WALAILAK JOURNAL
Applied Sciences
https://wjst.wu.ac.th https://doi.org/10.48048/wjst.2021.6502

How Can the Least Developed Member Countries of ASEAN Benefit from the 4th Industrial Revolution?

Robert Brian SMITH

Walailak University, Nakhon Si Thammarat 80160, Thailand

(Corresponding author's e-mail: r.b.smith@unswalumni.com)

Received: 4 March 2019, Revised: 30 July 2019, Accepted: 11 August 2019

Abstract

The ASEAN members Cambodia, Lao DPR, and Myanmar have been classified by the United Nations as least developed countries, with many of their citizens living below the poverty line, and its workers predominantly rural. This paper seeks to ascertain how these 3 countries can benefit from the 4th Industrial Revolution (4IR) and the changes required so that their citizens can benefit from increasing economic prosperity, improved social well-being, rising human values, and environmental protection. In this context, the 4IR can be defined as the revolutionary change when information technology proliferates in all industries and is the connection between technology and the market. An analysis of the contemporary data and reports, mainly from the Asian Development Bank and the World Bank, has identified niches which each of the economies can develop on the path to the 4IR. The analysis has also identified a common impediment to progress: namely, the current state of development of the educational system, with curricula which are often not relevant to the needs of the current and future market, and the methods of their delivery in both formal education and industrial training. The changes must ensure that recipients are encouraged to develop skills in critical thinking and communication, including the ability to ask questions. Finally, the paper suggests an appropriate model for the 4IR and the development stages for these economies as they move along the path to reach this goal.

Keywords: Developing economies, Social development, Poverty, Urbanization, Least developed countries, ASEAN

Introduction

The 4th Industrial Revolution (4IR) is a term credited to Klaus Schwab, founder of the World Economic Forum [1]. The 4IR is considered not to be a prolongation of the 3rd Industrial Revolution, because it is distinct in terms of speed and the scope of the change and its impact systems [2]. Whilst it will create new opportunities for business, government, and individuals, it threatens polarization within, and between, societies and economies [3]. Harvey sees the 4IR as the confluence of new technologies and their cumulative impact [4]. It can be defined as the revolutionary change when information technology proliferates in all industries and is the connection between technology and the market [5]. The objectives of Thailand 4.0, the Thai version of the 4th Industrial Revolution, are: economic prosperity, social well-being, raising human values, and environmental protection [6].

Of the 10 member states of the Association of Southeast Asian Nations (ASEAN), 3, namely Cambodia, Lao PDR, and Myanmar, are classified by the United Nations as least developed countries [7]. The World Bank classifies them as lower middle-income economies [8]. The remainder of the ASEAN members are classified as upper-middle or high-income economies. Interestingly, Cambodia, Lao PDR, and Myanmar are 3 of the 4 countries that share a land border with Thailand; the other being Malaysia. All 3 are experiencing bottlenecks that are impeding their development and the ultimate goal of reaching

upper-middle or high-income status. These bottlenecks will also prevent them from taking full advantage of the 4IR. Worse still, they could fall prey to other economies, who may use their resources to improve their own situation to the detriment of these poorer members of ASEAN.

There are a number of key questions that must be addressed: how can these 3 countries benefit from the 4IR? What lessons can be learned from an analysis of their developmental data as compared to that of Thailand? What are their current strengths and weaknesses? What model should be adopted by these countries, and what are the stages of their moving to the path of the 4IR?

To answer these questions, the author has sourced contemporary data and reports, mainly published by international financial institutions (IFIs), such as the Asian Development Bank (ADB) and World Bank, as well as other non-government organizations. Because of their financial resources and geographical spread, they are able to provide comprehensive development data and regular reports on the economic and social development of developing economies. This information is supplemented by the author's observations over the last seven years as an international development consultant in South and Southeast Asia. Of that time, around 18 months was spent as a Team Leader in Myanmar; there were also 3 shorter assignments in Cambodia.

The international financial institutions are providing significant technical assistance and concessional loans. Nevertheless, the countries have to take advantage of the opportunities provided and act upon the advice given. They need to ensure it is considered to be in the best interests of their country, as discussed by Smith [9].

Literature review

Peters argues that the 4IR will result in technological unemployment which will create greater inequalities, with lower returns to labor and greater returns to capital [1]. He argues that education must meet this challenge by the 'democratization of knowledge', with it becoming more accessible and open (i.e., open source, open access, open education, open science, and open management). Policy makers must consider the role of education in the digital age, when technological unemployment will be the rule rather than the exception. A new form of university is emerging, which is interdisciplinary and with virtual classrooms, virtual laboratories, virtual libraries and virtual teachers [10]. However, in the end, everyone will be responsible for their own lifelong learning and upskilling [11]. The skills that ensure success will remain the same, whilst the content will continue to change. Women and men, boys and girls, will be impacted differently.

