SUSTAINABILITY & DIGITAL INNOVATION

02|2021

Edited by
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DIGITAL INSIGHTS

ABOUT KONRAD-ADENAUER-STIFTUNG

Freedom, justice and solidarity are the basic principles underlying the work of the Konrad-Adenauer-Stiftung (KAS). The KAS is a political foundation, closely associated with the Christian Democratic Union of Germany (CDU). As co-founder of the CDU and the first Chancellor of the Federal Repu-blic of Germany, Konrad Adenauer (1876-1967) united Christian-social, conservative and liberal traditions. His name is synonymous with the democratic reconstruction of Germany, the firm alignment of foreign policy with the trans-Atlantic community of values, the vision of a unified Europe and an orientation towards the social market economy. His intellectual heritage continues to serve both as our aim as well as our obligation today. In our European and international cooperation efforts, we work for people to be able to live self-determined lives in freedom and dignity. We make a contribution underpinned by values to helping Germany meet its growing responsibilities throughout the world.

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EDITORIAL NOTE

Digital innovation, new technologies and sustainability are the paramount topics of our time. On one hand, the last decades cautioned humanity about the downsides of growth and development due to planetary boundaries. More and more people started realizing that our genius cannot sustain if we do not think sustainable. One sign of change is young people all around the world demonstrating for more climate action and a paradigm shift of governments towards more sustainable policies, means of production and behavior. Their reasons are incontestable: Oceans are filling up with plastic, rain forests and endangered species are disappearing in an unprecedented way and the frustration about political and economic elites reached a peak and historical turning point.

On the other hand, we have seen exponential technological advances in data sciences, robotics, artificial intelligence, mobile internet and 3D-printing technology, enabling new forms of doing business, changing value chains and social behavior. We have to go beyond technical questions of how to adopt. The really big question is how do we humanize the digital transformation and steer it in a direction, beneficial for the environment and ultimately humanity.

In order to achieve sustainable digital innovation, we need to bring cautious attitudes and tech potential together.

The necessity of sustainable digital innovation is reflected in manifestos like the Davos Manifesto 2020, the Global Risks Report and even dates back 50 years to the "The Limits of Growth" report, compiled by the Club of Rome. Further research and analysis has stressed the need for fast change. Like so often, a new compromise has to be found reconciling diverse generations, traditional and modern values, diverging societal systems and the multiplicity of ideas.

We have taken on a discussion of modern-day challenges for sustainable digitalization in this Digital Insights Issue. We want to thank our contributors for providing us with insightful academic studies as well as more straight-forward examinations of how digitalization can promote sustainable practices in business and empower the Cambodian People. More precisely, the articles compiled here revolve around the topics of job-loss due to automation, promising Cambodian Start-Ups, Cambodian Universities' contributions to preparing the country for the industrial revolution 4.0 and interlinked topics, pointing out both light and shadow on Cambodia's path to digitalized business and society.

I hope that this book will serve its purpose of facilitating and forwarding discussion and academic debate, raising public awareness, and serve as a useful resource for interested stakeholders at all levels in Southeast Asia and beyond.

Enjoy reading!

Robert Hör
Program Manager Digitalization and Foreign Affairs

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Digital Cooperation – An Opportunity to Advance Sustainable Development

Fabrizio Hochschild[1]

This article appeared previously in KAS International Reports 01/2020, under the same title.

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1   Fabrizio Hochschild is Under-Secretary-General and Special Advisor to the Secretary-General at the United Nations, working on Digital Cooperation and the Commemoration of the 75th Anniversary of the UN.

In today's complex digital world, we see enormous advantages of digital technologies, which will play an increasingly important role in sustainable development in the coming years. Of course, we are also experiencing risks and challenges in the rapid development of these technologies. These challenges can no longer be met by individual organisations or countries. Instead, the answer to these challenges depends on cooperation between different groups, sectors, stakeholders, and countries.

The Digital Age We Live In

Fifty years to the day since the first internet transmission was made, the world has experienced exponential transformation, driven by the evolution of the information and communication technologies (ICTs) in all aspects of our lives. ICTs have had a revolutionizing impact on our economies and societies, and further disruptive innovations and changes are expected in the near future. Greater levels of digitalization will create new ways and means for tackling global development, with major implications for the United Nations' 2030 Agenda on Sustainable Development. Technological developments are unfolding at a speed without parallel in human history. The increasing pace of change can be illustrated by the fact that it took about 50 years for the telephone to connect the first 50 million users, but it has taken only seven years to reach the same number of internet subscriptions, and just three years for a social media platform to reach its first 50 million users.[1] Today, there are more mobile cellular subscriptions worldwide than inhabitants on the planet, and 4.1 billion people use the internet.[2] The potential of the

internet will be at its greatest if we are able to cultivate it as a global resource or public good that is open, inclusive, reliable, robust, secure, and trustworthy. Through its evolution, the internet has become an integral part of our lives and has played a critical role in delivering social, economic, and environmentally sustainable progress. In today's world where we expect to be connected everywhere and at all times, and where we talk about artificial intelligence, bio technology, material science, and robotics, it is incredible how much progress has been made and how much more can be done for the advancement of human welfare. However, while the ICTs are shaping history and evolving alongside us, these same technologies have also exposed us to new types of threats, risks, and governance challenges. Capabilities to commit cybercrime or cyberattacks are developing at a tremendous rate, becoming more targeted, having a higher impact on physical systems, and undermining societal trust in ever more insidious manners. There is also a risk that the misuse and abuse of digital technologies will result in mounting inequality, as well as threatening a broad range of human rights. In addition, there are ever-growing concerns about the ethical and social implications of emerging technologies. We are thus increasingly feeling the pressure to develop effective and innovative governance models for new science and technologies. All these challenges are transnational and also trans-institutional in nature, thus no single government or institution can address the challenges ahead alone. They can be addressed only through international cooperation, which requires a robust process of digital cooperation across governments, private sector, particularly technology companies, research institutions, academia, civil society, and international organizations. To further develop this perspective, this article is structured into two parts: Firstly, "the Digital Society we shape", which is composed of three specific themes – digital inclusion, digital capacity and digital governance; and, secondly, "The digital

1. Desjardins, Jeff 2018: How Long Does It Take to Hit 50 Million Users? Visual Capitalist, 8 Jun 2018, in: https://bit.ly/2v5yX01 [25 Feb 2020].

2. International Telecommunication Union (ITU) 2018: Internet usage keeps growing, but barriers lie ahead, in: https://bit.ly/3940cXy [25 Feb 2020].

interdependence we respect", outlining the five thematic recommendations from the High Level panel on Digital Cooperation, as well as the United Nations' ongoing efforts to follow-up on these. This article will be then concluded in a section on "enhancing digital cooperation towards sustainable development".

The Digital Society We Shape

Digital Inclusion

New data released in 2019 shows that internet use continues to grow globally – on average by 10 percent every year between 2005 and 2009, with 4.1 billion people now using the internet, or 53.6 percent of the global population.[3] However, an estimated 3.6 billion individuals still remain offline and have no access to the wealth of knowledge available through the internet. This situation is more extreme in the world's Least Developed Countries, where more than 80 percent of the population is not connected. The digital divide also persists within countries; for example, men, urban residents, and young people are more likely to be online than women, rural residents, and older people, further exacerbating inequality in societies. Given that the internet has become an indispensable tool in our daily lives, it is therefore even more important to redouble our efforts to get the whole world connected, and to create an enabling environment for the industry to make the necessary investments in infrastructure, applications, and services. To build an inclusive digital society, technological solutions will be crucial, but will not be enough. This task also requires sustained and coherent efforts from many stakeholders across all areas. In this way, expanding access to digital infrastructure, combined with enabling policy and regulatory environments, will allow busi-

nesses and stakeholders to participate in the digital economy, and countries to increase their overall socio-economic wellbeing and competitiveness.

'Connecting the unconnected all over the globe requires a mix of technological and regulatory initiatives.'

There are many initiatives that support efforts to connect the unconnected. One good practical example is using new technologies in space and upper-atmosphere communication, such as high-throughput satellites (HTS),[4] massive non-geostationary orbits (NGSO) satellite constellation,[5] and high-altitude platform stations (HAPS).[6] Again, connecting everyone requires a mix of technological and regulatory solutions. While the ubiquity, reliability, and improved capability of these technologies will help expand connections to rural and remote areas, supporting regulatory frameworks such as the additional radio-frequency bands for HAPS approved at the World Radiocommunication Conference (WRC-19),[7] will also need to be updated in line with these technological developments.

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4. SES 2017: Four Reasons High Throughput Satellite will be a Game Changer, 27 Apr 2017, in: https://shar.es/ aH191R [25 Feb 2020].

5. European Space Agency: Types of orbits, in: https://bit. ly/2w2S0YK [25 Feb 2020].

6. Tseytlin, Michael 2019: High Altitude Platform Stations (HAPS) – bringing connectivity to all, ITU News, 14 Aug 2019, in: https:// bit.ly/2TjJ6hI [25 Feb 2020]; ITU 2019: HAPS – High-altitude platform systems, Dec 2019, in: https://bit.ly/ 37VW7TP [25 Feb 2020].

7. ITU News 2019: WRC-19 identifies additional frequency bands for High Altitude Platform Station systems, 22 Nov 2019, in: https://bit.ly/2ViB8rs [25 Feb 2020].

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3. ITU 2018: Statistics, Individuals using the Internet, 2005 – 2019, in: https://bit.ly/3c6q6fa [25 Feb 2020].

Digital Capacity

The world has already entered a digital age where new opportunities and challenges are emerging every day. ICTs are empowering people, especially those in disadvantaged and marginalized groups, with information and knowledge, and act as a catalyst in ensuring their rights within the comity of digital societies. In this increasingly connected world, we are not only the beneficiaries of, but also the driving force behind, the latest innovations and practices. This call for new knowledge, new knowhow, and new skills gives those who have the ability to learn and adapt fast a better chance to gain a competitive advantage over others. Digital capacity is important at every level, be it institutional, regional, or national, as ICTs are crosscutting and a critical enabler for growth and development. Bringing low-income countries into the digital economy will accelerate local innovation and research. Emerging technologies, such as AI, Internet of Things (IoTs), 5G, and sophisticated mobile technologies, can further boost employment and business opportunities, and improve the delivery of public services, from education to health clinics to garbage collection. For example, Africa is embracing technological change and leapfrogging ICT development, fuelled by mobile broadband, and enabling access to critical information and services. Much of the progress is driven by digitization and e-commerce. The digitalization of finance, such as M-Pesa,[8] is making it possible to provide low-income and rural populations with access to services at an unprecedented scale. This progress has also triggered efforts on the African continent to achieve greater heights in other sectors, such as education, health, transportation, and agriculture.

'Digital literacy training needs to accompany technology provision in order to mitigate the unequal distribution of knowledge and expertise.'

However, the lack of digital skills is a significant impediment for people to become connected, and connectivity gaps are further exacerbated by unequal distributions of knowledge and expertise. Even in areas where getting online is possible and affordable, extra efforts are still needed to empower people who may be discriminated against and excluded. In order to achieve this critical objective, e-strategies at the national, regional and international levels must address the special requirements of people so as to ensure their full inclusion in the digital societies. For example, investment in infrastructure for affordable access and the provision of digital literacy training could be a solid two-pronged approach to connect the unconnected. Within the UN system, we have a potentially game-changing connectivity project, called "Gavi for Gigabytes" or shortly "GIGA", which is being led by UNICEF and the International Telecommunication Union (ITU).[9] It aims to connect every school to the internet, and especially every young person to the information, opportunities, and choices created by digital technologies. Specifically, GIGA will build on the model of the Global Alliance for Vaccines and Immunization (GAVI) of common bidding with the private sector to map and then connect every school in the world to the internet by 2030. It is expected to connect young people who are excluded from the digital society by poverty, geography, lack of skills, or other disadvantaged circumstances.

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8. CNBC Africa 2019: M-Pesa has completely changed Kenyans' access to financial services, this is how…, 3 Apr 2019, https://bit.ly/38YtSFm [25 Feb 2020].

9. UNICEF 2019: UNICEF Executive Director Henrietta Fore's remarks at the Broadband Commission High-Level Event, 22 Sep 2019, in: https://uni.cf/2Vkx6Pj [25 Feb 2020].

It is an ambitious project which will require sustainable and coherent efforts from many stakeholders.

Digital Governance

Digital technologies have enhanced democratic participation in public life, facilitated globalized communication networks, and helped spread the availability of information for development and many other purposes. Through e-government, for example, state institutions around the world can be more efficient, provide better services, properly respond to the demands of citizens for transparency and accountability, and be more inclusive. The new generation of digital technologies, in the form of IoTs and AI, along with sophisticated mobile technologies, will enable even greater opportunities to improve the quality of people's lives, and will bring more transformative shifts in how our economies and societies function. However, digital technologies have been largely developed in an environment of minimal to no governance, because governance or regulation of the digital domain has often been framed as a threat to innovation. Yet, in an ever more digitalized world, these technologies have also brought about new threats. We are ever more concerned about cybersecurity, with new types of threats and vulnerabilities of ICT infrastructure, systems, and software, as well as dangers, posed to – and by – the vast amounts of data we harvest. Beyond cybersecurity, we also need to address human rights standards and global safeguards in emerging technologies, such as AI, autonomous weapons, biometric sensors, to name but a few. The ethical and legal implications of these technologies are in particular increasingly discussed, especially around the issues of privacy, accountability, and data protection. In some cases, where international norms or regulations are absent, we have seen

the private sector adopting its own guidelines, self-regulation, or non-statutory rules[10] based on business expertise and advanced knowledge. With this model, however, there is less accountability than when regulation is delivered by government authorities or elected public officials. Therefore, the private sector is slowly changing its attitude from 'regulation constrains innovation' to a desire for 'fast, adaptable and smart regulation'. Many countries have also started to develop national digital regulatory and policy frameworks on emerging technologies.[11] Both private and public sectors should work together to bridge the absence of regulation, and to develop effective and innovative governance models. From the experience of the World Summit on the Information Society,[12] we have learnt that when we consider the governance of new technologies, we must also consider the indirectly related public policy issues, which are of great significance, including wider legal, economic, developmental, and socio-cultural aspects. In order to better protect public safety, for example, we also need complementary national, regional, and international principles and guidelines. Within the United Nations system, many important initiatives, fora, and discussions are under way, which include, inter alia, the Group of Government Experts (GGE), the Open-Ended Working Group (OEWG), the UN General Assembly Plenary, the Multi-

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10. IEEE: The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, in: https://bit.ly/ 3a3zJcx [25 Feb 2020]; Association for Computing Machinery (ACM) 2018: ACM Code of Ethics and Professional Conduct, in: https://bit.ly/38ZZYQZ [25 Feb 2020].

11. Madiega, Tambiama 2019: EU guidelines on ethics in artificial intelligence: Context and implementation, European Parliamentary Research Service, Sep 2019, in: https://bit.ly/2w6gAIs [25 Feb 2020].

12. Initiated by the UN, the two-phase of the WSIS Summit took place each in Geneva, in 2003 and in Tunis, in 2005, to create an evolving multistakeholder platform aimed at addressing the issues and challenges posed by ICTs through a structured and inclusive approach at the national, regional and international levels. UN General Assembly 2002: Resolution 56/183, World Summit on the Information Society, 31 Jan 2002, in: https:// bit.ly/2VwdRmj [25 Feb 2020]; UN 2016: World Summit on the Information Society (WSIS), Sustainable Development Goals Knowledge Platform, in: http://bit.ly/2PlLh35 [25 Feb 2020].

stakeholder Forum on Science, Technology and Innovation (STI Forum), the Commission on Science and Technology for Development (CSTD), the World Summit on the Information Society (WSIS) Forum. In addition, in 2018, the UN Secretary-General initiated a key milestone in this era of digital transformation – convening a High-Level panel on Digital Cooperation[13] to advance global dialogue on how we can work together to realize the potential of digital technologies for advancing human well-being, while mitigating their risks. This is the first-ever panel of the UN Secretary-General which is chaired solely by private sector figures. It has resulted in experts' recommendations to strengthen our joint effort to build digital cooperation for sustainable development. Further details about the activities of the High Level panel on Digital Cooperation will be provided in the following section.

The Digital Interdependence We Respect

The High Level Panel's Recommendations

In June 2019, in its report, entitled "The Age of Digital Interdependence", the UN Secretary General's High Level panel on Digital Cooperation set out to help answer some of the biggest questions on digital transformation.[14] The panel outlined the following five thematic recommendations, which emphasise the need to close the digital gap, grow human and institutional capacity, recognise human rights in digital contexts,

build trust, security and stability in cyber-space, and agree on a new global architecture for digital cooperation.[15]

1. Build an Inclusive Digital Economy and Society

"[1A] We recommend that by 2030, every adult should have affordable access to digital networks, as well as digitally-enabled financial and health services, as a means to make a substantial contribution to achieving the SDGs." The panel stressed everyone, including those with disabilities, must have access to the internet by 2030 and that the internet provided must be stable, affordable, fast, and available in all languages, as internet access has become the entry point to e-commerce, entrepreneurship, educational and training programmes. internet access can enable digital literacy and help people to reskill or upskill throughout their lives. Here, the digital inclusion of marginalized groups is critical as it provides access to an untapped resource for economic growth and competitiveness. This also includes a digital public goods platform, which would serve as a place to pool data sets. For example, data can help governments, organizations and civil society better prepare for – and better deal with the aftermath of – climate disasters. It can support a city to better plan its transport networks, and aid public service authorities in providing universal and affordable health care, as well as in addressing persistent inequalities. Such a platform, that could involve the UN, would benefit developing economies in particular, which tend to have less data available to them.

2. Develop Human and Institutional Capacity

"[2] We recommend the establishment of regional and global digital help desks to help governments, civil society and the private sector to understand digital issues

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13. UN, High-Level Panel on Digital Cooperation: About The High Level Panel, in: https://bit.ly/ 2v59XpF [25 Feb 2020].

14. UN, High-Level Panel on Digital Cooperation 2019: The Age of Digital Interdependence, Jun 2019, in: https://bit.ly/2wG7X7r [25 Feb 2020].

15. Ibid.

and develop a capacity to steer cooperation related to social and economic impacts of digital technologies." As outlined in the high level panel's report, digital cooperation should be grounded in common human values, such as inclusiveness, respect, transparency and sustainability, as well as in human rights and international law.17 It is also understood that some of the key challenges facing regulators, consumers, and the private sector alike is the lack of simple entry points to digital cooperation support and related sources of knowledge, as well as insufficient understanding of digital technologies and their implications. In this context, the concept of "digital help desks" or robust capacity-building mechanisms and institutions can be a good entry point to provide support, such as with addressing the digital divide, with governance challenges, leveraging opportunities, and engaging talent and investing in infrastructures. The digital help desks could also collect and share best practices, monitor trends, and provide data on digital policy. Already governments and regional organisations have made calls to set up such capacity-building institutions, which could include support in the development of digital policy for capacity building, and viable approaches to invest in ICT infrastructure. One way to achieve this recommendation would be by building on the many existing digital help initiatives at national, regional and international levels, and to identify where gaps and challenges exist in capacity building and digital policy support.

3. Protect Human Rights and Human Agency

"[3A] Given that human rights apply fully in the digital world, we urge the UN Secretary-General to institute an agencies-wide review of how existing international human rights accords and standards apply to new and emerging digital technologies." Firstly, given that human rights apply fully

in the digital world, the High Level panel called for an agencies-wide review of how existing international accords and standards are applied to new and emerging digital technologies. They also called on social media companies to work with governments, civil society organisations and human rights experts around the world to fully understand and respond to concerns about existing or potential human rights violations. And finally, they proposed that autonomous intelligence systems should be designed in a way that does not perpetuate in-built biases, and that maintains human accountability. In particular, life and death decisions should not be delegated to machines. The UN Secretary-General himself has called for a ban on lethal autonomous weapon systems. For example, agreed standards and principles of transparency and anti-discrimination on emerging technologies should be developed. Universal principles on Artificial Intelligence, for instance, could address concerns that decision-making systems supported by AI may include discriminatory biases, such as skin cancer detection algorithms being less effective on dark-skinned individuals, or exclusion of accents/languages from speech recognition tools.

'Digital security and stability are critical to ensuring human well-being and securing sustainable development gains.'

4. Promote Digital Trust, Security and Stability

"[4] We recommend the development of a global commitment on digital trust and security to shape a shared vision, identify attributes of digital stability, elucidate and strengthen the implementation of norms for responsible uses of technology, and propose priorities for action." This is especially important as the

digital environment merges with the physical world. In this new era, how do we enshrine our shared values, principles, and understandings? How can we prevent trust and stability from being eroded by the irresponsible use of cyber capabilities? Digital security and stability are critical to ensuring human well-being and securing sustainable development gains. The call for some form of universal commitment to promoting digital trust at the global level, building on the many but scattered initiatives in this space, is thus timely. Moreover, to be effective and well-received, such an effort must be multistakeholder in nature, committing not just governments, but also other key players like technology companies and civil society to this collective endeavour. The panel thus suggested that such a commitment to digital trust could strengthen the implementation of agreed norms, help develop a societal capacity for cybersecurity, heighten resilience against misinformation, and encourage companies to strengthen authentication practices and to be more transparent.

5. Global Digital Cooperation

"[5A] We recommend that, the UN Secretary General facilitate an agile and open consultation process to develop updated mechanisms for global digital cooperation [… and] marking the UN's 75th anniversary in 2020 with a "Global Commitment for Digital Cooperation" to enshrine shared values, principles, understandings and objectives for an improved global digital cooperation architecture." In follow-up to the report, the Secretary-General has requested that the High Level panel's recommendations be discussed in earnest with the Member States and interested stakeholders. As such, multiple experts, multi-stakeholder and cross-regional roundtable discussions, involving member states, UN agencies, civil society, and other entities have been convened to discuss how to take the panel's recommendations forward.[16]

The expert roundtables will provide inputs and advice to be incorporated into a Roadmap on Digital Cooperation that the Secretary-General will present in Spring 2020.

Digital Cooperation in the 75th Year of the United Nations

In 2020, the world is celebrating the 75th anniversary of the United Nations. The story of the United Nations has been one of international cooperation across governments, private sectors, NGOs, and international organizations. Today, as a global community, we are facing questions and challenges posed by digital technologies to security, equity, and human rights, but international cooperation on these technologies remains very much in its infancy. Moreover, due to the resurgence of geopolitics and great power rivalry, multilateralism is under fire precisely when we need it most. As part of UN75, the United Nations has resolved to use this opportunity to reach out, to listen, and learn through the biggest-ever global conversation on "The Future We Want". It behooves us to address technology and digital cooperation as a critical part of this conversation. Drawing on the recommendations of the High Level panel on Digital Cooperation, the Secretary-General made three proposals at the 2019 Internet Governance Forum (IGF), which took place from 25 to 29 November in Berlin:[17] His first proposal was to strengthen the IGF into an institution that comes closer to living up to its name. It was created as an outcome of the World Summit on the Information Society (WSIS), which was the most wide-ranging, comprehensive and inclusive debate ever held on the future of the information society. Back in November 2005, at the second phase of the WSIS, the IGF was created as a starting point so as to pave the way

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16. Ibid.

17. Guterres, António 2019: Remarks to the Internet Governance Forum, United Nations SecretaryGeneral, 26 Nov 2019, in: https://bit.ly/2HVBVqp [25 Feb 2020].

for the international discussion to foster the sustainability, robustness, security, stability, and development of the internet. In 2020, the IGF needs actionable outcomes and it needs to increase inclusion of young people, women, parliamentarians, entrepreneurs, and under-represented countries. Second, he highlighted the specific recommendation of the high level panel on digital cooperation regarding the possibility of a global commitment on digital trust and security, by inviting all governments, industries, and institutions worldwide to consider this issue. Such a commitment should build upon agreed global norms for cyberspace and the pioneering work done by the Paris Call and the Christchurch Call, so as to bring the world together to agree on a vision for the 21st century that includes a more equitable, more accessible, and shared digital future.

'The UN works towards enabling international cooperation to nurture a shared digital future that puts people first.'

Lastly, the secretary-general announced his intention to appoint a technology envoy to work with governments, industry, and civil society, and advance collective efforts to nurture a shared digital future that puts people first. This will be critical if the United Nations is to optimize the use of digital technologies while mitigating their risks and harms. Once we ensure that everyone is connected, we will see extraordinary progress delivered towards each and every one of the Sustainable Development Goals (SDGs) through digital technologies.

Enhancing Digital Cooperation towards Sustainable Development

In today's complex digital world, digital technologies, which will play an increasing role in sustainable development over the coming years, can bring about tremendous benefits in areas such as education and healthcare, as well as commerce, food security, energy efficiency, and e-government. Unfortunately, risks and challenges also come attached to the rapid development of digital technologies, in areas such as security, trust, privacy, human rights, electric waste, and carbon emission through to technical issues, such as interoperability. These challenges can no longer be addressed by any single organisation or nation. Instead, finding the answer to these challenges depends on our ability to work together across disciplines and stakeholder groups, across nations and any type of divide. In 2020, during the 75th Anniversary of the United Nations, this process and indeed, our human story, will reach a critical juncture. An African proverb says, "If you want to go quickly, go alone. If you want to go far, go together". In looking to our digital future, the UN is seeking to enhance digital cooperation globally so that we can work together to fully leverage the benefits of technology, while curtailing its unintended consequences. This vision can only be implemented through global collaboration, engaging all the players in the ICT ecosystem, including governments, the private sector, academia, NGOs, and international organizations. If we are to truly build a future we want, we must come together to ensure that technology is used as a force for good, and for all.

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Fighting Automation through Education

Are workers in high-risk occupations educating themselves?

Todd Hunkin[1] and Dr. Daniel Schmücking[2]

1   Todd Hunkin is a British national who has lived in Cambodia for 7 years. He has a BA in Human Geography from Swansea University in Wales, UK and an MA in International Development Studies from Utrecht University in the Netherlands. During his time in Cambodia, he has been a researcher working to understand an eclectic mix of topics in the public and private sectors. At the start of 2020, Todd founded the research and consultancy agency Spear Insights in Cambodia.

2   Daniel Schmücking was born in 1982 in Germany. He studied political science and sociology at the Friedrich Schiller University in Jena (Germany) and the Palacky University in Olomouc (Czech Republic). His professional and scientific focus is on political communication and election campaigns. He worked as a campaigner for the Christian Democratic Union (CDU). In his dissertation he devoted himself to the topic of the effects and development of negative political advertising in Germany. As part of his doctoral studies, he spent time at the University of Maryland (USA) and the University of California (USA). He taught at universities in Jena (Germany), Erfurt (Germany) and Budapest (Hungary). From 2015-2017, he headed the Konrad Adenauer Foundation's (KAS) office in Mongolia. Since the beginning of 2018 he has been country director of KAS in Cambodia.

Introduction

Digitalization and sustainability are two of the most powerful influences in today's life. Each has spawned a massive amount of research about how it will change business and society. The intersection of these trends, however, remains largely unexplored territory. The Sustainable Development Goals (SDGs) of the United Nations were drafted at a time when the huge positive and negative effects of digitalization were not yet obvious. Digitalization brings challenges and opportunities for the successful implementation of the SDGs, especially for developing countries. An important prerequisite for the achievement of the SDGs is an inclusive labor market. This is not just important to achieve all targets in SDG 8 "Decent Work and Economic Growth," but also to fight poverty (SDG 1), hunger (SDG 2), inequality (SDG 10) and many more.[1] As the International Labour Organization states: "SDG 8 lies at the heart of the 2030 Agenda: it straddles the economic, social and environmental dimensions of sustainable development and is therefore inextricably linked to many other goals."[2]

Due to the ongoing and disruptive process of automation, connectivity and the knowledge explosion in the digital age leading to Industry 4.0, the way we work will change dramatically. Routine jobs are especially at great risk of being automated. At the same time, developing countries rely on cheap labor as an important factor for economic growth as is the case in Cambodia. But technology is not just a potential threat for these jobs,

it can also help to create new jobs that are more inclusive and better paid. To use this potential, workers need to permanently upgrade their skills. This leads us to the question: Are workers in occupations with a high-risk of being automated aware of the situation and therefore motivated to upgrade their skills?

To get an answer, we first looked into how automation affects high-risk occupations in general. Second, we assessed the status-quo of the Cambodian labor market to identify the scale of jobs at risk of being automated. In several focus groups, we asked workers in those occupations if they are aware of their future job prospects and therefore educating themselves. Finally, we chose the governance perspective to provide policy recommendations that limit the risks and utilize the chances of digitalization for the inclusiveness and productivity of the Cambodian labor market.

The Effects of Automation for High-Risk Occupations

The global discussion on the transformation toward sustainability, up to now, has hardly taken into account the fundamental dynamics of digitalization, e.g. the opportunities and risks of artificial intelligence, new technologies, data economies or the interlinkage between our physical world and virtual spaces. These topics cannot be found in the 2030 Agenda adopted by the UN in 2015.[3] At the same time analyses show that digitalization has a massive impact on all 17 SDGs. The debate on the implementation of the SDGs can no longer be conducted without an adequate understanding of the potential risks and opportunities of digitalization

1. Take Action for the Sustainable Development Goals, The United Nations, Sustainable Development Goals, 2020. https://www.un.org/sustainabledevelopment/sustainable-development-goals/

2. Time to Act for SDG 8: Integrating Decent Work, Sustained Growth and Environmental Integrity – International Labour Office – Geneva: ILO, 2019.

3. WBGU – German Advisory Council on Global Change (2019): Towards our Common Digital Future. Summary. Berlin: WBGU.

for the entire 2030 Agenda.[4] For this case, it means assessing what effects the digital transformation has for low-skilled workers in developing countries and in particular what effects automation has for high-risk occupations.

In general, there are risks and opportunities in the digital transformation for the labor markets in developing countries. However, it should be noted in this context that sufficient education and qualification in handling new digital technologies are essential prerequisites for all development opportunities. Against this background, the positive effects have been seen as rather small – especially when the education level is low.[5]

Risks will appear for the labor markets as digitalization is radically transforming them. People will continue to work in the future, but it remains to be seen how this can be embedded into society and organized in a way that the functions of gainful employment as we know them today – securing livelihoods, social participation, the basis of personal self-esteem — can be guaranteed.[6] In addition, increasingly 'intelligent' machines can be used to replace human labor in more and more areas. Although it is as yet unclear how far this substitution of labor by machines will extend and whether the loss of employment will be compensated by new activities and forms of work, this development is associated, at least in a transitional phase, with manifold distributional implications at various levels. The boundaries between adopters and non-adopters run between the 'classical' production factors of labor and capital, between workers

with different qualifications, but also between groups with different opportunities to use data and digital technologies.[7]

The biggest challenge for inclusive work is the "disruption of labor markets by the comprehensive automation and the danger that human labor will become increasingly irrelevant to the economy".[8] Especially workers in routine-based occupations are at risk of being replaced by automated processes. Many service jobs like driving a taxi or working in a fast-food restaurant could simply disappear.[9] These rationalization effects of innovations (e.g. substitution of human labor with machines) threaten to decouple economic growth from employment, jeopardizing social cohesion and political stability.[10] That means that automation in business will enable companies to do more with fewer workers, driving down wages, constraining the growth of (median) household income and exacerbating an already alarming income inequality.[11]

Automation is most simply defined as "the technology by which a process or procedure is performed with minimal human assistance".[12] Robots and machines are no longer just repeating a work step millions of times.

