"The Future of Work in ICT" Project

Skills shortages and labour migration in the field of information and communication technology in **India**, **Indonesia** and **Thailand**

International Labour Organization

SOCIAL JUSTICE DECENT WORK

厚生労働省
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Preface

The International Labour Organization (ILO) is the United Nations specialized agency dedicated to advancing opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity. The ILO Sectoral Policies Department promotes decent work by supporting the Organization's tripartite constituents, namely governments, employers and workers, in creating opportunities and addressing challenges in 22 different economic and social sectors at the global, regional and national levels.

Information and Communication Technology (ICT) is a key economic sector and generator of jobs and may be considered the backbone of the digital economy across all sectors. It increases productivity and has a profound impact on business processes, tasks and the organization of work across the entire economy. The ICT sector continues to represent an opportunity for future employment opportunities, particularly for young people. However, as is the case with other sectors, in many countries the global ICT sector is facing a shortage of skilled ICT workers. A lack of skilled labour will constrain future growth and job creation in the sector, but with the right policies in place – including targeted investments in education and skills training in the digital economy, and the efficient management of labour migration flows – the digital economy could make a significant contribution to advancing decent work and inclusive economic growth at the global, regional and national levels.

This report is the first outcome of an ILO development cooperation project entitled "The Future of Work in Information and Communication Technology (ICT)". The global research project focuses on the anticipated needs for skilled workers and strategies for addressing labour shortages, including the scaling up of investments in ICT education and training, and more efficient management of ICT specialist migration flows. The project will contribute to strengthening the ILO's knowledge base regarding the future of work, and to addressing the recommendation concerning "lifelong learning for all" proposed by the Global Commission on the Future of Work.

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Abbreviations and acronyms

AI	Artificial Intelligence
APTIKOM	Indonesian Association of Higher Education in Informatics and Computer Science
ASEAN	Association of Southeast Asian Nations
BNP2TKI	National Board for the Placement and Protection of Indonesian Overseas Workers
BPO	Business Process Outsourcing
DEPA	Digital Economy Promotion Agency
FICCI	Federation of Indian Chambers of Commerce and Industry
IIIT	Indian Institute of Information Technology
IIT	Indian Institute of Technology
INI	Institutes of National Importance
IoT	Internet of Things
IT BPM	Information Technology Business Process Management
ITeS	Information Technology enabled Services
ITI	Industrial Training Institutes
KADIN	Indonesian Chamber of Commerce and Industry
KKNI	Indonesian National Work Competency Standards
KOMINFO	Ministry of Communication and Informatics
KPO	Knowledge Process Outsourcing
NASSCOM	National Association of Software and Service Companies
NSQF	National Skills Qualification Framework
SMEs	Small and medium-sized enterprises
STEM	Science, Technology, Engineering and Mathematics
TPQI	Thailand Professional Qualification Institute
TVET	Technical and Vocational Education and Training

Executive summary

Transformative digital technologies and innovation have led to an increasing demand for highly-skilled specialists, both within the ICT sector as well as in other sectors of the digital economy. While the extent differs from country to country, there is a global shortage of skilled ICT workers, and this may negatively impact economic growth and limit job creation (Manpower Group, 2016). However, with the right policies in place, targeted investment in education and training, and more efficient management of labour migration, the digital economy is poised to make a significant contribution to advancing decent work and inclusive economic growth at the global, regional and national levels.

The aim of this report is to gain a more comprehensive understanding of the most critical aspects of the future of work in the ICT sector by assessing how technological changes, employment, migration and the organization of work and production in India, Indonesia and Thailand may be interrelated. The report analyses the following three areas: (i) trends in the ICT sector and labour markets; (ii) the potential demand for ICT jobs and the anticipated shortages of skilled workers in the digital economy, as well as approaches for improving the education and training of ICT workers; (iii) factors affecting the migration of highly-skilled ICT workers.

The report includes three chapters that analyse each of the aforementioned areas on the basis of a comprehensive literature review and through interviews with representatives from governments, training and higher education institutions and employers' and workers' organizations in India, Indonesia and Thailand. Those three chapters are followed by key findings and possible policy responses for governments, education and training institutions and employers' and workers' organizations.

Trends in the ICT sector and labour markets of India, Indonesia and Thailand

The overall digitalization of the economy is a driver in the growing demand for ICT specialists across sectors in India, Indonesia and Thailand. Digital technologies are transforming the way people work and the skill sets required of those workers. Technological changes may lead to job losses in the short-term, but in the future, job roles and skill sets will be centred on emerging technology areas, including artificial intelligence (AI), big data analytics, blockchain technologies, internet of things (IoT), Robotic Process Automation (RPA) and 3D printing.

Highlights:

a) The level of technological readiness, including aspects such as infrastructure, ICT penetration at the household and company levels, as well as general educational levels (excluding ICT skills) in India and Indonesia, and to a lesser extent in Thailand, remain relatively low.

b) India has specialized in ICT since the 1990s, but this is still a new trend in Indonesia and Thailand. The growth of the ICT sector in India has been driven by IT and IT-enabled services exportation. In Indonesia and Thailand, the growth of the ICT sector has been driven primarily by domestic demand, particularly in the financial, business and retail sectors. In addition, the exporting of hardware has also played an important role in growth in Thailand.

c) In India, the share of the IT sector as a proportion of GDP has increased from 1.2 per cent in 1998 to 9.3 per cent during the 2015-2016 financial year. In Indonesia, the ICT sector accounted for 7.2 per cent of total GDP in 2016 and revenues grew at a rate of about 9.5 per cent per year between 2014 and 2017, which was faster than growth in other sectors. The expansion of ICT has allowed for the growth of e-commerce and other digital services, both of which have contributed to the demand for ICT specialists. In Thailand, the ICT industry has grown in recent years, particularly in the area of software development, while the market for hardware products has declined slightly.

d) In India the Information Technology Business Process Management (IT BPM) sector, as defined by the industry association,

National Association of Software and Service Companies (NASSCOM), employed nearly four million knowledge workers in 2017. In Indonesia there are currently around 500,000 ICT professionals and technicians working across all industries, while in Thailand approximately 386,000 ICT specialists[1] are employed, accounting for around one per cent of total employment in the country. A new trend in all three countries has been the increase of start-ups in the ICT sector.

e) Roughly one-third of all employees in the ICT sector in India, Indonesia and Thailand are women. However, women in ICT tend to be at a disadvantage in terms of career advancement.

f) In all three countries, many ICT specialists hold advanced degrees and generally have completed a higher level of education as compared with workers in other areas of the economy.

g) In all three countries, ICT specialists earn salaries that are higher than national averages, although salary amounts vary depending on job roles and specific areas within the ICT sector.

h) Employers' organizations in the ICT sector, notably industry associations, play a key role in identifying and developing the skills required by the industry. At present, there are very few unions representing ICT sector workers and ICT specialists in the three countries discussed here.

Skills shortages, gaps and development in India, Indonesia and Thailand

According to employers in all three countries, while there seem to be a sufficient number of graduates with technical vocational training and bachelor's degrees in ICT, workers tend to lack both technical and soft skills. On the other hand, in interviews, workers' representatives expressed concern about a lack of access to training and upskilling for specific technical skills.

In all three countries, there are shortages of ICT specialists who have achieved a master's or postgraduate-level degree. Overall, an expansion of transversal ICT skills is needed, including cross-cutting technical skills, and soft skills, such as higher order critical thinking and analytical skills and social and cross-cultural competencies. Estimates done by employers' organizations in India suggest that between 60 – 70 per cent of the current IT workforce will require retraining because of changing skill requirements in the marketplace.

Highlights:

a) The availability of highly-skilled ICT specialists will become an important competitive factor in existing industries, including in the provision of IT services to industry 4.0[2] and within ICT, and for innovative industries and services that are currently being developed. In all three countries, future demand for ICT specialists will depend on the dynamics of domestic markets in areas including e-commerce, e-government, e-agriculture, e-medicine and health technologies, e-education, and e-banking as well as global demands in other sectors, the latter being particularly important in the case of India.

b) The ICT sector has become quite sophisticated in India, largely due to the fact that the type of IT-services provided includes a growing number of high-end IT services, and because many high-level education institutions specializing in ICT have been established. The employability of university graduates in India is higher for engineers and IT-related fields than for graduates in any other fields of study. In contrast to India, there are very few high-level education institutions that specialize in ICT in Indonesia and Thailand.

c) In all three countries, there is a shortage of graduates who have specific technical and soft skills that are now required in the ICT industry. Reasons for this shortage include, changes in technological trends, outdated and non-interdisciplinary education curricula, and poor instruction in mathematics, technology and ICT in certain technical and vocational education and training (TVET) and undergraduate institutions. In addition, there is a lack of coordination between education/ training institutions and other stakeholders,

[1] The counting of ICT specialists was done as per International Standard Classification of Occupations, see Annex A 1.2.

[2] Industry 4.0 is defined as, "the digitalization of manufacturing or the 'manufacturization' of the digital world", see https://www.oecd-forum.org/users/50593-oecd/posts/18280-policy-4-0-bringing-the-people-on-board-in-a-digital-world

including ministries of labour and workers' and employers' organizations. While public universities seek to equip students with a theoretical foundation and tools that allow them to adapt knowledge over their whole working life, private universities tend to focus on preparing students for employment in the short term and teaching the technical skills demanded by companies.

d) Companies have developed entry-level training for new graduates and have begun developing "reskilling" and "upskilling" programmes for employees considered to have great potential, while those who are not chosen to participate must retrain or undergo upskilling on their own. Continuous training has become a necessity for both workers and their employers in order to keep pace with rapidly changing technologies.

e) In all three countries, several ministries and government agencies are involved in defining skills development and strategies. Cooperation and coordination among these stakeholders with a view to promote education and training, as well as upskilling and reskilling programmes, are generally weak at all levels. As a result, a significant share of the workforce is not prepared for the fluid labour market of the digital economy.

f) In general, comprehensive skills forecasting and occupational data analysis are lacking. Increases of data in these areas could inform strategies for anticipating needed skills and appropriate skills development strategies.

g) The creation of educational and occupational standards based on industry involvement, the establishment of certification systems, and increased transparency in education and certification could help strengthen national qualification systems in India, Indonesia and Thailand.

h) Internships are seen as the primary means for ICT specialists to receive practical training in all three countries discussed here. Apprenticeships have been less successful because industry experts consider them not fit-for-purpose in the rapidly evolving ICT sector, and they are generally perceived as being less prestigious than internships. Apprenticeships are offered primarily for occupations that require lower technical skills, while internships are designed to combine tertiary vocational or university studies with workplace learning. Governments in all three countries are committed to improving TVET, in order to enhance employment opportunities and address skills shortages.

i) It has been widely acknowledged that the Indian ICT sector has been successful due to the excellent English language skills of its workforce. In addition, English language proficiency is a prerequisite for the international migration of ICT workers. By contrast, low rates of English language proficiency are considered a skills gap for workers in Thailand, and to a lesser extent, in Indonesia.

International migration of ICT specialists – into and out of India, Indonesia and Thailand

Over the past three decades, the global migration of ICT specialists has been on the rise, and began with the migration of Indian ICT specialists to the United States. International competition for attracting highly-skilled ICT specialists has encouraged this trend, although some destination countries have recently instituted more restrictive immigration policies.

Highlights:

a) India is one of the world's most important emigration countries for ICT specialists. The migration of Indian ICT specialists has partly been facilitated by Indian multinational ICT companies, especially those with offices in the United States. Those multinational companies have been able to grow largely thanks to India's supply of highly-skilled ICT specialists. In contrast, Indonesia provides low-skilled labour in other countries, and Thailand is a destination country for unskilled and low-skilled labour. There is little reliable data on the emigration of Indonesian or Thai ICT specialists, but research interviews during this project suggested that those numbers are low.

b) For ICT specialists, migration is often driven by opportunity rather than by necessity. Highly-skilled workers, including ICT specialists, increasingly migrate temporarily and often for project-based work. Multinational companies facilitate the cross-country movement of these ICT specialists.

c) Studying abroad may be a precursor of labour migration, especially in Organisation for Economic Co-operation and Development (OECD) countries that allow a two-step migration process, in which skilled migrants arrive first as international students, and then later enter the labour market as skilled professionals. International cooperation between universities, the availability of joint degree programmes and student and worker exchange programmes may help support future work-related opportunities for potential migrants to go abroad.

d) Incentives for highly-skilled ICT specialists to migrate include: higher income potential, greater job satisfaction, improved career prospects, education and skills development opportunities, evolving professional challenges, company reputation and values, as well as quality of life, and the attractive amenities and social welfare systems available in the host country.

e) Reasons for highly-skilled ICT specialists to return to India, Indonesia and Thailand include: family ties, quality of life, professional opportunities and dynamic career paths, smaller wage differentials if measured according to purchasing power parity, decent working conditions, and increasingly, new start-up opportunities. Moreover, many returning migrants express a desire to contribute to the development of their home countries and the temporary nature of contracts abroad reinforces the phenomenon of return migration.

f) Factors that inhibit migration, also known as "migration barriers", include: environments that are not ideal for families, complicated administrative procedures surrounding the recognition of educational qualifications, lack of informal learning recognition, lack of relevant technical and soft skills acquisition, inadequate language skills, and strict visa and immigration requirements.

g) The international labour migration of ICT specialists provides the destination country with benefits, and indeed, migration may be critical to the development of the ICT industry. However, benefits for the country of origin may not be immediately apparent. As shown in the case of India, investing in the education of ICT specialists may be beneficial in the long-term, leading to so-called "brain gain" if and when professionals return to their country of origin. In the past, there have been concerns about the opposite trend of "brain drain", which occurs when highly-skilled workers emigrate permanently. In general, there is increasing evidence that both destination and origin countries have benefitted from "brain circulation". The return migration of highly-skilled ICT specialists has supported development in the country of origin, since these workers return home with international experience, skills acquired while abroad and extensive professional networks. In many cases, international migration also benefits the workers by offering them the opportunity to develop human capital and acquire professional experience abroad.

Introduction

Digitalization is having a profound impact on economies and societies worldwide. The ICT sector is changing rapidly[1], but ICT services and products are also contributing factors in the shaping of other sectors, including financial services and manufacturing. In addition, digitalization is expected to transform other sectors in the future, including education, agriculture and medicine. The speed of change across sectors will depend on a number of factors, including the economic and social development of a country, its placement within global supply chains, the availability of basic digital infrastructure, competition and new markets, societal acceptance of technologies and the availability of highly-skilled labour. This report focuses on the last factor: the availability of highly-skilled labour.

ICT specialists do not fit into an easily defined occupational category. Current classifications and occupational subgroups may not capture new occupational groups that are emerging as technological development continues. New occupations could include AI-related occupations, big data analysts and other job types based on new technology. While this report uses the definition for ICT specialist that OECD and Eurostat have developed and use in their statistical analysis, the ICT sector and relevant occupations therein have changed rapidly in recent years and are expected to continue to do so in the future (see Annex Table A1.1 and A1.2). Increasingly, jobs in advanced ICT fields are an integral part of other sectors within the economy, and those jobs require transversal skill sets. There is a lack of reliable, detailed and comparable data regarding ICT occupations, rendering cross-country comparisons of the employment of ICT specialists within the ICT sector and across sectors difficult.

According to the available literature, many parts of the world are facing a potential shortage of ICT specialists and those shortages may have a negative impact on the economic growth and development efforts of a country. Therefore, the inadequate supply of ICT skills has become a major concern for governments, employers and workers.

There are several possibilities for maximizing potential human capital, including the following four measures: investment in the education and training of highly-skilled workers, including both initial education and training and upskilling and reskilling later on; foreign direct investment in countries with a large supply of ICT specialists and the outsourcing of operations to such locations; more efficiently managed migration; measures to support women workers such as removing gender barriers and providing incentives for women entering ICT occupations.

Objective

The objective of this report is to gain a deeper understanding of the following:

a) Trends in the ICT sector and ICT labour markets;

b) The potential demand for ICT jobs and the anticipated shortages of skilled workers in the digital economy, as well as approaches for improving the education and training of ICT workers;

c) Factors affecting the migration of highly-skilled ICT workers.

Gender issues are considered on a transversal manner.

The following will be explained in greater detail:

a) An analysis of existing approaches to ICT education and skills development in India, Indonesia and Thailand, with recommendations for how those initiatives may be scaled-up to promote decent work opportunities and economic growth;

b) An assessment of key issues and best practices for effectively managing the migration of ICT workers, and how that migration can benefit both origin and destination countries and the ICT workers themselves.

[1] The sector discussed includes ICT manufacturing, ICT trade, ICT service, telecommunications, computer programming, consultancy and related activities, data processing, hosting and related activities, web portals, repair of computers and communication equipment (see Annex Table A1.1 for a detailed definition).

Scope

This report focuses on skills development, skills mismatch and labour migration in the ICT sector in India, Indonesia and Thailand and is the first in a series of three reports. To varying degrees, these three countries have invested in the ICT education and skills development of their workers, and have supplied the global market with ICT specialists or have the potential to supply them. As demand for ICT specialists has risen, the three countries have experienced increasing shortages of highly-skilled ICT workers in their domestic ICT sectors.

India, Indonesia and Thailand were chosen as focal points in this report for the following reasons:

a) All three countries initially based their national economic development efforts on the provision of low-cost labour to the global market, and by attracting foreign direct investment;

b) In recent years, India, Indonesia and Thailand have experienced rapid growth and economic transformations which were driven, in part, by digitalization and globalization;

c) The three countries have adopted national policies that promote skills development and support the digitalization era;

d) The labour markets of all three countries will likely be affected significantly by growth and developments in the global ICT sector.

India, Indonesia and Thailand have also been selected because they have different roles in global supply chains and represent different economic models:

a) India has one of the world's largest and most specialized ICT sectors and has made enormous investment in the education and training of ICT specialists;

b) Indonesia has recently seen rapid growth in its ICT sector;

c) Thailand has invested in the training of ICT specialists for several decades in an attempt to foster economic growth in the sector and to improve its position in global value chains.

In terms of labour migration, each of the three countries faces unique trends and challenges:

a) India is currently experiencing high rates of short- and long-term ICT emigration;

b) Indonesia and Thailand have low rates of ICT migration even though workers in these two countries are highly motivated to move abroad for employment opportunities.

Methodology

This report is based on an extensive literature review, background reports prepared by national consultants in each country and three weeklong research missions to Bangalore and New Delhi, India, Jakarta, Indonesia and Bangkok, Thailand. In total, approximately 40 interviews were conducted with representatives from government, training institutions, universities, industry associations, trade unions, recruitment agencies and private companies from the ICT sector. The interviews were a fact-finding mission and provided information for assessing current and future trends and challenges faced by the industry and workers.

Due to a lack of comparable and up to date data for the three countries, a direct comparison of the skills mismatch situation was not possible. For example, detailed labour force survey data were available for Thailand, but equivalent information from the other two countries was not. Available studies that assess skills shortages and the future demand for skills have been taken into account in the report, and certain general conclusions were drawn by using employer survey data on labour patterns in India and Thailand. In addition, research mission interviews were a very valuable source of information and provided an overview of possible skills shortages, skills mismatch and inefficiencies in the education system regarding skills development for ICT specialists in both the ICT sector and for affiliated sectors.

Structure of the report

This report is divided into four chapters. To begin, chapter 1 provides an overview of the development of the ICT sector and the ICT labour markets in India, Indonesia and Thailand. Chapter 2 seeks to assess the extent of skills shortages and skills mismatch for ICT specialists, and also provides a brief review of recent policies with an analysis of the capacity of the education sector to address skills mismatch. The report then continues with chapter 3, which analyses the international migration of ICT specialists, in terms of incentives and the barriers migrants may face in working abroad. Lastly, chapter 4 provides suggestions regarding policy responses for governments, education and training institutions and social partners and advises on how best to promote the skills development of ICT specialists and effectively manage international migration.

