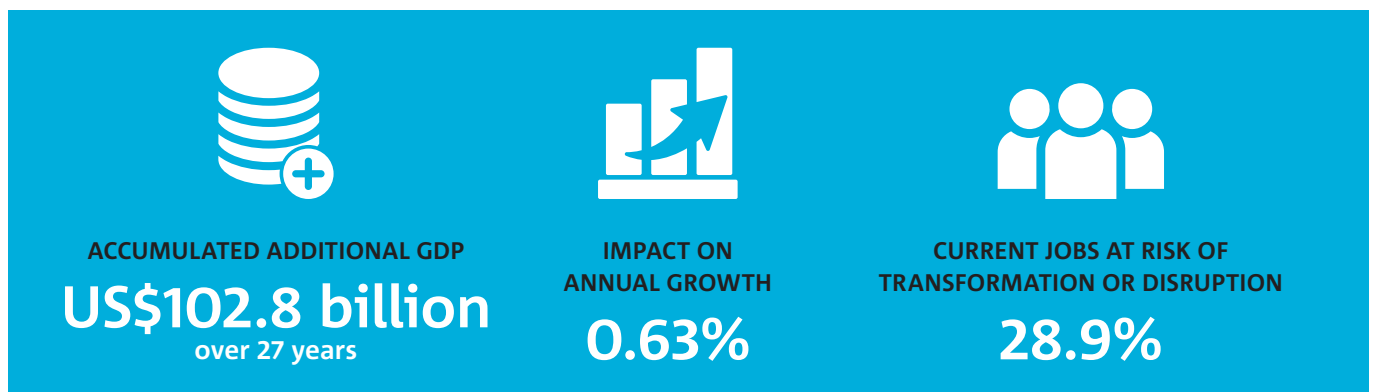
Exploitation of Vietnam labour, resources and industry: Vietnam is targeted by international firms for low labour costs and cheap inputs, and not value-added products and services. There is little technology transfer that accompanies investment in Vietnam.

Loss of intellectual capacity to more developed nations that can provide greater opportunities and higher wages.

# SCENARIO 4

## DIGITAL CONSUMER

Vietnam industry adopts ICT goods and services from other countries that can improve productivity across all sectors, but in the long run can cause a high public debt.



Note: GDP in real US\$, 2005 prices.

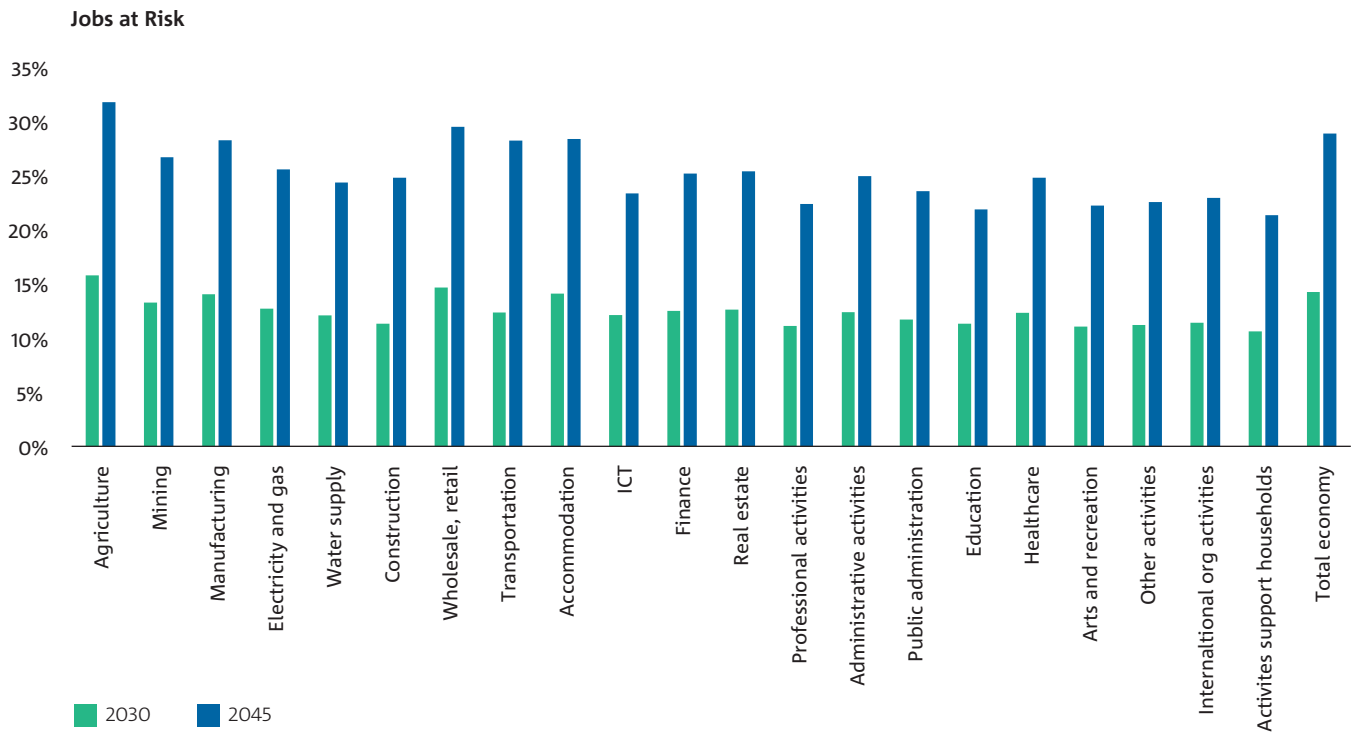


Figure 51 Impact of digital technology by % on labour market across industries of Vietnam by 2030 and 2045 – Digital Consumer Scenario

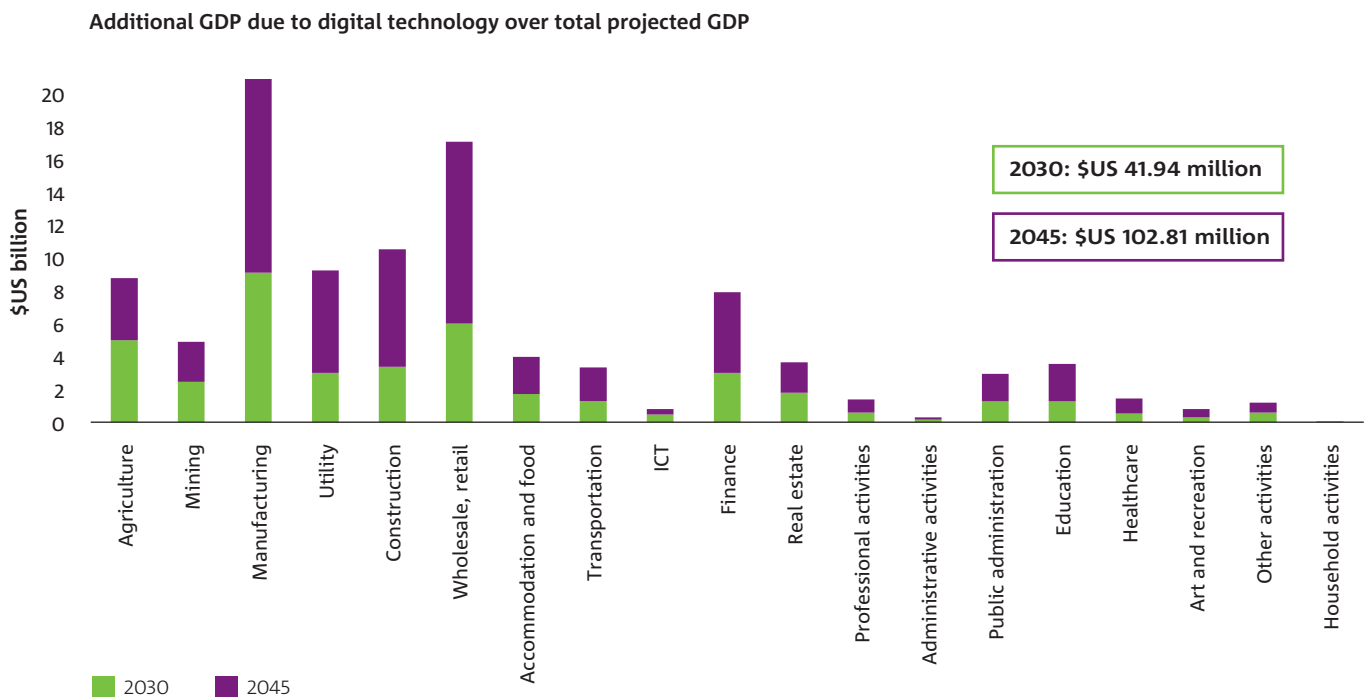


Figure 52 Impact of digital technology on GDP across industries of Vietnam by 2030 and 2045 – Digital Consumer Scenario

Note: GDP in real US\$, 2005 prices.

## Features of the Digital Consumer Scenario:

Digital adaptation across all industry sectors is high, and this has had positive impacts on labour productivity nationwide.

Unemployment is high in particular areas – due to the rapid automation of many industries.

Industrial transformation is broad but expensive due to the import of external technology and platforms. External multinationals dominate the ICT products and services sector, and the Vietnamese ICT sector is small by comparison.

Main export sectors: High-value agriculture, minerals, manufacturing, tourism, services

## Critical developments for the Digital Consumer Scenario to occur:

Broad investment in industry modernisation with Industry 4.0 policies.

Investments in secure and reliable ICT and energy infrastructure.

Regulatory reform to allow digital adoption and the implementation of new technology, and incentivise industrial transformation.

Taxation reform to derive more taxes from the productivity gains from digital transformation.

Investments in ports and smart city infrastructure, and e-government services.

Less investment/growth in education and ICT sector leading to the shortage of ICT skills to leverage the maximum benefit from digitalisation

## How can this scenario occur?

The Digital Consumer Scenario could occur in circumstances such as significant rises in commodity prices – particularly those from mining or agriculture. Rises in commodity prices in mining and agriculture may incentivise production efficiencies through technology application. This may also raise the currency rate, increases wages and decreases the market for labour intensive goods, including those in the ICT sector. For this scenario to occur there would need to be significant

reform in the land use and the agricultural sector, and successful attraction of modern production facilities and technologies from international countries. Internal investment would be concentrated on infrastructure and facilities. Most digital consumer economies are high income economies with significant natural resources—such as Australia or Canada. New Caledonia, a French foreign territory in the South Pacific, could also be considered a digital consumer economy—with high wages, costs of living, modern production and mining facilities, ports, airports and tourist facilities. Due to its small size, New Caledonia imports ICT and digital products, and most media content. New Caledonia produces around 10-20% of the world's nickel, and also benefits from significant subsidies from the French government (15% of GDP). Subsidies from the French government are invested in infrastructure and government services. Modernisation of infrastructure combined with a boom in income from nickel mining has lifted New Caledonia's GDP per capita from \$1,734 PPP in 1960 to \$38,000 PPP in 2011.<sup>26,306</sup> New Caledonia however is a relatively small island of 280,000 people, and transport, power and other infrastructure did not require retrofitting large urban areas with established legacy systems.

## Exports

- **Productivity increases but limited change in markets composition:** ICT hardware manufacturing as well as software and digital content not a significant proportion of exports<sup>32</sup> Growth in the export value of mining, agriculture, tourism, with the attraction of large technology and other companies to install modern facilities and services for greater production efficiency.
- **Vietnam's nation brand** has improved and increased in value as food and mineral provenance improves through the implementation of blockchain distribution networks, global marketplaces on platforms and efficient ports and transport facilities.
- **Services and tourism grow:** The services and tourist sectors are growing rapidly: offering remote services and easy tourist experiences.<sup>23</sup> There are increasing services exports – especially education, banking and finance and health.
- **High-value agriculture:** Some niche exports markets have developed in agriculture and there is an emphasis on quality over quantity of production.<sup>40</sup> Production of agricultural goods has transformed along with changes in land-use regulation, the introduction of blockchain systems for biosecurity and provenance, and the use of international platforms to buy and sell agricultural produce at the best prices.

## Digital economy and ICT industry

- **Growing ICT manufacturing:** Due to active Industry 4.0 policies and incentives, investment in ICT hardware manufacturing has grown and 90% of factory and logistics processes are now automated.<sup>307</sup>
- **Vietnam's ICT Industry stalls:** The ICT sector has grown but there has also been growth in other sectors to match it. Vietnam's ICT industry has remained centred on the hardware manufacturing sector, rather than on new products or software. International firms have taken the lion's share of government and other business within Vietnam over the last 25 years since 2020.<sup>160</sup> This has led to some technology transfer and local research contributions, but not significant levels.
- **Digitally transformed through imported technology:** Most of the technology used to improve labour and multifactor productivity and modernise industry has been imported. This has meant that Vietnam has had only 'second mover advantage' – saving on some costs associated with ICT development, but paying external companies more for their services over the longer term.
- **Data harvesting:** Using only external products, services and platforms also means that other countries collect and analyse a lot of data on businesses and citizens in Vietnam. Vietnam has participated in regional frameworks on data security and privacy, but the use of foreign technology companies for many government and other services make it difficult to control use of some of the data flows from Vietnam.<sup>193</sup>

## Productivity and innovation

- **Industrial reform and rapid transformation:** Innovation has been focussed on modernising industry. Industry incentives (grants for smart specialisation, tax breaks, guide-lines on FDI and innovation rewards) have created rapid change – first in manufacturing and mining then in agriculture.<sup>41</sup>
- **Job automation:** Rapid automation in many areas has created high local unemployment in towns with textile and foot-ware factories, whilst new levels of productivity and profitability have created employment in other areas.<sup>154</sup>
- **More manufacturing:** Government policy has also attracted some new manufacturing industries – and Vietnam has now built its first electric vehicles and robots for export. Many of the factories building these export goods are foreign but there is some internal technology transfer.

- **More FDI:** Vietnam's location in the heart of South East Asia, with safe and secure ports to the shipping channel in the South China Sea is attractive to large multinational companies – who have continued to invest and build modern facilities in Vietnam.<sup>84</sup>
- **Training credits:** Training credits have been provided to accommodate workers displaced by automation and AI – but without new industries many of these workers have not transitioned to new employment, and many have retired early.<sup>154,242</sup>
- **National Innovation System helps industry:** Investments in a national innovation system have focused heavily on industry partnerships and the implementation of new technology – rather than the development of new technology per se.<sup>41</sup>
- **Creating smart cities:** There has been coordinated roll outs of 5G and IoT networks and this has resulted in the development of smart city infrastructure and use of sensor networks across much of regional Vietnam.<sup>205</sup>
- **Skills outpaced by demand:** Education has improved and the number of unskilled workers in the workforce has declined.<sup>154,242</sup> There has not been enough investment to keep up with industrial demand however, and the number of students studying STEM subjects has stagnated.
- **High-value agriculture:** High-value agriculture has thrived through blockchain provenance systems linked directly to large international platforms like Amazon and Alibaba.<sup>101</sup> People can be assured of certified practices attached to their foods – organic food, humanely raised food, fair trade foods, and nutritional foods and for instance.<sup>53,54</sup> This is adding wealth to many regional areas across Vietnam.

## Skills and Labour

- **Brain gain:** Many Vietnamese graduates studying in other countries have been lured back with offers of work, scholarships and positions within newly established research institutions. These are often attached to research centres in other industries – such as mining and agriculture.<sup>277</sup>
- **Industry training from international firms** is available, along with high-quality courses from Vietnamese universities.
- **Local companies also increasingly hire and train new coders** and developers to create products for export and local applications.
- **Broad education policies** have improved digital literacy across the population.

## Urban development

- **Better city living:** Life in urban areas in Vietnam has changed significantly with the use of smart city infrastructure and the introduction of AI to monitor and control everything from waste collection, traffic flows, emergency response units and crime.<sup>160</sup>
- **Travel by autonomous vehicles and public transport apps:** Autonomous electrical vehicles and new public transport ordered by apps have now replaced many self-driven petrol cars, and reduced the need for private vehicle ownership.<sup>220</sup> This has improved urban life through better air quality and easier commutes. Most of apps are owned by foreign companies.
- **Economic segregation:** Moderate economic segregation in urban areas has developed alongside the rapid economic transformation and rapid urbanisation, although the quality of life of almost all citizens has improved with better access to services, information and infrastructure.<sup>304</sup>
- **Transformed education, health, and policing:** New schools, hospitals and police facilities have been built to service a larger population, and AI/automation makes them very efficient and cheap-to-run.<sup>160</sup>

## Environmental impacts

- **Better prepared for extreme weather:** Systems for environmental monitoring have improved,<sup>160</sup> this has translated into a high degree of on-the-ground resilience in natural disasters. Large urban centres are still subject to periodic flooding and storm surges, but good planning and communication systems mitigate much of their damage and keep people safe.
- **Land use monitoring:** Use of satellite data has accurately mapped land-use, and this is used to coordinate vegetation and land cover to ensure greater resilience to extreme weather.<sup>308</sup> Much of this data is open data which can be used by anyone with access to an Internet-connected phone.<sup>308</sup> Satellite monitoring of land-use also means the Vietnam Government can also better control vegetation cover, land clearing and agricultural practices, prevent landslides, soil erosion and flash flooding in many areas. These systems have been commissioned from international projects and systems.

- **Transformation to renewables:** Renewable energy has been introduced by external power companies along with smart grids and novel battery and storage facilities.<sup>305</sup> Most polluting coal fired power stations have been decommissioned and large renewable energy projects funded by international consortia have made Vietnam an energy exporter again.
- **Energy certainty:** Foreign investment in energy infrastructure also reassures foreign investors of sustainable growth within Vietnam,<sup>309</sup> and the reliable running of ICT platforms and systems.

### Critical risks for the Digital Consumer Scenario:

Vietnam misses out on developing new export markets in high technology fields through the ownership of IP, digital platforms, assets and services.

Digital systems created within Vietnam are not customised to local conditions, they are more expensive in the long run due to subscription costs and external influences on policy and local labour.

The taxation system does not reform to allow for the taxation benefits from companies profiting from increasing trade and productivity within Vietnam. Base tax may be eroded.

Vietnam is subject to greater levels of data-harvesting from foreign companies operating within the country and/or policy interference from multinational companies with increasing leverage on labour markets and distribution systems.

Over extension of loans and borrowings to modernise industry too rapidly increases public debt to unsustainable levels.

### Priority areas for action in the Digital Consumer Scenario

Support and encouragement of the local ICT industry through attraction and creation of venture capital, curation of start-up communities, regulation reform on privacy and consumer data rights, government contracts for local industry, Open Data and the creation of Vietnamese platforms for trade and social media.



PART V  
CONCLUSIONS AND  
A ROADMAP FOR  
WAY FORWARD

# ACHIEVING DIGITAL TRANSFORMATION FOR ECONOMIC GROWTH IN VIETNAM 2019-2045

You can't choose which scenario will occur, but you may change their probability of occurring.

The scenarios describe plausible futures that can occur over the next 25 years due to **external** factors acting on Vietnam's digital economy. These may include global economic slow-downs impacting on Vietnam's rate of internationalisation and trade, low adaption to emerging digital technologies (local or global), or GDP shocks due to extreme weather or international cyber attacks. These are drivers of change that are out of the control of policy makers and leaders of industry within Vietnam. Vietnam should be prepared for all four scenarios.

## HOW SHOULD POLICY MAKERS USE THE SCENARIOS?

Actions and strategies developed to advance Vietnam's digital economy should strengthen the economy in all four scenarios. All are considered plausible and possible under varying external conditions.

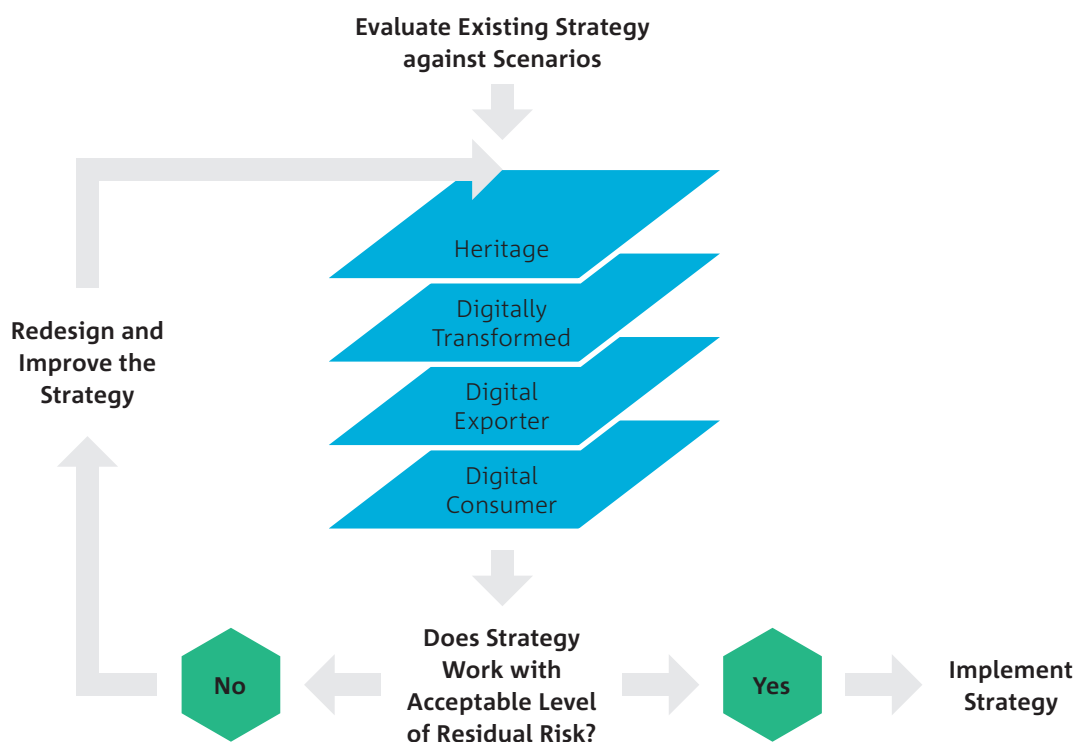


Figure 53 Using scenarios to assess strategies



As seen in Figure 53 the scenarios should be used to filter and balance strategies. For instance education and infrastructure spending should not exceed the ability of the country to repay it under the Heritage Scenario, as well as the Digitally Transformed Scenario. To increase spending to levels above that able to be repaid in Heritage Scenario runs the risk of rapidly increasing debt levels and causing higher inflation.

Wild-card events may also occur (high impact but low probability), and these may tip the trajectories of all scenarios.

## Internal strategies can change the probability of which scenario will occur

Even though external factors may dictate the scenarios, which scenarios will eventuate will rely on a mix of **internal and external** factors, and actions taken internal to Vietnam may change the probability of each occurring.

Scenario 2, for instance, is more likely to occur if there is a range of investment decisions and structural reforms from within Vietnam itself.

To achieve Scenario 2, Vietnam will need to show its potential for growth and transformation through a series of early technology adoptions and smart investments.

To examine the strategies that might increase the probability of digital transformation we have examined the Asian economies that have achieved high income status over the last 70 years through technological investment and intensification.

## Lessons from the past: The Five Asian Tigers

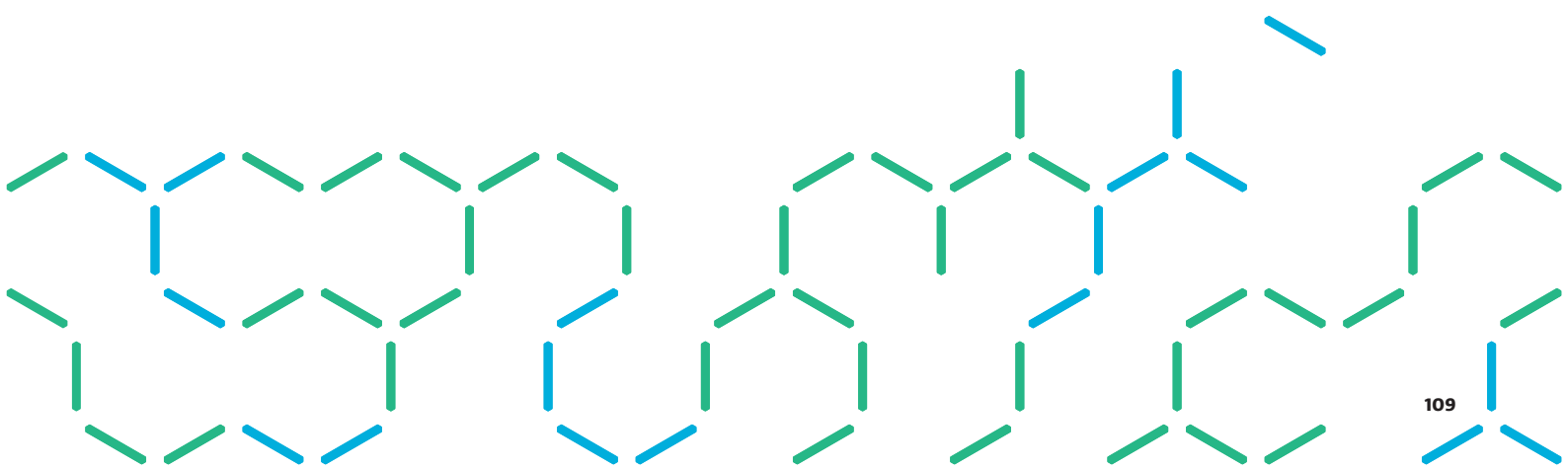
There have only been five Asian economies that have lifted themselves out of low or middle income status to high income status over the last 100 years: Japan, South Korea, Singapore and the self-governing regions of Hong Kong and Taiwan.

