SUPPORTING ECONOMIC TRANSFORMATION

Fostering an inclusive digital transformation in Cambodia

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Executive summary

Cambodia's digital transformation is gathering pace but with different results and prospects across different groups in the economy. Mobile phone and social media use has grown rapidly. New apps are being developed, tested and implemented frequently. There is a budding digital start-up sector. And new sectors with new job opportunities based on digital technology are emerging.

Such positive developments are helping Cambodia advance significantly in economic and social terms. But there is another side, and that is the uneven impacts. While business and financial services have implemented more digital apps, the agriculture sector, which remains the main source of employment, is catching up more slowly through blockchain or precision agriculture. The tourism sector, a major source of forex, has untapped opportunities, and, crucially, the manufacturing sector, which is a major source of female employment and foreign exchange, will be highly vulnerable unless it embraces innovation and digitalisation more fully. Further, digitalisation within the public sector is lagging behind that in the private sector.

This paper highlights the potentially significant distributional effects of digitalisation within and between sectors, and the implications for policy aimed at inclusive development. There are some 50,000 tech talents working in the Cambodia's formal sector, and some 300 digital start-ups, but according to the Cambodian government there are more than 800,000 workers (80% of whom are women, mostly under the age of 35) in garments who may have change jobs in the near future if further action is not taken. Evidence gathered through firm-level case studies brings out how payment systems significantly reduce transaction costs, benefiting urban (middle-class) consumers more than other groups. The case studies also describe how many tuk tuk drivers benefit from new digital technology, but those who are not part of digital platforms may lose out. They also show that applications such as BookMeBus and Blocrice are excellent innovations, reducing transaction costs, but they also replace (other) middlemen, and may also risk leading to concentration and control. The innovations themselves are good, but it is perhaps less well considered that they also have distributional consequences that do need attention at some point. We suggest this attention happen sooner rather than later.

Managing the differential impacts of digitalisation on different sectors and groups will be crucial to maintain inclusiveness while safeguarding political stability along the digital transformation path. Promoting inclusive development should be a central component of the new digital economy framework that the government is expected to roll out after mid-2020. However, while the government has embarked on several digital initiatives and strategies, there is a risk that the government itself will lack sufficient capacity and concentration to play such a role effectively. A rather slow move towards e-government in the past is indicative of this. There are greater expectations of a stronger role for government, exactly at a time when governments across the world are losing some control to the private sector, in terms of start-ups, innovation or large telecommunication deals.

Cambodia's digital profile is diverse, with both encouraging trends and significant gaps. Cambodia experienced continuous growth between 2008 and 2016 in the World Economic Forum Networked Readiness Index (an aggregate score of the quality of the education system, including maths and science, management schools, capacity to innovate, literary rates and enrolment rates), but it remains a low scoring country, particularly in comparison with Thailand and Vietnam. Cambodia is the lowest-ranking country out of the five measured on the Global Talent Competitiveness Index 2018. Although Cambodia's numbers are close to the low of Laos, there is substantial distance between it and Thailand and Vietnam. While internet use has been rising (WDI data) rapidly from close to zero in 2000 to 40% of population in 2018, it is still below Thailand (57%) and Vietnam (70%). Internet penetration in Cambodia is buoyant in the 15-25 age group; an impressive 85.7% of the population in this age group in Cambodia has access to internet. Cambodia is lagging behind other Asian economies in terms of internet penetration in the below 15 age group; only 4.5% of

individuals below 15 in Cambodia have access to internet, as comparted to 18.1% in Indonesia and 63.4% in Thailand.

There are specific gaps in the availability of digital skills. Less than 30% of the population in Cambodia has basic digital skills such as using basic arithmetic formula on a spreadsheet, as compared to almost 50% of the population in Indonesia having these skills. Less than 3% of the population in Cambodia has intermediate digital skills of connecting and installing new devices and less than 1% of the Cambodian population has advanced digital skills of finding, downloading and configuring software. Only 32.4% of individuals with tertiary education in Cambodia are using computers and internet, as compared to 68.1% in Bangladesh, 87.8% in Indonesia, 52.6% in Pakistan and 89.7% in Thailand. Employment in agricultural occupations has decreased, it has increased in services and clerical workers, but there has not been a marked change in professional, technical and managerial occupations.

Many organisations and individuals have developed suggestions for what the **government of Cambodia could do next to prepare well for the digital economy**, centring on the following areas:

- developing digital hard infrastructure, which needs to go hand in hand with soft infrastructure initiatives such as process-building or capabilities for operating and preserving data
- enhancing digital human resources by developing technical, cognitive and soft skills
- promoting business ecosystems
- promoting e-governance whereby government must transition into an e-government and
- promoting digital trustworthiness throughout the economy.

This is an important set of general policies on which there is reasonable consensus, though the details need to be worked out. However, Cambodia should also consider **targeted measures to enhance the inclusiveness of its digital transformation**. Without these additional measures, digitalisation may have severe distributional consequences in Cambodia. Such policy actions can be summarised in the following **five-point digital agenda**:

1. *Radically transform innovation in the manufacturing sector*. The weak position of Cambodia's manufacturing firms, which are dominated by buyer-driven global value chains, constrains the ability of manufacturers to innovate. Public action across skills and technology is required to address coordination failures around upgrading (installing new technology is good for sector and country competitiveness, but firms has fewer incentives) and come out of this *cul de sac*. Digitalisation may threaten manual, less-skilled employment in the garments sector, but it would be much worse not to have any garment assembly at all. Working with firms to enhance their innovation capabilities in the digital era is crucial now. A new incentives package (offering an ecosystem that encourages digital technology) should help attract technologically more intensive investment, encourage upgrading technology in factories and promote relevant skills, for example through an enhanced Skills Development Fund (SDF), targeted technical and vocational education and training (TVET) placements and Enterprise Khmer under the Entrepreneurship Development Fund (EDF) which is a mechanism to promote SMEs and start-ups. It could embrace further the concept of digital small and medium enterprise (SME) clusters.

2. *Provide appropriate and good quality skills for the future*. The provision of relevant and high-quality technical, cognitive and soft skills should run thoughout current policy initiatives. Lack of quality skills, especially at secondary schooling levels, is well known, but new initiatives at post-secondary level are important too. Bringing new dynamism into the sector skills councils (SSCs) to embrace a digital economy would be a helpful, targeted measure. The Ministry of Labour and Vocational Training needs to provide a signal they are taking these SSCs seriously. There could also be support in promoting links between higher education institutes and the private sector, such as through placements in industry. Support systems such as TVET cover very few manufacturing students – only 0.4% of the total – and public TVET barely caters for skills that are needed directly in manufacturing.

3. *Nurture the digital start-up economy for an inclusive economy*. The start-up economy in Cambodia is very dynamic, but a challenge lies in seeking a better link between this and how it delivers for the poorest. Several organisations already support or invest in tech start-ups. New incentives by government for collective action by start-ups could redirect some efforts to develop apps with relevant applications for the poorest.

4. *Protect and enable the most vulnerable groups to take part in the digital economy.* Targeted support is required to ensure that those who lose out from new technologies can take part elsewehere in the economy. This could take the form of rolling out digital infrastructure to those who need it most or raising digital literacy in vulnerable groupings.

5. *A public sector that leads by example.* Digital leadership will be very important in the next few years, and managing the process towards a new framework for a digital economy in a coordinated way is essential. Institutional strengthening inside government around the digital economy, and specifically securing the lead role of the Ministry of Economy and Finance, is an important part of this. Advancing towards e-government is not a straightforward issue and requires further attention. International comparisons suggest that the Cambodia public sector has a great deal to do to cover lost ground and catch up, and past attempts have been insufficient; this is not impossible to achieve, however, as, for example, advances on e-Estonia suggests.

This five-point digital economy agenda has implications for different public and private actors, both in the short term and in the long term.

Acronyms

ADB	Asian Development Bank
AI	Artificial Intelligence
ASEAN	Association of Southeast Asian Nations
CDC	Council for the Development of Cambodia
CDRI	Cambodia Development Resource Institute
DDP	Digital Development Partnership
EGDI	E-Government Development Index
EIF	Enhanced Integrated Framework
EMC	Emerging Markets Consulting
ERP	enterprise resource planning
EU	European Union
GPS	Global Positioning System
GSDMEH	General Department of SME and Handicraft
ICT	information and communication technology
IDP	Industrial Development Policy
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ILO	International Labour Organization
ITC	International Trade Centre
ITU	International Telecommunications Union
KOICA	Korea International Cooperation Agency
MEAC	Ministry of Economic Affairs and Communications (Estonia)
MEF	Ministry of Economy and Finance
MIH	Ministry of Industry and Handicraft
MLVT	Ministry of Labour and Vocational Training
MoEYS	Ministry of Education, Youth and Sports
MoP	Ministry of Planning
MPTC	Ministry of Posts and Telecommunications
NIPTICT	National Institute of Posts, Telecommunications and Information Communication Technology
NPIC	National Polytechnic Institute of Cambodia
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
RFID	Radio Frequency Identification
RGC	Royal Government of Cambodia
RIICE	Remote Sensing-Based Information and Insurance for Crops in Emerging Economies
SAR	Synthetic Aperture Radar
SDF	Skills Development Fund
SEZ	special economic zone
SMEs	small and medium enterprises
STEM	science, technology, engineering and mathematics
TC	Telecom Cambodia
T-ICT	Telecom/ICT (T-ICT)
TRC	Telecommunication Regulator of Cambodia
TVET	technical and vocational training and education
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children’s Fund
UNIDO	United Nations Industrial Development Organization
US	United States

WDI	World Development Indicators
WEF	World Economic Forum
WIPO	World Intellectual Property Organization

1 Introduction

Cambodia has advanced significantly in the development of its digital economy, and the Royal Government of Cambodia (RGC) is developing a long-term strategic framework in this regard. There are likely to be hurdles on the road to digital transformation, and a range of actions are crucial to develop the digital economy in the coming decades. A digital transformation does not automatically support all members of society, or to the same extent: complementary measures that include skills development are critical to use a digital transformation for inclusive development (World Bank, 2017; Banga and te Velde, 2018).

Cambodia has had noticeable development successes (CDRI and ODI, 2019) and this include several advances in the digital economy. It has more than 7 million broadband users, more than 100% mobile phone penetration and some of the cheapest internet in the world. It has developed a range of digital applications around financial services, tourism and other services sectors. There are also the beginnings of digital change in the agriculture sector. However, the future of the manufacturing sector is less bright without additional measures. In addition, some groups are likely to benefit more from digital transformation than others. This paper develops possible scenarios for the future to understand the challenges and opportunities involved.

The move towards a digital economy cannot come soon enough for Cambodia. The corona virus outbreak, threats to withdraw trade preferences, and a ban on online gambling has laid bare the fragility of Cambodia's development success. Over the past few months, construction and gambling activities has tumbled (affecting Sihanoukville), tourism has fallen sharply by some 20% y-o-y (initially because Chinese stopped travelling and they now constitute a third of the total), and Cambodia's garment may face some $100 million of additional duties in the EU after the EU decided to withdraw trade preferences from August 2020. Cambodia is now looking for a broader base to transform. The digital economy is one obvious promising area.

Several studies include suggestions as to what Cambodia needs to do to enhance the digital transformation (e.g. CDRI, 2018; Heng, 2018; World Bank, 2018b). These contain useful elements that can inform the development of a long-term strategic framework in this area. It is also important that additional measures address the losses some specific groups face, which may otherwise threaten long-term stability and inclusion. This paper identifies a range of measures that can help enable inclusive development in the area of digital transformation.

A review of indicators suggests Cambodia is behind in terms of skills development. What is perhaps less well known is what specific skills are crucial in a digital economy. This paper discusses how targeted skills development can enhance the prospects of the young and vulnerable to take part in the digital economy.

The structure of the paper is as follows. Section 2 provides a concise overview of the digital policies in Cambodia and Cambodia's digital profile. Section 3 looks ahead and examines which sectors and groups are likely to gain or lose from the digital transformation, focusing on the objective of inclusive development. Section 4 examines measures to enhance the inclusive aspects of the digital transformation. Section 5 concludes.

2 Recent developments in Cambodia's digital economy

Cambodia has already come a long way in terns if digital transformation, thanks to a range of relevant policies and other initiatives. We first review digital policies and strategies put in place by the RGC (Section 2.1) and then assess Cambodia's digital profile in broad terms (Section 2.2).

2.1 Recent developments in Cambodia's digital policies

Cambodia has introduced a range digital policy initiatives dating back to at least the early 2000s. A range of development plans mentioned information and communication technology (ICT). The attention to ICT has increased over the past decade. We review recent policies and strategies, and summarise these in Figure 1.

Cambodia's **Rectangular Strategy Phase III** (RGC, 2013) focused on, among other issues, science and technology across several priority sectors, including ICT, by 'mainstreaming scientific and technological knowledge and its applications in academic curriculums… and promoting R&D [research and development] including the introduction of a research network model, linking universities, public institutions and industry'. This was followed up by the country's **Rectangular Strategy Phase IV** (RGC, 2018), which identifies employment creation opportunities through the 'industrial revolution 4.0' and the digital economy, which Cambodia could take advantage of to 'improve its economic structure'. The Rectangular Strategy Phase IV sets a national direction, and the country is now prioritising readiness for the digital economy and Industry 4.0 as a way to achieve economic diversification and identify new sources of growth.

Cambodia's ICT Masterplan 2020 is an ICT framework adopted in 2014 to guide the country to be a leading ICT-driven society. It is based on four pillars to enable ICT to play a role as a key driving force for development in Cambodia.

1. ICT human resource development, which includes building up national-level ICT human resource development systems, for example setting up a standardised ICT skills certification board, strengthening ICT education, promoting ICT skills in government and building a knowledge base of ICT skills supply and demand gaps
2. e-awareness, which sets out to increase the awareness and support for ICT and the role it can play in the development process. The second pillar also supports ICT infrastructure, which basically aims to increase investment in physical ICT infrastructure such as an internet 'backbone' (i.e. a cable connection network) across the country. Finally, the second pillar also provides support to the legal, regulatory and policy systems that support ICT in Cambodia
3. enhancing ICT capabilities in Cambodia by providing support to ICT R&D, setting up an ICT standards body (with nationally and internationally recognised ICT standards certification) and the development of the ICT industry, allowing it to flourish within the country and provide it with access to international markets
4. enhancing government uptake and provision of public electronic services (i.e. e-government).

The RGC so far has selected five priority projects for this masterplan: e-government, cyber security, e-education, e-commerce and e-tourism (KOICA, 2014).

The **Telecom/ICT (T-ICT) Development Policy 2020** is another ICT framework, adopted in 2016. The policy aims to further enhance the country's ICT connectedness and readiness through improving ICT security and industry, promoting ICT applications and building a stronger foundation for T-ICT development (Tum, 2017). Most legal regulations, particularly those related

to electronic transactions, consumer protection for online purchases and cybercrime prevention, are in the drafting process (World Bank, 2018b). The **National Strategic Development Plan 2014–2018 (CDC, 2014),** the **Industrial Development Policy 2015–2025 (MIH, 2016)** and the **Cambodia Sustainable Development Goals Framework 2016–2030 (MoP, 2018)** also stress the importance of science and technology for the country's further development.

In 2015, Cambodia introduced its 10-year industrial development strategy, the **Industrial Development Policy (IDP) 2015–2025** (RGC, 2015). The IDP sets a vision to structurally transform the Cambodian economy 'from a low-skilled economy into a skill-based, technology, and knowledge-based economy', which sets the basis for the promotion of a digital economy, and increased digitalisation of existing industries, in the country. ICT is a priority sector; however, there is no significant detail on how the IDP will support it. More details are provided in the **Telecommunication and ICT Development Policy** (MPTC, 2017), which provides a vision on ICT development in the country. The policy largely reiterates the main points of the ICT Masterplan 2020, aiming to promote investment in ICT infrastructure, update the ICT regulatory framework, improve human resources in ICT and increase ICT security, promote e-government and support the growth of the local ICT industry and e-commerce.

The Ministry of Posts and Telecommunications (MPTC) has set up the National Institute of Posts, Telecommunications and Information Communication Technology (NIPTICT) with the intent of providing formal training, research and education on ICT in the country (Khmer Digital News, 2018). In 2016, the RGC launched an online single window and business registration portal to facilitate firm market entry. In May 2018, NIPTICT hosted a workshop on Cambodia's Digital Transformation, which brought together local and international experts to share lessons on digitalisation and push for Cambodian industry to embrace digital technologies (Foo, 2018).

The RGC also seeks to support integration of small and medium enterprises (SMEs) into the digital economy. The General Department of SME and Handicraft (GDSMEH), together with Start-Up Cambodia,[1] hosted the SME Go Digital Forums in 2017 and 2018, designed as a platform for start-ups and SMEs to discuss the opportunities of the digital industry. The RGC is also seeking to set up an SME and tech-start up centre hosted by the Ministry of Industry and Handicraft (MIH). According to the World Bank (2018b), the Cambodia e-Government Master Plan 2017–2022 has been drafted but not yet adopted.

In a speech at a Cambodia Development Resource Institute (CDRI) conference on digital transformation, Prime Minister Hun Sen argued that actions to date included development of the Cambodia ICT Masterplan 2020, drafting of the Cambodia e-Government Master Plan, establishment of a Data Management Centre and promotion of a legal framework for the digital ecosystem (Hor, 2019). But there are also challenges, such as building infrastructure to support the digital sector; developing an e-payment system and logistics network; creating a digital platform and developing an ecosystem; and promoting government digitalisation, entrepreneurship, digital literacy and open data. The Supreme National Economic Council has established a working group to formulate a digital economy policy framework.