4. WBGU – German Advisory Council on Global Change (2019): Towards our Common Digital Future. Summary. Berlin: WBGU.

5. WBGU – German Advisory Council on Global Change (2019): Towards Our Common Digital Future. Flagship Report. Berlin: WBGU.

6. WBGU – German Advisory Council on Global Change (2019): Towards our Common Digital Future. Summary. Berlin: WBGU.

7. WBGU – German Advisory Council on Global Change (2019): Towards Our Common Digital Future. Flagship Report. Berlin: WBGU.

8. Digital Momentum for the UN Sustainability Agenda in the 21st Century, Policy Paper No. 10, German Advisory Council on Global Change, June 2019.

9. Harnessing the Digital Revolution, UNDP, 2018, accessed at https://feature.undp.org/global-goals-technology/

10. Digital Momentum for the UN Sustainability Agenda in the 21st Century, Policy Paper No. 10, German Advisory Council on Global Change, June 2019.

11. David Kiron and Gregory Unruh, The Convergence of Digitalization and Sustainability, MIT Sloan Management Review, January 2018. https://sloanreview.mit.edu/article/the-convergence-of-digitalization-and-sustainability/?gclid=Cj0KCQj w9ZzzBRCKARIsANwXaeKkGfC9dnPr5KSWxMSxFtDujEjy3Oj0aw D7CHGUHBB26vT53nIEqEIaAn1DEALw_wcB

12. Groover, Mikell (2014). Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.

Networked production processes decide with minimal human intervention as how each component should be used.[13] The future factory can thus produce customer-tailored pieces because it decides by itself which component it manufactures in conjunction with other machines. The factory of the future can react flexibly and quickly to customer needs through big data concepts. Through increased efficiency, goods are produced according to real time needs. After all, no human could reschedule so quickly, process information on such a scale from diverse data streams and make the most efficient and effective business decisions.[14] An advanced form of automation is **computerization.**[15] Osborne and Frey refer to computerization as job automation by means of computer-controlled equipment.[16]

Automation changes the overall relationship between industrial employment and labor costs because it occurs faster in countries with high labor costs, assuming the incentive to reduce labor costs trumps other factors such as the location.[17] The current trend toward labor market polarization accelerates with computerized automation risking principally low-skill and low-wage occupations. As tech-nology races ahead, low-skill workers will reallocate to tasks that are non-susceptible to computerization – i.e., tasks requiring creative and social intelligence. For workers to win the

race, however, they will have to acquire these skills in the first place.[18]

When and to which scale automation has an impact on labor markets remains unclear. In an ILO survey, decision makers in the garment industry did not believe automation technologies will lead to sizable job losses in the industry in the near future, and suggest a likely outcome is greater worker-machine collaboration. Nevertheless, increases in productivity due to automation could reduce the industry's job generation potential. Workforce implications in the medium to long-term are, therefore, unclear. They argue that assessments on potential worker displacement based exclusively on the task composition of occupations overstate risk in light of practical issues faced at the shop floor – with the caveat that it is difficult to anticipate technological developments and their employment implications beyond the near future.[19]

The ongoing digital structural transformation in the international division of labor will lead to a readjustment of the role of developing countries and emerging economies. Unequivocal conclusions on the impact of digitalization on the international organization of value chains are currently limited. On the one hand, there are potentially substantial job losses due to digitally supported automation and production relocation processes; on the other hand, new markets are accessible, primarily via digital platforms.[20] A programmer or graphic designer can be e.g. based in India and working for a US company. Both can find each other via digital platforms. It seems that

13. Jann Ravling, Was ist Industrie 4.0? Die Definition von Digitalisierung, September 4, 2018, https://www.wfb-bremen.de/de/page/stories/digitalisierung-industrie40/was-ist-industrie-40-eine-kurze-erklaerung.

14. Ibid.

15. The Oxford Companion to United States History, Edited by Paul S. Boyer.

16. Carl Benedikt Frey, Michael A. Osborne, The Future of Employment: How Susceptible Are Jobs To Computerisation? September 17, 2013.

17. World Bank. 2019. World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank.

18. Carl Benedikt Frey, Michael A. Osborne, The Future of Employment: How Susceptible Are Jobs To Computerisation? September 17, 2013.

19. Fernanda Bárcia de Mattos, Jeff Eisenbraun, David Kucera & Arianna Rossi, International Labour Organization, Automation, employment and reshoring in the apparel industry: Long-term disruption or a storm in a teacup? May 2020.

20. WBGU – German Advisory Council on Global Change (2019): Towards our Common Digital Future. Summary. Berlin: WBGU.

the potential offered by new forms of market access and employment opportunities lags behind the societal challenges posed by automation and new forms of work, especially in developing countries and emerging economies.[21] Digital technologies could fuel consumption; hardening the digital divide; creating dislocation in the labor markets; and consolidating the power of the few over the many.[22] In many developing countries, the availability and the price of energy is a prerequisite for the introduction of advanced technologies and industrialization. In the manufacturing sector e.g. investments in advanced production technology are rarely done when the energy costs are too high. Additionally, sourcing decisions for the big textile brands are now also based on clean energy. Nevertheless, new technologies have not yet been widely adopted in developing countries, owing, among other reasons, to a lack of progress in establishing the necessary large-scale energy infrastructure.[23]

By reducing the costs of communication and information access, digitalization also opens up opportunities for developing countries to develop their economies independently. Companies and employees can also gain easier access to international markets when barriers to markets are falling. For instance, digital technologies can reduce the amount of capital needed to participate in international (digital) markets. In principle, for example, cloud computing also offers smaller companies in developing countries access to the latest technologies without having to fully

bear the high investment costs and risks of server infrastructures. At the same time, with the help of digitalization (service) activities can be outsourced and traded internationally. New pricing models and low first-copy costs lead to less capital-intensive business models. Digital work platforms represent a new, global labor market for such jobs, to which developing countries and emerging economies have direct access. Digital work platforms can lead to a new quality in the international division of labor.[24]

The increasing demand for medium and highly skilled labor compared to the falling demand for less-skilled labor generally harbors the risk of rising inequality and growing social tensions. This also applies to developing countries and emerging economies. In developing countries, however, these developments become even more explosive as a result of greater political instability, the often weaker (state) institutions, and the frequently lacking or considerably weaker social-security systems. Automation can also lead to lower demand for migrant workers in industrialized countries. The consequence would be a collapse in return remittances, which in many developing countries and emerging economies account for a significant proportion of the GDP.[25] Also, new forms of work (e.g. quasi-self-employment) in the digital economy undermine standards in occupational health and safety, and increase the risks of worker exploitation and control.[26] Estimates show that up to two-thirds of all jobs in developing countries could be at risk.[27]

21. WGBU – German Advisory Council on Global Change (2019): Transforming our World in the Digital Age. Berlin. WBGU. https://www.wbgu.de/fileadmin/user_upload/wbgu/publikationen/factsheets/flt_2019/WBGU_2019__SustainableDigitalAge_EN.pdf

22. Digital with Purpose: Delivering a SMARTer2030, Global Enabling Sustainability Initiative (GeSI), 2019.

23. Time to Act for SDG 8: Integrating Decent Work, Sustained Growth and Environmental Integrity – International Labour Office – Geneva: ILO, 2019.

24. WBGU – German Advisory Council on Global Change (2019): Towards Our Common Digital Future. Flagship Report. Berlin: WBGU.

25. Ibid.

26. Digital Momentum for the UN Sustainability Agenda in the 21st Century, Policy Paper No. 10, German Advisory Council on Global Change, June 2019.

27. Harnessing the Digital Revolution, UNDP, 2018, accessed at https://feature.undp.org/global-goals-technology/

This will lead to a situation in which digital technologies can become a threat to the implementation of the SDGs and inclusive work. The International Labour Organization (ILO) which is the custodian agency for 14 SDG indicators related to the labor market acknowledges that at the current pace, decent work for all will not be achieved by 2030. The progress in labor markets around the world has been too slow and uneven to ensure a sustainable future with decent work opportunities for everyone.[28]

Some groups will be especially affected by these developments. For example, women, young workers, disabled workers or low-skill-workers. As already mentioned, this study focuses on occupations at high-risk of being automated, as they are vulnerable and have, at least theoretically, the potential to upgrade their skills. Empirical findings point out that the higher the wages and the higher the education level, the lower the probability of jobs being automated.[29] Education is the key for inclusiveness. That means that on the supply side high-quality, future-oriented and affordable education has to be offered by state institutions and the private sector. Equally important is the awareness for future job prospects and the motivation by workers to educate themselves – the demand side. There is not much research yet that focuses on these factors. There is even less research for developing countries and the obstacles workers in routine tasks face personally and institutionally. Research in developed countries shows so far that low-skilled workers participate less often in training than highly-skilled workers, because of the lack of private returns to such investments and lack of the

intrinsic motivation to participate in training.[30] Other studies argue that workers in high-risk occupations are active and motivated; however, their motivational orientation may not be toward what is considered productive activities.[31] Even if motivation is one of the most commonly interpreted and diversely defined constructs in psychology, as too many factors affect motivation, this study still shows that the personality and mindset of the learner plays a crucial role for education.

The Cambodian Labor Market and its High-Risk Occupations

After discussing the challenges of automation for high-risk occupations in general, this chapter focuses on how automation affects the Cambodian labor market. Cambodia is an emerging economy with a growing manufacturing sector, which is predominantly driven by the garment industry (textiles, clothing and footwear) and low wages in the sector.[32] Due to steady economic growth and macroeconomic stability, the GDP per capita more than tripled since 2005. In 2017, Cambodia is a lower-middle-income country with a GDP per capita of 1,384.4 USD. At the moment, there is a continuous economic growth of approx. 7.0 percent annually.[33] The manufacturing sector, which contributed 33 percent of the GDP in 2017 is dominated by textile and leather. 800,000 employees generate approx. 75 percent of all export

28. ILO, Can we achieve decent work for all by 2030? https://ilostat.ilo.org/2020/02/21/can-we-achieve-decent-work-for-all-by-2030/

29. Carl Benedikt Frey, Michael A. Osborne, The Future of Employment: How Susceptible Are Jobs To Computerisation? September 17, 2013.

30. Training motivation of low-skilled workers, Didier Fouarge*, Trudie Schils** & Andries de Grip*, 7 JULY 2009.

31. 'In reality, i motivate myself!'. 'Low-skilled' workers' motivation: between individual and societal narratives, Kristina Mariager-Anderson, Pia Cort and Rie Thomsen, BRITISH JOURNAL OF GUIDANCE & COUNSELLING, 2016.

32. ASEAN in Transformation, How Technology is Changing Jobs and Enterprises, Cambodia Country Brief, https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_579672.pdf, April 2017.

33. World Bank, Data, https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=KH&name_desc=true, Accessed June 18, 2019.

earnings. The garment sector indirectly contributes to employment in retail, trade and transportation. The exports are totaling 8 billion USD in 2017. This strong focus on garment carries a big future risk as vulnerable groups heavily depend on it.[34]

Cambodia consistently had one of the lowest unemployment rates for the past 30 years according to official statistics from the World Bank: the latest figures put it at the 5th lowest. Cambodia's official unemployment rate has been between a low of 0.39 percent (2015) and a high of 1.35 percent (2005) since 1991, most recently in 2019, it stands at 0.68 percent.[35] The definition of the unemployment rate is "those individuals without work, seeking work in a recent past period, and currently available for work, including people who have lost their jobs or who have voluntarily left work."[36] Considered within the ILO's and the Cambodian government's definition of those employed are those "engaged in any activity to produce goods or provide services for pay or profit", which includes those "who worked in a job for at least one hour" and who receive remuneration payable "indirectly to a household or family member."[37] Those who are own-account workers or contributing family workers, although counted as employed, are not particularly safe in their employment. The ILO and World Bank acknowledge the pitfalls of this methodology: "Paradoxically, low unemployment rates can disguise substantial poverty in a country, while high unemployment rates can occur in countries with a high level of economic development and low rates of poverty. In countries without unemployment or welfare benefits, people eke out a living in vulnerable employment."[38]

The ILO, which calculates unemployment, suggests that for Cambodia a more accurate indicator for the health of the labor market is to count those in "vulnerable employment." Vulnerable employment is defined as the sum of the employment status groups of own-account workers and contributing family workers.[39] Although it has fallen sharply in recent years, as of 2019, approximately 50 percent of Cambodia's population is still considered to be in vulnerable employment. When assessing Cambodia's working population status through this lens instead of unemployment, it becomes clear that Cambodia has labor market issues which need to be addressed as own-account and contributing family workers are more likely to experience low job and income security than employees and employers as well as lower coverage by social protection systems and employment regulation.[40]

34. Jochen Saleth, Zur wirtschaftlichen Lage in Kambodscha, März 2019.

35. World Bank Unemployment Rate Data accessed at www. macrotrends.net. Retrieved 25 September, 2020.

36. World Bank: world development indicators Metadata Glossary; accessed at https://databank.worldbank.org/metadataglossary/ world-development-indicators/series/SL.UEM.TOTL.NE.ZS

37. ILO: Resolution concerning statistics of work, employment and labour underutilization (pg. 6); accessed at http://www. ilo.ch/wcmsp5/groups/public/---dgreports/---stat/documents/ normativeinstrument/wcms_230304.pdf

38. World Bank: world development indicators Metadata Glossary; accessed at https://databank.worldbank.org/metadataglossary/ world-development-indicators/series/SL.UEM.TOTL.NE.ZS

39. ILO: Employment by status in employment; accessed at http://www.ilo.org/global/about-the-ilo/newsroom/features/ WCMS_120470/lang--en/index.htm
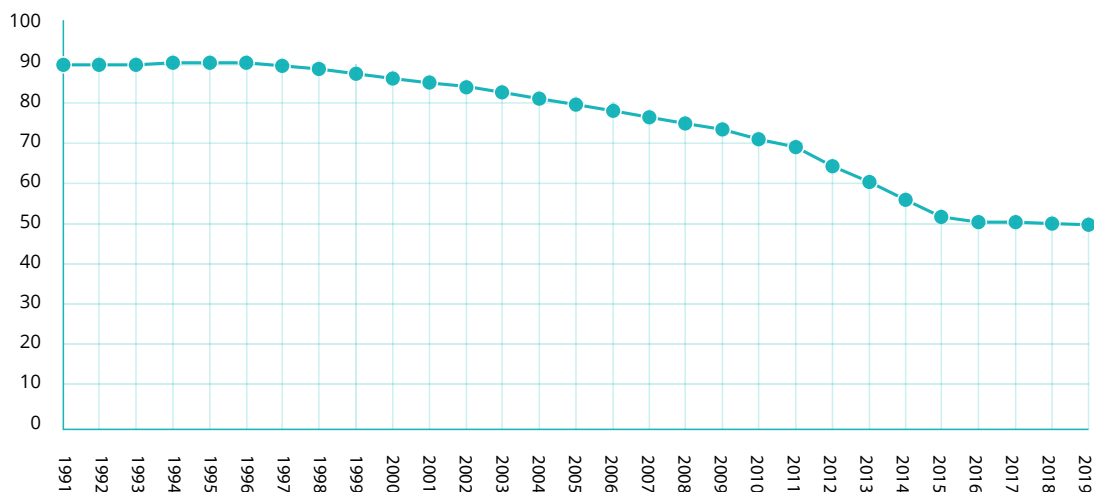
40. World Bank: world development indicators Metadata Glossary; accessed at https://databank.worldbank.org/metadataglossary/ world-development-indicators/series/SL.UEM.TOTL.NE.ZS

Graph 1: Percentage of Cambodia's population working in vulnerable employment

Source: World Bank (2020)

According to the ILO, 88 percent of jobs in the garment sector are at high risk of being automated. This could impact almost half a million sewing machine operators who primarily perform repetitive and manual tasks.[41] The ILO estimated that 57 percent of all Cambodian workers (or over 4 million jobs) face a high risk of automation.[42] It is likely that specific segments of workers will significantly feel the impact including women, young workers and primary school graduates. Cambodian women are 50 percent more likely to be employed in an occupation at high risk of automation compared to men.[43] Young Cambodian workers aged 15 to 24 are 10 percent more likely to have an occupation at high risk relative to adult Cambodian workers. Moreover, primary school graduates are 20 percent more likely to be in a high-risk occupation than post-secondary graduates. Workers with lower education levels tend to perform manual and repetitive tasks that are automatable in nature.[44]

Critically, one in five Cambodian enterprises blames the lack of skilled workers who can operate required technologies as the second largest barrier.[45] This highlights significant skill gaps in Cambodia resulting from low education levels among the Cambodian workforce. Enterprises in Cambodia also reported that technology does not have to be upgraded.[46] This could relate to the fact that wage levels in Cambodia are relatively low compared to other countries in the region, and technology is perceived as expensive.

41. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016.

42. Ibid.

43. ASEAN in Transformation, How Technology is Changing Jobs and Enterprises, Cambodia Country Brief, https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_579672.pdf, April 2017.

44. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016.

45. Ibid.

46. Ibid.

These findings could change in the near future as technology costs decline while labor costs increase.[47]

Cambodia's labor productivity in the garment sector is among the lowest in ASEAN and represents only 22 percent of the level in Thailand's garment sector.[48] Garment production in Cambodia will be impacted by technology uptake both inside and outside Cambodia. Inside Cambodia, enterprises are automating labor-intensive production processes to raise productivity. Increased automation will impact more than 650,000 Cambodian workers whose jobs would be at high risk of automation. The majority of these workers will be young women with low education. In terms of skill requirements, growing automation will increase the demand for technicians and high-skilled workers who can operate new machinery.

The economic success of Cambodia in previous years was possible through low wages for low skilled workers but this is unlikely to be a successful model any longer as wages rise. To be economically successful in the future, Cambodia will have to overcome its reliance on low-cost labor. It needs to invest more in skills to compete in higher value-added sectors to attract foreign investment. Limited educational opportunities are provided by the state and companies are reluctant to invest in the skillset of their workers. Almost every company expresses a concern that their staff will leave the company after receiving training which keeps companies from investing into the education of their staff.[49]

Obstacles to industrial development must be overcome. Currently, Cambodia runs short of home-grown technology, lacks research and innovations, and has high energy costs.[50] Cambodia needs to consider the future of specific sectors and activities: Who would be the main winners and losers of the digital transformation? Which skills are needed in the future and how can they be developed to prepare for a digital economy and especially: How can the poorest benefit from digitalization? Interviews with manufacturing firms suggest there is still little awareness of the changes that may come sooner rather than later.[51]

Digitalization is a threat to the inclusive labor market, but it is also a possibility, as technologies can provide vulnerable groups new employment opportunities and an easier way to upgrade their skill levels. Enhancing the positive impact needs to go hand in hand with minimizing the negative impacts.[52] "Digital technologies can trigger productivity and growth. With the right framework conditions, higher productivity and automation can, in turn, help the spread of decent work environments and create space for new models of sustainable work."[53] It will be crucial to develop the skill levels needed to navigate the knowledge economy, to create their own opportunities and design their own solutions. Investments in skills that cannot be automated are crucial: creative thinking, social intelligence,

47. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016.

48. Ibid.

49. Pheakdey Heng, Preparing Cambodia's Workforce.

50. ASEAN in transformation : perspectives of enterprises and students on future work / International Labour Office, Bureau for Employers' Activities (ACT/EMP). - Geneva: ILO, 2016 (Bureau for Employers' Activities (ACT/EMP) working paper ; No. 11)

51. Dirk Willem te Velde, Economic Transformation In Cambodia | Prospects, Challenges And Avenues For Further Analysis, ODI-CDRI, Background Note, April 2019.

52. Digital with Purpose: Delivering a SMARTer2030, Global Enabling Sustainability Initiative (GeSI), 2019.

53. Digital Momentum for the UN Sustainability Agenda in the 21st Century, Policy Paper No. 10, German Advisory Council on Global Change, June 2019.

creativity and transformative leadership.[54] If successful, new labor markets, goods and services (e.g. financial services, education) are created, which expand opportunities for economic inclusion, particularly in developing countries and emerging economies."[55]

When it comes to a more concrete question, which occupations will disappear in Cambodia, there is limited reliable data available. The International Labour Organization made a risk analysis in 2016 based on the methodology by Osborne and Frey.[56] "Frey and Osborne contend that nearly every occupation can be computerized in the next couple of decades, with the exception of those that involve high amounts of three broadly defined activities – creative intelligence, social intelligence, and perception and manipulation – that currently present automation bottlenecks. Frey and Osborne codify the probability of an occupation's automation in terms of the extent to which they require these three non-automatable tasks."[57] The ILO identified certain high-risk occupations for Cambodia. "Lastly, the methodology does not attempt to predict the precise number of jobs that will be automated or displaced, nor does it identify an exact year when this will happen."[58]

Table 1: High-risk occupations in Cambodia

High-risk Occupations	Employment (000)	Risk of Automation (%)
1. Stall and market salespersons	999.0	94.0
2. Crop farm laborers	616.2	87.0
3. Sewing machine operators	446.9	89.0
4. Livestock and dairy producers	263.2	76.0
5. Building construction laborers	242.7	80.0
6. Bakers, pastry-cooks and confectionery makers	92.4	89.0
7. Street food salesperson	89.8	90.0
8. Bricklayers and related workers	78.6	82.0
9. Forestry and related workers	69.6	79.2
10. Tailors, dressmakers, furriers and hatters	68.0	84.0

Source: International Labour Organization (2016)

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54. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016, p. 8.

55. Digital Momentum for the UN Sustainability Agenda in the 21st Century, Policy Paper No. 10, German Advisory Council on Global Change, June 2019.

56. Carl Benedikt Frey, Michael A. Osborne, The Future of Employment: How Susceptible Are Jobs To Computerisation? September 17, 2013.

57. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016, p. 8.

58. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016, p. 10.

Studies on the development of workers' skills in Cambodia thus far are either outdated, small in scope, or focus on different perspectives. In the 'ILO ASEAN in transformation' student survey from 2015, 102 students from Cambodia were questioned.[59] Which means that in the fast-changing Cambodian Labor market the data is comparably old and focused on high education as 95,9 percent of Cambodian participants are coming from top-tier-universities.[60] It excludes the vast majority of students from public and low-cost Cambodian universities and those who are not in formal education systems. In Cambodia, merely one in ten workers completed secondary schooling or some post-secondary education.[61] Newer but also limited is the survey by Heng on digital skills in Cambodia. In a mixed methodology, 100 employees were interviewed.[62]

Ouch Chandarany used a randomized experiment to provide evidence on the effects of vocational training programs for economically disadvantaged young adults in Cambodia. Individuals aged between 15 and 30 were randomly offered a two-month full-time training course in housekeeping for the hospitality sector. The program has positive but statistically insignificant effects on employment outcomes. The program led to many dropouts, their participation was mainly constrained by family obligations, lack of transport to the training center and temporary job opportunities. It became clear that they need other support in addition to training. Job-readiness training, job placement assistance, career guidance and counselling is needed to help economically disadvantaged young adults break into the labor market.[63] All studies conducted so far in Cambodia on future skills did focus on skill levels and skills that might be needed, but no research has been done so far on the motivation and awareness of workers to upgrade their skill level.

To conclude, there are a number of low-skilled jobs at risk in Cambodia. There is an urgency to upgrade the skills of these workers. Education, in general, is influenced by many different aspects; institutions like schools or universities, curricula, teacher-student relations, the income of families and many more. When it comes to lifelong learning or learning on the job the motivation and awareness of the learner is a crucial and often underrated aspect. Therefore, we bring those workers in high-risk occupations, their awareness of the problem, their motivation to educate themselves and the obstacles they face into focus. This leads to the main question:

Are workers in occupations with a high-risk of being automated aware of the situation and therefore upgrading their skills?

Methodology and Data Collection

As there is no research on awareness and motivation in Cambodia so far, we decided on an explorative approach to answer the question. This gives room to gain a better understanding of the situation and puts the workers and their

59. Jae-Hee Chang and Phu Huynh, ASEAN in transformation : the future of jobs at risk of automation, International Labour Office, Geneva 2016, p. 10.

60. ASEAN in transformation : perspectives of enterprises and students on future work / International Labour Office, Bureau for Employers' Activities (ACT/EMP). - Geneva: ILO, 2016 (Bureau for Employers' Activities (ACT/EMP) working paper ; No. 11)

61. ASEAN in transformation : the future of jobs at risk of automation / Jae-Hee Chang and Phu Huynh ; International Labour Office, Bureau for Employers' Activities ; ILO Regional Office for Asia and the Pacific. - Geneva: ILO, 2016 (Bureau for Employers' Activities (ACT/EMP) working paper ; No. 9)

62. Pheakdey Heng, Preparing Cambodia's Workforce.

63. Ouch Chandarany Vocational Training and Labour Market Transitions: A Randomised Experiment Among Cambodian Disadvantaged Young Adults, in: Vathana Roth, ed. 2019. Job Prospects for Youth, Low-skilled and Women Workers in the Greater Mekong Subregion. Phnom Penh: Cambodia Development Resource Institute.

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perception at the center. Using focus group discussions one can analyze the workers' feelings and perceptions toward their occupation and future employability. The focus groups allow in-depth conversations with a mixture of different workers. Using focus groups, assumptions can be tested, conversations can flow, and new ideas and questions can be posted on the fly. In particular, the focus groups were useful in proposing new hypotheses. Respondents for the groups were selected based on particular requirements. In this case, they were selected by their occupation being at risk of automation (the same 10 occupations identified by the ILO), their age, gender and location.

In total, six groups were undertaken, each group had six respondents within it, six being the ideal number for a focus group, considered large enough to allow a breadth of opinions and for diverse ideas to flow whilst also not being too large to be unwieldy. A foremost book on conducting focus groups explains that groups of four to six participants are ideal "if the study is to gain understanding of people's experiences, the researcher typically wants more in-depth insights. This is usually best accomplished with smaller groups. Also, smaller groups are preferable when the participants have a great deal to share about the topic or have had intense or lengthy experiences with the topic under discussion."[64]

Each focus group session lasted around two hours and was recorded in Khmer and English. The focus group discussions were conducted by Spear Insights, a market research and analytics company based in Phnom Penh.

Based on the aforementioned literature the following objectives structured the conversation in the focus groups:

> Understanding the factors which make someone choose a job at risk of automation

> Understanding workers' knowledge of job automation

> Understanding workers' perception of their own possible jobs at risk

> Understanding workers' attitudes toward education and upskilling to achieve job security

> Create hypotheses for changing worker attitudes toward upskilling

Respondent Criteria

These groups were divided up most critically by gender and location. For time and cost efficiency the sample was undertaken around Cambodia's capital city of Phnom Penh. As some of the high-risk occupations are more rurally focused, the groups were split between respondents who live in the urban part of the

64. Focus Groups: A Practical Guide for Applied Research. Accessed at https://www.corwin.com/sites/default/files/upm-binaries/24056_Chapter4.pdf

city and those who live in the outskirts of the city or the surrounding province of Kandal.

For both locations, the groups were split with a male-only, female-only and a male/female split group, totaling 6 groups overall.

Table 2: Organization of the groups

Group	Gender	Location
1	Male/Female split	Urban
2	Male	Urban
3	Female	Urban
4	Male Female split	Semi-urban/rural
5	Male	Semi-urban/rural
6	Female	Semi-urban/rural

Within each group, the respondents were divided so that two were within the age group of 20-24, two between 25-29 and two between the ages of 30-35. The age range of 20-35 was chosen under the impression that the people within this range would have a few years of work experience, but would not be too old to consider gaining further training or education. In Cambodia, more than 50 percent of those who aged over 15 years old have already entered the workforce.[65] It can be assumed that those who are younger are more likely to consider gaining further education or skills and thus these respondents would have higher potential than older demographics. Furthermore, with the average age of marriage in Cambodia being 20.5 for women and 23.0 for men and the average age of first childbirth

among women is 22.4,[66] these respondents would create a cross-section of those who are single, thinking about having families or already having their own offspring

Recruitment Methods

Before recruitment began, a screening questionnaire was created in English and then translated into the local Khmer language. The questionnaire set out the specific criteria that must be met for a respondent to join one of the focus groups. Once briefed, the recruitment staff set out to find respondents. The recruitment was undertaken with a mixture of random and purposive sampling. In addition to the specific criteria of the groups, maximum quotas were set for each district of Phnom Penh and for each occupation to ensure that there was a good mixture of responses within the groups. Furthermore, additional criteria needed to be met for a respondent to join the groups, such as not knowing any of the other respondents, being open and friendly to talk.

Focus Group Specifics

All six focus groups were undertaken at the Konrad-Adenauer-Stiftung (KAS) head office in Phnom Penh. To achieve the research objectives set out earlier in the report, a structured discussion guide was created. Each group followed the same discussion guide. However, based on the findings as the research continued and due to the individual responses within each group, the flow and probing questions asked varied slightly between groups. The discussion guide was created so that each group discussion would last two hours in length. The full discussion guide is contained within the annex of this report.

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65. Cambodia Labour Force and Child Labour Survey 2012. Accessed at http://www.oit.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-bangkok/documents/publication/wcms_230721.pdf

66. National Institute of Statistics, Directorate General for Health and ICF International. 2015. 2014 Cambodia, Demographic and Health Survey Key Findings. Rockville, Maryland, USA: National Institute of Statistics, Directorate, General for Health and ICF International. Accessed at https://dhsprogram.com/pubs/pdf/SR226/SR226.pdf

Respondent Demographics

In total, 51 respondents arrived at the venue to partake in the groups, 36 of these respondents were selected to take part in the discussions. The 36 selected were chosen based on their profiles to get the best mix of final respondents taking part. The additional 15 respondents were thanked for their time and sent home. A full table of respondent demographics can be found in the appendix of this report.