These are often called The Asian Tiger economies, or Asian Dragons. The start of economic reform for most of these economies began after the end of conflicts – most notably the end of the Second World War in 1945 and regional conflicts such as the Korean War.

Each of these economies have been assisted by particular historical factors and international allegiances, and are not directly comparable to Vietnam today. There are some similarities within their growth and transformation strategies however.

Interestingly, four out of these five economies are island economies, all five focussed early on export trade, manufacturing, skills-enhancement and regulatory reform. Pre-existing conditions – such as being existing trade ports – played a significant role in the development of at least two of these economies – Hong Kong and Singapore.

All five economies are now democratic states, although Taiwan became democratic late in its industrial transformation (1986) after a period of sustained and high growth under strict military law, and Singapore is predominately a one-party state. Hong Kong and Taiwan, although self-governing, are now recognised as part of China.



# CREATING A ROADMAP FOR VIETNAM'S FUTURE DIGITAL ECONOMY

## Getting the basic settings right

A landmark study of eight of Asia's high performing economies (Japan, Taiwan, Hong Kong, South Korea, Singapore, Indonesia, Thailand and Malaysia) by the World Bank in 1994<sup>310</sup> led the researchers to distil common features and four broad policy lessons for economic development and industrial transformation in the late 20<sup>th</sup> and 21<sup>st</sup> centuries:

1. **Exports and industrial reform:** all high performing economies pushed export growth to assist particular sectors in order to enhance total factor productivity (TFP). The analysis showed that export growth, and not selective assistance, did the most to enhance TFP.
2. **Rapid and inclusive growth:** The economies studied had both high growth over a long period, and high income growth for citizens. The growth was not restricted to pockets of selected industry sectors – the growth was economy-wide and inclusive across demographic groups. High growth Asian economies maintained low inequality co-efficients (Gini co-efficients). Tellingly, improvements in income distribution coincided with periods of rapid growth.
3. **Factor accumulation, total factor productivity change – rule of law and the role of technology:** The economies studied had substantially higher investments and resulting assets in physical and human capital than other comparable countries. They were also unusually successful at catching up technologically – and successfully used technology investments to improve total factor productivity across industry. To do this they provided a stable and reliable legal frameworks with low corruption to attract investment and expand their asset base. They also invested in the education and health of their populations.

4. **Macroeconomic management and broad-based education strategy:** The economies studied had good macroeconomic management of inflation, fiscal policy, debt and foreign debt and broad-based education policies. Debt was undertaken for projects with high returns, and often utilised national or domestic savings rather than external borrowings. The size of the debt was not as distinctive in this group as the fact that it was within the nation's ability to finance it. Long term stability in inflation and foreign debt was a feature of the high performing group.

More recent research also agrees with these findings, stating that the countries that have migrated from middle to high income status have had a particular focus on their economic structure, including a faster transformation from agriculture to industry, higher export orientation, lower inflation, and decreases in inequality and dependency ratios.<sup>311</sup>

All the economies performed particularly well in three areas – accumulation of capital, allocation of resources, and technological catch-up. This was through a combination of both market- and government-led policies.

Five Asian Tigers: Factors cited for rapid economic transition from low income status to high income status

	SOUTH KOREA	TAIWAN	HONG KONG	SINGAPORE	JAPAN
<b>Transition era</b>	<b>Start:</b> 1960 <b>Achieved high income status:</b> 2001 <sup>312</sup>	<b>Start:</b> 1949 <b>Achieved high income status:</b> 1987 <sup>312</sup>	<b>Start:</b> 1949 <b>Achieved high income status:</b> 1983 <sup>313</sup>	<b>Start:</b> 1959 <b>Achieved high income status:</b> 1988 <sup>313</sup>	<b>Start:</b> 1945 <b>Achieved high income status:</b> 1977 <sup>313</sup>
<b>Structure of Government</b>	Presidential democratic republic	Semi-presidential democratic republic, now subject to the One China policy with the Chinese mainland	Former British colony, now a Special Administrative Region of China with its own government and multi-party system	Parliamentary democratic republic, with a dominant party system	Parliamentary democratic constitutional monarchy
<b>Economic indicators</b>	<b>GDP (2019):</b> US\$1.7 trillion <sup>314</sup> <b>GDP per capita (2019):</b> US\$32.7 thousand <sup>314</sup> <b>Levels of freedom (2018):</b> 2 (mostly free) <sup>315</sup> <b>Corruption perceptions index (2018):</b> 45 <sup>th</sup> out of 180 (low corruption) <sup>316</sup> <b>Ease of doing business rankings (2018):</b> 5 <sup>th</sup> out of 190 (easy to do business) <sup>58</sup> <b>Global competitiveness index 4.0 (2018):</b> 15 <sup>th</sup> out of 140 (highly competitive) <sup>59</sup> <b>Global innovation index (2018):</b> 12 <sup>th</sup> out of 126 (highly innovative) <sup>60</sup>	<b>GDP (2019):</b> US\$626.7 billion <sup>314</sup> <b>GDP per capita (2019):</b> US\$26.5 thousand <sup>314</sup> <b>Levels of freedom (2018):</b> 1 (freest) <sup>315</sup> <b>Corruption perceptions index (2018):</b> 31 <sup>st</sup> out of 180 (low corruption) <sup>316</sup> <b>Ease of doing business rankings (2018):</b> 13 <sup>th</sup> out of 190 (easy to do business) <sup>58</sup> <b>Global competitiveness index 4.0 (2018):</b> 13 <sup>th</sup> out of 140 (highly competitive) <sup>59</sup>	<b>GDP (2019):</b> \$380.9 billion <sup>314</sup> <b>GDP per capita (2019):</b> US\$50.6 thousand <sup>314</sup> <b>Levels of freedom (2018):</b> 3.5 (partly free) <sup>315</sup> <b>Corruption perceptions index (2018):</b> 14 <sup>th</sup> out of 180 (low corruption) <sup>316</sup> <b>Ease of doing business rankings (2018):</b> 3 <sup>rd</sup> out of 190 (easy to do business) <sup>58</sup> <b>Global competitiveness index 4.0 (2018):</b> 7 <sup>th</sup> out of 140 (highly competitive) <sup>59</sup>	<b>GDP (2019):</b> US\$359.6 billion <sup>314</sup> <b>GDP per capita (2019):</b> US\$63 thousand <sup>314</sup> <b>Levels of freedom (2018):</b> 4 (partly free) <sup>315</sup> <b>Corruption perceptions index (2018):</b> 3 <sup>rd</sup> out of 180 (low corruption) <sup>316</sup> <b>Ease of doing business rankings (2018):</b> 2 <sup>nd</sup> out of 190 (easy to do business) <sup>58</sup> <b>Global competitiveness index 4.0 (2018):</b> 2 <sup>nd</sup> out of 140 (highly competitive) <sup>59</sup>	<b>GDP (2019):</b> US\$5.2 trillion <sup>314</sup> <b>GDP per capita (2019):</b> US\$41.4 thousand <sup>314</sup> <b>Levels of freedom (2018):</b> 1 (freest) <sup>315</sup> <b>Corruption perceptions index (2018):</b> 18 <sup>th</sup> out of 180 (low corruption) <sup>316</sup> <b>Ease of doing business rankings (2018):</b> 39 <sup>th</sup> out of 190 (easy to do business) <sup>58</sup> <b>Global competitiveness index 4.0 (2018):</b> 5 <sup>th</sup> out of 140 (highly competitive) <sup>59</sup> <b>Global innovation index (2018):</b> 13 <sup>th</sup> out of 126 (highly innovative) <sup>60</sup>
<b>Main industries</b>	<b>Before:</b> Agriculture <b>After:</b> Manufacturing (ICT, cars, ships, steel, chemicals), services (ICT, tourism)	<b>Before:</b> Agriculture <b>After:</b> Manufacturing (ICT, machinery, chemicals, textiles, steel)	<b>Before:</b> None (focused on trading instead) <b>After:</b> Services (finance, tourism, commerce, professional)	<b>Before:</b> None (focused on trading instead) <b>After:</b> Services (finance, tourism, professional), manufacturing (ICT, chemicals)	<b>Before:</b> Agriculture <b>After:</b> Services (tourism, real estate), manufacturing (cars, aircraft, ICT, chemicals)

Note: All US\$ in current prices.

Source: Data61 Analysis

		<b>SOUTH KOREA</b>	<b>TAIWAN</b>	<b>HONG KONG</b>
<b>Policy areas during transition</b>	All Tigers	<p><b>Trade policy</b> fostered exporters by improving their access to credit.<sup>317</sup></p> <p><b>Finance policy...</b></p> <p>Encouraged household and corporate savings (e.g. through improved bank solvency). All Tigers but Hong Kong used a <i>postal saving system</i>, allowing people without bank accounts to deposit savings at post offices.<sup>317</sup></p> <p>Established <i>development banks</i> (in all Tigers except Hong Kong), which provided long-term finance to businesses<sup>317</sup></p> <p>Provided <i>tax concessions to investors</i> (e.g. tax holidays, accelerated depreciation allowances)<sup>318</sup></p> <p>Stabilised the <i>macro economy</i><sup>317</sup></p>		
	In each economy	<p><b>Trade policy</b> favoured <i>local industries</i> – but protections were granted to firms on a competitive basis, and lasted for a short time period.<sup>319</sup> <i>Trade was liberalised</i> after 1980.<sup>319</sup></p> <p><b>Industrial policy</b></p> <p>Fostered ‘<i>chaebols</i>’ (family-owned conglomerates) to promote large-scale manufacturing and competition<sup>320</sup></p> <p>Established <i>Export Processing Zones</i> which provided duty-free access to imports<sup>319</sup></p> <p>Tightly limited <i>FDI</i>, instead building knowledge through reverse engineering of tech imports and <i>subsidised private R&amp;D</i><sup>319,320</sup></p>	<p><b>Trade policy</b> favoured <i>local industries</i> – but protections were granted to firms on a competitive basis, and lasted for a short time period.<sup>319</sup> <i>Trade was liberalised</i> after 1980.<sup>319</sup></p> <p><b>Industrial policy</b></p> <p>Fostered <i>SMEs and public enterprises</i><sup>319</sup></p> <p>Established <i>Export Processing Zones</i> which provided duty-free access to imports<sup>319</sup></p> <p>Attracted <i>export-oriented FDI</i>, with some sectors required source materials locally<sup>319</sup></p> <p>Built knowledge through <i>incentivised R&amp;D, public research institutions, and public-private ventures with ICT firms</i> (e.g. IBM)<sup>319</sup></p>	<p><b>Trade policy</b> emphasised <i>free trade</i>.<sup>318</sup> However, since the nation relied on imports for food, the <i>government regulated food prices</i> via a wholesaler cartel.<sup>321</sup> This boosted export competitiveness.<sup>321</sup></p> <p><b>Housing policy</b> widely used cheap public housing, which reduced the cost of living. This meant labour could work on low wages which attracted <i>FDI</i>.<sup>321</sup></p> <p><b>Industrial policies</b> were absent, but the economy is likely to have been influenced by the industrial policies of China.<sup>318</sup></p>
<b>Public investing strategy during transition</b>	All Tigers	<p><i>Broad population-wide education. Improved education and enrolment rates</i> – mainly at primary and secondary level<sup>310</sup></p> <p><i>Infrastructure</i> – such as roads, railways, ports, airports, energy, health<sup>319</sup></p>		
	In each economy	<p><i>Directed financial sector investment to exporters in strategic industries</i> – first labour intensive industries, then ‘heavy’ and chemical industries, then high tech industries<sup>319</sup></p>	<p>Funded exporters in strategic industries<sup>319</sup></p>	<p><i>Invested relatively more in social services</i> (public housing, welfare, health)<sup>321</sup></p>
<b>Reasons for a successful transition</b>	All Tigers	<p><i>Macroeconomic stability</i> – low debt, low inflation, active exchange rate management<sup>310</sup></p> <p><i>High savings and investment rates</i> among domestic households and businesses<sup>318</sup></p> <p><i>Greater export promotion</i><sup>313,320</sup></p> <p><i>Higher productivity</i> – through higher-skilled labour, improved physical capital (i.e. infrastructure, digital tech), greater labour inputs, and higher total factor productivity<sup>310,318</sup></p>		
	In each economy	<p><i>Successful industrialisation</i><sup>318</sup></p> <p><i>A strong domestic economy served by a strong domestic private sector</i><sup>320</sup></p> <p>Post Korean War aid</p>	<p><i>Successful industrialisation</i> – from light industries to heavy and chemical industries to high tech industries<sup>318</sup></p>	<p><i>A combination of industrialisation and commerce</i> (e.g. international trade, financial services)<sup>318</sup></p>

## SINGAPORE

## JAPAN

**Trade policy** emphasised free trade, after an initial five years with import protection.<sup>318</sup>

Finance policy imposed a 42% savings rate on workers.<sup>318</sup>

### Industrial policy

*Strongly attracted FDI*, which encouraged knowledge and technology transfer<sup>318</sup>

*Favoured knowledge-based and high tech activities* through tax concessions<sup>319</sup>

*Heavily subsidised private R&D and high-quality public research institutions* helped create a strong innovation ecosystem<sup>319</sup>

*Heavily invested in higher education and public research institutions*<sup>319</sup>

*A combination of industrialisation and commerce* (e.g. international trade, financial services)<sup>318</sup>

**Trade policy** protected local industries.

### Industrial policy

*Fostered 'keiretsu,'* which are informal business groups with strong relationships between banks and firms. Additionally 'keiretsu' include a strong network of firms, either across different industries or across the supply chain of one industry.<sup>322</sup>

*Required private-public cooperation* between industry bodies and the Ministry of International Trade and Industry<sup>318</sup>

The Ministry also *aided cooperation between local industries* in an era where industries shared compatible interests<sup>318</sup>

Funded exporters in strategic industries<sup>318</sup>

*Successful industrialisation* – from light industries to heavy and chemical industries to high tech industries<sup>318</sup>

Post WWII US aid via the Marshall Plan

## Moving from middle income to high income – The role of technology in economic advancement

Technology places a crucial role in increasing multi and total factor productivity (TFP) growth. For example, Vietnamese manufacturing firms that used the ICT tools in their operation had 196.6% of the average TFP level of firms that did not in 2015.<sup>159,166</sup> Total productivity growth, driven by technological intensification, is a large contributor to economic growth in higher income countries. Low and middle income countries have often gone through a period of 'catch-up' to the technological best practice of higher income countries by applying and adopting existing technologies. This often results in unsustainable high growth rates from a low base, with growth rates dropping as the country further develops. Best practice and new technologies developed in other countries are adopted to improve productivity and profitability through the middle income phase.

*"Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."*

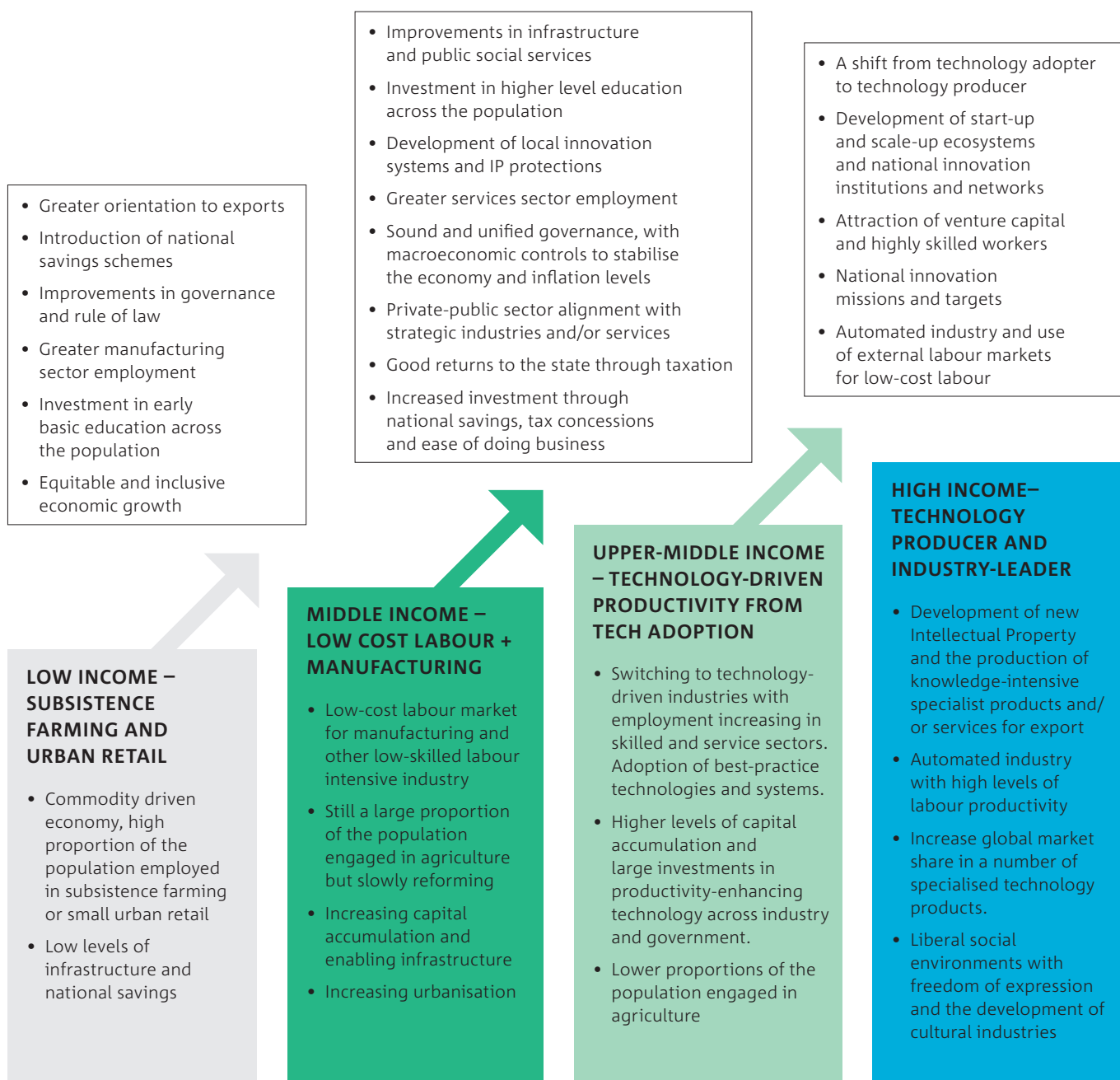
*Paul Krugman, The Age of Diminishing Expectations (1994)*

## The switch from technology adopter to technology developer

The determinants of growth change as countries move up the income scale. This means that strategies for economic growth also need to be re-evaluated at particular economic milestones, and if strategies do change, there is no reason why a country should stagnate in the middle income bracket.<sup>311</sup>

For instance, there is a point at which technological 'catch-up' no longer provides productivity dividends and the country must invest in the more investment-intensive role of technology creation and development.<sup>311</sup> It is this technology development that will drive knowledge intensive exports.

Technological development will only be worthwhile if wealth can be generated from the Intellectual Property developed, through licences, applications or sale of specialist goods and services. IP and products and services will also only be developed locally if there is available venture capital and R&D funding, a thriving start-up and scale-up ecosystem, and if there are the skills to successfully turn newly developed IP into business and enterprise activity.



**DEFINITIONS:**

Subsistence farming = farming mainly to feed own household

Commodity driven economy = an economy where the market values items equally, regardless of factors such as origin, who produced the item, brand, etc.

In the switch from technology adopter to technology developer it is necessary to attract creative and entrepreneurial talent. Innovative regions are generally culturally vibrant, environmentally pleasant, politically open and provide a high level of freedom of expression.<sup>323</sup> This includes being able to challenge dominant thinking and authoritarianism.

All of the Asian Tiger economies are now democratic (to varying degrees) and score well on scales of freedom and political expression. They also offer lifestyle benefits in the form of attractive environments with cultural and education opportunities.

## The middle income trap

'The middle income trap' is a term that was first used by Gill and Kharas (2007)<sup>324</sup> in a World Bank report to describe countries that grow strongly and move from low income to middle income, but then their growth rate drops and they stay as middle income for a protracted period of time; they do not progress to become high income countries.

Despite its growing popularity in the media, policy and academic papers, several analysts have challenged the term,<sup>325</sup> highlighting that the probability of a country moving from middle to high income is the same as moving from low to middle income – i.e. there is no unusual stagnation at middle income status. Some countries may transition faster and some may take longer catch up to leading countries, but most will progress to higher incomes over time.<sup>326</sup>

Han and Wei (2017) analysed 107 economies using World Bank data and found that comparatively fast growing 'progressive' countries in the middle income bracket have three determining factors –

1. Favourable demographics (a population where over 58.5% of the population is working age – 15-64 years old)
2. Good macroeconomic environment (low debt to GDP ratios, lower political constraints and few years in crisis per decade)
3. Sound financial development (credit to private sector and initial income less than \$5,437 per capita)

Countries that did not progress comparatively quickly from middle to upper income had:

1. Unfavourable demographics (a population with less than 58.5% are outside the working age group of 15-64 year olds)
2. Bad macroeconomic management (high government debt of greater than 55.9% of GDP)
3. Low levels of domestic credit to the private sector (less than 28.7% GDP)

Bulman et al (2017) also conclude that there is not a lot of evidence for stagnation at the middle income level.<sup>311</sup> They found, however, that countries that have escaped middle income status quickly and moved to high income tended to have sustained high growth over a number of decades. They attributed this higher growth to:

1. economic structure and the rate at which the country transitioned from agriculture to industry
2. higher export rates
3. lower inflation
4. decreases in inequality and dependency ratios across the country.

The tech start-up sector and productivity-enhancing skilled labour is being seen as an avenue for Vietnam to sustain high growth rates beyond the lower-middle income state and progress to high income status – out of the ill-defined middle income trap.<sup>260,327</sup> This may only come through prudent investment in both hard and soft infrastructure creating inclusive growth and total factor productivity across all industries.

## SWOT Analysis of Vietnam's Digital Economy in 2019

To construct a roadmap with useful actions likely to improve the chances of Vietnam using technology to lift productivity and sustain higher growth over the longer term it is useful to understand the current attributes of the digital economy. Below is a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis.