A recent workshop (4 November 2019) organised by the Royal Government of Cambodia, the CDRI and ODI discussed the draft long-term policy framework for Cambodia's digital economy[2], which aims to build a size digital economy to be one of the growth drivers, to continuously innovate, and to facilitate transformation of Cambodia into a digital society. It discusses four phases including digital foundation, digital adoption, digital transformation, towards Industry 4.0. It formulates possible targets for these by 2040, including 100% public service digitalisation, 60% digital literacy, 70% digital adoption by firms, 4% employment in ICT workforce, 100% urban and

[1] https://www.startup-cambodia.com/events-main/2018/5/7/smes-go-digital-forum

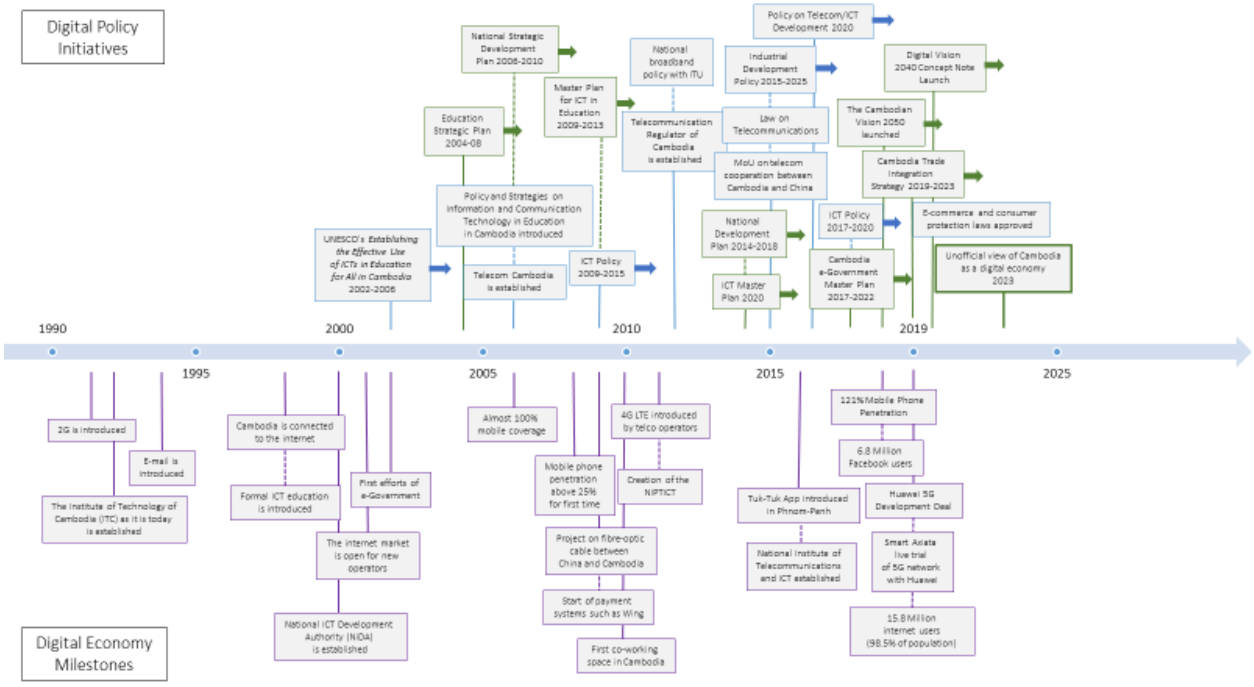
[2] https://set.odi.org/wp-content/uploads/2019/11/Presentation-on-Concept-Note-of-DE.pdf

70% rural high speed internet coverage, at least one smart city, and several others. It builds on five strategic thrusts: digital infrastructure, digital government, digital business, digital literacy, and digital trustworthiness. There are 6 sub-working groups centred around taking stock, digital infrastructure, software and platforms, legal and institutional arrangement, entrepreneurship and skills, and digital government.

In addition to the RGC's plans, international actors have also taken an interest in Cambodia's digital economy. For example, the United Nations Development Programme (UNDP) with the International Labour Organization (ILO) jointly organised a workshop in September 2018 looking at the Fourth Industrial Revolution (i.e. Industry 4.0) in Cambodia (UNDP, 2018). The aim was to identify the main policy gaps and key development recommendations to facilitate Industry 4.0 in Cambodia. The workshop highlight two main issues: ways to promote access to technologies in Cambodia, to allow industries to leapfrog less productive, pre-digital industrial methods; and the employment challenge – for example, understanding how Cambodia can maintain high levels of employment while promoting less labour-intensive manufacturing. The World Bank (2018a) expects Cambodia's next wave of growth to come from increased value addition and the 'nurturing of new sectors such as the digital economy'.

At the World Economic Forum (WEF) Association for Southeast Asian Nations (ASEAN) forum, held in Hanoi in September 2018, ASEAN heads of states discussed the opportunities of the Fourth Industrial Revolution (Chheang, 2018). Prime Minister Hun Sen stated that several areas revolving around digitalisation and automation concerned the RGC, as they could potentially negatively affect low-skilled employment in the country. In this regard, the RGC aims to upskill its labour force, promote investment in ICT and provide more support to the private sector to help the country maximise its comparative advantages through Industry 4.0.

Figure 1: Digital policy initiatives and other digital milestones in Cambodia



Source: Authors' analysis based on information in text.

Other relevant laws that have already been put into effect include the 2003 Law on the Copyrights and Related Rights (WIPO, n.d.), the 2015 Telecommunications Law (TRC, 2016), the 2018 Decree on SME Tax Incentives (DFDL, 2019) and the 2018 Decree on Digital Signatures (World Bank, 2018b).

The e-Commerce Law and the Consumer Protection Law, which were originally drafted in 2012, were finally approved on 12 July 2019 by the Council of Ministers. According to interviews, these

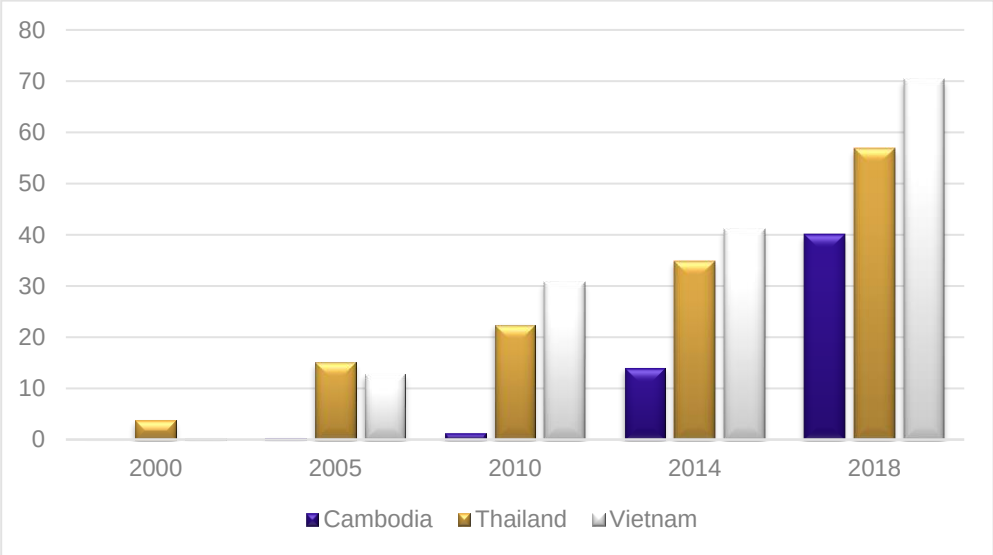
promote trade via electronic means, such as through the use of e-signatures, and foster the purchasing goods and services online, as well as payments through transferring of money. Some issues still need to be worked out, and in July 2019 businesses were yet to receive a copy of the law. Work is ongoing around a new commerce law and competition law. The e-Commerce Law passed on 8 October 2019.

2.2 Cambodia's digital profile

Several publications, by the United Nations Conference on Trade and Development (UNCTAD), the International Trade Centre (ITC), World Bank, Enhanced Integrated Framework (EIF) and others have discussed Cambodia's advances in the digital economy in great detail. The main conclusions are that internet penetration is rising fast; mobile phone and social media use is also growing fast and at very high levels; but Cambodia's digital readiness more generally still appears low in a comparative context, at least compared with its neighbours Thailand and Vietnam.

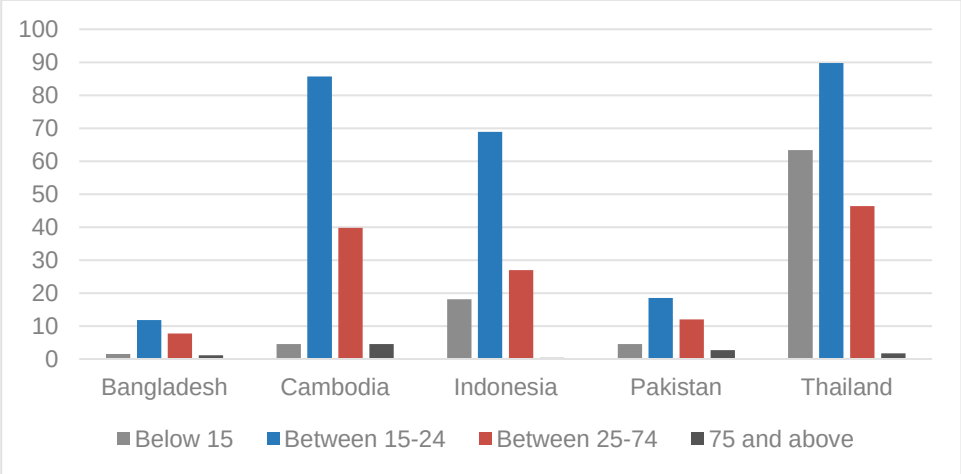
Figure 2 shows that, while internet use has been rising rapidly from close to zero in 2000 to 40% in 2018, this is still below Thailand (57%) and Vietnam (70%). Similar to other Asian economies, internet penetration in Cambodia is mainly dominated by the 15-25 age group; 85.7% of the population in this age group in Cambodia has access to internet. Cambodia is lagging behind other Asian economies in terms of internet penetration in the below 15 age group; only 4.5% of individuals below 15 in Cambodia have access to internet, as comparted to 18.1% in Indonesia and 63.4% in Thailand.

Figure 2: Individuals using the internet, Cambodia, Thailand and Vietnam, 2000–2016 (% of population)



Source: WDI

Figure 3: Percentage of individuals using the internet, by age group and country



Source: ITU (2018)

The Telecommunications Regulator of Cambodia (TRC) publishes data on internet use. By January 2019, the country had 13.9 million internet users (up from 5.0 million in 2004) and 19.5 million mobile phone subscribers (against 20.5 million in 2004).[3] There are some 7 million Facebook users.

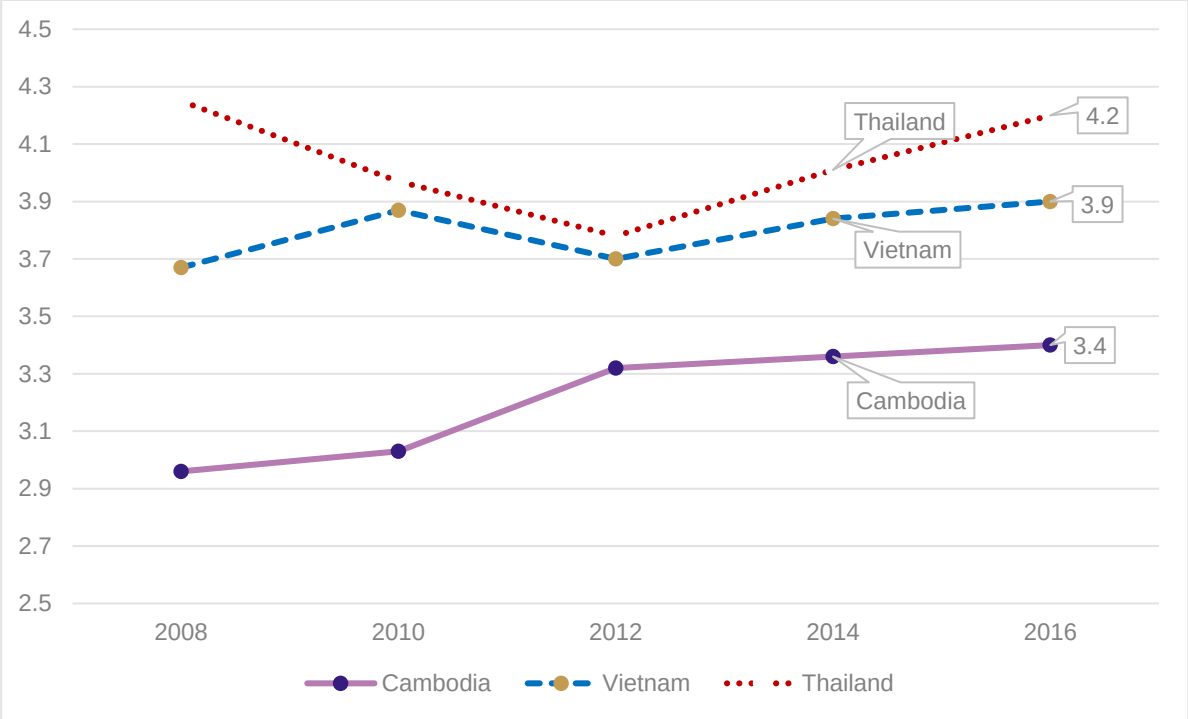
The World Bank (2018a) finds that, while there has been a rapid increase in mobile telephone penetration in the country, internet subscriptions (both mobile and fixed) remain relatively low. Firm adoption of digital technologies also remains low, with less than a quarter of Cambodian firms maintaining internet presence (i.e. a website), against the 46% world median. It also has a limited quantity of secure servers, limited use of digital services (i.e. in finance) and a lack of ICT enabling skills, or supportive legal/regulatory frameworks.

In its Rapid eTrade Readiness Assessment for Cambodia, UNCTAD (2017) states that there is significant potential to develop e-commerce in Cambodia; however, e-commerce remains limited. The report states that, while e-commerce is gaining prominence, there are a number of issues that limit its growth. For example, the majority of Cambodians are unbanked (only 22% held bank accounts by 2014 and only 39,000 people had access to credit cards in the same year).

Cambodia's digital profile and its readiness can be compared in various ways with different countries. The WEF Networked Readiness Index is an aggregate score of the quality of the education system, including maths and science, management schools, capacity to innovate, literary rates and enrolment rates. According to this index, Cambodia experienced continuous growth between 2008 and 2016 in its overall score (Figure 4). Thailand and Vietnam, by contrast, both experienced periods of decline. However, Cambodia remains a low scoring country, particularly in comparison with Thailand and Vietnam.

[3] https://www.trc.gov.kh/mobile-phone-subcribers/

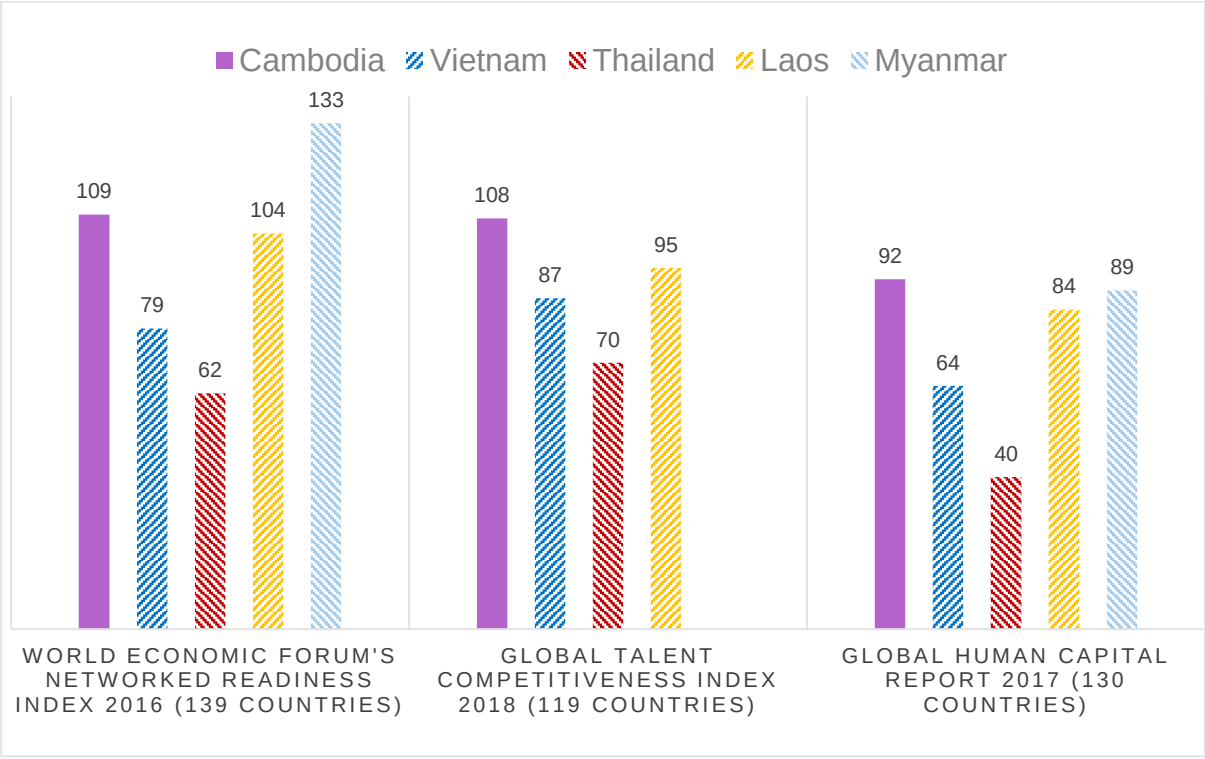
Figure 4: Networked Readiness Index, 2008–2016



Source: WEF (2008–2016)

Other indices examine talent and human capital in other ways. Cambodia is the lowest ranking country out of the five measured on both the Global Talent Competitiveness Index 2018 (although there are no data for Myanmar) (Lanvin and Evans, 2018) and the Global Human Capital Report 2017 (WEF, 2017a). Although Cambodia's numbers are close to the low rankings of Laos and Myanmar, there is substantial distance to both Thailand and Vietnam.

Figure 5: Digital Readiness Index overall rankings (lower is better)



Sources: WEF (2016, 2017a); Lanvin and Evans (2018)

3 Cambodia's development model in a digital economy: opportunities and threats

As Cambodia's digital economy is advancing, its development is undergoing major changes. This section discusses implications of digitalisation for Cambodia and focused on the differential effects on different sectors of the economy: agriculture, manufacturing and services sectors (3.1-3.3). Section 3.4 pulls the knowledge together and summarises implications for inclusive development, by highlighting major gainers and those that gain less.

3.1 Digitalisation and agriculture: a gradual start

Poverty rates (national definition) fell from 52.5% in 2004, to 47.8% in 2007 and 13.5% in 2014 (ADB, 2014), although two thirds remain living under $5.5 a day. Whilst poverty dynamics are complex (CPAN, 2018), a large number of poor people number are in rural areas, where small-scale farmers practise agriculture at the subsistence level, using traditional methods with low productivity. Our overview suggests that a range of AgTech initiatives are already being used in agriculture. Table 1 provides a summary of the different types used in Cambodia. It refers to four types of AgTech digital technologies supporting the sector with innovative products and data to improve productivity and sustainability (Krishnan et al., 2019): (i) Ag-platformisation; (ii) Ag-optimisation; (iii) mid-stream technologies; and (iv) robotics and automation (these types are further discussed in Appendix A).