Chapter 1

Trends in the ICT sector and labour markets in **India**, **Indonesia** and **Thailand**

1.1. Digitalization of the economy

In India, Indonesia and Thailand, digitalization of the economy is driving the demand for ICT specialists across many sectors of the economy. Innovations in big data analytics and the adoption of disruptive technologies such as 3D printing, IoT, AI, machine learning and robotics are all laying the foundation for a global economic transformation. As with any new technological changes, digitalization affects employment in three ways: (i) increases in labour demand; (ii) the effect of labour saving, or the automation effect; (iii) the structural effect on changing job roles, tasks, processes and work organization. All three effects have an impact on the overall number of ICT specialists needed, as well as on the skill sets required of those specialists, and to a certain extent, they influence where ICT specialists will be in demand.

There is much uncertainty regarding the size of the effect that labour saving has on the economy (OECD, 2018a). From a technology perspective, potential drivers of automation include IoT, which supports the automation of production processes when combined with advanced robotics. The use of AI-enabled robotics and machinery may result in the displacement of knowledge workers, including in the banking sector. Technologies such as AI and IoT require fewer workers, but those workers that are employed must have interdisciplinary skills and complementarities, including creative thinking skills and social and physical dexterity.

Recent studies have used a task-based approach to estimate the impact of digitalization on employment. Most studies assume complementarity regarding labour needs and the implementation of new technologies while automation is put in place, and not the absolute replacement of a job with automation. Using data from the Program for the International Assessment of Adult Competencies (PIAAC), Nedelkoska and Quintini (2018) estimated the effect of automation on individual jobs and found that medium-skilled jobs will be negatively affected in the future.[1] Generally, jobs that are comprised of more ICT content are less susceptible to becoming automated. However, tasks and activities that may be automated include data collection and processing, routine and codified tasks as well as tasks that do not require high-level or specialized skills. By contrast, tasks that cannot be automated are mainly related to non-linear decision making processes and may include, planning and creative work, and activities that require problem solving capabilities. Communication activities including interacting with stakeholders, managing and developing personnel, engaging in negotiations, and performing tasks that require social perceptiveness could all be included in the group of tasks that cannot be automated (Suta et al., 2018).

However, not every activity that can be automated in the future will be automated. Whether or not this will occur is related to the penetration capability of a technology and its acceptance, in addition to cost structures, potential cost saving effects, and the availability of skilled labour. As ILO (2018a) noted, the future adoption of certain technologies will depend on a complex interplay of factors including the cost of labour, education and skill levels, legal frameworks regarding innovation, labour protection policies, infrastructure support, and social and cultural norms that shape public attitudes concerning technological change and innovation.

[1] Bessen (2016) and McKinsey Global Institute (2017) found similar effects, as reported by Suta et al. (2018).

The level of technological readiness of individuals and firms in India and Indonesia remains relatively low, and this is also true, albeit to a lesser extent, in Thailand. That suggests that the benefits of innovative activities related to digitalization are not widespread in the three countries examined here (see Box 1.1). It has been determined that less than 1 per cent of Indian small and medium-sized enterprises (SMEs) are prepared for Industry 4.0. The World Economic Forum (Schwab, 2017) has stated that benefits to society from breakthroughs in innovation do not happen automatically; rather, complementary efforts are needed in order to ensure that more individuals and firms have the means to effectively access and utilize new technologies.

Box 1.1. Technological readiness in India, Indonesia and Thailand

The International Telecommunications Union (ITU) ICT Development Index is a synthetic indicator composed of a series of sub indicators related to ICT access, ICT usage, and several general skills indicators relevant to ICT. The 2017 ITU ranking of 176 countries showed that at number 78, Thailand ranked highest of the three countries, followed by Indonesia at number 111 and India at 134.[2] The results indicated that infrastructure and ICT penetration factors, as measured by the number of mobile phones per inhabitant, for example, were most developed in Thailand, followed by Indonesia and India.

The Digital Evolution Index is a similar ranking that measures supply conditions, demand conditions, the institutional environment, and innovation and change in terms of the digital development of a country, and was presented in a report by Chakravorti and Chaturvedi (2017). In the Digital Evolution Index ranking of 60 countries, Thailand ranked highest of the three countries examined here, at number 42, followed by Indonesia at number 45 and India at 53.

Developed by the World Economic Forum, the Networked Readiness Index measures the political/regulatory and business/innovation environments, individual/business/government usage, infrastructure, affordability and skills availability, and the economic and social impact of technologies. In this ranking of 139 countries, Thailand was once again ranked highest of the three countries examined here at number 62, followed by Indonesia at number 73 and India at 91. [3]

The effects of digitalization on employment

In India, Indonesia and Thailand future demand for ICT specialists is likely to be driven by dynamics in the domestic markets in areas such as e-commerce, e-government, e-agriculture, e-medicine and health technologies, e-education and e-banking. In general, interviewees in this project's research interviews said that the net employment effects of digitalization were positive. While studies on future employment effects have been conducted for India (Box 1.2), comparable data are not available for Indonesia or Thailand.

Box 1.2. Estimated effects of digitalization on employment – India

A study conducted by Federation of Indian Chambers of Commerce and Industry (FICCI) underscored that the emergence of robotics, AI, cloud technologies and robust computing power is contributing to redundancy in many low-skilled, rules based jobs in India, and that these jobs are being replaced by technology and automation (FICCI/EY, 2016). The labour market is moving towards analysis and skills-based jobs, and with an increase in research investment in developed countries, rules based jobs are gradually becoming redundant. The study estimated that 640,000 low and medium-skilled jobs will be lost in the IT services industry in India by 2021. This loss will only partly be offset by an increase in the number of new jobs being created. In addition, India's IT services industry is expected to shrink by 480,000 workers by 2021, a reduction of 14 per cent from current levels. With regard to growth in IT Business Process Outsourcing (BPO) jobs, the study reported a 56 per cent anticipated increase in highly-skilled jobs, but the sector will lose 28 per cent of low and medium skilled jobs. The highly-skilled jobs will require creative problem solving, analytical skills and critical thinking.

As digitalization increases, there is a risk that the demand for intermediate and even highly-skilled ICT specialists may be reduced due to automation. Automation potential is considered significant in the area of software development and testing. [4] In India, recent data indicate that the rate at which ICT specialists are being hired is slowing down. For example, in 2017 the IT industry in India reported that more than 50,000 employees were laid off, which is new for the industry, and in the near future, call centre agents, financial transfer and data entry operators, document processing and system administrator jobs are likely to become automated (EY/FICCI/NASSCOM 2018; research mission interview with Cellular Operators Association of India (COAI), Delhi).

Research conducted in 2018 by ILO indicated that the adoption of advanced robotics and related technologies during the next decade will occur in specific niches, and therefore, job displacement will likely be concentrated in specific industries and work processes (ILO, 2018a). However, the automation of intermediate skill level jobs in the organized sector and the stagnating, or declining, demand for software developers will likely increase the movement of workers from low-skilled jobs to highly-skilled jobs and higher income work. Since the ILO study assumed that India will be slow to adopt ICT technology in manufacturing, given the high presence of SMEs and low labour costs, the study predicted a lower number of jobs being displaced by automation, as compared with the results of many other studies, including the World Bank report on the "digital dividends" published in 2016.

[2] For full ranking, see http://www.itu.int/net4/ITU-D/idi/2017/index.html

[3] For full ranking, see http://reports.weforum.org/global-information-technology-report-2016/ networked-readiness-index/

[4] Research mission interviews conducted during focus group discussions with employer representatives hosted by think-tank Delhi Policy Group, NASSCOM in Delhi and Bangalore, and COAI of India in Delhi, and with the Indian Institute of Science in Bangalore

National strategies

Government programmes in India, Indonesia and Thailand promote digitalization of the economy. The governments of those countries have recently articulated their visions for how digitalization can contribute to economic growth, societal development and human resource development, and have launched programmes to support efforts in this regard (Box 1.3).

Box 1.3. National flagship programmes for digitalized economies and societies

Launched in 2015, "Digital India" is a flagship government programme that includes a number of government agencies and departments and is focused on three key areas: digital infrastructure as a utility for all citizens, governance and services on demand, digital literacy for the general population. The National Digital Literacy Mission (NDLM) seeks to provide at least one person in every Indian household with crucial digital literacy skills by 2020 and has a target of reaching 250 million individuals in the next few years, including 60 million rural households in 2.5 million villages across the country.

At the Making Indonesia 4.0 event held in Jakarta in April 2018, the Secretariat General of the Ministry of Industry and Trade stated that one of Indonesia's strategies for promoting Industry 4.0 is to work with the five manufacturing sectors of food and beverages, automotive, electronics, chemicals, and textiles, in order to strengthen the fundamental structure of industry within the country.

The Thai Ministry of Digital Economy established the Digital Economy Promotion Agency (DEPA) as a part of the Thailand 4.0 economic model. DEPA seeks to support innovation and the development of the digital industry, as well as the adoption and use of digital technologies to achieve economic, social and cultural benefits, including the goal of ensuring that approximately 30 million people, or almost half the population, acquire digital skills. Other objectives include: the promotion of 25,000 digital enterprises and 1,000 digital start-ups, the creation of 24,700 digitalized villages, seven smart cities, and significant investment in the digital industry sector of 10 per cent (research mission interview with DEPA, Bangkok).

1.2. Overview of the ICT sector

While India began specializing in ICT in the 1990s, the focus on ICT is a new trend in Indonesia and Thailand. The remarkable growth in the Indian ICT sector was powered by its dominance in IT services and through the export of ICT and ICT-enabled services. The development of the sector in Indonesia and Thailand has mainly been driven by domestic demand in the financial, business, and retail sectors, and additionally, in the case of Thailand, the export of ICT goods. As of 2015, the share of ICT goods as a portion of total foreign trade was 14 per cent in Thailand as compared with 4 per cent in Indonesia and 1 per cent in India[5], meaning that while India and Indonesia were net importers of ICT goods, Thailand was a net exporter.

India

ICT service provision and related fields have undergone dynamic developments over the past several decades. The share of the IT sector as a portion of India's GDP has increased from 1.2 per cent in 1998[6] to 9.3 per cent in the 2015-16 fiscal year. The IT services sector covers a wide range of activity, from low value-add tasks to highly specialized operations.

The development of the IT and Information Technology enabled Services (ITeS) sector in India began in the early 1990s, when U.S.-based companies started to outsource their work. Outsourcing occurred because India had a supply of skilled ICT specialists who were available at relatively low wages as compared with their counterparts in the United States. Between 1995 and 2000, investments in research and development and infrastructure increased, paving the way for the growth of IT services in India. Subsequently, the number and size of Indian IT sector companies grew, and those companies were able to offer increasingly holistic and complex service solutions to their clients. Companies headquartered in countries with highly developed economies increasingly established operations in India, thus nurturing development of the sector. When the American company General Electric set up the John F. Welch Technology Centre in Bangalore, the company's first multidisciplinary research and development centre outside the United States, they were considered a pioneer in the industry. The centre currently employs more than 5,000 engineers and scientists and, to date, has applied for over 1,000 patents.[7]

[5] OECD, 2018 based on United Nations Conference on Trade and Development (UNCTAD) data. The ICT goods list consists of 93 products defined at the six digit level as per the 2012 version of the Harmonised System, which includes the high level categories of computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components and miscellaneous.

[6] The share of the ITeS BPM sector as a portion of India's GDP has risen from 1.2 per cent in 1998 to about 7.5 per cent in 2012 (Babu, 2013).

[7] For further information, see https://www.ge.com/in/

Table 1.1. Revenues and export orientation within the IT sector – India, 2017

	IT BPM			
	IT services	ITeS BPO	Software products and engineering services	Hardware
Share of revenue as a proportion of total revenue in the sector (Total=100%)	52%	19%	19%	10%
Export orientation	**Very high** (81% of revenue earned from exports)	**Very high** (87% of revenue earned from exports)	**Very high** (84% of revenue earned from exports)	Low

Source: India Brand Equity Forum based on NASSCOM, Aranca Research, April 2018; www.ibef.org, accessed on 22 September 2018.

In contrast to Indonesia and Thailand, Indian firms have evolved into multinational companies with global delivery centres, including in the United States, and there are several Indian companies among the global market leaders in computer software. In 2017, just five IT firms contributed more than 25 per cent of the total ICT sector revenue in India.[8] Currently, growth in the Indian ICT sector constitutes a key component of service sector growth as a whole, accounting for approximately 60 per cent of GDP and providing 30 per cent of available employment in India. Between 2004 and 2009, the combined annual growth rate (CAGR), as reported by government statistics, for IT and ITeS revenues was 30 per cent, and export growth far exceeded domestic growth (NASSCOM, 2011). The IT BPM sector in India expanded at a CAGR of 13.7 per cent from 2010 until 2016, a rate three to four times higher than global IT BPM growth and NASSCOM estimates that the sector will grow at a CAGR of 9 per cent until the year 2025 (NASSCOM, 2017).[9] Indian IT companies have a market share of 68 per cent in IT BPM in the country.

IT BPM in India is dominated by large firms with approximately 11 multinational companies producing half of the total export revenue and employing about 38 per cent of all workers in the subsector. NASSCOM estimates that about 120 – 150 medium-sized companies currently employ approximately 28 – 30 per cent of all workers in the subsector. In addition, about 1,000 – 1,200 companies, providing mostly niche IT BPM services, employ approximately 15 – 20 per cent of total subsector employees, while 15,000 small companies employ another 15 to 18 per cent. The latter group of small companies focus mainly on niche areas of service within IT BPM.

Although dominated by IT services, the Indian IT and ITeS sector is comprised of four subsectors, three of which are largely oriented towards exports (Table 1.1).

Indonesia

In Indonesia, the ICT sector accounted for 7.2 per cent of total GDP in 2016 and, with revenues growing at approximately 9.5 per cent per year between 2014 and 2017, the growth rate was greater than rates in other sectors (Agahari, 2017 referring to Oxford 2016). ICT growth has been linked with e-commerce and other digital services, and those types of services continue to drive the increasing demand for ICT specialists

To date the ICT sector has not attracted a large amount of FDI and one reason for this may be the shortage of specialized labour and a lack of investment in digital economy skills (research mission interview with Telkomtelstra, Jakarta). The creative industry is integral for certain ICT occupations including graphic and multimedia designers and although the Animation and Creative Industry Association (AINAKI) reports that this sector is still in its infancy in Indonesia, it has great potential for growth.

Thailand

The production of hardware has traditionally been an important subsector in Thailand and has served as a growth driver for the economy with IT hardware exports accounting for 12.4 per cent of the country's exports between 2010 and 2016 (European Union,

[8] See https://www.ibef.org/download/IT-_ITeS-Report-Apr-20181.pdf. [Accessed 24 April 2019].

[9] NASSCOM, 2017. For furhter information, see https://www.ibef.org/download/IT-and-ITeS-January-2017.pdf

2018). However, recently the market for computer hardware declined slightly according to estimates of the Office of the National Economic and Social Development Council. As a share of total investment made in the manufacturing sector, greenfield FDI in ICT and electronics was higher in Thailand, at 10 per cent, than in India and Indonesia, where it was 8 per cent and 1 per cent, respectively (OECD, 2018a).[10]

More recently, software production also gained importance and the market value of both Thailand's software production and its software services and embedded software production grew at CAGR of 4.0 per cent and 3.2 per cent, respectively, between 2013 and 2017 (Thailand Board of Investment (BOI); DEPA). Those developments were due to transformations in the economy driven by digitalization that led to high demand for IoT, big data analytics, cyber security, industrial software and embedded software systems and design, all of which are used by businesses in production processes and delivery of services (BOI, 2017).

1.3. Employment of ICT specialists

1.3.1. ICT specialists by sector

ICT specialists work in a variety of occupations, both within the ICT sector (see Annex Table A1.1) and in other economic sectors. While the ICT sector in India employs a large number of ICT specialists due to the size of the country and its specialization in IT services, employment of ICT specialists is comparatively small in Indonesia and Thailand, both in absolute and relative terms (as a percentage of the workforce outside agriculture). In addition to the fact that ICT specialists work in sectors other than ICT, it should be taken into account that ICT jobs within the ICT sector have become increasingly interdisciplinary and "hybrid jobs" are growing in number, the result being that an individual's ability to work across disciplines is becoming increasingly important. For example, the recent integration of tech, finance and related fields is now an indispensable consideration in providing ICT services to the banking and finance sectors.

[10] OECD Development Centre calculations; fDiMarkets calculations, 2017, https://www.fdimarkets.com, [accessed 6 May, 2019].

India

Estimates indicate that India's IT industry employs about 10 million workers (OECD, 2018a). The share of the workforce whose employment depends either directly or indirectly on the ICT sector was approximately 3 per cent of the total workforce in 2017. According to NASSCOM statistics, in 2017 the IT BPM industry generated 3.96 million direct employment opportunities for knowledge workers and 12 million indirect employment opportunities (NASSCOM, 2017), which is approximately double of what they were ten years ago.

Employment growth in the IT/ITeS BPO sector may be broadly divided into two phases over the past several decades. In the first phase, employment was focused on tasks related to the export of services. Workers in India were mainly engaged in internationally outsourced business processing operations including call centres, clerking, software development and medical transcription. Since 2005 there has been a steady expansion of IT/ITeS BPO for the domestic market (Babu, 2013). At present, the ICT sector is experiencing a shift towards high-end technologies on a global level and this shift is also occurring in the Indian market. More specialized skill sets are required in order to adapt to rapid shifts in technology, with recent job expansion slowing down in many traditional areas, but growing in new areas that require highly-skilled workers (EY; FICCI; NASSCOM, 2017). In 2017, hiring trends were below the levels of previous years in the areas of in BPO, Knowledge Process Outsourcing (KPO) and ITeS.

Indonesia

In Indonesia the ICT sector currently employs 998,000 workers, with the sector being defined based on ISIC Rev. 4 (see Annex Table A1.1), as including broadcasting and movie activities, but excluding ICT manufacturing, trade and repair[11] (Badan Pusat Statistik (BPS), 2018). There were 500,000 individuals working as ICT professionals and technician roles as of 2018 across all sectors.[12] Growth has been greater in other sectors that use ICT rather than in the ICT sector itself, such as in the area of e-commerce for example, and the market is expanding rapidly led by tech and digital

[11] An additional 308,608 work in ICT as a supplemental form of employment.

[12] Labor Force Situation in Indonesia, Statistics Indonesia, Subdirectorate of Manpower Statistics, (2018, Catalog No. 2303004, February), references International Standard Classification of Occupations (ISCO) 25, 35, 215, 742, 2166, 2356, 2434, 3114.

companies including Tokopedia, Go-jek, Traveloka, and Bukalapak. Indonesia is poised to become a location for digital innovation, including in the areas of retail and financial services, with new business models acting as the primary form of innovation (McKinsey, 2017).

Thailand

There were 386,306 employed ICT specialists in Thailand in 2017, accounting for 1.03 per cent of total employment.[13] The employment of ICT specialists has grown by 7 per cent annually over the past five years and DEPA aims to increase the total number of digital workers to 500,000 within the next five years. In 2016, 59 per cent of ICT technicians and professionals worked in the service sector, including trade, banking and business administration, while 15 per cent worked in manufacturing and 24 per cent worked in public administration.[14] According to the 2017 Establishment Survey on the Use of ICT done by Ministry of Information and Communication Technology, which excluded companies in the manufacturing sector, 46 per cent of ICT specialists in Thailand were employed as computer associate professionals.

1.3.2. The role of start-ups

Two opposing trends in the ICT market can also be observed worldwide. On the one hand there is a concentration of businesses, fuelled by the creation of large network and platform providers in the ICT sector, who benefit from economies of scale. In addition, the most powerful global companies are headquartered outside India and Southeast Asia. On the other hand, India as well as Indonesia and Thailand are experiencing growth in the number of ICT start-ups being established domestically.

Bangalore, India is currently home to approximately 10,000 start-ups, and they play an important role in product development because they are a way for the industry to inexpensively test new ideas. The Indonesian start-up scene is also quite dynamic, and data provided by startupranking.com shows that there are currently around 2,100 start-ups located there, making Indonesia home to the fifth largest number of start-ups in the world.[15] Thailand's start-up industry is relatively new, but is growing rapidly. Thailand is home to more than 5,000 start-ups.