Overall, 39 percent of the respondents were single compared to 61 percent who were married. The respondents were split exactly 50 percent with children and 50 percent without. From each of the 10 high risk occupations, there were between 2-6 respondents who attended the groups, except 'forestry and related workers' due to the focus groups taking place in and around Phnom Penh where there is no forestry work to be had.
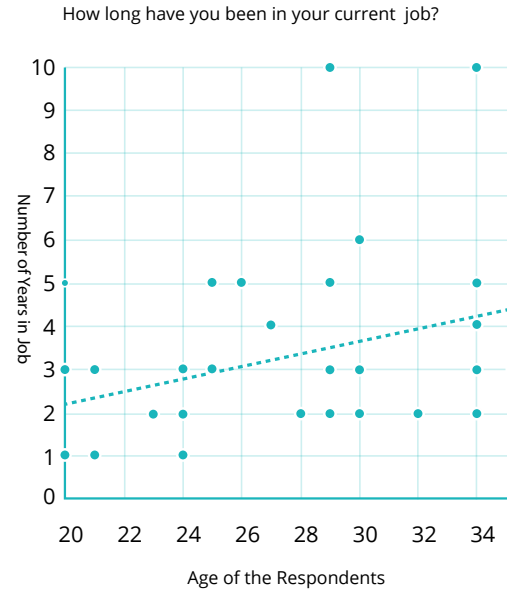
In total, 17 percent of respondents had only primary education, 42 percent had secondary education, 39 percent for high school education and 3 percent (1 respondent) had started university but had not yet graduated.

Result

Current Job

The respondents had on average (mean) been working in their current jobs for 3.3 years. There was a slight trend that the older the respondent, the longer they had been in their current job. In all cases, the respondents had found their current job through some sort of social connection, either through family, friends or neighbors. For all, there was little to no application process, the jobs did not require prior skills, knowledge or training and thus with a connection, they could almost immediately start work.

Graph 2: Length of time in job vs. Age of the respondents

How long have you been in your current job?

Age of the Respondents

Typical stories of how respondents got into their current professions were:

1. The respondents' parents needed assistance from them. This could be because their parents were aging, the respondents had many younger siblings or the family had less money coming in. This story was the most common among the respondents who worked in-home or in family-oriented occupations, for example, market sellers, crop farm laborers or livestock and dairy producers.

2. Women who worked in construction-related jobs (bricklayers and construction workers) usually found their jobs through their husbands. Most often they started work with the purpose of supporting their husband and then did not leave the job.

3. Men who worked in construction usually found the job through friends or neighbors and often joined because they wanted to get additional money quickly and because the job would pay them daily.

4. For those in other professions, the jobs most often came about after seeing others doing it and being successful at it. Respondents would get inspiration from others, thinking that they could achieve the same and imitate them. This was the primary story of those in more independent or self-employed jobs; the street sellers, bakers, pastry-cooks, and confectionery makers, sewing machine operators, tailors, dressmakers, furriers, and hatters.

Across all 36 respondents, there were only two exceptions to the above. A 30-35-year-old baker in the city had learnt his skills by attending a course by the NGO PSE: Pour un Sourire d'Enfant.[67] This course had been provided to youth from poor backgrounds to give them workforce-related skills. He mentioned that there were lots of options for learning there but "I learnt to work at the bakery and become a baker, it was free and I learnt it for a year. After that, I worked for others before I started my own [business]. I chose it because being a baker is not a common job for most so I thought it would work for me." The other case, a 25-29-year-old construction worker in the city had chosen to learn graphic design skills at Don Bosco[68] but had left the course because the skill would have taken 3 years to acquire.

Current Job Satisfaction

The majority of respondents gave fairly satisfied scores (7 or higher) on their current job satisfaction. There are many reasons why the respondents are satisfied and are willing to continue with their current jobs.

1. The salary is enough for their family.

The respondents achieve personal incomes of around USD229 per month and household incomes of USD473, which for the women was about 46 percent of their household income and 49 percent for the men. Although they would like more money, the money they make is enough for them and their family to be supported in their daily needs.

2. The jobs provide them with daily payment.

Most of the workers are in self-employed and informal work and thus make money daily, there is; therefore, an immediate pay-off to their work. They do not need to wait for every half month or the end of the month to be paid. As their families are not wealthy and do not have many savings, they see this mode of income as preferential. Furthermore, it allows them to spend freely when they have a good day and achieve more income than they expected.

3. They are self-employed.

For all jobs included in the groups, except the construction workers and some of the sewing machine operators, the respondents would consider themselves self-employed, or at the least working for the family business, so the money that they earn is theirs, they are not working to make money for someone else. It is gratifying to be paid for the work that they do and earn for themselves rather than for others.

4. Flexibility to take holidays

These jobs provide the respondents with the flexibility to take holidays when they require them, for example, to be able to visit family in the provinces when they want or need to. One 25-29 year-old street vendor in the city

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67. Pour un Sourire d'Enfant. PSE in Cambodia. Last accessed 30 October, 2020. https://www.pse.ngo/pse-cambodia

68. Don Bosco Foundation of Cambodia. Last accessed 30 October, 2020. http://donboscokhmer.org/

mentioned that he loved that he was selling from his motorbike as he could go and visit anyone or be anywhere and still make some income, "now I sell desserts so if I want to go somewhere I take my moto and I can still sell desserts, so I have so much freedom," he explained. Many of the men had, at some point previously, worked as security guards. They all disliked this as it only provided 2 days of holiday per month: "If I went to visit family in the province, it would give me less than one day there and when I returned to work I would have no other free time to use for the rest of the month, I could not go anywhere, I was so lonely" explained the same street vendor.

5. Free time to look after the household

What is of particular importance to the married women is, they noted, that they felt they were at a time in their lives when they had to choose a job which allowed for more flexibility. When the women married, they saw it as their duty to take a job with more free time to allow them to cook and perform other household chores. This was even more important to the women who had children as they knew they would have to work and look after children at the same time.

For example, a 30-35-year-old female tailor in the city, who used to sew in a factory but gave up that job so that she could be a stay-at-home tailor when she got married and had children: "I used to be a factory worker; I did that for 5 years. It changed when I married husband because I didn't have time to look after my husband with my previous job, so I quit to look after my family." Her new job gave her the ability to choose her hours, support her husband and look after her children while still bringing home an income.

Both women who worked in construction or bricklaying took this job so that they would be working at the same location as their husbands. "I was a factory worker before I got married to my husband. After I got married, I followed him. At first, I looked after my children but then I started to help my husband to make and prepare the bricks, my husband taught me to do so" explained a 30-35-year-old female construction worker. She further explained that he would typically take the more intensive jobs while she took on more of an assistant role at work so that she could still bring in an income whilst also supporting the children and finding time to shop, cook and clean.

Reasons for Being Dissatisfied

There were, however, 6 people who gave mixed scores (4-6) and 2 people who gave dissatisfied scores (lower than 4). The reasons for being unsatisfied were:

1. Wages are low

The primary complaint of those unsatisfied was that their salary was not as high as they would like. With their current income they are able to support their families but not to make enough to save or build for a more comfortable future. A 30-35-year-old male bricklayer commented, "In my field, because it is very labor intensive, it only earns a little money and it is hard to support my family."

2. Physically demanding work

Most of the respondents who joined the groups were in physically demanding jobs. Given the option, they would prefer to be a white-collar worker with the comfort of sitting in a cool place instead of being active in the heat or under the sun. "As long as I can get a new job that isn't labor intensive, I would be satisfied. I think I want to run a grocery store instead" explained a male 25-29 construction worker.

3. Being self-employed and not salaried have drawbacks

Working for themselves has many perceived positives, however, it is not a salaried job and thus if they miss a day of work they are not paid. There is no safety net for them if they were to encounter an unexpected medical or economic shock. Becoming sick and not being able to work were a huge concern for all of the workers in the groups, regardless of occupation.

Skill Acquisition

Almost entirely, the education and skill acquisition for their jobs, both past and present, came from either observation of others or on-the-job learning. There was only one respondent who had learnt skills for his job through an NGO course. Otherwise, all respondents would learn from observation of others whether on the job or not. For those in jobs with older or more experienced colleagues, they would watch them work and learn best practices through them. There was, however, no formal training. Only one of the respondents working for a company had seen any real progression of skills and had a path to further development. A construction worker who now specialized in ceilings had originally started out carrying bricks and over the years had progressed to a higher paid, more skilled job, working specifically on ceilings at his building sites. Again, this upskilling came from observation and learning skills by watching, rather than through any official course.

Those who were self-employed, for example, the market sellers, street vendors and tailors had learnt their skills by watching those around themselves and by participating in the field as consumers. "We can learn things from friends or family, those who are sellers or café owners, we can see those who do it and we can observe how they do, we don't need to go to school to learn this" remarked a 20-24-year-old male market stall salesperson.

Previous Jobs

The respondents typically found their jobs through their close networks. There was a large spread in the number of earlier jobs that respondents have undertaken. For some, they came into work through their family at a young age and have never changed professions. For others, particularly the males, they may have worked in numerous fields unrelated to each other. A 25-29-year old street vendor in the city, for example, had previously been a construction worker, a tuk-tuk driver, a security guard, a moto driver and a farmer.

The previous jobs that respondents had worked on were common among the groups and were similar regardless of their current job. Many of the males had, at one point, been a construction worker, farmer or security guard. Many of the females had been factory workers previously. Among both males and females some had been street food vendors or market stall sellers. The jobs that these respondents have worked in are thus, to a degree, interchangeable. They all require little training or skill to obtain the job and these jobs are currently plentiful in the country.

The most common reason for a woman to switch jobs was due to getting married or having children and thus wanting to spend more time at home, be closer to the family or in a job that allowed for flexibility. For men, the reasons varied to greater degrees; the need to be closer to home did come up but a change in occupation also came about due to being bored with one's work, disliking colleagues/superiors or being offered a better work opportunity elsewhere.

It is worth noting that the jobs that workers switched between were most often lateral in progression. A worker changing from one job to another might be doing so not because it pays more or has more responsibility but because it is closer to home or is perceived as being less tiring. For most, the jobs that the respondents have been working in were not stepping-stones as part of any aspirations or ambition but rather jobs that they had fallen into. As the workers are all in fields that are self-employed or are routine tasks there is very little upwards progression possible without changing careers completely.

Fear of Losing Employment

The fieldwork for this research project was undertaken between 11-13th September 2020. Although the Cambodian population has been largely unaffected by the effects of Covid-19 (Cambodia was at 275 total cases with 0 deaths at the time of the groups), the economic impacts of the global downturn have been clear in Cambodia with many restaurants and factories closing their doors. It was expected that the respondents may have a fear of losing their jobs due to Covid-19, if not from impending automation.

The respondents in many situations had felt the economic effect of Covid-19 through the reduced demand for goods; the tailors, in particular, noted that they had fewer customers recently than before the pandemic; "Things are getting worse, due to Covid-19 I don't have a lot of customers. A lot of weddings and events are cancelled so I lost a lot of customers" explained a female 30-35-year-old tailor in the city. Street food vendors and market sellers had also noted a downturn in custom for a time but felt that it was returning to normal with less fear in the population about the disease. "Due to Covid-19, I have been making less money as the nearby factory workers haven't come to buy

my vegetables. However, I am not concerned that I could lose my job" commented a female 20-25 market stall seller from the semi-urban area. Regardless, the workers had not been worried about being able to make ends meet.

The reason for their confidence was that they had easily obtained their current job. As mentioned previously, most had switched through several jobs in their lives already. They found jobs opportunistically and with ease. Should something happen to their current job, there was no fear in their mind that they could not find another job. For example, those who were tailors saw that if their customer numbers continued to drop, they could fall back on returning to factory work. "I would go back to being a factory worker as I have experiences doing that." Those who were market stall sellers or street vendors could not think of anything which would result in them stopping being able to sell food to people as "People will always have to eat." Those in construction have seen the city continue to develop and could not imagine something which would stop development altogether. One construction worker thinks the situation is even improving: "I think construction hasn't been affected by Covid-19. I think things are still the same but the prices are getting higher. In the past I would only get USD2.5 per day" claimed a 20-24-year-old male bricklayer in the city. They had seen constructions fail before and had seen the workers on that site lose their job, but there had always been other construction sites they could move to. Should even that fail, they could fall back on being a security guard, driver or loading goods "it would affect me but there are other things I can do, as long as it is legal I can do anything" stated a male 25-29 construction worker.

The respondents had little care about whether they were to continue in their current occupation or to switch to another. There are countless jobs available to these workers, all of which are of similar skill, ease

to find, difficulty in labor and monetary value: "I think that with the other things that I can do, the money I earn won't be much different" clarified a 30-35-year-old male construction worker. Ironically, it is Cambodia's high rate of vulnerable employment which provides those within vulnerable employment their perception of job safety.

Reasons for Stopping Education and Starting Work

Of the respondents, none had yet completed higher education, one was currently attending evening classes and one had the intention to attend university once he finished high school this year. The respondents' reasons for stopping their education at a young age were intrinsically linked to their reasons for starting work and as such are analyzed together below.

1. They had to conclude their education in order to help out family business

The most common reason for the workers being in their particular jobs was that they had inherited the work from their family; their parents were doing the same job but as they aged they were struggling to fulfil the work requirements alone and so encouraged their children to help take over, passing on the work to them. This reason was especially common among the women and those who are the elder offspring of a family, "I did it to support my family, that is why I am selling vegetables. First I just stayed at home while my mum sold vegetables but she was getting older so I started to help her to sell vegetables, other than that I would also help to look after my younger siblings" explained a female 20-24-year-old market stall seller. The older siblings, especially if female, are put to look after the home business, the siblings and household. Within these cases, it was often pointed out that they wouldn't have the money to continue their education and by helping out with the family

work they could save or earn more money instead of spending it on their education.

2. Could not afford to continue education, started work out of necessity

In a few cases, the respondents expressed that they would have liked to continue their education, however, they had to quit their schooling to assist the family in making more money. The family could not afford for them to continue their education. In these cases, they may often have started working to continue their parents' or relatives' job, as above.

3. There is little point in attending school, I should start working instead

On the basis of those around them, some see little point in pursuing further education. This comes from 2 perspectives:

1. They see that it is the only possible way to achieve a good job in Cambodia, if you are well connected or have access to large amounts of money. They think that without engaging in corruption, it is not possible to achieve these top jobs, so they think that even holding a degree will not influence their lives.

2. Others point out that many students who have finished university "still end up in a USD200 a month job." Although this may be true of some graduates, the respondents don't realize that these are entry-level jobs and most graduates will increase their salaries from this point on and in later years will be able to make much more than this.

4. They did not have the talent for it

A common belief among the respondents was that skills in learning were a purely naturally gifted trait. "I do not have talent in education" or "My memory for learning from books is not good" were frequently repeated phrases. The

respondents did not believe that they could achieve success in school and so decided it was time to leave and join the labor market. Their understanding is that education is not for everyone.

5. The lure of getting money in the short term was more appealing than waiting to achieve a better wage and earning more money later.

Many of the male respondents were lured into leaving school upon seeing their friends not going to school furthering their education and instead of making money. Simply the lure of quick cash instead of a longer pay-off convinced them to leave school. Getting paid daily is a guarantee compared to spending years in education for a potential payoff later. What they know from their environment is that others with low-level education work and make money. In these cases, they are usually encouraged by friends or family that education is not important and that they should rather start working.

In all cases, the respondents mentioned that they were not 'forced' to leave education but that it was their choice. However, it was also clear in all cases that these were not decisions that they made on their own. Their family and friends certainly had an impact on their decision and in most cases they were pushing them toward work instead of education.

Interestingly, as they have grown older, some have started to value education to a greater extent. A few of the respondents across the groups said that they wished that they had stayed in school longer and had come to regret their decision to leave now, "I could not catch up with the education, I was too lazy to study, my parents didn't force me to quit, I just didn't like studying, I kind of regret it now. I think my family could have afforded me to continue, I just didn't want

to study" explained a male 20-24-year-old construction worker. Ultimately, for some, even with their regret of not having obtained a full education, they still believed that they did not have the talent for it anyway and thus it was not a real loss to have left: "I think I don't have a good memory, my brain does not function well, I don't have the ability to catch up" claimed a 25-29-year-old female baker, cake or confectionery maker. Others still did not value education and were quite content with their decision to leave at a very young age. "My parents cannot afford my education, so they got me to stop. I quit and I don't have any regrets. My parents told me to strive for my own life. You could get higher education and still be a rice farmer so I was happy to quit and become a worker and earn my own money and spend the money I earn." explained a male 30-35 street food seller.

Children's Future

It could reasonably be expected that the re-spondents would, when asked about their children's future, suggest that they wanted their children to be very successful, wealthy and powerful, however, the reality was quite different. Many respondents expected their children to assume their occupation, as they had from their own parents. As they had thought about their own education, only some realized the value of it and wanted their children to continue in school and obtain an employment which would provide them with more wealth in the longer run than they had achieved themselves. "My wife is a dentist and I think that her job is good, and I want my children to be in her field. I do not want my children to work in my field because it is very labor-intensive, it only earns a little money, and it is hard to support my family. Other jobs will have more opportunity to grow rather than being just a construction worker" explained a 25-29-year-old male.

The key issue is that, apart from two, the respondents, whether they were parents yet or not, saw education as something that came from nature rather than nurture. "I think that education and skills are important, but it depends on my children. If my child is smart, not like me, then I will support them to get into further education" explained a 30-35-year-old father who works as a street food vendor. Surprisingly, the parents did not think that additional training or special care could support their children to get into higher education if they were not born with the natural ability to take to it. Across all groups, the popular opinion was that their children should each achieve a high school education, however, even then it was still with the caveat "if they have the talent for it."

Their intention is to support their children through school for as long as they can, all the way through university as long as their child has a natural ability for it. If not, they expect them to leave education and enter the workforce. They leave their children's education to their children's appetite for school and they do not show an inclination to push their child to learn, as a 30-35-year-old livestock farmer clarifies "it depends upon the level of the child, how smart they are." It is clear the respondents and now their children are not being raised in an education-friendly environment.

Attitudes Toward Education and Upskilling

Only some of the respondents understood that education is important to achieve high-value and a skilled job. Some regret that they did not continue their education: "I saw others making money in the factories and I wanted to get money to help my family. When I was young, I had a short vision, I wanted to earn money and make money then. If I knew then what I know now, I would have continued because you can earn so

much more if you continue. I regret it now" remarked a 25-29 female street food vendor in the city. However, this viewpoint is not very widespread. Within the groups, education was appreciated more by those who had more education. Those with only primary or an informal education saw little value in it whilst those who had completed high school, understood that it held at least some value. A 30-35-year-old market stall seller explained, "it depends on my children and whether they want higher education or not. I am not sure about it because my education is low and so I don't know what my children should be."

As shown in the respondent information table, only 42 percent of respondents had completed high school education. Across all six groups, only two respondents had a connection to higher education, one boy was currently in his 3rd year at Norton University studying management and another was in the process of finishing high school and intended to study English at a university once he had completed his high school education.

Interestingly, there was a correlation between these two students when compared with the other respondents. The crucial difference between those achieving higher education and those who did not was their parents' interest in education. The other respondents did not see a need for themselves to go to university or to send their children there if they did not "have the talent to do it." The two exceptions shared how their parents had been pushing them to achieve an education from a young age and wanted them to "not have the same job as them when they become adults". One of the two boys mentioned how his family was not religious but that he had been sent to Christian Church as they would teach him English and other skills that could help him achieve a better life. "I have been lucky that my family and siblings have pushed me into getting more. However, it comes down to you.

You must be clear in what you want and to push yourself. I went to church because my family pushed me to go there, they wanted me to go anywhere that would help me to study and learn" commented the 20-24-year-old bricklayer. Both of these men are currently in high-risk of automation jobs, one is a farmer and a bricklayer, but these jobs are a means to an end and once they complete their university courses, they hope to find other jobs.

The differences are clear, those going to university, at least from this small sample, have parents who want them to have an education and for their children to not have the same occupations as themselves. The indication from this research is that the key difference in the respondents' attitudes toward education and upskilling is learnt from their parents and instilled in them from a young age.

Awareness of Education and Training Methods

The methods of attaining education and skills the respondents were aware of are:

1. School and University
2. Learning from friends and relatives
3. Learning from observation or the surrounding environment
4. NGO or community workshops
5. NGO training courses (e.g. Don Bosco and PSE)
6. Online learning (e.g. school lessons happening during Covid-19)
7. Online learning through YouTube or Facebook pages
8. Learning from books

Although the respondents have attained awareness of the above methods, they have little inclination to learn from any of these sources besides learning from friends, family,

and observation of their surroundings. Their education stems from informal means by people they know.

The primary issues are that the respondents do not think they have the time to learn and that they do not have the money to be able to afford any further learning if it is not free "because of my living standard I don't have time to learn it and if I were to go to school I cannot afford it" said a male 25-29-year-old construction worker. The respondents see that through work, family, and household responsibilities their time is all accounted for and they cannot spare additional time for learning. With any of the above training options, if the cost is a factor the respondents will not pursue them. They are living from month to month. Those with savings are intending to put money toward a business, their children's education, or their future. The risk of spending money on learning without a guaranteed payoff is too much for them to contemplate. More specific barriers, for the individual methods included:

1. Schools and universities:
These are too intimidating for the respondents to join now: "I am really shy; it would embarrass me that the child would learn better than me" clarifies a 25-29-year-old female tailor. The respondents see education as only for children and once you have passed your early 20s the moment has passed. Even when probed with the suggestion of adult-only classes, the respondents think it is too late for themselves to attend.

6. and 7. Online learning through lessons or online pages:
Online learning through either official classes or free videos are unappealing for the respondents. For those who have children, due to the government's Covid-19 response closing schools, the parents have seen their children learning via online or remote

learning and they think that it is ineffective. "You must supervise them when they are online learning; otherwise, they just play on their phones" explained a 25-29 female tailor. They also point to the fact that if they were not talented at learning when they had a teacher present and learning materials with them in person whilst at school, the chances of them learning at home alone are improbable: "If I don't have any guidance or stress I will not work. When I was young, I needed my mum to guide me. Nowadays I see the children doing it all themselves. For me it wouldn't even be 5 percent effective" commented a 30-35 female street food seller. Some respondents have, at times, learnt through the use of YouTube. Examples given were typically on how to perform household tasks better, for example, how to cook specific foods. They did not see this as a long-term solution for learning a difficult skill though. Even if online materials are available freely to access at their convenience from within their home, for example as YouTube is, they don't think that they will be able to devote the time or attention necessary to learn it.

8. Learning from books:
Reading is not an option for the respondents as they typically do not enjoy doing it and remember from their school days that they are not very good at learning or remembering through this method.

Future Occupation and Ideal Work

The jobs the respondents could see themselves changing to were close to what they have already accomplished. Their 'dream jobs' were all achievable and typically required no significant skill improvements. For example, the bakers wanted to open their own bakeries, the market sellers wanted to start selling at wholesale levels, the street vendors wanted to save up enough money to rent a shop front and set-up a permanent location restaurant,

some of the construction workers wanted to save enough money to buy a tuk-tuk and begin working for ride-hailing apps like Grab and PassApp. "I have always planned to change my job; I plan to switch because I do not see any opportunity to grow as a construction worker. I have a family; my children are growing, and I need to support their education. In the future I may change my job, I am trying to find a solution and a way out. I am planning on buying a PassApp and being a PassApp driver. If I cannot afford to buy one, I will rent a PassApp first. I think this will increase my salary and help my family" described a 25-29-year-old construction worker. "I plan on opening a grocery store with my wife but right now I don't have enough capital to open the store. Maybe 3 or 4 more years with crops before I can do it" said a male 30-35-year-old crop farm laborer.

Once probed as to what their dream jobs as children were, they were most often no different; however, some did, at one point, have higher aspirations. The higher aspirations were typically to be government officials, teachers or doctors/nurses, the jobs that have often been thought of as respected in Cambodian society. Government jobs, in particular, are considered prestigious for the family, even if the job is not very well paid, it provides a stable salary and a retirement pension which can support the family in old age.

Why Not Switch Careers?

The respondents did not think of any skills that could be learnt which would lead them to switch to a more advantageous career with higher and more stable incomes. Across the groups, there were three interconnected reasons provided for this:

1. It is too late for them
They think that their time to learn has passed and they do not have the ability, time or money to be able to achieve a well-paid career.

2. Little ambition

They are satisfied with what they have and what they have achieved. They have little drive or ambition to change to another career.

3. No understanding of how to achieve another career and little understanding of what careers even exist

When asked which high-level careers exist and how to enter them, the respondents showed little knowledge or understanding. Classic careers like doctor, nurse, government official and teacher were mentioned but there was little knowledge of other well-paid jobs. The respondents also showed a poor understanding of how one would go about entering these fields of work. The common answers given were money and connections (or explicitly corruption). Two of the respondents clearly said, "I see others doing jobs that are less hard and make more money than me. I see others running a business and it looks a lot easier than what I do" and "Some other people have their big business while working as state officials and I want to be like them as well. I want to reach my dream by being like them and earn more money. Some people have a lot of money and I wonder what are they doing to earn a lot of money?"

In all cases, as with their reasons for not continue studying or skill upgrading, they see the primary barrier to achieving these jobs as not having the right social connections and not having enough money.

Skills Worth Learning

There is a common belief among the respondents that to run a successful business is easy. It does not take skills, it simply requires enough capital to get started. Most of the respondents are self-employed or small business owners, the exceptions being the bakers, construction workers and some of the sewing machine operators. They think that to work for someone else requires education but to own a business primarily requires money. For example, multiple market sellers have an ambition to eventually have enough capital to be able to sell wholesale. A street food vendor wants to become a caterer at weddings but needs money to expand. Even the respondent who had gained skills in his occupation and now specializes in ceiling work at construction sites sees the only way he can improve is by saving enough money to hire others and become a contractor. Consistently, improving their businesses is understood to come primarily by acquiring more capital not through upskilling. The only skills that the workers would consider learning would be in support of their small businesses or to alleviate living-costs.

Many of the men were interested in learning motorbike repair skills. However, only a few of them saw this as a useful career path, it was more often considered as a side job for them to fix neighbors' motorbikes or for them to save money if they were able to fix their own bikes when necessary. Those in the farming or livestock rearing occupations would like to know better techniques for growing crops and raising animals to increase harvests or to sell at higher prices; "I would like to have a topic on how to sell well. I only want to know how to earn more money" claimed a female 30-35-year-old market seller.

Languages were of interest to the respondents but as aforementioned, the respondents do not feel as though they have time to learn. They are aware of learning materials available online on places such as YouTube but only a few of them have an interest in pursuing this. They do all see at least some value in learning other languages and see the possibility to sell more products or scale up their business if they can speak either Chinese or English.

The indication from this research is that full-scale career development and change is not feasible among this target group as it would appear that none of these workers have any interest in it, even if provided to them for free. An idea is to support these workers within their current jobs and skills rather than to upskill with the goal to change the profession. The goal would be to identify key skills for simple innovations like public speaking, languages, sales and marketing tactics, budgeting, computer skills and soft skills. Although improving these skills will not take the workers out of high-risk occupations it will improve their skills within their field and provide them with more survivability in the market.

Understanding Job Automation

The respondents have never considered the thought of job automation before and when probed with the idea, they did not think it's relevant for themselves. In Cambodia, they have experienced some automation, but none that has resulted, at least to their knowledge, in the loss of someone's job. It is important to note that automation has likely resulted in the loss of jobs in Cambodia; however. Cambodians, especially those in low-skilled occupations such as these, change jobs so frequently and for a myriad of reasons that it is hard for the respondents to have been able to identify automation as a cause.

For example, those who work in construction and bricklaying can point to cement mixers doing the work that would have previously been fairly arduous manual labor. However, they also point to the fact that it still requires a human to put the cement into the mixer and to take it out. Furthermore, those who work in bakeries say "now we have ovens instead of fire" which makes the process more simple, but it "still requires people to make the bread or confectionery, to begin with." Those who operate sewing machines and work as tailors can see that machines now cut clothes that used to be cut by hand, but they still believe it is necessary for humans to sew, design and measure clothes.

The main location that the workers can see automation taking away jobs is within agriculture. The respondents pointed to the fact that fewer people work within agriculture than they used to. They have also noticed an increase in the number of tractors and other machinery being used for work which previously would have been undertaken by hand and animals.

In other sectors, they cannot imagine how automation will take away jobs. They have not experienced it and have trouble imagining it without a clear point of reference. In all examples, the respondents point to the machines making the human workers more efficient and quicker in their jobs but not removing them completely. The respondents still think humans are essential and will continue to be essential for jobs to be performed. They don't think that machines will be able to do manual jobs, occupations like sellers and handicraft workers cannot be replicated by machines as they do not have the dexterity of hands or the ability to talk to customers, "I think human hands can cut in factory better than a machine, I don't think machines can replace my work, we need humans to do it, for sewing we can use a machine but we still need humans to do it" claims a 25-29-year-old female tailor. A male 30-34-year-old vendor explains; "Selling things involves hands, hands cannot be replaced by machines." As such, when probed as to which jobs stand the best chance of surviving through automation the respondents do not choose high thought level jobs, they usually consider low skilled and manual labor jobs such as their own.

Even after being probed about automation, the workers interviewed still have no fear of

losing their jobs. They have little belief that they could lose their job to automation and still have faith that if they were to lose their job through automation or other means there would be plenty of alternative occupations for them to consider. A common career for the men to fall back on was within agriculture, ironically the occupation they also see as being most likely to be automated, as they believe that as long as they can obtain a patch of land in the province they will be able to survive off the land.

When asked about other countries, the respondents can identify that other countries use less manual labor and nowadays use more machines, however, they say that people in these countries still have jobs. Besides, they consider that Cambodia is so far behind the developed countries that use lots of machines that it is not something for them to consider yet.

Conclusion

Digitalization is a big threat to achieve the Sustainable Development Goals (SDGs) in Cambodia and automation is problematic for the inclusiveness of the Cambodian Labor Market. Many workers in routine tasks at some point in the future are at risk of losing their job. Even more worrying is that they are not aware of the direness of their situation and have no intention of upgrading their skills. As the findings show the problem does not only lie in the supply side of high quality and affordable education, but also in the demand side, due to a lack of awareness and motivation by the workers. Corruption plays a crucial role as it creates problematic role models. Wealth is not connected to education, but to corruption. Policies created have to keep both sides in mind.

The research design has certain limitations. Among others, the results of focus group interviews are not representative of the whole Cambodian population. Another aspect the study could not provide is assessing differences between certain socio-demographic factors, such as occupations, economic sectors, age, and gender. Further research needs to be done to test the hypothesis the study has found and which are outlined below:

Hypothesis 1:

The majority of workers in high-risk occupations are not aware of the risk of future job loss.

Hypothesis 2:

The majority of workers in high-risk occupations are not upgrading their skills.

Hypothesis 3:

The main obstacles for further education are motivation and confidence in their innate ability to learn.

Hypothesis 4:

The majority of workers in high-risk occupations feel comfort in the knowledge that there is a huge portion of the population who are also unskilled and so there are many similar jobs available to them should their current work fail.

Hypothesis 5:

Aspirations of workers in high-risk occupations are usually within their immediately achievable grasp and do not require upskilling or further learning but could be further supported through financial or entrepreneurial support (e.g. mentorship).

Hypothesis 6:

The younger generation is more ambitious to upgrade their skills, than the older generation.

Hypothesis 7:

Training on the job programs are more successful than higher education programs.

Hypothesis 8:

Parents are the most important target group for com-municating the value of edu-cation to their children.