### Strengths

- Location – in the heart of high-growth Asian countries
- High growth in foreign direct investment (FDI)
- Increasing investment in start-ups and skills
- Growing domestic middle classes
- Young population (77% of population are working age)
- High school student literacy, numeracy and science skills
- Government priority on digital transformation
- High levels of digital access and broadband coverage – rapidly growing 4G networks and world leading 5G trials and roll out
- High levels of digital adoption across the population, particularly smartphone adoption
- Dynamic domestic private sector and strong leadership
- Strong industry in agriculture, mining, manufacturing and tourism
- Highly ranked on Global Innovation Score
- Attractive tax incentives for ICT professionals
- High growth in the software sector
- Attraction of computer hardware manufacturing and high levels of high tech exports

### Weaknesses

- Vulnerable to global economic uncertainty
- Weak national brand for goods and services
- Lack of finance for digital investment
- Depleting natural resources and growing pollution
- The large informal economy
- High numbers of workers at risk of automation
- Deficit in high levels skills and capacity in the workforce – scoring low on global talent competitiveness
- Low cybersecurity capability and skills
- Low levels of foreign language skills
- Volatile macroeconomic indicators
- Infrastructure shortages
- Inefficient State owned enterprises
- Lack of coordination between state agencies
- Lack of innovation and digital take-up monitoring
- Licencing and release of Open Data
- Patchy and immature innovation network
- Most digital enterprises are small
- Lack of data collection and storage among enterprises
- Ongoing corruption across industry

### Opportunities

- Growth of the middle classes of South East Asia and Vietnam
- High growth in foreign direct investment (FDI)
- New financing options for infrastructure and development funding
- Increased participation in the platform economy and global markets
- Self-learning via digital platforms
- Untapped potential labour in non-working households in many regional and rural areas
- Growth of the domestic market in Vietnam
- Strong industry in agriculture, mining, manufacturing and tourism
- Low entry costs for new businesses
- Potential to reward quality products and good practice through blockchain and improved provenance
- More ICT manufacturing to Vietnam
- Attractive tax incentives for ICT professionals
- Formation of a national innovation network and data sciences collaboration organisation
- Opportunity for e-government reform and technology leapfrogging
- Potential for Open Data to fuel app development

### Threats

- Climate change
- Depletion of natural resources
- Pandemics
- Growth in tourism and over use of iconic places
- Global or regional economic slowdown
- Regional conflicts
- Cyber attacks
- External data-harvesting on Vietnamese businesses and citizens
- Loss of global competitiveness or falling productivity
- Talent drain
- High unemployment due to rapid job disruption
- Ageing population
- Growing wealth inequality
- Rising debt levels
- Loss of taxation revenues due foreign digital platform and services providers
- Infrastructure not keeping up with rapid urbanisation
- Mistrust in e-government, e-commerce, banking and other online systems
- Impact of e-commerce on local traders and retailers
- Difficulty digitalising micro to small and medium enterprises



# ROADMAP FOR VIETNAM'S FUTURE DIGITAL ECONOMY

The Vietnam Government views digital transformation across the broader economy as critical to continued growth and prosperity.<sup>284</sup>

Much has already been done through policies on Industry 4.0, cybersecurity, energy and digital skills attraction. Finding the best avenues for ongoing investment for the development of the digital economy is a matter of priority, as is properly sequencing development to ensure optimal allocation of resources and maximum returns to the state for ongoing investment.

To assist policy makers and leaders of industry moving forward, Vietnam's Ministry of Science and Technology and Australia's CSIRO have created a broad roadmap with a list of possible actions. While these actions are prioritised **they are not necessarily sequential**; many of these actions, particularly those related to regulatory reform, will need to occur at the same time. The level of investment is critical, and will be determined by other macroeconomic considerations. Vietnam will need to carefully balance spending with returns to the Vietnam government to reduce debt and control inflation.

A new co-ordinating whole-of-government agency within the Vietnam Government could monitor and facilitate actions in all six areas of reform.

## Priorities of the Roadmap

1. **Infrastructure:** The first priority for the government is the development of the ICT networks themselves and the energy security to power them. Without the infrastructure the digital economy cannot exist. Reliable, secure and ubiquitous connections to the Internet unpin the development of the digital economy and the take-up of emerging digital technologies and tools across Vietnam. The strategy to provide connectivity should be as inclusive as possible.
2. **Security of the networks,** and of activity on the networks, is equally important and should be an integral part of the infrastructure establishment. Increasing the number of secure servers, and developing cybersecurity capability to monitor online threats to traffic is essential to establish trust and use of the networks. Vietnam will need to work with regional partners on data flows and securing and reducing the barriers to online trade within and beyond Vietnam, as well as the rights and recourse of citizens in regard to data privacy and retention.
3. **Increasing digital skills and capabilities** is essential to derive value out of the digital networks and prevent Vietnam from becoming a net importer of digital content and products that do little to enhance the productivity of the nation or industries. Improving digital skills – both general literacy across the nation and expert skills within centres of excellence – will be the key to unlocking productivity benefits of the digital networks.
4. **Modernising government** will both increase public service efficiencies, particularly in urban areas, and provide a market for industry development from Vietnam's budding ICT companies and services – particularly in AI, digital platforms, blockchain and IoT. Procurement practices should support the development of local industry. Many of the digital tools developed for government applications can then be used in industrial applications across Vietnam.
5. **Industry 4.0 and National Innovation** policies and reforms will both accelerate adoption of digital products and services, and also prepare Vietnam for the switch to technology developer needed to jump to a high income economy. In many cases Vietnam may be able to specialise in technologies that will help it leap frog to much higher levels of productivity.
6. **Taxation and Regulatory Reform** policies will help attract investment in the digital economy in Vietnam, and assist in the transition of industry as a result of new business models. Careful consideration of regulatory reform is needed throughout the journey to a mature digital economy, as many new technologies and business models will challenge existing regulations.



### ICT and Energy Infrastructure

- Secure energy for digital infrastructure
- Improve backbone fibre infrastructure
- 5G trials and deployment
- Pilot and deploy new Smart City technologies



### Cybersecurity

- Improve network security with secure servers
- Contribute to regional and international frameworks for data security and cybercrime
- Build skills in cybersecurity



### Digital Skills

- Set national goals for digital development
- Improve digital literacy across the entire population
- Build specialist skills in areas of need
- Invest in technology transfer to Vietnam
- Build the start-up ecosystem and attract VC.
- Develop contingencies for workers replaced by automation and the digitisation of jobs
- Improve rights and recourse for citizens



### Modernise Government

- Invest in new e-government and digitally delivered services including using AI, blockchain, robotics and sensor networks
- Release government data on Open Data platforms and improve licence conditions
- Innovate procurement processes with challenges, hackathons, sandpits and trials for public innovation



### Industry 4.0 and National Innovation

- Set national goals for innovation
- Consolidate the National Innovation System through platforms and secure connecting infrastructure
- Develop foresight capacity within Vietnam to plan 10-20 years into the future
- Develop industry boards and build industry partnerships to better align education and research to industry needs
- Promote and encourage technology transfer



### Regulation and taxation reform

- Establish a panel to prioritise areas of regulatory reform to progress the digital economy
- Ensure consistency and fairness in the taxation and enforcement of taxes in the digital economy
- Experiment with taxes to fund digital transition – such as retraining credits
- Reforming constitution to focus on pathways to democracy and freedom of expression
-

## Priority 1: ICT and energy infrastructure

Reliable, ubiquitous and secure ICT infrastructure and the energy to power underpins all other actions in building a robust digital economy in Vietnam.

The availability of both data connections and stable energy supplies will dictate how, where and by how much the digital economy in Vietnam can grow. More than any other factor, access to power and bandwidth will determine which digital economy scenario will predominate over the next 25 years.

**Need for large investments in networks:** To build new power generators and fund the deployment more extensive fibre as well as 4G LTE and 5G mobile networks, Vietnam will need to invest significant funding over the next 10-25 years. Much of this funding may be returned to the state in asset value, and increase economy-wide productivity, however it may be difficult to balance development with debt accumulation during the construction phases.

**Private funding will be required:** Communications and power infrastructure are advantaged by the fact they can earn an immediate income from the sale of electricity and wholesale bandwidth. This will assist in attracting funding from private partners and investors, however there may still be a need for large contributions from the government.

**Energy infrastructure:** Energy consumption in Vietnam is growing by 10-12% annually, and the government's Power Development Plan VII will require up to US\$10 billion per year in capital investment, and up to US\$148 in investment from 2016 to 2030. Vietnam's Energy Agency has reportedly reached its credit limit and Official Development Assistance loans are not available for new generation investment. Foreign investment in energy infrastructure will thus be essential to its development, and the development of the digital economy it powers.

Under the Power Development Plan VII energy supplies will be bolstered by new coal-fired power plants and gas turbines (providing 70% of power needs in 2030), as well as modest investments in renewable energy – such as

wind, biomass, solar and small and larger hydro plants (providing 24% of power in 2030).<sup>328</sup> Innovation in the energy sector, particularly in smart grids with distributed power potential from numerous feed-in points, may change the energy mix, although significant investment in the existing energy infrastructure is required for this to occur. Concerns around air quality and carbon emissions contributing to global warming may place public pressure on a change to more renewable and non-carbon based energy sources.

**ICT Infrastructure:** ICT and telecommunications infrastructure will also require significant investment from both the public and private sector. Although estimates for Vietnam are not available, it is estimated that new 5G networks will cost US\$8 billion to build in South Korea – a country with approximately a third of the landmass and half the population of Vietnam.<sup>329</sup> A rough extrapolation means that 5G networks may cost close to US\$24 billion to install across the entirety of Vietnam. Innovation in production may bring this cost down substantially over the next 3 years. Much of this value will be returned as asset value and income from an expanding range of telecommunications services – including IoT networks. 5G networks are expected to be more energy efficient than 4G networks, but because they will be transmitting more data, they may also consume more energy in total from more base stations.

In January 2019 Vietnam awarded its first 5G license to Viettel – a military-run telecommunications company with majority market share in Vietnam, and an expanding portfolio of telecommunications assets in other countries. The company will launch 5G trials from early 2019-2020 in Hanoi and Ho Chi Minh City and may also develop its own 5G chipset for users.<sup>330</sup>

**Smart cities:** Smart city infrastructure is also expected to attract foreign investment, and has the capacity to significantly reduce many negative externalities associated with urban living. Internet of Things trials are already taking place in several locations across Vietnam. Some of the small and medium sized cities may also be efficient pilot locations for Smart City infrastructure.

## POSSIBLE ACTIONS TO ASSIST IN THE PROVISION OF ESSENTIAL INFRASTRUCTURE FOR VIETNAM'S FUTURE DIGITAL ECONOMY

<p><b>Explore new methods to finance infrastructure investments</b></p>	<p>This include the newer platforms such as G20 Global Infrastructure Hub to match projects to potential investors, distributed blockchain-based electricity charging, and distribution power generation systems – such as rooftop solar or farm-based small scale wind generation; as well as more traditional and used infrastructure bonds, viability gap funding or PPPs. Funding innovation in electricity generation and retail will be easier due to the development of the Vietnam Full Wholesale Electricity Market (currently being established) and the introduction of network feed-in tariffs.</p>
<p><b>Undertake energy network modelling</b></p>	<p>This could be done on differing supply and demand scenarios to ensure energy supply does not impede the growth of the digital and broader economy over the coming decades. The opening up of the electricity grid to feed-in options may also incentivise more small scale renewable energy construction – such as the use of solar panels and small wind and water generators.</p>
<p><b>Audit leakage from electricity transmission networks through smart grid technologies</b></p>	<p>Older networks and ad-hoc construction of connections have created significant power leakages and inefficient electricity networks. Introduction of smart grid technologies are part of the Power Development Plan VII, and will help identify areas of improvement for greater network efficiency.</p>
<p><b>Improve the amount and quality of Global Positioning Systems (GPS) in Vietnam</b></p>	<p>The lack of detailed GPS data in Vietnam is holding back the trialling and adoption of digital technologies such as autonomous vehicles and cyber-physical systems for agriculture 4.0.</p>
<p><b>Undertake an audit of digital infrastructure across Vietnam and review equality of access to digital infrastructure</b></p>	<p>National maps and real-time performance of networks can examine gaps in the backbone and offshore fibre connections of the telecommunications network, and links to wireless services. Also review equality of access to digital services to ensure digital inclusiveness – especially in regional and remote areas. Better connection and services to rural areas would also improve enterprise readiness for Industry 4.0, according to manufacturing and agriculture firms surveyed in the present study.</p>
<p><b>Pilot multiple smart city systems and create 'urban living labs' across urban environments</b></p>	<p>This could be done through working with foreign governments and companies to leverage investment in IoT infrastructure. Build frameworks and feedback loops to assess and evaluate smart city infrastructure across varying locations.</p>
<p><b>Review spectrum plans and allocations based on capabilities of new wireless systems such as 5G</b></p>	<p>Focus on increasing the footprint of broadband wireless services to reduce those reliant on satellite services. Particularly widen availability of 4G LTE and soon-to-be-offered 5G services. This may mean reducing some spectrum allocation for radio or other services. 5G may also mean many homes and neighbourhoods may not need direct wired-in connections.</p>

## Priority 2: Cybersecurity and data governance

The establishment of secure networks and strong cybersecurity capability is critical to the development and success of a number of the scenarios described – particularly the Digitally Transformed and Digital Consumer scenarios. Reasonably open data flows, and participation in global platforms, attraction of multinational companies and use of foreign data are also important and beneficial for the development of Vietnam’s digital economy.

This report has highlighted Vietnam’s need to build cybersecurity capacity – both across its networks as well as in its workforce.

In June 2018 Vietnam passed the *Law on Cybersecurity for the protection of national security and the maintenance of social order and safety on cyberspace*.<sup>331</sup>

This is a comprehensive law that covers almost all aspects of cybercrime associated with increasing online connectivity.

There has been concern however, that the legislation may harm the trade in digital products and services through

imposing tight restrictions on data flows, including data localisation policies for over-the-top services (such as Viber, WhatsApp and Skype).<sup>332,333</sup>

Trust in digital networks is an enabler in the digital economy, and take-up and use will be dictated by trust in not just the networks, but in the actions of the Vietnam Government and digital corporations, and the rights and regulations available to citizens and consumers when using the networks. For this reason it is important that citizen rights respond to the growing information asymmetry occurring over digital platforms and networks.

Creativity and innovation are linked to political openness, and the generation of new business models, products and services is more likely to thrive in environments where people feel safe and are able to express opinions, judgements and thoughts without fear.<sup>323</sup>

It is therefore important that essential cybersecurity to keep citizens, industry and the nation safe, is balanced with appropriate rights and regulation to ensure innovation, growth of the digital economy and Vietnam’s participation in international data flows.

## POSSIBLE ACTIONS TO IMPROVE CYBERSECURITY AND DATA GOVERNANCE IN VIETNAM’S FUTURE DIGITAL ECONOMY

<b>Contribute to the formation of regional data sharing framework for the ASEAN region</b>	ASEAN and other international groups are developing frameworks for consumer rights and the use and protection of personal and other data. Many of these measures may mean Vietnam can avoid expensive data localisation policies through exporting only de-identified or aggregated data.
<b>Further build cybersecurity capability through attraction of skills</b>	This may be through international collaborations, scholarships, cross jurisdictional policing agreements and exchanges.  Focus on security and data stored in critical systems such as finance, energy, water and transport systems.
<b>Appoint an independent, trusted and high-profile e-safety Commissioner take complaints, provide cybersecurity tools and training to businesses, institutions and citizens</b>	Create cyber safe toolkits to keep citizens safe – including filters, antivirus software, awareness notifications, and tips on how to avoid predatory or bullying behaviour and stay safe online  Build business toolkits to ensure awareness of industrial and other threats online, and their obligations on the collection and use of data.
<b>Monitor and ensure public data is available on hacks, data breaches and notifications – and keep the public aware of dangerous activities</b>	Citizen trust can be engendered through regular media updates on the cybersecurity situation in Vietnam – including numbers of hacks and data breaches, new areas of concern and other online statistics.
<b>Utilise blockchain systems to safeguard data and build trusted public systems</b>	Blockchain technology can be employed across government networks to increase security of many systems including registers, transactional systems and payments and remittances, as well as activities where recording evidence is key – such as police activities or legal processes.
<b>Continue to work with international organisations to monitor transnational cybercrime</b>	This would include monitoring cross-border terrorism, threats to national security, drug trade, arms trafficking, industrial and other espionage and cyber abuse.
<b>Ensure there is adequate legal recourse and protections for citizens who believe they have been unfairly targeted through the cybersecurity laws</b>	This may include rights of appeal, affordable access to cyber and legal experts in court.

## Priority 3: Digital skills

The lack of digital skills and capabilities to achieve the ambitious plans for digital transformation across the economy and industries in Vietnam has been highlighted by almost all development studies of Vietnam's economy in the last ten years.<sup>84,160,239,334-337</sup>

Vietnam has good basic education levels at a school level, but only 8% of the workforce has completed university education. Digital skills and competencies within the workforce will need to rise for Vietnam to transition to a more developed and knowledge-based economy.

Where and how digital skills are formed will be one of the greatest determinants in regards to the development of Vietnam's future digital economy, and which scenario described in the previous section will predominate.

The Asia Development Bank Institute (ADB) found that advanced digital skills in Vietnam were beginning to concentrate in export-only sectors, where a mainly younger, urban population were achieving higher wages in the employment of multinational companies. The ADBI also concluded that increased trade was driving the demand for technological skills, not the opportunities derived from the technology itself.<sup>335</sup>

To achieve widespread transformation of Vietnamese industry and become a leading digital nation, some of digital skills and capabilities will need to be developed and used in the domestic transformation of industry, and government, and in the development of a thriving ICT sector.

Technology companies are beginning to take part in the development of digital skills in industry in Vietnam. Google for instance, has partnered with the Vietnam Farmer's Union to get basic digital training out to 30,000 small agricultural enterprises.<sup>338</sup> These are very low-level digital literacy skills however, and while they will be effective, significant industrial transformation will require population-wide training and retraining, as well as the development of advance programming and other skills in specialist digital sectors.

Digital skills education will need to be available from early education to adult learning and retraining. The high proportion of people engaged in micro and small to medium sized enterprises (MSMEs) also creates difficulties in reaching much of the Vietnam workforce in need of digital skills training.

Digital skills are also a significant attractor for further investment in the Vietnamese digital industry.<sup>223</sup>

To create inclusive growth from digitalisation, it is also important to increase digital skills and STEM workforce participation in diverse groups such as women and the rural population. Women in the digital economy in Vietnam will be further discussed in the box below.

### WOMEN IN THE DIGITAL ECONOMY IN VIETNAM

Gender balance is important in the digital sector in Vietnam (and globally) in order to achieve better employment opportunities for women in a growing digital economy, better design of ICT products and services and equal access to the opportunities and wealth provided by existing and emerging digital products and services.<sup>339,340</sup> As the digital economy in Vietnam expands, access to opportunity within the sector will have a greater impact on the distribution of wealth and power.

#### Women in STEM in Vietnam

Digital economy jobs often exist in the science, technology, engineering and mathematics (STEM) fields. Women are under-represented in the STEM fields globally. This under-representation is not based on ability, but cultural factors and family expectations that discourage women from entering physical sciences – such as computer science, physics, chemistry and mathematics, or once they are qualified in those fields, encourage them to leave.<sup>341</sup>

Researchers have also found a phenomenon described as the 'gender equality paradox in STEM'. The paradox is that as gender equality in society increases, the gender imbalance in the STEM field also increases.<sup>341</sup> A possible explanation for this is that female students excel in reading ability from a younger age, and if given options, this promotes their success in other fields – steering them away from careers in science and technology.

Vietnam scores well on international comparisons of gender equality in STEM fields. Female students display higher abilities than male students in all STEM subjects tested in PISA scores in high school in Vietnam, and Vietnam scores well on PISA tests in relation to the country's GDP level – out competing the scores of students at high school in many high income countries.

But despite this ability, far fewer women enrol in tertiary education in STEM subjects in Vietnam's universities.<sup>341</sup> After a concerted effort by the Vietnam Government and various development agencies and programs, Vietnam has increased

the number of female students studying STEM subjects at the university level from 30% to 52% in the two academic years to 2014.<sup>340</sup> This is a significant gain, but has not yet translated to women in higher levels in STEM – either in university or the business community.<sup>340,342</sup>

### Women in Vietnam’s Tech Sector

Similar to other parts of the world, women reportedly face significant gender-based discrimination in Vietnam’s existing and emerging technology sectors. This includes access to finance, family-based expectations and sexual harassment in the sector. This is also a problem across the business sector in Vietnam.<sup>344</sup>

In a recent domestic survey of large companies, women represented 17.6% of board members, and just 6.7% of CEOs. This is however, similar to other parts of the world, including developed countries, and Vietnam outperforms other comparable Asian nations – such as Thailand, Singapore and China.<sup>345</sup>

Women have also taken the lead in many start-up technology groups in Vietnam, but particularly so in the development of blockchain and cryptocurrency markets. Examples include Ms Val Yap – CEO and founder of PolicyPal network to reform policy in cryptocurrency markets, Ms Nicole Nguyen – Asia Pacific head of Infinity Blockchain Ventures, and Bao Phuong Nguyen, CEO and Co-Founder at Bitcoin Vietnam.



Broad access to computers, bandwidth, education – especially in robotics and coding, and knowledge to access to finance is essential for women to maintain a strong presence in Vietnam’s technology sector. In many cases, specialist classes and courses for girls and women may improve participation rates, along with the promotion of role models and successful women in the technology sector and mentoring and funding available specifically to female entrepreneurs.

Monitoring of women in the STEM across education levels, and quotas of women on boards in public companies may also improve the status of women across the the digital sector. Some of these initiatives are already being implemented in Vietnam.<sup>346</sup>

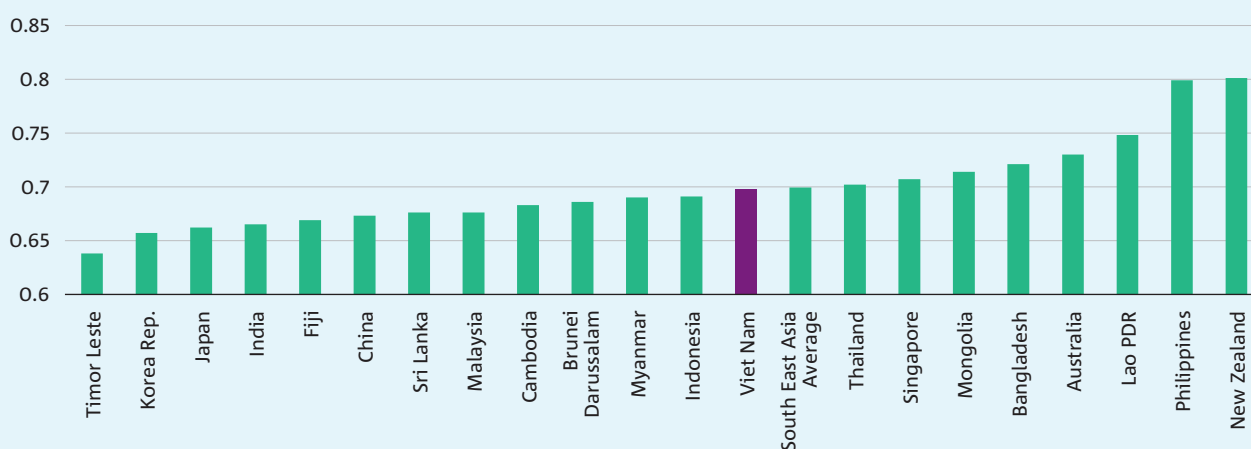


Figure 54 Global Gender Index – South East Asian Countries, 2018

Source: Global Gender Gap Report<sup>343</sup>

Note: Higher value = greater equality

## POSSIBLE ACTIONS TO BUILD DIGITAL SKILLS AND CAPABILITY FOR VIETNAM'S FUTURE DIGITAL ECONOMY

<b>Coding, STEM and computer skills in schools</b>	Introduce coding, app development, 3D printing and robotics into schools and curricula – creating an online platforms to access coding programs and teacher training courses. Also focus on human skills of creativity and business development: team work, speaking and presenting and inspiring others. Digital skills will supplement critical thinking in STEM. <b>Digital skills education in school will assist in closing the digital divide across Vietnam.</b>
<b>Develop Industry Boards to better align formal education offered in universities and tertiary institutions with the needs of the fast-evolving workforce</b>	The mismatch between knowledge and skills developed by universities and tertiary institutions across Vietnam, and the skills needed by large firms and government, is impeding the development of learning firms, and the recruitment of locally-trained students. Industry boards to help direct graduate flow would improve the efficiency of higher education in Vietnam.
<b>Attract foreign investment for digital equipment in education</b>	This includes school computing equipment for students, and advanced platform and sandpit access for higher education and vocational studies.
<b>Ensure inclusive growth in the digital economy</b>	This can be achieved through targeted digital education programs and support groups for women, people with disabilities, people living in rural areas and minority ethnic groups.
<b>Promote adult education and lifelong learning. Consider retraining credits or vouchers for people in jobs displaced by automation.</b>	This is especially important in centres of manufacturing. Adult education can be promoted through mandated organisational training, co-working centres, vocational education institutions, and social clubs and unions.
<b>Create pathways within education systems for building developer communities</b>	Developer communities can explore the new technical and business opportunities of the newer digital fields of AI, blockchain, augmented and virtual reality, big data analytics and visualisation, and cybersecurity.
<b>Encourage public-private partnerships in education through blended learning</b>	Create pathways across sectors and school systems through blended learning options and flexible accreditation based on skills and competencies.
<b>Curate or support start-up and developer communities</b>	These can take place in co-working and other centres, universities, and online forums and meet-ups. Start up communities can combine technical and business skills.
<b>Focus on skills rather than occupational training</b>	Provide flexible education and capability for a fast-changing business environment in the digital sector. This means not teaching for occupations, but focusing on transferrable competencies.
<b>Invest in advanced computing and coding capacity – particularly those associated with other industry sectors in Vietnam</b>	Centres of excellence can be formed through tertiary institutions and international partnerships – providing scholarships, capacity and equipment, and well-funded appointments. These can be associated with existing or emerging sectors – such as mining, energy, agriculture, health and urban technologies. Emerging sectors in fintech, food distribution, retail and healthcare, entertainment apps.
<b>Attract back trained expats and other skilled people</b>	Skilled visas and other incentives – such as jobs and appointments – for expats and trained people from other countries will fast-track skills profiles and provide technology transfer.
<b>Procurement reform: Promote the local digital industry through contracts, challenges and trials</b>	Procurement reform and technology challenges can support the development of local ICT hot-spots and industry, as well as provide intellectual stimulus to attract the world's best minds to solve Vietnam's technological challenges.
<b>Agreements with international firms to include technology transfer and training</b>	Contracts with multinational technology and other companies securing government work and significant market access should include technology transfer and training clauses.
<b>Promote trade in high tech goods and services</b>	Create Vietnam-brand awareness of digital skills found in Vietnam through media and other campaigns.
<b>Development of an AI, blockchain and IoT Ethics Framework</b>	Ethics frameworks for the development and deployment of many new technologies would increase trust in their use, and ensure there are user rights and responsibilities.