The governments of the three countries have launched programmes, initiatives and strategies to support start-ups in addition to programmes already in place through business associations and universities. In 2017, the Thai government approved the establishment of a US$147 million "Digital Fund" to support local start-ups[16] and DEPA aims to provide financial support to 1,000 start-ups within the next five years. In India, the government programme "Startup India" provides tax exemptions to start-ups for three of the first seven years after they are established (IBEF, 2018). Tax exemptions are also provided in Indonesia, and the government has issued an E-Commerce Road Map Presidential Decree[17], which includes tax incentives for start-ups and those who provide venture capital funding.[18]

An important condition for a dynamic start-up scene is that potential failures are not penalized by the labour market. For example, it is vital that individuals whose start-ups have been unsuccessful can find employment with other companies (research interviews with Human Resource departments and recruiters in India, Indonesia and Thailand). Interviewees in all three countries underlined the fact that the start-up culture in the ICT sector embodies the aspirations of the younger generation, who do not envision a working life that follows the rigidity of traditional companies, but who are instead seeking an innovative work environment.

1.3.3. Gender perspective

Opportunities for advancing gender equality in ICT may be achieved through investment in the removal of barriers and by providing incentives for individuals going into the field of ICT.

[13] According to Labour Force Survey data, National Statistical Office, Thailand.

[14] ISCO 25, 35; ILO; Labour Force Survey data, Government of Thailand; proprietary calculations.

[15] For the definition of start-ups in startupranking.com, see https://www.startupranking.com/what-is-a-startup, [accessed 12 May, 2019].

[16] For further information, see http://thaiembdc.org/2017/06/26/thailand-focus-2/.

[17] Presidential Decree No. 74/2017.

[18] The World Bank: Preparing ICT Skills for Digital Economy: Indonesia within the ASEAN context, presentation done through The World Bank Group auspices, Jakarta, 8 March 2018.

Female employment – the ICT sector and working as ICT specialists

In India, Indonesia and Thailand, roughly one third of total employees in the ICT sector are women.

In the IT-ITeS sector in India, the share of women employed was more than one third of the total workforce in 2017-2018 (see Table 1.2).

In Indonesia, 35.6 per cent of those employed in the ICT sector are women (BPS, 2018),[19] and the majority of these women work in marketing (see Table 1.3 for breakdown by job function).

Table 1.2. Share of female ICT sector workers – India (%)

Sector and Year	2014-15	2015-16	2016-17	2017-18
BPO, KPO and ITeS	34	30	37	38
Software and IT	32	35	33	27
Telecommunications and related services	33	29	-	-

Source: India Skills Report, 2014 – 2018.

Table 1.3. Share of female ICT sector workers by job function – Indonesia (%)

Professional/Specialist	28.2
Marketing	54.6
Other	19.4
Total	35.6

Source: BPS, 2018.

In Thailand, the Labour Force Survey (2017) showed that the share of female ICT specialists has been gradually increasing in recent years, rising from 27.3 per cent in 2012 to 32.6 per cent in 2017.

The share of women working as ICT specialists should be put into context and examined as part of female labour market participation rates overall. Labour market participation was highest in Thailand, at 61 per cent, followed by Indonesia at 50 per cent and then India at 28 per cent (in 2016, data retrieved from ILOSTAT). One important reason for the low share of women within the ICT specialist workforce, is that women's enrolment rates in IT-related study fields at technical vocational and higher education institutes are also low (see Chapter 2 for further information).

[19] Statistics Indonesia, Subdirectorate of Manpower Statistics, (Catalog No. 2303004), February 2018.

Career opportunities for women

Several studies that have investigated employment conditions in the ICT sector have revealed a gender divide with several nuances. A study from 2013 argued that women in India are at a disadvantage regarding the employment benefits of IT and are increasingly being marginalized with low-end work that is poorly paid (Babu, 2013).[20] Women tend to be overrepresented in job roles such as programming and testing, and underrepresented in higher level managerial positions, such as IT architecture, consulting and project management. Due primarily to social reasons and family obligations, women work fewer hours than men. Married women face additional constraints due to domestic responsibilities, which often require them to leave the office earlier than their male counterparts (Upadhya and Vasavi, 2006).

Table 1.4 shows that, in India, the proportion of women in entry-level jobs is significantly higher than the proportion of women at middle management and senior management levels, indicating that women tend to be at a disadvantage with regard to career advancement in the ICT sector. The gap is largest in the ITeS/BPO sector and smallest in the software industry and IT services, where women have relatively better career opportunities. In future, there may be more employment possibilities for highly-skilled women in the ICT sector given that the demand for those skills is on the rise and the fact that companies

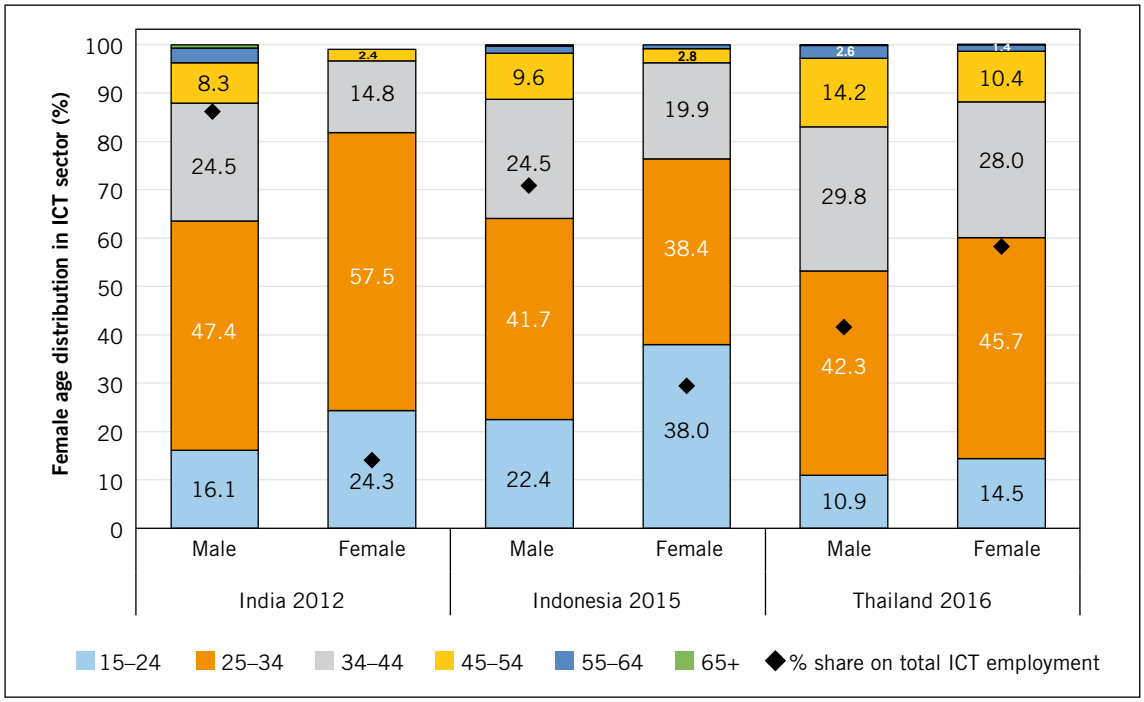
Table1.4. Women employees in the three core levels of work (%)

Sector / Level	Entry level	Middle management level	Senior management level
Software and IT services	14	11	5
ITeS/BPO	28	8	2
Telecommunications	13	7	3

Source: NASSCOM, 2014; Harvard Kennedy School, Evidence for Policy Design Initiative, 2013.

[20] Studies similar to the Babu, 2013 study include Upadhya and Vasavi, 2006.

Figure 1.1. Age structure of the ICT sector*, country comparison by gender



*Employment in the areas of manufacturing of computers, electronic and optical products, telecommunications, computer programming, consultancy and related activities, information service activities, according ISIC 4: 26 + 61 + 62 + 63.

Source: Labour force survey (SAKERNAS), Statistics Indonesia; Labour Force Survey, National Statistical Office, Thailand; National Sample Survey, Open Government Data Platform India; ILO database.

are implementing gender friendly policies (research mission interview with NASSCOM, Bangalore).

To enhance employment opportunities for women, a number of large IT companies in India, including Tata Consultancy Services (TCS), have raised their annual targets for hiring female employees. TCS currently employs approximately 400,000 workers, of whom 35.6 per cent are women. TCS provides incentives for female employees, including flexible working hours, the opportunity to work from home, and childcare facilities. Despite these efforts, few women hold high-level positions (research mission interview with employer representatives at a think tank meeting, Delhi).

Looking at the ICT sector as a whole, including non-ICT specialists, a number of jobs that are currently done by women are likely to be affected by automation in the future, including call centre agents and low-skilled positions in ICT hardware production lines.

1.3.4. Age structure of workers in the ICT sector

Of the three countries, the proportion of young people between the ages of 15 – 24 working in the ICT sector is largest in Indonesia, while the proportion of young adults between the ages of 25 – 34 employed in the ICT sector is largest in India, with young adults accounting for nearly half of all employees working in the sector in India. Thailand has the largest share of prime age and older workers (see Figure 1.1). Workers in the ICT sector are, on average, younger than the average ages of those employed overall, this trend holds true for all three countries. In particular, the number of women under 35 is larger in the ICT sector as compared to the age distribution of overall employment in the three countries.[21]

According to an employer survey conducted in India, the IT industry prefers to recruit young people (see Table 1.5). The preference for slightly older workers in software and IT-service may be linked to the higher educational level required and the value placed on previous work experience.

Table 1.5. Age preferences in ICT sectors – India

Sector	Age (years)
BPO, KPO and ITeS	22-25
Software and IT	26-29
Telecommunications and allied services	22-25

Source: India Skills Report, 2014.

[21] Age distribution of employed workers in India: ages 15-24 male: 15.8 per cent, female: 14.7 per cent; ages 25-34 male: 26.4 per cent, female: 25.3 per cent; Indonesia: ages 15-24 male: 14.0 per cent, female: 14.6 per cent; ages 25-34 male 25.6 per cent, female 23.8 per cent; Thailand: ages 15-24 male: 11.2 per cent, female: 9.1 per cent; ages 25-34 male 21.7 per cent, female 22.2 per cent.

1.3.5. Educational level of ICT specialists

In all three countries, ICT specialists have a higher level of education than the average worker in many other sectors within the economy. In India and Indonesia in particular, ICT workers tend to have more advanced skills. For example, in Indonesia, less than 10 per cent of the labour force holds a university degree (ILO, 2017), while 25 per cent of workers in the ICT sector have university degrees (see Table 1.6 below). In addition, if university degree holders are added to workers who have completed upper level vocational training, the share of highly-skilled workers in the ICT sector is 35 per cent of the total ICT workforce.

India

The ICT sector workforce in India is comprised of a diverse mix of individuals with varying skill sets and includes groups of highly-skilled engineers, programmers, designers and network specialists as well as groups of low and medium skilled workers working in the BPO and ITeS sectors as data entry operators, clerks, and telephone-based sales assistants. A detailed summary of employment within the various ICT segments by educational level[22] is shown in Table 1.6.

Indonesia

Half of all ICT specialists in Indonesia hold a degree from a senior high school known as *Sekolah Menengah Atas (SMA)*, or a secondary vocational high school known as *SMK*. Fifteen per cent of ICT workers have completed a level of education lower than high school, while 10 per cent have an upper vocational institution diploma and 23 per cent have a bachelor's degree from an academic institution. At present, only 2 per cent of ICT specialists hold a master's or doctorate degree (see Table 1.7).

Table 1.7. Workers in ICT by educational level – Indonesia, 2018

Educational level	Number	%
SMP and below (below secondary vocational education)	153 620	15.4
SMA or SMK (secondary vocational education)	499 981	50.1
Diploma (upper-vocational education)	97 588	9.8
S1 (bachelor's degree)	228 326	22.9
S2/3 (master's and doctorate degrees)	18 858	1.9
Total	**998 373**	**100**

Source: SAKERNAS, Statistics Indonesia, February 2018.

Thailand

In Thailand, as of 2017, two-thirds of ICT specialists had a degree from a higher education institution, while only one-sixth of all remaining employees were considered highly-skilled based on their level of education (Labour Force Survey, National Statistical Office, 2012-2017). As of 2017, approximately 24 per cent of all ICT specialists in the country had completed up to and including upper secondary level education and 11 per cent held a post-secondary non-tertiary level qualification. Approximately 56.8 per cent of workers held a bachelor's degree and 7.4 per cent held a master's degree, with only very few ICT specialists having obtained a doctorate-level degree (see Table 1.8).

Table 1.6. Workers in ICT segments by education level – India, 2016 (%)

	Universities or equivalent		Technical and Vocational Education and Training			Others	Total*
Education level	Engineering	Management	ITI (higher education)	Vocational (part of mainstream school education)	Diploma (higher education including polytechnic institutes)		
BPO and IteS	13	16	10	7	16	35	100
Software and IT	45	12	6	8	11	17	100
Telecom	43	14	25	5	9	3	100

Note: Aggregate numbers do not add up to 100 due to differences in rounding.
Source: India Skills Report, 2016.

[22] Note that in Indian publications, IT-specialists and ICT-specialists are often considered separate occupations. In this report they are mostly grouped together in the broad category of ICT specialists.

Table 1.8. ICT specialists by educational level and gender – Thailand, 2017 (%)

Educational level	Male	Female	Total
Pre-primary	0.1	0.0	0.1
Primary	2.6	0.9	3.5
Lower secondary	4.3	1.8	6.1
Upper secondary	10.5	3.9	14.4
Post-secondary non-tertiary	7.9	3.1	11.0
Bachelor's	37.2	19.7	56.8
Master's	4.3	3.1	7.4
Doctorate	0.2	0.1	0.2
Total	**67.4**	**32.6**	**100**

Source: Labour Force Survey, National Statistical Office, 2017; calculations by a national consultant.

While the share of ICT specialists with a bachelor's degree increased slightly from 54.2 per cent to 56.8 per cent between 2012 and 2017, the share of those with a master's degree decreased from 9 per cent to 7.4 per cent (Labour Force Survey, National Statistical Office, 2012-2017).

According to data obtained through the Establishment Survey on the Use of Information and Communication Technology, which excludes the manufacturing sector and is thus not comparable with the Labour Force Survey, only slightly more than one-third of those currently working as ICT specialists in Thailand hold a degree in an ICT-related field from a vocational or academic institution.[23] The remaining ICT specialists either hold a degree in another field of study, or do not have a degree. ICT specialists in large companies typically graduate in ICT-related fields, for companies with more than 200 employees, 71 per cent of employees have ICT-related degrees, while only between one-quarter and one-third of those working in small companies with up to 30 employees hold a tertiary degree (see Annex Table A1.3). This may indicate one or both of the following: that the nature of work in small companies does not require higher-level knowledge in ICT-related fields, and/or that ICT employees may be under-qualified in terms of formal education, particularly those employed in small enterprises.

1.3.6. Wages of ICT specialists

India

As the Indian IT services sector has moved up the global value chain and as demand for ICT specialists has increased in recent years, wages for ICT specialists have risen sharply. This increase also includes pay increases that change on the basis of pay variables, indicating that companies are linking employee pay to individual performance (see Table 1.9).

Table 1.9. Average increment pay and average variable pay as a percentage of cost-to-company (CTC) for the IT and ITeS subsectors[24] (%)

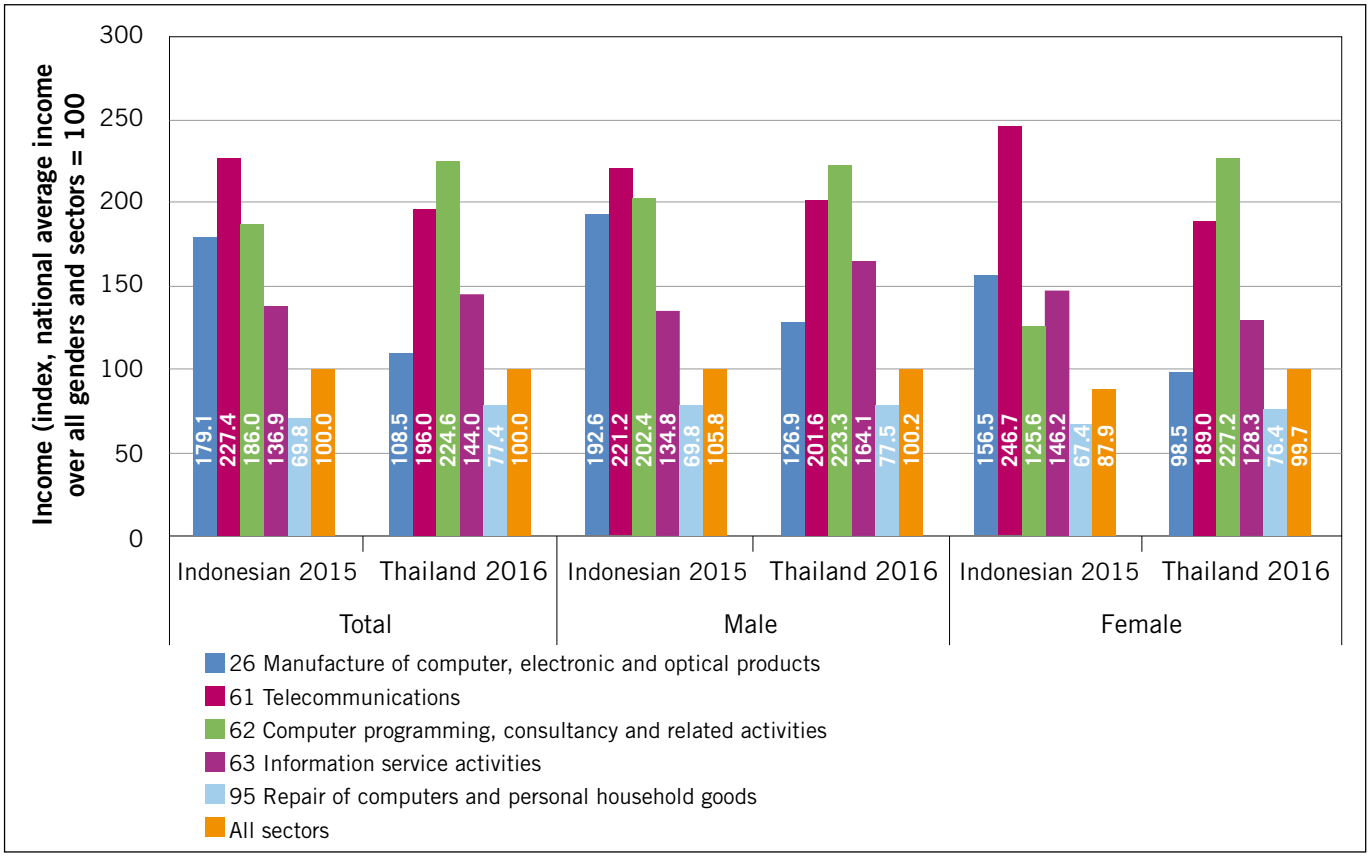
Subsectors	Average increment pay		Average variable pay	
	2016-17 actual	2017-18 projected	2016-17	2017-18
IT	10.7	9.8	15.2	15.6
ITeS	10.4	10.1	12.3	12.8
Banking and financial services	9.6	8.6	19.6	19.9
Retail	11.3	11.1	15.5	16.0
Pharmaceuticals and healthcare	11.7	11.4	17.1	17.4
Media and advertising	11.3	10.6	11.5	11.7

Note: This report is based on an annual survey analysis of 263 companies across 19 sectors by KPMG as of March 2017.
Source: KPMG, India's Annual Compensation Trends Survey 2017-18.

[23] ICT study fields include the following: a) Computer Engineering: Computer, Computer Sciences, Computer Technology, Computer Engineering, Computer Innovation, Electrical and Computer Engineering; b) Electronics: Electronics Technology, Electronics Physics, Electronics and Computer, Power Electronics Technology, Electronics; c) Information Technology: Information Technology Management, Information Technology for Businesses, Accounting Information Technology, Computer and Information Technology, Industrial Information Technology, Information Technology for Management, Technology of Information System Management, Statistical Information Technology, Information Technology and Computer Innovation, Information Technology, Computer Information System, Information Innovation; d) Applied Computer: Business Computer, Applied Computer Innovation, Computer Technology, Industrial Computer, applied Computer and Multimedia Innovation; e) Telecommunication: Telecommunication Management, Telecommunication, Electronics and Telecommunication Engineering Telecommunication Technology, Telecommunication Engineering; f) Statistics: Computer Data Processing, Statistics, Applied Statistics, Mathematical Statistics.