Recommendations

On the supply side, the quality of Cambodian schools and universities do not hold up to international standards; according to a study in 2013, approximately 48 percent of fresh ICT graduates did not have the skills to work effectively.[69] The Government of Cambodia seems to be aware of the need for better education as a statement from the Prime Minister Hun Sen in June 2019 shows: "The technological advancements of the Fourth Industrial Revolution will cause job losses but also create new ones. To retain their jobs, one needs to broaden technical knowledge and strengthen skills. (...) We have no choice but to boost capacity and skills in the workforce."[70] There are several ways to achieve this. It starts with early education in particular; there is a need for the curricula to be updated to catch up with the needed skills in addition to the construction of further schools to accommodate the growing population. Furthermore, the potential of online learning should be used to greater effect, especially in rural areas.[71]

An analysis of the current situation in higher education reveals an alarming mismatch between education and employment: the most popular areas of study among Cambodian university students are social sciences and business-related majors. Only a small percentage of students are studying science, engineering and agriculture, which are considered to be key skills to foster the growth of the Cambodian economy.[72] In addition, international accreditation of the Bachelor and Master programs is needed. There ought to be more international exchange of students and researchers. With higher automation in the garment sector, more modern skills are required in the factories as the tasks continue to become more demanding. For example, more engineers and IT-experts will be needed in the future. Also, further vocational training in the garment sector is crucial to upgrade the skill level of the workers. There are already initiatives from garment associations like the Cambodian Garment Training Institute which focuses on skills development, namely garment construction experts (pattern making and adaptation); garment production engineers (manufacturing processes); apparel merchandisers (garment designers); and quality assurance specialists (quality controllers).[73] The government could boost these initiatives to educate more workers. There is a high potential in the cooperation with development partners like Germany which have a high-quality vocational training system. Learning on the job seems to be a more successful way than switching career paths. As the focus groups show, there is a lack of imagination that education could lead to higher income.

69. Pheakdey Heng, Preparing Cambodia's Workforce.

70. Voun Dara, PM: Workers must train for Industry 4.0, Phnom Penh Post, June 14, 2019, https://www.phnompenhpost.com/national/pm-workers-must-train-industry-40.

71. Ausarbeitung Digitalisierung und Entwicklungspolitik.

72. Pheakdey Heng, Preparing Cambodia's Workforce.

73. World Bank, Cambodia Economic Update, Enhancing Export Competitiveness: The Key to Cambodia's Future Economic Success, October 2016.

Cambodian universities should move from being purely teaching institutions to research institutions that drive innovation. Inventiveness is needed for modern economic development.[74] At the moment research and development in Cambodia is more often coming from abroad. Improved and more focused research and development will lead to more efficient processes in the factories and could create more businesses around the sector. This in turn could bring more parts of the value chain into Cambodia, leading to a more diversified job market.

This lack of infrastructure is also one of the reasons that the high potential of online learning is not used. Online learning, especially Massive Open Online Courses (MOOCs) provide an easy to access way to upgrade the skill level of workers in Cambodia and could provide strong benefits to Cambodia if implemented. However, an often required skill to access the knowledge of the world is understanding of the English language as the majority of MOOCs are held in English.[75] This has also been noted by Cambodian enterprises as they answered in an ILO survey that missing foreign language skills are "the most critical" in Cambodia.[76] In the sense of the learning-to-learn approach, education in Cambodia should focus on the basic skills that open up the world of knowledge, especially English language skills and the infrastructure (electricity, fast internet and the availability of devices) to get there.

There is a need among the respondents interviewed for flexibility in work to accom-modate their families, especially among fe-males,

and to achieve an inclusive labor market. It should be made easier for workers in high-risk occupations to educate themselves. Low-skilled workers "need financial and temporal flexibility and support so that the transition from old to new occupations can be managed successfully and those who struggle to cope with the speed of technological progress are not left behind. Functioning social security systems are therefore more necessary than ever. However, should (paid) work lose so much economic importance that it no longer guarantees broad economic inclusion and an adequate income distribution, further mechanisms of income (re)distribution will be needed to maintain social cohesion."[77]

To face such a challenge, current efforts by the government are not enough. Policymakers, employers and training institutions need to work together to improve the skills of the workforce. Promoting academic pursuits in STEM will be vital in meeting the higher skill demands required to maintain and run automated machines, particularly among young women who would be greatly impacted by the technology uptake in the Cambodian garment sector.[78]

To make more people willing to upgrade their skills and raise awareness for the potential and opportunities of education the demand side plays a crucial role. The concepts of learning-to-learn and lifelong learning should be at the core of the messages sent by the government in all education-related communication. These messages also need to be narrowed down toward the specific requirements of high-risk workers. These workers must be informed about the future outlook of their occupations. They should be

74. Silvan Rehfeld, Digitalisierung in der EZ.

75. Riccardo Corrado and Patchanee Tungjan, How Digital Tech Can Help Fix Cambodia's Broken Education and Healthcare Systems, in: Digital Insights. E-Governance in Cambodia, Robert Hör, Christopher Perera, December 2019.

76. ASEAN in Transformation, How Technology is Changing Jobs and Enterprises, Cambodia Country Brief, https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---act_emp/documents/publication/wcms_579672.pdf, April 2017.

77. WBGU – German Advisory Council on Global Change (2019): Towards Our Common Digital Future. Flagship Report. Berlin: WBGU.

78. ILO: ASEAN in transformation: Perspectives of enterprises and students on future work.

guided toward the educational offers that are available from state institutions, the private sector and through e-learning. To shape these awareness campaigns the government needs a clear picture of which skill levels will be most impacted by job losses in key sectors. The government should precisely establish and communicate re-training programs for displaced workers. Those training programs demand to be shaped in light of emerging technological developments and the core skills (and new skills) necessary for predominant sectors. The education and training providers need to offer forward-looking training according to the changing enterprise skill needs.[79] As the Cambodian economy is based on exploitation and not exploration strategies it is difficult to predict skills achievable for low skilled workers. The potential upgrade of the skill level needs to be realistic: A street seller will probably not become a software engineer.

Therefore, efforts also certainly need to be put into changing workers' perceptions of what is possible for them to achieve and why they should achieve it. Three key challenges in upskilling or further educating workers is that,

1. they do not understand what highly skilled and low risk jobs are and those that do know do not understand how to achieve them;

2. they do not believe that it is possible for them to achieve higher education due to their innate abilities or lack thereof; and

3. They do not connect wealth with education. Therefore, role models need to be developed, as they can inspire people to educate. The dangerous connection in the perception between wealth and corrup-

tion needs to be corrected toward wealth and education.

The results of the focus group research paint a rather defeatist view as respondents were unreceptive toward engaging in further education or upskilling. At the respondent selection stage of this research project, respondents were chosen within the relatively young age group of 20-35 because it was perceived that the younger the respondent, the more likely they would be to harbor the ambition to continue skill upgrading. This was, in part, true. The younger respondents certainly showed more inclination toward gaining further skills. However, less so than had been anticipated. Ultimately, skill upgrading and further education to remove a worker from a job with a high likelihood of being automated appear to have little hope of being successful. That does not mean, however, that these workers cannot be helped. They are somewhat perceptive to gaining new skills, only just within their field or when it comes to soft skills deemed useful for their current career path. These types of skill-upgrading will not remove the workers from the firing line, but will provide them with more skills to maintain survivability in the market when other less-skilled workers in the same field are being replaced by machines. Many of the respondents showed entrepreneurial spirit and wanted to expand upon their work or possess their own businesses. They are flexible and they are owning their business, which is related to their close environment. This is a hindrance to formalize the labor market, but this flexibility gives the chance to upgrade their business via access to finance via micro finance, which later could lead to a formalized business. Efforts should be made by the Cambodian government, NGOs and enterprises to support this spirit by minimizing barriers for business development, providing easy to access and low interest loans, and entrepreneurial support (e.g. mentorship, networking, etc.). To guide this process, programs are needed to provide the additional skills required to run a

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79. Time to Act for SDG 8: Integrating Decent Work, Sustained Growth and Environmental Integrity – International Labour Office – Geneva: ILO, 2019.

growing business: administration, accounting, leadership etc.

However, the real opportunity suggested by the results of this research is to focus on these high-risk occupation demographics, but not as the primary targets of skills upgrading or education, but as the targets of marketing to instill within them the importance of education for their own children. Albeit from a small sample size, it was evident from the focus groups conducted, that those who saw the importance of education and skills to achieve gainful employment and wealth attained this notion from their parents. From all other respondents, it was clear that both they and their parents before them, under-valued education. The perceptions of the social and economic barriers to upskilling an adult are very strong and put in place an almost unachievable challenge in the eyes of the respondents. It is the recommendation of this report, therefore, that the efforts should be placed into the next generation of workers. The key to achieving this is to focus efforts upon current age adults to impact their decisions regarding their children. To make sure that adults support their children to attain sufficient skills and education, and not to encourage them to stop their education or enter the same employment as themselves. Unfortunately, the scope for improving the skills of those over 25 in these occupations appears to be low, but it would be a pro-active move to focus on helping the next generation. A concerted government, development partners and media effort in the form of an education first for a sustainable future campaign might be a good first step.

The private sector needs to contribute as well out of pure self-interest in the future. As such, the changing landscape of technology-prone sectors challenges the status quo for enterprises in terms of the way they function and their employment needs. To remain competitive, enterprises need to position themselves as adopters of enabling technologies and consider a more rigorous assessment of their workforce development strategy. In doing so, the following six questions could be considered:

1. What are the major technological trends and projections in the sector?

2. What is the speed of these technologies' application?

3. What are the main factors that influence these technologies' implementation? (wages, productivity, quality, government incentives, and reshoring initiatives, among others)

4. If faced with a skills shortage, can technology play a role in addressing the shortage?

5. How will enterprise skill needs change when these technologies are adopted?

6. What new skills will be required and which will become less relevant?[80]

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80. Time to Act for SDG 8: Integrating Decent Work, Sustained Growth and Environmental Integrity – International Labour Office – Geneva: ILO, 2019.

Annex

Full respondent information

Table 1: *Full respondent information*

Group	Location	Gender	Age Group	Job Category	Education Level	Marital Status	Children	Personal Income	Household Income
G1	Urban	Female	20-24	Stall and market salesperson	Primary	Single	No	151-200 USD	351-400 USD
G1	Urban	Male	20-24	Street food seller	High School	Single	No	151-200 USD	301-350 USD
G1	Urban	Female	25-29	Bricklayers	Secondary	Married	Yes	101-150 USD	401-450 USD
G1	Urban	Male	25-29	Street food seller	Secondary	Married	Yes	151-200 USD	401-450 USD
G1	Urban	Female	30-35	Tailor, Dressmakers,Furriers	Secondary	Married	Yes	251-300 USD	551-600 USD
G1	Urban	Male	30-35	Bricklayers	Secondary	Married	Yes	151-200 USD	401-450 USD
G2	Urban	Male	20-24	Stall and market salesperson	High School	Single	No	251-300 USD	451-500 USD
G2	Urban	Male	20-24	Stall and market salesperson	Secondary	Single	No	50-100 USD	251-300 USD
G2	Urban	Male	25-29	Construction worker	Secondary	Married	Yes	151-200 USD	401-450 USD
G2	Urban	Male	25-29	Construction worker	Secondary	Married	No	151-200 USD	401-450 USD
G2	Urban	Male	30-35	Bakers, pastry cooks and confection	High School	Married	Yes	451-500USD	801+ USD
G2	Urban	Male	30-35	Street food seller	Secondary	Married	Yes	301-350 USD	601-650 USD
G3	Urban	Female	20-24	Bakers, pastry cooks and confection	High School	Single	No	101-150 USD	351-400 USD
G3	Urban	Female	20-24	Street food seller	High School	Single	No	151-200 USD	351-400 USD
G3	Urban	Female	25-29	Street food seller	High School	Married	No	151-200 USD	401-450 USD
G3	Urban	Female	25-29	Stall and market salesperson	Secondary	Single	No	151-200 USD	451-500 USD
G3	Urban	Female	30-35	Construction worker	Primary	Married	Yes	251-300 USD	351-400 USD
G3	Urban	Female	30-35	Sewing machine operators	Primary	Married	Yes	201-250 USD	601-650 USD
G4	Semi-urban/rural	Female	20-24	Sewing machine operators	Secondary	Married	No	251-300 USD	601-650 USD
G4	Semi-urban/rural	Male	20-24	Construction worker	High School	Single	No	151-200 USD	351-400 USD
G4	Semi-urban/rural	Female	25-29	Tailor, Dressmakers,Furriers	High School	Single	No	151-200 USD	301-350USD
G4	Semi-urban/rural	Male	25-29	Crop farm labourers	High School	Single	No	201-250 USD	401-450 USD
G4	Semi-urban/rural	Female	30-35	Street food seller	Secondary	Married	Yes	50-100 USD	301-350 USD
G4	Semi-urban/rural	Male	30-35	Livestock and dairy producers	Secondary	Married	Yes	201-250 USD	401-450 USD
G5	Semi-urban/rural	Male	20-24	Bricklayers	High School	Single	No	151-200 USD	351-400 USD
G5	Semi-urban/rural	Male	20-24	Construction worker	Secondary	Single	No	151-200 USD	351-400 USD
G5	Semi-urban/rural	Male	25-29	Livestock and dairy producers	High School	Married	Yes	401-450 USD	551-600 USD
G5	Semi-urban/rural	Male	25-29	Crop farm labourers	Started university but not graduated	Married	No	251-300 USD	651-700 USD
G5	Semi-urban/rural	Male	30-35	Stall and market salesperson	High School	Married	Yes	201-250 USD	451-500 USD
G5	Semi-urban/rural	Male	30-35	Crop farm labourers	High School	Married	Yes	401-450 USD	551-600 USD
G6	Semi-urban/rural	Female	20-24	Crop farm labourers	Primary	Married	No	251-300 USD	551-600 USD
G6	Semi-urban/rural	Female	20-24	Tailor, Dressmakers,Furriers	Primary	Single	No	201-250 USD	351-400 USD
G6	Semi-urban/rural	Female	25-29	Sewing machine operators	Primary	Single	No	151-200 USD	301-350 USD
G6	Semi-urban/rural	Female	25-29	Crop farm labourers	High School	Married	Yes	201-250 USD	451-500 USD
G6	Semi-urban/rural	Female	30-35	Livestock and dairy producers	Secondary	Married	Yes	351-400 USD	751-800 USD
G6	Semi-urban/rural	Female	30-35	Livestock and dairy producers	Secondary	Married	Yes	301-350 USD	701-750 USD

Focus Group Discussion Guide

Objectives

1. Understand the factors which make someone choose a job at risk of automation
2. Understand workers' knowledge of job automation
3. Understand workers' perception of their own job risk
4. Understand workers' attitudes toward education and upskilling to achieve job security
5. Create hypotheses for changing workers attitudes toward upskilling

(xx minutes) = minutes in section. (xx) = running total of group length

1. Introduction (10 minutes) (10)
> Introduce yourself
> Let them know there is no right or wrong answers we are only interested to understand their ideas, no matter what they are
> Thank them for coming tell them to be relaxed and just enjoy the discussion
> Tell them we will be recording them, but they won't ever be named or identified in any of the work
> Go around the group in order and ask them to introduce themselves with their:
  o Name?
  o Life situation (e.g. married, with or without children)?
  o Current job?

2. Current job (30 minutes) (40)
> How long have you worked in your current job for?
> How did you start working in your current job?
  o How did you find it?
  o What made you apply for it / join it?
> How did you learn the skills for your current job?
  o Probe: family, friends, school,

university, on the job, specific course.
> How many jobs have you had in total?
> What was your previous job?
  o How long did you work there for?
  o Why change from that job?
> Do you plan on switching jobs again? Why / why not?
  o If yes:
> When do you think you will switch jobs?
  o If no:
> How long do you think you will work in your current job?
> If short time: why not longer?
> If it takes a long time: why so long?
> What do you think your next job will be?
> (For those with children) What sort of job would you like your children to have when they grow up?
  o Why /why not the same as you?
> Do you have any fear about losing your current job?
  o Why do you think you will lose your job?
> What do you think could be done to help you keep your job?
> How would your family cope if your job was lost?
  o How easily could you find another job? Why/why not?
  o What job would you fall back on?

3. Attitudes toward education and upskilling (30 minutes) (70)
> What schooling level have you achieved?
> Why did you stop there? Why not continue further?
> (For those who were unable to continue) If you were able to, would you have continued on? Why /why not?
> What types of education or training outside of school are you aware of?
> (If not brought up already) Have you heard of e-learning?

> Have you had any further education or training courses since leaving school?
  o What were these?
  o What did they entail?
  o How did you find them?
  o Did you get any benefits from them? Why / why not? What were these benefits?
> Were you ever offered any of these training types to skill-upgrade?
  o Why did you / did you not take it?
  o What types of training would you be interested in?
> Would you consider completing any further education or training courses now?
  o Why/why not?
> What barriers would stop you from joining the training?
  o Get a group agreement on the top barriers that would stop them from joining.
  o How could these barriers be alleviated?
> (For those with children) how much education would you like your children to achieve? Why this much?
> Can you speak any other languages?
  o Which ones?
  o How well?
  o How did you learn it?
  o Any interest in learning one/ others?
  o How would you go about learning another?

4. Job satisfaction (30 minutes) (100)
> "I am going to hand each of you a piece of paper, I want you to write down how satisfied with your current job on a scale of 1 to 10, 1 means not at all satisfied and 10 means totally satisfied".
  o What makes a job satisfying to you? Please tell me your ideas.
  o Collect scores and write how

many scored each number on the board.

- o So most of you scored xx. Why did you score around this number?
- > Why not 10?
- > What could be done to improve your satisfaction with work? What is missing from your job?
- > Has your job been getting better or worse for you over time? Why?
- > What is your dream job?
  - o Why is this your dream job?
  - o What is stopping you from achieving your dream job? Why haven't you achieved it yet?
  - o Do you think you could ever achieve your dream job?
  - o What help would you need to achieve your dream job?

5. Understanding of job automation (20 minutes) (120)

- > In Cambodia or other countries have you heard about people losing their jobs due to the development of machines?
  - o What do you know about this?
  - o Has this happened to anyone you know?
  - o What types of jobs do you think are likely to be automated in the near future? Why these jobs?
  - o Do you think your job could be automated? Why / why not?
- > (If yes) Is there anything you could do to stop your job from being automated?
- > What would this be?
  - o Which jobs do you think are resilient to automation? Why is this?

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Let There Be Light! Smart Grids And Cambodia's Blackouts

Aliaksei Patonia[1] and Sotheavin Doch[2]

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2   Sotheavin Doch, MSc in Disaster, Risk, and Resilience from the University of Canterbury, New Zealand. Currently, she is working for a local humanitarian organization, Phare Ponleu Selpak Association, as a Development Coordinator. Vin had research writing experience in her former job with the Learning Institute, the BBC Media Action, and Open Development Cambodia.

Introduction

In the past decade, with Cambodia's rapid economic development, the Kingdom's demand for electric power has been constantly growing.[1] As this growth is expected to continue with even greater magnitude in the foreseeable future, the Royal Government will need to initiate significant investment in energy generation, transmission, and distribution. At the moment, however, a large part of Cambodia's population is experiencing constant problems with the use of electric power, while either not having stable electricity supplies or not having access to electricity altogether.

To address these challenges, many Cambodians use various off-grid solutions allowing them to mitigate the disadvantages of constant blackouts and use the electric power at least for a couple of hours. In these circumstances, at the moment, despite not being environmentally-friendly, diesel generators appear to represent one of the most popular backup options.[2] Nevertheless, given the country's abundant solar power potential, this option often happens to be neither sustainable nor cheap in the long term. That is why a growing number of private investors and individual enthusiasts are relying on solar power generation. Despite the fact that such a reliance on this form of renewable energy seems to be promising, not every Cambodian household is able to install a personal solar panel due to significant budget limits.

This paper demonstrates that smart grids could not only help to mitigate such budgetary constraints of ordinary people but also contribute to solving Cambodia's persistent problem of power outages addressing the so-called 'energy trilemma': energy security is provided in an equitable and sustainable way. To do that, this paper first describes the current situation in Cambodia with respect to access to electricity and electricity supplies to highlight the key challenges faced by the local population as well as the steps taken by the government to address them. It then defines smart grids and identifies their role in providing sustainable electricity supplies and tackling the problem. Later, it views the current situation with the development of smart grids in Cambodia through the prism of policy-related, economic, social, and technological (PEST) factors to picture the challenges and opportunities that such technologies are facing in the country. Finally, the paper provides some recommendations on what potential barriers Cambodia's smart grid development could face in the future and how they could be eliminated.

Access To Electricity And Electricity Supply In Cambodia

According to the Royal Government's Power Development Plan, the total demand for electricity in Cambodia is "forecast to rise [...] to 18,000 GWh by 2030, or greater than threefold relative to demand in 2015".[3] To cater for such an immense surge in the expected electricity consumption, the Royal Government is planning to invest in large hydropower and thermal generation ("coal-fired in the short-term and both coal and natural gas in the long-term").[4] This plan, however, does not explicitly hint at any investments of a similar scale that

1. ADB. 2018. Cambodia. Energy sector assessment, strategy, and road map. https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf.

2. Bopha, P. 2019. As power cuts cripple Cambodia, generator saler soar. https://www.voacambodia.com/a/as-power-cuts-cripple-cambodia-generator-sales-soar/4930097.html
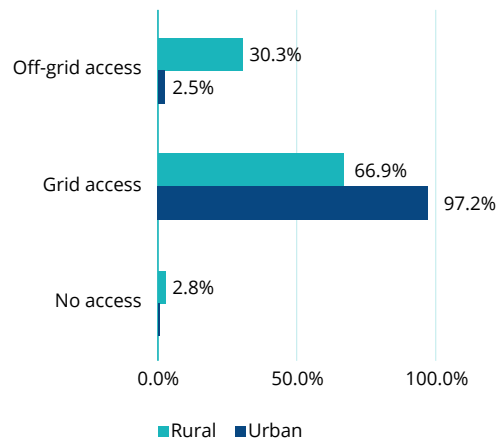
3. IBRD. 2018. Cambodia. Beyond connections. Energy access diagnostic report based on the multi-tier framework. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/141011521693254478/cambodia-beyond-connections-energy-access-diagnostic-report-based-on-the-multi-tier-framework.

4. ITOCHU. 2012. Study on the smart grid project in outskirts of Phnom Penh, the Kingdom of Cambodia. https://www.jetro.go.jp/jetro/activities/contribution/oda/model_study/infra_system/pdf/h23_result04_en.pdf.

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would be dedicated to the transmission and distribution systems.[5]

Such an approach may further aggravate the country's significant disparity in energy access and affordability, namely worsen the energy equity situation. In fact, according to Cambodia's Ministry of Mines and Energy (MME), prior to 2018, "only around 60 percent of the population [had] access to electricity" provided by the state suppliers.[6] Here, despite the gradual improvement in the following years and more optimistic picture in the urban areas, "some 30.3% of rural households used off-grid solutions as their primary source of electricity" in 2018.[7] This generally means that almost a third of the non-urban Cambodians still associate their personal access to electric power with generators, rechargeable batteries or solar lanterns.[8] That is why, in contrast to their fellow compatriots from the cities, rural citizens of the Kingdom that are currently constituting around 70 percent of the country's population are often not able to use electricity all the time (see Fig. 1).

Figure 1: *Access to electricity among Cambodian households*

Source: *World Bank (2018)*

On the other hand, even those entities that are connected to the grid often face significant challenges when it comes to using electric power with adequate reliability, security, quality, and safety.[9] In reality, only 13 percent of the most well-off citizens from the top supply category have access to 23 hours of power supply a day, while the rest of the population experiences constant unpredictable blackouts.[10] Facing this challenge on a daily basis, even the urban population is used to resort to diesel backup generators that further deteriorate the air quality already affected by the intense traffic and thus make the question of energy sustainability more acute.[11] Hence, apart from expanding the country's power generation capacity, the Royal Government will have to address this separate set of issues related to interrupted and unreliable supplies of electric power.

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5. Ibid.

6. MME. 2018. Draft National Energy Efficiency Policy, Strategies and Action Plan, Phnom Penh: Ministry of Mines and Energy.

7. IBRD. 2018. Cambodia. Beyond connections. Energy access diagnostic report based on the multi-tier framework. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/141011521693254478/cambodia-beyond-connections-energy-access-diagnostic-report-based-on-the-multi-tier-framework.

8. Ibid.

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9. Ibid.

10. ADB. 2018. Cambodia. Energy sector assessment, strategy, and road map. https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf.

11. Ibid.

In addition, even with the general intent to comprehensively connect all the households to the state electric network, the disparity in Cambodia's energy access is unlikely to be fully addressed. In fact, at the moment, "9.4% of grid-connected households cannot afford the electricity tariff".[12] Indeed, "the traditionally high electricity tariff in the country makes access unaffordable to the poor while constraining economic competitiveness and discouraging investment".[13] In this sense, investing limited budget funds into new energy generation facilities will probably not result in the tariffs rapidly going down. That is why, if no changes happen, to obtain a cheaper, more stable and predictable energy source, less well-off Cambodians both in urban and rural areas are likely to either still massively buy diesel generators in the future or suffer from blackouts. Thus, to change the situation for the better, some alternative solutions not only provide reliable access to stable electricity supplies but also reasonable prices for such services should be used.

Here, smart grids could potentially represent such a solution which can successfully address the challenges of obtaining stable and reliable access to electricity at a competitive and reasonable price.

Smart Grids and Cambodia

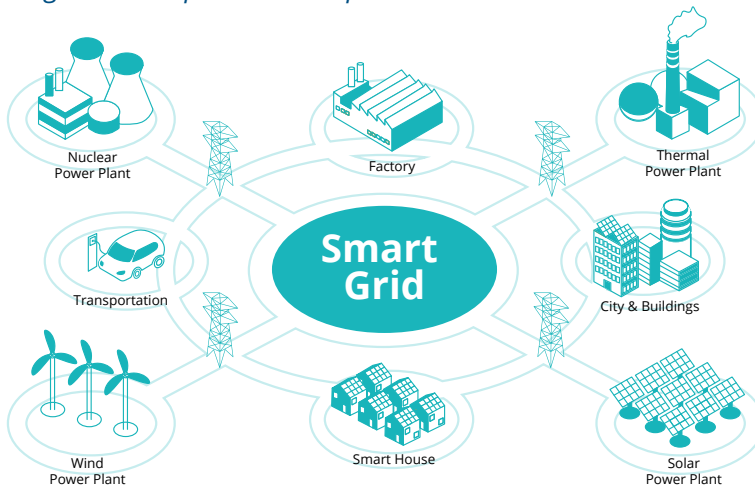## Smart Grids in Sustainable Electricity Supply

In general, smart grids are described as intelligent energy networks that establish a two-way dialogue between utilities (or energy producers) and various energy consumers (customers) in such a way that the efficiency and reliability of supply is increased particularly through the exchange of the information vital to the grid's functioning (see Fig. 2). Specifically, as defined by the International Energy Agency, a smart grid is "an electricity network system that uses digital technology to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users".[14] In this sense, smart grids that interconnect all or most of the energy generation facilities with the entities that use electric power (e.g. households or businesses) could address the challenge of blackouts through a more efficient redistribution of energy streams based on real-time data.

12. IBRD. 2018. Cambodia. Beyond connections. Energy access diagnostic report based on the multi-tier framework. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/141011521693254478/cambodia-beyond-connections-energy-access-diagnostic-report-based-on-the-multi-tier-framework.

13. ADB. 2018. Cambodia. Energy sector assessment, strategy, and road map. https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf.

14. International Energy Agency. 2011. Technology Roadmap - Smart Grids. https://www.iea.org/reports/technology-roadmap-smart-grids.

Figure 2: *Smart grid and its potential components*

Source: ENISA (2014)

As seen from Figure 2, in a smart grid, all the elements of the system are interconnected so that the data of electricity consumption and production are transmitted and delivered in real time.[15] For instance, based on the information about the amount of electricity produced by solar power plants, thermal power plants could adjust their generation process and either reduce or increase the output of energy to maintain the balance within the system in a more efficient way. Similarly, the electricity consumption data from residential buildings or factories are transmitted to such energy production facilities as wind power plants so that no excess energy is generated and the blades are timely stopped to not oversupply the electricity that cannot be used or stored. Such an intelligent approach to the generation and consumption process fosters load balance and contributes to a more efficient use of all the elements of the system.

Cambodia's Potential for the Development of Smart Grids

In Cambodia, apart from providing a more reliable up-to-date information on the potential electricity transmission and distribution faults, smart grids could incorporate previously non-integrated individual domestic energy producers that use off-grid systems as a primary source of electric power. As a result, the common challenge of low reliability expressed in daily blackouts could be mitigated through using the energy generated by power-producing households and delivering it to the areas experiencing outages. In addition, this approach could potentially make the electric power more affordable for the population, as integration of entities already engaged in electricity production is likely to be significantly less expensive than the construction of new large-scale power facilities, which may result in lower tariffs for the population.
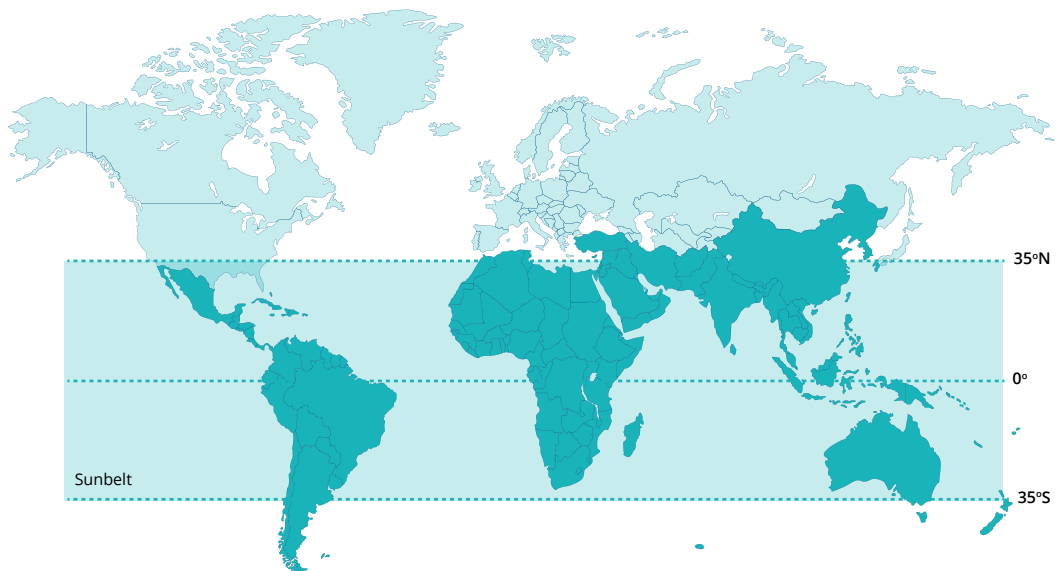
On the other hand, given the country's geographic complexity as well as the limitations of the budget, extending the grid to remote Cambodian communities may not be among the Royal Government's key priorities. This, however, does not appear to pose a sub-

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15. ENISA. 2014. Smart grid security certification in Europe: Challenges and Recommendations. https://www.enisa.europa.eu/news/enisa-news/smart-grid-security-certification-in-europe-challenges-and-recommendations.

stantial problem for smart grids, as they can still be utilized to provide access to more reliable and affordable electricity and integrate remote households into smaller micro networks without direct connection to the state-provided transmission system. For instance, with constantly decreasing costs of solar power generation, those communities that install solar panels would be able to share the installation costs and then take advantage of the shared access to the abundant renew-

able power. In fact, situated in the so-called "global Sunbelt" (i.e. within 35o of the Equator), Cambodia appears to be one of the world's most suitable places to harness the solar energy potential primarily due to the geographically-conditioned prolonged periods of direct sunlight (see Fig. 3).[16] That is why UNDP views off-grid solar devices as "critical in closing the gap in access to energy amongst rural households" of the country.[17]

Figure 3: Sunbelt countries

Source: EPIA (2010)

Nevertheless, without a smart grid in place, such an abundant sun exposure is likely to result in significant waste of energy generated during the day.[18] Indeed, with relatively low electricity needs in an average Cambodian household as well as no sound solution for the large-scale long-term electricity storage, the solar panels installed by rural communities will most probably produce surplus

power that does not have a high chance to be fully used by the owners. That is why connecting other entities to such generation devices though an intelligent network could result in a more efficient use of energy by all parties as well as significant reduction of costs.