## Priority 4: Modernisation of Government

Many of global innovation hot-spots, including Silicon Valley, have been built on the back of public sector procurement contracts.<sup>347</sup>

Government contracts and public sector modernisation can significantly boost the local digital economy through:

- Importing new technology, methods and models to an economy.
- Partnering with early-stage technology companies to undertake product and technology development.
- Commissioning for technology that does not yet exist – through publishing specifications and issuing technology challenges.
- Funding IP development that can then be used in the creation of consumer and exportable goods and services.

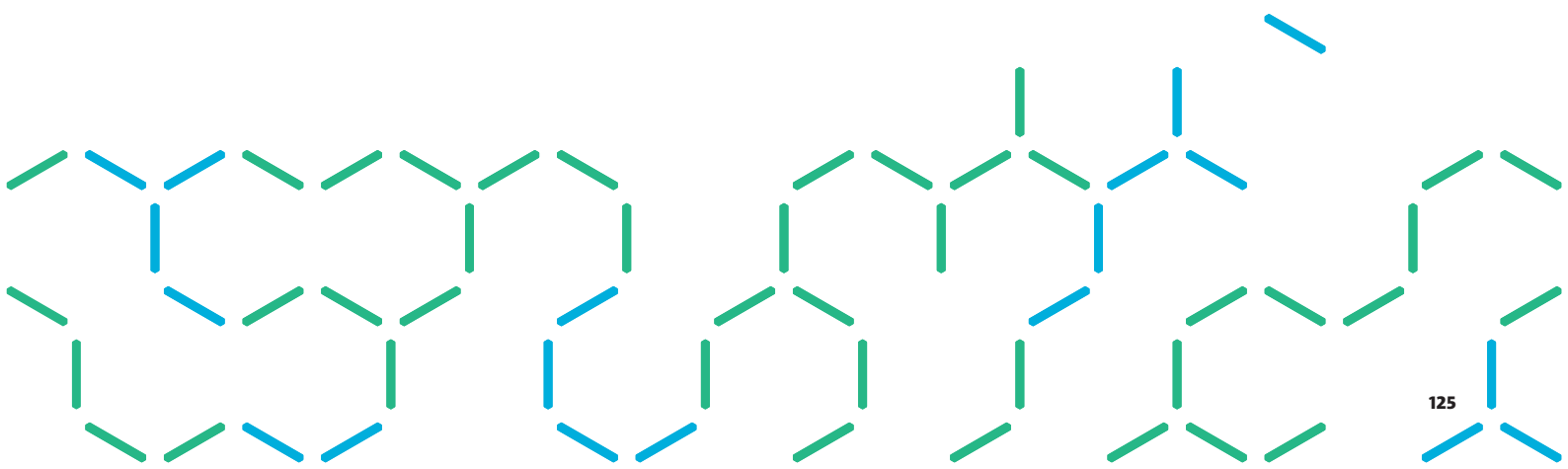
The benefits to the economy are often two-fold, as the public service becomes more efficient and can dramatically improve services and cut operating costs through modernisation, and the private sector can be sustained while commercial IP is generated, and once generated – can contribute to the growth of the start-up and technology sector through further commercialisation of IP for consumer goods and services.

In some areas targets (or missions) combined with government-research-enterprise coalitions have produced rapid government transformation and industry development.

Mission-led innovation promoted through open challenges is now being used by governments around the world to seek out the best and most efficient solutions to public sector problems or targets (examples include reducing traffic congestion, cutting operating costs, improving regulation compliance or public health, helping the environment or spreading public awareness).<sup>348</sup>

Challenges, hackathons, pilots, and the use of public sector systems for sandpits and applications test-bedding, are being increasingly used to keep pushing the progress of new technologies and engaging an ecosystem of technology companies within the private sector, rather than attempting to find all solutions ‘in-house’ in government research areas. For this to occur however, nearly all areas of government need to reform their procurement procedures, and learn to contract for innovation.

Apps, AI, platforms, blockchain systems and AR/VR solutions can be applied to many of Vietnam’s public sector missions – and have the potential to improve services (e-government delivered) and dramatically cut operating costs for many areas.



## POSSIBLE ACTIONS TO PROGRESS E-GOVERNMENT AND PROCUREMENT TO ADVANCE VIETNAM'S FUTURE DIGITAL ECONOMY

<p><b>Innovate with government procurement mechanisms – challenges, hackathons, sandpits, trials and partnerships</b></p>	<p>Introduce highly publicised technology and mission-led challenges to Vietnam's large public sector issues. Smart City challenges already exist, and these can be further applied to health, education, energy, defence, agriculture, environmental challenges, transport and finance – amongst others. Partners in challenges could include technology companies, development organisations and spending from government departments. Schemes such as the Small Business Innovation and Research Scheme (SBIR-UK/US), and MSME participation schemes also ensure that local and small businesses can participate in government tenders and contracts.</p>
<p><b>Open Data and Open Innovation Platforms</b></p>	<p>Open data provides the essential mining material for a lot of development through apps, platforms, big data analytics and AI systems. It will improve transparency and trust in the Vietnam Government, as well as spur innovation and reduce the cost of service delivery. Open data platforms and licencing systems need to be better developed within Vietnam – with a much greater proportion of automated real-time data inputs, outputs, visualisations and dataset in useful and interoperable API. Development required in Vietnam includes establishing data standards for use in open data systems and applications, input rules, security, and licencing standards and conditions.</p>
<p><b>Decision-framework and multi-criteria analysis on public sector spending priorities</b></p>	<p>Identify the most efficient and high-impact areas of government likely to benefit most from modernisation through the implementation of solutions from emerging digital technologies.</p>
<p><b>Continue to modernise government services, examining robotics, sensor networks and AI solutions to business systems and processes</b></p>	<p>Many government departments around the world are constrained lack of development and transition funding. So many departments are struggling to keep up with demand that funds are not set aside to contribute to service modernisation. Returns on investment for e-government reforms however, can be enormous, so every department would benefit from a request to set aside a proportion of operating funds for modernisation and transition.</p>
<p><b>Develop IP through public sector innovation</b></p>	<p>Public sector procurement can help develop the local digital industry, particularly if the IP remains in the private sector. This enables private companies within Vietnam's digital sector to further commercialise that IP or other business or consumer applications and goods. The public sector can play an important role in developing new IP for both public and private sector value.</p>
<p><b>Create digital registers of public assets – recording size and value</b></p>	<p>Registers of public assets – possibly created on blockchain technologies – may provide auditable accounts, reduce corruption and enable officials to see assets available for sale in case of a debt crisis.</p>
<p><b>Encourage public sector pilots of new technologies across a range of sectors.</b></p>	<p>Public servants often feel un-empowered to take risks and experiment with new technologies. Pilots of new technologies done in partnership with the private sector should be encouraged and rewarded.</p>

## Priority 5: Industry 4.0 and the National Innovation System

Industry 4.0 is a major economic strategy of the Vietnam Government, designed to modernise industry, increase investment and knowledge transfer and improve productivity. An aggressive Industry 4.0 policy was first put on the agenda in May 2017 with Directive 16/CT-TTg from Prime Minister Nguyen Xuan Phuc.

The Directive covered infrastructure, research and development, tax incentives, skills development and e-government reforms.<sup>349</sup> The Directive spurred a range of high profile activities – such as international summits, announcements from large industry bodies and media articles.

Some business people have expressed concern that much of the rhetoric around Industry 4.0 is not translating into effective digital economy development actions – such as support for start-ups, promoting smart phone adoption, increasing regional education or tax incentives for ICT skills in businesses.<sup>350</sup> Scepticism for term ‘Industry 4.0’ was also found in the workshops for this report; with participants suggesting the term was hyped and politicised, and there was a lack of leadership within organisations for large changes due to new digital technologies, no clear cost-benefit case studies to convince organisations to implementing new digital technologies, and not enough knowledge regarding digital standards and regulations. Some have suggested that terms such as digital transformation or digital take-up might be more useful in describing the next wave of transformation.

The term ‘Industry 4.0’ is gaining traction and awareness on the ground however. Surveys of people working in Vietnam anticipate rapid change from Industry 4.0 technologies, with 67% of workers foreseeing significant impacts of Industry 4.0 technologies and policies within their industry within the next three years.<sup>307</sup>

Industry 4.0 cannot be discussed in isolation from the broader innovation and start-up ecosystem within Vietnam however.

The digital economy in Vietnam is central to the development of the broader innovation network. *Vietnam 2035: Toward Prosperity, Creativity, Equity and Democracy* produced by the World Bank in conjunction with Vietnam’s Ministry of Planning and Investment was clear in its assessment of Vietnam’s current innovation system: “Vietnam’s National Innovation System is weak and contributes little to output or growth.”<sup>41</sup>

*Vietnam 2035* recommends building an innovation-led economy through:

- Increasing the competitive pressure under which firms operate
- Boosting firm learning and their capacity for technology adoption and R&D; businesses must become ‘learning firms’
- Improving the quality of R&D conducted in Vietnam, and improving research productivity
- Upskilling the workforce through continuous improvement and lifelong learning.

A strong National Innovation System in Vietnam will both boost the digital economy, and be boosted by it. A national innovation organisation and platform that could link researchers across Vietnam and around the world would have the capacity to turbo-charge digital transformation across industry sectors.

Existing and emerging digital technologies can be applied to all areas of research and modernisation, so a specialist and applied national industrial data analytics and ICT research organisation may assist in progressing Industry 4.0, and building relationships through collaborations and partnerships.

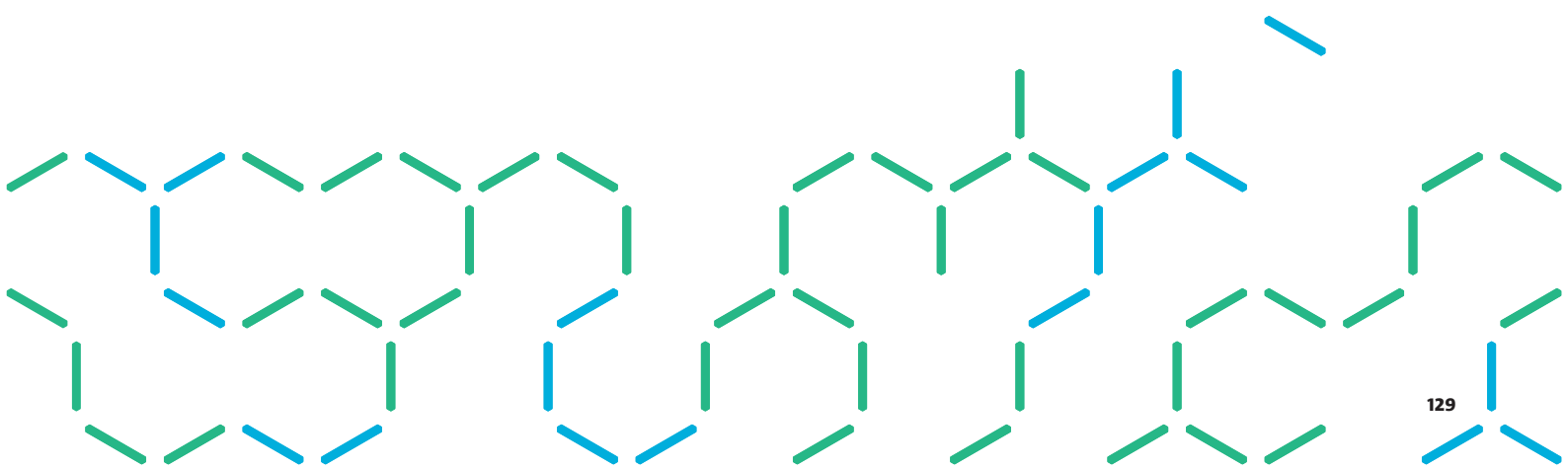
A number of contributors to this report commented on the need for stronger support for the start-up sector, and influencing SMEs – which constitute a large proportion of both enterprises and employment in Vietnam. Many also suggested SMEs and start-ups will be at the forefront of building new business models from emerging technologies. The start-up and SME sector is often viewed as an ecosystem due to the many small firms existing outside formal learning and research centres, or large organisations.

The start-up ecosystem in Vietnam is growing strongly, but could be supported through increased curation and better access to accommodation, networks, venture capital or finance, or opportunities to test new technologies and capabilities.

## POSSIBLE ACTIONS FOR ENHANCING THE INNOVATION ECOSYSTEM AND INDUSTRY 4.0

<b>Publish clear actions from government under the Industry 4.0 policies, including a national digital economy strategy</b>	Industry 4.0 is currently a vague and often misunderstood term, and some people are sceptical that the intentions announced under Industry 4.0 directives will not translate to meaningful actions on the ground. A clear set of actions would assist communicate the concept, policies and assistance available to help industry modernise.
<b>Build a national data and computer sciences organisation and platform to unify the National Innovation System and connect the many smaller research institutions across Vietnam</b>	Vietnam would benefit from building a nationally connected innovation or data sciences and research organisation to bring together the latest digital technologies, run pilots and technology trials, work with existing research institutions, build relationships and focus on building digital and ICT capacity in Vietnam industry.
<b>Determine and prioritise Vietnam's specialist industries and use digital technologies to build new business models, specialist research centres, pilots and market tools</b>	Vietnam should use digital technologies to build on its existing industrial strengths. Countries such as Australia, Indonesia and Singapore have focused their modernisation efforts and R&D spending on their areas of existing competitive advantage – which increases their productivity at the same time as developing new digital tools for export.
<b>Further promote Industry 4.0 within Vietnam – including showing the costs and benefits of certain technologies through case studies</b>	Industry 4.0 policies provided in Directive 16 are comprehensive. These should be promoted with awareness programs and help for firms and companies wishing to innovate. In particular, agriculture and manufacturing firms (surveyed in the present study) recommended better information sharing through multiple channels, especially regarding skills capacity building, technological capabilities and benefits, legal support and access to capital funding. They also recommended more government support – including capital, finance, technology development projects, tax incentives, supply system support and information on transportation logistics.
<b>Examine additional communication channels to SMEs in Vietnam possibly through third party advice services</b>	SMEs are notoriously hard to reach through common business communications methods such as conferences, professional networks or work with academia. Advice on technology benefits may be transmitted through third party advice services however, such as through accountants and tax services, schools or office supplies. Governments may also consider providing some free digital tools via platforms, or through targeted advertising on social networks.
<b>Provide assistance to build a start-up ecosystem across Vietnam</b>	This includes mentorships, innovators in residence from abroad, co-working centres, and government contracts for young companies. Support could be provided in developing new channels for access to finance including venture capital and small contracts for early stage companies, opportunities to test new technologies and capabilities, and support in networking and creating collaborations.
<b>Technology hubs and high tech precincts</b>	Vietnam has committed significant funding to improve infrastructure to industrial parks and high tech hubs. These should be linked into an over-arching organisational structure and shared digital administration system to ensure knowledge-spill-overs and effective industry and cooperative partnerships.
<b>Utilise international forums, relationships and trade agreements to advance Vietnam's technology base and digital economy</b>	Vietnam has entered into a high number of international trade agreements and is a member country of APEC and ASEAN. These relationships and forums are platforms to attract investment and showcase Vietnam's achievements and aspirations in the digital economy.

<b>Build greater levels of venture capital to invest in ideas</b>	Venture capital will fuel start-ups, spin offs and the development of new technologies. As a relatively young market Vietnam is in a good position to attract venture capital from other parts of the South East Asian region to feed into the local digital economy.
<b>Integrate industry and research through industry-student placements in the final years of STEM courses</b>	Student placements in industry will better align formal education with industrial needs and provide students with practical occupational skills.
<b>Vietnam Innovation/digital transformation Scorecard – an index to measure Vietnam’s innovation and the platform to see where it is occurring</b>	An index to measure innovation growth and location in Vietnam would measure/monitor the digital transformation and innovation development across existing industries and enterprises to provide data, inform further investment and provide feedback to policy makers.
<b>Promote and encourage technology partnerships and technology transfer between Vietnam industry sectors and large global technology providers</b>	Large multinational technology providers are already partnering with Vietnamese industry groups, unions, research organisations, government departments and special interest groups to build digital skills, literacy and diffuse their technology throughout Vietnam’s growing consumer and other markets. These partnerships can offer many benefits and could be further encouraged through better linkages.
<b>Build Government-Research-Private Sector partnerships across a range of economic sectors</b>	The ‘triple helix approach’ of linking government-funded research and applications to private sector partners has fostered both public sector transition as well as industry development. These could be explored in Vietnam.
<b>Introduce blockchain-based IP registers – available online, and publish guidelines and information on types of copyright and IP protection needing protection in a more digital future</b>	<i>Vietnam 2035</i> identified a number of trust issues in the current IP registration system in Vietnam. IP leakage and theft is robbing Vietnam of valuable export income and research capacity. IP systems could be reformed with the introduction of a national blockchain-based IP registration system. Copyright of digital content may also need closer examination to allow innovation in open systems and content sharing where appropriate. A balance between generating income from IP rights and licences, and promoting innovation through knowledge and content sharing needs to be debated and reached. According to manufacturing and agriculture firms surveyed in the present report, better protection and enforcement of IP rights would encourage investment in new technologies and help improve enterprise readiness for Industry 4.0.
<b>Blockchain and AI in food and mineral provenance and other systems: promotion of trials</b>	Industry 4.0 will only be achieved with the trial and application of the suite of new digital technologies in industrial settings. Many of these technologies have obvious applications for Vietnam – such as blockchain in food provenance, AI in manufacturing and administration, and biometrics in the use of identity verification. Many trials are already taking place in Vietnam and need further promotion across industry groups to have impact and take-up.
<b>Examine innovation in the informal economy in Vietnam, and innovative ways to engage with citizens earning incomes in the informal economy</b>	Trial the use of platforms, smart money, information sharing and service delivery to engage people working in the informal economy to work more in the formal economy and pay appropriate taxes. The informal cash-based economy is currently an estimated 25-30% of the national economy. <sup>351</sup>
<b>Stronger support for agriculture and manufacturing firms</b>	Agriculture and manufacturing firms surveyed in the present study recommended that there be stronger support for them to access Industry 4.0. In particular, they requested support in the form of: training provision, linkages between supply and demand (i.e. production and consumption), and development of pricing strategies. They also requested support in accessing export markets, and accessing quality ICT supplies with diverse and complex products.



## Priority 6: Taxation and regulation

### TAXATION

The digital economy is highly globally mobile. Large ICT companies are often attracted to fast growing consumer markets – such as those now found in South East Asia including Vietnam. There has been concern expressed from governments and citizens about the ability for digital companies to evade national taxes (particularly those on profits and local transactions) through global company structures headquartered in tax-havens. This may create base [tax] erosion and profit shifting (BEPS).<sup>352</sup>

Local retailers in particular worry that larger platform-based companies can avoid national taxes – such as consumer or sales taxes.<sup>353</sup> By doing so they under-cut local retailers who invest in a physical presence, employ local people and contribute towards the services and infrastructure of the community through taxes.

Platforms however, may stimulate economic activity, generate taxable income from global markets, and create new businesses and business models.

A comprehensive review of taxes impacting the digital economy by the International Telecommunications Union (ITU) in 2015 found that there are two main approaches to taxing the digital economy, and countries are divided on which approach to implement:<sup>354</sup>

1. Maximise taxation collections based on exponentially growing digital flows;
2. Lower taxation on the digital sector as it benefits consumers and businesses, and consequently, economic growth and GDP.

The ITU concludes that:

*The evidence regarding the economic impact of digital industries, ranging from fixed broadband to computing, the Internet, and mobile broadband, continues to grow. From that perspective, the argument to reduce potential distortions emerging from over-taxation of the sector is gaining ground.*

This conclusion is supported by a survey of 300 investors and company executives in the digital sector in the ASEAN region. Survey results suggest that companies look for well administered and enforced tax regimes when establishing within a country. This includes consistent treatment, established taxation rules, non-discriminatory taxation on the digital sector.<sup>223</sup> Consistency and fairness in the application of taxation rules is more important for many companies than the tax rate itself.

Respondents of that survey also stated that Vietnam's taxation authorities applied inconsistent or unpredictable treatment, special taxes that discriminate the digital sector, had high corporate tax rates, and applied aggressive enforcement of taxation laws. To a lesser extent respondents also considered Vietnam's taxation laws to be over-complex. This compared unfavourably to many of Vietnam's competitors in the ASEAN regions – such as Thailand and Malaysia.

Digital companies operating in Vietnam must declare and register to pay tax on any income created in Vietnam. This includes companies headquartered outside of Vietnam. These companies can pay both a tax on income and services sold within Vietnam, as well as a Foreign Contractor Tax for booking services – such as for car-rides, hotel rooms and accommodation, and tours and experiences.<sup>355</sup>

### POSSIBLE ACTIONS TO IMPROVE TAXATION FOR VIETNAM'S FUTURE DIGITAL ECONOMY

<b>Review taxation on digital products and services</b>	Examine the consistency of taxes on digital products and services with other parts of the economy, and undertake a business modelling on changes and simplifications to the taxation system on digital products and services.
<b>Regularly review tax incentives for workers and companies in the digital sector</b>	Tax incentives should be regularly reviewed to ensure consistent application and enforcement, effectiveness and efficiency.
<b>Review enforcement procedures</b>	Grow investor confidence in the Vietnamese business environment through better tax information, access to consistent taxation rulings, and online tools to estimate tax and other business charges.
<b>Be proactive in examining the tax impacts of new digital technologies</b>	Cryptocurrencies and other blockchain technologies, automation and Artificial Intelligence may all rapidly impact on taxation revenues over the coming 25 years. These impacts need to be carefully monitored and contingencies developed to manage large shifts in taxation if broad uptake occurs.
<b>Review experimental taxes to fund digital transition</b>	Robot taxes, training credits and universal basic incomes have been considered by technology experts as solutions to economic deflation brought about by lower consumer spending, and social inequality resulting from the rapid automation of jobs. These could be reviewed or even piloted in the Vietnam context.

## REGULATION

Participants in workshops conducted for this research cited a wide range of regulations that they consider could be reformed to progress the digital economy in Vietnam. Areas of regulation considered to be in need of reform will need to be prioritised and considered both separately and in the context of the overall benefit of to the economy and digital economy.