In higher education, there have already been a number of positive changes that have been introduced on a small scale, and these could be considered on a broader scale [12]. Consideration should be given to condensing the undergraduate academic experience by adopting strategies that are more focused, affordable, and practical. There could be less focus on credentials, and greater encouragement of job-seekers to improve their qualifications in more practical ways, such as online courses, accredited certificate programs, self-teaching, and entrepreneurship. The incentives for students and their educational institutions should be aligned, and there should be stronger ties between industry and academic institutions. These approaches will be strengthened by implementing project-based learning, which would address some of the issues raised in the next paragraph.

Jones and Pimdee consider that Thailand faces some significant hurdles in successfully implementing Thailand 4.0 [6]. It will require education to focus on providing appropriately skilled workers. Individuals with critical thinking capability are required for innovation and creativity. Communication skills are required, but these necessitate individuals being able and willing to ask questions. Across all sectors and all levels, there is the problem of lack of foreign language and cultural skills. Finally, the 4IR will require a cultural and moral compass- hence the need for studies in humanities as well as science [13].

In 2016, it was predicted that the top 10 skills required in 2020 to thrive in the 4IR would be, in descending order: complex problem solving; critical thinking; creativity; people management; coordinating with others; emotional intelligence; judgement and decision making; service orientation; negotiation; and cognitive flexibility [14].

Schwab has identified 4 attributes required of an economy to be successful in the 4IR. They must be resilient, agile, innovative, and human-centric in their approach to development [3]. Harvey sees the risk of 'premature de-industrialization' in Africa [2]. He notes that the manufacturing share of employment has declined in both developed and developing countries. Developing countries have moved from manufacturing into the services sector well before their developed country counterparts comparatively did so. For all nations, especially developing countries, it is critical that to understand the new technologies of the 4IR and their disruptive potential [15]. Technical uncertainty will be a dominant feature of the transformation caused by the 4IR. Whilst it will be knowledge based, it will overwhelmingly require new competencies. Leadership and human development capacity should be supported, focusing on experience, emotions, energy, ethics, environment, and engagement. A very significant issue is that technology is enabling an increasing concentration of wealth in the hands of a decreasing number of individuals and global corporations [16].

The ASEAN Integration Monitoring Directorate has identified 5 dimensions of readiness for the 4IR, namely: innovation and technology; human capital; regulatory frameworks; infrastructure connectivity; and inclusive sustainable growth [17]. They found that there was a variation in readiness across the ASEAN members, and that there are regional and national initiatives with variable comprehensiveness and coordination. There were still deficiencies in the areas of infrastructure, regulatory frameworks, and engagement. The requirement to address the skills need was highlighted. Finally, they identified the 'need to strengthen cross-pillar and cross-sectorial coordination'. At the same conference, the trade union representative noted that, whilst the trade union movement supported globalization and the digital economy, there must be a 'social compact that promotes social inclusion, balanced development and sustainable growth for all' [18]. Lifelong learning should not just be focused on economic needs but be available to those that wish to acquire skills and knowledge that will enrich their lives, including knowledge related to culture and humanities.

There are a number of key opportunities and challenges of the 4IR for ASEAN nations [19]. Increasing wealth could have a very significant impact in ASEAN by 2030. It could be a powerful force for economic inclusion, as citizens connect, trade, and gain access to services currently unavailable. There will be the potential for small and medium enterprises to be empowered by digital marketplaces and online services. People will be connected by physical and digital infrastructure. Technologies developed during the 4IR will assist in the fight against congestion and road deaths. There should be improved environmental management and a positive transformation of the agricultural sector. Finally, there should be improved health and healthcare, and upgrading of disaster preparedness. The challenges include job losses and disruption. The 4IR will lead to inequality and may lead to political instability. Current industries based on the supply of relatively cheap and low-skilled labor may disappear, and larger businesses may disappear as market power is concentrated in global giants. With digitalization, there will be greater exposure to, and therefore greater vulnerability to, cyber-attacks.

One of the common threads in many of these references is the need for each of the least developed economies to improve their education and training regimes. This need has also been identified for Thailand, the reference country.

Materials and methods

As noted in the Introduction, the World Bank is a valuable resource for data and reports on all of its member countries. For each of the 3 economies under review, the Bank issues economic updates up to 3 times a year. These updates usually have 1 or 2 thematic sections per issue, discussing areas of importance to their economic development. In addition, there is significant information that can be accessed from their databases.