For example, Oxfam works with small-scale rice farmers in Preah Vihear province, in the central north of Cambodia, who are empowered with information about their supply chain and by electronic verification of the terms of their contract.[4] The project will test a digital contract between primary producers organised in an agricultural cooperative, a Cambodian rice exporter and a manufacturer in The Netherlands, to improve farmers' livelihoods and their supply chain conditions. It will also design an electronic user platform with an application providing full value chain transparency and traceability to the cooperative, exporter and importer, but also to end consumers. In this way, the consumer will know that farmers have been paid correctly for their rice, which will contribute to sustainable livelihoods. Consumers are enabled to make an informed and conscious choice for rice that complies with social conditions and fair production standards. This project provides transparency and information to the value chain actor. The smart contract will be developed using blockchain technology in the organic rice value chain, by registering all chain actors with unique identification codes on blockchain. Appendix B discusses Amru Rice and its use of blockchain in more detail.

Another example, run by the International Fund for Agricultural Development (IFAD) in Cambodian rice (under the Remote Sensing-Based Information and Insurance for Crops in Emerging Economies – RIICE – project)[5] relates to the use of Synthetic Aperture Radar (SAR) sensors and data used for crop-mapping. This uses the Global Positioning System (GPS) and optical sensors to monitor changes in surface roughness, soil tillage and/or crop-specific field activities, thereby making it possible to detect where targeted crop practice interventions need to take place. This project accurately measured crop yields. The big data generated enabled the

[4] https://cambodia.oxfam.org/BlocRice; https://cng-cdn.oxfam.org/cambodia.oxfam.org/s3fs-public/file_attachments/BlocRice_0.pdf

[5] http://www.riice.org/

development of index insurance products that were used to hedge farmers losses (an example of Fintech).[6]

Precision agriculture using digital soil-testing for small-scale farmers has been pushed by Intel's Grameen Social Business.[7] The E-Agro suite farming app is to be rolled out in 210 locations in Cambodia. The digital test characterises soil samples, GPS data and environmental data to provide real-time recommendations. By testing the nutritive chemical makeup of their soil, farmers can reduce costs and time lost owing to travel off-site to procure such information. Intel plans to develop its 'connected logistics system' to save shipping costs through early detection of lost products and shipment damage, especially important for products such as Cambodian rice. The atom processor technology enables Cambodian shippers to automate tracking and increase shipment visibility, by sending automatic alters to packagers' locations.

Another example is the CGIAR-funded 'Nuru',[8] which uses a mobile Artificial Intelligence (AI) assistant to detect cassava diseases. This application works without the use of internet and provided value added as it is linked to real-time experts, through PlantVillage, which provides on-demand information on particular aspects of cassava diseases. The data in the AI application is trained through convolutional neural networks that recognise crop diseases based on images collected at International Institute of Tropical Agriculture (IITA) research plots, with data relying on the cloud. Nuru helped identify Cassava Mosaic Disease in Oddar Meanchey province in Cambodia, where there had previously been only unconfirmed reports; with the help of continuous monitoring, yields significantly increased.

Table 1 summarises these examples. The evidence suggests that Cambodia has begun to introduce digital technologies to connect farmers to international markets; enable transactions; improve information; reduce transaction costs; and increase agricultural production itself. This is likely to support and transform Cambodian agriculture. However, there may also be losers and early adopters may displace some "middlemen" for example. There are also entry costs, e.g. learning about digital technology.

[6] Index insurance products using SAR were developed for South East Asia in collaboration with sarmap as part of the RIICE project (http://www. riice.org/).

[7] https://www.intel.com/content/dam/www/public/us/en/documents/solution-briefs/iot-agriculture-farm-to-fork-brief.pdf

[8] https://bigdata.cgiar.org/inspire/inspire-challenge-2017/pest-and-disease-monitoring-by-using-artificial-intelligence/

Table 1. Illustrative examples of digital AgTech in Cambodia

Project examples of AgriTech	Types of AgTech				Position in the value chain
	Ag-platforms	Data connected optimisation (sensors, video imaging)	Blockchain	Robotics, AI and automation	
	Big data analytics				
Blocrice: value chain Oxfam	Connecting importers, exporters, processors of rice and farmers. Generating data to gauge creditworthiness of farmers		Smart contracts for transparency and traceability of organic standard		Full value chain: production to retail
RIICE IFAD	Connecting to input suppliers	SR sensor to capture crop structures. Facilitates optimisation of yields and aggregating data for insurance products			Production and processing node of value chain Supporting FinTech: insurance providers
e-Agro suite Intel Grameen Social Business		Aggregating and big data analytics of information collected on soil characteristics. Data stored in the Intel cloud and analysed			Production node
Intel Connected Logistics Platform				Systematising and simplifying the traceability of products FOB using big data analytics and radio frequency identification (RFID)	Export logistics of the value chain
AI and disease identification: Nuru	Connecting to experts on the field to verify and monitor disease control measures through Plant Village	Video imaging data collected		AI machine learning algorithms used to teach the mobile app to identify cassava diseases	Production node

Source: Appendix A

3.2 Digitalisation and manufacturing: a missed opportunity

Cambodia has relied heavily on the manufacturing sector, and especially garment exports, during its recent growth. The garments sector currently employs more than 800,000 people according to the Cambodian government (and 80% are women, mostly under the age of 35), according to GMAC and supports many more livelihoods. During past elections, it has also been an important political base for Cambodia's leaders. Garments are characterised by relatively standard products in a wider global value chain; firms often headquartered in China manufacture (or assemble) in Cambodia at low cost and exporting to Europe or the US. Wages are low but the minimum wage has risen considerably in recent years.

A recent study on the prospects and challenges of Industry 4.0 for Cambodia's manufacturing sector (CDRI, 2018) provides two main reasons why Cambodia needs to embrace the change presented by the Fourth Industrial Revolution. The first is that such a change would help Cambodia become a knowledge-based economy that would take advantage of the current prevalence of a digitally savvy under-30 labour force. The second is that the development of ICT-enabling infrastructure would help facilitate future economic diversification in the country.

For the garment sector, ILO (2016) states that some automation has already occurred in Cambodia, Bangladesh and India. The report states that automation has reduced labour costs

per garment to about 10–20% of the basic garment variable cost, hence wage increases only marginally affect production costs. Savings are therefore made on reducing waste and producing higher volumes of goods. The report states that it is hard to predict when full automation may occur, especially in the sewing component of the process, which remains labour-intensive. Meanwhile, although technological advances have helped improve sewing accuracy, they have not yet replaced jobs, with most large-scale garment exporters stating that the replacement is unlikely to occur within the next decade.

The ADB report also states that current estimates place cotton shirt production unit labour costs at about $7 per item in the US, against $0.50 in India, $0.22 in Bangladesh and $0.33 in Cambodia. It is estimated that sewing robots could potentially narrow the gap to $0.40 per item in the US and Europe. There is therefore concern that developing countries may lose jobs. However, it is also noted that demand for apparel in Asia may help offset these loses as exports are reoriented towards Asia.

We examined a range of manufacturing establishments during the course of our research. The conclusions confirmed suggestions that few improvements were being made to adapt to and implement digital technology in the sector. For example, we visited a factory that provides plastic components of watches, importing materials from China and sending watches back to China after basic processing. The factory had not innovated in recent years and just followed orders from headquarters in China. In the meantime, machines were already performing some tasks, and the whole operation process may come under threat if, for example, the production is shifting more towards digital rather than analogue watches. Whilst the factory does not employ many people, it contributes to the enhancement of productive capabilities which has externalities.

Another factory, a garment firm in the same Sihanoukville Special Economic Zone, employs around 1,000 people in one shift. It is Chinese-owned and imports textiles and clothing from China for export to countries such as Denmark and Spain. The functions it performs are basic tasks. There have been few attempts to upgrade capabilities and few to no digital technologies have been installed. A strong rise in minimum wages, tripling with a decade, reduced its competitiveness compared to other countries, and one Chinese firm’s subsidiary in Myanmar was growing faster than its subsidiary in Cambodia. There has been no attempt to upgrade and increase the competitiveness of the workforce, such as through installing sewbots. Garment firms in other countries, including those with lower wages, such as Ethiopia or Kenya, seem to have installed more digital technology.

Another garment factory around Phnom Penh, employing 2,600 workers and supplying the US, has introduced more modern sewing machines, increasing efficiency by 40%. However, it is currently not planning to upgrade further, arguing that the costs are high and it has no provision for maintenance. At the same time, the profit margin is falling as wages are increasing (even though it is not the main sources of costs any longer), with production expanding more rapidly in Myanmar at times of rapid increases in wages. This leaves Cambodia on a dead-end road, with garment production that fails to upgrade and cannot compete on prices.

A Japanese-owned wire-harnessing factory supplying Toyota employs around 2,000 assembly workers with wages at or slightly above the minimum wage. It has introduced an innovation in its production processes once since its establishment in 2012, but apart from that has kept the same technology. It imports raw materials from the region and performs basic assembly tasks around wire-harnessing for export. Whilst the factory is using digital payment systems (mobile phones) to pay workers, it is not using the digital economy much for its production processes.

Table 2. Innovation, new technology and manufacturing firms: selected interviews

	Ownership, trading arrangements, jobs	Innovation and digitalisation
Assembler of watch components	Chinese-owned, imports and exports, 25 jobs	No innovation; whole business model may soon be out of date
Garments assembler	1,000 jobs, China; exports to Europe	No apparent innovation and weak performance in overall value chain
Garments assembler	2,600 jobs, exports to the US	One innovation in past (though mobile payment systems) but competition increasing
Wire-harnessing assembler	Regional imports, exports to Japan, 2,000 jobs	One innovation in past but unclear of position in value chains in future

Source: Interviews during 2019.

Data from the World Bank Enterprise Survey corroborate the findings of these individual case studies. Table 3 shows that very few Cambodian firms have their own website. What is notable is the very low percentage of exporting, foreign-owned and manufacturing firms that have a website compared with other countries.

Table 3. Share of firms with own website: Cambodia in comparison (%)

Country	Year of survey	All firms	Exporting firms	Firms with more than 10% foreign ownership	Manufacturing firms
Cambodia	2016	24.2	12.4	22.6	14.3
Myanmar	2016	13.2	22.5	29.7	17
Laos	2018	30.9	69.1	75.6	
Thailand	2016	45.5	88.1	90.5	
Vietnam	2015	48.6	57.5	46.8	
Indonesia	2015	20.5	54.4	74.7	

Source: World Bank Enterprise Surveys.

This picture of the manufacturing sector is concerning. There is stiff global competition and pressures to reduce costs at a time when minimum wages have increased rapidly. This would be fine as long as there were sufficient signs of upgrading and adjusting to the digital economy. However, our discussions with manufacturers did not indicate significant efforts to innovate or embrace digitalisation. Many low-skilled workers have been employed in the manufacturing sector, which has a short-term direct poverty-reducing effect, but there is too little emphasis on increasing the productivity of the labour force. This is likely because most manufacturers are locked into value chains dominated by foreign interests without incentives to innovate inside Cambodian subsidiaries. The primary motivation to invest in Cambodia centres around low wages and preferential trade access in the EU and US. A public response is required to enhance prospects for upgrading and productivity enhancements, and we discuss this further in Section 4.

3.3 Digital economy and services: significant advances in the private sector

The services sector appears to be different from the other sectors when it comes to digitalisation. While there has been little digital advancement in manufacturing, and some in agriculture, the services sector is full of digital applications. Recent developments and theoretical discussions suggest low-income countries have an increasing comparative advantage in exporting services across borders through digital means, as long as there is digital connectivity. A core question for Cambodia's development is whether these efforts are enough to offset employment losses elsewhere, how inclusive such a services-based transformation really is and how new digital apps are linked to agricultural or manufacturing production, shifting productivity permanently (dynamic efficiency) rather and a one shift in incomes (allocative efficiency). We discuss a range of services case studies, drawing on our visits, in Appendix B, and summarised in Table 4.

Table 4. Providers of digitally enabled services: selected examples

Type of services	Progress	Opportunities and challenges

Transport services: PassApp, Grab, Wego or TADA	Many TukTuk drivers now use one or these platforms	Excludes less technologically advanced drivers
Financial services: Pi Pay	Significant coverage accounting for some $150 million, compared with Wing, which processed $2 billion	Targeted initially at urban consumers; how can the poorest also benefit?
Transport services: BookMeBus	More efficient ticketing and greater occupancy	Dealing with those dependent on inefficient ticketing, control over receipts
Telecommunications sector	Competitive sector but dominated by major deals	Will this be rolled out to rural areas; who gains most from large telecomms deals?
Business services: Ink Animation	Initial progress with around 60 staff, exports of services to major companies	Can this sector reach scale in Cambodia? If so, how?
Business services: MangoTango	Founded in 2014, providing offshored (exports of) services e.g. for Google	Much scope for digital labour
Government	Weak implementation of e-government initiatives Significant telecommunications deals	Opportunity for progress, but threat it is the weakest link

Source: Interviews during 2019.

Financial services: A number of digital payment platforms are in place in Cambodia, serving different purposes.[9] One platform, Pi Pay, provides an electronic payment system, using European technology and partnering with a growing number of retail partners. There are many other payment systems in place, such as mobile phone-based systems that are used for salary payments, which have taken off, including in some of the manufacturing firms discussed above. But platforms such as Pi Pay have also taken off, as they combine ease of paying with retail opportunities. Pi Pay is operating in Phnom Penh and some other urban locations, hence the emphasis on serving urban consumers. It is important that Pi Pay enables transactions and reduces the cost of buying and selling but its effect on new and more efficient production is perhaps more limited. Benefits are likely to be targeted and involve reduced transaction costs.

Transport services: Transport in buses was until recently based on paper reservations and tickets were sold by middlemen. One company, BookMeBus, went through a start-up phase and has now become a mature company with more than 30 employees. Its website enables the booking of buses and helps raise bus occupancy. This is more efficient than previous experiences of middlemen and offices on location and has raised occupancy to currently 70%. The firm takes a small cut on the price of tickets. It is working to enhance the interoperability of different buses within one system. There are other examples such as last-mile delivery and food courier services which have been booming due to the technology disruption and quick adoption among young population. The leading delivery start-ups includes Joonak Delivery, E-Gets, Nham24, Muuve, FoodPanda, and others.

Digital start-ups: The emergence of digital start-ups and co-working spaces is a noticeable change in recent years in cities such as Phnom Penh and Siem Reap. These spaces enable individuals or small teams to come together, design and innovate. For example, the BookMeBus company started work from a co-working space in Phnom Penh. There are at least 300 active technology

[9] Some 13% of the population use mobile money in 2018, including (a) TrueMoney, which offers payroll services and international transfers to select markets, and is located in over 5000 locations across the country; (b) Pi Pay offers discounts at partner merchants when you use the Pi Pay phone app, they rely mostly on Pay&Go terminals for customers to top-up their Pi Pay wallet; (c) ABA-Bank E Cash, ABA's mobile app offers payment services like bill pay, money transfer and E-Cash enables money transfer recipients to withdraw money from an ABA ATM without needing an ATM card.

start-ups in Cambodia, at least 50 in Fintech, 40 in digital media and 30 in e-commerce.[10] There is much potential here, because half of the population is below 25 years and there is 120% mobile penetration, cheap data access, more than 7 million Facebook users and lack of financial inclusion (50% unbanked)[11]. Some 50,000 tech talents are employed, mostly in large companies, but there is a huge potential for talents staring small scale firms. Some 96% of Cambodians aged 18–35 have the desire to start their own company. Incubators such as Impact Hub organise competitions, aimed at fostering entrepreneurial and digital growth across the tourism, agriculture and urban landscapes.

The *telecommunications sector* itself is changing rapidly. According to TRC, the main mobile service, fixed service and internet service companies in Cambodia include Smart Axiata Co., Cellcard, Metfone, CooTel, CADCOOMS, Seatel, Camintel and Telecom Cambodia. In February 2019, Telecom Cambodia signed a memorandum of understanding with Chinese-owned Seatel. Seatel had previously invested around $300 million in the development of fibre optic cable networks in Cambodia, and contributed its future investment and collaboration to the relationship developed between the countries through the Belt and Road Initiative. In March 2019, Cambodia signed an agreement with Chinese Huawei to develop 5G mobile network technology in the country. The agreement also commits Huawei to future digital development in Cambodia. Cambodia is the first Southeast Asian country to sign such an agreement. In July of 2019, it was announced that Smart Axiata, Cambodia's leading mobile telecommunications company, would collaborate with Chinese Huawei in building the 5G network in Cambodia.

Business services: Ink Animation is a very promising example of the new opportunities in a services-led economic transformation. The firm is involved in animation of films and distributes animated films internationally through online means, using its good contacts abroad, including through a Netflx series. It employs some 60 staff, with plans to expand to 200–300 in coming years, and starting salaries are much higher than the minimum wage. It is a very good example of a promising digitally based services exporter in a lower-income country. Unfortunately, this activity it still low in scale, compared with that reached in Japan and India, among other countries.

Although digital innovations in the ride-hailing and bus-booking sectors are likely to increase the efficiency of the economy overall, it is not clear that they will have direct net positive effects on employment, and they are already generating hardship among specific employment groups. Offshore business services provide a more unambiguously positive story. There is considerable scope for absorbing educated labour through business process outsourcing or 'managed services'. In addition to the example of Ink Animation above, MangoTango is providing back-end processing for global brands such as Google and Facebook. Both currently employ less than a hundred employees, taking mainly university graduates and skilling them up by providing between two and eight weeks' training. Yet both believed there was plenty of scope for expansion, the main fear being that once they grew to a certain size they would begin to invite more predatory attention from various stakeholders. There were also some examples of 'sharp practices', in which cheaper, less ethical businesses could poach contracts and staff. The inclusive employment dimensions can be strengthened by NGO schemes to provide digital and soft skills training to disadvantaged communities, some of which these firms are already taking advantage of.

Despite significant advances in the private sector, projects to roll out digitalisation in government are much more modest, and previous initiatives have not led to satisfactory results.