[24] Apart from the IT and ITeS sectors referred to in the table, some other important sectors, including Automotive and Auto Components, Engineering and Manufacturing, Infrastructure, Construction and Real Estate and Consumer Goods were also considered in the survey. The compensation related figures are indicative of industry inputs and should be considered in conjunction with other secondary reports, India mission findings and industry expert validations.

Figure 1.2 Income by ICT subsectors Index of national averages among men and women within the whole economy = 100 (Indonesia and Thailand)



Source: Labour Force Survey (SAKERNAS), Statistics Indonesia; ILO database, 2015, 2016; calculations by a national consultant.

Recent trends show that newer technology jobs, including big data analysis, network planning and optimization, are commanding higher salaries than more traditional jobs such as IT recruitment and SQL development. According to a 2017 report by TeamLease, job roles that are in high demand at present include big data experts, HADOOP developers, network planning and optimization specialists, and packet core specialists.[25] Those types of jobs can pay a monthly average salary of between 66,700 rupees (INR) and INR87,500, or approximately US$920 and $1,210.[26] The report also discusses future job roles and their corresponding salaries, including those for copywriters, lead content strategists, data scientists, content marketing managers and publishers, and integration managers all of whom could earn between INR20,000 and INR55,000 monthly, or the equivalent of approximately $280 and $760.

When asked, students studying ICT fields respond that ICT product manufacturing companies are less prestigious within the ICT value chain than ICT service companies are because the latter may offer salaries up to three times higher than those offered by the product manufacturing companies (research mission interview, IIIT Bangalore).

Indonesia

In recent years, average wages for employees with tertiary qualifications have nominally increased, while the wages of those with a junior high school education or less have remained stagnant (Allen, 2016). Workers with university degrees earn the highest wages as compared with the rest of the labour force, and on average, earn three times as much as those who have only completed junior high school.

Figure 1.2 shows the income gains for employees in the ICT sector in Indonesia and Thailand[27], as compared to the average income for workers overall in the respective labour forces of the two countries. According to the Figure, in Indonesia incomes are highest for workers in the telecommunication industry, followed by computer programming, consultancy and related activities, and the manufacturing of computer, electronic and optical products. The data include the income of employees

[25] TeamLease Salary Primer – Part 2, Analysis Report, 2017, http://www.teamlease.com/sites/default/files/resources/salary%20primer-part%202.pdf, [accessed 29 March 2019].

[26] Exchange rate as of 24 September 2018.

[27] There is no comparable data for India.

in the ICT sector as a whole, and therefore those who were not employed as ICT specialists, but rather in other jobs, are also included in the averages.

The data also show that on average, the incomes of women in computer, electronic and optical products manufacturing were lower than the average wages for men in that industry in both Indonesia and Thailand. In the area of telecommunications, women in Indonesia had a higher average income than their male counterparts, while women in Thailand had lower average incomes than men. Both genders had similar average incomes in Thailand in jobs including computer programming, consultancy and related activities, but the average incomes of women in those areas in Indonesia were lower. Despite the differences that may be observed in the data, there is a lack of information regarding why these differences exist and further investigation would be required to determine the contributing factors in the discrepancies.

For ICT specialists with diverse job roles working in different economic sectors there are likely to be even greater variations in salaries. For example, based on data provided by Michael Page (2018), the annual salary for a social media executive in the digital sector could range from IDR91 million (Indonesian rupiahs) to IDR156 million, or the equivalent of US$6,200 to US$10,500,[28] and the annual salary for an e-commerce director could range from IDR650 million to IDR1300 million, or between $43,700 to $87,600 (see Table 1.10).

Table 1.10. Annual gross salaries in the digital sector (excluding bonus), 2018

Role	Salary range (IDR, million.)		
	Minimum	Maximum	Average
Online / Digital marketing manager	195	780	488
Content production manager	195	325	260
Online product manager	195	650	423
Director / Head of digital	585	1105	845
Social media executive	91	156	124
Social media manager	91	520	306
SEO / SEM executive	91	156	124
User experience specialist	195	325	260
E-commerce manager	325	650	488
Director / Head of e-commerce	650	1300	975
Partnership manager	325	520	423

Source: Michael Page, 2018.

[28] Exchange rate as of 21 September 2018.

Thailand

In Thailand, average ICT wages were BHT23,845 (Thai Baht) or $763.56[29] per month, almost twice as high as the monthly salaries of non-ICT workers, who earned BHT13,563 or $434.31) on average (BOI, 2017). Among those working in highly-skilled jobs, ICT service managers received the highest wages, with an average monthly salary of BHT47,663, equivalent to $1,526.26 (see Annex Table A1.4 for further information).

In Thailand, hourly wages for graduates with a master's degree are generally four times higher than for those with only an upper secondary education. Wage premiums are highest for workers with tertiary degrees in the fields of engineering and the sciences (Patmasiriwat, 2011).

1.3.7. Challenges

Labour data for the countries of India, Indonesia and Thailand[30] indicate the share of the total number of workers in the ICT sector who are self-employed as being 13.1 per cent in Indonesia, 10.9 per cent in India and 3.6 per cent in Thailand.[31] According to the online labour index at Oxford University, United Kingdom,[32] while only about 6 per cent of all freelance "gig" work is offered by companies in India, globally, compared with 40 per cent of vacancies being posted in the United States, India provides more than 30 per cent of the total number of software developers for the market. Among gig workers in Asia, 48.8 per cent work in software development and technology, 23.5 per cent work in the creative industry and multimedia, while 15.4 per cent perform clerical and data entry tasks, the latter being a significantly higher percentage than the number of gig workers in other parts of the world who do clerical and data entry work. The gig economy is not easily categorized since it is comprised of a wide range of workers across several sectors, from those who are highly-skilled and voluntarily provide services on a contractual basis, to others who are unable to obtain a permanent position and for whom the only option is to work

[29] Exchange rate as of 6 February 2019.

[30] For India: Annual Employment Unemployment Survey Report; for Indonesia: Labour force survey (SAKERNAS), Statistics Indonesia; for Thailand: Labour Force Survey, National Statistical Office.

[31] Proprietary calculations from ILO database information.

[32] The index measures the supply and demand of online freelance labour across countries and occupations by tracking the number of projects and tasks that are offered across platforms in real time. The index tracks all projects or tasks posted on the five largest English language online labour platforms, which represent more than 70 per cent of the market for freelance work, as measured by traffic.

freelance. The gig economy and freelancing are trends that are increasing in India, and these trends are likely to continue in the future.

Globally, concerns have recently been raised regarding new forms of work related to digitalization, including, for example clickworkers and online platform workers, which are types of work not necessarily done by trained ICT workers.

ICT workers benefit from the gig economy in that they may offer services, such as coding for example, to a broader, and even an international, marketplace. At the same time gig work may have a negative impact on access to training opportunities usually provided by mainstream employers that offer permanent employment. A key element for the success of an ICT specialist is the ability to develop skills that enable a response to rapid technological developments, regardless of whether those ICT specialists are employees of a company or are self-employed. In future, re-skilling will also become necessary for those who perform tasks that are at risk of becoming automated.[33]

While the advantage of the gig labour market is its inherent flexibility, which may offer workers an amenable work location and a flexible schedule, it may also present certain risks for workers, since working conditions cannot be regulated. Surveys conducted by ILO (Berg, 2016), have shown that for Indian Amazon Mechanical Turk workers, the most important reason cited for choosing this type of employment was that respondents preferred to work from home (31.7 per cent) and about one-sixth of women respondents indicated that due to caretaker responsibilities, they had to work from home.

However, working conditions for many individuals may not be optimal. For example, the number of weekly or yearly hours worked can be difficult to control, and the worker may not have access to social security contributions. One study on gig economy flexibility examined the time management of online piecework, which is estimated to account for between 10 – 20 per cent of all online work within the gig economy, and is characterized by a particularly short cycle time (Lehdonvirta, 2018). The study revealed both changes to working life structures compared to traditional work modalities and changes in the nature of work spaces (e.g. co-working spaces). The author concluded that, "some win greater temporal sovereignty for themselves, while others find the constant tyranny of the clock replaced by a fickle tyranny of the app" (Lehdonvirta, 2018). In addition, there are few opportunities for workers to communicate with clients about the work that they are carrying out or to report information about their working conditions. In some circumstances this may result in unfair treatment (ILO, 2018b).

New forms of work related to the gig economy also create questions regarding social security regulations, including pensions. Workers on online platforms are mostly self-employed and are remunerated on the basis of pieces or tasks completed (ILO, 2018b); meaning they may not receive benefits such as health insurance through their job. A survey conducted on 103 crowd workers in India (Berg, 2016), indicated that among those for whom crowdwork was their primary employment, only 12.3 per cent contributed to a private pension fund, while 42.3 per cent of those for whom crowdwork was not their primary employment contributed to a private pension.

The lack of job security inherent to gig work may contribute to overall poor health and psychological distress, with poor health being more likely for those who did not choose gig work voluntarily. Gig work may also lead to increased isolation due to a lack of social support and having fewer or no face-to-face interactions with colleagues (Tran and Sokas, 2017).

Attracting more women into ICT professions is another challenge. Although some large IT-service companies do have some gender-focused strategies in place, awareness about gender discrimination and the working conditions of women is still lacking, with one major issue being sexual harassment of women at the workplace. In India, the Sexual Harassment of Women at Workplace – Prevention, Prohibition and Redressal Act 2013 was ratified by the Indian Parliament in December 2013. The results of a non-representative survey, conducted by EY Forensic & Integrity Services among 120 employers, of whom 17 per cent were operating in the IT/ITeS sector and 43 per cent were multinational companies, indicated that about 27 per cent of the large companies and 50 per cent of the small and medium-sized companies that were surveyed were not compliant with the Act (EY, 2015).

Sexual harassment and non-compliance issues should be a concern to social partners, but such topics are not yet part of general social dialogue and self-employed ICT specialists and gig software

[33] Chapter 2 will explore skills development issues.

developers lack the ability to voice concerns about those issues and the opportunity to organize.

1.4. The role of ILO constituents

The aforementioned developments within the ICT sector mean that ILO stakeholders have an increasingly important role to play. Ministries are critical in the area of education policies and skills development governance. While industry associations in the ICT sector are well established, skilled ICT workers in the sector have only just begun to become organized. At present, social partners are primarily concerned with skills development for ICT specialists, while contract condition negotiations have only recently emerged as an issue. To promote decent work in the ICT sector, further social dialogue will be necessary.

Ministries

In the ICT sector, ministries responsible for skills development, such as vocational training and general education, can play a significant role in formulating policies and defining strategies to address skills shortages and skills development. Relevant ministries include the Ministry of Skill Development and Entrepreneurship (MSDE) in India, the Ministry of Manpower in Indonesia and the Ministry of Labour in Thailand (see Chapter 2 and Annex A4 for further information).

Employers' organizations

In the ICT sector, employers' organizations and industry associations in India, Indonesia and Thailand play a key role in identifying and developing the skills required by the relevant industries (see Chapter 2).

In India, industry associations are very influential and the following is a list of important associations:

a) NASSCOM is a not-for-profit trade association and the premiere organization representing the IT BPM industry in India. The more than 2,200 members, constituting 90 per cent of total industry revenue, have supported the association in spearheading initiatives at local, national and global levels. Therefore, NASSCOM is strongly aligned with the industry and is influential in shaping policies.

b) COAI is an important industry association comprised of mobile service providers, telecom equipment, and Internet and broadband services providers in India.

c) Manufacturers Association of Information Technology (MAIT) is an important association for the IT hardware industry.

d) In addition to the aforementioned national industry associations and chambers of commerce associations, the Confederation of Indian Industry (CII) and the Associated Chambers of Commerce and Industry (ASSOCHAM) also have their own ICT councils.

The Thai Federation of ICT Technology Association (TFIT) has worked towards developing national professional standards and most companies in the Thai ICT sector are affiliated with TFIT (research mission interview with Thailand Professional Qualification Institute (TPQI), Bangkok).

In Indonesia, certain industry associations, including the Indonesian Internet Service Providers Association, provide training to workers.

Workers' organizations

Trade unions in the ICT sector have only recently been established. The establishment of the trade unions has been motivated by labour disputes that have occurred, including major ones in India and Indonesia. Those organizations focus on a number of issues, including skills development.

In India, the Forum for IT Employees (FITE), an IT specialist workers' organization, was founded in 2014 in order to protest unethical layoffs after an IT company dismissed between 25,000 and 30,000 workers. FITE has cited the fact that the IT industry in India has not yet obtained official recognition as an industry as a reason for a lag in formalizing employee associations in the manner that industry trade unions have been formalized (research mission interview with FITE, Bangalore).

In Indonesia, the trade union SINDIKASI was established in August 2017 and covers 18 sectors, including media, advertising, photography and the film industry. The average age of workers in those sectors is relatively young. SINDIKASI provides career development and training to its members and also acts as a platform for highlighting the concerns of individuals, including freelancers working in media, advertising and creative industries.

In Thailand, workers' organizations for ICT specialists have not been established, however, the state owned telecommunication companies TOT and CAT have their own trade unions. Among

major trade unions, the State Enterprise Workers' Relations Confederation (SERC) represents 47 different trade unions with approximately 200,000 total members, who primarily work for state owned enterprises. In the view of SERC, the government of Thailand should adjust the national education strategy to address emerging issues related to human resources, technology and skills development (research mission interview with SERC, Bangkok). The Thai Trade Union Congress (TTUC) is a trade union federation in Thailand that represents 82 unions from various industries, including the automobile, textile, electronics and chemical industries. TTUC had been working to raise awareness regarding both general and advanced IT skills training for workers through communication and coordination with company managers and the Ministry of Labour (research mission interview with SERC and TTUC, Bangkok).

Chapter 2

Education and skills development

This chapter seeks to assess the extent of skills shortages and skills mismatch for ICT specialists in India, Indonesia and Thailand. It also provides a brief review of recent policies that address skills issues and offers an analysis of the capacity of the education sector to address skills mismatch challenges.

2.1. Education and training for ICT specialists

2.1.1. Vocational training and education and academic education in ICT and related fields

India

ICT subjects are primarily taught in upper vocational education institutions and in certain departments of the university education system.[1] The higher education system, or "tertiary education", has both a vocational and an academic stream for students. Therefore, advanced vocational education in ICT may be pursued at a university or as part of a TVET course at a polytechnic or industrial training institute.[2] At schools below the level of the higher education, ICT courses are taught under the umbrella of vocational studies within the secondary school education system (see Figure 2.1). In addition to formal ICT education and training, it is possible to obtain an ICT education in the non-formal education system.

Academic stream

In India, higher education in ICT is commonly taught as part of engineering courses, including for the degrees Bachelor of Technology or Master of Technology in Computer Engineering and Information Technology. ICT is also taught as part of computer application courses, including for the degrees of Bachelor of Computer Application, Master of Computer Application and doctorate-level ICT courses.[3]

A teaching institute is considered to be an Institute of National Importance (INI), or a "premier institute", if it is deemed to have a pivotal role in the development of India. Institutions in this premier category include Indian Institute of Technology (IIT),[4] Indian Institute of Information Technology (IIIT)[5] and National Institutes of Technology (NIT)[6], which are all considered prestigious institutions offering courses in ICT and related study fields. INI receive special financing from the government and entry exams for these institutions are highly competitive, with only 113,700 of the 4.4 million total students in India enrolled in INI undergraduate programmes. Out of the nearly 2 million postgraduate students at the master's and doctorate levels, only 41,300 were enrolled at an INI during the 2016-2017 academic year (AISHE, 2016-2017).

[1] School education in India may be divided into four categories based on years of schooling: primary (up to year 5), upper primary (year 6-8), secondary (years 9-10), and senior/ higher secondary (years 11-12).

[2] Tertiary education builds on senior secondary education by providing learning opportunities in specialized fields. In India, tertiary education is generally understood to include specialization/ professional education at the higher education or advanced vocational level. Vocational education includes programmes designed for the acquisition of knowledge, skills and competencies specific to a particular occupation or trade. Definitions are done according to Ministry of Human Resource Development (MHRD), Indian Standard Classification of Education, 2014.

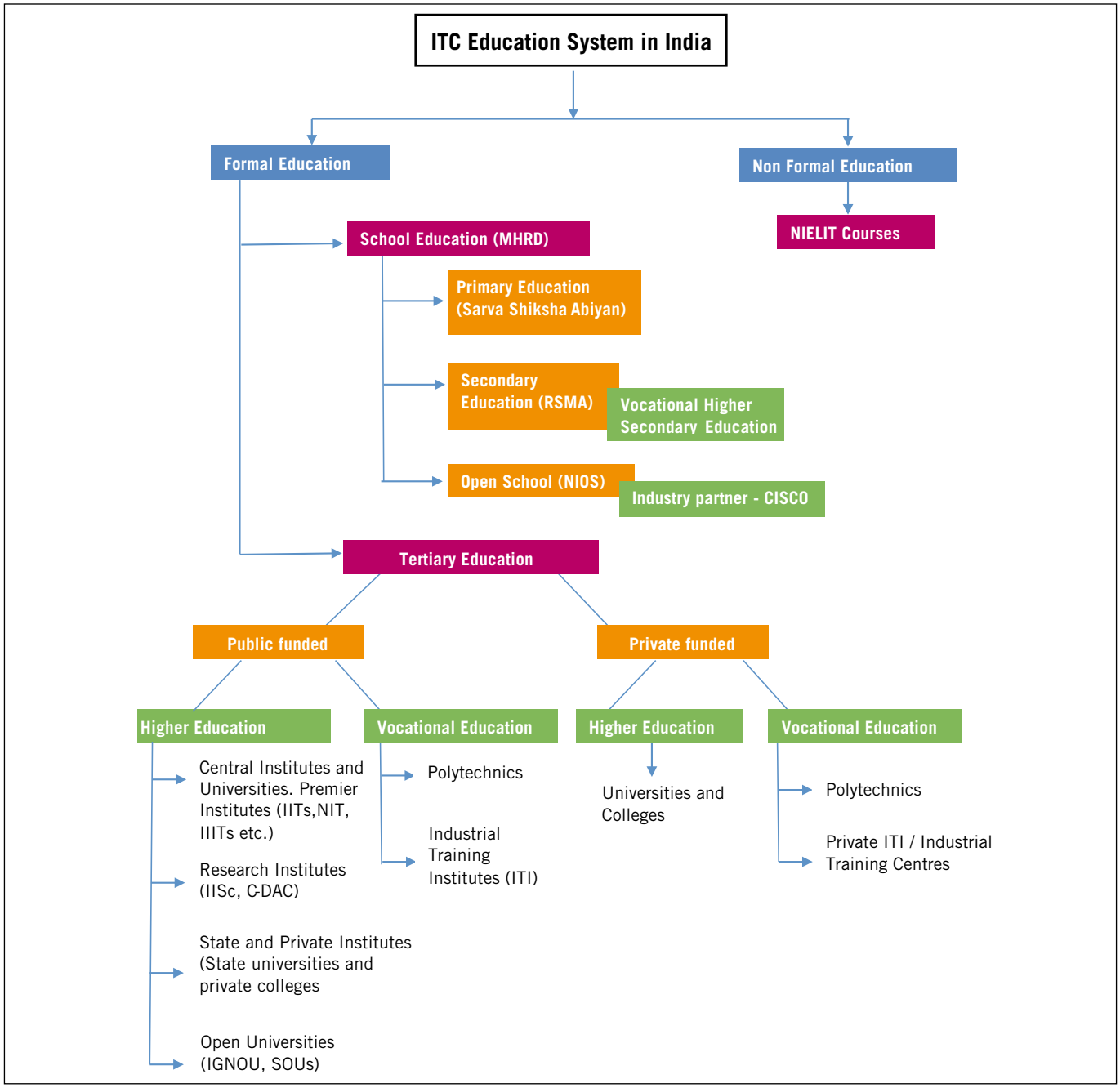
[3] Bachelor of Technology, Master of Technology degrees in Computer Engineering and Information Technology are highly sought after because they provide extensive theoretical and practical ICT knowledge that can be further developed for research and innovation, whereas most bachelor and master degrees in Computer Application provide a background only in functional applications.