Each of these areas of regulatory reform are complex, and in many cases there are already reforms being implemented or discussions occurring regarding regulatory reform. Some have much greater impacts on the future growth and concentration of digital economy than others. A recent report written for the Hinrich Foundation on digital trade and Vietnam for instance, prioritises regulation reform that ensures regional data flows, minimises border frictions, and reduces content restrictions.<sup>333</sup>

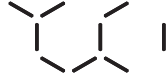
## AREAS OF REGULATION CITED AS BEING IN NEED OF REFORM FOR VIETNAM TO GROW THE DIGITAL ECONOMY INCLUDE:

DIRECTLY RELATED TO THE DEVELOPMENT OF DIGITAL PRODUCTS AND SERVICES	RELATED TO ECONOMIC MODERNISATION IN RESPONSE TO EMERGING DIGITAL PRODUCTS AND SERVICES
<ul style="list-style-type: none"> <li>• use of radio frequency spectrum</li> <li>• cybersecurity and encryption</li> <li>• use of cryptocurrencies</li> <li>• privacy and the use of personal data</li> <li>• use and application of AI technology</li> <li>• ISP registrations and responsibilities</li> <li>• digital content provision and creation</li> <li>• data use, copyright, IP registration and ownership</li> <li>• data standards and interoperability</li> <li>• digital authentication and personal identification including use of biometrics</li> <li>• use of mobile and other devices in cars and public places</li> <li>• aerospace (to be used by drones)</li> <li>• e-government, procurement, open data, government platforms and services</li> </ul>	<ul style="list-style-type: none"> <li>• state owned enterprises</li> <li>• freedom of expression</li> <li>• land use</li> <li>• economic and trade zoning</li> <li>• health</li> <li>• courts and administration of laws</li> <li>• policing and surveillance</li> <li>• agriculture</li> <li>• environmental standards and recycling</li> <li>• vehicle registrations</li> <li>• building standards</li> <li>• employment and labour regulation</li> <li>• business registration and compliance</li> <li>• ease of doing business</li> <li>• local government</li> <li>• urban planning</li> <li>• education</li> </ul>

## POSSIBLE ACTIONS TO IMPROVE REGULATION FOR VIETNAM'S FUTURE DIGITAL ECONOMY

<b>Establish an expert regulatory reform advisory panel</b>	This panel would to prioritise and identify regulation inhibiting the growth of the digital economy in Vietnam, and offer solutions and recommendations for reform. The panel may also commission in-depth reports on areas of public concern – such as use of biometrics or facial recognition in public places.
<b>Participation in legal and other frameworks for digital economy development and data flows in the Asia Pacific region</b>	Participate and encourage forums for developing regional standards, safeguards, and security on data use, technology platforms, open data and interoperability to promote the future trade of digital products and services across the Asia Pacific region. This would also supplement the need for increased data-driven policy making capacity.
<b>Encourage public participation in debate on regulation of the digital economy</b>	Workshops identified a number of anxieties related to the development of digital technologies and systems in Vietnam. Creating trust and discussion around the industrial and government application of digital technologies used in the 4 <sup>th</sup> Industrial revolution will be critical to widespread adoption and transformation.
<b>Improve freedom of expression and political participation to improve creativity and entrepreneurialism</b>	Global innovation hot-spots – such as Silicon Valley in the US – are known for their cultural and political openness, willingness to experiment and design new technologies, and invest in creative ventures.

# CONCLUSION



## Vietnam at the crossroads

Vietnam in 2019 is at a particular point in its development and in technological history – in middle-income status at the beginning of the Fourth Industrial Revolution – where critical decisions need to be made in regards to economic strategy, and in the support and adoption of the digital economy.

Vietnam has grown rapidly and inclusively over the last 40 years. This has been done through a market-development strategy involving opening up the economy to international trade, attracting high levels of Foreign Direct Investment (FDI), growing the manufacturing base, and becoming a competitive low-cost labour market. Public investments in infrastructure, education and health have also helped lift 40 million people out of poverty and into the middle classes, powering domestic consumption. Vietnam, as a country, achieved lower-middle income status in 2010, and is achieving high year-on-year growth rates.

Now that Vietnam has achieved middle-income status however, it will start to feel competition as a low-cost labour market from lower-income countries.

When per capita income levels are low, low levels of value-added still contribute significantly to both GDP growth and improvements in quality of life. As income levels rise however, particularly above \$5,000 per capita, there is often a sharp deceleration in growth as the relatively unproductive labour is eventually made uncompetitive by either technology available in more advanced countries, or the flight of industry to less developed nations with lower-cost labour costs.<sup>356</sup>

## Need to shift focus on economic strategy

The economic strategy that led to Vietnam's success and high GDP growth over the last four decades will not continue to provide the same growth and prosperity into the future. The paths to upper-middle income and high income status are far from guaranteed. To move from middle income status to high income status, Vietnam will need to go beyond being a low cost labour market with a heavy reliance on FDI for export growth, and move to increasing the capacity to use technology to increase total factor productivity growth across all industry sectors.

**The way forward is through improving labour productivity and knowledge-based industries through technology adoption, structural reform, skills development and education.**

## Industry 4.0

As the industrial world modernises with a new suite of powerful digital tools – including automation, AI, blockchain, platforms and cloud services and the Internet of Things – Vietnam will benefit from a shift from relying on labour inputs, to better utilising technology, skills and creating value-added products across all industry sectors. Technology intensification through the application of this next wave of digital technology by businesses, government and industry is what many are describing as Industry 4.0.

Awareness and promotion of Industry 4.0 within Vietnam is encouraging, but technology adoption remains low.

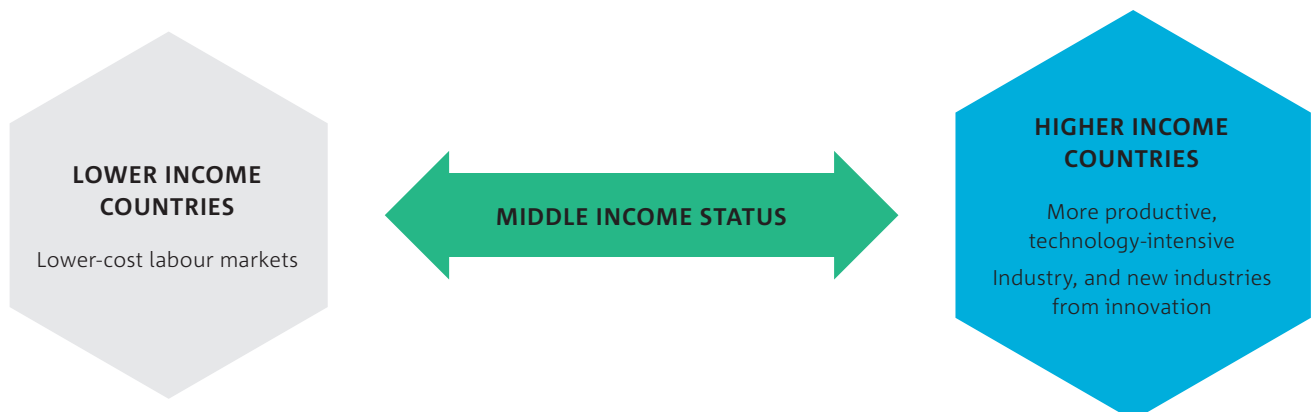


Figure 55 The competitive squeeze on economic strategy



How Industry 4.0 policies and technologies will be adopted and taken up across Vietnam will determine which scenario described in this report will unfold over the next 25 years.

## Scenarios and actions for resilience

This report highlights the current digital megatrends for Vietnam, and creates four potential scenarios for the digital economy in 2045. The futures of Vietnam are distinctly different, reliant on a mix of internal and external factors with varying estimated impacts on GDP and job disruption. These impacts have been estimated through long-range modelling. There are benefits and risks for each.

The decisions now are for the people of Vietnam. Many encouraging policies are in place. These will need to be translated to enthusiastic actions on the ground.

To assist policy makers and leaders of industry moving forward we have created a broad roadmap and list a range of possible actions that can prevent critical failures of the Vietnamese economy in all four scenarios, and that could potentially boost digital adoption, economic productivity and resilience.

**The key challenge** for Vietnam in this digital transition will be to keep the macroeconomy strong, and foreign debt and inflation under control, while at the same time investing efficiently in infrastructure and skills to unlock productivity growth. Control of the macroeconomic

environment and efficient allocation of resources has been key in lifting other nations from low to high income status through the application of technology.

To control inflation and debt, investments will need to be carefully sequenced – focussing on high-speed ICT infrastructure to as much of the population as possible, cybersecurity to ensure trust, and broad-based digital skills unlock the productivity benefits of digital connections. Government and regulatory reforms to modernise government services and allow the efficient allocation of resources, and strengthening the innovation network will also be necessary to mature the economy.

The actions listed in this report are to provide ideas for Vietnam’s policy makers and heads of industry tackling investment decisions for the next 25 years.

While no-one can accurately predict the long-term future, the information in this report provides options and opportunities to guide Vietnam in the next wave of digital innovation and the Fourth Industrial Revolution.

With a young and vibrant population, high investment and a location in the heart of high-growth Asian economies, Vietnam has a good chance of surging forward with the new digital tools available, if the transition is managed well.

This transformation will not come without risk, but the biggest risk in these times of rapid change, is not transforming at all.



Figure 56 Different strategies for different stages of development

# APPENDIX A

## COMPANIES OPERATING IN THE DIGITAL ECONOMY IN VIETNAM



# APPENDIX B

## MAIN REGULATIONS ON INFORMATION TECHNOLOGY IN VIETNAM

### B.1 Main regulations on Information Technology in Vietnam

- Law on Information Technology No. 67/2006/QH11
- Decree No. 71/2007/NĐ-CP of May 03, 2007, detailing and guiding the implementation of a number of articles of the Law on Information Technology regarding the IT industry
- Decree No. 154/2013/ND-CP stipulating the concentration of information technology parks
- Circular No. 99/2003/ND-CP promulgating the regulation on hi-tech parks
- Circular No. 64/2007/NĐ-CP promulgating ICT application in governmental agencies
- Circular No 102/2009/NĐ-CP on the management of investment in information technology application using the state budget
- Circular No. 43/2011/NĐ-CP on the provision of online information and public services on websites or web portals of the state
- Circular No. 31/2015/TT-BTTTT on the list of used IT products that are prohibited from importation
- Resolution No. 41/NQ-CP on tax incentives for development and application of information technology in Vietnam
- Law on Technology Transfer No. 07/2017/QH14
- Decree No. 97/2008/NĐ-CP on the management, provision and use of Internet services and electronic information on the Internet
- Decree No. 142/2016/NĐ-CP on the prevention of online information conflicts
- Decree No. 25/2011/NĐ-CP detailing and guiding the implementation of the Law on Telecommunications
- Joint circular No. 02/2005/TTLT-BCVT-VHTT-CA-KHĐT on management of Internet agents
- Joint circular 60/2006/TTLT-BVHTT-BBCVT-BCA on management of online games
- Circular No. 09/2008/TT-BTTTT on guiding the management and use of Internet resources
- Circular No. 14/2010/TT-BTTTT detailing articles in Decree No. 97/2008/NĐ-CP on the management, provision and use of Internet services and electronic information on the Internet
- Circular No. 18/2012/TT-BTTTT on promulgating a list of telecommunications enterprises, groups of telecommunications enterprises with market dominant position for important telecommunications services and Circular No. 15/2015/TT-BTTTT revising some regulations of Circular No. 18/2012/TT-BTTTT
- Circular No. 15/2015/TT-BTTTT revising some regulations of Circular No. 18/2012/TT-BTTTT on promulgating a list of telecommunications enterprises, groups of telecommunications enterprises with market dominant position for important telecommunications services
- Circular No. 48/2016/TT-BTTTT detailing and guiding the operating licenses of newspapers, electronic newspapers, publishing additional publication, opening specialised pages of electronic newspapers and specialities
- Decision No. 05/2017/QĐ-TTg on providing emergency response plans to ensure national cybersecurity

#### B.1.1 MAIN REGULATIONS ON POST, TELECOMMUNICATION, INTERNET AND BROADCASTING

- Law on Telecommunications No. 41/2009/QH12
- Law on Radio Frequency No. 42/2009/QH12
- Law on Network Information Security No. 86/2015/QG13

### **B.1.2 REGULATIONS ON DIGITAL TRANSACTIONS**

- Law on E-Transactions No.51/2005/QH11
- Decree No.35/2007/ND-CP on e-transactions in banking activities
- Decree No.26/2007/ND-CP detailing the implementation of the Law on E-Transactions on digital signatures and digital signature certification services
- Decree No. 35/2007/NĐ-CP on banking e-transactions
- Decree No. 27/2007/NĐ-CP on e-transactions in financial activities
- Decree No. 106/2011/ND-CP revising some articles in Decree No.26/2007/ND-CP detailing the implementation of the Law on E-Transactions on digital signatures and digital signature certification services
- Decree No. 52/2013/ND-CP on e-commerce
- Decree No. 170/2013/ND-CP revising some articles in Decree No.26/2007/ND-CP detailing the implementation of the Law on E- Transactions on digital signatures and digital signature certification services
- Decree No. 156/2016/ND-CP revising some articles in Decree No. 27/2007/NĐ-CP on e-transactions in financial activities
- Circular No. 78/2008/TT-BTC detailing articles in Decree No. 27/2007/NĐ-CP on e-transactions in financial activities
- Circular No. 59/2015/TT-BCT on prescribing the management of e-commerce activities via applications on mobile equipment
- Decision No.1563/2017/QĐ-TTg on approving the overall plan for e-commerce development 2016-2020

### **B.1.3 REGULATIONS ON CYBERSECURITY**

- Law on Information Security No. 86/2015/QH13
- Decree No. 58/2016/ND-CP on the trade, import and export of civil cryptographic products and services
- Decree No. 85/2016/ND-CP on the security of information systems by classification
- Decree No. 108/2016/ND-CP on the provision of cyber information security products and services
- Decision No. 05/2017/QĐ-TTg on emergency response plans to ensure national cyber information security
- Decree No. 1622/QĐ-TTg on cyber information security for e-government
- Law on Cybersecurity 2018 No. 24/2018/QH14

### **B.1.4 REGULATIONS ON INDUSTRY 4.0.**

- Law on High Technologies No. 21/2008/QH12
- *Directive* No. 16/CT-TTg on the strengthening of the ability to access the Fourth Industrial Revolution
- Decision No. 66/2014/QĐ-TTg on the list of high technologies prioritised for development investment and the list of hi-tech products eligible for development promotion
- *Decision* No. 19/2015/QĐ-TTg prescribing criteria for identifying hi-tech enterprises
- Decision No. 4246/QĐ-BCT detailing the action plan to implement Directive No.16/CT-TTg on the strengthening of the ability to access the Fourth Industrial Revolution in Industry and Trade
- *Decision* No. 844/QĐ-TTg on promulgating the scheme to support the national innovative start-up ecosystem through to 2025
- Resolution No.1/2019/NQ-CP on implementing the socio-economic plan and budget estimates for 2019, to issue: the National strategy on implementing Industry 4.0, Resolution on improving capacity to approach Industry 4.0 toward 2025, and Solution to develop national human resources to meet the requirements of Industry 4.0
- Resolution No.2/2019/NQ-CP on improving business environment and national competitiveness in 2019 to 2021, developing a scheme for the National Innovation Center, developing solutions to master key Industry 4.0 technologies, deploying the scheme 'developing the digitalised knowledge system', and promoting electronic payments

### **B.1.5 REGULATIONS ON E-GOVERNMENT**

- Resolution No. 36a/NQ-CP on e-Government
- Decision No. 846/QĐ-TTg on promulgating the list of public online services of levels 3 and 4 in ministries, branches and localities
- Decision No.1072/2018/QĐ-TTg on establishing the National E-Government Committee
- List of national databases to be prioritised to create a foundation to develop e-government (Decision No. 714/QĐ-TTg)
- Resolution No. 17/NQ-CP on a number of key tasks and solutions to develop e-government during 2019-2020, with orientations towards 2025

### B.1.6 MAIN ICT AND DIGITAL DEVELOPMENT STRATEGIES/PLANS

- Vietnam post and telecommunications development strategy till 2010 and orientations till 2020 (Decision No. 158/2001/QĐ-TTg)
- Vietnam strategy on information and communication technology development till 2010 and orientations toward 2020 (Decision No. 246/2005/QĐ-TTg)
- Telecommunications development master plan till 2020 (Decision No.23/2012/QĐ-TTg)
- Programs on development of Information Technology human resources to 2020 (Decision No. 05/2007/QĐ-BTTTT)
- Master plan on development of Vietnam's electronics industry up to 2010, with a vision toward 2020 (Decision No. 75/2007/QĐ-TTg)
- Program on software industry development and the program on Vietnam's digital content industry development (Decision No. 50/2009/QĐ-TTg)
- National planning on development of digital information security through 2020 (Decision No. 63/QĐ-TTg)
- Scheme to make Vietnam a country strong in information and communication technologies (Decision No. 1755/QĐ-TTg)
- The target program on Information Technology development through 2020, with a vision toward 2025 (Decision No. 392/QĐ-TTg)
- The program on development of broadband telecommunications infrastructure through 2020 (Decision No. 149/QĐ-TTg)
- List of prioritised areas to ensure network and information security (Decision No. 632/QĐ-TTg of May 10, 2017)
- The national program on IT application in the operation of state agencies 2016-2020 (Decision No. 1819/QĐ-TTg)

### B.2 Main regulations on Intellectual Property

- Law on Intellectual Property No. 50/2005/QH11
- Law No. 36/2009/QH12 on amending and supplementing a number of articles of the Law on Intellectual Property
- Decree No. 105/2006/ND-CP detailing and guiding the implementation of a number of articles of the Law on Intellectual Property on Protection of Intellectual Property Rights and on State Management of Intellectual Property
- Decree No. 103/2006/ND-CP detailing and guiding the implementation of a number of articles of the Law on Intellectual Property regarding industrial property
- Circular No. 44/2011/TT-BTC guiding the struggle against smuggling and protection of Intellectual Property rights in customs
- Joint Circular No. 07/2012/TTLT-BTTTT-BVHTTDL stipulating the liabilities of intermediary services providers in protection of copyright and related rights in the Internet and telecommunications network
- Joint Circular No. 14/2016/TTLT-BTTTT-BKHCN guiding the order and procedures for changing and revoking domain names infringing upon Intellectual Property rights

### B.3 Other regulations to be developed

- Decree to replace Decree No. 27/2007/NĐ-CP guiding e-transactions on financial activities
- Decree to replace Decree No. 86/2014/ND-CP on business and conditions for transportation business by auto



# APPENDIX C

## METHODOLOGY FOR SURVEYS AND DIGITAL ADOPTION INDEX

As part of the Vietnam's Future Digital Economy Project, the research team obtained data from surveys to investigate the level of digital awareness and adoption across enterprises and consumers. Data from the surveys were also used to create a Digital Adoption Index to measure the level of digital adoption and potential for digital transformation in representative enterprises in the agriculture and manufacturing sectors.

### C.1 Survey Response Rates and Demographics

#### C.1.1 MODULE 1

Approximately 500 enterprises and 200 household businesses in the agriculture and manufacturing sectors were randomly selected to be surveyed. The enterprises and businesses were selected from a list obtained from provincial statistics departments.

The enterprise survey was conducted in 12 provinces and cities, including Hanoi, Thanh Hoa, Hai Phong, Ho Chi Minh City and Can Tho. These areas were chosen as they have the highest concentration of agriculture and manufacturing enterprises in Vietnam.

Overall response rates were relatively high – averaging 45% across both sectors.

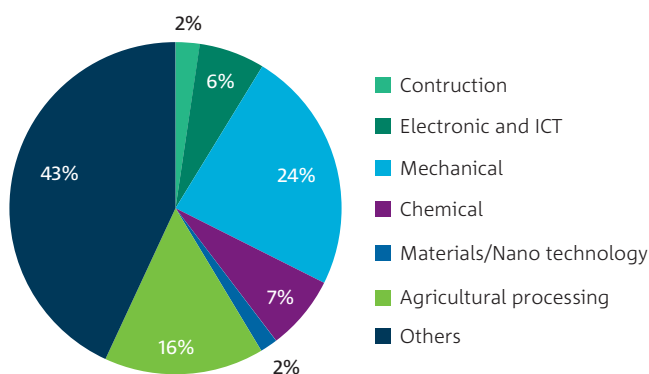
#### C.1.2 MODULE 2

To get an overview on the level of digital readiness among the representative enterprises in the two sectors, 70 companies in both the manufacturing and agriculture sectors were invited to participate in in-depth surveys. Respondents were considered to be leading firms in their field in terms of firm size, technology development and adoption, and enterprises who had participated or presented in seminars on the digital economy and Industry 4.0 organised by Vietnamese Ministries, and/or industrial and local organisations during the survey period.

#### C.1.3 MODULE 3

The consumer survey included around 500 respondents. The majority of respondents were aged between 18 and 30 years, with higher than average education levels. The respondents' level of income is quite similar to the standard distribution, with an average income of VND7.5-15 million per month.

Responses across manufacturing subsectors



Responses in agriculture sector

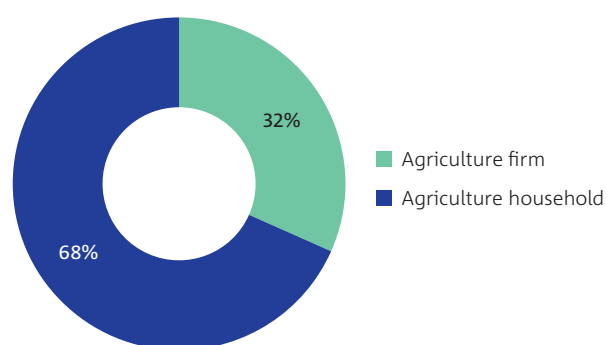
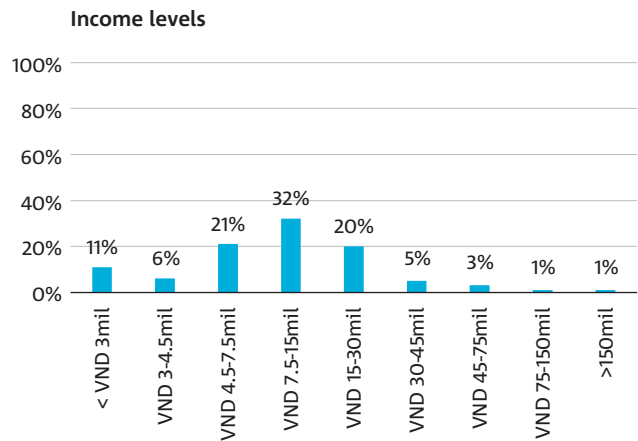
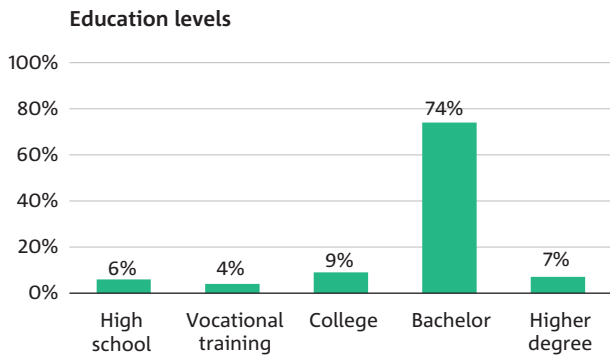


Figure 57 Enterprise survey participants by type of enterprise

Source: Ministry of Science and Technology analysis



**Figure 58 Customer survey participant demographics**

Source: Ministry of Science and Technology analysis

## C.2 Digital Adoption Index

The Digital Adoption Index (DAI) was calculated from the data of representative firms in Vietnam’s manufacturing and agriculture sectors. The objective of the DAI is to explore businesses’ current stage of digital adoption and their perceptions on digital transformation.

The DAI is expected to be a good reference to different users. These include governmental agencies and development agencies who want to better understand the current situation of digital adoption in manufacturing and agriculture in Vietnam. This understanding would help them prioritise policies and investment programs accordingly. The DAI also helps businesses identify where they are in their digital transformation journey, as well as analyse their capacity, potential and barriers to advancement.

For the purpose of our index, “Digital Adoption” represents the stage at which companies’ production is transformed to a new business model to create new customer experiences, build up new revenue/value added and utilise resources much more efficiently by leveraging opportunities offered by digital technologies.

The major economic potential of digital adoption is the ability to accelerate decision making and adaptation processes within businesses. This thus requires balanced digitisation in all different areas of the business’ value chain, and the formation of corporate structures which enable them to make the most of new digital business models. Complete digital transformation/adoption for businesses is characterised by:

- Horizontal integration through networks where the networks can be managed in real-time from the moment an order is placed right through to outbound logistics.
- Vertical integration and networked manufacturing systems where the IT systems at levels of sensor, control, production, execution and corporate planning work together. Production processes and automation will be designed and commissioned virtually in one integrated process and through the collaboration of producers and suppliers. Physical prototypes will become less important.
- End-to-end digital integration of engineering across the entire value chain ranging from design, inbound logistics to production, marketing, outbound logistics and service to after-sales services.