[10] https://static1.squarespace.com/static/56a87acd05f8e263f7b16c7f/t/5c9b0762085229887ba9af72/1553663849501/Cambodian_Tech_Startup_Report_Final_250319.pdf

[11] According to NBC, around 50 % of the population has access to at least one financial service: either a bank account or borrowing account, an insurance account or an electronic wallet (e-wallet) account, see: https://capitalcambodia.com/fintech-to-promote-financial-inclusion-and-end-to-poverty/

3.4 Digitalisation and inclusive development: what is the biggest challenge?

The impacts of digitalisation are likely to be substantial and probably overall positive (e.g. the impact of broadband access on productivity are well understood, Banga and Te Velde, 2018a), but affected groups are likely to feel them very differently. There may therefore be significant distributional effects; such risks are not always acknowledged or addressed in official documents on digitalisation. Digitalisation is advancing rapidly in developing new applications, especially for use in the services sector; platforms are emerging rapidly; and in agriculture there are new advances. However, such advances are less clear for the future of the (manual/routine task) manufacturing workforce. Whole sectors look vulnerable in the future.

For example, some estimate that there are some 50,000 tech talents working in large firms such as banks and there are some 300 digital start-ups. The numbers working in the latter are rising. However, there are 750,000 (organised) workers in garments (according to GMAC) who may eventually lose or have to change their jobs. This could eventually contribute to political instability.

There will also be distributional consequences within sectors, such as transport, financial services or agriculture. While payment systems (e.g. Pi Pay) represent a significant advance, as they reduce transaction costs, they may benefit urban (middle-class) consumers more than other groups. PassApp and Grab drivers may continue to benefit from new digital technology, such as for bookings, but those who are not part of digital platforms may lose out. Applications such as BookMeBus are excellent innovations but they also replace (other) middlemen, and they themselves take a cut and a core question is whether this is and will be less in the future compared to traditional middlemen. Some countries, regions, firms and individuals benefit more from large telecommunication deals than others. Agriculture blockchain applications (e.g. Blocrice) will make agriculture more efficient but middlemen again may lose out (from dependency on inefficiencies).

Managing such differential impacts of digitalisation on different sectors and groups will be crucial to maintain inclusiveness while safeguarding political stability. Promoting inclusive development should be a central objective of the digital economy framework. Efforts need to be directed towards digital connectivity improvement to ensure nationwide network broadband coverage. However, the RGC faces a lack of capacity and political incentives to fully incorporate inclusivity effectively. A rather slow move towards e-government is indicative of this. We expect more from governments at a time when they are losing control to the private sector, start-ups, telecommunication deals, etc. Table 5 shows the EGDI (e-Government Development Index) is very low for Cambodia – and the rank actually declined between 2008 to 2018, to 145 out of 192 UN members included.

Table 5. E-Government Development Index rankings

	EGDI score	2018	2008
Thailand	0.6543	73	64
Vietnam	0.5931	88	91
Cambodia	0.3753	145	139
Myanmar	0.3328	157	144
Laos	0.3056	162	156

Source: United Nations E-Government Survey 2018

4 A policy framework for an inclusive digital transformation

4.1 A forward-looking digital economy policy framework: a review of what has been suggested

Several organisations and individuals have suggestions for what Cambodia should do next (see e.g. Banga and te Velde, 2018b; Heng, 2018; World Bank, 2018b; CDRI, 2018; UNCTAD, 2019). This section reviews this literature by comparing the suggestions in these documents with some of the areas that the RGC is currently considering in its long-term framework:

- digital hard infrastructure
- digital human resources
- digital business ecosystem
- e-governance
- digital trustworthiness, soft infrastructure.

Digital infrastructure is both hard and soft. Often, digital infrastructure is seen in terms of hard infrastructure, such as creating different networks with quality, affordability and coverage. While this is a very helpful step, it may not sufficiently outline soft infrastructure initiatives such as process-building or capabilities for operating and preserving data. As a comparison, ODI's framework outlines the development of digital infrastructure in five points (see Appendix C for further information): (i) infrastructure sharing; (ii) data infrastructure; (iii) innovation and intellectual property (IP) protection; (iv) technological and innovation hubs; and (v) regional approach to e-commerce and digital products.

The second point outlines soft digital infrastructure and discusses a comprehensive legal framework. Heng (2018) divides digital infrastructure into hard, soft and data infrastructure. Hard infrastructure here includes matters regarding transport. Soft infrastructure includes skills, data availability and support. Data infrastructure is the creation and sharing of trusted data. Heng thus provides a broader definition of digital infrastructure compared with what is commonly used. UNCTAD (2019) also discusses 'harder' ICT infrastructure and 'softer' infrastructure initiatives such as laws and regulations, training institutions, etc. The World Bank (2018a) similarly discusses both hard and soft infrastructure, though it puts most of its weight on hard infrastructure, such as the facilitation of energy networks.

Digital skills. It is encouraging that RGC has a human resources working group as part of its work for the long-term framework. More attention needs to go to considering how digital skills should be developed and implemented. There is also a need for soft skills within digital skills. Banga and te Velde (2018) define 'targeted skills development' as three separate categories: (i) job-specific digital skills; (ii) job-neutral digital skills; and (iii) job-neutral soft skills. Other literature also defines digital skills in categories of technical, cognitive and soft skills. UNCTAD further discusses the need for education policy that focuses on digital skills as well as complementary soft skills such as entrepreneurship, and mentions the importance of science, technology, engineering and mathematics (STEM)-focused education and lifelong learning. Appendix D provides further indications.

There is good coverage of **e-governance** in the Government's report. The concept note (RCG, 2019) and most of the other literature stresses the importance of government leadership in the transition into a digital economy. This includes measures such as a digitalised government master plan. Heng (2018) argues that the government must demonstrate digital leadership and transition into an e-government to ensure this development is visible throughout the economy. E-

government should be an integral part of the digital economy framework, as it also interacts with the rest of the economy. The Ministry of Economy and Finance (MEF) should have an overarching coordinating role. In this context, it would be good to ensure leadership of activities in line ministries such as MPTC.

Digital trustworthiness, law and regulation (part of soft infrastructure). Developing a comprehensive regulatory legal framework is something all policy documents on Cambodia's digital economy consider. Most stress the importance of creating digital trustworthiness and benefiting regional and international competitiveness. Most also stress the importance of regional coherence, such as ASEAN as a powerful system of coherent regulation.

Other studies also consider important points. Lopez-Gomez (2018) examines implications of digitalisation for Cambodia. Cambodian industries need to better understand the concept of Industry 4.0 and the current threats and opportunities. A nationally agreed response is required to ensure local firms remain competitive in light of rapid technological change and its impacts on employment. Firms should understand what upgrading and diversification opportunities exist thanks to Industry 4.0. Three major implications in Cambodia include:

1. It is not just about the introduction of a single technology (i.e. A.I.) but the gradual introduction of different combination of technologies, where the key challenge for Cambodia is on how to integrate them in its existing industries.
2. Industry 4.0 should not be thought of as just a threat; the opportunities for firms across all sectors should be considered. Cambodia's value chains should be analysed to identify areas where significant opportunities could be leveraged.
3. R&D is only one part of the policy challenge; other policy areas also need to be considered, such as standards, infrastructure, SME capacity, digital security, etc. There are several international examples that Cambodia could learn from.

ADB (2019) argues that Cambodia will need to build a skilled workforce that can adapt to rapid technological change, including automation and robotics. While the country has made progress in education, there is a widening gap between the skills in the workforce and those needed. Specifically, there is a large mismatch of skills between what industry requires and what is provided by formal education and technical and vocational training and education (TVET).

World Bank (2018) finds that, while the RGC is interested in enabling public electronic services (i.e. e-government), its efforts are 'siloed and fragmented' with no clear leadership or guiding framework and security standards. Comparisons on the online provisions of government services at the global level place Cambodia in the second quintile. ADB argues that, if Cambodia wants to benefit from digitalisation, it should invest in the necessary physical infrastructure, develop complementary regulations and support the development of required skills and institutions.

The report identifies four priority areas that could support digitalisation:

1. closing the digital gap by enhancing spectrum reallocation and mandating passive infrastructure-sharing among telecom operators
2. elaborating a Digital Skills Readiness Strategy
3. adopting laws in e-commerce, cybersecurity and data protection and privacy
4. aligning efforts towards implementation of the Digital Government Strategy.

4.2 Specific measures for an *inclusive* digital transformation

Notwithstanding the importance of a range of general policies on which there is reasonable consensus, including provision of digital hard infrastructure, digital human resources, a digital business ecosystem, e-governance and digital trustworthiness, Cambodia should also consider measure to enhance the inclusiveness of digital transformation. Without these additional measures, digitalisation may have severe distributional consequences.

4.2.1 Radically transform innovation in the manufacturing sector

Cambodia has a large manufacturing base, especially compared with other least developed countries. But it has major weaknesses as well. First of all, it is dominated by garments, and it has difficulties diversifying its manufacturing base. The product space for Cambodia has become more complex, but only to a limited degree, and it lags behind Vietnam and Thailand (CDRI and ODI, 2019). The Economic Complexity Index in Cambodia fell over 1995–2017, whereas that for Vietnam and Thailand increased. There are only minor signs of diversification into bicycles, footwear and, to some extent, maize, vegetables, sugar and palm oil. Cambodia also exports a limited number of promising products, such as machinery, metallurgy, chemicals and furniture (as revealed by product space analysis). Special economic zones have played a crucial role in kick-starting manufacturing.

The second weakness is Cambodia's place in value chains, which limits the incentives to innovate. World Bank Enterprise Survey indicators show that Cambodia scores very low on some digital indicators (see, e.g., Table 3). Many value chains involve basic manufacturing operations in Cambodia, headquarters in China and buyers in the US and Europe. The main reason manufacturing takes place in Cambodia relates to preferential trade access and low wages. Operations are of the simple assembly type. Anything that is more complex is produced in other countries. This applies to garments, bicycles and electronics. Chinese or Japanese owners are more likely to automate at home than promote innovation in Cambodia.

NEA (2018) provides further evidence that garments firms in particular have few inclinations to innovate (only 35% of establishments say they want to introduce new products, services or technologies, the lowest of all sectors, and compares to the total of 46% and more than 80% in education and finance and insurance) or provide training (only 10% of establishment provide training, compared to an average of 16% and 29% in finance).

Having examined a range of manufacturing factories, it is essential that government step in to help prepare these firms for a better digital future. A new incentives package (offering an ecosystem that encourages digital technology) should help attract technologically more intensive investment, encourage upgrading technology in factories and promote relevant skills, for example through an enhanced Skills Development Fund (SDF) and targeted TVET placements. RGC has now set up Enterprise Khmer under the Entrepreneurship Development Fund (EDF) which is a mechanism to promote SMEs and start-ups. New technology may lead to loss of jobs immediately, but it also helps with the competitiveness for future growth. It is better to have a digitalised manufacturing sector with fewer jobs rather than no manufacturing jobs at all.

One way to have a coordinated approach towards leapfrogging digital technologies in manufacturing is through the concept of digital SME clusters – see Box 1.

Box 1: Digital SME clusters

Even if the garment sector goes into decline, Cambodia may be able to take advantage of other Industry 4.0 opportunities. One proposal envisages creating mini-special economic zones (SEZs) for full supply chain manufacturing, linking, for example, basic agro-processing to progressively higher value-added agro-industrial products. This would involve clustered end-to-end solutions involving logistics, R&D, training, manufacturing (using robotics and 3D printing), certification and compliance, all linked using automated procedures and blockchain technology, with physical proximity strengthening feedback loops and innovation.

Cambodia's comparative advantage here has less to do with cheap labour or its openness to business – though both of these are significant – and more to do with the fact that the idea for this type of zone originates in-country. By being a first-mover in this field, Cambodia could potentially capitalise on a new approach to industrial organisation, just as Ireland, China and Malaysia did with respect to old-style SEZs.

There has been some momentum behind the idea of Industry 4.0 SME clusters since conclusion of the Industrial Development Policy of 2015; a memorandum of understanding with MIH in 2016 and UNDP and UNIDO in 2018; and links with SME banks. In the medium term there could be around 20 such clusters in Cambodia, each employing hundreds of low-, medium- and high-skilled workers. In the longer term, there may be scope for further expansion. According to the proposal's author, Cambodia has a real opportunity to leapfrog industrial stages and get ahead of its rivals. Government can do various things to help, for example providing a high-grade team of mobile, single-window officials to service the licensing and compliance needs of the zones, supporting within-zone renewable energy solutions and extending export processing tax exemptions to the SME level.

Source: Interview with Charles Esterhoy of WorldBridge International; and Esterhoy, C. (n.d.).

4.2.2 Provide skills for the future

What are the skills for the future?

The digital transformation requires a new set of skills, and Cambodia needs to step up its efforts to provide these. They apply to all levels of the education system. Table 6 summarises the skills for the future to support a digital transformation. Different authors and organisations use different terms, but we can summarise them in three categories. UNCTAD (2019) contains several definitions of the necessary digital skills and competencies for the 21st century. These are 'digital competence encompasses the knowledge and skills required for an individual to be able to use ICT to accomplish goals in his or her personal or professional life'. Digital skills cover technical skills, but also cognitive, and social and emotional, or soft, skills. They involve a complex and critical understanding of media and a multifaceted 'digital competence' that is constantly evolving. Box 2 also discusses digitalisation and basic education levels.

Table 6. Suggestions to provide skills for a digital future: technical, cognitive and soft

Studies/digital skills	Technical	Cognitive	Soft
Preparing Cambodia's Workforce for a Digitalised Economy (Heng, 2019)	Technical skills, including ICT skills: 'those abilities needed to carry out one's job… ICT skills refer to the effective application of ICT systems'	Higher-order cognitive skills: 'the ability to understand complex ideas, deal with complex information processing, adapt effectively to the various forms of reasoning, to overcome obstacles by critical thought'	Interpersonal skills: 'a broad range of malleable skills, behaviours, attitudes and personality traits that enable individuals to navigate interpersonal and social situations effectively'
Job-ready digital skills for decent jobs (ILO and ITU) (UNCTAD)	Basic digital skills (related to the use of technologies)	Advanced digital skills (coding and other algorithmic knowledge)	Soft skills (such as communication and leadership); digital entrepreneurship (online market research and using financial platforms)
Work-related skills (WEF) (UNCTAD)	Abilities (physical) Cross-functional skills (technical skills)	Abilities (cognitive); basic skills (content and processing skills); cross-functional skills (complex problem-solving)	Cross-functional skills (social systems, resource management)
Future of work (OECD) (UNCTAD)	Technical and professional skills (specific and often industry-specific skills such as installation and operation of robots)	Generic ICT skills (skills needed to understand, use and adopt technologies; life-learning ability to adapt to technology changes)	Complementary ICT soft skills (creativity, communication skills, critical and logical thinking, teamwork, digital entrepreneurship)
Digital Skills Toolkit (ITU) (UNCTAD)	Basic, intermediate, advanced: foundational skills; emerging and specialised skills (computational thinking and coding, data literacy, mobile literacy)	Basic, intermediate, advanced: competencies; emerging and specialised skills (computational thinking and coding, data literacy, mobile literacy)	Basic, intermediate, advanced: character qualities
The Digital Economy in Southeast Asia: Strengthening the Foundations for Future Growth (DDP)	Basic digital/ICT skills: ability to use digital technologies (e.g. send email, find work-related information on the Internet, use digital apps and non-specialised software, awareness and ability to stay safe in cyberspace)	Advanced and specialist skills: drive innovation, support digital infrastructure and the functioning of the digital ecosystem	Digital/ICT complementary skills: soft skills required to work in a technology-rich environment and address the expanding number of opportunities for ICT-enabled collaborative work (e.g. communicate on social networks, brand products on e-commerce platforms, analyse data gathered from the web)

Sources: Heng (2019); UNCTAD (2019); DDP (2019).

Heng (2019) argues that content skills, cognitive abilities and process skills will play a major part in the future core skills necessary in a digital economy. Out of these, high cognitive abilities are predicted to be required in more than half of all future available jobs. Further, there will be a change in demand for skills, whereby 'physical skills' will decline in demand and 'technical skills'

will increase in demand. Some 34.4% of employers in Cambodia currently express a particular shortage of technical or practical skills (ibid.).

In order for Cambodia to prepare for the emerging digital economy, key educational improvements are needed. According to the International Telecommunications Union (ITU) and its Digital Skills for Jobs Campaign, there is a growing need for skills such as basic digital skills (related to the use of technologies), advanced digital skills (coding and other algorithmic knowledge), and soft skills (such as communication and leadership) and digital entrepreneurship (online market research and using financial platforms).

Table 7 compares how Cambodia is faring in different types of digital skills compared to other Asian economies of Indonesia, Pakistan and Thailand. Table 7 shows that less than 30% of the population in Cambodia has basic digital skills of copying or moving a file or folder, using copy and paste tools and using basic arithmetic formula on a spreadsheet, as compared to almost 50% of the population in Indonesia having these skills. Less than 3% of the population in Cambodia has intermediate digital skills of connecting and installing new devices or creating electronic presentations and less than 1% of the Cambodian population has advanced digital skills of finding, downloading and configuring software or writing a computer programme.

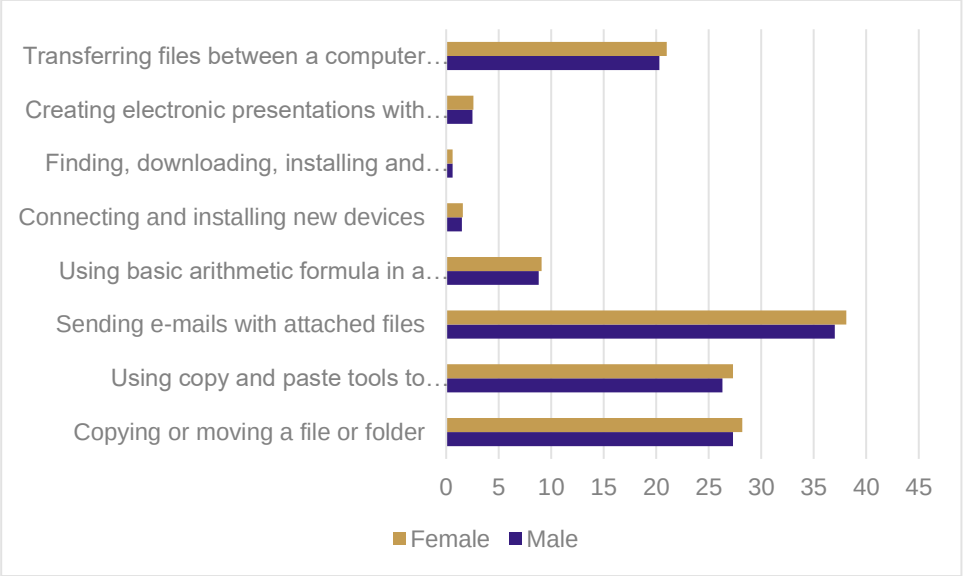
Table 7. Individuals with ICT skills, by type of skill (% of population).