[4] There are 23 IITs in India and they are autonomous institutes governed by the Institutes of Technology Act, 1961. The umbrella IIT Council, chaired by the MHRD, oversees the administration of these institutes.

[5] There are currently 20 IIITs in India, and MHRD established five of these, namely Gwalior, Allahabad, Jabalpur, Kancheepuram, and Kurnool. The remainder operate through not-for-profit public private partnerships.

[6] In order to transform existing Regional Engineering Colleges into institutions of national importance, NIT were established by the National Institutes of Technology Act, 2007. India now has 31 NIT, all governed by the NIT council and offering courses at the undergraduate and postgraduate levels.

Figure 2.1. ICT education institutional framework – India



Note: National Institute of Electronics and Information Technology (NIELIT), Rashtriya Madhyamik Shiksha Abhiyan (RMSA), National Institute of Open Schooling (NIOS).
Source: National Center on Education and the Economy, country background report on India, 2019, not published.

An INI focuses on building a theoretical foundation for the student in order to prepare them for lifelong learning. Other university types focus more on teaching practical skills, including specific programming languages while private institutions generally place great importance on responding to specific labour market demands (research mission interview with IIT, Delhi[7]). The employment placement rate for INI graduates is close to 100 per cent, with IIIT Bangalore reporting that more than 90 per cent of its students go on to work in the corporate sector, including for IBM, Hewlett- Packard, Qualcomm, Dell, Cisco and Amazon. Of the students attending IIIT Bangalore, 2 to 3 per cent opted to pursue doctoral degrees after graduation, and another 2-3 per cent chose entrepreneurial careers (research mission interview with IIIT Bangalore).

A presumed weakness of higher education institutions in India is the limited focus on research. Most premier institutions and universities in India are not research oriented, despite the fact they have

[7] More information provided on the IIT, Delhi website, http://www.iitd.ac.in/content/iit-delhi-granted-status-institute-eminence

great potential in this regard, given that India is home to some of the world's leading ICT universities.

In light of the digitization of the Indian economy, the increasing need for interdisciplinary ICT curricula and interfaculty cooperation has emerged as new challenges for universities. One example is Indian Institute of Information Technology and Management (IIITM) Gwalior, where courses are designed to allow interdisciplinary study and collaboration through an approach defined by the motto "no departmental boundaries exist" (research mission interview with IIITM Gwalior, telephone interview).

At present, cooperation between universities and industry is limited. This is likely to become a necessary precondition in order for India to secure a global role in industry 4.0. In fact, universities plan to focus more on providing students with practical experience in future. ICT educational curricula had previously focused on a combination of 80 per cent theory and 20 per cent practice, but recent changes reveal a trend towards reversing these two in order to maximize practice (research mission interview with Centre for Development of Advanced Computing, India).

Vocational stream

Industrial Training Institutes (ITI) are post-secondary schools in India that provide industry-oriented technical certification in line with the National Skills Qualification Framework (NSQF)[8] level 4. One of the most popular courses in the country provides qualifications for becoming a computer operator and programming assistant. Students may take the yearlong course if they have completed senior secondary schooling. The course prepares them to work as assistant programmers in software development. Nationally, there are plans to introduce four new courses related to the IoT, which will be offered in selected ITI in agriculture and mining departments. Although no direct partnerships with companies are presently in place, courses are designed in collaboration with subject specialists and Sector Skills Councils[9], and the curriculum is updated every three years (research mission interview with Directorate General of Training, MSDE). It is estimated that approximately 90 per cent of students who complete the courses are placed in jobs. However, tracking placements is difficult since ITI are not responsible for these placements.

The Draft National Education Policy 2016 underscored the importance of skills development through vocational education given that new technologies are emerging rapidly amidst an expanding economy (Ministry of Human Resource Development, 2016). However, the reputation and image of the vocational stream is often questioned, and in response to this general perception, serious attempts are being made to mainstream vocational education and formally link vocational skills to academically equivalent degrees through the Occupational Standards and Qualification Framework[10]. In recent years, internships have also become increasingly important for young workers (see section 2.3.2 for details).

Non-formal education

The National Institute of Electronics & Information Technology (NIELIT) is an autonomous body under the administrative control of the Ministry of Electronics and Information Technology (MEITY) and offers various types of ICT courses.[11] NIELIT courses are more popular in regions with less advanced educational infrastructures and fewer resources. There are no age restrictions for enrolment in the courses and no time limit for course completion. In addition, modular certification is available. NIELIT offers 32 diploma and certificate courses at different levels and in subjects such as IT, hardware, and bio-informatics that are in line with NSQF standards. With the exception of a few courses based at specific locations for practical training purposes, attending classroom lectures is not mandatory. Instead, online assistance is provided, and accredited institutions teach courses, administer exams and provide certifications. This process is an important education pathway, especially in remote areas of India. In addition to these non-formal courses, NIELIT also offers degree programme and professional courses, which lead to bachelor, master and PhD degrees.

[8] The NSQF is a competency-based framework that organizes all qualifications according to a series of levels of knowledge, skills and aptitude. It was approved on 27 December 2013. For further information, see https://msde.gov.in/nsqf.html.

[9] Sector Skill Councils are designed by national Skills Development Cooperation to be autonomous industry-led bodies. They, in turn, create occupational standards and qualification bodies, develop competency frameworks, conduct "Train the Trainer Programs", collect data on skills gaps and assess and certify trainees according to National Occupational Standards and curricula. Approximately 37 Sector Skill Councils are currently operational with over 600 corporate representatives participating in the governing councils of those Sector Skills Councils. For further information, see https://msde.gov.in/ssc.html.

[10] National Occupational Standards (NOSs) determine standards of performance, knowledge and understanding regarding workplace tasks. Each NOS defines one key function in a job role.

[11] For further information, see http://www.nielit.gov.in/.

Indonesia

After completing compulsory school at the lower secondary educational level, which is generally after nine years of schooling that finishes at age 14, pupils may choose to enrol in upper secondary education or secondary vocational education. Students may then choose to pursue undergraduate higher education or tertiary vocational education (OECD; United Nations Educational, Scientific and Cultural Organization, 2016). There are some opportunities for students to crossover between the tertiary vocational and the academic streams.

Academic stream

There are more than 120 public and 4,000 private higher education institutions in Indonesia that provide different types of advanced vocational and academic education. Bandung Institute of Technology, the foremost technology oriented university in Indonesia, currently ranks 331 in the 2018 QS World University Rankings[12]. According to the Indonesian National Accreditation Agency for Higher Education, only four out of 99 higher education institutions in Indonesia received an accreditation at the highest level, for computer science programmes[13] (research mission interview with the Ministry of Research, Technology and Higher Education, Jakarta).

Vocational stream

Students receiving a degree in Information Management from a D3 programme, or a programme of vocational studies at a level below a bachelor degree (see Figure 2.2), are trained in: computer systems, with a focus on either software or hardware; software design based on relational database management system analysis techniques; the application of scientific methods to solve informatics problems with cutting edge programming skills. Graduates of those programmes may pursue careers as system analysts, programmers, system development consultants, system designers, database administrators, web developers, IT technical support staff, data processing supervisors, senior programmers, and information systems department managers.

Figure 2.2 Education system comparison and correspondence to the Indonesian National Work Competency Standards (KKNI) – Indonesia

<table>
<tr><th rowspan="2">KKNI</th><th colspan="3">Education al Level/Type</th><th rowspan="2">Grade/ Leng th</th><th rowspan="2">Degree</th><th rowspan="2">Career Development Based on Occupational Training</th><th rowspan="2">Career Development Based on Experience</th></tr>
<tr><th>Professional Program</th><th>Vocational Program</th><th>Academic Program</th></tr>
<tr><td>9</td><td>Specialization 2</td><td>S3T</td><td>S3</td><td>3-4 year</td><td>Doctor / PhD</td><td rowspan="3">Expert</td><td rowspan="2">Expert</td></tr>
<tr><td>8</td><td>Specialization 1</td><td>S2T</td><td>S2</td><td>2 year</td><td>Master</td></tr>
<tr><td>7</td><td>Profession</td><td colspan="4"></td><td rowspan="2">Technician /Analyst</td></tr>
<tr><td>6</td><td rowspan="6"></td><td>D IV (D4)</td><td>S1</td><td>4 year</td><td>Diploma 4, Bachelor</td><td rowspan="3">Technician /Analyst</td></tr>
<tr><td>5</td><td>D III (D3)</td><td></td><td>3 year</td><td>Diploma 3</td></tr>
<tr><td>4</td><td>D II (D2)</td><td></td><td>2 year</td><td>Diploma 2</td><td rowspan="3">Operator</td><td rowspan="3">Operator</td></tr>
<tr><td>3</td><td>D I (D1)</td><td></td><td>1 year</td><td>Diploma 1</td></tr>
<tr><td>2</td><td>Secondary Vocational School (SMK)</td><td>SMA</td><td>Grade 10-12</td><td>No degree</td></tr>
<tr><td rowspan="2">1</td><td colspan="2">SMP</td><td>Grade 7-9</td><td>No degree</td></tr>
<tr><td colspan="2">SD</td><td>Grade 1-6</td><td>No degree</td></tr>
</table>

Source: SKKNI; Ministry of Education and Culture; input from a national consultant.

[12] For further information, see https://www.topuniversities.com/university-rankings/employability-rankings/2018

[13] Information provided by Direktori Akreditasi BAN-PT, 2018. The higher education accreditation system in Indonesia assigns three grades according to scoring factors in seven key areas: A is very good, B is good and C is fair. No grade is assigned if a minimum score is not met.

The Indonesian Ministry of Manpower provides free vocational training in the ICT sector for the unemployed. This training includes three months of theoretical training and six months of apprenticeship opportunities. The programmes are mainly offered to young jobseekers, including high school graduates, in order to promote a smooth transition from school to work.

The total vocational training capacity of Balai Latihan Kerja workplace training centres[14] for 2018 is for approximately 250,000 trainees,[15] but this is expected to increase to 550,000 trainees next year as per a presidential order. According to the Ministry of Manpower, almost 100 per cent of trainees, including non-ICT trainees, are able to find work after completing the training offered by the centres (research mission interview with the Ministry of Manpower, Jakarta).

Formal equivalence in the academic and vocational streams

A unique part of the Indonesian education system is that there is a formal equivalence system in place between the upper level vocational stream, or D4-Level, which focuses primarily on practical training, and the bachelor degree level (S1) of the academic stream, which focuses more on theoretical education.[16] However, the market values of these two degrees differ and those with D4 degrees are generally paid lower salaries throughout their careers than those with S1 degrees. The discrepancy is partly due to the social perception that a D4 degree is less valuable than a S1 degree, although interestingly, some universities offer both streams. One example of a university offering both streams is Telkom University, a higher education institution specializing in ICT that offers a vocational secondary high school programme in ICT in addition to diplomas and academic degrees.

It is estimated that of the approximately 300,000 students who graduate from Vocational Education and Training (VET) and universities with a qualification ranging from levels D3 to S1, approximately 50,000 studied ICT, engineering, and related fields (research mission interview with the Head of the Research Division, Ministry of Communication and Informatics (KOMINFO)).

A 2017 forecast report conducted by Computerworld identified ten IT skills and job roles that are currently in demand in Indonesia, and has classified them according to a national qualification framework (see Table 2.1).

Table 2.1. In demand skills and job roles and corresponding education requirements in Indonesia

	In demand skills and job roles	KKNI educational level
1	Software / Application developer	(D1 / level 3 KKNI)
2	Help desk / Technical support	(D2 / level 4 KKNI)
3	Security analyst with a focus on Governance, Risk and Compliance	(D3 / level 5 KKNI)
4	Cloud skills with a focus on software as a service	(D2 / level 4 KKNI)
5	Business Intelligence / Data analytics / Visualization	(D4, S1/ level 6 KKNI)
6	Web development	(D4, S1/ level 6 KKNI)
7	Database administration	(D4, S1/ level 6 KKNI)
8	Project management	(D3 / level 5 KKNI)
9	Big data	(Post S1 / Level 7 KKNI)
10	Mobile application development	(D1 / level 3 KKNI)

Source: Geer, 2017.

Non-formal education

There are a number of schools outside of the formal education system that teach ICT skills, including the skills necessary for employment as a network technician, computer technician, programmer, graphic artist, animator, operator and web designer. Some of these non-formal education institutions, also known as ICT training centres, have partnerships with ICT training centres outside of the country.

Thailand

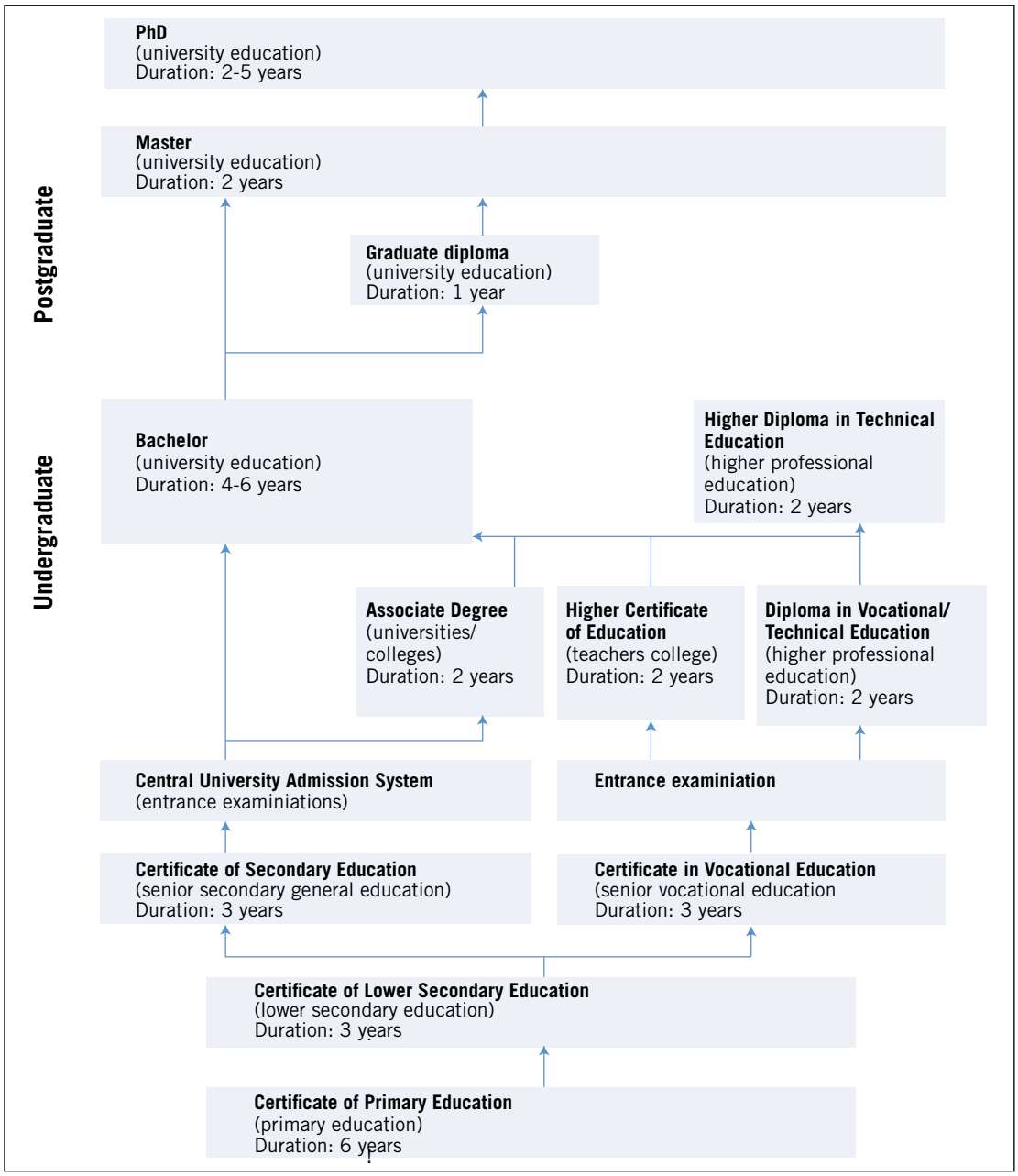
In Thailand, 63 per cent of the young people who completed their studies in 2018 and entered the workforce had obtained a university degree. An additional 15 per cent had a higher vocational level degree, or diploma, 8 per cent had earned a lower

[14] Balai Latihan Kerja centres provide technical skills training to workers and jobseekers in Indonesia. For example, Balai Besar Pengembangan Latihan Kerja – Bekasi focuses on ICT and electronic skills and offers 12 skills training courses in ICT, including graphic design, IT software solutions for business, mobile programming and web development.

[15] For further information, see www.lemsar.net.

[16] Recognized as per the Minister of Education Decree No. 234/U/2000, article 1 (16).

Figure 2.3 The education system - Thailand



Source: Nuffic, 2015.

vocational level qualification, while 3 per cent and 11 per cent had completed a higher secondary level or a lower secondary level, respectively.[17] Figure 2.3 provides an overview of the education system in Thailand.

Academic stream

In 2017, there were 34,283 graduates in the fields of science, mathematics and computing, or the equivalent of 10 per cent of the total number of graduates in Thailand. That was a 2 per cent decrease for those fields of study as compared with 2008, while the number of graduates in engineering, manufacturing and construction increased by 20 per cent over the same period, reaching 11 per cent of all graduates, or a total of 40,627, in 2017.[18] (Annex Table A2.1)

Vocational stream

Vocational education in Thailand can be divided into secondary vocational education and upper, or tertiary, vocational education.

[17] National Labour Information Centre, Ministry of Labour; calculations by a national consultant.

[18] Ministry of Education, Thailand, 2017; author calculations.

In 2014, of the 652,800 students enrolled in vocational education under the auspices of the Office of Vocational Education Commission (OVEC), only 400 chose to study ICT. A modular scheme has been established in which credits can be earned over a period of three to eight years, either through evening classes, or by taking short-term courses. Students choosing either of these options may obtain a vocational certification.

The TVET curriculum has not been updated on a regular basis and has failed to respond adequately to changing labour market needs and trends in technology. According to research mission interviews, curriculum inadequacies have led many employers to hire workers who are over-qualified in order to ensure that they have the capacity to perform certain jobs. In recent years, OVEC and the Ministry of Education, in collaboration with private sector agencies, have worked closely to improve TVET policies and practices. For example, they introduced the Dual Education Programme, which combines company internships and vocational education into one course, and in 2014 there were 61,244 vocational students enrolled in the OVEC Dual Education Programme.

2.1.2. Work-based learning and training

Due to rapidly increasing technological developments, there is a growing need for work-based training and the development of new skill sets, both technical skills and soft skills. Company sponsored entry level training and continuous training are critical to ensuring that the skills of graduates and experienced workers may be adapted to meet company needs.

Entry level training

Entry level training is provided in order to adapt a worker's skill set to the specific needs of companies. In addition, in-house training may be needed to compensate for skills gaps in the TVET and university system. The previously discussed case of India noted that ICT companies offer, on average, three to six months of entry level training for new employees (Anand, 2016). In the IT BPM sector, about 2 per cent of industry revenue is spent on training employees, and of this amount, approximately 40 per cent is spent on new employee training. Numerous firms have forged alliances with leading education institutions with a view to providing appropriate training to future employees (IBEF, 2018).

Box 2.1 illustrates examples of entry level training programmes.

