

Industry 4.0: Prospects and Challenges for Cambodia's Manufacturing Sector

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1. What is Industry 4.0?

Industrial revolution, in modern history, implies radical economic and social structural changes that take decades to unfold. The first began in the 18th century and was characterised by the use of steam power in manufacturing industry. It brought about mechanisation and shaped a new economic structure that relied mainly on textiles and iron. The second industrial revolution occurred in the late 19th and early 20th century. The discovery of new energy sources – electricity, oil and gas – led to the invention of the internal combustion engine (Sentryo 2017). The assembly line was introduced, allowing mass production, which led to improved systems of transportation, communication and banking. It added a series of new dimensions to the economic structure. The third industrial revolution began in the late 1960s fuelled by electronic and IT systems, prompting the invention of robots and programmable logic controllers. High-level automation in mass production was made possible. New technologies such as the internet, consumer electronics, renewable and nuclear energy, high-speed trains and aircraft were introduced, facilitating production abroad (Schwab 2016).

The 2000s mark the beginning of the fourth industrial revolution. Industry 4.0, also known as smart manufacturing, was introduced in 2011 at the Hannover Messe trade fair by the German government. Industry 4.0 marks the technological transformation from embedded

systems to cyber-physical systems, connecting embedded production technologies and smart production processes. It goes beyond simple connection of a manufacturing system and its objects, transferring physical information into the digital realm, then further communicating, analysing and using that information to lead intelligent action back into the physical world to perform “a physical-to-digital-to-physical transition” (Sniderman, Mahto and Cotteleer 2016, 5). In short, the product is able to communicate with the machine to tell it exactly what to do in the production process.

Industry 4.0 represents an integration of the IoT and relevant physical technologies, including analytics, additive manufacturing, block chain, robotics, HPC, artificial intelligence and cognitive technologies, advanced materials, and augmented reality, that complete the physical-to-digital-to-physical cycle. (Sniderman, Mahto and Cotteleer 2016, 8)

1.1 Why Cambodia needs Industry 4.0

Globally, five technology trends underlie manufacturers' push towards smart factories: 1) rapid technological evolution and advances in artificial intelligence, cognitive computing and machine learning and resultant real-time and predictive analytics enable tactical decision making; 2) increasing complexity of global supply chains and fragmented production systems; 3) intense, often unanticipated, competitive pressures from smart technologies that lower market entry costs; 4) organisational restructuring associated with the convergence of information and operational technology; and 5) pressing talent management challenges (Burke et al. 2017, 8–9).

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Cambodia's long-term vision is to become an upper-middle-income country by 2030 and a high-income country by 2050. The government also aims to "complete the transition into a digital economy" by 2023, as announced by the Ministry of Posts and Telecommunications in March 2018 (Sum 2018). The country's journey towards this goal will be determined by its ability to master and leverage emerging digital technologies. The rise of Industry 4.0 provides Cambodia with opportunities to leapfrog its way into the future in at least two ways (CDRI 2018). First, technological trends will help move Cambodia towards a knowledge-based economy. With almost two thirds of the population under 30, a large proportion of the potential workforce will have grown up with digital technologies. However, the country will have to move fast if it is to reap the benefits of this demographic dividend. Second, the development of technology infrastructure will be a crucial determinant of Cambodia's future industrial diversification, productivity growth and competitiveness, as exemplified by China, Hong Kong, Singapore, South Korea and Taiwan. To achieve sustainable and inclusive growth, these countries have long prioritised investment in tertiary education and vocational training to create a highly qualified, skilled and knowledgeable workforce that can meet the changing demands of rapid industrialisation.

1.2 Readiness for Industry 4.0

The World Economic Forum and A.T. Kearney have developed a readiness diagnostic framework "to help countries understand their current level of readiness for the future of production, as well as corresponding opportunities and challenges" (WEF 2018b, v). The framework comprises 59 indicators across two main components: drivers of production and structure of production. Of the 100 countries assessed, only 25, including just five Asian countries (China, Japan, South Korea, Malaysia and Singapore), are deemed ready (WEF 2018b, 12). Cambodia is among the countries that are least ready for future production, ranked 91st for drivers of production with an

overall score of 3.63 (out of 10) and 81st for structure of production with an overall score of 3.56. The following presents a brief analysis of Cambodia's Industry 4.0 readiness.