This paper delves deeper into the statistics, identifies and reports key issues, and offers potential strategies to support the development of these countries.

The results of the analyses are assessed to ascertain whether recommendations discussed in the next sections fit into the paradigm developed by Schwab and reported in the literature review above [3]; that

is, for an economy to be successful in the 4IR, it must be resilient, agile, innovative, and human-centric in its approach to development [3].

Results and discussion

The aim of this section is to provide an overview of the 3 economies under discussion, with some data from Thailand used for comparison. This is followed by a country by country review of their levels of development, and the challenges and opportunities available to them as part of the 4th Industrial Revolution.

The final section will analyze the data further to ascertain whether there are common issues and solutions across all 3 economies, using the attributes identified by Schwab (2018) as a guide. It will also suggest what role the other ASEAN member states might play in assisting these countries to reach their full potential.

Overview

Cambodia, Lao PDR, and Myanmar are classified by the World Bank as lower middle-income economies, as their Gross National Income (GNI) per capita is between $US996 and $US3,895 [8]. The data from Thailand is presented for comparison purposes. Thailand is an upper middle-income economy, as its GNI per capita is between $US3,895 and $US12,056.

The level of development of all 4 countries can be gauged from the data presented in **Table 1**. Unfortunately, no current statistics were available on the level of poverty in Cambodia and Lao PDR. The statistics of particular concern are the reported levels of secondary school enrolment in Thailand's neighbors.

Except for Lao PDR, mobile cellular connections per 100 persons are very high, providing a high level of interconnectivity. As many of the cellular connections would be for smart phones that provide mobile internet access, the relatively low level of individual internet access is not really surprising.

Finally, almost none of the manufactured exports from Cambodia and Myanmar include high technology products.

Table 1 Selected 2017 World Development Indicators.

Parameter	Cambodia	Lao PDR	Myanmar	Thailand
Population (million)	16.01	6.86	53.37	69.04
Poverty headcount at national poverty levels (% of population)	n.a.	n.a.	32.6	8.6
Poverty headcount ratio at USD 1.90 per day (% of population)	n.a.	n.a.	6.4	0.0
Gross national income (GNI) per capita (Atlas Method) (current USD)	1,230	2,270	1,210	5,950
Primary school completion rate	90	102*	96	93
Primary school enrolment (% of gross)	108*	107*	113*	100
Secondary school enrolment (% of gross)	n.a.	68	64	117*
Mobile cellular subscriptions per 100 persons	116	54	90	176
Individual internet usage (% of population)	34	22	25	53
High technology exports (% of manufactured exports)	0	34	6	22
Net official development assistance received (current USD millions)	842.9	475.9	1,542.8	250.0

Data from World Bank [20].
*reported figures are greater than 100 % because of method of calculation used by World Bank
n.a. = not available

The World Bank undertakes regular enterprise surveys to measure the health of firms in the non-agricultural, formal private economy, in sectors including manufacturing; construction; motor vehicle sales and repairs; wholesale; retail; hotels and restaurants; storage, transportation and communications; and information technology [21]. Selected data from the 2016 surveys are presented in **Table 2**. Female participation was high across all 3 measures, except for Myanmar. The provision of training across all sectors was low. Where training was provided in the manufacturing sector, the proportion of staff trained was relatively low, especially when compared to Thailand. Nearly 50 % of Cambodia's manufacturing firms were reliant on inputs from foreign imports for their manufacturing output. Lao PDR and Myanmar were less reliant.

Table 2 Selected Data from World Bank 2016 Enterprise Surveys.

Parameter	Cambodia	Lao PDR	Myanmar	Thailand
Female Participation in Workforce				
Firms with female employees (%)	46	45	31	37
Firms with a female top manager (%)	57	45	41	65
Firms with female ownership participation (%)	46	43	35	64
Training				
Percent of firms offering formal training (%)	22	7	6	18
Firms offering training, proportion of workers trained - manufacturing firms only (%)	44	38	58	94
International Trade				
Firms exporting directly or indirectly	14	6	5	5
Inputs of foreign origin (manufacturing firms only)	46	14	28	5

Data from World Bank [21-24].

The United Nations Development Program (UNDP) Human Development Index (HDI) assesses progress on 3 basic developments of human development: health; access to knowledge; and standard of living [25]. **Table 3** shows the world ranking for each of these indicators. It is clear that the quality of health in Thailand is significantly higher than in those of its neighbors. In quality of education, Cambodia, Lao PDR, and Myanmar perform better than in quality of health, but only 2 or 3 of 6 indicators were measured. Even Thailand appears in the bottom third in 3 of the quality of education indicators. As will be seen later, the quality of education provided in each country is far from satisfactory. Finally, the quality of standard of living is relatively high in Thailand, but poor in the other 3 countries.