Box 2.1: Entry level training – company examples

a) Tata Consultancy Services, India: the largest IT services firm in India, the company offers an Initial Learning Programme for trainee employees. The programme offers a combination of learning platforms (iON), digital interactive classrooms (iQlass), virtual labs and a competency tracking platform (iEvolve), which all serve to facilitate learning opportunities for employees worldwide (Tata Consultancy Services Annual Report, 2016). "ASPIRE" is an additional digital learning programme that facilitates faster learning for entry level workers (research mission interview with employer representatives at a think tank meeting at Delhi).

b) Tech Mahindra, India: provides one example for entry level training in which college students studying engineering, receive basic training. Special evening courses are also offered by the firm to provide employees with sufficient knowledge in their working areas (research mission interview with Tech Mahindra, India).

Lifelong learning and continuous training

The Global Commission's report on the future of work highlights the need to invest in people's capabilities to enable them to thrive in a digital age. A core element of this is lifelong learning for all which allows people to acquire skills and enables them to reskill and upskill (ILO, 2019). From the perspective of working over the course of a lifetime, the objectives of lifelong learning strategies are manifold: to avoid or minimize the loss of skills over time, to adapt skills to labour market needs, to increase internal and external job mobility, to break the cycle of low level skills or skills not in demand and poor employment prospects, to increase incentives to work longer before retirement, and to increase worker motivation.

Policies to promote lifelong learning, training measures and initiatives designed to meet learning goals may be initiated by various stakeholders, including governments, social partners, occupational organizations and companies. Interventions may cover a wide range of initiatives, including lifelong vocational guidance, remedial education, promoting participation in further training for all workers, and recognizing and certifying skills derived from informally acquired knowledge. One of the key issues

related to lifelong learning is access to continuous training with responsibilities for that training being shared between employers, workers and the government.

Due to rapid technological change in ICT job roles and the proliferation of technologies including cloud computing, virtual reality, big data analytics and IoT, there is a great need for continuous training in the sector. However, no data on the topic is currently available (research mission interview through round table discussion with NASSCOM and its IT-ITeS Sector Skill Council, Delhi).

The nature of continuous training is undergoing a transformation given the rapid technological changes that are occurring. In the short term, digital technologies will provide more channels for affordable and efficient online training, allowing more workers to not only remain up-to-date their competencies, but to continue improving their skills too. Online courses with video lectures, discussion boards for students and automated systems that grade coursework, have become widespread in education and "adaptive learning", or courses tailored to individual students, may finally become a reality thanks to new machine-learning techniques that could make learning both more flexible and more inclusive (International Organization of Employers, 2017). Increasingly, skills such as learning to learn, and the ability to both unlearn and relearn are becoming important key competencies for ICT specialists.

Both workers and companies are incentivized to invest in continuous training (see Box 2.2). While large ICT companies offer continuous training courses, this is generally not the case in SMEs. According to interviews, workers who do not participate in upskilling and reskilling activities in the ICT sector are more likely to lose their jobs and to have difficulty finding new jobs (research mission interviews with NASSCOM).

Linking the education and training policies of the government to the needs of the industry is an important component, not only for students at TVET and higher education institutions, but for currently employed ICT workers and for those changing jobs. Universities should begin providing continuous education courses on specific topics for currently employed workers. In addition to overseeing university education systems and work-based training, KOMINFO in Indonesia provides training programmes in AI and digital business in cooperation with Microsoft.

Box 2.2: Case study examples – corporate continuous training

a) Infosys, India

Infosys offers reskilling opportunities for specific projects to employees who show great promise. The company also follows an approach to reskilling that includes: creating an online learning platform, designing in-house courses, offering a "teach to lead" training programme and setting expectations for its employees regarding participating in self-study for 30 minutes per week (research mission interviews with NASSCOM, Bangalore).

b) Tech Mahindra, India

The Tech Mahindra IT company aims to train a very high number of their employees in basic IoT, cloud analytics and network skills. About one-tenth of employees are trained in Robotic Process Automation, and at present, 52,000 employees have been trained and certified in digital technologies (research mission interviews with Tech Mahindra, India).

c) Microsoft, Thailand

Microsoft provides continuous training through an e-learning system for employees that facilitates the development of their knowledge in diverse areas. The employees must participate in this online training every month and are monitored by their managers to ensure that they do not miss participation deadlines for the courses. The number of training modules required for employees depends on varying worldwide requirements across the company (research mission interview with Microsoft, Bangkok).

d) Telkomtelstra, Indonesia

Telkomtelstra, a telecommunications company based in Jakarta, has developed its own proprietary competency standards. The standards are used to identify training needs and to provide company certified training for employees. Training certification is considered to be particularly important in the Indonesian labour market (research mission interview with Telkomtelstra, Jakarta).

2.2. Skills mismatch and future skills gaps and shortages

Broadly speaking, skills mismatch refers to a situation in which the skills offered by employed workers and those seeking employment do not match the skills required by employers. This phenomenon creates inefficiencies, and increases direct and indirect costs for the government, companies and individuals since the rate of return in investment is lower than what could be expected. Skills mismatch reduces the potential productivity of the individual worker and of a company as a whole.

The Global Commission's report on the future of work notes that the skills of today would not match the

skills that are needed for the jobs in the future. In light of the skills mismatch, there is an urgent need to invest in education, training, upskilling and lifelong learning for both employers and workers (ILO, 2019). Therefore, key issues to be considered include, whether the current education and training systems in place provide the skills needed in the job market; whether workers possess skills that will allow them to adapt to economic, technological and organizational changes in the future; and whether employers are investing in the reskilling and upskilling of workers.

Box 2.3: Measurement of skills mismatch

Skills mismatch is a complex problem affecting both employed and unemployed workers. There are different ways to capture and to measure that issue, including measuring whether the quantity and quality of available skills match the market demand. In order to create clarity regarding how to measure skills shortage and mismatch, ILO has recently issued guidelines for the measurement of qualifications and skills mismatch of employed individuals; those guidelines were adopted by the 20th International Conference of Labour Statisticians, 10-19 October 2018, Geneva (ICLS)[19].

An employed worker may experience two types of mismatch: qualification mismatch[20] and skills mismatch[21], as explained below.

Qualification mismatch occurs when an employed person has a job in which the qualification requirements do not correspond to the level and/or type of qualification that the person has, and may include the below.

a) Over-educated: when the level of education and training of the person in employment is higher than what is required for the job.

b) Under-educated: when the level of education and training of the person in employment is lower than what is required for the job.

Skills mismatch occurs when an employed person has a job in which the requirements do not correspond to the skills that the person possesses. The mismatch may occur with job related skills or technical, basic and transferable skills.

a) Under-skilled: when the level and/or the types of skills of the person are at a lower level than those required to adequately perform the job.

b) Over-skilled: when the level and/or the types of skills of the person are at a higher level than those required to adequately perform the job.

Indicators that can be used to measure skills mismatch may include the below.

a) Skills shortage: when the demand for a particular skill or set of skills exceeds the supply of those available with that skill.

b) Skills gap: when workers do not have the right skills required for competent job performance.

c) Vertical mismatch: when the educational level is either less than or more than what is required.

d) Horizontal mismatch: when the education type or field of study are not appropriate for the job.

Oversupply of labour is usually measured by unemployment rate by educational level or occupation.

From a medium and long-term perspective, labour and skills shortages are difficult to assess in quantitative terms, because companies inherently build their corporate strategies based on the human capital available to them. In the short term, part of the recruitment difficulties that employers attribute to skills shortages may, in fact, be due to the inability of those employers to offer an adequate salary or working conditions that would attract workers with the required skills (McGuiness, Pouliakas, Redmond, 2017). Measuring the skills of those in the workforce is a difficult exercise. Often, indicators like educational level are used as proxy indicators, but these indicators do not take into account skills acquired through previous experience, non-formal workplace learning, or continuous training, be that formal or informal.

India

Skills gaps

The India Skills Report seeks to assess the employability of students. In 2017, students from various educational backgrounds who were studying at 5,200 education institutions participated in the India Skills Report, although students studying at IITs, IIITs, NIT and other premier institutes were excluded from the survey. Employability was measured using the Wheebox Employability Skills Test, a 70-minute test that measures a job candidate's cognitive skills, English language ability, behavioural traits and subject matter knowledge. The test is targeted at those students entering the labour market and aims to provide them with a snapshot of their capabilities in areas including numerical aptitude, problem solving, English language, and computer skills. In 2017 the test result data showed that 45.6 per cent of students were ready to begin jobs. In the five years between 2012 and 2017 overall employability grew from 34 per cent to more than 45 per cent. As an example, 52 per cent of engineers were found to be employable, while IT and computer science students had the highest employability rate, at 64.5 per cent and 56.1 per cent respectively. The

[19] For further information, see https://www.ilo.org/global/statistics-and-databases/meetings-and-events/international-conference-of-labour-statisticians/20/WCMS_648557/lang--en/index.htm.

[20] Qualification refers to the completion of a certified education programme, (or portion of an education programme) or validated knowledge, skills and competencies acquired through non-formal education or informal learning.

[21] In this context, skills refer to either job specific or technical, basic and transferable skills, with the latter including skills such as problem solving, physical skill, language skills, and personal behavioural skills.

report noted that employability among ITI and polytechnic students was an ongoing challenge. Even though both subject areas are practical and employment focused, the report noted that the low employability of ITI and polytechnic students was due to the fact that those institutions had an insufficient focus on core employable skills and on forging partnerships with industry.

A recent FICCI report identified a set of technical skills, soft skills, emotional intelligence and cross-cultural competencies as key skills of the future (FICCI, 2016) and noted that higher education institutions were considered insufficient in the teaching of soft skills.

Horizontal skills mismatch

One hypothesis about why a horizontal skills mismatch exists is that many young people who would prefer to work as business administrators are pressured by their parents to study informatics, which is seen as more likely to lead to well-paid employment (research mission interview with IIT, Delhi). Many parents of students in India consider the study of informatics as being prestigious, and elite universities have strong informatics departments. However, the views of those parents are not necessarily in line with the aspirations and academic strengths of their children.

Assessing future skills demands

In the future, the skill sets demanded of ICT specialists will undoubtedly either expand or change, or both, as the digitalization trend continues. Today's top ICT firms in India are largely IT service providers and not innovators or creators of ICT devices and these firms will have to adapt in order to cater to future demands of the market and to remain competitive globally (research mission interview with the Indian Institute of Science (IISc) Bangalore). The employers' associations in Delhi cites the following three skills as being currently in demand: vanilla skills, including Java developers, server managers; niche skills, including Systems Applications and Products software, Hadoop software utilities; and super niche skills, including cloud computing and AI. As mentioned previously, the demand for those skills indicates an increasing need for specializations and cross-cutting skills (research mission interview with Adecco, Bangalore). The unanimous view in the sector is that ICT is likely to continue its expansion and that Indian ICT specialists will not face a shortage of jobs as long as they are given opportunities for continuous reskilling (research mission interview with employers' associations, Delhi).

While the government has not been involved in skills forecasting activities, an analysis of skills development and skills forecasting has been undertaken by industry associations in India. In that regard, NASSCOM, in collaboration with the Boston Consulting Group, identified 55 job roles in eight technology areas that they believe will become relevant in the near future. The outcome of that research is shown in Table 2.2. Table 2.3 shows the job roles that NASSCOM identified as being likely to gain in importance for ICT specialists in the future.[22]

Table 2.2. Mapping job roles in eight emerging technology areas – India

Technology areas	Number of job roles
Virtual reality	16
IoT	15
Big data analytics	6
AI	12
Robotic process automation (RPA)	6
3D printing	7
Cloud computing	3
Social and mobile	6
Total	**55**

Note: Social and mobile jobs could include social engagement manager, UI designer, UX designer, application developer testing engineer and digital marketing.
Source: NASSCOM, 2017.

A 2016 study entitled, "The Future of Jobs and its Implications on Indian Higher Education", by FICCI identified areas in which job creation is likely to grow before 2020. The Social Mobile Analytics Cloud (SMAC) sector is expected to generate between 500,000 and 600,000 jobs by 2020. In addition, cloud computing support will create jobs for security architects, network engineers, and cloud based developers and specialists. Job growth is also expected in areas such as custom visualization software, predictive analytics and machine-to-machine learning, and those types of jobs will require skills in the areas of data science and statistics, but will also require skills related to critical thinking.

Those types of changing skills requirements will pose huge challenges for the sector, not only in terms of adapting curricula at higher education institutions, but more importantly, in terms of adapting the

[22] In the absence of official detailed data on occupations, data provided by NASSCOM are used in this report.

Table 2.3. New job roles for ICT specialists by sector

Sector	New job roles for ICT specialists
IT – BPM	VFX artist, computer vision engineer, wireless network specialist, embedded system programmer, data scientist, data architect, AI research scientist, RPA developer, language processing specialist, deployment engineer, 3D modelling engineer, 3D designer, cloud architect, migration engineer, Android/IOS app developer, digital marketing specialist
Automotive	Automotive analytics engineer, 3D printing technician, machine learning-based vehicle cyber security expert, sustainability integration expert
Textile and apparel	Apparel data analyst scientist, IT process engineer, e-textile specialist, environment specialists, programmable logic controller maintenance specialist
Banking and financial services	Cyber security specialist, credit analyst, robot programmer, block chain architect, process modeller expert
Retail	Customer experience leader, digital imaging leader, IT process modeller, digital marketing specialist, retail data analyst

Source: NASSCOM, 2017.

skills of the workforce. FICCI estimates that approximately 60 to 70 per cent of the current IT workforce will need to be retrained in biotechnology, nanotechnology, smart technology and advanced analytical skills.

Reasons for skills mismatch

Skills mismatch is believed to be linked to shortcomings of the education system for reasons that include the following: (i) despite the influence of skills sector councils on education institutions, the curriculum of ICT education in schools and colleges has not kept pace with industry requirements; (ii) current curriculum and teaching methods do not allow students to sufficiently develop their soft skills; (iii) students are not provided with high-quality information and career counselling services; (iv) a lack of trained teachers for ICT courses is problematic; (v) there is a lack of IT-enabled infrastructure in many remote areas in India (research mission interview with MEITY, NASSCOM round table, Delhi).

In the view of employers, recent graduates lack basic employability attributes, including skills related to communication, higher order problem solving, analysis and the ability to present information (research mission interview, NASSCOM round table, Delhi). Therefore, employers prefer to employ ICT specialists who already have some work experience.

Indonesia

Assessments of skills demands and shortages

According to KOMINFO, Indonesia is facing a labour shortage of workers with a master's or doctorate level degree, or the equivalent of the Indonesian national qualification framework level 7 – 9 (research mission interview with KOMINFO, Jakarta). Thus, management positions including the jobs of director of technical services, chief knowledge officer and director of multimedia communication will likely be filled by highly-skilled immigrants to Indonesia.

There is a general consensus in Indonesia that available ICT jobs in the area of Technology 4.0 include those of animator, designer, graphic design operator, art worker, content writer, and audio/video editor (Pambudi, 2018). According to estimates by AINAKI, a business association comprised of 60 companies in the animation industry, Indonesia needs an additional 15,000 to 20,000 IT specialists to fill jobs in the animation sector.

The aforementioned estimates indicate that the multimedia industry is one of the sectors facing skills shortages. Recruiting skilled workers has proven to be very difficult, since only three universities in the Indonesia offer a degree in animation and multimedia, and only 85 vocational schools offer multimedia courses. At present, no polytechnics or community colleges offer that specialization. This lack of skilled workers in this area is likely to discourage foreign multimedia companies from investing in Indonesia. While the multimedia industry would need to hire 4,000 young graduates, annually in order to be viable, the education system only produces 1,400 graduates per year, as per compliance with basic education schemes established by the Ministry of Industry and Trade. Furthermore, graduates from vocational schools would need ongoing training in order to keep their skills up to date (research mission interview with AINAKI, Jakarta). The limited access to relevant

training has also been pointed out by the workers' association (research mission interview with workers' association, Jakarta).

In the autumn of 2018, the ILO office in Indonesia carried out an assessment of in demand ICT skills by analyzing ICT job vacancies over a two week period from various media, both online and offline, with the goal of identifying the educational background, technical skills and soft skills required in the current job market.[23] The main sectors searching for ICT specialists were: manufacturing, finance, real estate and financial services, transportation and communication, commerce, and hospitality and restaurants. Overall, 62 per cent of job openings were entry level, requiring between 0-2 years of experience or middle level, requiring 2-10 years of experience. A bachelor's degree was far and away the educational level most in demand for the ICT jobs advertised.

The job descriptions most in demand by companies included, web developer/web programmer, graphic designer, front-end developer and programmer, Android developer, and Java developer and programmer.

The most often requested technical skills included, familiarity with, database query (SQL, MySQL, mSQL), HTML, JavaScript, CSS, PHP, Java, jQuery, Adobe Photoshop, Adobe Illustrator and Angular JS.

The following table shows the most demanded soft skills for entry and middle level positions.

In cooperation with the Indonesian Chamber of Commerce and Industry (KADIN), KOMINFO has undertaken a study on the potential impacts of Industry 4.0 on jobs in 2018 and they are planning on publishing their findings in 2019. The study will provide important insights for education and employment policy makers.

Skills gaps

According to KOMINFO, there are sufficient numbers of ICT workers with medium-level technical skills and a diploma or bachelor's degree. There are many workers in Indonesia who have completed either basic education or high school and vocational training at the D1 level (KKNI levels 1 – 3), but the skills of those workers need to be improved (research mission interview with KOMINFO, Jakarta). Similarly, Indonesian Association of Higher Education in Informatics and Computer Science (APTIKOM) noted that certain skills gaps of new graduates with a tertiary-level education might be addressed by improving the quality of the education they receive (research mission interview with the Chairman of APTIKOM, Jakarta). One example of the technical skills gap in Indonesia is that they are often unable to produce embedded software or hardware despite having the necessary skills for programming the contents of apps[24] (research mission interview with Telkom University, Jakarta).

In addition to a technical skills shortage, private companies including the telecommunication company Telkomtelstra, and the private recruitment agency Michael Page, point to the lack of soft skills

Table 2.4. Ranking of the top 10 most in demand soft skills

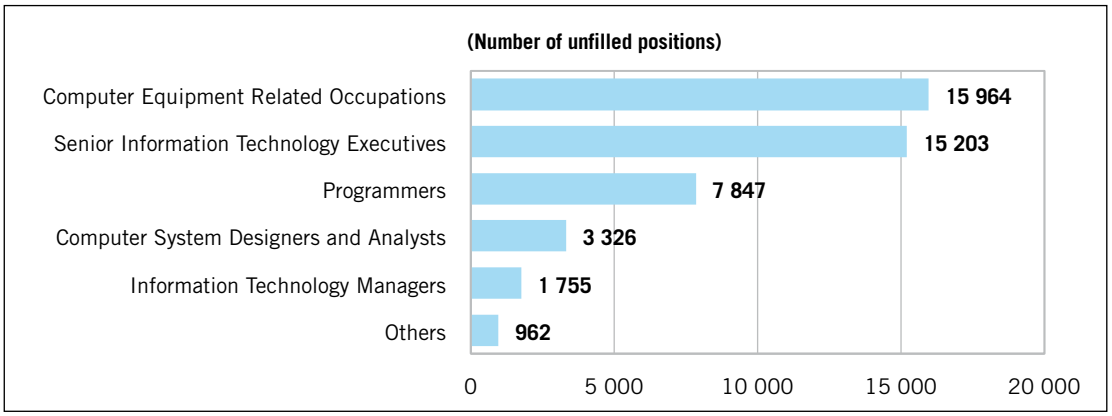
	Entry level	Middle level
1	Ability to work in a team and individually	Good communication skills
2	Good communication skills	Ability to work in a team and individually
3	Ability to work under pressure	Strong conceptual/analytical thinking
4	Self-motivated	Good attitude/personality
5	Interested in learning about new technologies	Self-motivated
6	Responsible	Quick learner
7	Honest	Problem solving skills
8	Disciplined	Managerial/leadership skills
9	Creative	Responsible
10	Thorough	Hard working

Note: The assessment analysed ICT job vacancies posted by various multimedia companies, both online and offline, over a two-week period in October/November 2018.
Source: ILO, Jakarta office, November 2018, unpublished.

[23] ILO, Jakarta office, 2018.

[24] Embedded software is computer software written to control machines or devices that are not considered computers in the traditional sense.