1.2.1 Drivers of production

- **Institutional framework:** The first and most important area is sound institutional framework in the form of, but not limited to, regulatory efficiency, strong legal system, rule of law, intellectual property protection, data security and good governance. The current institutional framework is not keeping up with changes and innovations. A strong institutional framework is needed to reduce uncertainty and establish norms and standards. Cambodia scored 3.09 out of 10 (rank 100th).
- **Human capital** is crucial for Industry 4.0. Aside from the debate about whether automation will lead to job losses, the remaining jobs will be more productive and there will be more job opportunities due to technology. To draw more benefit from the revolution, it is critical to have flexibility and adaptability through the right mix of human capital, especially digital, technical, commercial and management expertise. With a score of 3.75, Cambodia ranks 86th for this driver. In Cambodia, human capital is both a strength due to the youth of the workforce and a challenge due to their low skills. The right skill sets must be developed to keep up with the change from a labour-intensive to a knowledge-intensive environment. The ongoing implementation of STEM and TVET policies is perfectly in line with the need for a healthy development of industry 4.0.
- **Technology and innovation** are key enablers, as the adoption and diffusion of emerging technologies are the crux of Industry 4.0. For Cambodia, this driver is still underdeveloped, as evidenced by the score of 3.28 out of 10 and rank of 83rd. Thus, main priorities should be research and development (R&D), internet coverage and cybersecurity.
- **Global trade and investment:** At the core of Industry 4.0 lies global connectivity.

Cambodia’s overall score for global trade and investment is 3.96 (rank 79th), but investment and infrastructure (components of this driver) score less than 2.5. Despite a high level of FDI, infrastructure gaps and lack of openness to trade may be the cause of the slow rate of transformation.

- **Sustainable resources** must be a main consideration for industrial strategies because the goal is not just a productive, but also a sustainable, future. Cambodia received a score of 4.51 (rank 90th).
- **Demand environment:** This will push producers to increase innovation and production techniques. Cambodia received a score of 3.93 out of 10 (rank 75th).

1.2.2 Structure of production

- **Complexity:** A country produces by using and combining existing knowledge in the economy. Complexity aims to measure the mix and uniqueness of a country’s products: the higher the complexity score, the more sophisticated the productive capabilities and knowledge of a country. Cambodia’s score is 3.40, ranking it 84th.
- **Scale:** This tells us the total output of manufacturing within a country and the share of manufacturing in the country’s GDP. Cambodia’s score is 3.79, ranking it 58th.