Table 3 Results of 2017 Survey of Human Development- Cambodia, Lao PDR, Myanmar, and Thailand.

	Quality of Health (3 indicators)			Quality of Education (6 indicators)			Quality of Standard of Living (4 indicators)		
	Top 1/3	Middle 1/3	Bottom 1/3	Top 1/3	Middle 1/3	Bottom 1/3	Top 1/3	Middle 1/3	Bottom 1/3
	Number of indicators								
Cambodia	0	0	3	1	0	2	0	0	4
Lao PDR	0	1	2	1	1	0	0	2	2
Myanmar	0	1	2	1	1	0	0	0	4
Thailand	1	1	1	2	1	3	3	0	1

Data from UNDP [25].

The next sections highlight key findings for each economy. It will be seen that the economies of Cambodia, Lao PDR, and Myanmar are different, but there are some common themes across all 3. Because of the different resources base in each economy, the opportunities can be different. Finally, they will be compared to the situation in Thailand.

Cambodia

The year 2017 showed moderation in exports of clothing and textiles, which had been one of the main drivers of the Cambodian economy, and a rise in non-textile products, especially electrical machinery, equipment, and auto parts [26]. The World Bank considered that this was indicative of Cambodia being on the cusp of moving up the manufacturing value chains, which requires investment in industries that produce high value-added products, such as electrical appliances and their components, as well as auto parts. The key constraints were identified as high electricity and logistics costs, together with the skills gap. In order to address the skills gap, it is necessary to promote and improve the skills and quality of graduates from both the educational and vocational sectors.

According to the World Bank, around half of the jobs in Cambodia have been in the traditional sector, with the other half in the modern sectors [27]. One third of all jobs are in the farming sector, and around 18 % are in non-farm economic enterprises. Another 3.3 million people are engaged in wage-employment, whilst managers, professionals and technicians, and associate professionals account for around 5.4 % of the total. Future opportunities will continue in the garment and related trades sector as Cambodia participates in global and regional supply chains. The domestic tourism sector and the aged care sectors in aging regional countries are expected to be major job markets due to what the Bank considers to be the comparative advantage Cambodia has in English language skills. To meet the challenges, it has identified that Cambodia's education system needs to be updated to provide the right skills for the future generation, and the current workforce needs to upskill to be part of a technologically-enhanced workplace. The Bank also recommended that, ideally, more language skills should be encouraged, in addition to English and Chinese.

Based on the experience of other East-Asian economies and those of its neighbors, World Bank modeling shows that Cambodia's ambition to be an upper-middle income economy by 2030 is optimistic, although its ambition to be a high-income economy by 2050 is achievable [28].

Lao PDR

The Lao economy is highly dependent on the resources sector, particularly hydro-power, forestry, and mining, with two-thirds of the workforce employed in the agricultural sector- traditionally small-scale farming households [29]. The World Bank sees greater regional integration and improvements in the business environment, opening up opportunities for agriculture, agro-processing, and tourism. Opportunities in manufacturing could provide Lao PDR the opportunity to become part of regional value chains. These sectors should potentially create jobs and reduce poverty. There is a major impediment to progress, however. Without significant progress in boosting human capital, the full potential of its population will not be realized. Health and education outcomes need to be improved [30]. Additionally, the Bank identified the requirement for sector-specific interventions, including the provision of early childhood education and improved service delivery, with funding to be prioritized and targeted at poor and ethnic minorities. A systematic country diagnostic reported by the World Bank in 2017 identified 3 pathways for inclusive growth: management of natural resources in a sustainable and efficient manner; development of the potential in the non-resource sector; and building the assets of the people so that they might take advantage of the increased opportunities [31]. To achieve this, the Bank identified the need for enhanced governance and a rules-based environment. It also considered that improved access to, and quality of, health services would lead to more productive people.

Myanmar

In Myanmar, agricultural output only accounted for 26 % of the Gross Domestic Product (GDP) in 2017/2018, although the sector employs around 50 % of the total workforce, and 64 % of the rural workforce [32]. The agricultural sector is constrained by the use of manual systems with poor productivity, lack of knowledge of nutrients, and poor seed quality [33]. On the other hand, livestock and fishery markets have been successful, and contribute around 26 % of the total agricultural GDP with only a fraction of the total agricultural work force. Manufacturing, including food processing and garment manufacturing for export, accounts for 75 % of the activity in the industrial sector [32]. The major exports are gas and garments, with gas representing around 25 % of total exports, and garments representing around 18 %, in the first 3 quarters of 2017/2018. The oil and gas sector accounts for close to 15 % of government revenue, with other extractive industries accounting for around 5 % [34]. A large share of jade and gem production is likely to be part of the informal economy and, hence, likely to be undeclared.