Level of digital skills	Type of skills	Cambodia	Indonesia	Pakistan	Thailand
Basic	Copying or moving a file or folder	27.8	49.5	5.5	
	Using copy and paste tools to duplicate or move information within a document	26.8	49.5	4.0	5.1
	Using basic arithmetic formula in a spreadsheet	9.0	7.9	2.1	
Intermediate	Connecting and installing new devices	1.5	21.8		
	Transferring files between a computer and other devices	20.6	56.6	2.4	25.8
	Creating electronic presentations with presentation software	2.5	7.9	1.7	27.6
Advanced	Finding, downloading, installing and configuring software	0.6	12.5	3.4	7.4
	Writing a computer programme using a specialised programming language	0.1		1.5	

Note: Data are for 2016 or 2017.
Source: ITU (2018).

Although overall the Cambodia population is lagging in digital skills development, the percentage of females with digital skills is actually marginally higher than the percentage of males with digital skills, across all digital skills categories considered in Figure 6.

Figure 6: Individuals with digital skills by gender (%)



Source: ITU (2018).

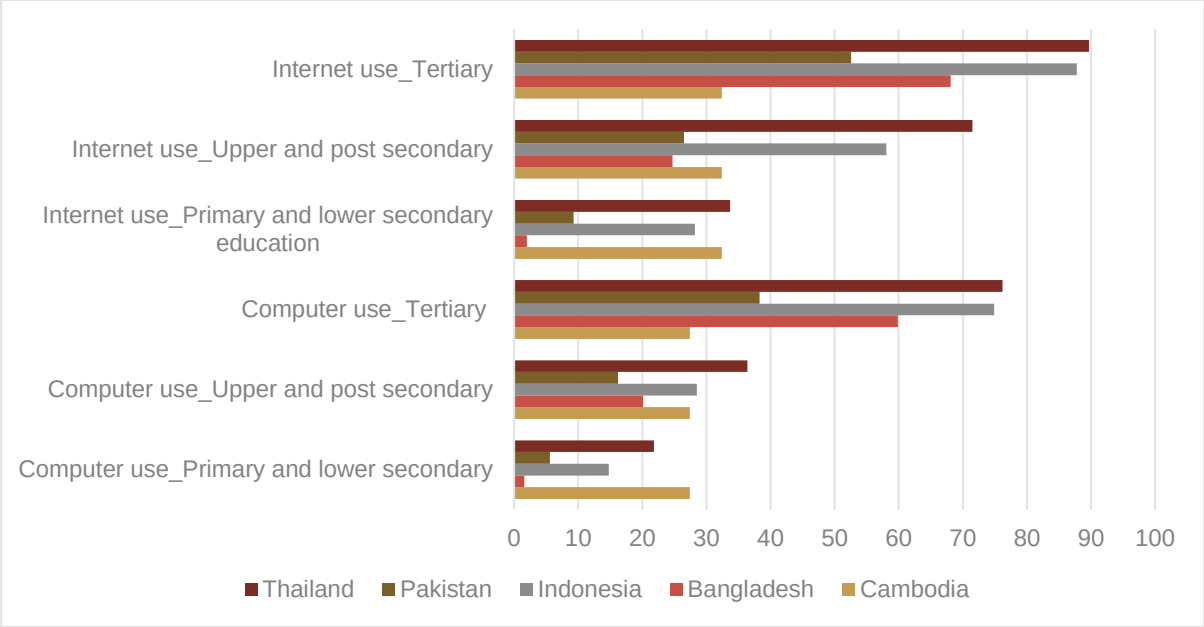
Is Cambodia's skills system set up to provide skills for a digital future?

A National Innovation Systems approach is a useful lens in mapping progressing on skills-development in the digital economy. Banga and te Velde (2019) highlight key mechanisms of skills-development in this framework. On the supply side, skills-development can be facilitated through three channels; a) formal education and TVET i.e. through schools and universities, b) non-formal TVET and c) employer led-training. **Formal channels** of skills development can target children in the formal education system through provision of digital and soft skills at different academic levels; primary, secondary, post-secondary and tertiary levels or through technical and vocational education and training (TVET) at the secondary and tertiary levels. **Non-formal TVET** channel targets out-of-school youth, marginalised sections of the society and adult learners. This kind of TVET training is provided by government institutes outside the formal education system; NGOs and civil society, international organisations and the private sector. **Employer-led training** forms the third channel, targeted skills-development of the existing workforce through a mixture of class-room based learning and private training.

Under the formal channel of skills-development, high-quality basic education remains a key priority for development of future skills. New skills for the future require high-quality basic education. Although some progress has been made in Cambodia's education system, there remain some key challenges for future development of basic skills. In the 2017/18 academic year, the enrolment rate for primary education was 97%, following a continuous rate of above 90% for the past decade (UNICEF and MoEYS, 2018). However, there has been a decline in the primary completion rate in recent years. For lower secondary education, the enrolment rate was 59% in 2017/18, continuing the trend of an enrolment rate at around 55% for over three years. For upper secondary education, the enrolment rate was just 24.3% in 2015/16. However, dropout rates for both lower and upper secondary students remain above 20%, with upper rates slightly higher. The prime reason for students dropping out was recorded in the 2014 Cambodia Socio-Economic Survey as 'economic factors', by 43.5% of female students and 36.7% of male students. Although progress has generally been made with regard to enrolment, many discouraging numbers seem to reflect the faltering quality within the educational sector (ibid.).

Figure 7 shows use of internet and computer, by level of education. Only 32.4% of individuals with tertiary education in Cambodia are using computers and internet, as compared to 68.1% in Bangladesh, 87.8% in Indonesia, 52.6% in Pakistan and 89.7% in Thailand. Cambodia fares better than the selected Asian economies in terms of internet and computer use by individuals with primary and lower secondary-education.

Figure 7: Percentage of individuals using computers and internet, by level of education



Source: ITU (2018)

There are many challenges in using digital technology in the supply of education and skills – see Box 2.

Box 2: The challenges of providing education and skills in a digital economy; views expressed in interviews

Following the Prime Minister's recent pronouncements on Industry 4.0, different ministries are trying to respond. There is a lot of commitment but currently some confusion and a lack of coordination. There is no central body in charge of the various initiatives. The MOEYS was trying to provide e-learning, social media, and online courses. But provision remains largely brick-and-mortar based, with little flexibility or use of new media. The teaching staff are still not qualified to use technology in the classroom, beyond, for example, using PowerPoint. There is little production of online resources or own-content. The idea of the Smart Classroom has been promoted with requests that some Universities do some pilots with blended learning, but with little take-up.

At a basic education level, New Generation Schools provide a new model. There are currently ten such schools in Cambodia, seven at secondary and three at primary. All are trying to focus on STEM subjects and digital literacy, with well-equipped laboratories and extended teaching hours and they also teach IT and coding, with each student spending an extra hours a week at least on science and a minimum of three hours in the computer lab each week. Teachers all have laptops and the schools have licensed a variety of educational software packages including TWEAK, the 3-D classroom, electronic formative assessment and X-reading, for reading out of class. The curriculum also encourages critical thinking skills and project work. As such, there are high hopes that over the next ten years the schools will produce a new generation of Cambodian leaders and innovators, filling a gap in high quality human resource development.

Such schools, are not, however, a particularly inclusive strategy. As well as recruiting teachers and heads extremely selectively, students are also selectively recruited, mainly by examination (though some schools also have a lottery component). This puts middle class students at an advantage. Although the socio-economic background of students is not rigorously measured, at Sisowath High School in Phnom Penh, only a fifth of students self-identified as poor. Some of the more rural schools are likely to have a higher percentage of recruits from poor families, although experience suggests it can be challenging finding students from rural communities that have the requisite literacy and numeracy skills to take advantage of the education provided. Moreover, the model is not one that can be rapidly scaled. To begin with, it is resource intensive. Although the approximately $250 per student per head that the schools cost is low compared to some ASEAN competitors (Thailand apparently spends $1600 per student on

education, let alone the OECD average of $9000 (2015)), it is much higher than the rest of the system. Even if funds could be found, there is considerable resistance from the mainstream teaching profession to expanding the model.

New Generation Schools are governed by operational guidelines which provide increased autonomy to schools but also require them to maintain certain standards, and, crucially to prohibit teachers providing private lessons to their own students. Since most Cambodian teachers rely on such classes to supplement their salaries, many Cambodian schools have turned down the opportunity to adopt the new model. A case in point is the Sisowath High School in Phnom Penh, in which the Ministry was forced to set up a 'school within a school' due to resistance from the existing teaching staff. When students from the new school vastly outperformed old school students in national examinations, teachers took to the streets to protest. Although the experiment has recently been recognised in the Government's Rectangular Strategy, it is fair to say that its future is not entirely politically secure. Thus it seems likely that the model will expand at best very gradually, and that it will take 30 years or more before the current experiment, based on only six secondary and four primary schools, can be replicated country wide. Given the global pace of technological change, New Generation Schools are not, by themselves, a solution. Recently, the Ministry announced a new, Grade B, school initiative, to affect an initial 50 schools in the country. These will not be as well resourced as New Generation Schools, but better than those in the normal school system.

The rest of the basic education system is also subject to reform. Teachers' salaries have improved dramatically and there also apparently some improvements when it comes to school inspections. However, the government has not yet prohibited private tuition, which arguably creates a conflict of interest with respect to public reforms—in the sense that teachers have a pecuniary interest in keeping freely provided education sub-par. Basic educational performance is still low. Recently Cambodia joined the PISA-D programme, but the results to date are not encouraging. Only 8% of the 30% of students still in school at age 15 met minimal acceptable standards in literacy and only 10% in maths. What this means is that only 3% of Cambodian 15 year olds are currently minimally proficient in maths https://riseprogramme.org/blog/PISA-D_low_learning. To provide some kind of comparison, in 2015 in Vietnam, only 5.9% of the nearly 50% of students still in school were *not* minimally proficient in science.

Moreover, the TPAP was devised before the current surge in interest around Industry 4.0 and remains geared to a largely conventional, frontal teaching approach—though there are some short courses for basic education teachers, some of which address digital resources. However, there is some anecdotal evidence that many teachers are resistant to the new methods, as it takes longer to learn the skills and longer to prepare lessons. In theory, the frontal aspects of teaching could be delivered digitally by the best Cambodian teachers, with classroom teachers playing a support role, facilitating group work, etc. However, they would need to be retrained to do so. Currently there are also infrastructure constraints. In many rural areas there is little broadband access and schools are digitally equipped.

Smartphones are widespread in Cambodia and apps are beginning to emerge that address some of the deficits in the traditional education system. For example, a locally developed app, Tesdopi, encourages self-learning and revision by making examination course curricula digitally available, with individual testing and feedback. Six months after launching it has good feedback and more than 11,000 users, with clear potential to scale. Nevertheless there are equity issues, since smart phones are beyond poorest families' reach.

At tertiary education level there is a plethora of donor-funded initiatives in both academic and technical education. They include improvements to facilities, curricula, and teacher training and they foster links to other research institutions and training institutes in the region and further afield, as well as to industry and SMEs. While on the face of things the sheer number of initiatives is impressive and to be welcomed, they currently suffer from a lack of overall coordination and are probably insufficient in scale to prevent Cambodia falling further behind its regional competitors, let alone the more developed world with which Cambodia is hoping to catch up.

Cambodia has been one of the fastest growing countries in the world in recent years thanks to its ability to exploit a low-skilled, labour intensive niche in the global market for garments. Modest initiatives in industrial policy, not least a tripartite arrangement between government, employers and labour, brokered by international actors, have facilitated this. But finding similar niches in the digital age is likely to be less straightforward. Conceivably, as we discussed above, Cambodia can continue to exploit its relatively

cheap labour by producing at the lower value end of global digital commodity chains. But the vast majority of Cambodians, on current trends, may not have the skills to compete, even at these levels.

Source: Interviews in July 2019.

A World Bank survey (2018c) highlights key policy and quality aspects in the Cambodian education system. Two key challenges were the 'timeliness of funds delivery to schools', where delays caused a decrease in educational operations and overall quality, and the 'poor' financial recordkeeping in many schools (p.50). The survey also evaluated different types of quality, including school, financial, classroom and environmental. In primary education, the survey showed that only 33% of schools had adequate student furniture, 56% reliable electricity, 64% safe drinking water and 60% adequate learning materials. In secondary school, the numbers varied from lower to upper, and only 32–56% had adequate student furniture, 48-75% reliable electricity, 37-47% safe drinking water and 49–69% adequate learning materials (p. 30). Secondary urban schools had the highest quality score out of 19 (12.6), whereas primary rural (8.9) and remote (7.5) schools scored the lowest (p. 35). Further, there was a distinct division between different areas: Phnom Penh scored the highest out of 19 (11.7) and Preah Vihear the lowest (8.1). With regard to financial quality, above 20% of all schools met 'the financial management requirements', although remote and rural schools showed a clear disadvantage (p. 38). With regard to classroom quality, secondary schools had lower scores (p. 50).

The UN Educational, Scientific and Cultural Organization (UNESCO) suggests there are additional threats to the quality of education in Cambodia, including 'uneven access, low quality of teaching and learning, dated curricula, informal costs for families, limited prospects for good jobs after secondary or tertiary education, a lack of vocational training and second-chance programmes, as well as a generally perceived low rate of return for completing basic education' (UNESCO, 2018: 10). Overall, primary and secondary education in Cambodia have shown some progress, there is a great need for efforts to increase quality.

One opportunity to enhance digital skills is through higher education. Total enrolment in higher education institutions has increased from around 20,000 throughout the 1990s to 174,000 in 2018, of which 106,000 students are enrolled in private establishment. However, there has also been continuously low enrolment in scientific fields 'because of the high unit cost and limited availability of highly skilled faculty members', resulting in only around 20% of students pursuing a STEM or agriculture education (World Bank, 2018d). Comparatively, higher education in Cambodia comes in behind its regional neighbours. While the tertiary gross enrolment rate of Cambodia is 12% (2011), Vietnam and Korea have numbers of 30% (2014) and 98% (2013), respectively. Further, while Cambodian STEM graduates are at 12%, Vietnam and Korea have 24% (2013) and 35% (2013), respectively (ibid.).

Another means to achieve more advanced digital skills is TVET. ADB approved a TVET Sector Development Programme in 2014 and the RGC implemented a second tranche in December 2017. As a result of this, the amount of trainees in TVET programmes facilitated by the Ministry of Labour and Vocational Training (MLVT) nearly doubled from 2013 (14,565 (18% female)) to 2017 (28,702 (20.7% female)). This increase is largely attributed to key policy reforms such as the IDP 2015–2025, the National Employment Policy 2015–2025 and the National TVET Policy 2017–2025. However, challenges remain, and TVET graduates reportedly still showcase 'slow adaptation to the new industrial working requirement and lack of motivation and interpersonal skills' (ADB, 2018a).

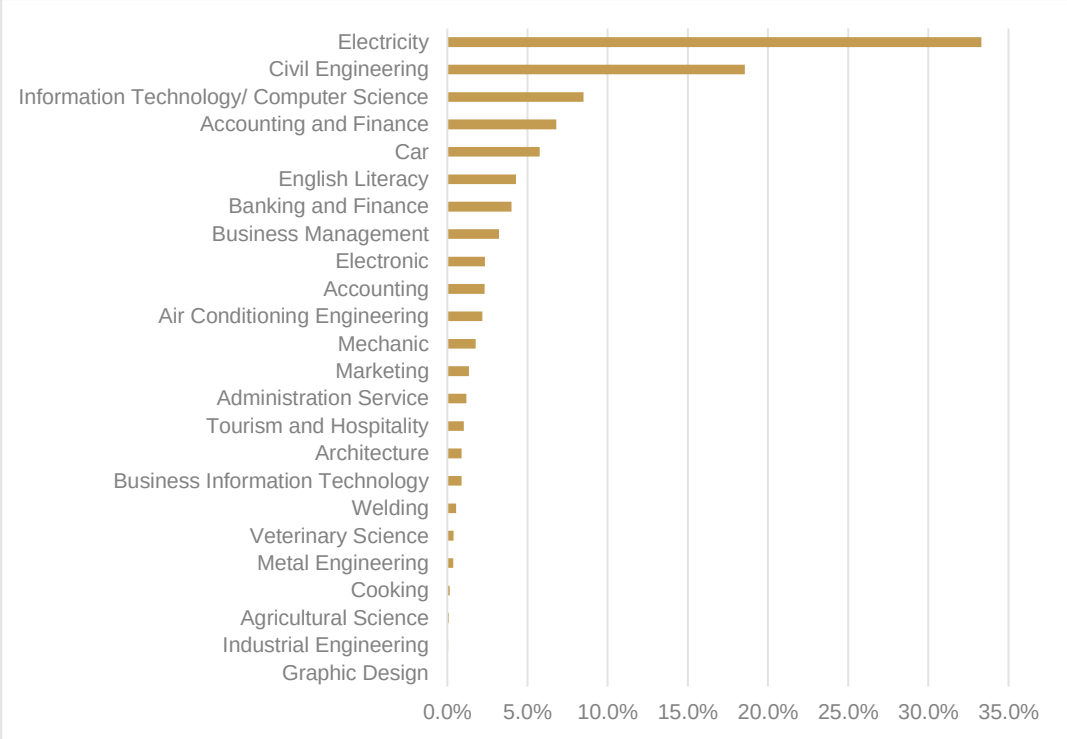
It is noticeable that TVET cover students very few manufacturing students (Table 8) – only 0.4% of the total – and that public TVET barely caters for skills that are needed directly in manufacturing (Figure 8). There is a considerable amount of students in electricity, civil engineering, accountancy and IT (together two thirds) but fewer in engineering.

Table 8. TVET students by sector

TVET students	Enrolment		Female	
	Number	Share of total	Number	Share
Electrical/electronic	12,067	28.0%	1,056	8.8%
Agriculture	10,693	24.8%	6,074	56.8%
Construction	7,449	17.3%	885	11.9%
Business/ICT	5,202	12.0%	2,210	42.5%
Others	4,963	11.5%	3,676	74.1%
Mechanic	2,627	6.1%	84	3.2%
Manufacturing	170	0.4%	3	1.8%
Total	43,171	100.0%	13,988	32.4%

Source: MoEYS.