2. Ecosystem of Industry 4.0

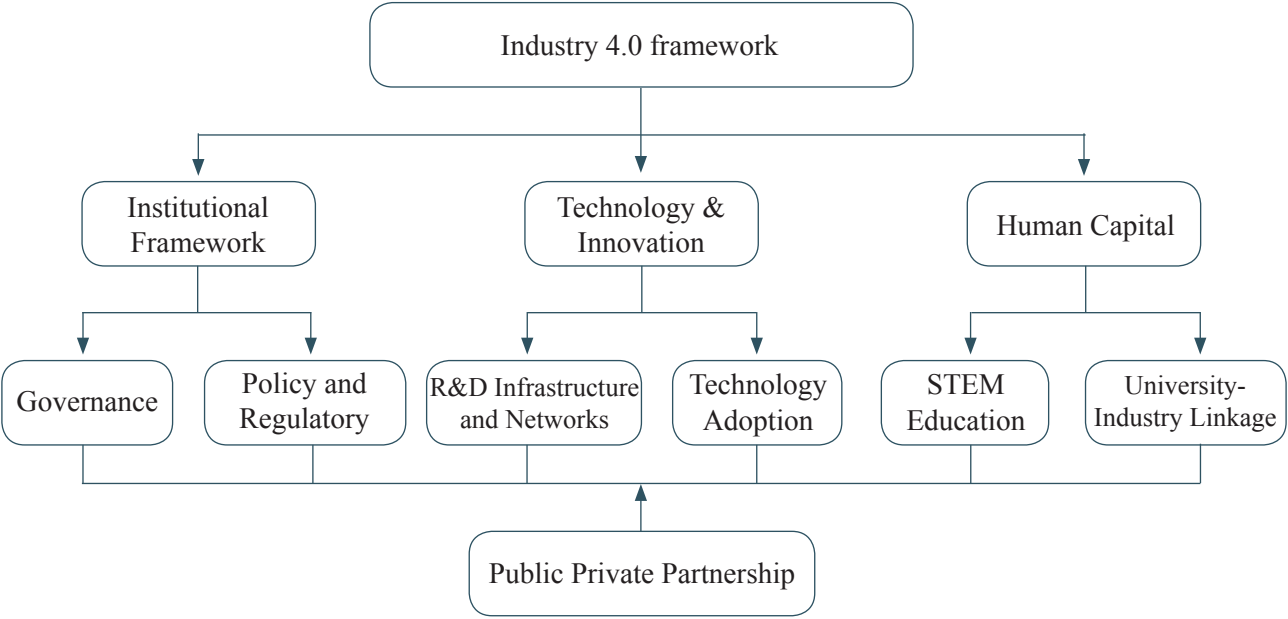
Industry 4.0 relies on new and emerging technology that requires an ecosystem for supporting and maintaining fast growth. Building a strong national innovation ecosystem, with the government playing a lead role, is crucial. The Industry 4.0 framework should focus on four elements: institutional framework, technology and innovation, human capital and public-private partnership, as shown in Figure 1.

2.1 Institutional framework

2.1.1 Governance structure

The Cambodia Outlook Conference 2018 highlighted the imperative for “Visionary, technologically savvy, inspiring and resolute political leadership with a firm belief in the opportunity to leapfrog Cambodian industry into the digital era” (CDRI 2018). In the ASEAN region, for instance, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam have dedicated ministries responsible for coordinating national efforts to promote scientific and technological innovation across sectors. In Brunei, the Ministry of Development is responsible for overseeing S&T policy and strategy. And Singapore set up the Agency for Science, Technology and Research (A*STAR),

Figure 1: Industry 4.0 framework



a statutory board under the Ministry of Trade and Industry, to support R&D in areas of technical competitive advantage for the country. Several ASEAN member states also have chief scientific advisers attached to the government, whose mandate is to support the design and implementation of industrial policy and strategy.

In Cambodia, the Department of Technique, Science and Technology of the Ministry of Industry and Handicraft, and the General Secretariat of the National Science and Technology Council (NSTC) of the Ministry of Planning, deal with some aspects of S&T development. However, there is a need for better coordination and governance of S&T policies. To that end, key actions include (CDRI 2018):⁷

- elevating the NSTC profile within the state administration and enhancing its own capacity to promote S&T across inter-ministerial bodies;
- institutionalising NSTC within the administration by making it an autonomous budgeting unit;
- enabling the NSTC to develop and enforce a whole-of-government consensus on the creation and strengthening of a national science, technology and innovation system;
- creating a Science Advisory Office at the cabinet;
- establishing a mechanism to engage national scientific and research communities to provide inputs and monitor S&T strategy implementation.

2.1.2 Policy and regulatory framework

A strong policy and regulatory framework can help spur S&T development. However, S&T policy should not be pursued independently, but collaboratively with industry, universities and research institutes. It is also important to ensure that S&T policy and strategies are aligned with other national development plans and policies, including the Rectangular Strategy, IDP, STEM education and TVET policies.

⁷ These recommendations are also proposed in the Cambodia Outlook Brief 2018.

Promoting legislation to protect intellectual property rights and improving legal frameworks can stimulate and motivate entrepreneurs and scientists to develop and commercialise new products, technologies and services. South Korea, for example, passed its first Technology Development Promotion Law in 1972, which included various incentive mechanisms to regulate and promote technology transfers from abroad and stimulate technological development in small and medium-sized enterprises (SMEs).