16. EPIA. 2010. Unlocking the Sunbelt potential of photovoltaics. Brussels, Belgium: European Photovoltaic Industry Association.

17. UNDP. 2019. Harnessing the solar energy potential in Cambodia. https://www.undp.org/content/dam/cambodia/docs/ResearchAndPublication/DREIBooklet/DREI%20Booklet%20English.pdf.

18. Gross, D. 2016 Why renewable power can still be wasteful. https://slate.com/business/2016/07/how-energy-waste-in-solar-and-wind-power-still-happens.html.

Approaches Towards Smart Grids

Though each country describes smart grids in a slightly different way, the specific definition depends on the exact needs it should satisfy. That is why, in Japan, for instance, at the very beginning of its implementation, a smart grid was initially viewed as the core technology development allowing for the integration of renewables, whereas the EU primarily saw it through the prism of greenhouse gas reduction, energy system improvement, and a single wholesale market.[19] Similarly, while the US mostly aimed at supporting grid modernization and providing economic stimulus, Korea identified smart technologies as IT applications catering for the country's green growth in the long term.[20] Here, however, despite the various goals of its implementation, all these key smart grid concepts were introduced at a state level. Later, some autonomy to develop pilot projects was delegated to the regional (e.g. state or provincial) authorities.

Unlike most of the countries, until now, Cambodia has not issued its official strategy on the development of smart grids. At the same time, this does not exclude the country from the process of promoting this solution to energy challenges altogether. In fact, instead of following the top-down approach and developing smart grids under the supervision of the Royal Government, the country is currently hosting private companies that take the initiative and introduce these technologies "from the bottom". Indeed, though one of the first feasibility studies on a smart grid project in Phnom Penh's outskirts was prepared for the Royal Ministry of Economy, Trade, and

Industry in 2012, it was not accomplished.[21] Instead, such foreign investors as e.g. Okra Solar took the lead in providing distributed sharing of sustainable energy to more than 290 households in some of the country's most remote areas.[22]

In fact, similarly to bigger industrial brands, Okra is relying on the off-grid solutions while utilizing the immense solar power potential of Cambodia. Here, as the country does not have reliable electricity supplies provided by the centralized state-run electricity network, companies like Adidas and Coca-Cola are ensuring their production process is stable and not prone to any negative aftermath of frequent power outages. In this respect, Okra Solar goes forward to capitalise on this specific feature of the national Cambodian power system and turn this disadvantage into a profitable business model.

Since Cambodia demonstrates such an un-con-ventional approach, analyzing factors related to policies, economics, social and technological (PEST) environment associated with the development of smart grids seems to be particularly useful for the identification of current gaps and future challenges as well as the elaboration of sound recommendations on how smart grid development could be fostered so that it successfully contributes to eliminating the country's power outages.

19. Jensterle, M. and Venjakob, M. 2019 Smart power grids and integration of renewables in Japan. Berlin: Adelphi; Cision, 2016. South East Asia Smart Grid: Market forecast (2016-2026); European Commission. 2019. Smart grids and meters. https://ec.europa.eu/energy/topics/markets-and-consumers/smart-grids-and-meters/overview_en.

20. Ibid.

21. ITOCHU. 2012. Study on the smart grid project in outskirts of Phnom Penh, the Kingdom of Cambodia. https://www.jetro.go.jp/jetro/activities/contribution/oda/model_study/infra_system/pdf/h23_result04_en.pdf.

22. Jvenad Jerevin, interview by Sotheavin Doch, Phnom Penh, September 9, 2020.

Factors Influencing Smart Grids in Cambodia

1. Policies

In Cambodia, with the unsuccessful attempts of the Royal Government to supervise the launch of a pilot smart grid project outside of Phnom Penh in the early 2010s, the state policy continues to focus primarily on the expansion of the transmission grid to rural areas so that the citizens will be able to pay unified charges for the access to electricity.[23] In addition, the authorities are actively supporting the delusion of the conventional energy mix with renewable energy sources. Here, the main focus is given to hydropower and solar energy.[24] Despite these attempts to improve the citizens' energy access, the Royal Government has not yet shaped a comprehensive state policy with respect to smart grids.

On the other hand, with assistance from ADB, Cambodia is currently attracting private investors ready to arrange solar energy production and discharge such renewable electricity to the national grid. Specifically, in 2018, the Electricity Authority of Cambodia (EAC), the responsible energy authority, set a regulation on conditions for the installation and connection of distributed solar energy projects to the national grid. According to the regulation, large (medium voltage) and bulk (high voltage) consumers are allowed "to install solar power systems for self-consumption and synchronize with the distribution system of the national grid".[25] Besides, it stated that "solar PV systems designed for self-consumption only and not connected to the grid are also allowed".[26] This statement officially gave the green light to the operation of micro smart grid initiatives in remote areas where the extension of transmission lines is hampered by geographic and economic reasons.

Okra Solar, one of such micro smart grid projects, started its operation in Cambodia in 2019. Currently, through the technological solutions of the company, around 300 (297) households have stable access to electricity. This smart electricity network, however, is not connected to the main state-developed grid. Instead, it connects the households to each other allowing for an efficient energy production, sharing, and use. Being located in Takeo and Kampong Speu provinces, far from the main transmission lines, these communities would otherwise have to live in uncertainty and without reliable electricity until the Government electrification plan would reach their area.[27] That is why, working with authorities in areas where traditional grid connection cannot be delivered, Okra Solar is complementing the government grid extension.[28]

Indeed, according to the EAC's regulation, standalone solar PV systems are allowed to be developed without asking for permits.[29] In fact, the permit procedure often "becomes a hindrance, making solar PV unattractive

23. Vannak, C., 2019. Solar Lights up Cambodia Villages. Khmer Times, May 06 2019. https://www.khmertimeskh.com/50600764/france-to-support-development-of-electrical-grid/; ADB. 2019. ADB-Supported Solar Project in Cambodia Achieves Lowest-Ever Tariff in ASEAN. https://www.adb.org/news/adb-supported-solar-project-cambodia-achieves-lowest-ever-tariff-asean.

24. Ibid.

25. ADB. 2018. Cambodia. Energy sector assessment, strategy, and road map. https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf.

26. Ibid.

27. Jvenad Jerevin, interview by Sotheavin Doch, Phnom Penh, September 9, 2020.

28. Ibid.

29. ADB. 2018. Cambodia. Energy sector assessment, strategy, and road map. https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf.

for consumers".[30] As a result of this policy, however, the electricity produced by solar power installations not connected to the general grid appears to be "more affordable for rural households".[31] On the other hand, further expansion of such systems will necessitate a comprehensive integration of such facilities into the general grid, which, in its turn, will require respective policies and regulations to be prepared by the Royal Government.

2. Economic

The projected installation cost of the previously mentioned unsuccessful smart grid initiative outside of Phnom Penh was relatively high: USD319 million for the capacity of 30MW.[32] Given that the project was expected to cover only around two percent of the peak electricity demand in the capital area, its substantial costs were likely the main reason for the Government to let the private sector promote smart grid solutions on their own.[33] Otherwise, the extreme installation expenses would find their reflection in the electricity bills of the local population, which would further disincentivize to use the electric power provided by the state. Instead, with micro smart grid solutions, where costs are born by private companies, shared ownership and use of the service that requires a lesser amount of investments could allow for a substantial reduction of the electricity bills.

In fact, in the case of Okra Solar, with a cost deposit of USD 20-30, depending on the tariff they choose, households pay between 5 and 12 USD/month for a stable access to renewable electricity.[34] In comparison, in Phnom Penh, a household of similar size (i.e. consuming up to 50 kWh/month) would pay around USD 7.5 every month.[35] Hence, as seen, though the electricity consumption in the rural areas is usually lower than in the urban ones, the electricity charges in Okra's areas of operation appear to be comparable to the ones in the capital where households take advantage of the centralized connection to the grid. Here, though this may ultimately be slightly more costly for the rural population to consume one kWh per month if compared to their urban opposite numbers, a great advantage of Okra is that their customers do not pay any cost for the installation of solar panels - i.e. they only pay for the electricity they use.[36]

As Okra is currently expanding its operations in Cambodia, no direct subsidies from the Royal Government have been received.[37] In this sense, this means that, despite the absence of any overarching support initiated by the official authorities, the company is still able to provide sustainable access to renewable electricity to hundreds of Cambodians in remote areas at a competitive rate. This makes such micro smart grid initiatives a particularly promising development option for the territories where grid extension appears to be too expensive for the Royal Government. At the same time,

30. Asean Centre for Energy. 2018. Cambodia's solar regulation. https://www.phnompenhpost.com/opinion/cambodias-solar-regulation.

31. Asean Centre for Energy. 2018. Cambodia's solar regulation. https://www.phnompenhpost.com/opinion/cambodias-solar-regulation.

32. ITOCHU. 2012. Study on the smart grid project in outskirts of Phnom Penh, the Kingdom of Cambodia. https://www.jetro.go.jp/jetro/activities/contribution/oda/model_study/infra_system/pdf/h23_result04_en.pdf.

33. Ibid.

34. Jvenad Jerevin, interview by Sotheavin Doch, Phnom Penh, September 9, 2020; Raksmey, H. 2019. Clean, cheap and efficient: the firm leading Cambodia's Solar Revolution. The Phnom Penh Post, 20 March 2019. https://www.phnompenhpost.com/creativity-innovation-post-life/cheap-clean-and-efficient-firm-leading-cambodias-solar-revolution

35. Sok, C., 2018. New electricity bills cut planned to start in April. Khmer Times, February 21 2018. https://www.khmertimeskh.com/109671/new-electricity-bill-cuts-planned-start-april/.

36. Jvenad Jerevin, interview by Sotheavin Doch, Phnom Penh, September 9, 2020.

37. Ibid.

as the future unification of all Cambodian entities into one smart grid necessitates the involvement of all the state bodies, further negotiations between such companies as Okra and respective ministries need to be conducted when the project gains momentum.

3. Social factors

When it comes to the social dimension of smart grid projects in Cambodia, the main challenge associated with the introduction of such solutions is currently related to the lack of awareness about the smart grid systems altogether. Due to the limited operational area of private smart grid investors, the majority of the population that experience significant challenges with obtaining stable access to electricity cannot establish direct links with the representatives of companies like Okra Solar.[38] In fact, people are either unaware of such micro smart grid solutions or do not know how to get them. That is why it is extremely important for the smart grid pioneers to invest in community engagement and training either directly or through partners so that more and more people are aware of the existing opportunities to change their lives for the better.

Apart from promoting awareness, persuading rural citizens to use micro smart grid technologies instead of already popular 'conventional' technologies (e.g. generators) could become a challenge. To address it, Okra Solar arranged 'free trial' periods allowing the locals to take advantage of the systems and test them for a certain period of time.[39] Later, if they decided to use it on a permanent basis, Okra would sign an agreement with them. As practice shows, seeing their neighbors with stable electricity could be a great stimulus for other households from the same community to join the micro smart grid initiative.

4. Technological factors

Finally, due to the lower scale and 'bottom-up' nature of the micro smart grid endeavors in Cambodia, some of the most common 'traditional' technical and technological challenges associated with the 'top-down' approach in most other countries appear to be of lesser significance. In particular, micro smart grids of Okra Solar simply connect solar panels with household networks enabling energy sharing between them and thus do not require elaborating large-scale complex systems from scratch. In addition, since, "in most cases, [in the solar households systems], the panel and battery assets are not sized appropriately so up to 50 percent of solar generation is wasted as batteries become fully charged just after mid-day and are drained quickly at night time", intelligent distribution of excess power among the participating households not only optimizes energy consumption, but makes the process more attractive than the traditional use of fossil fuels for the backup.[40]

Indeed, micro smart grids that utilize algorithms and machine learning can minimize power loss and maximize reliability and efficiency of electricity consumption. According to Okra's CEO, such grids "have 99.9 percent uptime, even during the hot months, which over the past few weeks with power cuts scheduled in Phnom Penh, [...] surpassed the reliability of the Cambodian national power grid".[41] In addition, what is more important sustainability-wise, "it costs from 10 to 100 times more to use kerosene than it does to use electricity from Okra networks, and all kerosene can do is provide poor lighting

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38. Ibid.

39. Jvenad Jerevin, interview by Sotheavin Doch, Phnom Penh, September 9, 2020.

40. Raksmey, H. 2019. Clean, cheap and efficient: the firm leading Cambodia's Solar Revolution. The Phnom Penh Post, 20 March 2019. https://www.phnompenhpost.com/creativity-innovation-post-life/cheap-clean-and-efficient-firm-leading-cambodias-solar-revolution

41. Ibid.

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and fuel for cooking".[42] Hence, with relatively compact hardware and simple installation procedures, no major technological difficulties were encountered by the company while working on the ground.

In practice, through partnering with Ptean Baitong, a producer of solar panels, Okra Solar dramatically simplifies operation procedures for the end-users through utilizing the 'plug and play' approach.[43] As a result, with the installation of solar panels conducted by Pteah Baitong and the network setting done by Okra Solar itself, the customers use the system as a normal grid without needing to have any specific knowledge or skills.[44] Apart from that, the system itself is managed online by Okra, while hardware malfunctions are rapidly tackled by Pteah Baitong. Hence, at the moment, due to the concerted efforts of both companies, micro smart grid systems appear to be functioning in a sustainable mode. At the same time, in the future, as the system expands, Okra and other similar companies are likely to face such problems as inadequate infrastructure and necessity to manage large masses of private data while keeping them secured. As for now, however, Okra's micro smart-grid approach allows for the relatively safe and uninterrupted exchange of smaller amounts of data.

Conclusions and Recommendations

As demonstrated, the current Cambodian approach towards the development of smart grids offers a significant number of benefits while facing substantial challenges at the same time. Specifically, on the policy side, having adopted a broad piece of legislation allowing companies to technically develop micro smart grids, neither a joint smart grid promotion strategy nor further stimulating steps to engage a greater number of potential investors were taken. Hence, in the future, this is likely to prevent smart network initiatives from scaling up and spreading around the country, unless adequate supportive measures are taken.

Economically, micro smart grids appear to be attractive both for the Royal Government and the end-users. Here, while the former does not spend any additional funds on its development, the latter gain energy supplies at affordable prices. Nevertheless, further expansion of these initiatives and unification of all entities into a joint Pan-Cambodian intelligent network are likely to be financially challenged, as a larger specifically tailored energy infrastructure will have to be elaborated.

Socially, lack of awareness and absence of any information about the potential benefits that smart grid solutions could bring appear to constitute the greatest barriers for the development of such projects. Specifically, in the case of Okra Solar, these factors prevented the rural population from contacting the company in order to install the system solving their problem (lack of reliable access to electricity). Hence, in the future, further development will need a more efficient community engagement strategy.

Finally, due to the limited scope of Okra's smart grid initiative and the necessity to create energy networks from scratch, there was no need to adjust the already existent obsolete state-owned energy grid. Apart from that, due to the lower number of households involved, sustainable and secure data processing did not pose a great challenge. This, however, is extremely likely to change in the long term, if and when projects like this expand and the Royal Government decides to create a

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42. Ibid.

43. Okra Solar. 2017. Services. https://okrasolar.com/.

44. Jvenad Jerevin, interview by Sotheavin Doch, Phnom Penh, September 9, 2020.

unified smart grid system incorporating all the electricity-consuming entities in Cambodia.

As seen, the micro smart grid approach of Okra Solar appears to work in a pretty efficient way despite the lack of a well-developed financial and policy support from the Royal Government. On the other hand, though this approach has already improved the reliability of electricity supplies and provided the very access to its stable use, at the current stage, it is unlikely to completely eliminate the problem of blackouts all over the country. Nevertheless, this should not be viewed as a reason to limit support to the initiatives of this kind.

Apart from that, with the gradual expansion of micro smart grid solutions and the ultimate will to transform the Cambodian electricity system into an overall intelligent network, the Royal Government will have to not only support the bottom-up initiatives, but also create and promote larger top-down ones. As a result, to foster a more efficient implementation of smart grid projects and potentially avoid the challenges already faced by the Okra Solar, the following steps will have to be taken:

> First, apart from elaborating an over-arching smart grid strategy, a number of more detailed policies stimulating wider stakeholder involvement should be developed.

Such an efficient and detailed provision of guidelines is likely to attract a greater number of partners.

> Second, while micro smart grid projects could still rely on a total coverage of the costs by the engaged companies, larger ones are expected to be implemented in a form of partnerships (e.g. government institutions and agencies could cooperate with a number of private contractors).

This is likely to significantly decrease the expenses for each partner while potentially delivering a project of a larger scale and greater costs.

> Third, in order to avoid a number of potential social challenges described above, both the companies already engaged in delivering smart grid technologies and the Royal Government should promote awareness among the population with respect to the benefits of smart grids.

This could be done through the community engagement programs and other informative activities.

> Finally, alongside the creation of a new transmission network that will sustain intensified energy transfer, a secure and sustainable data management system should be established.

This step will not only help to make the smart grid more resilient to any potential technical challenges but prevent any sensitive personal user data from being mismanaged.

When all these recommendations are implemented and an efficiently functioning national smart grid system is established, Cambodian blackouts have a high chance to be eliminated altogether.

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The Digital Climate Impact: How To Neutralize It?

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Introduction

Global warming changes the climate causing rising sea-levels, the acidification of oceans, desertification, and an increase in extreme weather events such as heatwaves, droughts, floods, cyclones, and wildfires. The changes have led to the displacement of people, the destruction of property and infrastructure, and declining agricultural productivity causing new poverty in many countries. According to the International Panel on Climate Change (IPCC), human-induced greenhouse gas emissions (GHG) have massively increased since the first technological revolution which was the industrial revolution, causing an average global combined surface air and sea surface temperature increase of 0.85ºC between 1880 and 2012. The IPCC projects that when no climate action is taken, the growth of human-induced GHG emissions could further increase the average global surface temperature of between 2.6ºC and 4.8ºC by the end of the 21st century.[1]

It is against this background that the article investigates the digital climate impact and how to neutralize it. The article argues that digital technologies are not per se carbon-neutral, which means that they do contribute to GHG emissions. However, policies can be developed to neutralize the negative climate impact and at the same time enhance the positive climate impact of digital technologies. The article begins with a description of the global rise of digital technologies and then examines the negative and positive digital climate impacts before developing policy recommendations on how to neutralize the digital climate impact.

The Global Rise of Digital The Technologies

According to the ITU and the European based Global e-Sustainability Initiative (GeSI), digital technologies are defined as information and telecommunication technologies (ICT) that include digital devices (mobile phones, tablets, laptops, desktops, displays), digital infrastructure (fixed and mobile communication networks, data centers) and frontier technologies such as Artificial Intelligence, Machine Learning, Internet of Things, 5G, 3D Printing, Robotics, Cloud and Blockchains among others.[2] Digital technologies are conquering the world at a rapid pace. The International Telecommunication Union (ITU), a specialized agency of the United Nations, reported that more than half of the world population already had access to the internet in 2015 and that global business-to-business e-commerce exceeded USD22 trillion while business-to-consumer trade was valued at USD3 trillion.[3] In 2017, the world counted 7.7 billion mobile-cellular subscriptions and 4.2 billion active mobile-broadband subscriptions.[4] Also, the digital divide between the developed and developing world is shrinking as investments in digital technologies are growing while prices keep falling.[5] The Cisco Annual Internet Report (2018-2023) predicts that by 2023 nearly two-thirds of the world population will have access to the internet, that Wi-Fi speeds will triple,

2. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/research /download/ 52.

3. Balde, C. P. 2017. The Global E-Waste Monitor, United Nations University (UNU), ITU and International Solid Waste Association (ISWA), Bonn/Vienna/Geneva: 18, website: https://collections.unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017__electronic_single_pages_.pdf

4. Ibid.

5. ITU. 2019. Turning digital technology innovation into climate action, ITU Publication: 2. Accessed August 12, 2020. https://www.uncclearn.org/wp-content/uploads/library/19-00405e-turning-digital-technology-innovation.pdf.

1. IPCC: Global Warming of 1.5ºC, Special Report 2019: 53. Accessed August 12, 2020. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf.

and that the number of devices connected to IP networks will be more than three times the world population with 29.3 billion devices up from 18.4 billion in 2018. One of the fastest-growing developments in the digital technology sector is the Internet of Things with 14.8 billion connected devices predicted in 2023, compared to 6.1 billion in 2018, and smartphones with 6.7 billion in 2023, departing from 4.9 billion in 2018.[6] Below table shows the average number of devices and connections per capita worldwide in 2018 and the Cisco projections for 2023:

Table 1: Average number of devices and connections per capital

Region	2018	2023
1. Global	2.4	3.6
2. Asia Pacific	2.1	3.1
3. Central and Eastern Europe	2.5	4.0
4. Latin America	2.2	3.1
5. Middle East and Africa	1.1	1.5
6. North America	8.2	13.4
7. Western Europe	5.6	9.4

Source: *Cisco Annual Internet Report (2018-2023)*

The Climate Impact

Several studies have controversially assessed the digital climate impact. Studies that emphasize the positive climate impact of digital technologies argue they lead to efficiency gains in transportation, buildings, manufacturing, and energy production that will more likely reduce GHG emissions, referring to this as Digital Decarbonization. Meanwhile other studies, emphasizing the negative climate impact, argue that the complete value chain of digital technologies from getting the raw materials to producing, consuming, and disposing of/recycling will more likely increase GHG emissions. They point out what is referred to as the Digital Carbon Footprint. Yet, the solution to the paradox is not to abandon nor to oversupply digital technologies, but to develop policies to ensure that potential negative climate impacts of digital technologies are mitigated and their anticipated positive climate impacts are enhanced consequently making digital technologies carbon-neutral.
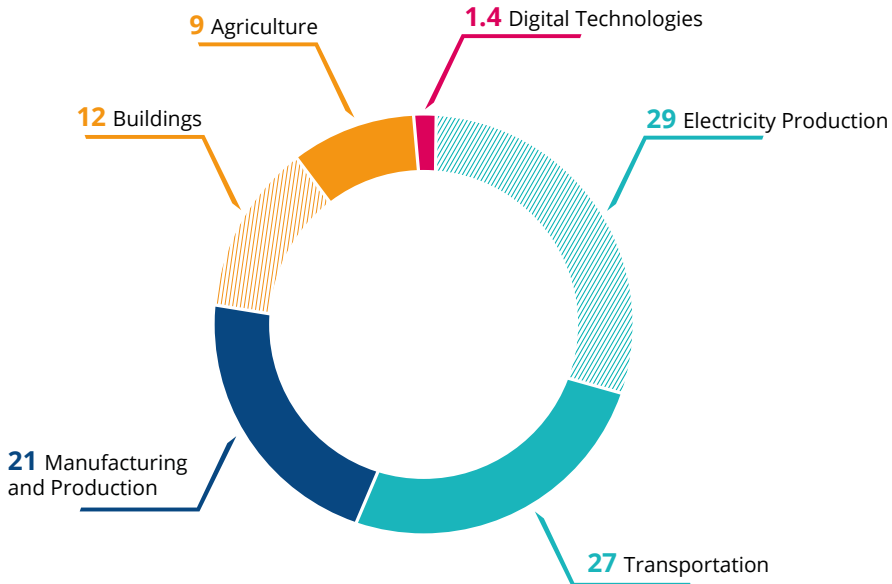
The Digital Carbon Footprint

Studies found that digital technologies contribute to GHG emissions but to a much lesser extent than other sectors. According to ITU, digital technologies were responsible for only 1.4% of global GHG emissions and 3.6% of the global electricity usage in 2015. Other sectors display much bigger carbon footprints as shown in the graphic below:[7]

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6. Cisco. 2020. Annual Internet Report (2018-23) White Paper. Accessed August 31, 2020. https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html.

7. Belkhir, Lotfi and Elmeligi, Ahmed. 2018. "Assessing ICT global emissions footprint: Trends to 2040 & recommendations, Journal of Cleaner Production 177: 449.

Figure 1: Digital Carbon Footprint 2015

Source: ITU (2015)

However, this situation might have changed already. The ITU expects that the rapid expansion of digital technologies will likely increase GHG emissions. By 2025, it is estimated that digital technologies will contribute to 14% of global GHG emissions overtaking those from buildings and agriculture. Also, digital technologies might be responsible for up to 20% of global electricity consumption by 2025.[8] More liberal estimates expect that their global electricity usage will increase to 21% by 2030.[9] Even though the predictions of the studies differ, it is only a matter of time until the GHG emissions of digital technologies will grow. Another, more critical study on the issue even warned: "Both the maximum and minimum projections suggest that continued exponential growth of the ICT Footprint, if unchecked, will reach as high as

14% of the total worldwide footprint, a clearly unacceptable level as it will definitely undermine any reductions achieved from the other global GHG emission sources."[10] Furthermore, studies of ITU and other stakeholders found that data centers (45%) and communication networks (24%) contribute the most to GHG emissions followed by smartphones. For smartphones, the percentage share of digital GHG emissions grew from 4% in 2010 up to 11% in 2020, and for data centers from 33% up to 45% in the same period. Smartphones exceed the emissions of laptops (7%), displays (7%), and desktops (6%). Also, studies found that alone the production of one million laptops emits up to 10 million tonnes of carbon dioxide.[11] Also, frontier technologies like Artificial Intelligence are expected to increase GHG emissions because they are

8. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/research /download/ 52: 8-9.

9. Andrea, Anders S. G. and Edler, Thomas. 2015. "On Global Electricity Usage of Communication Technology: Trends to 2030, Challenges 6: 138.

10. Belkhir, Lotfi and Elmeligi, Ahmed. 2018. "Assessing ICT global emissions footprint: Trends to 2040 & recommendations, Journal of Cleaner Production 177: 458.

11. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/research /download/ 52.: 10, 461, 547.

very energy-intensive. For example, it was found that machine learning processes, which are a subset of Artificial Intelligence, improving computer algorithms through experience, can emit as much carbon dioxide "than the lifetime emissions of one American car including the manufacture of the car itself."[12]

Another factor contributing to GHG emissions is the short life cycle of certain digital products that have been designed for premature obsolescence and fast fashion to increase repeat sales. For example, smartphones have average life cycles of only 18 months to two years, and new models are often yearly introduced to the market.[13] Consumers tend to also replace other digital devices with the newest and most updated versions, including among other laptops, desktops, and routers.[14] Cisco estimates that by 2023, consumers make up for nearly three-fourths of all connected devices accounting for 74% of all digital devices worldwide, while business will account for 26%.[15] The short lifecycle of digital technologies is also one important cause of the increase in digital e-waste. According to the Global E-Waste Monitor Report 2020, total e-waste including digital e-waste is estimated to have reached 93 metric tonnes in 2020 and only 17% of it has been recycled.[16] Digital e-waste contributes not only to environmental degradation and health hazards but also to global warming as digital e-waste releases

GHG emissions like methane into the atmosphere.[17]

The situation is expected to worsen as the recycling of digital e-waste is not progressing at the same pace as it is globally growing.[18] Often, digital device producers are criticized to contribute to the growth of digital e-waste because no universal compatibility standards are applied. For example, companies produce their power adapters in a way that they can only be used for their products such as smartphones and laptops, and often they are only applicable to one particular model.[19] Further, digital products are more often replaced with new devices instead of being repaired, even though developing countries might do better in this regard than developed countries as repair markets provide important income. Currently, it also lacks worldwide government policies and regulations on how to cope with the growing digital e-waste. Only 78 states have yet introduced such legislation so far.[20] The UN E-Waste Coalition that brings states together to develop digital e-waste policies argues that without a circular economy that repairs and recycles digital e-waste, the growth of digital e-waste will further accelerate.[21]

12. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/ research /download/ 52.: 15.

13. Balde, C. P. 2017. The Global E-Waste Monitor, United Nations University (UNU), ITU and International Solid Waste Association (ISWA), Bonn/Vienna/Geneva: 18, website: https://collections. unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017__ electronic_single_pages_.pdf.: 21.

14. Ibid.: 20.

15. Cisco. 2020. Annual Internet Report (2018-23) White Paper. Accessed August 31, 2020. https://www.cisco.com/c/en/us/ solutions/collateral/executive-perspectives/annual-internet- report/white-paper-c11-741490.html.

16. Forti, V.; et. al. 2020. The Global E-waste Monitor 2020: Quantities, flows, and the circular economy potential, UNU, ITU and ISWA, Bonn/Geneva/Rotterdam.
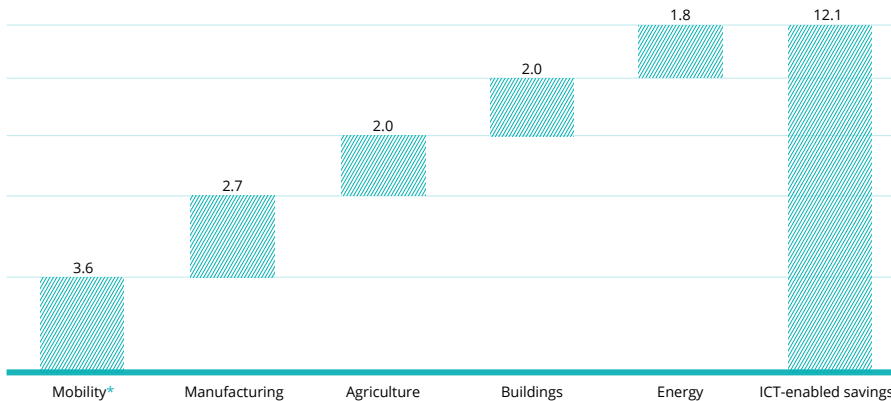
17. World Economic Forum, The Platform for Accelerating the Circular Economy (PACE). 2019. A New Circular Vision for Electronics. Time for a Global Reboot. In Support of the United Nations E-Waste Coalition. Geneva. Accessed August 31, 2020. http://www3.weforum.org/docs/WEF_A_New_Circular_Vision_ for_Electronics.pdf A-New-Circular-Vision-for-Electronics.pdf.

18. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/ research /download/ 52.: 9.

19. Balde, C. P. 2017. The Global E-Waste Monitor, United Nations University (UNU), ITU and International Solid Waste Association (ISWA), Bonn/Vienna/Geneva: 18, website: https://collections. unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017__ electronic_single_pages_.pdf.: 21.

20. Forti, V.; et. al. 2020. The Global E-waste Monitor 2020: Quantities, flows, and the circular economy potential, UNU, ITU and ISWA, Bonn/Geneva/Rotterdam.: 15.

21. World Economic Forum, The Platform for Accelerating the Circular Economy (PACE). 2019. A New Circular Vision for Electronics. Time for a Global Reboot. In Support of the United Nations E-Waste Coalition. Geneva. Accessed August 31, 2020. http://www3.weforum.org/docs/WEF_A_New_Circular_Vision_ for_Electronics.pdf A-New-Circular-Vision-for-Electronics.pdf.

Digital Decarbonization

Studies emphasizing the positive digital climate impact argue that the efficiency gains won with applying digital technologies for electricity generation, manufacturing, transportation, building, and agriculture far outweigh their negative climate impacts. It is estimated that by 2030, they could save 12,08 Gigatonnes (GT) or 20% of global GHG emissions while only emitting 1,25 Gigatonnes (GT) or 1.97% of global GHG emissions. The largest reductions could be achieved in transportation and manufacturing as shown in the figure below:[22]

Figure 2: CO_2 abatement potential by sector (2030)

* Mobility solutions consider ICT-enabled improvements to private and commercial mobility and additionally consider the reduced need to travel from various sectors, including health, learning, commerce, etc.

Source: GeSI (2020)

Likewise, comparative studies of seven countries (Brazil, Chile, China, India, Kenya, South Africa, Vietnam) predict that digital energy generation alone can reduce global GHG emissions by 1.034 Gigatonnes until 2030. The same study also predicts that China alone could reduce 777 million tonnes of global GHG emissions through the usage of digital technologies by 2030, which is "equivalent to the decommissioning of over 170 Chinese average coal-power plants."[23]

The introduction of intelligent energy systems known as smart grids is seen as another potentially positive climate impact of digital technologies. Smart grids can increase the efficiency of electricity distribution because of smart meters and sensors that can collect information about electricity output and demand. For example, smart microgrids can facilitate the supply of electricity in remote areas and feed into a decentralized system when renewable energy sources like solar and wind energy are oversupplied. Also, frontier technologies could improve larger energy systems known as macro smart grids allowing them to distribute electricity more efficiently on the national and interregional level.[24]

22. GeSI. 2015. #SMARTer2030 – ICT Solutions for the 21st Century: 15-17. Accessed August 17, 2020. http://smarter2030.gesi.org/downloads/Full_report.pdf.

23. Ibid., 51.

24. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/research /download/ 52.: 25-27.

In the transportation sector, which is considered the largest global GHG emissary, studies found that digitized traffic systems for cities and highways could make transportation more efficient reducing GHG emissions. For example, digital technologies can help to reduce traffic congestion, improve logistics for road and sea freight, and reduce individual and group traveling through online shopping, online video-conferencing, and self-driving vehicles.[25] Similar positive climate impacts have been found for the manufacturing sector.[26] For example, one study points out that between 171 and 495 million tonnes of carbon dioxide emissions (CO_2 - the largest contributor to GHG emissions) could be avoided thanks to smart factories (Industry 4.0) whereby 50% of the savings would relate to China alone.[27] Likewise, the building sector, the second-largest GHG emissary besides agriculture, could become more carbon-neutral with digital technologies. For example, smart sensors can measure buildings' energy use, optimize energy distribution, and automate building operations such as smart heating, ventilation, cooling, lighting, and window shading.[28]

Neutralizing the Digital Climate Impact

The presented studies and examples demonstrate that digital technologies have negative and positive climate impacts and it remains difficult to predict which ones will prevail. In order to ensure that the negative impacts are mitigated and the positive impacts prevail, new policies need to be developed.

One decisive factor will be if governments and private companies succeed in reducing the dependency of digital technologies on non-renewable energy sources with an energy transition to renewable energy sources. Even though current developments indicate that such an energy transition is underway, it might not keep pace with climate change unless more efforts are made to increase the pace of this transition. A recent study on the energy transition estimates that the installed renewable energy capacity was only about one third or 27.3% of global electricity generation by the end of 2019.[29]

Another important factor to neutralize the digital climate impact depends on how digital technologies are utilized to make transportation, buildings, and manufacturing more energy efficient. Presented studies are promising that digitalization will revolutionize these sectors and significantly contribute to reducing GHG emissions worldwide. Governments and the private sector will need to continue emphasizing research on how to extend their use and based on the findings, develop policies that ensure they are utilized in a carbon-neutral way.

Similarly important will be, if governments and the private sector succeed to develop smart energy systems that ensure the efficient distribution of electricity on national and

25. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/research /download/ 52.: 22; GeSI. 2015. #SMARTer2030 – ICT Solutions for the 21st Century: 15-17. Accessed August 17, 2020. http://smarter2030.gesi.org/downloads/Full_report.pdf.: 67.

26. International Energy Agency (IEA). 2017. Digitalization and Energy. IEA Publications: 49.

27. GeSI. 2015. #SMARTer2030 – ICT Solutions for the 21st Century: 15-17. Accessed August 17, 2020. http://smarter2030.gesi.org/downloads/Full_report.pdf.: 79.

28. ITU 2018: xi and GeSI: Digital Solutions for Climate Action, Brussels 2020. Accessed August 12, 2020. https://gesi.org/research /download/ 52.: 24.

29. REN21. 2020. Renewables 2020. Global Status Report. Accessed September 1, 2020. https://www.ren21.net/gsr-2020/.

interregional levels. Digital technologies also have great potential to support the energy transition to renewable energy sources such as solar and wind energy generation that can be more efficiently utilized with micro- and macro smart grids like outlined by some studies.

Finally, it will also depend on government policies and on the behavior of producers and consumers on how to cope with the growing digital e-waste. The establishment of a circular economy as promoted by the UN E-Waste Coalition is providing here a promising global direction. Governments and private companies should support the new UN coalition and develop policies to prolong the life cycle, the universal applicability, and the recyclability of digital technologies. Additionally, it will need policies prohibiting planned obsolescence for producers and incentives to build a recycling and repair economy for digital technologies.

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The Role of Cambodian Universities in Preparing Cambodia for a Digital Economy

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2   Sereyvuth Khat holds a Bachelor's Degree in English, Major in Teaching English as a Foreign Language, from Norton University, Cambodia. Her love for educational development together with her background in education merged with her management professional background push her to continuously explore and analyze the current educational ecosystem in Cambodia, with a specific focus on what technologies can do for supporting Cambodian students. In 2021 she is going to pursue a Master's Degree in Education.

3   Panha Vattey Nhean is a former Political Science and International Relations student, and a current premed student at the University of Cambridge, UK. Her interest in science and technology at the service of the community motivates her for constant growth and improvement for a future career in research and development.

Introduction

With the advent of the Fourth Industrial Revolution (4IR), Cambodia is trying hard to adapt to the era of digitalization. In fact, in the last decade, the Cambodian Minister of Education, Youth, and Sport (MoEYS) began many initiatives to facilitate greater integration of Information and Communication Technologies (ICTs) in education, but with weak financial support, mainly in the public schools, it meets many challenges. Cambodia is still spending only less than 2.6 percent of its gross domestic product (GDP) on education and many schools lack human and technological resources.[1]

Within the last decade, the Cambodian government has only slowly begun to focus on digital education in the HE sector as reflected in the first comprehensive HE Quality and Capacity Improvement Project (HEQCIP) 2010–2015, the Education Strategic Plan 2019–2023, and the Higher Education Vision 2030.[2] To assist in supporting key areas of HE, the World Bank, in an agreement with the MoEYS in 2011 has provided USD23 million to fund for five years the HEQCIP 2011-2015. The main objectives have been the improvement of the quality of teaching, management, and research in project-supported entities and pilot projects that target disadvantaged students for enhanced access and retention, something that today is still missing.[3] Additionally, the MoEYS is currently cooperating with the UNESCO International Centre for Higher Education Innovation (UNESCO-ICHEI) aiming

to carry out cooperation in the field of higher education for supporting and boosting a process of digital transformation. The areas involved in this cooperation include promoting digital teaching and learning in Cambodian HEIs, exchanging information and lessons learned in the field of mutual interests, providing consultation experts upon projects, conducting shared research projects, supporting the creation of digital learning policies, and organizing symposia and workshops.[4]

In this article, we will describe where Cambodia stands in terms of digital education or Education 4.0, and what Cambodia will need to do to get ready for a digital economy in the national and ASEAN context. We will examine the level of digital education in HE in preparing Cambodian citizens for the digital economic transformation. We will describe the steps to follow and problems to address by the Cambodian government, industries, and universities to achieve an effective digital education. Finally, in alignment with the discussed topics, we are going to provide policy recommendations useful for achieving a digital education capable of supporting Cambodia in its digital transformation process.

Cambodia's Digital Readiness in the ASEAN Context

The ASEAN region has seen a dramatic increase in internet access with social media penetration rates exceeding 60 percent, and about 80 percent of consumers are collecting information on products and services from social media.[5] The ASEAN digital economy is

1. REN21. 2020. Renewables 2020. Global Status Report. Accessed September 1, 2020. https://www.ren21.net/gsr-2020/.

2. Chanphirun Sam and Heidi Dahles, "Stakeholder Involvement in the Higher Education Sector in Cambodia," Studies in Higher Education 42, no. 9 (2015): 1764–84, https://doi.org/10.1080/03075079.2015.1124851.

3. MoEYS, "Higher Education Quality and Capacity Improvement Project (HEQCIP)," Ministry of Education, Youth and Sport, 2011, http://www.moeys.gov.kh/en/heip/heip-report/higher-education-quality-and-capacity-improvement-project-heqcip.html.

4. UNESCO-ICHEI, "The Partnership between UNESCO-ICHEI and MoEYS Takes a New Step Forwards," Institutional website, ichei.org, 2020, http://en.ichei.org/2020/09/03/the-partnership-between-unesco-ichei-and-moeys-takes-a-new-step-forwards/.

5. Boutheina Guermazinata and Natasha Beschorner, "Southeast Asia Can Build a Stronger Digital Economy for All Its Citizens," World Bank Blogs (blog), 2019, https://blogs.worldbank.org/eastasiapacific/southeast-asia-can-build-stronger-digital-economy-all-its-citizens.

worth about USD 200 billion, or seven percent of ASEAN's total GDP.[6] These statistics indicate that the growing digital economy presents potentially huge benefits for the development of Cambodia's economy. Additionally, a key element in the growth process of an economy is represented by the expansion of global value chains supported by digital technologies that lead to efficiency gains and can generate employment opportunities.[7]
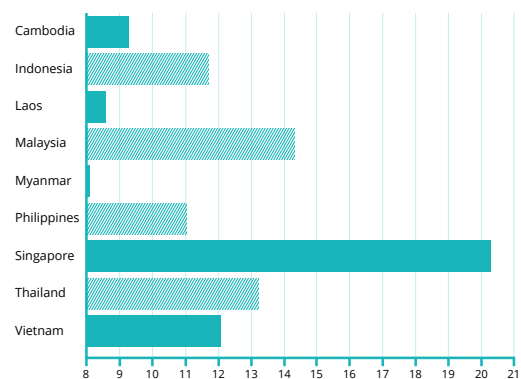
Important drivers of the digital economic transformation are micro-, small-, and medium-sized enterprises (MSMEs). The Economic Research Institute for ASEAN and East Asia (ERIA) estimates "that MSMEs contribute to 30 to 53 percent of ASEAN's gross domestic product [...] and to 10 to 30 percent of its imports."[8]

To gain from the development potential of the digital economy, digital education is much needed. In this context, even if the ASEAN region has already achieved good literacy and numeracy rates, the education systems of some member countries are still weak in developing those skills needed in a digital economy, ranging from basic computer knowledge to advanced skills such as coding and data analytics.[9] The Asian labor force is projected to grow from 1.9 billion in 2015 to 2.1 billion in 2030 and up to 2.2 billion in 2050, with more than 60 percent of the population aged less than 30 years.[10]

Asia and Southeast Asia represent a growing important pool of labor force to train, and some ASEAN member states (Thailand, Malaysia, Vietnam, and Singapore) have already prepared the young generation for a digital economy. Others, including Cambodia, are just beginning to meet this challenge.[11]

Even though Cambodia has 8.5 million Internet users out of a 16 million population, much more needs to be done in terms of digital skills. More specifically, the skills needed in a digital economy are content skills, cognitive abilities, process skills, social skills, such as persuasion and emotional intelligence, and finally a higher degree of cognitive abilities, such as creativity, logical reasoning, and problem sensitivity. In Cambodia, these skills appear to be often missing. To prove this, Cambodia is still ranked in the Global Digital Readiness Index as one of the countries with the weakest readiness index equal to 8.6 against the global average of 11.96, and also weakest in the ASEAN region as shown in the graphic below:[12]

Figure 1: *Global Digital Readiness Index (ASEAN)*

Source: *Cisco Global Digital Readiness Index (2019)*

6. Pheakdey Heng, "Embracing the Digital Economy: Policy Consideration for Cambodia," in Economic Transformation in Cambodia and Abroad, Digital Insights (Phnom Penh, Cambodia: Konrad Adenauer Stiftung, 2018), 141.

7. The World Bank, "Global Value Chains," Text/HTML, World Bank, August 21, 2019, https://www.worldbank.org/en/topic/global-value-chains.

8. Jason Thomas, "Strengthening ASEAN's Digital Economy," The ASEAN Post, exact date of publication? 2019, The ASEAN Post edition, https://theaseanpost.com/article/strengthening-aseans-digital-economy

9. Ibid.

10. Anita Prakash, "The Importance of Industrialisation and Trade Facilitation for Employment-Led Growth in the Digital Economy," Institution who published it? Policy Brief, 2019, https://think-asia.org/handle/11540/10872.

11. ODC, "Science and Technology," Open Development Cambodia (ODC) (blog), 2015, https://opendevelopmentcambodia.net/topics/science-and-technology/.

12. Pheakdey Heng, "Embracing the Digital Economy: Policy Consideration for Cambodia," in Economic Transformation in Cambodia and Abroad, Digital Insights (Phnom Penh, Cambodia: Konrad Adenauer Stiftung, 2018).

Education 4.0 in Cambodian Universities

Education 4.0 can be considered as that school of thought that encourages thinking outside the box and approaches education in a non-traditional way. Essentially, Education 4.0 refers to the use of technological tools for supporting learning while in the meantime providing new innovative solutions for learning designers and teachers to support them in their roles with learners, and for learners to learn more effectively. Education 4.0 requires tech-savvy educators and prepared students, but at the same time, a change in mentality toward the given importance of technology itself, on which Education 4.0 relies on.

It is essential to emphasize that the Cambodian education sector must be ready to prepare the new generations for the challenges that they will face with a digital economy. According to studies, Cambodia is not yet ready for that: "Foreign language, technical or practical skills, customer handling, oral communication, problem-solving, and teamwork skills are generally lacking in the labor market."[13] The Fletcher School at Tufts University has created a Digital Evolution Index (DEI) to illustrate how countries compare in their readiness for becoming a digital economy.[14] The DEI cluster plot shows that countries fall into four trajectory zones:

1. Stand Out: nations that have high digital evolution and strong momentum, like Singapore.

2. Stall Out: nations that have high digital evolution but weak momentum, like the Netherlands.

3. Break Out: nations that have low digital evolution but strong momentum, like China and India.

4. Watch Out: nations that have low digital evolution and weak momentum, like Egypt and Hungary.[15] Cambodia was not mentioned.

To address the problem of lack of tech-savviness and enable Cambodian HEs to prepare new generations for the digital economic transformation, the Royal Government of Cambodia has adopted the Cambodian National Science and Technology Master Plan 2014-2020. Furthermore, digital projects were initiated like for example the Cambodian Science & Engineering Festival, which is a national yearly initiative to advance education in science, technology, engineering, and mathematics (STEM) and inspire the next generation of scientists and engineers (the first one took place in 2015). The exhibitors, performers, speakers, partners, sponsors, and advisors of the festival "represent the best in Cambodia and are drawn from both local and international academic institutions, government ministries, cutting-edge companies, and non-governmental organizations (NGOs)."[16]

To tackle the low digital readiness of Cambodia, where universities struggle to attract students to STEM majors instead of business-related degrees, the MoEYS launched in 2020 an innovation center for digital and distance

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13. Pheakdey Heng, Preparing Cambodia's Workforce for a Digital Economy, Digital Insights (Phnom Penh, Cambodia: Konrad Adenauer Stiftung, 2019), 9.

14. Bhaskar Chakravorti, "Where the Digital Economy Is Moving Fastest," Harvard Business Review, 2016, V. No. 7.

15. Ibid.

16. CSEF, "We Are Dedicated to The Promotion of STEM Education, Innovation, Industry and Careers in Cambodia," Cambodia Science and Engineering Festival, 2016, http://www.cambodiascience.org/festival-organization/.

learning. The center wants to accelerate the digital transformation of education while advancing the educators' capacity to cope with the new Education 4.0 technologies. Following the MoEYS's website, "the establishment of the centre responds to the ministry's vision not only to promote digital education but also to develop technical capacity of teachers and professors to lead the process."[17] This project preceded in 2014, the New Generation Schools project of the MoEYS to create 'autonomous' public schools "with a mandate to innovate and improve educational quality."[18] According to the Kampuchea Action to Promote Education (KAPE), the largest local NGO in Cambodia's education sector, "this new development track seeks to move public schools to the next level so that they can achieve 'maximal' standards of education, especially in the STEM subjects."[19]

Other digital projects include the American University of Phnom Penh, which inspired by the model of Israeli Technology incubators, announced to open up a Technology Center in 2021 that "will nurture novice entrepreneurs at the earliest stage of technological innovation, helping them transform their ideas into commercial products and form productive business ventures in Cambodia and abroad."[20] Furthermore, relying on international opportunities to improve the STEM sector, Cambodia takes advantage of its close ties with China.[21] Over the past 20 years,

more than 2,000 Cambodians graduated from Chinese universities.[22] Additionally, in 2016, the International Centre for Higher Education Innovation (ICHE) was established in Shenzhen, China in cooperation with the Royal University of Phnom Penh (RUPP) and UNESCO. The cooperation focuses on two main areas: improving teaching and research at RUPP by building ICT capacity and providing scholarships for Cambodian students to pursue Engineering and Science degrees in China.[23]

Challenges for the Transition to Education 4.0

In a Cambodia that slowly is turning every sector into its "e-" version, the transition of the education sector to a more digital version of itself will represent one major challenge to tackle, worsened by the Covid-19 pandemic which invested the world in this year. In addition to the difficulties, another issue present in Cambodia is represented by its strong dependency on donors and external investors. When examining stakeholder involvement in Cambodia's HE sectors, the first noticeable factor is the prominent presence of donors, a stakeholder that is not acknowledged in the commonly used triple helix model, which demands a closer relationship between governments, universities, and industries. This model assumes that "the driving force of economic development in the post-industrial stage is the production and dissemination of socially organized knowledge" and that "institutions that generate knowledge increasingly play a role in the networks of relations among the key actors: university (science), industry (business), and government (governance)."[24] Cambodia depends on international donors,

17. MoEYS, "Centre For Digital and Distance Learning Broken Ground," Ministry Website, Ministry of Education, Youth and Sport, 2020, http://www.moeys.gov.kh/index.php/en/minister-page/.

18. KAPE, "New Generation School (NGS)," NGO website, KAPE, 2014, http://www.kapekh.org/en/what-we-do/16/?pro_id=20.

19. KAPE, "New Generation School (NGS)," NGO website, KAPE, 2014, http://www.kapekh.org/en/what-we-do/16/?pro_id=20.

20. AUPP, "AUPP to Launch New Technology Center Early Next Year," University website, AUPP - American University of Phnom Penh, August 31, 2020, https://www.aupp.edu.kh/aupp-to-launch-new-technology-center-early-next-year/.

21. CDRI, "International Technical Assistance: Lessons Learned from Cambodia-China STEM Diplomacy," Policy Brief (Cambodia: Cambodia Development Resource Institute (CDRI), 2018).

22. Ibid.

23. Ibid.

so-called development partners, in many areas and education is no exception. This strong dependence on donors makes long-term planning difficult.[25]

Recently, the Accreditation Committee of Cambodia (ACC) has worked in cooperation with universities, public and private ones, intending to align all the curriculums and documentation to specific standards, following the ASEAN educational requirements dictated by the ASEAN University Network (AUN). Following some of the ACC members, Cambodia is still far from a total alignment with the ASEAN standards, but the first steps have been taken. The ACC has also expressed timid support to include more professional training in the universities' curriculum and asked universities to include more internships and activities capable of providing the required digital and STEM-related skills to students for being ready for the job market. Furthermore, the ACC is regularly reviewing the curricula of HEIs. Often, HE curricula have not been updated to be aligned with the current needs and state of the art in the different fields.[26] Regarding for example the engineering curriculum, one study proposed a new curriculum for Engineering Education 4.0 based on the "analysis of different references and essential relevant documents that explain the necessity to well-formed a new generation of professionals."[27]

Studies recommend to the Cambodian government to heavily invest in ICT infrastructure to facilitate deeper ICT integration in the education system, to closely monitor the implementation progress of the policy of Higher Education Vision 2030, to gradually build up a large pool of ICT trainers for schools across the country and to develop a nation-wide initiative to retrain teachers to use innovative teaching methods by integrating ICTs. This approach has been taken from the neighbor Thailand, which has begun this process before Cambodia with the first national ICT policy known as IT-2000, followed by the IT-2010 policy, and then expanded by the Thai Ministry of Information and Communication Technology into the ICT policy framework (2011–2020) or ICT 2020.[28]

Other studies suggest for Cambodia to provide incentives to firms to invest in digital infrastructure, promote entrepreneurship and innovation by creating a healthy competitive marketplace, and in the longer-term, monitor emerging labor market trends and exploring ways of developing the labor market programs.[29] For example, Thailand has addressed this challenge with the revised Investment Promotion Act[30], the Competitiveness Enhancement Act[31], and the draft Eastern Economic Corridor Act.[32] These policies were created to provide

24. Irena Vaivode, "Triple Helix Model of University–Industry–Government Cooperation in the Context of Uncertainties," Procedia - Social and Behavioral Sciences, 20th International Scientific Conference "Economics and Management 2015 (ICEM-2015)," 213 (December 1, 2015): 1063–67, https://doi.org/10.1016/j.sbspro.2015.11.526.

25. Deborah Bräutigam, "Foreign Aid and the Politics of Participation in Economic Policy Reform," Public Administration and Development 20, no. 3 (2000): 253–64.

26. Sheith Khidhir, "Cambodia's Failing Education System," Online Newspaper, The ASEAN Post, 2019, https://theaseanpost.com/article/cambodias-failing-education-system.

27. R. A. Ramirez-Mendoza et al., "Engineering Education 4.0: — Proposal for a New Curricula," in 2018 IEEE Global Engineering Education Conference (EDUCON), 2018, 1273–82, https://doi.org/10.1109/EDUCON.2018.8363376.

28. MFA, "ASEAN ICT Masterplan 2020 (AIM 2020) – ASEAN THAILAND 2019," Ministry of Foreign Affairs of Thailand, 2019, https://www.asean2019.go.th/en/infographic/asean-ict-masterplan-2020-aim-2020/.

29. Pheakdey Heng, Preparing Cambodia's Workforce for a Digital Economy, Digital Insights (Phnom Penh, Cambodia: Konrad Adenauer Stiftung, 2019), 9.

30. ASEAN Briefing, "Thailand's New Investment Promotion Policies Open a New Door to Foreign Investors," ASEAN Business News (blog), August 19, 2015, https://www.aseanbriefing.com/news/thailands-new-investment-promotion-policies-open-a-new-door-to-foreign-investors/.

31. Thailand Board of Investment, "National Competitiveness Enhancement for Targeted Industries ACT" (Thailand Board of Investment, 2017).

32. Eastern Economic Corridor (EEC), "EEC-EEC Act" (Eastern Economic Corridor (EEC), 2018), https://www.eeco.or.th/en/eec-act.

investors, national and international ones, with a satisfactory business and investment environment in Thailand.

Conclusions and Recommendations

The steadily growing offerings that ICTs provide, represent an appealing opportunity for countries to switch to, or to boost their existent digital economy, and Cambodia needs to embark on a digitalization process, with the facilitation of its government. But the digital economy needs an education sector that is aligned with its digital demands in terms of skills, and it is fundamental for the Kingdom to prepare Cambodians for this new digital labor market. ICTs can represent a powerful tool not only for a digital economy but also for supporting education itself allowing a transition to an Education 4.0.

This process requires preparation, planning, and investments. The government of Cambodia has already taken some steps in the past decade with the creation of some plans to support and boost digital education. Additionally, in the last years, the MoEYS has begun the transition to Education 4.0 with some pilot projects, like high-tech schools, and the creation of an innovation center in 2020. Hackathons, tech-boot camps, and digital competitions can spark an interest in the young pupils for technology and can attract them toward the digital world, demystifying the idea that only a few can understand technology. But when looking into the HE sector, still issues like outdated curriculums, unprepared instructors, lack of transparency, and quality education undermine an effective transition to Education 4.0. This issue needs to be addressed and curriculum in HEIs updated in alignment with the job market demands and future vision of the government.

Additionally, the highest number of enrollments in business degrees proves that a shift in mind needs to happen in Cambodia. In a world where business has become digital, the preparation of students must take place in alignment with the market, or to be more specific, with the digital market. And it is the role of the universities to offer programs that are modern and answer to the latest needs. In a world where finance is becoming fintech, business is transforming into a digital business, governance is converting into e-governance, education needs to step up and prepare the Cambodian generations for these requirements. Thus, the introduction of standards for monitoring universities, a commitment to increase investments in education for providing public schools and universities with the tools to support Education 4.0, revision, and update of curriculums are fundamental steps that Cambodia needs to take.

Additionally, to prepare the new Cambodian generations for the digital economic transformation, Cambodia must perform a transition from their classical educational curriculum to an Education 4.0, taking advantage of the examples of other countries that have already embarked on this process. Universities have an important role in this process as they are still often tied to an archaic educational model with little to no vision, and without a specific framework for monitoring and supporting quality standards. This scenario had resulted in Cambodian students suffering from a lack of competitiveness in comparison to other ASEAN graduates, and thus subject to the risk of missing opportunities in the digital economic transformation process.

In summary, Cambodia has moved some steps towards more digital education but still today, the kingdom is not ready for the digital economy. Lack of policies and clear

Train educators for guiding pupils in the digital world

STEP 01

Prepare Schools for supporting digital inclusion and foster digital literacy

STEP 02

Aligning standards across the country and provide quality curricular based on learning design and pedagogical theories

STEP 03

Facilitate and reward companies that invest into education

STEP 04

Organize events, competitions and programs in cooperation between MoEYS, universities and companies

STEP 05

Move to e-government for providing transparency on expenditures and public investments

STEP 06

Create effective vocational training programs to prepare Cambodians to the job digital market

STEP 07

guidance show an evident lack of preparation, highlighted even more by the current situation caused by the Covid-19, presenting a scenario of universities, just beginning to initiate Education 4.0 and facing many obstacles in overcoming related challenges.

Following policy recommendations should be considered to boost Cambodia's digital education:

1. Create training programs for teachers, allowing them to be ready to drive pupils to strong digital literacy, beginning from their young age.

2. Provide schools with technological tools for supporting digital inclusions and digital literacy for every student in Cambodia, regardless of the school being in Phnom Penh or a small province.

3. Continue with the process of alignment of standards and curriculum for every school in the country, enforcing quality and shifting away from the mentality of getting a diploma without quality education.

4. Introduce facilitations and benefits for private companies that want to invest in education.

5. Organization of hackathons, tech-boot camps, and competitions in co-organization between MoEYS, industries, and schools.

6. Move to an e-government model capable of providing transparency and fighting against the misuse of international grants, which could be used for improving education. Digital contracts, digital payments and smart money digitally tied to a purpose are solutions to investigate.

7. Creation of a quality short training program capable to prepare those interested to face the digital job market, with the skills needed.

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Re-Imagine Cambodia 2030

Melanie Mossard[1]

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Introduction

Even though 2020 didn't start as we wish, this might be the time to reflect on what we want the next decade to look like to "build back better". Personally, I have hope for the upcoming 10 years. In this article I will share what Cambodia could look like if we make use of the innovations that are currently emerging, whether they are already happening or only prototyped so far. You will see what grand progress is possible if we succeed in scaling them up. This article might sound utopian for a few or it might give hope for others. In any case, I am sure it can direct the spotlight onto grassroots innovations that are happening right in front of us, here in Cambodia, who are in their infancy, or lacked the recognition they deserve so far.

With 68% of its population under 30, Cambodia is in a great position to design its country.[1] So much will happen in the next 10 years, and it's up to us to be the change we want to see in this country.

I hope that by 2030, the global definition of "Growth" would have shifted significantly, away from a purely economic understanding towards a more comprehensive assessment taking into account the people and the planet. Understanding the limits of economic growth[2] and initiating this change could increase the fairness and sustainability of the system.

The GDP would not be the main indicator that we would refer to, but we would rather focus on concepts like the Gross National Happiness Index[3] to measure how countries are performing. It includes indicators such as Psychological wellbeing, health, education, time use, cultural diversity and resilience, good governance, community vitality, ecological diversity and resilience and living standards.[4]

Can growth be driven by the principle "how can we make the country better for our children, and their children?", and move away from this old principle of the short-term growth aiming at maximizing the profits in the short terms? As, although children are only 33 percent of the global population, they're 100 percent of our future.

Let's dive deeper into each sector and explore which change could happen/is already happening in Cambodia and let's get inspired by solutions from around the world that would have the greatest impact in Cambodia.

#LetsNotReInventTheWheel

1. UNFPA Cambodia. "Report on Urbanization." 2014. Accessed November 11, 2020. https://cambodia.unfpa.org/en/publications/report-urbanization.; Worldbank. "Urban Population - Cambodia | Data." World Development Indicators, 2019. Accessed November 12, 2020. https://data.worldbank.org/indicator/SP.URB.TOTL?locations=KH.