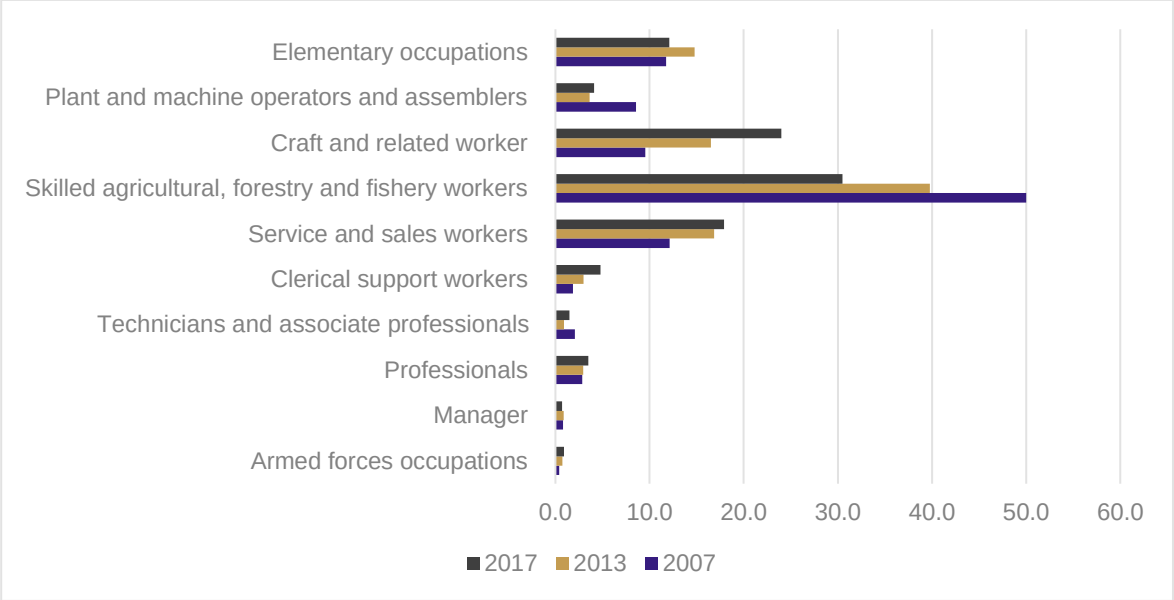
Figure 8: Public TVET students by skills (share of total)



Note: Total public TVET students: 29,797.
Source: MoEYS.

Data on employment by occupation support the view that there have been no major movements in the skilled share of employment, though there has been movement from one to another type of unskilled workers. Figure 9 shows that employment in agricultural occupations has decreased but it has increased in services and clerical workers. But there has not been a marked change in professional, technical and managerial occupations. This is concerning as we should see an increase in technical skills, especially in manufacturing.

Figure 9: Employment by occupation, 2007, 2013 and 2017



Source: SET and Socio-Economic Survey 2017.

Limited implementation and effectiveness of TVET programmes was further recorded in a 2017 survey conducted by the National Employment Agency (NEA, 2018). This recorded that only 20% of firms believed that their employees had good ICT skills. Further, over 45% of employers said it was hard to hire staff with right ICT skills (Heng, 2019). The three ICT skills most highly sought after for the future were managing online information (90.2%), online collaboration (82.0%), and analytics (49.2%). Reportedly, over 40% of employees also expressed that it was hard to find training to develop ITC skills such as 'coding, computer literacy, network security' (Heng, 2018). This proves that, though there has been progress in the development of TVET systems, these lack sufficient quality or effectiveness.

The current challenges to TVET systems, as outlined in ADB's policy brief on Cambodia's new Technical and Vocational Education and Training Policy 2017–2025, include lacking quality; negative perceptions; limited resources; limited acceptance of TVET qualifications across other education streams; and a lack of foundational skills among graduates. The primary issues that affect quality include 'a lack of a quality assurance system, outdated training methods and equipment, trainers that lack direct industry experience, and poor training infrastructure' (ADB, 2018b). In conclusion, there is evidence that the RGC is prioritising TVET systems but that more progress is still needed.

Targeted ideas to unblock the skills challenge

It is well known that a range of measures are needed to improve Cambodian skills and the education system, but we suggest targeted interventions that may help unblock a sub-set of these challenges. These would aim to (partially) address the lack of technical skills, especially in STEM, and in general the mismatch between what sectors need and what skills are provided.

The first solution would be to work with polytechnics to update curricula and work with (manufacturing and other) firms to create more space for internships. Box 3 below discusses the example of the National Polytechnic Institute of Cambodia (NPIC). It emerges that a combination of closer cooperation with industry, more support from business, selected allowances and a more flexible and forward-looking assessment of the content of courses needed could unblock some of the challenges. This could include more attention to manufacturing in particular. A coordinated but targeted approach is important here.

Box 3: National Polytechnic Institute of Cambodia

NIPC is a major Cambodian training institute that provides TVET training. It has been adapting gradually to changing needs but more work is needed for it to make a step change in the provision of skills to support digital transformation.

NPIC has eight faculties and focuses on nineteen majors/skills, up from five in 2005, with certificates for Grade 9 equivalence up to Bachelor level. It has 3,500 students, with 800 enrolments and 3,000–400 graduates each year, up from 260 students in 2005. Subjects have changed slightly: for example, civil engineering has become civil engineering and architecture and IT has been split up into smaller sub-subjects. Electricity is popular, having seen increased enrolments. This is impressive, but there are no plans to create new topics over the next three years, although digital technology will be included in all majors. No foresight studies have been conducted on the skills needed 10 years hence.

NIPC is self-financed with support from MEF. The number of students going through the system is limited by a number of issues. Industries send workers and NPIC trains them in special programmes relevant to their work, which can take three to four months. The RGC matches the costs but students still need to pay $600 per year. It is also difficult to get trainers, who earn around $400 per month (compared to $2,000 in the private sector).

Relationships with industry are improving, with human resource managers from companies coming to discuss the skills needs, including through links with, for example, a Hyundai or Siemens factor. NPIC has a job placement unit and coordinates with 182 industry partners. However, industry needs to organise and support the apprenticeship programme and to cooperate with training providers. Government regulation may help push industries to support apprenticeships.

More could also be done to enhance participation of vulnerable groupings. Poor people find it difficult to take advantage of NPIC training – despite the subsidised fees/ accommodation allowance – as they cannot forgo the lost income because they have family responsibilities (this is also a problem for garment workers). The school has had a recruitment drive but it seems important to support apprentices with allowances.

NPIC has cooperated closely with MEF on implementation of SDF training. NPIC took 153 of the total 500 students who participated in the SDF pilot, in subjects including civil construction, optics, restaurants and cooking. NPIC also wanted to offer mechanics and automation training under the Fund, as this is developing quickly (faster than construction/electricity), but businesses are not yet requesting this or sending workers.

Analysis suggests that a range of issues need to be addressed together to enable a push on digital skills: more (mandated) support from business, targeted allowances for selected students (e.g. through the SDF) and more forward-looking and flexible content of subjects taught.

Source: Interviews in July 2019.

The second idea, linked to the first, is to enhance the SDF, especially around digital skills. Previous government attempts have failed to substantially increase the level of skills, despite increases in budgets. MEF has now begun to implement a pilot SDF, which deserves more attention. This is dealing with the mismatch of skills, with 500 people using the pilot in the first year, with a planned further 1,000 people to access the fund each year. The budget is $5 million government funding, with a funding cap of $2,000 per student per year. The SDF targets five sectors: ICT, construction, electronics, tourism and manufacturing. Key stakeholders include schools and the private sector. Firms and service providers apply for funding, including in their application an outline of key performance indicators and objectives for training. The training courses are then approved (or not) and go to the review committee. MEF's role is financing only; MLVT is in charge of coordinating, providing standardisation, certification of training and recognition.

Other countries, including Singapore and Malaysia, have levied a modest skills levy on industry. This is something Cambodia can work towards while the industrial and private sector base is developing (ODI and UNDP, 2009). Skills development makes firms more competitive, and much of this should be self-financing, but this is not working in the case of Cambodia where firms

respond to what their headquarters (usually abroad) allow them to do, which is very little. Cambodia should continue the SDF and target the development of digital skills, as firms themselves, especially manufacturers in buyer-led value chains, have too few incentives to upgrade into these.

A final idea is to kick-start and provide momentum to the sector skills councils. These focus on four sectors – auto mechanics, construction, electrical works, and manufacturing. They aim to bring together the public and the private sector and can help address collective action failures around skills-building in targeted areas. Recent discussions indicate that the RGC still needs to seriously engage with these, for example by failing to allocate sufficient staffing to organising meetings, and doing this would help unblock some of the challenges.

4.2.3 Nurture the digital start-up economy for an inclusive economy

Cambodia has a vibrant digital start-up sector. This caters for the young and helps attract skilled individuals who otherwise might have worked in other countries. These workers are extremely valuable assets to the Cambodian economy. They develop new applications often for the new middle classes. For example, BookMeBus emerged through this route. This needs to be promoted, including through incentives for co-working spaces and returning migrants.

Ensuring that such apps also serve the bottom of the pyramid and promote an inclusive economy is perhaps a challenge. Public support should be directed at encouraging innovation that supports the poorest, accounting for where they live and work. This may need further incentives (e.g. impact prizes, solving investors problems) or complementary action.

Several organisations already support or invest in tech start-ups (EMC, 2019), for example Cellcard Lab, SmartStart, Business Model Competition; the ADB-supported Mekong Business Initiative and Mekong Angel Investment Network; Smart Axiata Digital Innovation Fund with investments in Joonaak Delivery, Morakot Technology, Nham 24 and Agribuddy; Belt and Road Capital Management with investments in Digital Classified Group and Sabay Digital Corporation); and EMIA, Insitor, Uberis capital. Organisations that support start-up support services include SHE Investments, Impact Hub, CIC, Small World, CJCC, Social innovation Lab and others.

Government could help support the **ecosystem for start-ups**. Start-ups often begin in co-working spaces, and treating these as public goods (these spaces also create externalities) from a fiscal point of view would be beneficial. SMEs Bank and Techo Startup Center have been established as to provide financial and technical supports to SME and start-ups. Encouraging return migration of skilled workers would also be good. Permissive legislation and implementation for regulation will be crucial here. For additional information:

There is no guarantee these digital start-ups will be inclusive or adapt their technology to the ‘bottom of the pyramid’ but companies could be supported to **overcome their collective action problems** (e.g. around firms could learn from each other on how they might design new apps that help the poorest in particular; bringing firms together for peer review and coaching would be useful), especially around the poorest. Impact prizes or similar incentives could help here.

4.2.4 Protect the most vulnerable from digital exclusion through targeted support

Any change will have winners and losers, even when the overall net benefits are positive; it may also involve larger gains for some than for others. Digitalisation could lead to winners, such as in activities that depend on digitalisation, such as Ink Animation. But there may also e-losers – and we have highlighted a number of examples in Sections 3 and 4.

ILO (2016) estimates that 57 % of the Cambodian workforce (over 4 million workers) face a high likelihood of automation affecting their jobs, with low-skilled workers, women, youth and less educated workers being more at risk. Sectors that are likely to be particularly affected by

automation include construction, and female-intensive sectors of retail and garments ILO (2016). Currently, the garments sector is also facing acute crisis due to the ongoing coronavirus pandemic. It is estimated that at least 200 factories in Cambodia will face raw material shortages and the worst case scenarios predicts roughly 160,000 workers affected. In other sectors, composition of skills is changing; for instance, the introduction of navigation and GPS systems, and platforms such as Uber, have lowered the barriers into entry into driving, allowing less-skilled workers to enter the occupation, pushing down wages for taxi drivers. But in countries such as Indonesia, the strong presence of a labour union has prevented taxi wages from dropping, with a large number of app-based rides actually creating secondary industries or helping in shifting informal workers to the formal sector (Banga and te Velde, 2019).

Rising work on digital platforms further reveals new challenges for social protection in the digital age. On the one hand, the increase in digital platform work- such as ride-hailing- can increase flexibility in work arrangements and job opportunities in Cambodia, but on the other hand, there is a risk of a "race to the bottom", in terms of labour conditions and standards, which needs to be addressed. In the digital economy, traditional employment relationships have also given way to new work arrangements that do not permit the identification of an employer and employee. Identification of employers, classification of workers as employees or independent workers and classification of platforms as brokers are key issues that need will need to be addressed for allocation social protection-related rights and responsibilities (Harris and Krueger, 2015).

There is rising consensus that social protection and collective bargaining needs to be strengthened in the digital age. The current National Social Protection Policy Framework (NSPPF, 2016-2025) in Cambodia provides overarching guidance for contributory and non-contributory (tax-funded) social security, covering both social assistance and social security (ILO, 2019). The social assistance subsidies poor and most vulnerable groups in the society, focusing on (i) emergency response, (ii) human capital development, (iii) vocational training, (iv) welfare provision to the most vulnerable people. Its coverage is about 10-15% of the population and incudes vocational training programme. Social security offers programs and schemes for protection people from abrupt loss/ decline of income through (i) pensions, (ii) health insurance, (iii) work injury insurance, (iv) unemployment insurance, (v) disability insurance (ibid). Overall, the social protection provision suffers from important challenges; it is highly fragmented, biased toward workers in the formal economy, lacks financial capacity development and capacity for existing mechanisms and programs are not yet sufficient for dealing with potential crises (ILO, 2019).

Social protection mechanisms in Cambodia need to be urgently revised and extended to vulnerable groups to deal with the transformational changes that the Cambodian economy is likely to see over the next couple of decades. Social protection needs to be extended to workers who are most risk of losing their jobs to automation- digitally excluded workers, those performing non-cognitive tasks, and workers whose jobs have been de-skilled- as well as digital labour. It is key to note that digital technologies are also improving the viability and efficacy of policy solutions, including those facilitating extension of social protection. For instance, as part of future goals, the NSPPF is exploring the potential of developing a comprehensive database management system for correctly identifying poor and vulnerable people by linking the system to the ID poor system (ILO, 2019). This can be facilitated by digital technologies and be particularly important in extending social protection to the poor, especially to deal with the on-going covid-19 crisis. As a response to factory closures during the pandemic, the Government has announced that it will pay 60% of workers' minimum wage for up to six months to deal with work suspension (although this requires co-operation from the factories), and vocational training in the event that production in suspended (VOA, 2020). Digital platforms will serve as an important tool in delivering these courses online and remotely.

We summarise in broad terms the social protection measures needed in Table 9. Support to address these vulnerabilities can operate at different levels:

- *Digital literacy for affected groups from digital platforms.* How can Tuk-Tuk drivers not connected to e-platforms be supported? Or retailers using physical shopping, not e-commerce? Can they be offered digital literacy or provided alternative job opportunities?
- *Social protection for directly affected groups*. Many digital apps will cut transaction costs and enable direct transactions previously enabled by middlemen exploiting inefficiencies. It is therefore important to find solutions for those that lose out from the move new technology, even though this may need to address only a few targeted groups.
- *Support for workers in affected sectors to diversify.* Some sectors and activities may disappear if no additional action is taken. Workers released from these activities need to be retrained. Manufacturing has a window of opportunity to implement digital technology (and this needs support); if this is missed, this could lead to the loss of many jobs.

Table 9. Social protection measures required to complement digitalisation

	Digital literacy and pro-poor digital infrastructure	Support for affected groups	(Re)training and sector support
Drivers or retailers not yet part of digital platforms	X		
Booking apps		X	
Blockchain in agriculture		X	
Garments and other manufacturing			X

Source: Text.

4.2.5 A public sector that leads by example

While the private sector is introducing many new digital solutions, the public sector is lagging behind (see also Table 5). A few targeted ideas will help foster digital inclusion.

First, the RGC should make significant steps to further ideas around **e-government**, so the public sector can move in tandem with the private sector. MPTC and MEF should consider a joint push. A more digitalised and transparent government will provide more accountability and a level playing field for all types of firms. One aspect of this would be to mandate digital payments over a particular amount. Another would be a softer version, to encourage a digital culture throughout the economy, including among the smallest and informal players. There will be political economy challenges to taking steps towards e-government; good leadership is crucial, and partial steps in selected ministries and departments could be a useful step, but risks leading to an un-coordinated approach which is less effective.

Advancing towards e-government is not a straightforward issue and requires further attention. On the one hand, Cambodia has a great deal to do to catch up, and Table 5 suggests that significant advances over the past decade have not materialised. On the other hand, it is possible for countries to many rapid advances, as appendix E clarifies. Estonia has made marked progress towards digital transformation and has become one of the leading digital economies in the world over the last two decades through a range of activities such as X-Road, Digital ID, e-Residency, and Digital Strategy 2020 . The key factors behind Estonia's success include (i) openness to change after independence, including through young leadership; (ii) privatisation and innovation; (iii) low costs of digitalisation; (iv) availability of ICT talent and closeness to digital leaders in Scandinavia; and (v) decentralisation and flexibility.

The second issue is around the **telecommunications sector** more broadly. While the lack of limitations and restrictions in the sector may have helped raised local and international investment, and internet prices are low, better regulation has become increasingly important in handling growth in the sector and in sharing the benefits.

Currently, the main regulator of the telecommunications sector in Cambodia is TRC. However, MPTC, the previous main regulator, remains important. TRC was established in 2012 as an independent and accountable regulator and is currently vested with 'regulatory and supervisory authority including the responsibility of issuing and administering licenses and the administration of Cambodia's radio frequency spectrum' (DFDL, 2017). Telecom Cambodia (TC) was established as a state-owned enterprise in 2006 in an effort to relieve MPTC as 'operator of Cambodia's fixed-line telephone network' and allow it to focus on policy and regulation (ibid.). However, TC is currently still under 'the technical administration of the MPTC and the financial administration of the Ministry of Economy and Finance' (ibid.). Because of the lack of a comprehensive telecommunications regulatory framework, TRC has discretion over the granting of licences, determination of terms and conditions attached to these and general policy-making surrounding the sector. TRC established the Law on Telecommunications in 2015 but there remains great 'disparity between regulations and some of the legal and technical practices in place' (ibid.). The granting of licences, and determination of fees, by TRC or MPTC, involves discretionary powers. A more transparent system that does not practice such discretion or potential conflicts of interests is crucial.