Government-led S&T efforts are needed to build a consensus on the value of technological innovation among ministries, line departments, universities, research institutions, industries and businesses. They must come together and work collaboratively to formulate and ensure comprehensive, harmonious and coordinated S&T policy and strategy.

Key recommendations include (CDRI 2018):

- developing sound S&T infrastructure and regulations within a coordinated policy framework;
- creating incentive programs to promote the digital transformation of SMEs;
- establishing a mechanism to expedite patent applications at different intellectual property registration offices;
- increasing societal engagement in S&T by raising awareness of the value of S&T in everyday life and its importance to Cambodia's future economic growth.

2.2 Technology and innovation

It is critical to establish high quality research infrastructure and dynamic research alliances through government-led initiatives and public-private partnerships to support world-class R&D practices and enable technology transfer and commercialisation. Apart from increasing public spending on R&D across various ministries, the government should 1) encourage the private sector to expand their R&D investment in product and process innovation, and 2) provide incentives for national and international research collaboration between industries, research institutes and universities

that allows access to and sharing of information and technology.

2.2.1 R&D infrastructure and networks

R&D infrastructure and networks include equipment and facilities and collaborative networks that bring together public and private research. They play important roles in creating a supportive environment for encouraging researchers to conduct more applied research (i.e. industrial research and experimental development), accumulate their knowledge and get their ideas heard. Government agencies, universities and research institutions need to take the lead in research that is directly linked to national socioeconomic development planning. Government initiatives, along with sufficient and sustained funding and a well-designed incentive and reward system, are needed.

For example, China's R&D Infrastructure and Facility Development Program is a major component of its national S&T planning system, aiming to adjust, enrich and strengthen S&T capacity. The program covers the State Key Laboratories Development Program, National Key Science Projects Program, National Engineering Technology Research Centres, S&T Basic Work Program and the Program on Key International S&T Cooperative Projects.

The role of government agencies is also important in fostering industry-academic collaboration and public-private partnerships as evidenced by Singapore's strategy. The National Science and Technology Board, which in 2002 transitioned into A*STAR, was established to take the lead in transforming Singapore into a key hub for research in selected fields, giving the country technical advantage. A*STAR believes that to ease the transfer and exchange of ideas, research institutions should be built close to each other, as in the case of Fusionopolis One, Fusionopolis Two and Biopolis – hubs for the conduct of research by public and private organisations (Sciencemag 2016).

A strong collaborative network through public-private partnerships is also associated with SMEs, which often take the lead in introducing new technologies. Universities and research institutions should actively reach out to businesses and the public to maximise

the relevance of research, seek research collaboration and promote the value of S&T. Some key actions include (CDRI 2018):

- initiating government-led programs in R&D activities and networks, introducing foreign technologies and mobilising national talent;
- diversifying funding sources for R&D (foreign and domestic investments and public-private partnerships) with proper allocation of resources;
- creating reward and incentive system to recognise and value local S&T talent, while encouraging SMEs to leverage digital technology.

2.2.2 Technology adoption

New technologies can provide firms with many benefits: reduced operational costs, improved communication, increased productivity and a broadened customer base, to name a few. Today's firms need to incorporate technology to stay competitive and sustain their business. The pace at which new technologies are brought to market is accelerating. It is therefore important for firms to keep up with existing and emerging technologies needed for their business. To help firms adopt technology, we recommend the following.

- *Technology and innovation show:* A Technology and Innovation Show should be organised annually to keep firms, especially SMEs, informed of existing technologies and the latest trends, encourage them to adopt new technologies, and drive innovation in universities and research institutions and possibly at SMEs.
- *Incentive schemes for technology adoption:* An incentive scheme should be established to promote and accelerate technology adoption in business. For example, the scheme might incentivise SMEs to adopt technologies by lowering taxes on their incomes and/or technology imports. This should include research institutions and universities, because they also need to adopt cutting-edge technologies for their research.
- *Technology and innovation database:* A technology and innovation database of

existing and emerging technologies is of great importance. It can be an invaluable tool for manufacturers, R&D departments, venture capitalists and private equity funds to find relevant technologies, exciting opportunities and innovation partners.