Myanmar is lagging in relation to its investment in human capital, with less public expenditure on health and education than its neighbors, whether measured in terms of per capita spending or share of total expenditure. On both measures, it is marginally lower than Cambodia, and much lower than Lao PDR [34]. The Bank concluded that Myanmar needs to spend more and spend better.

Cunningham and Huertas studied Myanmar's workforce data and discovered that, whilst professionals, managers, skilled technicians, and associate professionals drive an economy and manage a government, only 3 % of Myanmar's workers occupy such positions [35]. Only 13 % of those with high school education or above work in professional occupations, with women outnumbering men 3 to 1. Low levels of skills acquisition and the lack of job-relevance of such skills contributes to the perception of some employers who complain that they have an inadequately skilled workforce. Education attainment is also low, with more than half of Myanmar's workers not reaching middle school; 20 % never had formal education, and 39 % did not complete primary school; 21 % had high school education or above. There is a change with the younger generation, where workers in the 15 - 24 years age group have much higher secondary and tertiary education than older workers, with 30 % of the younger generation attending high school or above.

Thailand

Unsurprisingly, Thailand is much further on the pathway to the 4IR, which is a focus of the National Economic and Social Development Council (NESDC) [35]. Thailand's aim is to be a high income developed nation, with low income disparity, and with social equality. NESDC sees opportunities arising from global industrial transformation through disruptive technologies and globalization with the free flow of goods, services, capital, and people. This would lead to a free flow of information and knowledge.

Thailand would benefit through its strong macroeconomic foundation, strategic location, and biodiversity. This will be supported by its existing strong industrial and services bases. Nevertheless, NESDC has identified a number of challenges: moderate innovation capability, low investment in research and development, the quality of its human capital, an aging society, inflexible rules and regulations, and an ineffective public administration. The Ministry of Industry is addressing these challenges through its Industry Strategy 2017 - 2022. It has identified 3 growth engines. The Green Growth Engine will be based on a low carbon, climate resilient economy. The Productive Growth Engine will focus on the development of industrial production. Finally, the Inclusive Growth Engine will aim to ensure that the economic benefits are shared nationwide and that all communities benefit. They envisage that the Thai economy will benefit from economic wealth, social well-being, human capital, and environmental wellness. Linked to the world economy, NESDC claims that this will lead peace and security, shared prosperity with neighbors, sustainable growth, and a secure future for the planet.

Common themes from the analysis of the data from Cambodia, Lao PDR, and Myanmar

As has been seen, there are a number of recurring themes in the analysis.

The most striking issue is that each of the countries has a very large agrarian population of up to around 59 %. They often tend to cultivate small family holdings with labor-intensive methods and often plant poor seed stock. This results in poor productivity and social depravation for the family, as they lack access to good educational opportunities and health services.

What the Gross Domestic Product per capita tends to hide is that the wealth is not evenly spread, and the figure is inflated, particularly in the case of Lao PDR and Myanmar, because of their rich natural resources: hydro-electric power production, mining, and logging in the case of Lao PDR [29], and oil and gas, and jade and gems in the case of Myanmar [34].

Health and primary care services, particularly in rural areas, tend to be inadequate.

Education attainment is low, especially in the post-primary school sector.

The higher educational and vocational sector is considered not to be providing graduates with adequate skills for their chosen career. This is critical in a society where the number of managers, professionals, skilled technicians, and associate professionals is low; around 5.4 % in the case of Cambodia [27] and 3 % in the case of Myanmar [35].

Implementation of formal staff training appears to be a relatively minor consideration of managers.

With these bottle-necks, the 3 economies have not met any of Schwaub's criteria to be successful in the 4th Industrial Revolution, as they are not resilient, agile, innovative, or human-centric.

This is gradually changing, as their governments, often guided by the advice of the International Financial Institutions, as well as Non-Government Organizations, seek to develop their economies and improve the human potential of their workforces. Each economy has particular strengths that can be successfully exploited with a suitably trained and motivated workforce. There is, however, a long way to go before their countries reach the status of an upper-middle income economy. In the case of each country, the World Bank and others, as described above, have identified sector specific initiatives which, if adopted, would greatly assist these aspirations.