2. Meadows, Donatella H., Dennis L. Meadows, Randers Jorgen, and Willian W. III. Behrens. "The Limits of Growth." New York, USA: Universe Books, 1972. Accessed November 10, 2020. http://www.donellameadows.org/wp-content/userfiles/Limits-to-Growth-digital-scan-version.pdf.

3. Oxford Poverty & Human Development Initiative. "Bhutan's Gross National Happiness Index." 2020. Accessed November 05, 2020. https://ophi.org.uk/policy/national-policy/gross-national-happiness-index/.

4. Centre for Bhutan Studies & GNH Research. "A Compass towards a Just and Harmonious Society. 2015 GNH Survey Report." Timphu, Bhutan: Centre for Bhutan Studies, 2016. Accessed November 07, 2020. https://www.bhutanstudies.org.bt/a-compass-towards-a-just-and-harmonious-society-2015-gnh-survey-report/.

Agriculture & Landscape

Despite rapid urbanization in recent years[5] Cambodia is still dominated by the countryside, as 76% of the population is living in rural areas[6] and over 31% of the labor workforce is employed in the agriculture sector.[7] Agriculture is definitely one of the sectors that would face lots of change in the upcoming years. Climate change will be one of the main reasons for it, as droughts will be harsher and floods will be more devastating.[8] The growing heat waves and power cuts will make the crops even more vulnerable. In addition, the Mekong water flow management will become a new source of conflict for the populations crossed by the river.[9] A new resilient agriculture needs to be adopted.

1. Farmers will be tech-savvy and will make decisions on which crop to grow, when and how, thanks to easy to access data that they will collect from their smartphones. Their children will help them through this transition and teach them how to use these new tools.

5. UNFPA Cambodia. "Report on Urbanization." 2014. Accessed November 05, 2020. https://cambodia.unfpa.org/en/publications/report-urbanization.

6. Worldbank. "Rural Population (% of Total Population) - Cambodia | Data." World Development Indicators, 2019. Accessed November 06, 2020. https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=KH.

7. Worldbank. "Employment in Agriculture (% of Total Employment) (Modeled ILO Estimate) - Cambodia | Data." World Development Indicators, 2020. Accessed November 06, 2020.https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=KH.

8. Robert Mendelson and Ariel Dinar. "Climate Change, Agriculture, and Developing Countries: Does Adaptation Matter?." The World Bank Research Observer 4, no. 2 (1999): 277–93; Fan Zhai and Juzhong Zhuang, "Agricultural Impact of Climate Change: A General Equilibrium Analysis with Special Reference to Southeast Asia," in Climate Change in Asia and the Pacific: How Can Countries Adapt?, by Venkatachalam Anbumozhi et al., ADBI Working Paper Series (B-42, Panchsheel Enclave, New Delhi 110 017 India: SAGE Publications India Pvt Ltd, 2012), 17–35, Accessed November 06, 2020. https://doi.org/10.4135/9788132114000.n3.

9. Haffner, Andrew. "'Us' vs 'Them': The Politics Dictating the Rise and Fall of the Mekong." South East Asia Globe, 2020. Accessed November 05, 2020. https://southeastasiaglobe.com/mekong-river-politics-china/.

2. **SmartAgro** would master regenerative agriculture practices, and would bring back fertility to tired soils thanks to their cover-crops, composting and no-till techniques.

3. **Smart Farm Assistance** will equip farmers with smart irrigation systems that will help them irrigate their crops in the most efficient way; saving time, money and water.

4. **Agribuddy** would have mainstream data-driven agriculture thanks to their network of buddies. They would have connected farmers to market more easily.

5. **Saart Mushroom** would help mushroom growers increase the quality and yield of the mushrooms, thanks to their solar-powered growing rooms controlling humidity and temperature.

6. New resilient agriculture practices would emerge and be mainstreamed such as permaculture, hydroponics, or aquaponics. It would help farmers adapt to the growing droughts. **AgroNature** will be leading on it.

7. Cambodia would focus on the production of niche agricultural products with a high value which would be known internationally. Kampot Pepper would be used by the best restaurants in the world. **Krassna_Cambodi** would lead the production and would empower thousands of farmers to grow niche Cambodian raw materials such as Cambodian liquid resin, Elephant Yam, Wild Almond Nuts, agar wood and Siam Cardamom.

8. **Agri Smart** would be making low-cost and low-tech machines that would help

Cambodian farmers mechanize their production, and increase their productivity, while preserving the environment.

9. The world demand for **cricket** would have risen a lot, since crickets contain two to three times more complete protein than a beef steak of the same weight and it's very rich in iron, vitamins, and fiber as well.[10] In addition, a cricket steak represents a huge ecological advantage, compared to a chicken one. Its production requires only one-third of the land and would require more than 30% less water.[11] Cricket House would be leading on the cricket production in Cambodia and would have rolled out **Cricket House** across the country. Community farmers will dry and process their cricket locally thanks to low-cost solar dryers. It would be a great source of additional income for the farmers. The demand for cricket-based products would be exploding and companies such as **Criche** and PCR would be supplying it.

10. Incorporating innovation together with agriculture and technology, **Vitamin Air** will be actively engaged in reforestation efforts, permaculture, and natural organic farming. Vitamin Air will provide business and employment opportunities for students and families of surrounding forest communities, while serving as guardians to protect and preserve Cambodia's national forest lands. Research and development initiatives will include drone-assisted forest surveillance and seed bombings, together with alternative water and irrigation systems for enhanced reforestation practices. Community development initiatives will extend into general education programs, occupational training, eco-adventure tourism, as well as outdoor living and learning programs.

11. A new generation of regenerative farmers would have emerged after joining **WeFarm** educational camps. Proud farmers' children or curious graduates from the city would reconnect to nature and thrive for regenerative and sustainable agriculture practices. They would also be able to learn permaculture practices at the **YiFamily**.

12. People would be more and more careful of their health and would understand that what they eat directly affects their health. People would choose local organic vegetables from producers like **KaseHealth** or **Khmer Organic**, and would want to know exactly where the product comes from. Wrapping fruits and vegetables in plastic would not be necessary anymore as they would have built trust with their customers and farmers over the years about their supply chain control and standards.

Great Inspiration from Abroad:

1. Rural areas would be empowered thanks to programs similar to **Serve For China**[12] which is creating a network of young graduates originally from the provincial areas, who come back to their village and support the local farmers. Serve For China fellows undergo extensive training prior to and during their village assignments that covers three core areas: public policies

10. Bennington-Castro, Joseph. "How Crickets Could Help Save the Planet." NBC News, 2017. Accessed November 05, 2020. https://www.nbcnews.com/mach/environment/how-eating-crickets-could-help-save-planet-n721416.

11. Huis, Arnold van, and Dennis G. A. B. Oonincx. "The Environmental Sustainability of Insects as Food and Feed. A Review." Agronomy for Sustainable Development 37, no. 5, 2017. Accessed November 05, 2020. https://doi.org/10.1007/s13593-017-0452-8.

12. UNESCO Asia and Pacific Regional Bureau for Education. "Serve For China: Top University Grads Aim to Revitalize China's Villages." UNESCO Bangkok, 2017. Accessed November 04, 2020. https://bangkok.unesco.org/content/serve-china-top-university-grads-aim-revitalize-china%E2%80%99s-villages.

and agricultural knowledge, including agricultural policies, land reforms, political systems in villages, but also leadership development, including team-building, communication and negotiation skills; and business skills, such as accounting, marketing and branding, case management.

2. Rooftops will be covered by aeroponics systems that would allow the urban citizens to grow pesticide-free vegetables, like **Aeroroots** is doing in Nepal.

Energy & Resource Management

Resources are becoming scarce, and we would need more than ever to think about how we can use waste as a new resource, instead of pulling new raw materials from our shrinking deposits.

Resources have always been limited but their increasing scarcity will become much more noticeable in the years ahead. Despite this, energy consumption in Cambodia increased by 23% between 2018 and 2019[13] alone. We will need to work together to think of innovative ways to manage our resources, abandoning worn-out approaches of exploitation. Fortunately, Cambodia hosts a high number of promising Start-Up companies and initiatives developing working concepts of a circular economy, responsible resource usage and recycling.

1. Off-grid communities and villages would leapfrog the traditional energy grid by leveraging low cost distributed solar and

storage thanks to **Okra Solar**. Okra's plug & play smart grids would be set up in remote communities across Cambodia using IoT to interlink distributed systems, allowing the efficient sharing of power and providing 24/7 clean energy to off-grid households. This model would also be considered for neighborhoods within urban areas who want to move away from fossil fuel-based power.

2. A new generation of renewable energy talents would be unveiled, thanks to the **EnergyLab's** startup and internship support programs.

3. A new generation of Water Sanitation and Hygiene Entrepreneurs and professionals would have emerged thanks to the training of the **Center for Sustainable Water**.

4. Virgin factory waste would be recycled, turning them into new soap thanks to NGOs such as the **EcoSoap Bank**, which will be distributed at a very subsidized price to NGOs and schools in need.

5. Industries and households would be equipped with wastewater management systems made out of eco-friendly biological filters extracted from recycling coconut waste by **SUdrain,** which would treat organic wastewater and domestic sewage.

6. **TapEffect** would connect households in isolated and under-served areas in Cambodia to direct access to safe and affordable piped water.

7. People would be aware of the pressing issues of climate change and how badly it is affecting Cambodia. They would take decisions of what they consume, buy and in their work keeping in mind their

13. Open Development Cambodia (ODC). "Energy." Open Development Cambodia (ODC) (blog), 2015. https://opendevelopmentcambodia.net/topics/energy/; Asian Development Bank, "Cambodia:: Energy Sector Assessment, Strategy, and Road Map," 0 ed. (Manila, Philippines: Asian Development Bank, December 2018), Accessed November 04, 2020. https://doi.org/10.22617/TCS189801.

children's well-being and how it could affect them.

8. The coconut shells would all be transformed into clean charcoal thanks to Khmer **Green Charcoal**.

9. The smallholder-farmers raising cows could make additional revenue by producing vermicompost from the cow dungs, thanks to **Junlen**.

10. Restaurants would have their food waste eaten by black soldier flies larvae, thanks to **Ruy Reach**, which would then transform the larvae into animal feed and sell the natural compost produced to plant nurseries.

11. Growing cricket would be easy thanks to cricket feed developed by PCR made out of waste from the cassava-top. The cricket would be also able to lay their eggs into some rice biochar.

12. **HUSK!** would support smallholders farmers to transform their rice husk into biochar, a soil conditioner that enhances water retention, improves nutrient uptake and increases fertilizer efficiency.

13. **ATEC BioDigester** will transform organic waste into biogas for cooking and fertilizer for farming through their biodigester.

14. Old batteries will be regenerated by **EcoBatt Energy**.

15. Garment factories based in Cambodia would have adopted circular principles in their supply chain. Clothes will be made from safe and renewable materials such as lotus or banana leather from **Samatoa**,

new business models would increase their use, and leftover fabric would be turned into new, like **Tonle** and **Dorsu** have been pioneering. Garment factories would commit to use sustainably sourced materials.

16. Conservation NGOs will team up with young and caring entrepreneurs to develop conservation community enterprises (CCEs) in rural areas, where profits and conservation will go hand in hand, led by the **YEA** or **CDRT** or **Sansom Mlup Prey Cambodia**

17. Cambodia would be a plastic free country as single used plastic would be banned from the shops thanks to the strong advocacy from **GoGreenCambodia**.

18. Cambodia would have got some autonomy in recycling instead of relying on neighboring countries. Recycling facilities would be processing industrial waste, like **ChipMong Ecocycle** through their co-processing system or plastic waste like **Gomi Recycle 110**.

19. **Naga Earth** would have a large-scale factory where they will be recycling, reusing and repurposing discarded materials, such as cooking oil, plastic, glass, paper and more.

20. Households would compost 80% of their daily waste on their balconies thanks to the balcony composter from **Compost City**. A "Compost Museum" would host weekly activities for families and gardening lovers to foster their love for nature and soil.

21. Citizens would contribute to the city's waste management effort by voicing

areas that require cleaning up, areas that have improved and requesting bins, thus generating real-time data. In turn, this data would be submitted to the municipality which will process the data, verifying the information and placing bins where needed. These efforts, in addition to changing behaviors, would contribute to the creation of a more responsive and strategic plan for waste collection, thanks to the app created by **GoGreenCambodia**.

Great Inspiration from Abroad:

1. Flowers from each temple would be recycled and turned into new scents, thanks to **Phool**, from India.

2. Leftover fabric and old clothing materials would be turned into industrial materials such as insulation pads, or **shoddy pads**.

3. The solid waste from the rivers will be collected thanks to floating barriers such as **Sea Defence Solutions** before ending up in our oceans.

Education

Departing from the topic of using and managing natural resources we should never forget about our biggest resource: children, as the 31st President of the United States, Herbert Hoover once said.[14] Cambodia's children deserve the best education possible. While school enrollment fees have been reduced in past years[15] primary school enrollment seems to fall behind expectations.[16] Besides improving coverage, Cambodia's education system must address the mega-trends of the 21st century. Schools and Universities must endorse digital competencies and leadership skills. A diverse set of inspiring approaches proposed by our partners can be outlined here already.

1. Project-based learning curriculum by **Liger Leadership Academy** would be scaled up across the country. Project-based learning has the capacity to be co-designed by kids for kids, and would put a strong emphasis on developing the socially conscious, entrepreneurial leaders of tomorrow.

2. Environmental education will be part of the curriculum developed by **GoGreen**, and each school will have a compost system, teach recycling and gardening and will be able to understand the soil, and the cycle of life, thanks to **Compost City** or **Coconut School**.

3. A new generation of coders would have emerged thanks to the access to the **Koompi** computers. This very affordable computer combining modest hardware with powerful open-source software, would empower the next generation of Cambodian youth as the creators and innovators of tomorrow.

4. All universities across the countries would have access to an entrepreneurship curriculum thanks to the **SmartStart Unipreneurship platform**, a certified curriculum in Khmer endorsed by the Ministry of Education Youth and Sport, and the Ministry of Post and Telecommunication.

14. Compassion International. "Famous Quotes About Children." 2020. Accessed November 04, 2020. https://www.compassion.com/poverty/famous-quotes-about-children.htm.

15. Chhinh, Sitha, and Sideth S. Dy. "Education Reform Context and Process in Cambodia." In The Political Economy of Educational Reforms and Capacity Development in Southeast Asia: Cases of Cambodia, Laos and Vietnam, edited by Yasushi Hirosato and Yuto Kitamura, 113–29. Education in the Asia-Pacific Region: Issues, Concerns and Prospects. Dordrecht, NL: Springer Netherlands, 2009. Accessed November 04, 2020. https://doi.org/10.1007/978-1-4020-9377-7_8.

16. Worldbank. "School Enrollment, Primary (% Gross) - Cambodia | Data." World Development Indicators, 2019. Accessed November 05, 2020. https://data.worldbank.org/indicator/SE.PRM.ENRR?locations=KH.

5. **WEduShare** would continue to equip more and more Cambodian students to study abroad and strengthen their skills to be able to compete for scholarships, and have access to the best education and exposure.

6. **Wapatoa** will be the go-to platform for young university students where they will be able to find fun, inspiring and intelligent content in Khmer and in English regarding knowledge that makes their life easier and more meaningful.

7. The Khmer language would not be a barrier anymore, since thanks to the **Khmerism** keyboard, it would be much faster to type, and many of the international platforms such as **TED-Ed**, **Khan Academy** or **Code.org** would be translated by groups of volunteers or organizations such as **InSTEDD iLab Southeast Asia** to become accessible in Khmer.

8. Students' ability to access quality education would be driven by their self-learning habits that they would have learned through apps like **Tesdopi**, or online courses through **Koompi Academy** or **Impact Hub online**.

9. High schools would be able to implement a blended learning curriculum in their school with high quality STEM-related digital content alongside school-based & learning management systems thanks to **Tesdopi Learning Ecosystem by Edemy**.

10. Youth would be able to make career choices based on easy to access information related to TVET thanks to **"Are you Ready"**, an inspirational magazine on TVET careers, or from **Little Scientist**, a magazine igniting the scientific spirit of kids.

11. A large-scale mentorship program would have emerged, powered by **Wedu**, to nurture the lifelong leadership development of women around Cambodia from all sectors.

12. A new generation of STEM professionals would emerge thanks to the exposure they would receive since very young by joining the STEM Festival every year, enrolling as one of **Sisters of Code**, or playing with **Doydoy** since they were toddlers.

13. Youth will "make stuff". Training programs in IoT, wood and steel processing and robotics will be run by **Arrowdot, Makerbay** and the new Innovation Center's Maker space at **NIPTICT**.

Great Inspiration from Abroad:

1. The **School 42** would open a campus in Cambodia and train the next generations of coders. The school would be free for all and without teachers, as all its pedagogy is based on peer-to-peer learning.

2. Universities would involve their students, alumni, and private sector stakeholders in the design of their curriculum, their campus and their vision through participatory methods like **IESEG** did in France, in order to better fit the job-market demands and constantly improve the quality of the teaching and university-life approach.

Society & Culture

What defines a nation? It's culture and its citizens' stands on the big questions of life certainly constitute an important part of such a national identity. Digitalization and globalization will bring big changes to

Cambodia and accompanying societal change bears both opportunities and challenges. The increasing occurrence of mental health issues[17] and ongoing discrimination of women need to be addressed properly. Especially, as they hinder Cambodia's prospects in the future.[18] Simultaneously, Cambodia's growing cultural sector must be supported as it comes with great chances of fostering the development of the country as a whole.

1. A new generation of young and educated graduates who would realize that they can be the change they want to see in Cambodia, and would kick-start impactful projects, NGOs and businesses with this strong desire to make Cambodia a better place for their children.

2. Finding a job would not be only about "how much can I get paid here", but rather "what is the work environment here? Will I be able to grow, to learn from my colleagues and to see the impact of my work in others' lives?". They would be looking for a career with purpose, helping others while being able to get paid for it. Youth would aim at reaching their **Ikigai**.

3. More youth would experience mental health issues, growing pressure and break-down. Platforms such as **Untangle** or **SpeakOut** would be their main community, where they could get emotional support from peers in order not to feel alone anymore. In addition, mindfulness classes and the practice of yoga will be included in schools' programs and in the local communities across Cambodia thanks to **Azahar**.

4. Companies and NGOs would have realized the importance of investing in their staff's wellbeing for better cohesion and loyalty to the organization. **Vipassa** would conduct mindful leadership workshops for them across the country and staff would be able to enroll in their Academy where they can grow and find their potential.

5. A new generation of professional and personal coaches would have emerged through the **Cambodia Coaching Institute**.

6. Girls would have access to sexual and menstrual education at school thanks to **Green Lady Cambodia** and it would become a new norm to get reusable pads for period.

7. **Sisters of Code** chapters would have spread across the countries and high school girls would have great programming skills and would have boosted their confidence, as well as feel empowered for a successful digital future.

8. It will be normal to have female engineers, coders, makers and more women will be represented and fill leading positions in politics and administration.

9. **The Factory Phnom Penh** will be a landmark in ASEAN for its iconic events and its creative hub cultivating the next generation of entrepreneurs, makers and creative professionals.

17. United Nations - Department of Economics and Social Affairs. "Mental Health and Development." 2020. Accessed November 06, 2020. https://www.un.org/development/desa/disabilities/issues/mental-health-and-development.html.

18. Ferrant, Gaëlle, and Alexandre Kolev. "The Economic Cost of Gender-Based Discrimination in Social Institutions." OECD Development Center, 2016. Accessed November 06, 2020. http://www.oecd.org/development/development-gender/SIGI_cost_final.pdf.

10. Cambodian cuisine will be known to the world thanks to **Chef Nak**'s passion for celebrating, developing and preserving the art of Cambodian (Khmer) cuisine. Through the publication of recipe books and Facebook's shows, Chef Nak will be portraying hundreds of authentic and native Cambodian ingredients and spices in a delicious variety of home-made dishes, while making sure culinary culture and stories are shared across different generations.

11. **SmallWorldSmallBand** will continue to inspire the new generation of Cambodian youth thanks to their positive and em- powering songs like **BanTe**, where every- one can identify themselves.

12. Battambang will be the creative capital of Cambodia, and every year hundreds of young creative professionals will be trained by Phare Ponleu Selpak. Phare Circus (the social enterprise of **Phare Ponleu Selpak** the school), will help the mother NGO reach financial-self sustainability, provide gainful employments and careers in creative skills making it towards a vibrant Cambodian creative industry and brand Cambodia positively as the kingdom of culture.

13. During Khmer New Year all the main cities of Cambodia will host their **BonnPhum** Festival and will showcase Cambodian art traditions, while putting the spotlight on a new generation of contemporary artists mixing Khmer heritage and new influences such as **Prumsodun Ok & Natyarasa** or **La Chhouk**.

14. Young creatives would self-learn from the best creatives of the country through **KLEM**, and would have access to freelance opportunities and be paid a fair price.

15. **Wapatoa** would be the platform of refer- ence for youth looking for quality content in Khmer and English on productivity tips, wellbeing, art, and student life. They would have supported the next generation of positive content creators through their media collective by providing funds, training and connections.

16. **Phsar Art** by **Nowhere**, would be the most respected art festival and market of the year, where young artists would showcase their art for the first time and connect their first fans and buyers.

17. **Apple Love MakeUp** artist would have built up a professional makeup school, from which Hollywood productions would be sourcing their artists from.

Great Inspiration from Abroad:

A Cambodian community of **LowTechLab** would be up and running, where passionate makers would share their passion for making low-tech tools, and open-source their innova- tion on the platform for others to use them out.

"Low-tech" are technologies, services and know-how that meet the following criteria:

1. Useful: A low-tech meets essential needs in the fields of energy, food, water, waste management, construction materials, hou- sing, transport, hygiene or health.

2. Sustainable: Robust, repairable, recyclable, it is designed to ensure that its ecological and social impact is optimal from pro- duction, distribution, use until the end of its life.

3. Accessible: Unlike high-tech, its cost and technical complexity are not prohibitive for a large part of the population.

Living & Communities

Our changing society must be mirrored in Cambodia's fast developing cities and villages. While Cambodia's urbanization is happening at an impressive speed,[19] with Phnom Penh growing in the direction of three million citizens at a consistent pace,[20] it's lack of comprehensive planning creates numerous problems.[21] To make our cities safe, sustainable and improve the overall quality of life we need to endorse innovative projects. The companies and organizations featured below are already providing solutions to some of the most pressing problems in Cambodia's roaring centers.

1. **My Dream Home** would continue to make affordable and ecological housing thanks to its Lego bricks, and will focus on building life-long, cross-generational living, with shared facilities and services such as communal dinners, joint daycare, urban gardening, and public fitness facilities. For self-sufficient sustainability, the community will be responsible for its own water harvesting, clean energy generation and local food production.

2. **Eco-Bricks** would be providing another great alternative as they are using 30% of shredded plastic waste in their Lego-shaped and resistant bricks.

3. Buildings will be energy-efficient and business owners, organizations, government and schools will spend much less energy thanks to a gamification of the power consumption initiated by **ATS** and **Sevea**.

4. The very heavy and wood-intensive furniture would not be fashionable anymore, people would prefer buying elegant furniture from discarded wood from old houses that would have been designed and manufactured by **Pisor workshop**.

5. The government would support the creation of student apartments where students from the province would be able to get very cheap accommodation in Phnom Penh to continue their studies Implementation would follow a similar model as the **Harpswell Foundation**, providing in-house leadership support to the tenants to grow their soft skills.

6. Phnom Penh and Cambodia would be finally accessible for people with dis abilities, especially to move across the city thanks to the innovation developed by **Agile** such as the Mobilituk, the powered wheelchair or the adapted rickshaw.

7. Access to the job market would be much easier thanks to the personalized professional training led by **Inclusion+** who would also facilitate and advocate for better job integration in companies.

8. Every new building would be designed taking into account access needs from people with disabilities and hotels would have at least one room accessible.

9. Electric vehicles would be mainstreamed, and we would see drivers from every

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19. Worldbank. "Urban Population - Cambodia | Data." World Development Indicators, 2018. Accessed November 09, 2020. https://data.worldbank.org/indicator/SP.URB.TOTL?locations=KH.

20. Worldbank. "Urban Development in Phnom Penh." 2017. Accessed November 05, 2020. https://openknowledge.worldbank.org/handle/10986/28958.

21. Ibid.

age driving their comfortable and energy efficient **Voltra**, their hipster **Tinky Bike** or the convenient **Oyika**'s electric motorbike.

10. As many special lanes for bicycles would be built across the city, it would be much more convenient to commute using e-bicycle like **Grood** or **Soben**, rather than using an expensive-to-maintain car that would be stuck in traffic jams most of the time.

11. Practicing sports would be easier thanks to the new stadiums made for the SEA Games 2023, and the easy-to-access fields. **National and international fashion companies** would also make it more accessible to practice sports thanks to their range of affordable footwear and sportswear products.

12. **LumaSystem** would have set up a data-driven waste management system to monitor the trash collection (weight, loca-tion, time), optimize the collection routes and detect dysfunctions.

13. **Agile Development** Group would have been active in the disability and mobility sector for several years. Their wheelchair accessible and solar-powered tuk-tuk, and powered attachable wheel for wheelchairs would make it easier for disabled people to move around and have access to great quality jobs.

Great Inspiration from Abroad that would have a Market in Cambodia

1. A platform such as Prekelt in India will take care of supporting rural high school students matching them with mentors originally from the same province, who are their seniors

and already pursue higher education. Their role would be to guide the high school graduates in their universities' choice, find safe and affordable accommodation and make it easier for them to move from their hometown to a new city.

Tourism & Private Business

Tourism has long been the backbone of Cambodia's economy,[22] constituting over 10% of the total, national GDP.[23] However, tourism is mostly targeted to Siem Reap, the southern coast and Phnom Penh and suffered greatly from the current pandemic situation.[24] This stresses the need for economic diversification and further development of alternative touristic concepts. Cambodia has huge, untouched potential regarding both fields, which our partners intend to activate.

1. More than ever, tourists will be looking for an authentic experience out of the crowded tourist attraction. They are looking for a meaningful experience where they see that their money directly impacts the ones most in need. **Haystome** would match them with handicraft makers with whom they can learn old, traditional techniques, recipes or craft practices.

2. The Ministry of Tourism would have partnered with the best video makers and photographers of the countries such as **VibeSoul**, or **Run Away**, **the Cambodian**

22. OECD. "Structural Policy Notes - Cambodia." In ECONOMIC OUTLOOK FOR SOUTHEAST ASIA, CHINA AND INDIA 2019: TOWARDS SMART URBAN TRANSPORTATION, 196–202, 2018. Accessed November 10, 2020. http://www.oecd.org/dev/asia-pacific/saeo-2019-Cambodia.pdf.

23. World Travel & Tourism Council. "2020 Annual Research: Key Highlights." 2020. Accessed November 10, 2020. https://wttc.org/Research/Economic-Impact.

24. VNA. "Cambodia: Angkor Wat Records 99.5 Percent Drop in Monthly Revenue." The Cambodia Daily, 2020. Accessed November 09, 2020. https://english.cambodiadaily.com/business/cambodia-angkor-wat-records-99-5-percent-drop-in-monthly-revenue-163665/.

Backpacker and **Asia Media Lab**, who would showcase the Cambodian nature, tradition, food and incredible landscapes and built up a unique Cambodian brand recognized internationally.

3. A new generation of tourists are emerging. They are Cambodian youth, travelling in groups and looking for adventures and fun. They are appreciating the forest and nature with **Derprey** or **Solo Landscapes** trips, and following famous travel pages such as **Run Away**, **Unseentra**, **Planet Diew.**

4. Siem Reap and Angkor Wat would not be the single main tourist attraction of Cambodia anymore. Secondary destinations would have emerged, especially Community-Based Tourism destinations, where travelers could stay in homestays and enjoy the peace and fresh environment of the countryside thanks to **Impact Explorer**.

5. The agro-industry would have risen exponentially as now fruits and vegetables would be manufactured in Cambodia directly. The hygiene and manufacturing standards would be aligned to the international standards, and agro-processing manufactures would be run by the new generation of ITC, RUA, UBB and RULE graduates from the **FoodSTEM** project, who would innovate new and healthy recipes.

6. Sustainable beauty products would be locally produced, using natural and authentic ingredients from Cambodia revealing their healthy properties, by **Senteur D'Angkor**, **Bodia, LumR Ang**, **Dai Khmer** or **Boran Care**.

7. Women run 65% of the businesses in Cambodia, but 96% of those businesses are micro-sized and engage less than 4 people. **SHE Investments** will bridge the gender gap in the SME sector by scaling up women's micro-small enterprises, supporting them to enter the formal economy, and create long-term social and economic impact through job creation and women's economic empowerment.

8. Private sector would be driven by long term strategic thinking and would collaborate with external stakeholders to grow and stimulate their internal entrepreneurial mindset in order to develop innovations internally and externally, like **Smart Axiata** has been doing for the past years.

9. Intrapreneurs (entrepreneurs within a company) would be leading innovative and visionary projects complementing and strengthening the core activities of the company.

10. Community Champions will be leading local and decentralized cooperatives bringing together their strengths and networks, and increasing their bargaining power in the supply chain.

11. Companies would have shadowing programs where young graduates would be able to follow the work-life of successful managers and leaders, from which they can learn by observing for a few days or weeks.

12. Internships would be compulsory in the curriculum and special programs would be created to train the interns. They would also have the option of doing some apprenticeship where companies would

pay for the school fee, and then would provide a secured job opportunity.

13. Each of the big companies would be obliged to give away 2% of their profits to CSR activities like in India.

Finance & Investment

While economic diversification is necessary, it demands high and continuous investment. Crowdfunding and philanthropist initiatives constitute alternatives to classical "investment banking". This would make it possible, to tailor financing to socially and environmentally conscious companies, bringing real added value to Cambodia.[25] We hope to make Cambodian products available all around the globe as soon as possible.

1. SMEs would all have access to easy-to-use accounting solutions such as **BanhJi**.

2. The traditional **TongTin** will be digitized thanks to TongTin app.

3. Saving groups like the **Lady Saving Group** and **Friends Help Friends** would be spread across Cambodia, and would help their members save money together for mutual help group members, contribute to better living and funding of entrepreneurial projects and build friendship and solidarity among friends.

4. It would be easy to access prototyping funds to kick-start and grow innovative projects, thanks to funds given by incubator programs such as **SHE Investments** and their **Thriive program** or **Impact Hub Phnom Penh**.

5. A new generation of local angel investors and philanthropists will emerge. They will have inherited from their parents' money and assets, and would be looking to use this money in a more impactful way by investing in early stage and impact-driven projects, or by donating money to innovative NGOs solving Cambodia's pressing issues.