- *Technology incubation centre*: A technology incubation centre is needed to provide a whole new ecosystem for young entrepreneurs running tech start-ups. This might include a platform where technology ideas can be nurtured into viable businesses, and where expert mentoring is provided on funding, networking, customer validation, customer strategy and so on.
- *Technology and innovation park*: A technology and innovation park for a region (e.g. in Phnom Penh) should be established. It should consist of research laboratories with cutting-edge technologies, offices for industrial services and relations, and workshops for technology development. As a result, the park would generate support structures for innovative technology and promote technology transfer.

2.3 Human capital

2.3.1 Labour market changes

Industry 4.0 and its enabling technologies – AI, robotics, big data, internet of things and cloud solutions – will disrupt every sector of the economy. The new industries (e.g. smart factories and fintech) require a wide range of technical skillsets and professions such as operators, robot programmers, data miners, and product and service researchers. There will be significant changes in the labour market as new technologies will displace some jobs, change others and create new ones. In some occupations such as sewing and agri-product sorting, automation will replace human workers. In other occupations such as processing, skilled agricultural work and web designing, people work alongside machines. At the other end of the spectrum, professional and management jobs are unlikely to be automated.

Research has shown that the probability of a job being automated is closely linked to

the level of education and training required to do a job. Occupations that have the highest probability of being automated typically do not require specific skills or training. The next category are workers with some training. The last are occupations that require a high level of education or training and involve a high degree of social interaction, creativity, problem solving and caring for others.

A WEF survey on the employment outlook for 2015–20 in 15 major developed and emerging countries reported expectations of “strong employment growth across the Architecture and Engineering and Computer and Mathematical job families, a moderate decline in Manufacturing and Production and a significant decline in Office and Administrative roles” (WEF 2016a, 11). Employment in business and financial operations, sales and related and construction and extraction is expected to remain the same.

The likelihood of automation also varies with the economic sector. Industries with a high risk of automation belong mostly to the primary and secondary sectors. Few service industries face a high risk of automation.

Overall, at least 50 percent of the tasks of about 40 percent of current occupations are at high risk of automation (WEF 2016a). It is estimated that 65 percent of the jobs the next generation will do in 2030 do not yet exist (WEF 2016b).

2.3.2 STEM education

Building and maintaining pools of highly skilled home-grown talent is essential to prepare Cambodia for Industry 4.0 and smart manufacturing. High-quality STEM (science, technology, engineering and mathematics) education and training is vital to the success of Cambodia’s future industrialisation and economic growth. Policy priorities include (CDRI 2018):

- training outstanding STEM teachers to drive STEM education agenda;
- prioritising STEM education in general, vocational training and higher education;
- integrating STEM education with other disciplines such as economics, commerce and finance to optimise career pathways;

- preparing learners and STEM graduates to meet the demands of Industry 4.0;
- building university-industry linkages for the conduct of applied research, technical collaborations and R&D partnerships;
- enhancing basic S&T knowledge and skills for all Cambodians.

2.3.3 Technical and vocational education and training

The dual roles of technical and vocational education and training (TVET) in the context of Industry 4.0 are to provide the skills needed in the labour market and to cultivate the ability to adapt to new technologies. The former ensures the relevance of TVET while the latter protects the workforce from job displacement due to automation. TVET must go beyond narrow hard skills to specific technical tasks, which are susceptible to technological replacement. TVET providers must therefore:

- ensure that learners have strong basic numeracy and literacy skills;
- promote soft skills such as problem-solving, communication and adaptability;
- encourage application of different skills in real job situations;
- shift focus from preparatory job-specific skills training to life-long learning;
- provide upskilling and reskilling programs as pathways to higher education and training or to different careers;
- establish joint qualification routes in collaboration with higher education institutes.