An appropriate 4IR model for Cambodia, Lao PDR, and Myanmar

Each of these 3 countries is seeking to focus on its economic strengths. This will not, in itself, lead, to what Thailand has identified as its goals of becoming a high income developed nation with low income disparity and social equality [35], which is no doubt the aspiration of its neighbors. All 3 are largely agrarian economies, with extensive poverty and poor infrastructure. Currently, there is high income disparity and extensive social inequality. This will not improve whilst development is focused on the main population centers, such as Phnom Penh, Siem Reap, and Sihanoukville in the case of Cambodia; Vientiane and a number of regional cities in Lao PDR; and Yangon, Mandalay, and Nay Pyi Taw in Myanmar.

In light of the above discussion, the author has prepared the following model for the 3 countries, bearing in mind that they are still classified as least developed countries:

A cohesive country where diversity is celebrated and all its inhabitants are equal under the law; its total population connected by reliable physical and telecommunications infrastructure that provides access to essential services including health and education; an education system that is focused on the skills that enhance the development potential of the country; an information technology (IT) savvy and connected population able to access appropriate services through the world-wide web; the productivity of the rural sector enhanced by the introduction of innovative cultivation techniques; industry focused on upskilling its workforce and value adding in areas where the country has a competitive advantage.

There is no quick fix. Change takes time!

The 1st step is to recognize that a large percentage of the population lives outside of the main urban centers, often living in near poverty and without access to basic services.

As noted in **Table 3** above, all 3 countries scored badly on all 3 pillars of the human development indicators, namely health, education, and standard of living. These factors are, in fact, interrelated, and impact most on the large rural population. The immediate need is to improve productivity by improving the seed stock, introducing intensive farming techniques and, where necessary, diversifying to meet market needs [29,33]. All of this must be based on scientific evidence, and not on chasing the latest fad. The author has observed the situation in Cambodia, where virgin forest was destroyed to plant rubber trees which, in turn, no doubt due to low rubber prices, were uprooted to plant cassava.

Care needs to be taken that the rural inhabitants are not exploited and lose what land they have for little or no benefit.

There is clearly a role here for countries like Thailand, which has been highly successful in improving the productivity of the agricultural sector [37] and its downstream supply chain, including the processing, marketing, and distribution of products to the worldwide market (for instance, see [38-40]). The aim would be to develop long-term rural extension services, where specialists work in the community to improve productivity and work with the government to develop downstream opportunities for processing, marketing, and logistics. This will take significant time and will also require mobilization of local specialists to be trained to undertake the extension activities. Agricultural institutes and universities could work with the local agricultural institutes to develop seed stock better suited to the local conditions. They could also assist in crop diversification. Taken as a whole, this will raise the standard of living of the local populations and allow them to pursue better education opportunities and obtain better health services for their children.

Costs associated with improving infrastructure so that everyone has the same quality of access to services would be prohibitive, especially in the case of Myanmar, with its extensive mountainous regions. This requires the development of innovative information technology delivery techniques in all service areas, including medical services and education.

Changes to the education system will, by their nature, be slow. Even Thailand, as discussed in the literature review, has significant deficiencies in developing the skills required for a successful transition to the 4IR. Changes are required at the primary, secondary, and tertiary levels.

The initial challenge at the primary and secondary levels is to improve attendance and retention rates to teach life skills and to provide a foundation for studies in the vocational and tertiary sectors.

Changes in the tertiary sector would probably be the easiest to initiate and bring the greatest benefit to the country. Based on lessons learned in Thailand, the curriculum will have to be recast to provide appropriate education to provide appropriately skilled workers [6]. Critical thinking capability is required for innovation and creativity. Communication skills are required, with individuals able and willing to ask questions. Foreign language and culture skills are essential. This will be a challenge in these economies, as is the case in Thailand, where the author has observed that critical thinking and a questioning demeanor are not really part of the culture, which in many ways focuses on conformance. Critical thinking and communication skills can be included as part of the method of delivery of the current curriculum whilst consultation is undertaken to develop a new curriculum.

Similar changes will be required in the vocational sector, where the curriculum will need to change to meet the skills required as businesses modernize their systems.

Even more critical is the need to recognize the importance of training of existing staff and developing their skills to better match the requirements of their industry as they increase the use of technologies to meet competition in their market place. The current workforce needs upskilling to meet the challenges of the future job-market. Whilst this can be partially addressed locally by greater focus on training, a more productive path may be to employ key foreign nationals within either training institutes or even individual companies to provide intensive training opportunities. Short-term training is of limited value, as staff need to be immersed in the training/development process. The focus should be on current and priority areas of future employment. For instance, as mentioned above, the World Bank has identified nursing in the aged care sector in developed countries as a niche market for Cambodian nurses.

Industrial development should focus on those sectors where the country already has a competitive advantage. A number of these sectors have already been identified by the World Bank and others and were described earlier in this paper.