Figure 2.4. ICT Specialist Shortages – Thailand, 2017



Note: Companies were asked if they had difficulties in filling certain positions over a six-month period. Only limited companies and public limited companies were asked to participate.
Source: The Establishment Survey on the Use of Information and Communication Technology, National Statiscial Office, 2017.

of recent graduates as being an issue for employers (research mission interviews with Telkomtelstra and Michael Page, Jakarta). Based on surveys in their research, Chang (2016) and Rynhart (2017), confirm that employers encounter difficulties when trying to recruit employees with soft skills such as problem solving, and innovation and creative capabilities. In addition, ICT specialists in Indonesia and Thailand, often lack adequate English language skills (Pinprayong 2016 and research mission interview with Telkom University, Jakarta).

Reasons for skills mismatch

The variable quality of universities and polytechnic institutions may be a reason for skills shortages and skills gaps in the ICT sector (Allen, 2016). Polytechnics tend to suffer from inflexible management, and work placement services are poorly organized, financial support of the institution is often inadequate, and connections with the private sector are weak. Few young people decide to enrol at polytechnics, since these are perceived to be second choice alternatives to universities.

A study conducted by J.P. Morgan and Singapore University in 2016 concluded that Indonesia is facing the challenge of equipping its workers with the basic skills and knowledge required by key growth industries, including a foundation in science, technology, engineering, and mathematics skills. Unfortunately, the practical training and skills taught at TVET institutions are not aligned with the demands of the labour market. This skills gap is exacerbated by an uneven balance of teachers with academic versus practical backgrounds at TVET institutions, with the latter group being underrepresented (Global Business Guide Indonesia, 2016).

Thailand

Skills shortages and skills gaps

Based on the Establsihment Survey on the use of ICT, in 2017 there was an estimated shortage of approximately 45,000 ICT specialists in Thailand (see Figure 2.4). A shortage of workers with sufficient science, technology and engineering skills is a key challenge facing the country. In the opinion of the chairman of the Federation of Thai Industries, even though roughly 400,000 young people graduate from Thai universities every year, the industrial sector faces a labour gap due to the mismatch between the skills of job seekers and job requirements (Mala, 2018).

In addition to a shortage of highly-skilled ICT specialists, Thailand faces a shortage of the semi-skilled ICT workers that provide support and maintenance for ICT services, including networks, servers, software packages and computer equipment. The shortage of semi-skilled workers is largely due to the low quality of vocational education available in Thailand (research mission interview with the College of Population Studies, Chulalongkorn University, Bangkok). Recently, the unemployment rate of TVET graduates has increased more rapidly than the unemployment rate of university graduates, thereby underscoring the growing skills gap for TVET graduates as compared with university graduates (research mission interview with the Office of the National Economic and Social Development Board (NESDB), Bangkok).

A recent labour skills survey showed that the overall skill sets of most individuals currently employed in the workforce failed to meet the standards required by employers (World Bank, 2016; research mission

interview with NESDB, Bangkok). As of 2016, officials from the Association of Thai ICT Industry estimated that nearly 90 per cent of graduates had failed to acquire the basic skills sought by ICT companies during the course of their studies. This enormous deficit was attributed to the teaching of irrelevant and outdated curricula in the education system, with many of those graduates lacking even basic skills, including computer coding and a foundation in core subjects such as advanced mathematics (Tan and Tang, 2016). In addition, a lack of English language proficiency and gaps in soft skills, including communication and leadership, contributed to the overall skills shortage (research mission interview with the Ministry of Labour, Department of Skills Development, Bangkok).

Vertical and horizontal skills mismatch

Over-education has been a defining characteristic of skills mismatch in Thailand. One reason for the rate of over-education may be attributed to young people's aspirations of obtaining highly-skilled jobs that are well paid, even though it is primarily unskilled and semi-skilled jobs that are available in Thailand (research mission interview with the College of Population Studies, Chulalongkorn University, Bangkok). Over-education is also relevant to horizontal skills mismatch, given that young people are not directed towards fields of study that are demanded in the labour market. For example, despite the fact that graduates with degrees in physical or biological science are in great demand, approximately 70 per cent of new graduates have degrees in the social sciences (Mala, 2018).

According to the most recent survey on ICT specialists prepared by the National Statistics Office and the Ministry of Digital Economy and Society, as of 2017 there were 386,306 ICT specialists in Thailand, indicating a roughly 3 per cent increase in this number since 2016. Of this total number of ICT specialists, more than 54 per cent did not have an educational background in ICT.

A comparison of educational levels by occupation in the general labour market, and the distribution of educational achievement of ICT specialists specifically, showed that 80 per cent of ICT specialists working in jobs requiring a high level skill set were indeed highly qualified, while only 67 per cent of those in non-ICT occupations requiring a high level skill set had an equivalent level of education. Thus, in general, highly-skilled ICT jobs are well matched to the educational levels of those employed. However, data showed that this match was poor for intermediate level ICT occupations, given that only 40 per cent of those employed in occupations requiring an intermediate level of skills had an appropriate educational level. An additional 39 per cent of workers had a high level of education, suggesting that many of those workers were over qualified for their positions. The remaining 21 per cent had a low level of education, and this last group may have either learned skills on the job, or they may have been self taught. It may be assumed that given the lack of education, some of those in the last group may perform poorly in their jobs (see Table 2.5).

Future skills demand

The Thailand Development Research Institute has created a forecast for the domestic labour market, in which researchers used the manpower database PmanP to forecast future supply and demand. The Thai Ministry of Labour has also used the PmanP database to predict future supply and demand in the labour market at the provincial level (research mission interview with Ministry of Labour, Bangkok). Given that it only examined major occupational groups, the forecast is not detailed enough to assess the future demand for all types of ICT specialists.

The Employers' Confederation of Thailand (ECOT), believes that a more thorough ICT skills shortage forecast is needed in order to gain a full picture of the situation. Such a view would help guide reforms in Thailand's education system and link the education system to national economic and social development plans (research mission interview with ECOT, Bangkok).

Table 2.5. Average number of employees by skill level and educational level, 2012 – 2017

Occupation	Educational level			Total
	Low	Intermediate	High	
ICT	**32 565**	**81 005**	**218 481**	**332 050**
Highly-skilled	4%	16%	80%	100%
Intermediate	21%	40%	39%	100%
Low-skilled	-	-	-	-
Non-ICT	**23 248 973**	**7 648 424**	**5 354 512**	**36 251 909**
Highly-skilled	13%	20%	67%	100%
Intermediate	70%	22%	7%	100%
Low-skilled	85%	14%	1%	100%
Overall	**23 281 537**	**7 729 429**	**5 572 993**	**36 583 960**
Highly-skilled	13%	20%	67%	100%
Intermediate	70%	22%	8%	100%
Low-skilled	85%	14%	1%	100%

Source: Labour Force Survey, National Statistical Office, Thailand, 2012-2017; ICT specialists defined as per Annex Table A1.2; calculations by a national consultant.

Reasons for skills mismatch

There are several reasons for the phenomenon of skills mismatch in Thailand. Firstly, the education system is not adequate in providing the means for a sufficient number of students to pursue the Science, Technology, Engineering and Mathematics (STEM) fields of study. Secondly, the teaching of logical thinking skills needs to be improved and an interest in technology must be fostered at an early stage of schooling. Curricula should be adapted accordingly and teachers must then be appropriately trained (research mission interview with the Institute for Promotion of Teaching Science and Technology, Bangkok). Lastly, according to interviews, many higher education institutions providing courses in ICT fail to equip their graduates with the technical and soft skills demanded by employers. The responsibility of attracting more young people to STEM fields rests not only with education institutions, but also with the government and employers, the latter of whom need to provide attractive work opportunities for graduates in those fields.

Box 2.4. Upskilling and reskilling teachers for the future of work

The world of work that today's primary school students will enter when they complete their studies will be considerably different from the one of today. Therefore, teachers need to prepare students for jobs of the future and for meaningful participation in a future society that has yet to be imagined.

Trends like digitalization are rapidly transforming the world of work and they are creating a demand for varied skill sets. Those trends are prompting both a rethinking of current education practices and an exploration of new models for teaching and learning. An increased access to technology and the Internet has brought about new opportunities for learning, but those developments also come with challenges. In order to equip students with the right skills, teachers will need to teach more than just rote technical skills. They will also need to help students understand the complexities of the world around them and impart analytical knowledge and the soft skills they need to adapt to rapidly changing technologies.

Teacher training institutions must update their teacher education curricula as they prepare new teachers to meet the challenges of the future. Despite the ubiquitous presence of technology in society, teacher education programmes have been slow to fully integrate the use of technology for pedagogical purposes (ILO and UNESCO, 2018). Continuous training for teachers should be provided to facilitate the adaption of their teaching methods and skills for the future of work.

2.3. Policy strategies for ICT education, training and skills development

2.3.1. Promoting ICT skills development for women

Statistically, women complete vocational education and training in ICT related study fields much less frequently than men. In this respect, the three countries examined in the report are not very different from many developed countries regarding women's education, although there are large variations among the three countries and the respective levels of education generally completed by women. In India, Indonesia and Thailand, women tend to be better represented at the postgraduate level and above, as compared with the undergraduate level and below. Several strategies have been adopted to increase the enrolment rates of women in the field of ICT.

India

During the 2016-2017 academic year, less than 30 per cent of undergraduate students in engineering and computer science were women. However, in the field of computer engineering women comprised 57 per cent of postgraduate students and 40 per cent of PhD candidates (AISHE, 2016-2017).

Overall, the gender divide in enrolment rates was larger at INI than at other higher education institutions, although the INI reflected the aforementioned general trend of more women being enrolled in graduate studies than at the undergraduate level (AISHE, 2016-2017). At present, women comprise between 8–10 per cent of INI students at the undergraduate level, 20 per cent of master's level students and 30 per cent of PhD students. Fewer women than men pass the IIT entrance exam, and this may be due to the fact that preparing for this entrance exam is costly and intensive, and therefore women may be discouraged from doing so by societal and cultural pressures. Some interviews in the research mission also indicated that young women are not drawn to study STEM fields and the ICT related studies (research mission interview with IIT, Delhi). Given this gender imbalance, the government has intervened by introducing national quotas at IIT for women students of at least 14 per cent in the 2017-2018 academic year, with a planned increase of 3 per cent in subsequent years. Consequently, IIT Delhi has recently experienced a record enrolment rate of

16 per cent for women at the undergraduate level (research mission interview with IIT Delhi). However, not all universities have implemented similar measures.

Polytechnic institutions in India are encouraging women through measures including the introduction of a 30 per cent quota of women's enrolment at certain polytechnics and the establishment of polytechnics exclusively for women (research mission interview with Directorate of Technical Education, Delhi). Of the 300,000 spots in compliance with NSQF level 4 available for vocational study, 20 per cent have been reserved for women (research mission interview with Directorate General of Training, MSDE).

Indonesia

In general, women in Indonesia are underrepresented in STEM study areas, including ICT study fields. According to a 2015 ILO survey, nearly 25 per cent of men studying at universities and TVET were enrolled in ICT study fields, while only 8 per cent of women chose ICT study fields at their respective institutions. As of 2017, the gender divide in ICT study fields was even higher than it was in engineering studies (ILO, 2017). There are no specific policies in place to help increase the number of women studying ICT or STEM fields in Indonesia. However, the government has introduced certain incentives, including the Kartini Next Generation Award, which is a competition to encourage the creativity and achievements of women who use ICT in areas including education, empowerment and the improvement of living standards.[25]

Thailand

Among Thai ICT workers, women hold higher education qualifications. For example, while 75 per cent of female ICT workers hold a bachelor's or higher level academic degree, only 62 per cent of male ICT workers graduated with a university degree (Labour Force Survey, averages from 2012 – 2017).

Table 2.6 provides an overview of over-education and under-education in ICT and non-ICT occupations. Although the over-education and under-education of ICT specialists is noticeable, skills matching for those workers is twice as good as it is for those

Table 2.6. Qualification mismatch by gender and occupation – Thailand, 2012-2017

Occupation	Male		Female		Total	
	Average number of employees	Share of employees	Average number of employees	Share of employees	Average number of employees	Share of employees
ICT	**234 090**	**100%**	**97 961**	**100%**	**332 050**	**100%**
Under-education	52 098	22%	15 603	16%	67 701	20%
Matched	156 304	67%	62 664	64%	218 968	66%
Over-education	25 688	11%	19 694	20%	45 382	14%
Non-ICT	**19 765 562**	**100%**	**16 486 347**	**100%**	**36 251 909**	**100%**
Under-education	12 015 751	61%	8 998 621	55%	21 014 372	58%
Matched	6 607 131	33%	6 027 247	37%	12 634 379	35%
Over-education	1 142 680	6%	1 460 479	9%	2 603 159	7%
Total	**19 999 652**	**100%**	**16 584 308**	**100%**	**36 583 960**	**100%**
Under-education	12 067 849	60%	9 014 223	54%	21 082 072	58%
Matched	6 763 435	34%	6 089 911	37%	12 853 346	35%
Over-education	1 168 368	6%	1 480 173	9%	2 648 541	7%

Source: Labour Force Survey, National Statistical Office, Thailand; ICT specialists defined as per Annex Table A1.2; calculations by a national consultant.

[25] For further information, see: https://www.itu.int/en/ITU-D/Digital-Inclusion/Women-and-Girls/Girls-in-ICT-Portal/Pages/events/2015/Asia-Pacific/Indonesia-2015-2.aspx.

employed in non-ICT jobs. Interestingly, there was a higher incidence of men being under-educated versus women, with women tending to be over-educated more often than men.

2.3.2. Government policies to tackle skills mismatch and enhance the skills of ICT specialists

Strengthening skills governance through improved communication between industry and government

In India, Indonesia and Thailand, various ministries and government agencies have taken action with regard to enhancing ICT education and training. One main challenge involves improving cooperation between ministries and government agencies (see Annex A4).

As mentioned above, the primary reasons for skills mismatch in all three countries are related to the quality level of the education and training available, and inadequacies in addressing the gap between skills demanded by employers and the skills provided by education and training institutions. There is a divide between employer perceptions of the employability of new graduates and the perception of education institutions in terms of how well prepared their students are. This discrepancy was illustrated in a 2012 McKinsey survey in India, which concluded that while education institutions believed that 83 per cent of new graduates were ready for employment, employers believed that only 51 per cent of those graduates were in fact prepared.[26] Interviews conducted during the research mission in Thailand and Indonesia confirmed that a similar difference in perception existed in those countries. Part of this perception gap may be explained by differences in the long-term objectives of education providers, including teaching students how to learn, and the goals of companies, which are often driven by short-term objectives. In all three countries, a lack of flexibility regarding adapting curricula in the face of technological changes is an issue. For example, curricula are only revised once every five years in Indonesia, according to information gathered during research mission interviews. A key to bringing the perceptions of educators and industry in line with one another involves putting processes in place to adapt curricula to rapid changes in technology. In order to address the situation, employers and industry associations are now becoming involved in the design of curricula to ensure that they can meet market needs.

India

During the period from 2010 – 2014, the National Skill Development Council in India established 38 Sector Skills Councils (SSCs) to prepare a future workforce training framework for leading growth sectors in the economy. During this process, SCCs conducted skills gap studies and asked industry what their skill requirements were. The SSCs also designed a competency framework, known as the NSQF, and created qualification packs that corresponded to national occupational standards in order to assess and certify workers for particular job roles.[27] The qualification packs were validated by industry representatives and approved by the National Skills Qualification Committee. Each qualification pack is designed to establish competency levels, which theoretically make it possible to create competency-based training for all entry level jobs in the IT BPM industry.[28] One difficulty currently faced by stakeholders is the lack of a framework for recognizing prior training in the high-skilled and digital ICT sector, and thus new methods for recognizing such training must be developed. Creating national competency assessment mechanisms for ICT and digital skills, in cooperation with the ICT industry, would be useful. Since large ICT companies play a role in providing certifications that are recognized within the industry, training certificates from well-established IT companies have become important for certifying technical skills obtained through continuous training. NASSCOM is currently building a «skilling for the future» roadmap that focuses on skilling and re-skilling 1.5 – 2 million entry level and junior staff within the next four to five years on next generation technology.

Indonesia

In Indonesia, the Information & Communication Technology Alignment Committee (KPTIK) was established in order to improve coordination between the government, training institutions and industry needs. The Committee is made up of 17 organizations in the ICT sector, several companies, and a large number of secondary vocational schools. In order to encourage ICT knowledge development,

[26] An even larger gap was recorded in the United States and Germany.

[27] For further information, see: Ministry of Skill Development and Entrepreneurship QPs and NOSs, http://www.skilldevelopment.gov.in/qp&nos.html#.

[28] For further information, see: www.sscnasscom.com

the Committee conducts research and holds training courses, seminars, lectures, workshops, and discussions related to ICT education. There is also collaboration between KOMINFO and KADIN for a survey on market demand for ICT graduates.

Thailand

TPQI and OVEC have collaborated with entrepreneurs, governmental agencies, and private organizations to develop a competency-based curriculum for vocational education and training to work towards closing the skills gaps of new graduates. In addition, a 20 year national strategic plan aims to roll out similar competency-based curricula in universities, so that new generations are provided with needed skills and will possess the flexibility required to work in the digital era (research mission interview with the College of Population Studies, Chulalongkorn University, Bangkok).

Improving the link between theoretical education and workplace training

One disadvantage for young people who have just graduated from universities is that they lack work experience. This is also true of vocational school graduates, although to a lesser extent. Internships and apprenticeships are designed to remedy this issue. In ICT study fields, internships are preferred over apprenticeship schemes in all three countries because apprenticeships are generally offered for occupations that require lower technical skills.

International companies have played a role in setting up training centres and providing theoretical education and workplace training and one example of this is Siemens in India. Siemens offers both theoretical education and workplace training through their proprietary Siemens Technical Academy in Mumbai, which offers certification in line with the National Qualification Framework.

Internships allow vocational tertiary education and university education to be combined with workplace-based learning. Internships offer young people the opportunity for potential employers to become familiar with their work. For example, at Microsoft most new recruits are former interns who participated in internship programmes that lasted between three and twelve months (research mission interviews with Microsoft, Bangkok). In Indonesia, KOMINFO has engaged with KADIN in order to promote internships. The Indonesian Ministry for Research and Higher Education Institutions is currently developing a new curriculum at polytechnics to implement the "3,2,1 scheme" a programme that includes three semesters on campus, two semesters working in the industry and a one semester return to campus (research mission interviews with the Ministry of Research, Technology and Higher Education, Jakarta). In all three countries, strengthening links between industry and universities is a challenge. In India, new formats for studying are being rolled out at premier institutes in order to address this challenge. For example, at IIITM Gwalior, a new master's programme includes a project year, known as a "majors project", in which students work on developing a research paper, an app, or other software. The projects significantly increase the students' chances of being hired in the ICT industry upon graduation. In addition to that new initiative, approximately 25 per cent of students participate in an internship. Inputs from the industry are also solicited so as to enable timely revisions of course curricula, with the aim of keeping the education relevant (research mission interview with IIITM Gwalior).

Preparing Qualification Frameworks

Designing common qualification standards is essential for increasing transparency and ensuring the quality and portability of qualifications. Standards create benchmarks for the validation of prior learning and a certification system for course participation. India, Indonesia and Thailand have all taken steps to establish national professional standards for IT and for ICT specialists.

Qualification standards, if developed jointly with employers' and workers' organizations and education and training institutions, can help reduce skills gaps between the training that is offered and the needs of companies in the industry. One example of a country that includes social partner representatives in the approval process of qualification frameworks and in curriculum development in VET is Germany[29], reflecting the idea that in order for standards to be effective, they must be accepted by social partners.

In order to increase transparency and create shared standards across the countries in the Association of Southeast Asian Nations (ASEAN), the ASEAN Qualifications Reference Framework was developed in 2014. This framework was designed to serve as a common reference for enabling qualification comparisons among participating ASEAN members. Thailand led the development of the Framework in the area of ICT and a report was produced that

[29] Social partners are represented on the administrative board of the Federal Institute for Vocational Education and Training (BIBB)

included the definitions of professional standards in ICT for five primary career areas, namely, software development, ICT project management, enterprise architecture design, network and system administration and information system and network security (TOT Academy, 2014).