In this report we develop an indexing methodology to identify the level of digital adoption among agriculture and manufacturing businesses. The DAI examines businesses' digital adoption in seven dimensions:

1. Strategy and organisation
2. Finance
3. Infrastructure
4. Human resources
5. Smart production
6. Forward and backward linkages and logistics

These pillars were selected based on M. Porter' value chain system of businesses.<sup>357</sup> Each pillar of the index was also factor analysed to ensure that it measures a unique aspect of the digital adoption process. For each pillar, sub-indicators are used to capture the level of digital adoption in that aspect. The number of sub-indicators are selected to balance between the comprehensiveness and level of complexity of the survey. Detailed indicators for each pillar can be found in the table below.

Evaluation of adoption level through the sub-indicators within an enterprise was conducted by using a standardised questionnaire consisting of one closed-ended question per item. Each question required an answer to a Likert-scale value from 1 "not implemented/not crucial" to 5 "extensively implemented/very crucial."

The value of each pillar was calculated using the following formula:

$$Index_p = \frac{\sum_{k=1}^n M_{pk} * g_{pk}}{\sum_{k=1}^n g_{pk}}$$

Where:

- $Index_p$  is the adoption level of Pillar  $p$
- $M_{pk}$  is the adoption level of the analysed indicator  $k$  of Pillar  $p$  (there are a total of  $n$  indicators to be analysed)
- $g_{pk}$  is the weighting factor of indicator  $k$  of Pillar  $p$

The weighting factor was determined using a Likert scale from 1 (not important) to 4 (very important). The weighting matrix was obtained by interviewing experts in the field on the importance of each sub-indicator and pillars to the digital adoption process of businesses, and then taking the average weights of the expert opinions.

The overall DAI score was calculated from the weighted average of all pillars' values.

According to value of DAI, businesses are categorised into three levels of digital adoption:

- **Newcomers** (with DAI value from 1 to 2) who have done either nothing or very little to deal with digital adoption, or those who indicated Industry 4.0 was either unknown or irrelevant
- **Learners** (with DAI value of 3) who have already taken their first steps in digitalisation
- **Experienced/top performers** (with DAI value from 4 to 5) who are already well on the way to digitalisation and are therefore far ahead of most companies in the field.

Although self-assessment of digital adoption is a valid method and easy to conduct, we are aware that most businesses in Vietnam may not have comparable knowledge about Industry 4.0 and the adoption level of their company. To ensure accuracy of results, we selected representative businesses that are either large in scale or have already been engaged in Industry 4.0 and therefore possess the required basic knowledge. Each company received a questionnaire through e-mail to allow for reflected assessment of their internal situation in their own time.



PILLAR	SUB-INDICATORS
<b>Strategy and organisation</b>	
	Existence of digital strategy, digital roadmaps, etc.
	Leader support
	Existence of central coordination unit for digital adoption
	The suitability of the existing business model to digital adoption
	Regulation and suitability to technological standards and IP protection
<b>Finance</b>	
	Level of investment in digitalisation in the last year
	Level of investment in digitalisation in the next 3 years
<b>Infrastructure</b>	
	The level of infrastructure to support digital adoption (energy, telecommunication, transport, etc.)
	Connectivity quality
	The competence of the existing ICT system and requirements for digital adoption
	The level of cybersecurity methods in the business
<b>Human resources</b>	
	ICT skills of employees
	The extent that the business applies digital technologies to daily operations
	Training and retraining in digital related areas
	Business culture in terms of knowledge sharing, open innovation, etc.
<b>Smart production</b>	
	Application of advanced production management techniques (autonomous production line, FMS, CIM, etc.)
	Application of other digital technologies in production (blockchain, robotics, sensors, etc.)
	Level of digitalisation of production equipment
	The level of real-time data collection and utilisation
	The extent that the business has a real-time view on production
<b>Forward and backward linkages and logistics</b>	
	The amount the business uses multiple integrated sale channels
	The level of multiple information channel usage
	The level of automation and digital integration in logistics (from order capture, inventory management to warehousing and transportation)
	Collaboration among different players in the value chains
	Utilisation of customer data and consumer's digital competence

# APPENDIX D

## SCENARIO MODELLING METHODOLOGY

There is little doubt that digital technologies hold enormous potential to bring far-reaching changes to individuals, firms and countries. Quantifying these impacts can help employees, businesses, investors and governments to identify ways to embrace the benefits while minimising potential disruptions.

In this study, the research team developed a model to examine the economic consequences of digital technologies on the future economic growth of Vietnam. In particular, our model aims to evaluate the impact of digital technologies on labour changes and productivity growth across industries in Vietnam.

### D.1 Existing studies of how digital technologies impact an economy

There has been a growing literature that explores the link between digital technology, and labour, growth and productivity.

In 2013, Frey and Osborne (2013) showed that 47% of jobs in the United States were at high risk of automation by 2030.<sup>358</sup> More recently though, Arntz, Gregory and Zierahn (2015) concluded that only 9% of US jobs were at high risk.<sup>359</sup> In AlphaBeta's report on automation, machines were estimated to save over 2 hours of work per week in the most repetitive manual jobs in Australia by 2030.<sup>360</sup> The predicted impacts are significantly larger in developing nations. The ILO estimated that around 56% of all employment in the ASEAN-5 (Cambodia, Indonesia, the Philippines, Thailand and Vietnam) are at risk of displacement due to computerised technologies.<sup>361</sup> Among the ASEAN-5, Vietnam saw the highest risk at 70% of existing jobs.<sup>361</sup> More recently, Faethm estimated that only around 15% of total jobs in Vietnam will be automated by 2033.<sup>361</sup> Another recent report, by CISCO and Oxford Economics, estimated that AI will displace around 14% of the labour force in Vietnam by 2028.<sup>362</sup>

A number of studies have showed that digital technology has positive impacts on labour productivity and economic growth.<sup>363,364,365,366</sup> Graetz and Michaels (2015) analysed data on robot adoption in 17 countries, and found that robots are attributable to a 0.36% increase in productivity

growth, and lowering output prices between 1993 and 2007. Other studies also anticipate an economic boom followed by increased productivity and favourable labour supply adjustments with the application of digital technologies. PwC predicted that global GDP can be up to 14% higher in 2030 as a result of digital technologies.<sup>367</sup> These studies focus on the worldwide economy. The impact of digital technologies and automation on developing countries are also expected to be significant. For example, McKinsey & Company estimated that AI can contribute around 0.6% and 1.2% to the annual GDP growth of Pakistan and Malaysia respectively by 2030.<sup>368</sup>

### D.1 Data and methodology

**The data in this study are obtained from the General Statistic Office of Vietnam (GSO).** The data include a range of time series variables spanning from 1995 to 2017: gross domestic product, production inputs (labour, capital, land/indwelling construction, investment), and other indicators (R&D investment, proportion of skilled labour,\* inflation, interest rate). The time series are adjusted by the GDP deflator index to obtain the real value. They are also transformed to a stationary time series for computation purposes.

**The next section summarises the modelling methodology.**

In this model, digital technologies have two impacts on GDP growth: (1) digital technology causes labour replacement in industries and (2) digital technology improves total factor productivity of industries.

To estimate the two impacts on GDP growth for the four scenarios, we follow a 2-step procedure:

First, to calculate the potential labour replacement in the four scenarios, we utilise two estimates from AlphaBeta (2017) and Frey and Osborne (2013) on the proportion of labour at risk across different occupations in Australia and the United States by 2030.<sup>369,358</sup> We use these estimates to calculate the number of jobs at risk in each industry, taking into account the different occupation mix of each industry in Vietnam.

\* The proportion of skilled labour is calculated by the percentage of labour force holding bachelor degree or higher over the total number of labour in each industry.

To take into account the development gap between Vietnam and the two countries, we use the estimate to evaluate the impact in Vietnam by 2045. The Networked Readiness Index<sup>69,370</sup> is also used as a discount factor to represent the capacity gap between Vietnam and the two countries in leveraging ICT technologies and innovation. In addition, we follow PwC and assume that Vietnam will obtain 70% of digital impacts by 2045 due to a range of barriers such as economic, legal or organisational constraints.<sup>371</sup>

Second, to estimate the impact of digital technology on GDP development. We use a complex approach to evaluate the impact of AI on economic growth. In particular, our approach follows two main steps:

**Step 1.** Identify the direct impacts of digital technology to productivity and labour replacement using past data of Vietnam’s industries.

**Step 2.** Use the results of Step 1 as inputs to extrapolate the impact of digital technology on GDP growth across industries of Vietnam by 2045.

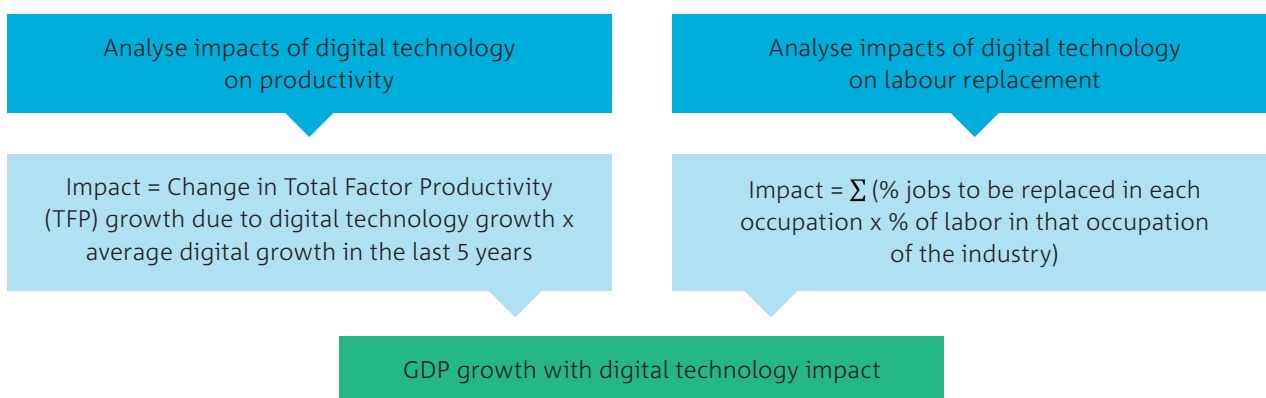
The impact of digital technologies is calculated by comparing the obtained GDP growth to a baseline of long-term growth.

In the following section, we provide a more detailed description of the two steps.

**Step 1. Identify the potential impact of digital technology growth on productivity**

The objective of Step 1 is to identify the relationship between digital technology and productivity. In the model, total factor productivity (TFP) is used as a measure of productivity. TFP is normally considered as a more comprehensive measure of productivity since it can shed light on technical changes that may not necessarily be revealed with single-factor productivity such as labour productivity.<sup>372</sup>

In the existing literature, there are many different ways to measure TFP, ranging from non-parametric (i.e. Laspeyres, Paasche or Tornqvist indices), to parametric (ordinary least squares (OLS), stochastic frontier) and semi-parametric (Olley and Pakes (OP) or Levinsohn and Petrin (LP) and so on).



In this report, we adopt the Olley and Pakes method and use investment as a proxy to address the simultaneity and selection problem. The Cobb-Douglas production function takes the form of:

$$y_{it}^n = \alpha^n + \beta_1 labour_{it}^n + \beta_2 capital_{it}^n + age_{it}^n + \epsilon_{it}^n$$

Where  $y_{it}$  is the log of output for firm  $i$  in industry  $n$  at time  $t$ ;  $labour_{it}^n$  and  $capital_{it}^n$  is log of the two inputs of firm  $i$  at time  $t$  while  $\epsilon_{it}^n = \Omega_{it} + \eta_{it}$  is the error term of industry  $n$ , which contains the productivity shock  $\Omega_{it}$  that is observed by decision makers in firms but not econometricians and the productivity shock  $\eta_{it}$  that is unobserved by both econometricians and firm decision makers. The unobserved productivity shock  $\Omega_{it}$  is then approximated with a second-order polynomial series of age, capital and investment. Thus the model becomes

$$y_{it}^n = \alpha^n + \beta_1 labour_{it}^n + \beta_2 capital_{it}^n + h(investment_{it}^n, capital_{it}^n, age_{it}^n) + \eta_{it}^n$$

In the next step, survival probabilities are estimated to control for selection bias and then non-linear least squares is used to estimate an unbiased coefficient for capital and labour and thus calculate TFP for each firm in the industry at time  $t$ .

Next, we identify the impact of digital uptake on productivity growth using the following model:

$$TFP\ growth_i^n = \beta_0^n + \beta_1^n digital\_growth_i^n + \sum_e \beta_i^n control\ variable\ e's\ growth_i^n + t_i^n + \epsilon_i^n \quad (1)$$

TFP growth of firm  $i$  sector  $n$  is expressed as a function of the firm's digital adoption growth along with other control variables including growth in the proportion of employees who work in relatively high-skilled occupations, R&D investment, lag of R&D investment, and a linear time trend to capture deterministic trends of productivity growth. All variable values are in real terms to minimise biases raised due to inflation.

Due to data limitations, the proxy for digital technology is the number of computers used in firms across industries. Though the proxy may not cover new business models such as the sharing economy or e-commerce, it is helpful to capture the adaptation of digital technologies across individual businesses across industries of Vietnam. We also did sensitivity analysis by replicating the analysis using other digital proxies such as the number of computers with Internet in each firm or the number of computers with broadband. The results obtained using these proxies did not significantly change the forecast.

The value of coefficient  $\beta_{1n}^n$  represents the impact of digital growth on change in TFP of sector  $\epsilon_{in}^n$ . The error term  $\epsilon_{in}^n$  is assumed to follow a normal distribution  $N(0, \sigma_n^2)$ .

The confidence interval is conducted. The lower, mean and upper bound of the confidence interval represent the low, medium and high impacts of digital technology on TFP growth.

To estimate the expected impact of digital adoption on productivity growth in the future, we make another assumption that the level of digital adoption will grow at a similar rate to the last five years. This can be considered a conservative assumption as it is expected that firms will increasingly invest in digital technology in the future.

Then, the expected impact of digital adoption in TFP growth across industries in Vietnam in the future will be:

$$Impact = \widehat{\beta}_1^n \times digital\ adoption\ growth^n$$

Where  $\widehat{\beta}_1^n$  is the estimated coefficient from the previous estimation, measuring how TFP growth changes due to a 1% change in digital adoption.

## **Step 2. Estimate the impact of digital technology on GDP growth across industries of Vietnam by 2030 and 2045**

We use a Vector Auto-regression (VAR) model to estimate the impact of labour and productivity change (due to digital adoption) on GDP growth. Forecasts are made one-step-ahead and iterates forward. The VAR model of  $q$  lags takes the form of:

$$Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \dots + \alpha_q Y_{t-q} + \epsilon_t,$$

where  $Y_t = (y_{t1}, y_{t2}, \dots, y_{tn})$  is a vector of explanatory variables including growth rate of labour, growth rate of capital, inflation and growth rate of TFP with  $t = (1, 2, \dots, T)$  and  $(\alpha_1, \alpha_2, \dots, \alpha_q)$  is the coefficient matrix while  $\epsilon_t$  is the vector of unobserved zero mean white noise.

For each industry, we estimate four different GDP levels of growth for 2045:

- GDP growth forecast in the base case
- GDP growth forecast in the high case (where the impacts of digital technology on labour replacement is at the high level and TFP growth are at the upper bound of the confidence interval in the previous estimation)
- GDP growth forecast in the medium case (where the impacts of digital technology on labour replacement is at the medium level and TFP are at the mean/medium level)
- GDP growth forecast in the low case (where the impacts of digital technology on labour replacement is at the low level and TFP are at the lower bound of the confidence interval in the previous estimation)

To manipulate labour changes over time, we follow the previous academic research on innovation adoption to assume that digital adoption will follow an S-shape.<sup>373,374</sup> As such, labour replacement due to automation will follow a logistic function whereby the replacement is slow in the short-term but starts to accelerate when major obstacles such as limited resources or information asymmetries have been overcome. The adoption will then slow down again once the technology has reached its peak.

The impact of digital technology on GDP growth in the four scenarios for each sector is calculated by comparing the difference between the GDP growth obtained from the VAR model in the base case and those calculated in the other three cases to obtain the net GDP growth increase due to digital adoption.

Detailed results of the econometric models can be found in the research paper to be published in association with this report.

It is noted that the model does not take into account factors such as unexpected global crises or a shift in world trade flow which may alter the digital technology adoption trajectories. As such, the results of the model may contain various uncertainties, especially in the longer-term forecasts. The results, however, are useful to give readers an idea about different futures across the four scenarios. There are other impacts of digital technology that are not considered in the model. For example, automation can also increase individual welfare through improvement in quality and variety of goods and services, and additional safety at the workplace.



# APPENDIX E

## AUS4INNOVATION

In November 2017 Australia and Vietnam announced the Australia-Vietnam Innovation Partnership. **As part of this partnership, the AU\$10 million Aus4Innovation program aims to help Vietnam strengthen its innovation ecosystem, prepare for and embrace opportunities associated with Industry 4.0, and shape its innovation agenda in science and technology.**

A number of institutions and actors in the innovation ecosystem take part in the Aus4Innovation program to achieve these goals, including:

- Vietnam's Ministry of Science and Technology (MOST)
- Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Australian Embassy, Hanoi
- Australia's InnovationXchange, under the Department of Foreign Affairs and Trade
- Vietnamese and Australian research institutes
- Vietnamese and Australian private sector companies.

Together through the Aus4Innovation program, Australia and Vietnam are conducting activities to promote innovation in Vietnam and build Vietnamese capability in areas such as strategic foresight, scenario planning, commercialisation and innovation policy.

**Between 2018 and 2021 the Aus4Innovation program will invest AU\$10 million across four complementary activities:**

1. The **digital foresighting** activity – presented in the current report – explores the trends, probable impacts and implications of digitalisation on the Vietnamese economy. This activity also closely examines Vietnam's manufacturing and agriculture sectors and their readiness for digital adoption.
2. The **science commercialisation** activity will explore and pilot innovative models for brokering and building partnerships between research institutes and the private sector for science commercialisation. Partnerships between businesses and research institutes in Vietnam will be identified and built around an innovative idea and a shared R&D process.
3. A **competitive grants** mechanism will provide targeted funds to scale already tested activities to address emerging challenges or opportunities in any sector of Vietnam's innovation system. Grants will be available for existing partnerships or working relationships between Australian and Vietnamese institutions that can demonstrate an articulated pathway for scale or sustainability in Vietnam.
4. An **innovation policy** activity will address emerging challenges in the implementation of Vietnam's innovation agenda. This activity will be responsive to emerging needs, issues and opportunities of relevance to Vietnam and MOST.

Investments in future Aus4Innovation projects will be partially guided by the insights and recommendations from the *Vietnam's Future Digital Economy Project*.

# REFERENCES



- 1 Conner B P, Manogharan G P, Martof A N et al. 2014. Making sense of 3-D printing: Creating a map of additive manufacturing products and services. *Additive Manufacturing*, 1-4(0): 64-76.
- 2 Dawson D, Schleiger E, Horton J et al. 2019. Artificial Intelligence: Australia's ethics framework. CSIRO's Data61: Australia.
- 3 Klopfer E, Squire K. 2008. Environmental detectives - The development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development*, 56(2): 203-228.
- 4 Gantz J, Reinsel D. 2011. The 2011 digital universe study: Extracting value from chaos. IDC.
- 5 World Bank. 2017. Distributed ledger technology (DLT) and blockchain. World Bank Group: Washington D.C, United States.
- 6 Cyber Physical Systems Public Working Group. 2016. Framework for cyber-physical systems: Release 1.0. National Institute of Standards and Technology: United States.
- 7 Bratanova A, Devaraj D, Horton J et al. 2019. Towards the blockchain plateau of productivity: Trends and scenarios for the blockchain technology uptake in Australia out to 2028. CSIRO: Brisbane, Australia.
- 8 Reinsdorf M, Quirós G, STA Group. 2018. Measuring the digital economy. Washington D.C, United States.
- 9 de Reuver M, Sørensen C, Basole R C. 2018. The digital platform: a research agenda. *Journal of Information Technology*, 33(2): 124-135
- 10 Mattila J, Seppälä T. 2015. Machines in a cloud – or a cloud in machines? Emerging new trends of the digital platforms in industry and society.
- 11 Organization for Economic, Co-operation and Development. 2002. Glossary of statistical terms.
- 12 European Political Strategy Centre. 2016. The future of work: Skills and resilience for a world of change. EPSC: Europe.
- 13 Davies R. 2015. The Internet of Things: Opportunities and challenges (PE 557.012). European Parliamentary Research Service: Europe.
- 14 Codagnone C, Biagi F, Abadie F. 2016. The passions and the interests: Unpacking the 'sharing economy'. European Union: Seville, Spain.
- 15 European Commission. 2018. Smart cities.
- 16 European Commission. 2016. Social Media guidelines for all staff.
- 17 Godlovitch I, Kotterink B, Marcus J et al. 2015. Over-the-top (otts) players: market dynamics and policy challenges. European Parliament's Committee on the Internal Market and Consumer Protection.
- 18 Kilhoffer Z, Lenaerts K, Beblavý M. 2017. The platform economy and industrial relations: Applying the old framework to the new reality.
- 19 Bezegová E, Ledgard M A, Molemaker R-J et al. 2017. Virtual Reality and its potential for Europe.
- 20 Nghiep L T, Quy L H. 2000. Measuring the impact of Doi Moi on Vietnam's Gross Domestic Product. *Asian Economic Journal*, 14(3): 317-332.
- 21 World Bank. Vietnam country overview. [17 July 2018]. Available from: <http://www.worldbank.org/en/country/vietnam/overview>.
- 22 Blume L. A late start: Renewable energy development in Vietnam. *Medium*. 3 April 2018.
- 23 General Statistics Office of Vietnam. 2016. Gross domestic product at current prices by economic sector. GSO: Hanoi, Vietnam.
- 24 World Bank. Vietnam's economic prospects improve further, with GDP projected to expand by 6.8 percent in 2018. Press release. 14 June 2018.
- 25 General Statistic Office of Vietnam. Social and economic status in 2018. Available from: <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=19037>.
- 26 World Bank. World development indicators. [January 3, 2019]. Available from: <http://data.worldbank.org/>.
- 27 VNS. PM stresses key role of private sector in economy. *Viet Nam News*. 2 October 2017.
- 28 Anh H, Anh H. Striving for the contribution of private sector in GDP to 50% by 2020. *Customs News*. 31 July 2017.
- 29 VNA. FDI sector significantly contributes to Vietnam's economy. *The Voice of Vietnam*. 23 May 2018.
- 30 Foreign Investment Agency. 2017. Vietnam FDI in the Past 30 years. Ministry of Planning and Investment: Hanoi, Vietnam.