6. E-commerce platforms such as **SEPAK** would help handicraft producers access the market by selling their product on their platform but also thanks to their design training to help them develop products that fit the market needs.

Great Inspiration from Abroad:

1. Financial literacy courses in the curriculum from high school like **Jump Start** are doing across the world.

2. Crowdfunding platforms such as **Indiegogo** or **Start Some Good** would be all accessible for Cambodian bank account holders, since Cambodia would be on the list of the eligible countries for **Stripe's online payment solutions**.

3. Crowdinvesting would be possible and funders would be able to fundraise directly from individuals who would like to put their capital in a more meaningful project than a bank, like **Lita.co** is doing in Europe.

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25. Khut, Sornnimul. "A Case Study of Cambodian Crowdfunding Framing for Development Projects." University of Uppsala, 2016. Accessed November 09, 2020. http://www.diva-portal.org/smash/record.jsf?pid=diva2%3A944859&dswid=8984.

Public Services & Security

While the situation regarding Cambodia's healthcare system[26] and further public services has been increasing in terms of quality and coverage since reforms starting in the 90's,[27] concepts targeting the need for public service digitalization are still missing.[28] With increasing network coverage and almost 16 million internet users as of 2019[29] the demand for such solutions and new interconnectivity is clearly visible. Talking about healthcare one must mention Cambodia's own wounds. With millions of landmines still undetected,[30] clearing these leftovers of civil war will keep on being a key field in desperate need of innovative ideas.

1. **Peth Yoeung** thanks to their cloud-based EMR and hospital operating management system would have digitized all the patient's medical records of patients in Cambodia and beyond. Every citizen would have a medical identity that would be centralized and accessible easily wherever in the country.

2. **Meet Doctor** would allow anyone to get affordable and easy to access online consultation through their telehealth solutions.

3. Thanks to their amazing sense of smell, **APOPO's** team of mine detection rats would have found the hidden landmines quickly, with each rat able to search an area the size of a tennis court in just 30 minutes, something that could take up to 4 days using conventional methods.

4. Once identified, the robot **Demine_Robotics** would take care of the excavation, transportation and identification of UXO and landmines in ways previously impossible. They would clear all the areas difficult to access and Cambodia would be mine-free. New areas would be available to turn it into fertile agricultural land or parks to be explored with peace of mind.

And What about Impact Hub?

We would have invested in easy to access inspiration and training toolkits in order to decentralize entrepreneurial activities across the country thanks to the creation of local **Phum Impact**. We will continue to connect the dots, identify and empower the next generation of Cambodian Changemakers through our training and mentoring programs. We would have invested in people and their ideas through our prototyping funds that would allow anyone to try, test, fail, learn and succeed. We would continue to advocate for a friendlier entrepreneurial ecosystem.

How to Make it Happen?

Solutions are already here, it's time to give them a chance to grow and scale. It doesn't require lots of money, it requires passion, commitment, network and partnerships.

26. World Health Organization. Regional Office for the Western Pacific. (2015). The Kingdom of Cambodia health system review. Manila : WHO Regional Office for the Western Pacific. Accessed November 11, 2020. https://apps.who.int/iris/handle/10665/208213.

27. Ibid.

28. Khidhir, Sheith. "Upgrading Cambodia's Public Service." The ASEAN Post, 2020. Accessed November 04, 2020. https://theaseanpost.com/article/upgrading-cambodias-public-service.

29. Bangkok Post. "Internet Users in Cambodia near 16m." Bangkok Post, 2019. Accessed November 06, 2020. https://www.bangkokpost.com/business/1719527/internet-users-in-cambodia-near-16m.

30. Dunlop, Nick. "Clearing Cambodia's Leftover Land Mines: A Dangerous Job." DW.COM, 2018. Accessed November 04, 2020. https://www.dw.com/en/clearing-cambodias-leftover-land-mines-a-dangerous-job/a-45293663.

1. If you are a decision maker, an investor, a donor and you are interested in any of these projects, get in touch with the founders, meet them, know their story and their ambition. Help them get access to strategic partnerships and the right funding opportunities.

2. If you have the skills, a network and you are interested in any of these projects, get in touch with the founders, meet them, know their story and their ambition and explore how your skills can benefit them.

3. If you are a journalist, a reporter or video maker and you are curious to know more about these projects, get in touch with the founders, meet them, know their story and their ambition and write about them, let the world know that these practices and innovation are already happening in Cambodia!

4. If you are a government official or a policy-maker, involve these organizations and their experts in the discussion of the drafting of new policies. Be open to their vision and support them in providing data related to their industry. Bring youth at the table, who would bring the perspective from the youth and would share their desires and concerns for the country they want to live in.

As we always say at **Impact Hub Phnom Penh**, "Impact cannot happen in isolation, it requires collective action.".

I wrote this article after watching this powerful movie: **2040**, since then, I always dreamt of having a Cambodian version of it, so if you are a video maker, and you would like to be part of this project, ping me!

Our future is in our hands. We have 10 years.

Finally, I would like to finish this article with my favorite quote:

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has." - Margaret Maed

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On the Convergence of Diplomacy and Big Data: Preparing Cambodia for Data Diplomacy

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Introduction

In 2013, Phil Simon coined a particular phrase in the title of his book which said data would be "too big to ignore."[1] Indeed, data has deeply planted its roots in people's daily lives. From social networking to the workplace and entertainment, more and more people gradually connect themselves to digital life. The connected devices which people use generate, collect, and transmit data. Every day, people produce data without even realizing it. Following one estimation, each person would generate 1.7 megabytes per second in 2020.[2] By 2023, the Data analytics market is expected to reach a value of USD103 billion.[3]

As data begins to penetrate into every aspect of human society, it has found its way into international diplomacy as well. There is increasing interest and a number of discussions on the relation between big data and diplomacy. Many key players on the international stage such as intergovernmental and international organizations have also taken an interest in the potential of big data. For example, the United Kingdom Foreign and Commonwealth Office stated that "diplomats must harvest and adapt the best innovations from elsewhere. Big Data will require us to reshape how we find and use information; how we deliver a service; and how we network and influence.[4]

1. Simon, Phil. Essay. In Too Big to Ignore: the Business Case for Big Data.: 35–36. Hoboken, NJ: Wiley. 2015.

2. Domo. Rep. Data Never Sleeps 6.0. 2020. Accessed September 30.: 1-7. https://www.domo.com/assets/downloads/18_domo_ data-never-sleeps-6+verticals.pdf.

3. Kobielus, James. "Wikibon's 2018 Big Data Analytics Trends and Forecast". Wikibon Research. 2018. https://wikibon.com/ wikibons-2018-big-data-analytics-trends-forecast/.

4. United Kingdom Foreign and Commonwealth Office. Rep. "Future FCO Report", 2016. https://www.gov.uk/government/ uploads/system/uploads/attachment_data/file/521916/Future_ FCO_Report.pdf.: 9

There are also potentials for Big Data in Cambodia as it is becoming more abundant every day. More data is being generated when there is an increase in the use of social media. Indeed, the use of social media in Cambodia has seen a significant increase. In January 2020, there was an estimation of 9.7 million social media users in the kingdom, resulting from an increase of 1.4 million users between April 2018 and January 2020. But what about its effects on the kingdom's politics and foreign affairs? How are Cambodia's foreign policy and diplomatic practices influenced by Big Data? This paper conducts an analysis on the primary and secondary data extracted from articles, journals, and reports hailing from both governmental and non-governmental institutions. This paper explains how Big Data can shape Cambodia's diplomacy in terms of data science, data security, and data privacy. The paper also takes a look at the current situation of data science, data security, and data privacy in Cambodia. Lastly, it concludes with several suggestions on how Cambodia should prepare for the age of data diplomacy.

Definition of Big Data and Data Diplomacy

Big Data refers to datasets which are extremely large and complex. As a consequence, their information needs to be analyzed and systematically extracted in order to produce useful patterns and associations. As Big Data is recognized as an important tool that could shape how diplomacy is conducted, a new concept was introduced and coined as "data diplomacy." Data diplomacy is a sub-branch of a larger type of diplomacy called "digital diplomacy." Digital diplomacy refers to methods of conducting diplomacy with the assistance of Information and Communication Technologies (ICT). Besides data diplomacy, other sub-branches of digital diplomacy include cyber diplomacy which

discusses security issues in cyberspace; tech and science diplomacy which focuses on the mediums of how states interact in innovation hubs; and net-diplomacy which concerns Internet governance. Data diplomacy, on the other hand, can be simply understood as the use and effects of Big Data on diplomacy.[5]

Data Science and Diplomacy

Impact of Data Science on Diplomacy

Data science provides methods and techniques to extract non-obvious but useful patterns from large data sets.[6] Those large datasets encompass Big Data. Big Data can supplement important functions of diplomacy by making them more efficient and effective. Big data is especially relevant for public diplomacy, and for information gathering and analysis to support foreign-policy decision-making. Big Data provides policymakers a broader picture of developments and new tools to verify information that challenge persistent assumptions and also generate new insights that are otherwise not available through traditional methods of information gathering and analysis.

For instance, among various sources of Big Data, social media is one of the widely accessible sources that can be utilized to conduct public diplomacy. "Twitter diplomacy," for example, describes how politicians and diplomats tweet on certain events and new policy frameworks to the public. Other politicians and diplomats would come in and respond to those tweets with their own opinions, thus establishing a discussion online which is able to shape the public opinion. Twitter, as well as Facebook, have become powerful platforms which politicians and diplomats can use to send and receive messages and keep in contact with each other and citizens. Information from social media platforms such as Facebook, Twitter, and Instagram; including posts, tweets, and hashtags are valuable as these are Big Data which can be analyzed through opinion mining, sentiment analysis or network analysis.[7]

Besides public diplomacy, social media can also be utilized to gather and analyze information. Social media combined with techniques such as data mining can obtain real-time information on terrorist attacks, natural disasters, and political and geopolitical crises. Data mining and other Big Data technologies can also be applied to satellites and drones' that further enhance information-gathering and analysis capabilities for foreign policy-makers.

Current Situation of Data Science in Diplomacy in Cambodia

Although the availability of data on the Internet has kept increasing, the same could not be said for the capacity of Cambodia's youth to effectively utilize this data. In fact, data literacy in Cambodia is the lowest in the ASEAN region with a mean rank of 15.60, significantly below ASEAN's average rank of 20.5.[8] This shows that Cambodia needs to put special attention on developing the necessary skills for youth to be able to utilize Big Data in order to fulfill diplomatic objectives.

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5. E-Diplomacy. "Digital Diplomacy: E-Diplomacy: Cyber Diplomacy". E-diplomacy. Accessed October 15, 2020. https://www.diplomacy.edu/e-diplomacy.

6. Kelleher, John D., and Brendan Tierney. "Data Science". Cambridge, MA: The MIT Press. 2015.: 15

7. Jacobson, Barbara Rosen, Katharina E. Höne, and Jovan Kurbalija. "Data Diplomacy. Updating diplomacy to the big data era. 2018". https://www.diplomacy.edu/sites/default/files/Data_Diplomacy_Report_2018.pdf.https://www.diplomacy.edu/sites/default/files/Data_Diplomacy_Report_2018.pdf.: 21–22

8. Kusumastuti, Ayu, and Astrida Fitri Nuryani. Rep. "Digital Literacy Levels in ASEAN (Comparative Study on ASEAN Countries)", 2019. https://eudl.eu/pdf/10.4108/eai.23-10-2019.2293047.:8

Recognizing the importance of improving human resources in the field of data science, the Royal Government of Cambodia (RGC) launched an action plan called "The Cambodian ICT Masterplan 2020" in 2014. The plan aligns with the ASEAN ICT Masterplan 2015, in which its mandates focus on human resources, training and enhancing digital literacy, computer access of government employees, expanded ICT infrastructure, cybersecurity and much more. For instance, the first part of the action plan provides details on how the government empowers human resources to develop ICT skills.[9]

Moreover, the RGC has not established any platforms to enable cooperation between data scientists and diplomats. Without turning diplomats into data scientists, these platforms could provide opportunities for diplomats to gain knowledge on how data could be used for diplomacy. For instance, Singapore partnered with DiploFoundation to conduct a workshop which gathered diplomats from thirty states including another ASEAN member state, Lao PDR. Through the workshop, the diplomats learned about various digital and data tools and how they could be used in the areas of public diplomacy, information gathering and reporting.[10]

Data Security and Diplomacy

Impact of Data Security on Diplomacy

While technology paves ways for people to generate more data rapidly, it also brings vulnerability of this data getting hacked and stolen. Thus, the topic of cybersecurity has become a diplomatic topic, discussed at the negotiation table. Cybersecurity refers to technologies, processes, and practices which are used in order to secure networks, devices, programs, and data from attack, damage, or unauthorized access.[11] There are many incidences of data breaches which cost the government millions of dollars. For instance, in 2019, the average damage created by a data breach is valued at USD3.9 million, a 1.5 percent point increase from the previous year.[12] Due to cyberattacks, many governments are looking for alternatives to secure their critical data from hackers. One of the alternatives is to establish a data embassy. Data embassies are a method implemented by states in order to protect the government's critical servers. A data embassy is not an embassy in the traditional sense. Basically, it is referred to as a data center which stores critical data of the state outside its physical boundaries.

The first data embassy was founded by the government of Estonia. This new concept was established following a series of cyberattacks on crucial governmental data. The Baltic country experienced the first cyberattacks back in 2017. The attacks reportedly originated from Russia, and they managed

9. Telecommunication Regulator Cambodia. Rep. "Summary on Cambodian ICT Masterplan 2020". 2014.https://www.trc.gov.kh/wp-content/uploads/2016/10/Cambodian-ICT-Masterplan-2020-%E1%84%8B%E1%85%AD%E1%84%8B%E1%85%A3%E1%86%A8%E1%84%87%E1%85%A9%E1%86%AB%E1%84%8B%E1%85%A7%E1%86%BC%E1%84%86%E1%85%AE%E1%86%AB.pdf.

10. Ministry of Foreign Affairs Singapore. "Singapore and DiploFoundation Partner to Unlock the Potential of Digital Diplomacy for Small States". 2018. https://www.mfa.gov.sg/Overseas-Mission/Geneva/Mission-Updates/2018/05/press_20180508.

11. Groot, Juliana De. "What Is Cyber Security? Definition, Best Practices & More". Digital Guardian, October 5, 2020. https://digitalguardian.com/blog/what-cyber-security.

12. Ponemon, Larry. "What's New in the 2019 Cost of a Data Breach Report". Security Intelligence, July 23, 2019. https://securityintelligence.com/posts/whats-new-in-the-2019-cost-of-a-data-breach-report/.

to take down fifty-eight Estonian websites at once, including those of the government, most newspapers and numerous banks. However, no information was lost because the Estonian government backed up their data by storing it in the Estonian embassies all around the world. To ensure data continuity, Siim Sikkut, the Estonian government's ICT policy adviser stated that the government needs to back-up their data outside its territories in case of a large-scale cyber-attack, natural disaster or a conventional attack on a data center.

This data embassy project involves diplomacy in many ways. As a state needs a secure place to protect data that is deemed crucial to national security. Thus, they need to develop the project with a friendly and trusting host country. Thus, it was launched in 2015 and the finalized agreement between Estonia and Luxembourg was signed in 2017. Luxembourg was chosen by Estonia due to its high technical quality capacity as well as the host government's openness to the new concept. "data embassies" are new under international law, however, they have been granted the same rights as the physical embassies, including immunity.

Current Situation of Data Security in Cambodia

Cambodia is considered to be the country least committed to cybersecurity in the Southeast Asia region. In the Global Cyber-security Index 2018, Cambodia ranked worst compared to other ASEAN Member States with the regional rank of 27th over 38 and global rank of 131st over 175.[13] The table below shows the rankings of ASEAN member states:

Likewise, Cambodian governmental institu-tions also showed a big flaw in the protection of data. For instance, in November 2019,

Table 1: GCI Ranking 2018, ASEAN Member States

Country	Score	Regional Rank	Global Rank
1. Singapore	0.898	1	6
2. Malaysia	0.893	2	8
3. Thailand	0.796	7	35
4. Indonesia	0.776	9	41
5. Vietnam	0.693	11	50
6. Philippines	0.643	12	58
7. Brunei Darussalam	0.624	14	64
8. Lao P.D.R.	0.195	22	120
9. Myanmar	0.172	26	128
10. Cambodia	0.161	27	131

Source: Global Cybersecurity Index (2018)

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13. ITU. Rep. "Global Cybersecurity Index 2018". 2019. https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2018-PDF-E.pdf.

individuals from outside of Cambodia were able to hack into seven official Facebook pages of Cambodian national and sub-national institutions.[14] It was not the first time that the Cambodian ministries' websites were attacked. In 2014, a small group of young Cambodian university students was able to hack into a total of 30 government websites, including those of the National Election Committee (NEC), the Ministry of Foreign Affairs, the Ministry of Defense, the Anti-Corruption Unit and the Phnom Penh Municipality.[15] Recognizing the prevalence of cybersecurity issues in Cambodia, the government began to take some action by drafting a law on cybercrime as well as establishing a response unit against cybersecurity related incidents called CamCERT.[16]

Regionally, the ASEAN member states lag behind in strengthening cyber-security. Data has shown that ASEAN member states spent an estimated USD1.9 billion in 2017, equating to only 0.06 percent of the region's gross domestic product (GDP), on cybersecurity.[17] Even the most tech-savvy ASEAN member states such as Singapore have fallen victim to cyber-attacks. For instance, in 2017, the City-State was the target of not one, but three major cyberattacks in one year including the Ministry of Defence cyber breach in February, WannaCry Ransomware attacks in May, and the Petya Ransomware activity in June. Furthermore, another tech-savvy state

Malaysia faced cyber-security threats with a data breach concerning around 46 million mobile subscribers that occurred in 2014 and was only discovered one year later.[18] Thus, the ASEAN Member States including Cambodia will inevitably have to implement alternatives, such as data embassies, to protect against cyber-attacks.

Data Privacy and Diplomacy

Impact of Data Privacy on Diplomacy

In 2013, Edward Snowden disclosed highly classified information from the National Security Agency when he was employed as a subcontractor at the organization. The leak revealed numerous global surveillance programs which are mostly operated by the NSA and Five Eyes Intelligence Alliance in cooperation with European governments. This has prompted a discussion about national security and individual privacy. Edward Snowden's whistleblowing has ignited some tensions between the US and Europe. In July 2013, the European Commissioner for Home Affairs, Cecilia Malmström wrote to two US officials stating that "mutual trust and confidence have been seriously eroded and I expect that the US to do all it can to restore them." Many other European countries such as France and Germany summoned their respective US ambassador to clarify and explain the NSA's surveillance of their own and European citizens. In response to the outrage from European leaders, President Obama claimed that all nations collect intelligence information and the countries that expressed outrage towards the US all conducted similar surveillance efforts in July 2013.[19]

14. Voun, Dara. "Interior Ministry Regains Control of Seven Hacked Gov't Facebook Pages", PhnomPenh Post, November 20, 2019. https://www.phnompenhpost.com/national/interior-ministry-regains-control-seven-hacked-govt-facebook-pages.

15. Sinary, Sany, and Joshua Wilwohl. "Hackers Arrested in Joint Operation With FBI". The Cambodia Daily, April 25, 2014. https://english.cambodiadaily.com/news/hackers-arrested-in-joint-operation-with-fbi-57065/.

16. CDRI Publication. "Cybergovernance in Cambodia: A Risk-Based Approach to Cybersecurity". CDRI Special Report No. 18. 2020. Phnom Penh: CDRI.: 6-7.

17. The ASEAN Post Team. "Strengthening ASEAN's Cybersecurity". The ASEAN Post, December 3, 2018. https://theaseanpost.com/article/strengthening-aseans-cybersecurity.

18. The ASEAN Post Team. "Strengthening Cybersecurity in ASEAN", The ASEAN Post, December 18, 2019. https://theaseanpost.com/article/strengthening-cybersecurity-asean.

Edward Snowden's actions can be considered as an example of how data could play a role in diplomacy, provoking policy changes. His actions also influenced diplomatic actors to focus on the protection of data privacy. For instance, high-profile phone tapping and the potential harvesting of European citizens' data by US-based companies led to calls for the EU General Data Protection Regulation to require explicit citizen content for all data use.[20] The European Union was the earliest region to focus on the issue of data protection. Privacy has been recognized as a fundamental human right in the Universal Declaration of Human Rights. In fact, the first modern data law was created in the 1970s in Hesse, Germany as a reaction to computer advancements and the processing of data.[21] By 1979, many EU Member States had incorporated data protection laws as fundamental rights in their legislations. In 2016, the General Data Protection Regulation (GDPR) was approved by the EU parliament following four years of discussions. The GDPR came into effect in 2018, replacing the Data Protection Act.

Current Situation of Data Privacy in Cambodia

Cambodia has not enacted any comprehensive data protection legislation. However, there are a few laws and regulations such as the constitution, the civil code, and the e-commerce law. For instance, there are some clauses in the e-commerce law containing provisions which state that consumer data which has been gathered over electronic communication will be protected. On the other hand, other legislation related to data protection generally falls under the right to privacy granted in the constitution, the civil code of Cambodia 2007 and the 2009 Criminal Code of Cambodia.[22] In the constitution, Article 40 states that Cambodian citizens have the rights to privacy of residence, and to the confidentiality of correspondences by mail, telegram, fax, telex, and telephone. In addition, Article 27 of The Ministry of Post & Telecommunication ICT License states that "all ICT & Telecommunication operators and all relevant persons must protect personal information, security, and safety of using their ICT & Telecommunication System" Regionally, ASEAN has shown its commitment to promote data protection. One of the targets in the Strategic Schedule for the ASEAN Economic Community is to adopt good guidelines on cyber-law issues including data protection.

Preparing Cambodia for Data Diplomacy

Data Diplomacy may be a new concept for Cambodia. However, it is necessary for the Kingdom to take Big Data's huge impact on Cambodia as well as Southeast Asia as a whole into consideration in the near future. The following needs to be done:

1. **Capacity-Building:** Cambodia's digital literacy is low, signifying that the Kingdom does not have sufficient human resources to put Big Data into great use. The Kingdom should focus on the development of capacity in the field of Big Data in order to facilitate the necessary skills to use Big Data to carry on their diplomatic goals. The Cambodian

19. Cohen, Tom, and Michael Pearson. "All Nations Collect Intelligence, Obama Says". CNN. Cable News Network, July 2, 2013. https://edition.cnn.com/2013/07/01/world/europe/eu-nsa/index.html.

20. Boyd A, Gatewood J, Thorson S, Dye TDV. "Data Diplomacy". Sci Dipl. 2019;8(1). http://sciencediplomacy.org/article/2019/data-diplomacy.

21. Rudgard, Sian. Rep. "Origin and Historical Context of Data Protection Law". International Association of Privacy Professionals (IAPP). 2012.

22. Cohen, Jay, David Mol, Bunthan Pichrotanak, and Sar Marina. "Cambodia - Data Protection Overview". DataGuidance. 2020. https://www.dataguidance.com/notes/cambodia-data-protection-overview.

government should foster dialogue between professional communities such as diplomats, data scientists, policy experts, and others in an attempt to close the knowledge gap between the data science and diplomatic field.

2. **Legal Framework:** It is undeniable that data-flows will be necessary for the modern digital economy. However, enabling the flow of data would draw in the question of whether the data which are being collected are within the consent of the owners of those data. In terms of data privacy, the RGC should focus on creating a comprehensive data privacy law in order to ensure that the sensitive data of the Cambodia's citizens, as well as information deemed crucial to national security, are being protected. On the other hand, the Kingdom should also strongly advocate for other states to respect data sovereignty. Data sovereignty refers to the concept that data is subject to the laws and governance structures within the nation it is collected. Data sovereignty should be promoted in order to avoid the situation of US-EU tensions in the aftermath of Snowden's whistle-blowing.

3. **Institution:** The Kingdom should focus on building an organizational structure which function is to conduct research and utilize Big Data's usefulness for diplomatic activities. Cambodia should also establish a small yet efficient data unit to recruit and train human resources in Big Data skills. With capable human resources and strong institutions to support the knowledge on the use of data, Cambodia will be able to use Big Data as a tool to make better informed decisions regarding strategy, policy, and communication.

4. **International Cooperation:** Cambodia, as well as ASEAN, needs to step up to develop their barriers against malware and other kinds of online attacks. First, the MFA and other Cambodian ministries should step up in training their officials and employees in basic guidelines of safe practices when online such as identifying phishing and malware attacks. International cooperation remains the weakest spot for the Asia Pacific region, as the issue of cyber-security transpasses political boundaries. It is important for Cambodia to advocate for stronger inter-state cooperation in order to develop a common framework and institutions in order to deal effectively with cyber-security issues in the region.

Conclusion

Ultimately, data and diplomacy indeed will be interconnected in the future. As more data are being generated in Cambodia, policy-makers will find out that data is becoming increasingly influential in how diplomacy is conducted. First of all, data science will enable diplomats to discover new tools in order to assist and fulfill their diplomatic objectives. However, the kingdom is still far behind in terms of human resources in the field of data science. Moreover, there are no platforms which provide opportunities for cooperation between diplomats and data scientists. Secondly, the issue of data security could also become another topic for diplomats to discuss on the negotiation table. Cyberattacks have been a prominent issue in Southeast Asia. New alternatives could be implemented in order to ensure that data deemed to national security is being protected. Innovative concepts such as data embassies could enable states to solve the data security issue as well as improve relations between the host and client states. Thirdly, the issue of data privacy could

also have an impact on diplomatic relations between states as well. For instance, the leakage of information on NSA surveillance by Edward Snowden has prompted tensions between the US and European Union member states. This surveillance not only violates the privacy of individual citizens, but also puts the national security of the states at risk as well. Cambodia is still in an early stage of developing a legal framework for data protection, thus, is vulnerable to all of those issues. It could be seen that data can influence diplomacy in many ways. Thus, to prepare Cambodia for this new form of diplomacy, the Kingdom must develop human capacity, institutions, international cooperation, and a legal framework.
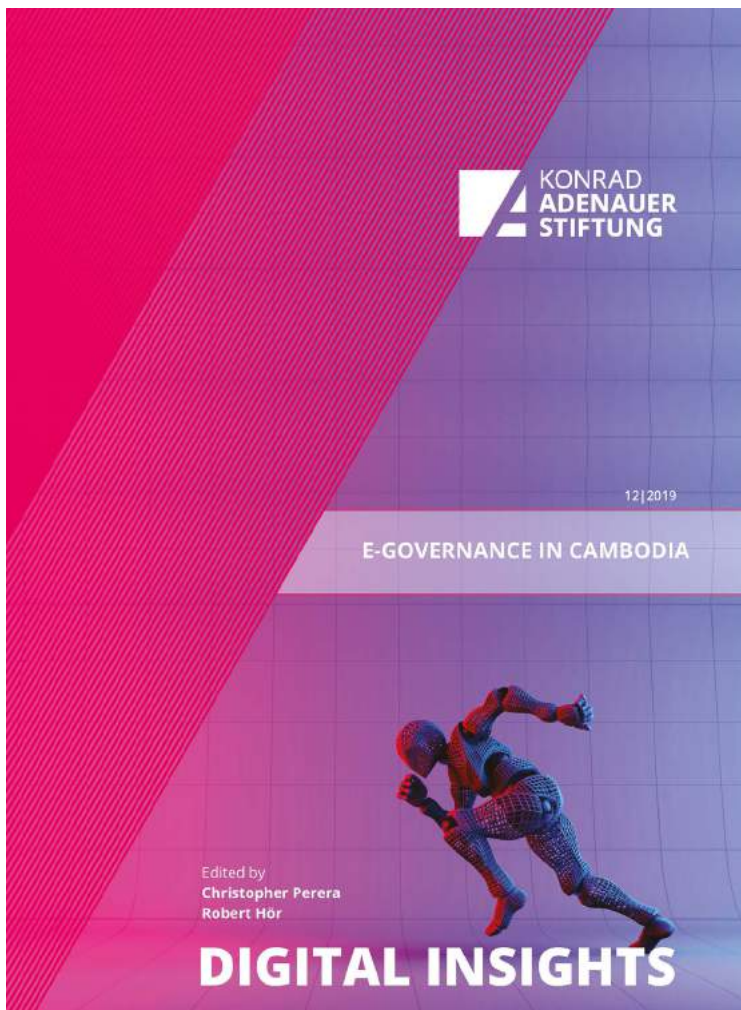
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edited by

Christopher Perera, Robert Hör

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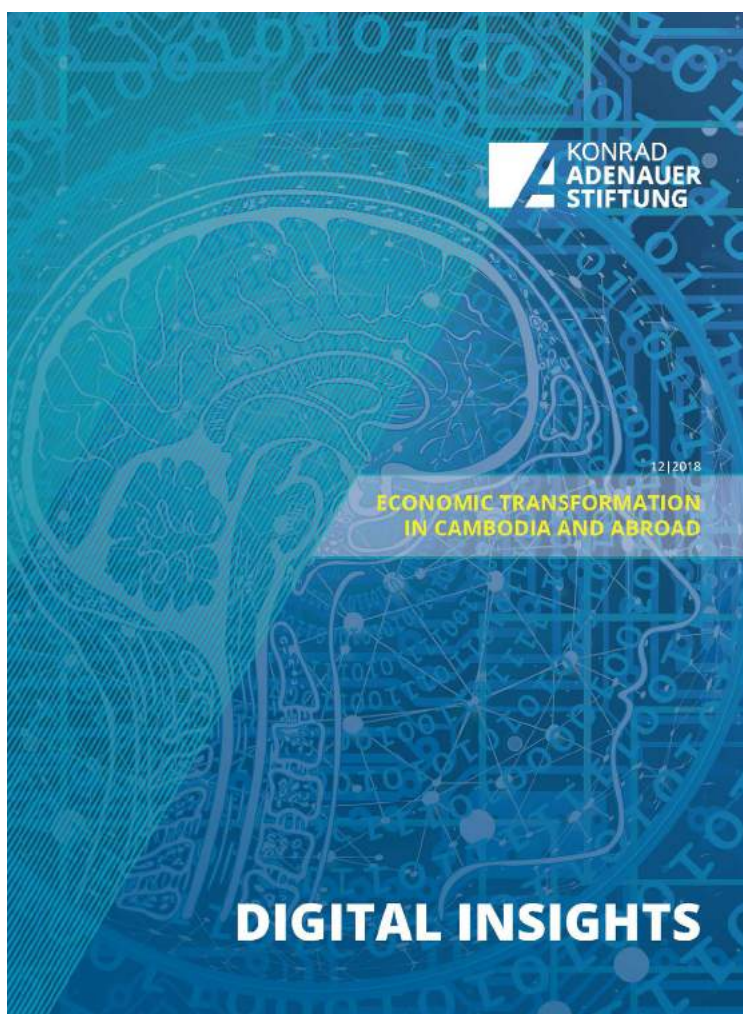
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