2.3.4 Future talent development strategy

While it is quite certain that many new professions will be created, as in previous industrial revolutions, scholars are not sure what kinds of jobs will be created due to the fast pace and fluidity of technological change. However, training in STEM, industrial development and entrepreneurship is indispensable. In addition, it is recommended that skills dubbed robot-proof, such as problem solving, critical thinking

and creativity, should be emphasised by education and training programs. These are skills that are even more needed in AI-based production systems. According to the WEF (2016a) study on the future of jobs, the 10 most required skills are:

1. Complex problem solving
2. Critical thinking
3. Creativity
4. People management
5. Coordinating with others
6. Emotional intelligence
7. Judgment and decision making
8. Service orientation
9. Negotiation
10. Cognitive flexibility

The following are some options that have been proposed to cultivate talent for the new industries:

- **Fostering cross-industry collaboration and public-private partnerships:** To ensure that training is effective and relevant, it is essential to have a complete view of future skills requirements and labour demand. This is where businesses from different industries can be most helpful by working together to map out future employment needs and skill demand. Stakeholders, especially the government, businesses, education and training institutions, should then pool training resources for priority industries. Experiences from countries such as Germany and Switzerland show that training in the workplace is most effective in keeping up with the numerous technological changes in industry. Again, this requires strong involvement from business and well-functioning public private partnerships.
- **Rethinking education and training:** The training system has to be flexible and adaptive to keep pace with rapid advances in technology and changing demand for skills and has to build a workforce that can adapt to an everchanging workplace. How to prepare for this eventuality is controversial as technical skill requirements

for future jobs are yet to be determined. However, certain skills will not become obsolete or will become more necessary in this new industrial revolution and should therefore be the focus of education and training. Those skills include technological literacy, entrepreneurship, adaptability and learning. Thus training should emphasise soft skills such as self-reflection, learning-to-learn, problem solving, creativity and communication.

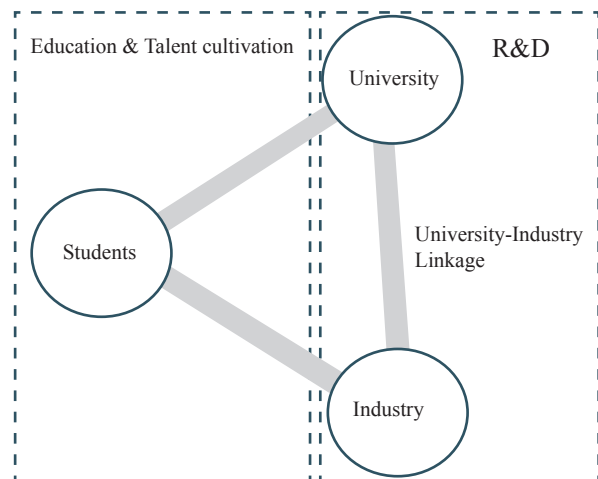
- **Incentivising lifelong learning:** Given the fast pace of technological change, knowledge and skills can become irrelevant or obsolete very quickly. One-shot (pre-service) education before entering the job market is inadequate to train an adaptable workforce that can respond quickly and effectively to changing environments. Governments and businesses must ensure that individuals have the time and means to focus on continuous self-development. It would be wise to prepare individuals who are in jobs that are likely to be replaced by automation for future employment mobility.

2.3.5 Public-private partnership

University-industry linkage, which is a form of public-private partnership, deserves particular attention for its important role in talent development and, most importantly, in research and innovation promotion. Figure 2 shows the connections between stakeholders in a human resource ecosystem. The degree of connection between students and university can greatly affect students' ability to learn and absorb knowledge. Students' competencies should surpass the average competencies demanded in a competitive job market as a global digital economy emerges. The connection between students and industry paves the way for graduates' early career development. The knowledge acquired at university should be aligned with the core work skills required in industry. The university-industry linkage is essential for tackling new problems and upgrading industry and improving university education. This linkage takes the form of

collaborative R&D, training, knowledge and technology transfer. Another important benefit of university-industry linkage is promoting technology and innovation, as discussed in Section 2.2.

Figure 2: Prominent stakeholders as a driving force for talent development



To support collaboration between university and industry, roles must be clarified.