Linked to this, it will be important to ensure the poorest, rural and most vulnerable obtain adequate access to telecommunications services. There are accounts of how the gambling sector in Sihanoukville has benefited from broadband access between Cambodia and China, but cross-subsidisation is needed for digital connectivity of the poorest. It is not clear whether the current structure of the sector is sufficiently pro-poor.

Further analysis will need to be devoted to the influence of China on Cambodia's digital economy. Since 2013, the Cambodian government has moved steadily closer to China, geopolitically, a phenomenon reflected by increased loans and investment, especially in the construction and tourism sectors, and visible particularly in Sihanoukville (CDRI and ODI, 2019). China is also a major player in the global digital economy and may not take advantage of its close connections to enter that sector. It is involved in 5G expansion in Cambodia. Fintech company Alipay, has also begun to roll out in Cambodia, currently catering mainly to Chinese tourists via a partnership with local firm Pi Pay.12 E-commerce giant Alibaba recently announced that it would make Cambodia its regional logistics hub. While Amazon has expanded into Vietnam, a spokesman for Alibaba stated that, 'the Chinese government's relationship with Cambodia has guaranteed Alibaba the resources and ease of regulations that are not found in neighbouring countries. China's ties with the government are another factor behind this logistics (move). Cambodia is very close to China which makes doing business here easier when one has access to the central government.'[13]. It may be only a matter of time before it also enters the e-commerce sector. What kind of deal Cambodia will be getting from such investments remains to be seen.

[12] https://www.thepaypers.com/mobile-payments/alipay-pi-pay-partner-for-mobile-payments-in-cambodia/771367-16#

[13] https://capitalcambodia.com/e-commerce-giant-alibaba-makes-cambodia-its-regional-logistics-hub/

5 Conclusions

Cambodia has introduced a range digital policy initiatives dating back to at least the early 2000s. Attention to ICT has increased over the past decade including through development plans. Relevant policies and strategies include the Rectangular Strategy Phase IV, Cambodia's ICT Masterplan 2020, the Telecom/ICT Development Policy 2020, the National Strategic Development Plan 2014–2018, the Industrial Development Policy 2015–2025 and the Cambodia Sustainable Development Goals Framework 2016–2030.

Several publications, by UNCTAD, ITC, the World Bank, EIF and others have discussed Cambodia's advances in the digital economy in great detail. The main conclusions are that internet penetration is rising fast and mobile phone and social media use is also growing fast and at very high levels, but Cambodia's digital readiness more generally still appears low in a comparative context, at least against its neighbours Thailand and Vietnam.

The impacts of digitalisation are likely to be substantial, but different groups are likely to feel very different effects. There may therefore be significant distributional effects, and official documents on digitalisation do not always acknowledge or address such risks. Digitalisation is advancing rapidly in the development of new applications, especially for use in the services sector, platforms are rapidly emerging and in agriculture there are new advances, but progress is less clear for the future of the (manual/routine task) manufacturing workforce.

Whole sectors look vulnerable in the future, and there will also be distributional consequences within sectors, such as transport, financial services and agriculture. Managing such differential impacts of digitalisation on different sectors and groups will be crucial to maintain inclusiveness while safeguarding political stability. Promoting inclusive development should be a central objective of the digital economy framework. However, government faces a lack of capacity to play such a role effectively. A rather slow move towards e-government is indicative of this. We expect more from governments at a time that governments are losing control to the private sector, start-ups, telecommunication deals, etc.

We discuss policy suggestions for Cambodia based on a range of relevant publications, comparing the suggestions in these documents with the areas that the RGC is currently considering in its long term framework:

- digital hard infrastructure
- digital human resources
- digital business ecosystem
- e-governance
- digital trustworthiness, soft infrastructure.

There is an important set of general policies on which there is reasonable consensus. However, Cambodia should also consider targeted measures to enhance the inclusiveness of its digital transformation. Without these additional measures, digitalisation may have severe distributional consequences for the country. These can be summarised in the following five-point digital agenda (and discussed in the executive summary):

1. Radically transform innovation in the manufacturing sector.
2. Provide skills for the future.
3. Nurture the digital start-up economy for an inclusive economy.
4. Protect and enable the most vulnerable groups to take part in the digital economy.
5. A public sector that leads by example.

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Appendix A: What is AgTech?

AgTech refers to digital technologies providing the agricultural industry with innovative products and data to improve productivity and sustainability. There are four broad segments of AgTech (Krishnan et al., 2019):

a) Ag-platformisation;
b) Ag- optimisation;
c) Mid-stream technologies; and
d) Robotics and automation.

(a) Data connected agriculture through platformisation (service delivery) consists of Ag-market places or platforms which connect farmers with retailers or processors in the value chain or input suppliers such as fertiliser and chemicals manufactures, seed suppliers, credit agencies and ag machinery service providers. Ag-Platforms can serve as (i) '*marketplaces'* or virtual intermediaries that match buyers and sellers; or (ii) as '*trading and sharing'* platforms, which allow business-to-business renting of inputs such as hardware (tractors, sprayers), software (including IoT equipment) and knowledge sharing; and (iii) as *add-ons to extension services* such as health services or insurance services that provide socio-economic protection to the users of platforms. Furthermore, already established platforms such as M-Pesa can be used in conjunction with AgTech platforms.

(b) Data connected AgTech for optimisation consisting of a range of software and services such as farmer enterprise resource planning (ERP)[14] optimisation, decision software and sensors to improve crop productivity, are hardware devices that are used in precision agriculture. For instance, sensors provide spatial and proximate information, location sensors; optical sensors use light to measure soil properties, electrochemical sensor measure soil nutrient levels; soil moisture sensors to unearth soil water levels. The sensors can be used through multiple ancillary devices that can be used as handheld sensors, for instance through smartphone cameras, pictures of leaves can be taken. These pictures are aggregated to develop a large dataset that can help predict diseases of leaves. Sensing technology is used to monitor yield, variable rate of fertilisers and pesticides, spraying, mapping soil water levels (smart irrigation) and soil quality; and for disease identification. Thus, big data analytics are combined with hardware to create tools for increasing productivity and efficiency of production.

(c) Midstream technologies such as blockchain, are decentralised, distributed and public digital ledger that are used to record transactions in blocks across all computers. This prevents records from being altered retroactively, as such an alteration would involve significant time and cost implications, as the alteration would need to occur across all subsequent blocks. Digital ledgers of economic transactions can be programmed to record nearly all forms of transactions. These are relevant because they enhance traceability requirements, and help farmers adhere to standards. Blockchain enabled platforms can trace a product's provenance, carry detailed attributes for the product in each transaction and ensure its authenticity. It also reduces transaction costs, by disintermediation of transactions in agricultural supply chains and the use of smart contracts enable frictionless and real-time payments for agricultural financial services. This provides real time management of the overall value chain.

(d) Robotics, AI and automation. These technologies make use of digital technologies such as drones and other autonomous equipment for monitoring and remotely controlling agricultural processes. For example, drones are unmanned aerial vehicles used in agriculture for monitoring

[14] An ERP software system can integrate planning, purchasing inventory, sales, marketing, finance, human resources, and more

and data capturing. They are commonly equipped with sensors that enable the capturing of images, which can support crop monitoring. Companies such as Hello Tractor, by IBM have used Internet of Things technologies to develop driverless tractors that till farmers land effectively, while gathering data on soil properties across North America and Africa.

Appendix B: Case studies - private sector experiences of digital economy in Cambodia

Transport sector: BookMeBus

BookMeBus is an electronic ticket booking system for bus, van, and ferry tickets and private taxi across Cambodia. All tickets can be purchased and generated online through both a web-based platform and mobile app. BookMeBus covers 60-70% of the Cambodian electronic bus ticket market, capturing 50 of the around 70 bus operators.

BookMeBus founder Chea Langda established the start-up in 2015, appreciating that there were significant inefficiencies with bus and taxi booking systems in Cambodia and realising that electronic ticketing was a significant gap in the market. His team has worked to move people from offline to online ticketing, educating them about the functionality of online ticketing and promoting digital literacy.

Building trust in the digital platform was crucial to success as Cambodian travellers have traditionally had little trust in online services. Reflecting on Cambodia's new E-Commerce and Consumer Protection laws, he suggested that a law to protect businesses and consumers was needed.

BookMeBus has also had to build trust with bus companies and incentivise them to the adopt BookMeBus's systems – at first they were unable to see the benefits. BookMeBus can help small operators and SMEs to increase their occupancy by up to 70% by going digital through the BookMeBus system, which effectively develops an online presence and undertakes online marketing for operators on their behalf.

The BookMeBus system integrates with a wide variety of electronic payment systems including Pi Pay, Wing and those of major banks like ABA Bank. An additional challenge of working with bus operators is that, being family businesses, they have traditionally sought to avoid banks. 'Winners' - those benefiting from the system - include those bus operators part of the system, government, the tourism industry and the consumer whilst losers include those who have traditionally benefited from inefficiencies in the Cambodian bus ticket market including middlemen ticket sellers. He explained that the platform improves the quality of the service offered for consumers. It allows passengers to provide feedback on operators including in terms of safety, price and quality which is fed directly to the business owner.

BookMeBus requires an extensive team with IT and programming skills for quality assurance of the app, machine learning etc. They have, over time, had to hire more senior programmers. BookMeBus has focused on attracting Cambodian graduates who have studied abroad and also take international interns, mainly from France, through the Impact Hub. The company started in a home office, before moving to a private room in the Emerald Co-working Space and then eventually to a series of dedicated office spaces.

Finance services: Pi Pay

Pi Pay is a cashless payment platform - built around an app that incorporates merchant payment services along with additional features such as chat and maps. It is partnering with a growing network of retail partners. Pi Pay's CEO Tomas Pokorny argues that Pi Pay operates on an open loop system with which banks and other financial institutions can integrate. In this way, Pi Pay encourages users to send their money from their bank to Pi Pay and then to the merchant.

Such open networks work better than closed networks in Cambodia because the market is so scattered. He did acknowledge that there are challenges with this approach given the low bank account registration in Cambodia but that Pi Pay is working to attract Cambodia's 'unbanked' by, for example opening its infrastructure to partners in rural areas, such as microfinance institutions such that it will soon be possible do cash out with Pi Pay.

Practical government support such as tax exemptions to the private sector could further strengthen the digital economy in Cambodia. Whilst Pi Pay initially outsourced the development of its mobile transaction technology to the Germany company Wirecard, it is now gradually moving operations in house and building the requisite skill set required to service it. Pi Pay has developed a business tool kit and is planning to train local staff with it over the coming years.

Pi Pay initially experienced challenges finding developers with the requisite experience and knowledge of financial services applications. Cambodian universities do not teach the digital skills his company requires and often provide instruction in outdated technologies. Relevant skills are therefore generally developed through on the job training.

Pokorny has recently set up the Cambodian Finance and Technology Association which will operate like a business association and work to influence policy makers in the area of finance and technology whilst also focusing on practical implementation support for members.

Entertainment services: Ink Animation

Ink Animation is an animation and post-production studio based in Phnom Penh. It provides outsourced animation services for both Cambodian and internationally distributed animated television series, including Netflix series and animated feature films.

Animation is a higher order skill set and growing industry where demand is outstripping labour supply. Cambodian universities generally do not teach the skills required by Ink Animation. There is one animation school in Cambodia, located in Battambang and some graphic design schools in Phnom Penh. It is nonetheless difficult to find students with the requisite skill set. Ink Animation therefore provides in house training to employees and has developed an online curriculum, which is currently being expanded.

It is possible for an animation firm to have a dispersed labour force and that the Ink Animation model could theoretically be replicated in the provinces, as the only resources required include digital files, hardware, internet and electricity. Internet coverage is very good across country but access to reliable electricity in the provinces could cause challenges.

Drawing comparisons with his previous experience in the Cambodian garment industry, whilst the garment industry is heavily regulated (due largely to international pressure), this is less so the case in the animation industry (apart from requirements to pay at least the the minimum wage used in garments). There are no helpful animation industry associations to support Ink Animation's work. This is in contrast to the garment sector where there are strong industry associations (and the ILO) which work together to create standards and influence government.

Agriculture: Amru Rice (Cambodia) Co., Ltd

With extensive experience working for non-governmental organisations in the field of community development, Mr Saran Song founded Amru Rice (Cambodia) Co., Ltd in 2011. The company initially focused on buying Cambodian rice from traders and then exported. Since 2013 onwards, the company started its integrated operation from farms to potential buyers. Specifically, it cooperates with contract farmers and brings organic rice sustainably produced and harvested by these farmers to its own milling and processing facilities before sending out to the market. Organic Jasmine rice, Rumduol rice, rice paper, and rice noodle are its core products currently shipped to Europe, Singapore, China, Malaysia, and the United States.

The company hopes to improve the livelihood of poor Cambodian rice farmers and, at the same time, wants to become the top rice exporter nationwide. So far, it has recruited contract farmers from Preah Vihear, Kandal, Battambang, and Kampong Thom province. Because it strictly adheres to organic certification standards, all recruited contract farmers are required to never use pesticides or genetically modified organisms and are taught about the technical know-how aspects of this requirement by the company itself. Together they are able to produce high quality organic rice which has a high margin in the export market. The farmers, therefore, are paid far more than what they had previously earned from their harvest.

The company is growing over the years. In 2016, it recruited 2,500 contract farmers and sold 11,000 metric tons of organic rice. Now the numbers reach 10,000 and 30,000 respectively. Such growth stresses the need for the company to digitalize its business process more. Unlike before when the process involved a lot of paperwork, today's contract farmers can use the company's Smart Farm App on their smart phones to organize profiles, record harvest values, calculate payments, and monitor progress. They can easily bring all the data being stored in the App to the bank of their choice in case they want to seek loans. At the milling and processing facilities, the company has automated some processes to increase efficiency and implemented the Supervisory Control and Data Acquisition system to help identify and fix operation issues on time. For export, the company utilises block-chain technology to improve and enhance communication in the entire value chain.

Human resource is the main driver behind the company's success. However, the company finds it very difficult to find people with not just commitment but also skills able to use its technology. New recruits have to go through a lot of on-the-job trainings before they can actually do their jobs well. Other challenges facing the company include water shortage and issues concerning rice quality. Typically, the company receives assistance in the form of technical support and subsidy from relevant development organizations and the government, especially the Ministry of Agriculture, Forestry, and Fisheries.

Manufacturing: Wire-Harnessing Company (name requested to be withheld)

This Japanese factory, which requested to remain anonymous, produces wire harness (floor, side, and front panel wire harness) for Toyota automobiles. All of their products are exported to Japan. It was established in 2011 and began its operation in 2012 in Phnom Penh Special Economic Zone. Back then, it had a total of 600 employees. Now, there are 2,000 workers and 54 office staffs. There are also four expatriate technicians who are changing every three to six months.

The factory serves as an assembler. They receive purchase orders and needed designs from the headquarter in Japan. Then, they purchase input materials by themselves from Japan, Thailand, the Philippines, and Vietnam. Machines operated in the factory include cable rolling, cutting, cutting and crimping, stripping, and taping machines. Information related to the cables (width,

length, etc.) are put into computers before printing out as a barcode. The barcode will then be scanned into the cutting machine. Despite all these technologies, the factory still relies on workers throughout their assembly lines. The cutting and crimping machine is the latest technology that the factory has begun to use since 2016. Besides this upgrade, the factory also increases the number of production lines.

In the factory, both internal and external communications rely on digital technologies which include internet and email, VoIP and TV conference. Employees receive their salaries through electronic transfers, particularly via bank and Wing. Interaction with the Ministry of Labour and Vocational Training regarding to the National Social Security Fund and the Ministry of Commerce for certificate renewals can be done easily via the publicly provided online platforms. However, other relevant ministries still require a lot of paperwork due to their limited digital adoption.

The lack of skills is one of their biggest concerns. Recruited workers do not have enough skills needed in their factory, so all of them have to undergo on-the-job trainings. New workers generally receive a four-week training depending on their roles and responsibilities. The retraining for all workers is held annually. Since Technical and Vocational Education and Training institutes in Cambodia lack quality equipment for practices and do not provide specific technical skills required in the factory, it tries to solve this issue by offering internship opportunities to students. Some of them are recruited right after completing their internships.

Manufacturing: Garment Factory (name requested to be withheld)

Started its operation in September 2005, this garment factory supplies products for some well-known brands, such as GAP, Walmart, and Old Navy. There are two factories in Cambodia, two in Indonesia, five in Vietnam, and one in Central America. The interviewed factory is based in Phnom Penh with 2,600 Cambodian employees and 33 expats. The highest educational attainment of workers is grade 12, while the lowest is illiterate. All office staffs have Bachelor's Degrees.

An auto-fabric spreading machine unrolls and cuts fabric with the help of several workers. Fabric is stacked before being transferred to an auto-cutting machine.

Ninety percent of the products are exported to the United States while 10 percent are exported to Canada. Imported materials are 40 percent from China, 40 percent from Vietnam, and 20 percent from Korea. Cardboard boxes and elastic bands are purchased locally. Machines used in the factory include sewing, overlock, buttonhole, buttonhole attachment, auto-cutting, and auto-fabric spreading machines. Most of them are Japanese products, while the others are Chinese products. In 2016, to increase productivity, the factory began to replace old sewing machines with modern ones, which can cut the thread automatically after sewing. They also started operating auto-fabric spreading and auto-cutting machines. Such upgrade increases efficiency by 40 percent comparing to when they spread and cut fabric manually. On top of that, quality of the auto-cut fabric is higher and more unified than before.

Despite that the factory currently does not plan to further upgrade its technologies, they agree with the benefits of technological advancement, and they would prefer upgrading as well. However, the cost of upgrading, though decreasing, is still high. In addition, maintenance is also quite challenging for the factory because they lack maintainers, and spare parts are mostly imported. Hence, the factory still employs nearly the same number of workers since 90 percent of production relies on workers.

An auto-cutting machine cuts the stack of fabric accordingly to patterns input by an operator. Several other workers then group similar-pattern fabric.

While their products are getting cheaper, the cost of production, specifically wage, is increasing (minimum wage increased from USD55 in 2007 to USD170 in 2017 and USD182 in 2019). The factory stated that the minimum wage in Cambodia is relatively higher than that in other countries. They find it hard to compete with other factories in India, Pakistan, Myanmar, etc. since their profit margin is getting smaller. Another challenge is competition in recruiting workers. The lack of workers which may partially be due to migration intensifies the said competition. Particularly, some Chinese factories would increase salary to attract workers. Their other concerns include too many holidays, labour law ambiguity, unstable mobile communication service, and complication from workers' union.