- 31 PwC. 2017. Spotlight on Vietnam - the leading emerging market.
- 32 Vietnam Customs. 2018. Merchandise export and import. Ministry of Planning and Investment: Hanoi, Vietnam.
- 33 General Statistics Office of Vietnam. Social and economic situation in 2017. [13 July 2018]. Available from: [http://www.gso.gov.vn/default\\_en.aspx?tabid=622&ItemID=18670](http://www.gso.gov.vn/default_en.aspx?tabid=622&ItemID=18670).
- 34 Socialist Republic of Vietnam. 2016. Socio-economic development plan 2016-2020. Hanoi, Vietnam.
- 35 World Integrated Trade Solution. 2011. Labor value added of all sectors for final output or exports of Vietnam in 2011. WITS: Washington D.C, United States.
- 36 VietnamNet Business. Vietnam's public debt stands at 61.3% in 2017: Finance Ministry. VietnamNet Business. 1 August 2018.
- 37 International Monetary Fund. 2017. Vietnam - Selected issues paper. IMF: Washington D.C, United States.
- 38 Viet Nam News. SBV aims to hold inflation under 4% in 2017. Viet Nam News. 17 January 2017.
- 39 VOV5.vn. Government aims to curb inflation in 2018. VOV5.vn. 27 December 2017.
- 40 PricewaterhouseCoopers. 2017. Spotlight on Vietnam - The leading emerging market. PwC: Ho Chi Minh City, Vietnam.
- 41 World Bank, Ministry of Planning and Investment of Vietnam. 2016. Vietnam 2035: Toward prosperity, creativity, equity, and democracy. The World Bank Group: Washington D.C.
- 42 Organisation for Economic Cooperation and Development. 2013. The digital economy 2012. Paris, France.
- 43 G20 Research Group. 2015. G20 digital economy development and cooperation initiative. G20 Research Group: Hangzhou, China.
- 44 The Oxford Dictionary. 2018. Digital economy - definition.
- 45 Bukht R, Heeks R. 2017. Defining, conceptualising and measuring the digital economy. GDI Development Informatics Working Papers, No. 68(0): 1-24.
- 46 Nitescu Alina. 2016. Trends and dimensions of digital economy. Annals - Economy Series, Constantin Brancusi University, Faculty of Economics, 4(0): 103-107.
- 47 Ahmad N, Ribarsky J, Reinsdorf M. 2017. Can potential mismeasurement of the digital economy explain the post-crisis slowdown in GDP and productivity growth? OECD Publishing: Paris, France.
- 48 Burke R, Mussomeli A, Laaper S et al. Smart factory connected manufacturing. Deloitte Insights. 31 August 2017.
- 49 Binder Dijker Otte. 2016. Industry 4.0 Report. BDO: Zaventem, Belgium.
- 50 PwC. 2016. Industry 4.0: How digitisation makes the supply chain more efficient, agile, and customer-focused. Munich.
- 51 Food and Agriculture Organization. 2015. Europe entering the era of 'precision agriculture'. Rome, Italy.
- 52 365FarmNet. 2017. White paper: Agriculture 4.0 – Ensuring connectivity of agricultural equipment. 365FarmNet: Berlin, Germany.
- 53 McDonald M. Blockchain technology and the food supply chain. Food & Beverage.
- 54 Staples M, Chen S, Falamaki S et al. Risks and opportunities for systems using blockchain and smart contracts. Sydney, Australia: CSIRO; 2017.
- 55 Libelium. Fish farm monitoring in Vietnam by controlling water quality in ponds and tanks. [13 July 2018]. Available from: <http://www.libelium.com/fish-farm-monitoring-in-vietnam-by-controlling-water-quality-in-ponds-and-tanks/>.
- 56 Organization for Economic Co-operation and Development. 2016. PISA 2015: PISA results in focus. OECD: Paris, France.
- 57 International Telecommunication Union. 2018. Measuring the information society report: Volume 1 2018. ITU: Geneva, Switzerland.
- 58 World Bank. 2018. Ease of doing business index. WB: Washington D.C, United States.
- 59 World Economic Forum. 2018. The global competitiveness report 2018. WEF: Geneva, Switzerland.
- 60 Cornell University, INSEAD, WIPO. 2018. The global innovation index 2018: Energizing the world with innovation. Cornell University, INSEAD and WIPO: Ithaca, Fontainebleau, and Geneva.
- 61 Brand Finance. 2018. Nation brands 2018. BF: London, England.
- 62 World Bank. 2018. Logistics performance index. WB: Washington D.C, United States.
- 63 INSEAD. 2019. The global talent competitiveness index 2019. INSEAD: Fontainebleau, France.



- 64 Education First. 2018. EF English proficiency index. EF: Lucerne, Switzerland.
- 65 International Labor Organization. 2016. ASEAN in transformation: The future of jobs at risk of automation. ILO: Geneva, Switzerland.
- 66 International Telecommunication Union. 2017. Global cybersecurity index (GCI) 2017. ITU: Geneva, Switzerland.
- 67 Cable. 2018. Worldwide broadband speed league 2018. Lichfield, England.
- 68 Economist Intelligence Unit. 2018. Inclusive Internet index. EIU: London, England.
- 69 World Economic Forum. 2016. The global information technology report 2016: Innovating in the digital economy. INSEAD The World Economic Forum and: Geneva, Switzerland.
- 70 we are social., Hootsuite. 2018. Digital in 2018 in southeast Asia. we are social. and Hootsuite:
- 71 AT Kearney. 2015. Lifting the barriers to e-commerce in ASEAN. AT Kearney: Chicago, United States.
- 72 United Nations. 2018. United Nations e-government survey 2018. UN: New York, United States.
- 73 Onishi T. Vietnam's Viettel to roll out 5G service in 2021. Nikkei Asian Review. 5 December 2018.
- 74 General Statistic Office of Vietnam. 2017. National account. GSO: Hanoi, Vietnam.
- 75 VIR. Vietnam's 4.0 ambitions in one hallmark strategy. Vietnamnet. 9 December 2018.
- 76 Nguyen H, Marc S. 2015. Internet, reorganization and firm productivity in Vietnam. World Bank, Washington DC.
- 77 Alibaba Group. 2017. OSB opportunity solution and business.
- 78 Vietnam National Internet Exchange. 2017. Internet resource statistics. Hanoi, Vietnam.
- 79 Ministry of Information and Communications of Vietnam. 2017. Report on the National Industry Strategy 2016-2025 and Vision by 2035. Hanoi, Vietnam.
- 80 Marvin R. Vietnam's tech boom: A look inside Southeast Asia's Silicon Valley. PC Magazine. 23 June 2016.
- 81 Vietnam Information Technology Outsourcing Alliance. 2018. Why Vietnam?
- 82 Ministry of Information and Communication and Vietnam Association for Information Processing. 2016. Vietnam ICT index 2016. Hanoi, Vietnam.
- 83 Ministry of Information and Communications of Vietnam. 2017. ICT white paper. Communications Ministry of Information and: Hanoi, Vietnam.
- 84 Oxford Business Group. 2017. The Report - Vietnam 2017. OBG: Dubai, United Arab Emirates.
- 85 VNDIRECT. 2017. High-tech index database. VNDIRECT: Hanoi, Vietnam.
- 86 Philippines Statistics Authority. 2017. Business process outsourcing. Manila, Philippines.
- 87 VietnamNet Bridge. Vietnam ranks second after China in software outsourcing for Japan. VietnamNet Bridge. 18 July 2016.
- 88 Kepios. 2018. 2018 Q2 global digital statshot. Kepios: Singapore.
- 89 Ministry of Science and Technology of Vietnam. Digital Vietnamese Knowledge System. [19 October 2018]. Available from: <https://dev.itrithuc.vn/>.
- 90 Hai V. Vietnam launches digital database aimed to increase public knowledge. VN Express International. January 2, 2018.
- 91 Vietnam E-Commerce Association. 2017. Vietnam e-commerce index (EBI) 2017. VECOM: Hanoi, Vietnam.
- 92 Newzoo. Top 100 countries by game revenue. [13 July 2018]. Available from: <https://newzoo.com/insights/rankings/top-100-countries-by-game-revenues/>.
- 93 EU-Vietnam Business Network. 2014. IT sector research report.
- 94 ITP. Vietnam is the biggest game market in Southeast Asia. [13 July 2018]. Available from: <http://www.vnu-itp.edu.vn/vi/tin-tuc/thi-truong/178-vietnam-hien-nay-la-thi-truong-game-lon-nhat-khuvuc-dong-nam-a.html>.
- 95 Reuters. 2014. Update 1 - Popular game Flappy Bird flies no more.
- 96 Vietnam E-commerce, Industry and Trade Agency. Vietnam seeks to boost its digital economy. [13 July 2018]. Available from: <http://www.vecita.gov.vn/tinbai/1593/Vietnam-seeks-to-boost-digital-economy/en>.
- 97 Vietnam e-Commerce and Digital Economy Agency. 2019. E-commerce whitebook 2018. Vietnam.
- 98 Vietnam E-commerce, Industry and Trade Agency. 2017. National e-commerce development program 2014 - 2020.
- 99 Son M. E-commerce booms in Vietnam but top firms stay in the red. VNExpress. 17 July 2018.

- 100 Vietnam E-Commerce and Information Technology Agency. 2016. E-Commerce Survey. Hanoi, Vietnam.
- 101 EU-Vietnam Business Network. 2018. E-Commerce Industry in Vietnam: Edition 2018. EVBN: Ho Chi Minh City, Vietnam.
- 102 Ministry of Industry and Trade of Vietnam. 2017. Vietnam logistics report. MIT: Hanoi, Vietnam.
- 103 Vietnam Logistics Business Association. Proceedings of the “Logistics and ecommerce: Developing together” workshop.
- 104 Arvis J-F, Saslavsky D, Ojala L et al. 2016. Connecting to compete 2016: Trade logistics in the global economy. The World Bank Group: Washington D.C, United States.
- 105 Liên T P. Du lịch Việt Nam 2017: Nhiều dấu ấn đặc biệt! . Cafef. 25 December 2017.
- 106 Giang T. Phát triển du lịch thông minh là mô hình tất yếu. tin tức. 2 January 2019.
- 107 Tran Q. Hướng tới xây dựng nền y tế thông minh. Nhan Dan. 31 January 2019.
- 108 sự T. Triển khai mô hình “Số hóa Truyền thông Y tế” cho bệnh viện đầu tiên tại Việt Nam. Suckhoe & Doisong. 12 September 2018.
- 109 World Bank. 2016. Digital Dividends. Washington D.C., United States.
- 110 United Nations. 2017. World population prospects: The 2017 revision. UN: New York, United States.
- 111 Vietnam e-Commerce and Digital Economy Agency. 2019. Vietnam e-commerce index (EBI) 2018. Vietnam.
- 112 Bhunia P. Brief look at open government data in 6 ASEAN countries. OpenGov Asia. 18 October 2017.
- 113 VN Economic Times. 2015. Vietnam Uber’s second fastest growing market.
- 114 Lendbiz. 2017. Project selection criteria. Hanoi, Vietnam.
- 115 Sieburg M, Tran T. 2018. Unlocking Vietnam’s fintech growth potential. Solidiance: Ho Chi Minh City, Vietnam.
- 116 Ernst and Young. 2018. ASEAN fintech census 2018. EY: London, England.
- 117 Ha V D, Ha P D T, Nguyen H M L. Fintech ecosystem in Vietnam and other countries. State Bank of Vietnam.
- 118 Viet Nam Institute for Economic and Policy Research. 2018. Viet Nam annual economic report 2018: Understanding the labour market for productivity enhancement. VEPR Viet Nam National University: Hanoi, Vietnam.
- 119 Ministry of Industry and Trade of Vietnam. 2018. Comprehensive survey on enterprise 4.0. MOIT: Hanoi, Vietnam.
- 120 World Economic Forum. 2018. The future of jobs report 2018. WEF: Geneva, Switzerland.
- 121 World Economic Forum. 2015. Expanding participation and boosting growth: The infrastructure needs of the digital economy. Switzerland.
- 122 Vu V. Vietnam beats US in new 4G speed survey, ranks second in Southeast Asia. VN Express International. 21 February 2018.
- 123 Asia IoT Business Platform. The IoT Market in Vietnam. [20 August 2018]. Available from: <http://iotbusiness-platform.com/iot-vietnam/>.
- 124 Thuy B. Foreign investors rush to invest in smart city projects. Vietnam Investment Review. 19 June 2018.
- 125 Mekong Business Initiative, Asian Development Bank, Australian Government et al. 2017. Smart city innovation for Vietnam. Smart City VN: Vietnam.
- 126 Bhunia P. Smart city plans (2017-2020) unveiled for Ho Chi Minh City in Vietnam. OpenGov Asia. November 29, 2017.
- 127 Nguyen D V A. The smart cities race in Vietnam. Asia IoT Business Platform. 1 May 2017.
- 128 Asia IoT Business Platform. Current state of IoT in Vietnam – Asia IoT business platform Vietnam. Asia IoT Business Platform. 8 December 2017.
- 129 Reback G. New IoT Competition hopes to turn Ho Chi Minh City into a smart city. Geektime. 18 April 2018.
- 130 Columbus L. 2017 roundup of Internet of Things forecasts. Forbes. December 10, 2017.
- 131 McKinsey Analytics. 2018. Analytics comes of age. McKinsey & Company: New York, United States.
- 132 Finos R. 2016 – 2026 worldwide big data market forecast. Wikibon. 30 March 2016.
- 133 Faggella D. Valuing the Artificial Intelligence market, graphs and prediction. Tech Emergence. 12 August 2018.
- 134 CMC Corp. Chuyên gia nghiên cứu CMC: “Những phần mềm AI nước ngoài không thể áp dụng được ở Việt Nam”. CMC Corp. 13 August 2018.
- 135 Ha N. FPT.AI – Launching the trial version of conversational platform. FPT Tech Insight. April 19, 2017.

- 136 Viet L H. Implementation of AI Platforms to create competitive advantages for enterprises. Presentation at the Conference on Artificial Intelligence for Life; Hanoi, Vietnam: FPT; 2018. p. 1-28.
- 137 Grand View Research. Blockchain technology market size worth \$7.59 billion by 2024. [20 August 2018]. Available from: <https://www.grandviewresearch.com/press-release/global-blockchain-technology-market>.
- 138 Research and Markets. Global blockchain technology market - by provider, application, industry, region - market size, demand forecasts, company profiles, industry trends and updates (2017-2023). [20 August 2018]. Available from: [https://www.researchandmarkets.com/research/qgg9vl/global\\_blockchain?w=4](https://www.researchandmarkets.com/research/qgg9vl/global_blockchain?w=4).
- 139 Wan L. Blockchain Technology to Extend GS1 Standards to Food Testing Labs “For First Time”. Food Navigator Asia. 12 March 2018.
- 140 OriginTrail. OriginTrail now integrates data from forensic laboratories with the blockchain. Medium. 11 March 2018.
- 141 Henggeler A. Meeting smallholder coffee farmers in Vietnam. Provenance News. 27 March 2018.
- 142 Ethitrade International. Vietnam: Dragon Fruit Export. [20 August 2018]. Available from: <https://ethitrade.com.au/portfolio/vietnam-dragon-fruit-export/>.
- 143 Das S. Blockchain Payments Platform OKLink Launches in Vietnam. CCN. January 17, 2017.
- 144 Fintechnews Singapore. Blockchain Remittance Platforms Enters Vietnam. January 13, 2017.
- 145 Hynes C. Vietnam may soon emerge as one of Southeast Asia’s blockchain innovation hubs. Forbes. 27 March 2018.
- 146 Research and Markets. Global augmented reality (AR) and virtual reality (VR) market is forecast to reach \$94.4 Billion by 2023 - Soaring demand for AR & VR in the retail & e-commerce sectors PR Newswire. 31 July 2018.
- 147 Research and Markets. Augmented reality and virtual reality market by devices, by component, by application by geography - Global market size, share, development, growth, and demand forecast, 2013 - 2023. [20 August 2018]. Available from: [https://www.researchandmarkets.com/research/6w5hnb/global\\_augmented?w=5](https://www.researchandmarkets.com/research/6w5hnb/global_augmented?w=5).
- 148 FPT Software. FPT showcases digital transformation capabilities at Cloud Expo Asia 2017. News. 13 October 2017.
- 149 Nhien A. Vietnam ICT Summit 2017 brings a hope for Vietnam’s ICT sector Public Security News. 9 September 2017.
- 150 Viettel. Viettel attends Mobile World Congress 2018. Viettel Headlines. 28 February 2018.
- 151 Augment. Meet Ondris Pui and his students from RMIT University Vietnam. [20 August 2018]. Available from: <https://www.augment.com/portfolio-items/rmit-university-vietnam/>.
- 152 Frost & Sullivan. 2016. Global additive manufacturing market, forecast to 2025: Connected supply chains of the future take shape as change is unleashed from concept to production. F&S: San Antonio, United States.
- 153 Angelo R, Kurdys A, Brannen S. 2017. 3D Printing: Disrupting the \$12 trillion manufacturing sector. ATKearney: Chicago, United States.
- 154 International Labour Organization. 2016. ASEAN in transformation: How technology is changing jobs and enterprises. ILO: Geneva, Sweden.
- 155 Costello K, Hippold S. Gartner forecasts worldwide public cloud revenue to grow 17.3 percent in 2019. Gartner newsroom. 12 September 2018.
- 156 The Software Alliance. 2018. 2018 BSA global cloud computing scorecard: Powering a bright future. BSA: Washington D.C, United States.
- 157 Araral E, Aye T, Hartley K et al. 2017. A cloud for doing good: A technology revolution for all in ASEAN. National University of Singapore and Microsoft: Singapore.
- 158 Organization for Economic Co-operation and Development. 2018. Transformative technologies and jobs of the future. OECD: Montreal, Canada.
- 159 Organization for Economic Co-operation and Development. 2018. Economic outlook for Southeast Asia, China and India 2018: Fostering growth through digitalisation. OECD Publishing: Paris, France.
- 160 Asia Development Bank, World Economic Forum. 2017. ASEAN 4.0: What does the Fourth Industrial Revolution mean for regional economic integration? WEF and ADB: Geneva, Switzerland and Manila, Philippines.
- 161 Faethm. 2018. Faethm Vietnam analysis for economic, industry, technology and skills planning. Australian Department of Foreign Affairs and Trade: Australia.
- 162 APEC Human Resource Development Working Group. 2017. Data science and analytics skills shortage: Equipping the APEC workforce with the competencies demanded by employers. Asia-Pacific Economic Cooperation: Singapore.

- 163 Buolamwini J, Gebru T. Gender shades: Intersectional accuracy disparities in commercial gender classification. *Proceedings of the Conference on Fairness, Accountability and Transparency*; 77-91.
- 164 Singer N. Amazon's facial recognition wrongly identifies 28 lawmakers, A.C.L.U. says. 26 July 2018.
- 165 O'Neil C. *Weapons of math destruction: How big data increases inequality and threatens democracy*. First edn, New York, United States: Crown; 2016.
- 166 World Bank. 2016. *World development report 2016: Digital dividends*. The World Bank Group: Washington D.C, United States.
- 167 Kharas H. 2017. *The unprecedented expansion of the global middle class*. The Brookings Institute: Washington D.C, United States.
- 168 Ortega D L, Tschirley D L. 2017. Demand for food safety in emerging and developing countries: A research agenda for Asia and Sub-Saharan Africa. *Journal of Agribusiness in Developing and Emerging Economies*, 7(1): 21-34.
- 169 Karippacheril T G, Rios L D, Srivastava L. 'Global markets, global challenges: Improving food safety and traceability while empowering smallholders through ICT ' In: *ICT in agriculture (updated edition): Connecting smallholders to knowledge, networks, and institutions*. Washington D.C, United States: International Bank for Reconstruction and Development, World Bank Group; 2017.
- 170 Vietnam Nam News. Dragon fruit dominates Việt Nam fruit exports. *Viet Nam News*. 9 June 2018.
- 171 World Bank. Annual remittances data (updated as of Dec 2018). Available from: <http://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data>.
- 172 Nguyen T D. 2016. On the approval of the Proposal "Direction for attracting, managing and using ODA and concessional loans from international donors for 2016 – 2020 period" (Decision No: 251/QD-TTg). Hanoi, Vietnam.
- 173 General Statistics Office of Vietnam. 2016. *In-migration rate, out-migration rate and net-migration rate by province*. GSO: Hanoi, Vietnam.
- 174 Institute of Labour Science and Social Affairs, International Labour Organization. 2018. *Labour and social trends in Viet Nam 2012-2017*. ILO: Hanoi, Vietnam.
- 175 VNS. Unemployment greets Vietnamese overseas workers returning home. *Viet Nam News*. 27 January, 2017.
- 176 World Travel and Tourism Council. 2018. *Travel & tourism: Economic impact 2018 Vietnam*. WTTC: London, England.
- 177 Smith K E I. 'What is globalization?' In: Smith Keri E lyall. *Sociology of Globalization*. New York: Routledge; 2018.
- 178 Nguyen T T, Johanson G. 2008. Culture and Vietnam as a knowledge society. *The Electronic Journal of Information Systems in Developing Countries*, 33(1): 1-16.
- 179 7-Eleven. 7-Eleven. [1 August 2018]. Available from: <https://www.7-eleven.vn/>.
- 180 Doan N, Pham T, Pham M et al. 2018. English as an international language in Viet Nam: History and development. *Asian Englishes*, 20(2): 106-121.
- 181 Truong D T. 2013. Confucian values and school leadership in Vietnam.
- 182 Obstfeld M. The global expansion: Still strong but less even, more fragile, under threat. *IMFBlog*. 16 July 2018.
- 183 Nguyen H P, Pham H T. 2012. The dark side of development in Vietnam: Lessons from the killing of the Thi Vai River. *Journal of Macromarketing*, 32(1): 74-86.
- 184 International Organization for Migration. 2017. *Viet Nam Migration Profile 2016*. IOM: Hanoi, Vietnam.
- 185 Graham M, Hjorth I, Lehdonvirta V. 2017. Digital labour and development: Impacts of global digital labour platforms and the gig economy on worker livelihoods. *Transfer: European Review of Labour and Research*, 23(2): 135-162.
- 186 Piemwichai W. Regulation of cross-border transfers of personal data in Asia: Jurisdictional report Vietnam. Singapore: Asian Business Law Institute; 2018.
- 187 Marsh and McLennan Companies. 2017. *Cyber risk in Asia-Pacific, the case for greater transparency*.
- 188 ESET. 2015. *ESET Asia cyber-savviness report 2015*. ESET: Bratislava, Slovakia.
- 189 Vietnam Computer Emergency Response Team. 2017. *Cyber security report*. Hanoi, Vietnam.
- 190 Manyika J, Lund S, Bughin J et al. 2016. *Digital globalization: The new era of global flows*. McKinsey & Company: New York.
- 191 BKAV. Viet Nam cyber security overview in 2017 and predictions for 2018. *BKAV Global Task Force Blog*. 27 December 2017.
- 192 CISCO. 2018. *Cisco 2018 Asia Pacific security capabilities benchmark study: Regional breach readiness*. CISCO: San Jose.

- 193 ATKearney. 2018. Cybersecurity in ASEAN: An urgent call to action. ATKearney: Chicago, United States.
- 194 ASEAN Today. Vietnam's dangerous new cybersecurity laws ASEAN Today. 31 May 2018.
- 195 Viet Nam Internet Network Information Centre. 2017. Report on Viet Nam Internet resources: 2017. VNNIC: Hanoi, Vietnam.
- 196 Microsoft. 2017. Microsoft security intelligence report: Volume 22. Microsoft: Redmond.
- 197 Microsoft. 2016. Microsoft security intelligence report: Volume 21. Microsoft: Redmond.
- 198 Sicari S, Rizzardi A, Grieco L A et al. 2015. Security, privacy and trust in Internet of Things: The road ahead. *Computer Networks*, 76(0): 146-164.
- 199 Sang S, Lee J-D, Lee J. 2009. E-government adoption in ASEAN: The case of Cambodia. *Internet Research*, 19(5): 517-534.
- 200 Sturgeon T. 'Vietnam's evolving role in ICT global value chains' In: *Vietnam at a Crossroads: Engaging in the Next Generation of Global Value Chains*. Washington D.C, United States: World Bank; 2017.
- 201 Heintz C H. 2014. Regional cybersecurity: Moving toward a resilient ASEAN cybersecurity regime. *asia policy*, 18(1): 131-159.
- 202 Dinh V S, Nguyen H V, Nguyen T N. 2018. Cash or cashless? Promoting consumers' adoption of mobile payments in an emerging economy. *Strategic Direction*, 34(1): 1-4.
- 203 Microsoft, Frost & Sullivan. Securing the modern enterprise in a digital world. [17 October 2018]. Available from: <https://news.microsoft.com/apac/features/cybersecurity-in-asia/>.
- 204 Ponemon. 2017. 2017 cost of data breach study - global overview. Michigan.
- 205 Oxford Business Group. The report: Vietnam 2017. Oxford Business Group; 2017.
- 206 Das K. Renewables in Vietnam: Current opportunities and future outlook. *Vietnam Briefing*. 1 March 2019.
- 207 Vietnam National University, Economic Research Institute of Post and Telecommunication. 2015. The socio-economic impact of allocating spectrum for mobile broadband services in Vietnam. VNU, ERIPT: Hanoi, Vietnam.
- 208 International Energy Agency. 2017. World energy outlook 2017. IEA: Paris, France.
- 209 Ministry of Industry and Trade of Vietnam. 2017. Vietnam energy outlook report 2017. MOIT: Hanoi, Vietnam.
- 210 Minh A. Vietnam poised for renewable energy boom. *VNExpress International*. 14 March 2019.
- 211 Appota. 2017. Vietnam mobile report Q2 2017. Appota: Hanoi, Vietnam.
- 212 Thanh H. FMCG market to see growth 4%. *Vietnam Economic Times*. 2 November 2016.
- 213 Gabriel C, Wilson S, Cooperson D. 2017. The impact of 5G on fixed wireline networks in Asia Pacific. *Analysys Mason*: London, England.
- 214 Audinet P, Singh B N, Kexel D T et al. 2016. Exploring a low-carbon development path for Vietnam The World Bank Group: Washington D.C, United States.
- 215 Durairajan R, Barford C, Barford P. 2018. Lights out: Climate change risk to Internet infrastructure.
- 216 Organization for Economic Co-operation and Development. 2018. OECD urban policy reviews: Vietnam. OECD Publishing: Paris, France.
- 217 Ministry of Planning and Investment of Vietnam. 2018. Viet Nam's voluntary national review on the implementation of the sustainable development goals. MPI: Hanoi, Vietnam.
- 218 United Nations. 2018. World urbanization prospects: The 2018 revision. United Nations Department of Economic and Social Affairs, Population Division: New York, United States.
- 219 Global Infrastructure Hub. 2018. Infrastructure investment at current trends and need. GI Hub: Sydney, Australia.
- 220 Vincent Chin, Mariam Jaafar, Jason Moy et al. 2017. Unlocking cities: The impact of ridesharing in Southeast Asia and beyond. Boston Consulting Group: Boston, United States.
- 221 Schirmbeck S. 2017. Vietnam's environmental policies at a crossroads: Salinated rice fields, hunted-out national parks, and eroding beaches – and what we can do about it. Friedrich Ebert Stiftung: Hanoi, Vietnam.
- 222 Koplitz S N, Jacob D J, Sulprizio M P et al. 2017. Burden of disease from rising coal-fired power plant emissions in Southeast Asia. *Environmental science & technology*, 51(3): 1467-1476.
- 223 AlphaBeta. 2017. Digital nation: Policy levers for investment and growth. AlphaBeta: California, United States.
- 224 Ministry of Natural Resources and Environment of Vietnam. 2016. Climate change and sea level rise scenarios for Vietnam. MONRE: Hanoi, Vietnam.
- 225 Perry S. Virtual and augmented reality: Applications and issues in a smart city context. *AI4Life*; Hanoi, Vietnam: AI4Life; 2018. p. 1-26.