Role of government

Besides guidance, the government has a crucial role in stimulating the development of R&D activities in enterprises through various incentives designed to boost university-industry research collaborations. It also plays a major role in monitoring and directing research in line with national development priorities. Although the initial investment to foster research is large, innovation will deliver returns to all stakeholders in the long run.

Role of enterprises

The role of enterprises' R&D activities is to initiate university-industry linkages in research collaboration, technology and knowledge transfer. Enterprises communicate their problems and needs to university researchers and collaborative research generates possible solutions. They also keep university researchers updated on their status, products and services. Collaboration can be massive when an enterprise needs to upgrade its technological system or develop new products and services.

Role of universities

Universities take a major role in administering university-industry linkages and cultivating talent. They manage financial flows and ensure that talented researchers receive reasonable incentives. They can seek out the best researchers and provide an enabling R&D environment. They also help initiate technology incubators for start-ups and innovation.

Role of researchers

Researchers must conduct research professionally and ethically and disseminate research outputs to partners, collaborators, stakeholders and society at large. They should work with industry to solve challenging problems via university-industry linkages. They should also mentor early career researchers and students to give a broader perspective on research and career development. Internal and external collaboration is important for conducting multidisciplinary research. With limited financial and human resources, research priority setting should be aligned with policy priorities.

3. Industry 4.0 and SMEs

3.1 Diagnosis of challenges among SMEs

The challenges facing Cambodian SMEs have evolved from the ones outlined in the 2005–2010 SME Development Framework. A 2014 survey⁸ identified a number of challenges facing SMEs in Cambodia, summarised below.

- **Governance:** The challenge is seen as exogenous for SME owners or managers, but it has direct impact on competitiveness and survival. Issues include the high cost of electricity and insufficient supply (frequent outages) and unofficial payments. Other issues are high tax rates and complicated

⁸ In 2014, Cambodia Development Resource Institute was commissioned to conduct the survey to identify issues and challenges facing small and medium enterprises in Cambodia. The final draft report was submitted to Japan International Cooperation Agency and Department of Small Industry and Handicraft, Ministry of Industry and Handicraft. The report is for internal use only.

tax procedures, and lack of SME support policies.

- **Customers/markets:** Three main challenges are difficulty in collecting sales from customers (when purchase on credit), rising competition and unfair competition.
- **Human resources:** Skills shortages and high employee turnover, along with lack of employee discipline and commitment hamper productivity and profitability.
- **Products and services:** The high cost of raw materials, partly attributable to heavy reliance on imports remains an operational constraint for most, if not all, SMEs.
- **Access to finance:** Accessing conventional credit remains a pervasive problem. Loans are used for investment and business expansion, and the need for finance remains high. Two possible causal factors are borrowers' lack of collateral and SMEs' poor cashflow records.

Lack of knowledge about technology investment and adoption was also reported by SME owners and managers, further constraining their ability to compete with imports. The survey also identified different needs between Phnom Penh-based SMEs, which need advanced technology, and provincial SMEs, which need finance and low-cost technical assistance from the government, development partners or both.

3.2 Policy framework – areas of possible engagement and advancement

Recognising the challenges SMEs face, in 2015, the government updated the 2005 SME Development Framework and drafted the SME Promotion Policy Framework. The new policy outlines areas for program intervention and the role of the government in facilitating and achieving program goals. It describes three pillars: (1) business-enabling environment, (2) SME capacity development and (3) business development services.⁹ It also highlights the identified problems and how to address them.

⁹ Refer to the policy framework for detailed strategies under each pillar.

Table 1: Trends in access to technology in Cambodia (ranking)

	2013/14 [148]	2014/15 [144]	2015/16 [140]	2016/17 [138]	2017/18 [137]
Global Competitiveness Index	88	95	90	89	94
Availability of latest technologies	82	87	101	100	93
Firm-level technology absorption	82	97	97	99	90
FDI and technology transfer	44	51	59	53	54
Quality of science research institutions	101	118	122	123	114
Company spending on R&D	57	79	91	84	82
University-industry collaboration in R&D	105	115	114	102	96

Note: Figures in brackets are number of countries evaluated.