Appendix C: Comparing policy suggestions for a digital economy

This appendix compares policy suggestions in seven documents (RGC, 2019; Heng, 2018; Banga and te Velde, 2018, UNCTAD, 2019; World Bank, 2019; CDRI, 2018) based on the five areas government's draft concept note: digital infrastructure, human resources, ecosystems, e-government and digital trustworthiness.

	Digital Infrastructure (hard infrastructure)	**Digital Human Resources**	**Digital business ecosystem**	**E-governance**	**Digital Trustworthiness: Law and Regulation (soft infrastructure)**
The Concept Note	Digital infrastructure development A common digital payment system Physical address is needed for goods and services delivery	Digital transformation needs leadership and supporting skills	Private sector plays key role to scale up digital economy PPP in developing digital infrastructure	Government has to take lead in digitised service and enable digital business	Law and Regulations are needed to support digital economy Digital trustworthiness is pillar for building Cambodia digital economy The coordination mechanism to sustain development digital economy
ODI Study: How to Grow Manufacturing and Create Jobs in a Digital Economy: 10 Policy Priorities (Kenya)	Improving access to internet and digital services through 'infrastructure sharing' Building a national data infrastructure Promoting innovation for 'glocalisation' and protecting intellectual property rights Developing a well-embedded manufacturing ecosystem of digital and manufacturing start-ups and technology hubs Using regional approaches on e-commerce and digital products	Targeted skills-development to increase absorptive capacity of the workforce	Developing a well-embedded manufacturing ecosystem of digital and manufacturing start-ups and technology hubs Financing digitalisation of manufacturing through lowering the cost of capital, new sources of financing, reducing interest rate spreads and introducing lower collateral requirements for new investment Focus on problem-driven governance to create a digitally enabling environment with flexible institutions,	(Implicit in the other points)	Building a national data infrastructure Using regional approaches on e-commerce and digital products Focus on problem-driven governance to create a digitally enabling environment with flexible institutions, better dialogues, permissive regulatory practices and inclusive growth

	Digital Infrastructure (hard infrastructure)	Digital Human Resources	Digital business ecosystem	E-governance	Digital Trustworthiness: Law and Regulation (soft infrastructure)
	Improving transport infrastructure, trade logistics and postal competence for better market access for manufacturers		better dialogues, permissive regulatory practices and inclusive growth		
Heng: Embracing the Digital Economy: Policy consideration for Cambodia	Improve digital infrastructure	Boost digital literacy	Promote entrepreneurship and innovation Develop a national digital economy strategy	Demonstrate digital leadership	Develop a national digital economy strategy Build trust and security in the use of ICTs
WBG: Benefitting the digital economy: Cambodia policy Note	Close the digital divide by coordinating investment in and use of connectivity infrastructure	Support the development of digital skills	Align efforts toward the implementation of a Digital Government Strategy	Align efforts toward the implementation of a Digital Government Strategy	Complete the regulatory framework governing the digital economy, to boost digital adoption by firms
Cambodian ICT Masterplan 2020	National ICT Infrastructure ICT Industry	ICT Human Resource Development E-Education services	ICT Industry Research and Development : e-Economy services	e-Awareness e-Government Services e-Public Services	Legal framework Cybersecurity ICT Standards
UNCTAD: Building Digital Competencies to Benefit from Frontier Technologies (General)	Creating an enabling environment: investment in infrastructure and institutional development	Building digital competencies through educational frameworks	Establish initiatives that promote entrepreneurship in the digital economy Support collaboration among all stakeholder, including at the international level		Creating an enabling environment: investment in infrastructure and institutional development
CDRI: Science and Technology for Industrialization, Economic Growth and Development in Cambodia		High quality talent pool in S&T and skilled S&T workforce through STEM education and national TVET programmes	An ecosystem to conducive to creating a strong national innovation system for industrialisation	A technology driven growth strategy led by strong government agencies	

Sources: See text.

Appendix D: Cambodia's skills system in a digital economy

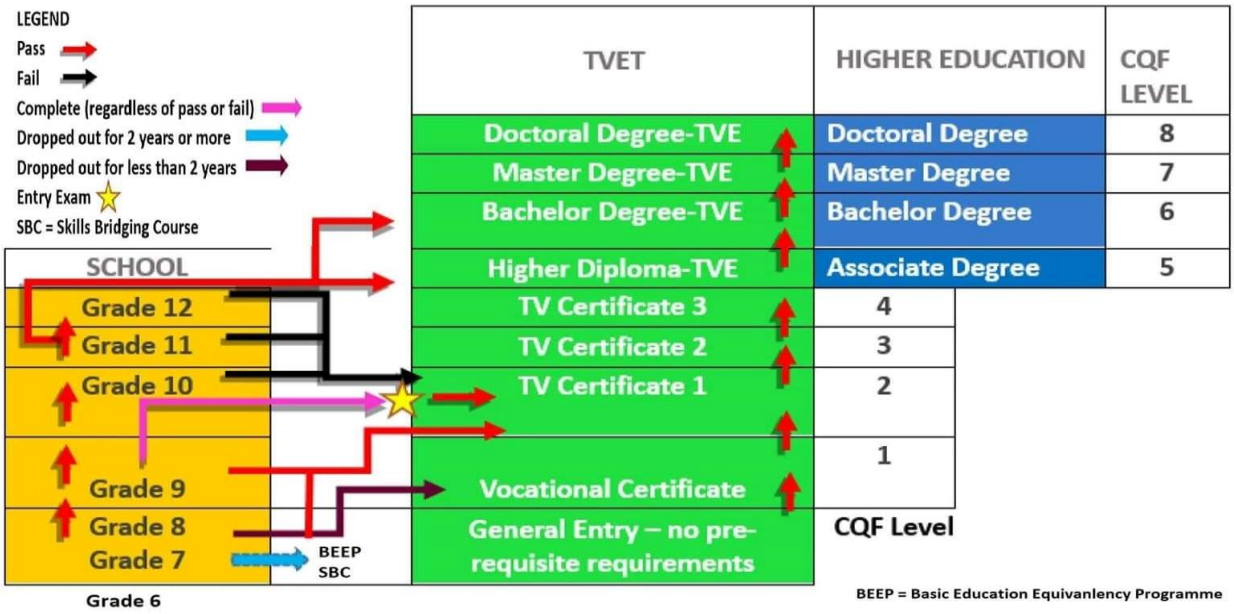
Cambodia is currently embarking on a digital transformation. The 2018 Rectangular Strategy Phase IV (Section 2) argues that the country needs to prepare for the digital economy and the Fourth Industrial Revolution in order to diversify its economy and identify new potential sources of growth. Without preparation, the country may not be able to realise its vision of transitioning into an upper-middle-income country by 2030 and a high-income country by 2050. The present economy still heavily relies on cheap labour, produces low value-added products, undergoes slow structural reforms, and has low labour productivity, all of which will not be able to sustain the annual average growth rate of around 7% that one has seen so far (MEF, 2016). Embracing a digital transformation towards achieving a fully functioning digital economy is important. As this economic ambition requires Cambodia getting its workforce ready for the digital future, many people question whether the current skills system in the country helps provide the workforce with necessary skills or it is a mismatch.

Summary of education system in Cambodia

The current education system in Cambodia includes four levels, including pre-school education, primary education, secondary education (lower and upper), and higher education, which can be provided through general stream interconnected with the TVET system. TVET is further divided into formal, and non-formal / informal.

The formal TVET system offers five main certificate levels: level 1 (C1), level 2 (C2), level 3 (C3 or Diploma), level 4 (Higher Diploma), and level 5 (Bachelor's Degree). After completing basic education, that is six years of primary education combined with three years of lower secondary education, students can either continue to upper secondary education or enter upper secondary TVET programmes. It is important to note that having completed basic education is a requirement (Ven and Sry, 2017). Otherwise, students have to first take the basic education equivalency programme. Upper secondary TVET programmes last for a year or longer and cover a variety of subjects, including graphic design, engineering, vehicle repairing, general mechanics, computer technology, agricultural mechanics, electricity, electronic, and repairing of cooling mechanics. Certificates or diplomas are awarded to students upon completion in accordance with their study levels. Students who complete twelve years of general education can decide whether they want to go for vocational training next or to universities. They will be awarded with higher diplomas and bachelor's degrees or advanced when they finish at least two and four years or more of training, respectively (Ven and Sry, 2017).

For the non-formal and informal TVET system, there are no strict standard education requirement and curriculum. Trainings are in the form of short courses that run between one week and four months on basic agriculture, motor repair skills, craft, food processing, and construction which are expected to help lift rural residents out of poverty (Ven and Sry, 2017). In-service trainings from enterprises to their employees as well as English, computer, driving, and dance classes, or even workshops are also included in this system, but they are more for the purpose of competency building (UNESCO, 2013).



Source: NGO Education Partnership of Cambodia (2019).

Educational and training institutions

There are around 13,000 public and private schools covering from pre-primary to upper-secondary education level (MoEYS, 2017). In 2013, the total number of public and private higher education institutions amounted to 97, among which 57 fell under the governance of the Ministry of Education, Youth and Sport (MoEYS) (CDRI, 2013). These institutions offer a wide range of majors from foreign languages to business, management, economics, agriculture, tourism, medicine, and STEM (UNESCO, 2010). In the TVET system, the number of TVET institutions is about 704. Many of them are small TVET schools. 39 out of 214 that registered with MLVT are public TVET institutions. Currently, there are 6 polytechnic institutes, namely NPIC, Industrial Technical Institute, National Institute of Business, Preah Kossomak Polytechnic, Polytechnic Institute of Battambang Province, and National Technical Training Institute (Ven and Sry, 2017). There are also a few large non-governmental-organisation TVET institutions, including Paul Dubrule and Sala Baï in Siem Reap province as well as Pour un Sourire d'Enfant, Don Bosco, and Passerelles Numériques in Phnom Penh (ADB, 2012).

STEM education promotion and priority skills in TVET

The emergence of digital technologies is altering the labour market landscape in a way that most jobs in the future will require at least basic scientific understanding. While there undeniably is a growing demand for labour in the fields of STEM, a lot of university students in Cambodia are not interested in STEM education (UNESCO, 2013). There are no recent statistics on the number of those who enrolled in and graduated from STEM areas of studies. It is known from MoEYS that in 2016 nearly half of Cambodian students majored in business management, yet only 3 percent chose to study STEM subjects at the university level. However, the local universities had confirmed an increase of about 40–50% regarding students' applications to their STEM programmes when compared with a few years before that (Hul, 2016).

In addition, the country's TVET system at large is hampered by the lack of facilities, teachers, and standards, causing a negative view on almost all TVET institutions (Un, 2012). It is not surprising that only a small portion of the population has pursued their education and training through the system. Specifically, the number of students who successfully completed their studies across all levels at those public and non-public TVET institutions under MLVT was 85,490 in 2014 and fell to 53,969 in 2015 and 33,025 in 2016. The year of 2018 saw a bounce back but just to 52,252. Every year students enrolled more for vocational certificates and undergraduate programmes among all the offers, with the numbers respectively recorded at 36,366 and 5,552 in 2018.There

were six major sector priorities, such as electrical/electronic, construction, mechanic, business/information and communication technologies, manufacturing, and agriculture. In terms of enrolment rates, electrical/electronic (12,067) and agriculture (10,693) were the two most popular sectors, while manufacturing (170) was the least popular one (MLVT, 2019).

Quality of Education

Cambodia's education system requires much improvement amidst the country's transformation towards becoming a digital economy. Although the government expenditure on education increased from 7.2% of the total government expenditure in 2012 to 9.6% in 2013, the number was lower than that of its neighbouring countries, such as Thailand (19.1%), Vietnam (18.5%) and Laos (12.8%) (World Bank, 2019). Several education indicators show that the country's education system lacks effectiveness, quality, and equity (see e.g. Kelsall et al, 2019[15]). In the 2016/17 academic year, the gross enrolment rate for primary, lower secondary and upper secondary education ranged from 108.9% to 55.7% and 25.1%, respectively. The primary, lower secondary and upper secondary school dropout rates in urban versus rural areas were 4.0% to 4.8%; 14.1% to 17.7%; and 15.5%to 21.4%, respectively. The completion rates for primary, lower secondary and upper secondary schools in urban versus rural areas were: 71.0% to 82.0%; 45.0% to 42.0%; and 33.5% to 16.4%, respectively (MoEYS, 2017). According to the Education for All Development Index, which focuses on universal primary education, adult literacy, gender parity, and quality and effectiveness of education, Cambodia was ranked 100 among 120 countries in 2010. The later three components were not up to par, scoring only 0.739, 0.883, and 0.621 out of 1, respectively (UNESCO, 2019).

It will be a challenge for the country's skills system to generate sufficient skills for the digital economy ahead. However, the country is still in the nascent stage of digital transformation and has the opportunity to speed up preparations.

[15] http://fdslive.oup.com/www.oup.com/academic/pdf/openaccess/9780198835684.pdf

Appendix E: e-Estonia

Estonia has made marked progress towards digital transformation and has become one of the leading digital economies in the world over the past two decades. With a relatively small population size and unfavourable demographics, the country has used digital innovation to make it prosperous and globally competitive. In 2018, it ranked among the top countries on the Global Innovation Index (14) and the Global Cybersecurity Index (5). It also ranked eighth on the European Commission's Digital Economy and Society Index (2019), with top scores in Digital Public Services and Human Capital. Further, Estonia was named the most advanced digital society in the world in 2016 by tech magazine Wired. Now, Estonia is looking towards creating a digital nation for every world citizen through the e-Residency platform, a revolutionary initiative with which the country would work to digitally empower the rest of the world.

The key factors behind Estonia's success include (i) openness to change after independence, including through young leadership; (ii) privatisation and innovation; (iii) low costs of digitalisation; (iv) availability of ICT talent and closeness to digital leaders in Scandinavia; and (v) decentralisation and flexibility.

Digital initiatives

In the late 1990s, Estonia took its first steps towards a digital society by introducing e-governance, which has resulted in '99% of public services being available to citizens as e-services'. This has allowed for an increase in efficiency for officials and ordinary people, as time spent on bureaucracy and document handling has been able to radically decrease. E-tax was another early initiative that increased efficiency, and has today resulted in 95% of tax declarations being filed electronically.[16]

In the early 2000s, Estonia introduced X-Road, which has been the perhaps most crucial development in creating the modern day e-Estonia. X-Road is a decentralised system 'that allows the nation's various e-services databases, both in the public and private sector, to link up and operate in harmony'. Government systems have been able to grow organically through X-Road.[17]

Digital ID was another major initiative during this time, which led to the development of i-Voting, which allows citizens to vote electronically from all over the world. Further, in order to ensure security in its newly developed digital systems, Estonia introduced its own blockchain technology in 2008. Since then, the technology developed by Estonia has been used by the North Atlantic Treaty Organization, the U.S. Department of Defense and the EU.

e-Residency is Estonia's latest digital development, introduced in 2014. This is a 'transnational digital identity' that gives any person around the world the opportunity of a 'government-issued digital ID and full access to Estonia's public e-services'.[18] Estonia introduced this initiative in order to enhance global innovation. It will improve competitiveness and has the potential to unlock global growth by facilitating access to entrepreneurship and e-commerce.

Cyber security continues to be a top priority for Estonia's digital society, especially with the rise of cybercrime and politically motivated attacks on electronic services.[19] Estonia is also investing

[16] https://e-estonia.com/

[17] http://reports.weforum.org/digital-transformation/e-estonia/#

[18] https://e-estonia.com/

[19] Ibid.

in the development of a Data Embassy, and extension of the Estonian government in the cloud. Other areas Estonia is focusing on for future development include intelligent transportation, Reporting 3.0, Healthcare 4.0, cross-border data exchange and digital transformation in education. With regard to cross-border data exchange, Estonia established its first 'public sector data exchange facility' with close neighbour Finland in 2017.

The Digital Strategy 2020 for Estonia was introduced in 2018, setting out four key goals for digital transformation in 2020:

- ICT infrastructure: develop ICT infrastructure that supports economic growth, the development of the state and the welfare of the population
- jobs and competitiveness: more and higher value-added jobs, improved international competitiveness and higher quality of life
- governance: smarter governance and proactive services
- promotion: export promotion and awareness of Estonian e-government.

Factors behind e-Estonia

At the collapse of the Soviet Union in 1991, Estonia became independent with almost no experience of digitalisation. It needed to distinguish itself and find a place in the international sphere as an established, independent, country. Digitalisation quickly was one answer, for various reasons.

First, the government that entered into power in the early 1990s wanted change. Notably, there was a significant 'alternation of generations' at this time, whereby 'the average age of members of the Estonian government was 35 years' (Savina, 2016). Their receptiveness to innovation at this time played a vital part. Then-Prime Minister Mart Laar began introducing policy around 'flat income-tax, free trade, sound money and privatisation' in order to incentivise the economy. This also encouraged the telecommunications sector (Schulze, 2019).

Rather than being hindered by the weak infrastructure that was a legacy of the Soviet Union, the Estonian government treated it as a clean sheet in its attempts at rebuilding the country (The Economist, 2013). It encouraged the development of e-governance, leapfrogging more expensive technologies. By relying on domestic innovation and supporting local IT-companies, Estonia was able to avoid large fees from more established international corporations.

Other reasons include the availability of ICT talent in Estonia as well as the country's closeness to other digitalised countries. Estonia had much R&D talent in ICT through various Academy of Sciences institutes, such as the Institute of Cybernetics and other highly advanced academic institutions (Mergel, 2018). Much of the talent became involved with the telecommunications sector shared with Scandinavia, which included newly digitalised Nordic countries that were global leaders in digitalisation. Finland played a particularly big part in incentivising Estonia's digital development, and generally this closeness to Scandinavia brought with it the 'opening up of both-policy-making processes (through advice and joint ventures) and markets (through privatisation and regulations) to Scandinavian partners that brought know-how and investment' (ibid.).

Digitalisation was further carried by the innovation and decentralisation of early governments, and in particular doing away with legacy thinking and allowing flexibility. Instead of simply replicating a paper-based tax-filing procedure, Estonia created its digital infrastructure based on the idea of no papers and stamps. This radical show of innovation was beneficial in many ways, and made the Estonian government highly effective very early. Estonia has never had a central office for digital transformation, as the digitalisation process has been largely ad hoc and informal.