This all needs to be underpinned by a streamlined legal and administrative framework so that the government can meet new challenges as they arise. This is not an argument for deregulation, but rather that laws and administrative practices be agile. This will allow them to meet challenges as they arise, whilst at the same time ensuring that society as a whole benefits from the 4IR and the environment is protected.

Conclusions

The challenges facing ASEAN's least developed members, namely Cambodia, Lao PDR, and Myanmar, to be able to fully participate in the 4th Industrial Revolution are significant. Each of these countries has potential, but they need political will and insight to provide the impetus for change. This will take time, especially as their political and government structures are not necessarily resilient, agile, innovative, or human-centric. Change is, however, occurring, and must accelerate to bring about the necessary changes required to improve the health, education, and standard of living of their citizens.

With the help of their international development partners, supported by ASEAN and its institutions, in removing the bottle-necks to development, each of these economies will be able to be active players in the 4th Industrial Revolution.

Acknowledgements

All of the data reported in this paper is from publicly available resources, mostly published by the World Bank. However, reporting and analysis of the data is the sole responsibility of this author. The paper has greatly benefited from the comments of anonymous reviewers.

References

[1] MA Peters. Technological unemployment: Educating for the fourth industrial revolution. *Educ. Philos. Theory* 2017; **49**, 1-6.

[2] K Schwab. *The Fourth Industrial Revolution: what it means, how to respond*. Available at: https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond, accessed July 2019.

[3] K Schwab. *The Global Competitiveness Report 2018.* World Economic Forum, Geneva.

[4] R Harvey. The 'fourth industrial revolution': Potential and risks for Africa. *The Conversation*. Available at: https://theconversation.com/the-fourth-industrial-revolution-potential-and-risks-for-africa-75313, accessed July 2019.

[5] MH Lee, HJH Yun, A Pyka, DK Won, F Kodama, G Schiuma, SK Park, J Jeon, KB Park, KH Jung, Min-Ren Yan, SY Lee and X Zhao. How to respond to the fourth industrial revolution, or the second information technology revolution? Dynamic new combinations between technology, market, and society through open innovation. *J. Open Innov. Technol. Mark. Complex* 2018; **4**, 21.

[6] C Jones and P Pimdee. Innovative ideas: Thailand 4.0 and the fourth industrial revolution. *Asian Int. J. Soc. Sci.* 2017; **17**, 4-12.

[7] United Nations Conference on Trade and Development. *UN list of Least Developed Countries,* UNCTAD, Geneva 2019. Available at: https://unctad.org/en/Pages/ALDC/Least%20Developed %20Countries/UN-list-of-Least-Developed-Countries.aspx, accessed February 2019.
[8] World Bank. *World Bank Country and Lending Groups,* World Bank, Washington DC 2019. Available at: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, accessed February 2019.
[9] RB Smith. Sustainability: Lenders Know Best - A Practitioner's View. ATINER'S Conference Paper Series, No: CBC2018-2613. Available at: https://www.atiner.gr/ papers/CBC2018-2613.pdf, accessed February 2019.
[10] B Xing and T Marwala. Implications of the fourth industrial age for higher education. *The Thinker* 2017; **73**, 10-5.
[11] NW Gleason. *Introduction. In*: NW Gleason (Eds.). Higher Education in the Era of the Fourth Industrial Revolution. Palgrave Macmillan, Singapore, 2018, p. 1-10.
[12] M Doepker. *5 ways students can graduate fully qualified for the Fourth Industrial Revolution*. Available at: https://www.weforum.org/agenda/2019/01/how-students-can-graduate-qualified-for-fourth-industrial-revolution, accessed July 2019.
[13] H Vestberg. *Why we need both science and humanities for a Fourth Industrial Revolution education*. Available at: https://www.weforum.org/agenda/2018/09/why-we-need-both-science-and-humanities-for-a-fourth-industrial-revolution-education, accessed July 2019.
[14] A Gray. *The 10 skills you need to thrive in the Fourth Industrial Revolution*. Available at https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution, accessed July 2019.
[15] M Xu, JM David and SK Kim. The fourth industrial revolution; opportunities and challenges. *Int. J. Financ. Res.* 2018; **9**, 90.
[16] G Brown-Martin. *Education and the Fourth Industrial Revolution.* Prepared for Groupe Média TFO. Available at: https://www.groupemediatfo.org/wp-content/uploads/2017/12/FINAL-Education-and-the-Fourth-Industrial-Revolution-1-1-1.pdf, accessed July 2018.
[17] J Tija. *Assessment of ASEAN Readiness for the Fourth Industrial Revolution*. Special Session on the Fourth Industrial Revolution in ASEAN. Available at: https://drive.google.com/drive/u/0/folders/1y3Cxh6pP2kpSFTR-3crmY9uWIetQhe7r, accessed July 2019.
[18] C Ng. *Forging a just and balanced transition to a future work under the Fourth Industrial Revolution*, UNI Apro & ASETUC Reference Paper for the Special Session on the Fourth Industrial Revolution, on the sidelines of the 9th Meeting of the Committee of the Whole (CoW) for the ASEAN Community. Available at: https://drive.google.com/drive/u/0/folders/1y3Cxh6pP2kpSFTR-3crmY9uWIetQhe7r, accessed July 2019.
[19] World Economic Forum and Asian Development Bank. *ASEAN 4.0: What does the Fourth Industrial Revolution mean for regional economic integration?* The Asian Development Bank (ADB), Manila, Philippines.
[20] World Bank. World development indicators database. World Bank, Washington DC. Available at https://datacatalog.worldbank.org/dataset/world-development-indicators, accessed February 2019.
[21] World Bank. *Enterprise surveys: Cambodia 2016 country profile.* World Bank Group, Washington DC, 2016.
[22] World Bank. *Enterprise surveys: Lao PDR 2016 country profile.* World Bank Group, Washington DC, 2016.
[23] World Bank. *Enterprise surveys: Myanmar 2016 country profile.* World Bank Group, Washington DC, 2016.
[24] World Bank. *Enterprise surveys: Thailand 2016 country profile.* World Bank Group, Washington DC, 2016.
[25] United Nations Development Program. *Briefing note for countries on the 2018 Statistical Update: Cambodia.* Human Development Indices and Indicators: 2018 Statistical Update. United Nations, New York, 2018.