- 226 VNS. SBV working on framework for P2P lending. Viet Nam News. 3 October 2018.
- 227 Valerio A, Puerta M, Pierre G et al. 2012. Skills for productivity: An analysis of employer skills survey 2011. The World Bank Group: Washington D.C, United States.
- 228 UNESCO Institute for Statistics. 2016. Education (full dataset) UIS:
- 229 Ministry of Education and Training of Vietnam. 2015. Education for All 2015 national review: Viet Nam. MOET: Hanoi, Vietnam.
- 230 HocMai. HocMai. [9 August 2018]. Available from: <https://hocmai.vn/>.
- 231 Ministry of Education and Training of Vietnam. 2009. The development and state of the art of adult learning and education: National report. MOET: Hanoi, Vietnam.
- 232 Vietnam Association for Learning Promotion. Phát huy hiệu quả hoạt động của trung tâm học tập cộng đồng. [9 August 2018]. Available from: [http://www.hoikhuyenhoc.vn/modules.php?name=News&op=vi\\_ewst&sid=3630](http://www.hoikhuyenhoc.vn/modules.php?name=News&op=vi_ewst&sid=3630).
- 233 Kahn K. 2017. Reconnecting work & health: A report from the 2017 Aspen Institute Economic Security Summit. Aspen Institute Economic Security Summit: Washington D.C, United States.
- 234 World Economic Forum, Accenture. 2017. Digital transformation initiative: Unlocking B2B platform value. WEF: Geneva, Switzerland.
- 235 Kässä O. Mapping the demand for online labour. The iLabour Project. October 27, 2016.
- 236 Kässä O, Lehdonvirta V. 2018. Online labour index: Measuring the online gig economy for policy and research. *Technological Forecasting and Social Change*, 137(0): 241-248.
- 237 Austrade. 2019. Vietnam's innovation ecosystem 2019. Commonwealth of Australia: Australia.
- 238 CPA Australia. 2018. The CPA Australia Asia-Pacific small business survey. CPA Australia: Melbourne, Australia.
- 239 Bodewig C, Badiani-Magnusson R. 2013. Vietnam development report 2014 - Skilling up Vietnam: Preparing the workforce for a modern market economy. The World Bank Group: Washington D.C, United States.
- 240 World Bank. 2014. Inequality in Vietnam: A special focus of the taking stock report July 2014 - Key findings. Washington D.C.
- 241 Asian Development Bank. 2014. Technical and vocational education and training in the socialist republic of Viet Nam. Bank Asia Development: Metro Manila, Philippines.
- 242 General Statistics Office of Vietnam. 2016. Annual employed population at 15 years of age and above by occupation and year. GSO: Hanoi, Vietnam.
- 243 Means B, Toyama Y, Murphy R et al. 2010. Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. US Department of Education: Washington D.C, United States.
- 244 Volberda H, Mihalache O, Fey C et al. 2017. Management and organization review special issue 'Business model innovation in transforming economies'. *Management and Organization Review*, 13(3): 689-692.
- 245 PricewaterhouseCoopers. 2018. The future of ASEAN – Time to act. PwC: London, England.
- 246 Food and Agriculture Organization. 2018. The future of food and agriculture: Alternative pathways to 2050. FAO: Rome, Italy.
- 247 Van Tran K. 2016. The value of community cohesion among Vietnamese students in era of urbanisation and globalisation. *Social Indicators Research*, 126(3): 1225-1242.
- 248 Nguyen N N, Özçaglar-Toulouse N, Kjeldgaard D. 2018. Toward an understanding of young consumers' daily consumption practices in post-Doi Moi Vietnam. *Journal of Business Research*, 86(490-500).
- 249 My N H D, Demont M, Van Loo E J et al. 2018. What is the value of sustainably-produced rice? Consumer evidence from experimental auctions in Vietnam. *Food Policy*, 79(0): 283-296.
- 250 Charlotte D K J I J, Crul M R M, Wever R et al. 2015. Sustainable consumption in Vietnam: an explorative study among the urban middle class. *International journal of consumer studies*, 39(6): 608-618.
- 251 Lee J, Nguyen M J. 2017. Product attributes and preference for foreign brands among Vietnamese consumers. *Journal of Retailing and Consumer Services*, 35(0): 76-83.
- 252 Poushter J, Bishop C, Chwe H. 2018. Social media use continues to rise in developing countries but plateaus across developed ones. Center Pew Research: United States.
- 253 Nguyen T, Nguyen T. 2015. Factors that make a marketing campaign go viral: Case study -- Campaign "Share a Coke" by Coca Cola in Vietnam.

- 254 Abidin C. 2016. "Aren't these just young, rich women doing vain things online?": Influencer selfies as subversive frivolity. *Social Media + Society*, 2(2): 1-17.
- 255 World Federation of Advertisers. 2018. Influencer marketing study. WFA: London, Brussels and Singapore.
- 256 Q&Me Vietnam Market Research. 2017. The digital marketing landscape in Vietnam: Voices of Vietnam digital marketers and agencies. Q&Me: Ho Chi Minh City, Vietnam.
- 257 Nguyen H M. 2018. Influencer marketing via social media: The perceptions of Vietnamese consumers.
- 258 Roll M. Asian brand strategy (Revised and Updated): Building and sustaining strong global brands in Asia. London, England: Palgrave Macmillan UK; 2015.
- 259 Binh N-P. 2018. Grey markets in customer-to-customer transaction and social networking – The case of Vietnam. *Asian Journal of Business and Accounting*, 11(2): 277-314.
- 260 Barbour-Lacey E. Has Vietnam fallen into the middle income trap? Vietnam Briefing. 7 April 2014.
- 261 Kasenda D. 2015. Can Asian developing countries stuck in a "middle-income trap" learn from South Korea's economic development experience? *Network Global Development: Jakarta, Indonesia*.
- 262 World Bank. The World Bank in Indonesia. [21 February 2019]. Available from: <https://www.worldbank.org/en/country/indonesia/overview#2>.
- 263 Asian Development Bank. 2018. Asian development outlook update September 2018: Maintaining stability against heightened uncertainty. Manila, Philippines.
- 264 Sorensen N. 2017. Open access and open data in Vietnam: Current status and challenges. *Open Education Resource: Vietnam*.
- 265 Khanh T N N, Winley G K. 2018. An investigation of ICT knowledge and skills in Vietnam. *The Electronic Journal of Information Systems in Developing Countries*, 84(3): 1-27.
- 266 Kilovaty I. "Balkanization" of the Internet as a response to cybersecurity threats - A viable solution or a serious obstacle for the future of the net? *Cyber Blog*. 11 May 2015.
- 267 Piemwichai W, Trinh T N. Vietnam's new Cybersecurity Law will have major impact on online service providers *Lexology*. 18 June 2018.
- 268 Chi L. Asian companies have world's worst cybersecurity says study. *BBC News*. 24 August 2016.
- 269 Boly A. 2018. On the short- and medium-term effects of formalisation: Panel evidence from Vietnam. *The Journal of Development Studies*, 54(4): 641-656.
- 270 World Bank Group and Ministry of Planning and Investment. 2016. Vietnam 2035 : Toward Prosperity, Creativity, Equity, and Democracy . . Washington DC.
- 271 European Patent Office. ASEAN member states' IP offices and the EPO strengthen co-operation on patents. *European Patent Office*. 27 February 2014.
- 272 The ASEAN Secretariat. 2015. ASEAN 2025: Forging ahead together. Association of the Southeast Asian Nations: Jakarta, Indonesia.
- 273 Vietnam General Statistics Office. 2011. Migration and Urbanisation in Vietnam: Patterns, Trends, and Differentials.
- 274 Schirmbeck S. 2017. Vietnam's Environmental Policies at a Crossroads Salinated Rice Fields, Hunted-Out National Parks, and Eroding Beaches – and What We Can Do About It. Hanoi.
- 275 VietnamNet Bridge. Vietnam gears up to develop a digital economy. 22 January 2018.
- 276 Vietnam E-commerce I a T A. 2018. Vietnam seeks to boost its digital economy. Hanoi.
- 277 UNESCO. Vietnam takes action towards stem education for sustainable development. UNESCO. 31 March 2017.
- 278 VNITO Alliance. 2018. Why Vietnam?
- 279 Ministry of Science and Technology. Digital Vietnamese Knowledge System. [19 October 2018]. Available from: <https://dev.itrithuc.vn/>.
- 280 Heintz C H. 2014. Regional cybersecurity: Moving toward a resilient ASEAN cybersecurity regime. *Asia policy*, 18(0): 131-160.
- 281 Skills Future Singapore. Skills future credit. Available from: <http://www.skillsfuture.sg/Credit>.
- 282 Kassi O, Lehdonvirta V. Online labour index: Measuring the online gig economy for policy and research. *Internet, Politics & Policy* 2016, 22-23 September; 2016. p. 1-19.
- 283 Vietnam Ministry of Planning and Investment. 2018. Summary report on economic restructuring plan for period 2016 - 2020. Hanoi.
- 284 Foreign Investment Agency. Policy supporting development the digital economy in Vietnam. Ministry of Planning and Investment. 11 July 2018.
- 285 Benjamin D, Brandt L, McCaig B. 2017. Growth with equity: Income inequality in Vietnam, 2002–14. *The Journal of Economic Inequality*, 15(1): 25-46.

- 286 World Bank. 2014. Inequality in Vietnam: A Special Focus of the Taking Stock Report July 2014 - Key Findings.
- 287 Nguyen D V A. The smart cities race in Vietnam. Asia IoT Business Platform. 1 May 2017.
- 288 Fagnant D J, Kockelman K. 2015. Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations for capitalizing on self-driven vehicles. *Transportation Research*. 167-181.
- 289 Research and Markets. Global augmented reality (AR) and virtual reality (VR) market is forecast to reach \$94.4 Billion by 2023 - Soaring demand for AR & VR in the retail & e-commerce sectors PR Newswire. 31 July 2018.
- 290 Morganson V, J., Major D, A., Oborn K, L. et al. 2010. Comparing telework locations and traditional work arrangements: Differences in work-life balance support, job satisfaction, and inclusion. *Journal of Managerial Psychology*, 25(6): 578-595.
- 291 Hariis T. 2015. Drones and new applications for precision agriculture. *Earth Imaging Journal*.
- 292 MoIT. 2017. Vietnam energy outlook report 2017. Vietnam Ministry of Industry and Trade of: Hanoi, Vietnam.
- 293 Nguyen K L, Nguyen D L, Le H T et al. 2018. Automated procedure of real-time flood forecasting in Vu Gia – Thu Bon river basin, Vietnam by integrating SWAT and HEC–RAS models. *Journal of Water and Climate Change*.
- 294 Verhagen J, Blom-Zandstra G, Nguyen D X C et al. 2017. Mapping the potential (quicksan) for salt and drought tolerant crops and cropping systems in the Mekong Delta.
- 295 Ethitrade International. Vietnam: Dragon fruit export. [20 August 2018]. Available from: <https://ethitrade.com.au/portfolio/vietnam-dragon-fruit-export/>.
- 296 Lasko K, Vadrevu K P, Nguyen T T N. 2018. Analysis of air pollution over Hanoi, Vietnam using multi-satellite and MERRA reanalysis datasets. *PloS One*, 13(5):
- 297 Cassou E, Jaffee S M, Ru J. The challenge of agricultural pollution: Evidence from China, Vietnam, and the Philippines. Washington D.C, United States: World Bank; 2018.
- 298 Goldblatt R, Deininger K, Hanson G. 2018. Utilizing publicly available satellite data for urban research: Mapping built-up land cover and land use in Ho Chi Minh City, Vietnam. *Development Engineering*, 3(0): 83-99.
- 299 Hiep N H, Luong N D, Nga T T V et al. 2018. Hydrological model using ground-and satellite-based data for river flow simulation towards supporting water resource management in the Red River Basin, Vietnam. *Journal of environmental management*, 217(0): 346-355.
- 300 Hauser L T, Vu G N, Nguyen B A et al. 2017. Uncovering the spatio-temporal dynamics of land cover change and fragmentation of mangroves in the Ca Mau peninsula, Vietnam using multi-temporal SPOT satellite imagery (2004–2013). *Applied Geography*, 86(0): 197-207.
- 301 Bartolome J. 2014. How has India’s rapidly growing ICT sector impacted its rural poor? Theses University Honours: Paper 49.
- 302 Dugal I. India’s two speed economy: The widening gap between consumption and investment. *BloombergQuintOpinion*. 1 September 2016.
- 303 Sriratanaviriyakul N, Felipe A L, Shillabeer A et al. Awareness and impact of Vietnamese security concerns in using online social networks. *Proceedings of the 18th World Multi-Conference on Systemics, Cybernetics and Informatics; International Institute of Informatics and Systemics*; 1-5.
- 304 Knight Frank Research. 2017. The wealth report, 11th Edition. Knight Frank: London, England.
- 305 Dung N T. 2016. Decision on the approval of the revised national power development master plan for the 2011-2020 period with the vision to 2030. Hanoi, Vietnam.
- 306 Trading Economics. New Caledonia GDP per capita. [21 February 2019]. Available from: <https://tradingeconomics.com/new-caledonia/gdp-per-capita>.
- 307 PricewaterhouseCoopers. 2018. Industry 4.0 Vietnam survey 2018. PwC: Ho Chi Minh City, Vietnam.
- 308 Open Data Cube. CEOS DATA CUBE. [3 August 2018]. Available from: <https://www.opendatacube.org/ceos>.
- 309 GitHub. Global infrastructure project pipeline. [26 July 2018]. Available from: <https://pipeline.github.org/UserInfo>.
- 310 Page J. 1994. The East Asian miracle: four lessons for development policy. *NBER macroeconomics annual*, 9(0): 219-269.
- 311 Bulman D, Eden M, Nguyen H. 2017. Transitioning from low-income growth to high-income growth: Is there a middle-income trap? *Journal of the Asia Pacific Economy*, 22(1): 5-28.



- 312 World Bank. 2018. Historical classification by income. WB: Washington D.C, United States.
- 313 Felipe J, Kumar U, Galope R. 2017. Middle-income transitions: Trap or myth? *Journal of the Asia Pacific Economy*, 22(3): 429-453.
- 314 International Monetary Fund. 2018. WEO Data: October 2018 Edition. IMF: Washington D.C, United States.
- 315 Freedom House. 2018. Freedom in the world 2018. FH: Washington D.C, United States.
- 316 Transparency International. 2018. Corruption perceptions index 2018. TI: Berlin, Germany.
- 317 Stiglitz J E, Uy M. 1996. Financial markets, public policy, and the East Asian miracle. *The World Bank Research Observer*, 11(2): 249-276.
- 318 Stiglitz J E, Yusuf S. Rethinking the East Asian Miracle. Washington D.C, United States: World Bank; 2001.
- 319 Weiss J. 2005. Export growth and industrial policy: Lessons from the East Asian miracle experience.
- 320 Hassink R. 1999. South Korea's economic miracle and crisis: Explanations and regional consequences. *European Planning Studies*, 7(2): 127-143.
- 321 Schiffer J R. 1991. State policy and economic growth: A note on the Hong Kong model. *International Journal of Urban and Regional Research*, 15(2): 180-196.
- 322 Ito T, Weinstein D E. 1996. Japan and the Asian economies: A "miracle" in transition. *Brookings Papers on Economic Activity*, 1996(2): 205-272.
- 323 Florida R. The rise of the creative class - Revisited: Revised and expanded. New York, United States: Basic Books; 2014.
- 324 Gill I S, Kharas H. An East Asian renaissance: Ideas for economic growth. Washington D.C, United States: World Bank; 2007.
- 325 Venzon C. New ADB chief economist says middle-income trap a myth. *Nikkei Asian Review*. 8 September 2014.
- 326 Han X, Wei S-J. 2017. Re-examining the Middle-Income Trap Hypothesis (MITH): What to reject and what to revive? *Journal of International Money and Finance*, 73(0): 41-61.
- 327 VNS. Productivity key to escaping mid-income trap. *Viet Nam News*. 14 December 2017.
- 328 Deutsche Gesellschaft für Internationale Zusammenarbeit. 2016. Vietnam power development plan for the period 2011-2020: Highlights of the PDP 7 revised. GIZ: Bonn, Germany.
- 329 Royal F. The cost of 5G. *Smart & Resilient Cities*. 21 August 2018.
- 330 Vu K. Vietnam awards first trial 5G license to Viettel. *Reuters*. 23 January 2019.
- 331 Vũ H. Toàn văn luật an ninh mạng trình quốc hội thông qua. *VN Economy*. 12 June 2018.
- 332 Palatino M. Decree 72: Vietnam's confusing Internet law *The Diplomat*. 8 August 2013.
- 333 Hinrich Foundation. 2018. The data revolution: How Vietnam can capture the digital trade opportunity at home and abroad. Hinrich Foundation: Hong Kong.
- 334 Breu M, Dobbs R, Remes J et al. 2012. Sustaining Vietnam's growth: The productivity challenge. McKinsey Global Institute: Hanoi, Vietnam.
- 335 Poole J P, Santos-Paulino A U, Sokolova M V et al. 2017. The impact of trade and technology on skills in Viet Nam. Asian Development Bank Institute: Tokyo, Japan.
- 336 Shillabeer A. The impact of IT development outsourcing on worker dynamics in Vietnam. *Proceedings of the International Conference on Managing the Asian Century*; Springer; 153-162.
- 337 Truong M V, Nguyen V N A. 2017. The fourth industrial revolution - A Vietnamese discourse. Friedrich Ebert Stiftung: Hanoi, Vietnam.
- 338 Gajria N. Bringing digital skills training to 30,000 farmers in Vietnam. *Google in Asia*. 26 May 2017.
- 339 Biteye M, Datta N, Robinson D. Creating new opportunities young women digital economy. World Bank. 9 April 2018.
- 340 Quade A. VN needs more women working in STEM: Experts. *Viet Nam News*. 14 November 2017.
- 341 Stoet G, Geary D C. 2018. The gender-equality paradox in Science, Technology, Engineering, and Mathematics education. *Psychological Science*, 29(4): 581-593.
- 342 Quade A. STEM education for women in Vietnam. Borgen Project. 18 April 2018.
- 343 World Economic Forum. 2018. The global gender gap report 2018. WEF: Geneva, Switzerland.
- 344 AFP. Too hard for girls': IT student defies Vietnam's gender norms. *VN Express*. 11 January 2018.
- 345 Global Center for Corporate Governance. 2017. Women in the boardroom: A global perspective. Deloitte: London, United Kingdom.

- 346 UNESCO. Viet Nam takes action towards STEM Education for Sustainable Development. [Internet]. 2017 Available from: [http://www.unesco.org/new/en/hanoi/about-the-hanoi-office/single-view/news/viet\\_nam\\_takes\\_action\\_towards\\_stem\\_education\\_for\\_sustainable/](http://www.unesco.org/new/en/hanoi/about-the-hanoi-office/single-view/news/viet_nam_takes_action_towards_stem_education_for_sustainable/).
- 347 Molella A P, Karvellas A. Places of invention. Washington, D.C.: Smithsonian Institution Scholarly Press; 2015.
- 348 Mazzucato M. Mission-oriented innovation policy. [31 October 2018]. Available from: <https://marianamazzucato.com/projects/mission-oriented-innovation-policy/>.
- 349 Anh D. Vietnam sets out plans for Industry 4.0. Vietnam Economic Times. 5 August 2017.
- 350 Ky D H. Vietnam's grand illusions about industry 4.0. VN Express. 23 October 2018.
- 351 Chi K. How big is Vietnam's informal economic sector? Vietnamnet. 6 February 2018.
- 352 Organization for Economic Co-operation and Development. 2017. Tax challenges of digitalisation: Comments received on the request for input - Part II. OECD: Paris, France.
- 353 Khadem N. 'Red flags' raised over Amazon's Australian tax arrangements The Sydney Morning Herald. 3 October 2017.
- 354 Katz R. The impact of taxation on the digital economy. 15th Global Symposium for Regulators; International Telecommunication Union; 2015. p. 1-61.
- 355 Vietnam K i. 2017. Integrated international tax. KPMG: Vietnam.
- 356 Kim J, Park J. 'The role of total factor productivity growth in middle-income countries - ADB Economics Working Paper 527' In: Asian Development Outlook 2017. Asian Development Bank; 2017.
- 357 Porter M E. The comparative advantage: Creating and sustaining superior performance. New York, United States: Free Press; 1985.
- 358 Carl Benedikt Frey and Michael A. Osborne. 2013. The future of employment: how susceptible are jobs to computerisation. United Kingdom Department of Engineering Science.
- 359 Arntz M, Gregory T, Zierahn M. 2015. The risk for automation of jobs in OECD countries: A comparative analysis. OECD Social, Employment and Migration Working Paper No. 189.
- 360 AlphaBeta. 2017. The Automation Advantage. Australia.
- 361 International Labor Organization. 2009. ASEAN in transformation: The future of jobs at risk of automation. Geneva, Switzerland.
- 362 Oxford Economics, CISCO. 2018. Technology and the future of ASEAN jobs - The impact of AI on workers in ASEAN's six largest economies. Oxford, England.
- 363 Zeira J. 1998. Workers, machines and economic growth. Quarterly Journal of Economics, 113(0): 1091-1113.
- 364 Zeira J. 2006. Machines as engines of growth. Dynamics, Economic Growth, and International Trade Conference Papers.
- 365 Aghion P, Jones B F, Jones C I. 2017. Artificial Intelligence and economic growth - NBER Working Paper No. 23928. National Bureau of Economic Research: Cambridge, United States.
- 366 Acemoglu D, Pascual Restrepo. 2018. Artificial Intelligence, automation and work. NBER Working Paper 24196.
- 367 PricewaterhouseCoopers. 2018. The macroeconomic impact of Artificial Intelligence. London, England.
- 368 Bughin J, Seong J, Manyika J et al. 2018. Notes from the AI frontier modeling the impact of AI on the world economy.
- 369 AlphaBeta. 2017. Could a robot do your job. ABC: Australia.
- 370 World Economic Forum. 2017. Global information technology report. Geneva.
- 371 PricewaterhouseCoopers. 2018. What will be the net impact of AI and related technologies on jobs in China. London, United Kingdom.
- 372 Coelli T, O'donnell C J. An introduction to efficiency and productivity analysis. New York, United States: Springer; 2005.
- 373 Hall B H, Khan B. Adoption of new technology. Academic Press: San Diego, United States; 2003.
- 374 Nieto M, Lopez F, Cruz F. 1998. Performance analysis of technology using the S curve model: The case of digital signal processing (DSP) technologies. Technovation, 18(6/7): 439-457.



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