Source: WEF Global Competitiveness Reports 2013–2018

The remaining task is to ensure consistent and systematic implementation of the strategies set out in the framework. Also, linking strategies in the policy framework with those in IDP 2015–25 is crucial to avoid overlap and waste of human and financial resources. Systematic coordination of policy formulation and implementation is needed.

3.3 Industry 4.0 and technology adoption for SMEs

It is clear that one of the implications of the Industry 4.0 is the use of technology in operations – human, finance, and production. Thus, the speed and willingness to adapt and adopt relevant technology are crucial for survival and productivity improvement of SMEs and large firms alike. This will be one of the most pressing challenges for the government as well as SME owners or managers.

Table 1 highlights the trends in access to technology in Cambodia between 2013 and 2018, measured by the Global Competitiveness Index. There has been no significant improvement in Cambodia’s ranking. Areas to improve include “quality of science research institutions” and “university-industry collaboration in R&D”.

Within that context, the government has recently acknowledged the importance of science, technology and innovation. At the policy level, for instance, the former Ministry of Industry, Mines and Energy initiated in 2010

a draft policy called the Strategic Framework for Technology and Innovation in Industry Sector 2010–2015. The aim of this policy is to improve SMEs’ access to technology.

However, progress has been slow, and human and financial resources to implement the planned policy actions remain limited. Challenges in technology adoption among SMEs are also well documented by the 2014 SME survey report. Technology adoption, discussed in Section 2.2, may also help promote technology awareness and adoption of SMEs.

3.4 Industry 4.0 and access to finance

The majority of SMEs in Cambodia still have access to conventional finance (banks, microfinance institutions, state-run or private SME specialised banks). Initiatives to mobilise public money through stock markets have had limited success. Some MFIs have increased their SME loan portfolio, hoping to tap into underserved market segments. Nonetheless, they are not making the expected progress. The new SME Policy Development Framework outlines strategies for improving SMEs’ access to finance: (1) credit guarantee scheme and (2) leasing, risk capital and other options. With the advent of fintech, the government can explore new financing options with the private sector. They include: (1) block chain technology that enables the existence of cryptocurrency such as Bitcoin, (2) peer-to-peer lending, (3)

crowd funding, (4) angel investment and (5) venture capital.

- 1. Cryptocurrencies using block chain technology:** Although this technology has been on the rise, the degree of adoption varies. We are not aware of the use of block chain technology by Cambodian SMEs.
- 2. Peer-to-peer lending:** A platform is run by a fintech company. Loan requests are reviewed and posted on the platform with interest rates. Individuals who wish to lend can review the request and provide the required funds in return for interest. The interest rate is usually lower than that charged by banks or MFIs.
- 3. Crowdfunding** enables investment in a company through an online platform. An SME is registered and listed on the platform, and individuals can decide to provide funds in return for equity.
- 4. Angel investment:** UNESCAP (2018) defines angel investors as “wealthy individuals, often business owners themselves, [who] invest in and help smaller start-up businesses”. It is difficult to quantify the impact of angel investing on business start-ups in general or SME start-ups in particular because the arrangement is often informal and sometimes happens among closed and well-connected groups. Activities by the Young Entrepreneurs Association of Cambodia and the Cambodia Investor Club partially bridge the financing problem among start-ups. However, the amount of financing is limited.
- 5. Venture capital:** Venture capital funds can be set up by the government or by private companies. The capital injection, usually in the form of equity, is to help start-ups bridge gaps in their operations. Cambodia does not have a legal framework for risk capital such as venture capital. There are, however, privately run venture capital firms (e.g. Devenco), though their operations are limited to tech start-ups and not designed for SMEs (Ministry of Industry and Handicraft 2015).

Each financing approach carries risk, and the need for an enabling environment and support has never been greater. That would include strong rules and regulations, capable and qualified oversight, and internet of things infrastructure. The ecosystem for non-traditional financing is scant or non-existent, making it hard for SMEs to take advantage. The development of a financing scheme for SMEs also needs to be linked to schemes specified in Financial Sector Development Strategy 2016–25 (RGC 2016).

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