[26] World Bank. Cambodia climbing up the manufacturing value chain, *Cambodia economic update.* World Bank Group, Washington DC, October 2017.
[27] World Bank. Recent economic developments and outlook, *Cambodia economic update*. World Bank Group, Washington DC, April 2018.
[28] World Bank. Recent economic developments and outlook, *Cambodia economic update*. World Bank Group, Washington DC, October 2018.
[29] World Bank. Safeguarding stability: An ongoing agenda. *Lao PDR economic monitor.* World Bank Group, Washington DC, June 2018.
[30] World Bank. Macroeconomic stability amidst uncertainty. *Lao PDR economic monitor.* World Bank Group, Washington DC, January 2019.
[31] World Bank. Lao People's Democratic Republic: Systematic country diagnosis - priorities for ending poverty and boosting shared prosperity. *Report No: 112241-LA*. World Bank Group, Washington DC, 2017.
[32] World Bank. Growth amongst uncertainty. *Myanmar economic monitor.* World Bank Group, Washington DC, 2018.
[33] European Chamber of Commerce in Myanmar. *Agricultural Guide 2019*, European Chamber of Commerce in Myanmar, Yangon, 2018.
[34] World Bank. Navigating risks. *Myanmar economic monitor.* World Bank Group, Washington DC, 2018.
[35] W Cunningham and DA Huertas. *Myanmar's Labor Force*. *In*: W Cunningham and R Munoz. (Eds.). Myanmar's Future Jobs: Embracing Modernity. World Bank Group, Washington DC, 2017, p. 29-64.
[36] P Teanravisitsagool. *Thailand 4.0: the Fourth Industrial revolution strategy from the national perspective*. Special Session on the Fourth Industrial Revolution in ASEAN. Available at: https://drive.google.com/drive/u/0/folders/1y3Cxh6pP2kpSFTR-3crmY9uWIetQhe7r, accessed July 2019.
[37] H Leturque and S Wiggins. *ODI Development Progress: Thailand's progress in agriculture: Transition and sustained productivity growth.* Overseas Development Institute, London, 2011.
[38] C Miller, G Reed and P Talerngsri. Foreign direct investment and vertical integration of production by Japanese multinationals in Thailand. *J. Comp. Econ.* 2004; **32**, 805-21.
[39] A Kohpaiboon and N Poapongsakorn. Industrial upgrading and global recession: Evidence of hard disk drive and automotive industries in Thailand. *ADBI Working Paper Series No 283*, ADB Institute, Tokyo, May 2011.
[40] S Komolavanij, C Jeenanunta, V Ammarapala and P Chongphaisal. *Thailand Regional Free Trade Agreements (FTA) and the Effect on Industrial Clustering*. *In*: A Kuchiki and M Tsuji (Eds.). The Formation of Industrial Clusters in Asia and Regional Integration: Midterm Report (IDE-JETRO Research Project 2008 No. 1-11 Midterm Report), Institute of Developing Economies, Chiba, Japan, 2008.