Thailand and Indonesia are also currently developing their own national qualification frameworks and those will be comparable to the ASEAN Qualifications Reference Framework at some point in the future. TPQI in Thailand has developed competency-based occupational standards in five main ICT fields. TPQI has also developed a certification scheme for the skills and competencies of graduates from TVET and universities, as well as for workers with qualified prior learning experience. TPQI has also accredited certain universities to carry out certifications on their behalf.

In Indonesia, several standards for ICT specialists that may lead to a certification are currently in place, including the National Competence Certificate, issued by the National Agency for Professional Certification (BNSP). The ICT professional standards, or SKKNI, are used to evaluate individual ICT workers in terms of potential, skills, attitude, competency and knowledge (Pinprayong, 2016). Recently, an occupational ICT field map was prepared by KOMINFO (see Box 2.5) and it has been recommended that the occupational map be widely disseminated and revisited frequently so as to adapt it to effectively respond to the quickly changing world of ICT (research mission interview with Telkomtelstra).

Box 2.5. Occupational ICT field map – Indonesia

In Indonesia, KOMINFO and stakeholders in the area of ICT have created an ICT occupational field map that includes 16 key function areas. The map was launched in 2017 and a guidance booklet was published in April 2018. Currently, there are 19 skill set groups.

The Ministry of Manpower, the Ministry of Finance, KADIN, BNSP, and professional ICT associations were involved in the drafting of the occupational field map.

In India, a NSQF that sets standards for the vocational education schemes regulated by the National Skills Qualification Committee has been implemented, and is overseen by the National Skill Development Agency.[30] The NSQF offers training and provides certification for individuals who have undertaken formal or informal learning. The IT-ITeS industry is the second largest sector in the country, as measured by the number of people who receive certification in the field. A total of one million people have received certification, of which approximately 10 per cent have been tested according to the NSQF and are currently working in the IT-ITeS industry.[31] Of the ten skill levels provided for in the NSQF, courses designed for IT and ICT specialists in the IT-ITeS sector were primarily at levels 7 and 8.[32]

Creating incentives for companies to provide continuous training

For companies wishing to be competitive in the marketplace, adapting skills to rapidly changing technology is critical. Therefore, it is necessary for companies to invest in the upskilling and reskilling of workers, and social partners may view this as a point of negotiation in the future. Governments may also create incentives in this respect.

In Thailand, for example, income tax exemption incentives have been granted to companies in order to encourage the private sector to conduct training courses for workplace learning and training and companies with at least 100 employees are obliged to provide training for 50 per cent of their staff. According to the Skill Development Promotion Act B.E. 2545, 2002, if companies are not able to meet this target, employers must pay an annual contribution to the Skill Development Fund of approximately BHT480 or $15.09[33] for every employee that did not participate in training. The Act was designed to encourage companies to provide training to their employees.

In addition to training courses organized by companies, the Department of Skills Development of the Ministry of Labour in Thailand has organized ICT courses in a response to employer requests to assist in promoting continuous training within companies.

2.3.3. ICT skills as a transversal skill set in education to improve digital literacy among the population

In order for a country to make best use of the full potential of digitalization, the digital literacy skills of its population must be at a certain level. In the case of the three countries examined, an improvement of

[30] https://www.nsda.gov.in/nsqf.html

[31] National Skill Development Agency, Ministry of Skill Development and Entrepreneurship, 2019.

[32] National Qualifications Register, 2019.

[33] Exchange rate as of 8 March 2019.

those skills is necessary and therefore, they are each devising strategies to pursue this objective. However, the proposed strategies do not address issues such increasing access and awareness regarding the education of girls and young women in technology, mathematics and informatics.

India

Incorporating ICT education into school curricula has been part of India's educational policy since the 1970s, following the creation of the first National Policy on Education in 1968. In 2009, the government drafted a national policy for ICT in school education, which was revised in 2012. ICT in schools is primarily implemented through a government scheme, known as the Rashtriya Madhyamik Shiksha Abhiyan (RMSA). Two key components of the scheme are teacher interventions, including capacity enhancement measures for all those who teach ICT, and a national ICT award, which serves as an incentive for teachers. Furthermore, the use of ICT to improve educational access and quality is considered critical for India, as articulated in the 2016 National Policy on Education. MHRD has launched a programme called swayam, or study webs of active learning for young aspiring minds, which is a web portal where Massive Open Online Courses (MOOC) on various subjects are available. Those MOOC are offered as a means of ensuring educational quality, promoting innovation, and reshaping and modernizing open distance learning.

Indonesia

In Indonesia, ICT study subjects were introduced after the implementation of the competency-based curriculum (KBK) in 2004. Although ICT became a study subject in elementary, junior and senior high school education in 2006, the government subsequently removed it from the curriculum structure in 2013, and instead sought to promote ICT learning in a transversal manner. The Ministry of Education and Culture still offers ICT education as a co-curricular or extra-curricular subject, but there have been concerns about its removal as a standard school subject, a sentiment expressed by several stakeholders interviewed during the research mission to Indonesia. Indonesia is also promoting the use of ICT to improve access to education and skills development. APTIKOM has been appointed by the government to implement a nationwide open education concept on a large scale.

Thailand

Thailand has launched ICT courses at primary and secondary school levels, including on topics such as coding and web programming, digital textbooks, and long-distance learning. Over the past decade, Thailand has made significant efforts to improve the ICT skills of both teachers and students through government-initiated programmes and public-private partnerships associated with ICT initiatives for rural schools and disadvantaged students. In 2009, the Institute for the Promotion of Teaching Science and Technology (IPST) implemented a programme aimed at familiarizing children with scientific, mathematical, and technological topics by using their daily surroundings entitled, "Little Scientists' House". IPST activities also include measures to improve the qualifications of STEM staff at universities and in schools (research mission interview with IPST, Bangkok).

Chapter 3

The **international migration** of **ICT** specialists

3.1. Overview of migration trends

Globally, the migration of ICT specialists has risen over the past three decades. The phenomenon began with the migration of Indian ICT specialists to the United States.[1] International competition to attract highly-skilled ICT specialists has increased as a result of the digitalization of global economies and the increasing use of ICT. Furthermore, ICT workers who migrate are increasingly doing so on a temporary basis due to several factors.

3.1.1. Overview of labour migration patterns in India, Indonesia and Thailand

Migration patterns have distinct features in each of these three countries as detailed below.

India

India is a country that is significantly affected by emigration and it has the largest diaspora of individuals living outside their homeland (United Nations, Department of Economic and Social Affairs (DESA), 2017). The number of migrants originating from India increased from 6.7 million in 1990 to 16.6 million in 2017.[2] Apart from other countries in Asia, English-speaking countries have been the primary destination for those migrants: the United States with 2.3 million Indian migrants, the United Kingdom with 836,000, Canada with 602,000 and Australia with 409,000 (DESA, 2017). According to data compiled in December 2017 and published by the Indian Ministry of External Affairs in 2018, there were 13.3 million non-resident Indian nationals outside the country, and the number of "Persons of Indian Origin" living abroad was 17.9 million, bringing the total number of "overseas Indians" to 31.2 million. Emigration of the labour force has been highly polarized, with highly-skilled workers on the one hand, and low and semi-skilled workers on the other.[3] A new trend, while still a relatively small one, is that skilled Indians are migrating to non-English speaking countries in Europe (Faist et al., 2017; research mission interview with Adecco, Bangalore).

The international migration of ICT specialists, particularly in terms of temporary migration, has increased significantly in recent years. This trend is linked to a growing demand for ICT specialists, mainly in developed countries, as well as the availability of skilled and highly-skilled ICT specialists in India.

During the 1990s, there was significant emigration of the country's most educated and skilled graduates and workers, with over 90 per cent of INI computer science graduates emigrating from India (Meil and Salzman, 2017). Interviews conducted during the research mission indicated that the emigration rate among ICT graduates has declined since then, while the number of ICT graduates has increased steeply. For example, in a research mission interview with IIITM Gwalior India, an institute that primarily offers postgraduate courses in ICT and management, institute staff reported that, according to the institute's alumni database, approximately 30 per cent of graduates had taken up employment abroad, primarily in the United States, the United Kingdom and other European countries. Furthermore, it was estimated that approximately 10 per cent of individuals graduating from IIIT Bangalore, including those who had completed postgraduate courses,

[1] Migration to the United States has recently slowed.

[2] For further details, see www.un.org/en/development/desa/population/migration/data/estimates2/estimates17.shtml.

[3] See e.g. on the migration of less skilled migrants: https://www.mea.gov.in/overseas-employment.htm

took up employment abroad (research mission interview with IIIT Bangalore). However, compared to the situation in the 1990s, graduates today are more likely to find good jobs in India, and salaries in India for ICT graduates have improved (Giordano and Terranova, 2012 and see Chapter 1.3).

Box 3.1. Start-ups by immigrants

In the late 1990s, a high proportion of the founders of high-tech firms in the Silicon Valley had been born abroad, with most of those migrants coming from China and India (Saxenian, 2002). However, the superior educational level of Silicon Valley's Asian immigrants was only partially reflected in their occupational status, possibly encouraging many immigrants to establish such start-ups. A follow-up study published in 2008 revealed that individuals born outside the United States were more likely than United States nationals to set up high-technology start-ups, particularly in the ICT sector. Those founders, some 25 per cent of whom had been born in India, usually held at least a master's degree. The overwhelming majority of founders had entered the United States with the intention to study or because of a job opportunity, while only a very low proportion had intended to found a company when they entered the country (Wadhwa et al., 2008).

The migration of Indian ICT specialists, particularly, to the United States, has been in part facilitated by Indian multinational ICT companies, including HCL Technologies, Infosys and TCS. This is very different from the situations of ICT specialists from Thailand and Indonesia. In the case of India, the specialization of the country's labour force and its investment in training ICT specialists have contributed to the success of Indian companies in the global market. In the recent past, emigration from India, mainly to the United States, has been facilitated by the hiring practices of successful Indian ICT companies, but those practices have, to a certain extent, also facilitated the return migration of ICT specialists to India (research mission interviews in Bangalore and Delhi). As a result of increasingly restrictive visa policies in the United States and some other countries, migration of Indian ICT specialists has recently been redirected to other countries, including Canada and some European States (further details of that trend are provided in section 3.3.3).

Indonesia

Generally speaking, Indonesia supplies other countries with low-skilled labour. There are over 9 million Indonesians working overseas. That number is the equivalent of nearly 7 per cent of the Indonesian labour force (World Bank, 2017).[4] Over 72 per cent of current Indonesian migrants are from rural areas, and over three quarters of Indonesian migrants have received, at most, a middle school education.

Labour Force Survey data in the ILOSTAT database confirm that only a very small number of Indonesian professionals and technicians migrate (see Annex Figure A3.1). Nonetheless, interviews conducted during the research mission with various stakeholders in Indonesia suggest that the migration balance of ICT specialists is likely to be negative for the country, with more ICT specialists emigrating than immigrating.

Although there is no reliable data available to confirm this, it can be assumed that only a small number of Indonesian migrants are ICT specialists. The National Board for the Placement and Protection of Indonesian Overseas Workers (BNP2TKI), a government agency that monitors migration issues, compiles a registry of all emigrants, since the placement of migrants abroad must be recorded, but that registry contains little data on the migration of highly-skilled workers. In practice, it is a challenge to track the movements of independent workers who move overseas since the main objective of the registry is to ensure decent living and working conditions abroad for low-skilled workers. Thus, it is not a political priority to track the migration flows and status of highly-skilled workers (research mission interview with BNP2TKI[5], Jakarta).

According to the most recent data on registered emigrants provided by BNP2TKI, only 545 Indonesian workers are currently employed abroad as ICT specialists.[6] This is far lower than most estimates for the number of ICT specialists who have left the country. According to BNP2TKI registry data, the breakdown of highly-skilled ICT workers who have left the country by work is as follows:

[4] According to data provided by DESA, there were 4.3 million Indonesian migrants in 2017, of which 3.8 million had immigrated to other Asian countries.

[5] BNP2TKI was established pursuant to Law No. 39/2004 on Placement and Protection of Indonesian Overseas Workers as a national agency that reports directly to the president on migration workers issues. BNP2TKI has developed a sophisticated system to collect data on the migration of workers, namely SIsko TLN.

[6] According to the registry, those ICT specialists are employed as equipment installation mechanics, electronics engineers, computer programmers, software engineers, IT managers, computer technicians, IT/MIS administrators, telecommunication engineers, IT engineers, telecommunication technicians, web developers, CPU operators, computer system analysts, computer programmers, computer engineers, IT technology specialists, data entry operators, data processors, communication technicians, and computer operators.

electronics engineers (22 per cent), computer programmers (15 per cent), software engineers (10 per cent), IT engineers (9 per cent) and computer technicians (8 per cent). However, it is unclear whether that data are representative of all emigrating Indonesian ICT professionals.

Thailand

Thailand is primarily a destination country for unskilled and low-skilled workers, and, according to the Ministry of Labour of Thailand, those workers are heavily concentrated in low-level occupations. As of mid-2017, there were 902,928 Thai migrants living abroad, or approximately 1.3 per cent of the population of Thailand. Of those workers, 789,037 were living in high-income countries, 113,274 in middle-income countries and 617 in low-income economies (DESA, 2017). However, there is a discrepancy between the data provided by DESA and the data contained in the official records of the Ministry of Labour,[7] which calculated that only 163,768 Thai workers were living and working abroad as of August 2018.[8]

According to official figures, there were 2,062,807 immigrant workers in Thailand at the end of 2017, with half of those workers living in or around Bangkok. According to registry data on immigrant workers in Thailand, only 148,000 highly-skilled workers were working in Thailand in 2016. More than half of those highly skilled workers were from China, Japan and the Republic of Korea (OECD and ILO, 2017).

Due to data gaps on the occupations of migrants, it is not possible to ascertain the number of Thai nationals working as ICT specialists abroad, or to measure the balance of migration flows of ICT specialists in and out of Thailand. However, based on information provided in interviews conducted during the research mission, there is reason to believe that all those figures are low. Figure A3.1 in the Annex shows that the outflow of professionals and technicians, and therefore the outflow of ICT specialists, remains very low. There are also indications that the international migration of ICT specialists from Thailand could increase if adequate measures were taken to address entrenched barriers to migration (see below), while a survey conducted by the Japanese Ministry of Economy, Trade and Industry indicated that a large number of ICT specialists in Thailand would like to emigrate, particularly to Japan (58.4 per cent of survey respondents), Singapore (32.5 per cent) and the United States (58.4 per cent).

3.1.2. Factors shaping the international migration patterns of ICT specialists

The number of ICT specialists choosing to migrate internationally is rising because of a number of factors, including the following:

a) An increase in project-based work has led to increased movement in the "external" labour market (research mission interview with employers' associations, Delhi). According to the Michael Page recruitment agency in Indonesia, it is common for technology experts to take on project-based work rather than being employed at only one company (Michael Page, 2017). Adecco, a recruitment agency that operates internationally, also confirmed this trend and reported that the average term of employment is between 12 and 18 months (research mission interview with Adecco, Bangalore). Thus, many Indian ICT specialists move abroad on a temporary basis to take up employment.

b) The globalization of labour markets increases the movement of employees of multinational companies from one country to another. This is also known as migration within companies' "internal labour markets". Multinationals tend to send their own ICT specialists abroad for a variety of reasons, including the need to fill management positions, the need to address skills shortages and facilitate training, and the need to strengthen a company culture. Shortages of highly-skilled specialists mean that companies are forced to adopt a strategy of "buying technology and borrowing labour", as was highlighted by an interviewee in Thailand (research mission interview with Microsoft, Bangkok).

c) Interviewees in all three countries emphasized that, when compared with previous generations, the millennial generation has greater aspirations, is more demanding with regard to working conditions, and is more inclined to change jobs. Individual preferences on the supply side and the increasing temporary nature of jobs on the demand side mean that ICT specialist career paths are increasingly

[7] Ministry of Labour, Overseas Employment Administration Division.
[8] Ministry of Labour, Overseas Employment Administration Division, 2018.

characterized by numerous job changes.[9] A choice regarding international migration does not necessarily mean a desire to permanently leave one's country, but it may dovetail with dynamic career plans (CODEV-EPFL, IDSK, JNU, ILO, 2013). This clearly underlines the fact that the motivation to emigrate is driven by temporary and project-related opportunities and is not necessarily part of a life plan that includes a permanent move.

3.1.3. Migration of students

Globally, the number of students studying abroad increased from 1.9 million students in 1998 to 5 million students in 2016. Student migration is often a precursor of labour migration. This is particularly the case for Indian students, and the proportion of Indian students among all foreign students enrolled in tertiary-level education courses in OECD countries increased from 4 per cent in 2001 to 7 per cent in 2016. Indian students are the second largest group of students from non-OECD member countries, with the largest group being Chinese students (OECD, 2011; OECD, 2018b). The number of Indians studying abroad rose by 78 per cent between 2013 and 2016. In 2016, 45 per cent of Indians studying abroad went to the United States, 14 per cent to Australia, 7 per cent to Canada, 5 per cent to the United Kingdom and 4 per cent to Germany. In the case of Indonesian students, 22 per cent of Indonesian students studying abroad went to Australia, 20 per cent to the United States, 7 per cent to the United Kingdom, 6 per cent to Japan and 5 per cent to Germany (OECD, 2018b). Those destination countries mainly attract students at the master's and doctorate levels. In the 2016 – 2017 academic year, there were 186,267 students from India enrolled at United States universities.[10] More than one-third of those students were studying mathematics and/or computer science. The numbers for Indonesia (8,776 students, with 7.1 per cent studying mathematics and/or computer science) and for Thailand (6,893 students, with 8.7 per cent studying mathematics and/or computer science) were much lower.

International cooperation among universities can also facilitate work-related stays abroad. Whether migration is mainly in one direction only or not depends on several factors, including the structure of exchanges, the ranking of universities, and the attractiveness of a country for potential migrants. International cooperation, including student exchange programmes, staff exchange programmes and research cooperation, also supports the exchange of ideas and helps to strengthen universities' teaching and research capacity.

Joint degree programmes carried out in collaboration with foreign universities also allow students to study abroad. An example of such collaboration is illustrated in Box 3.2.

Cooperation among academic institutions can also take the form of exchange programmes. In Thailand, for example, the Asian Institute of Technology has established several exchange programmes with universities in Asia and Europe, while the Faculty of Engineering at Chulalongkorn University has set up several exchange programmes with universities abroad, including Dartmouth College in the United States, Peking University in China, and RWTH Aachen University in Germany.

Box 3.2. The Swiss German University in Indonesia

The Swiss German University (SGU),[11] an Indonesian university that, inter alia, teaches courses in ICT, has introduced a unique internship programme for its students. SGU students must complete two mandatory internships, one locally and one abroad. SGU is the only private university in Indonesia that offers this kind of internship programme. The first internship normally takes place in Indonesia during a student's third semester, with the second internship occurring in Germany or elsewhere abroad during the sixth semester.

To facilitate a student's internship period abroad, SGU has established a representative office, Swiss German University Westphalia (SGUW), which is located at the South Westphalia University of Applied Sciences at Soest, Germany. SGUW has appointed staff to cater to the needs and concerns of students during their internship period in Germany. This programme fosters close cooperation between graduates and the industry in which they are working, and has facilitated the establishment of close links between SGU and partner institutes and companies abroad. Nevertheless, according to alumni reviews, the vast majority of SGU graduates are employed in Indonesia. Some may also continue their studies in master's or PhD programmes abroad.

Eligible and qualified students also have the opportunity to receive an international degree from a partner university in Germany.

[9] There is evidence that the migration of the highly-skilled is influenced by the business cycle. The global financial crisis in 2007 and 2008 adversely affected employment of highly-skilled personnel in banking, IT and related sectors. An analysis of migration flow data reveals that annual immigration flows to major OECD countries declined after 2007 (Czaika and Parsons, 2016).

[10] Institute of International Education, 2017-2018 data. For further information, see www.iie.org/Research-and-Insights/Open-Doors/Data/International-Students/Fields-of-Study

[11] For further information, see www.sgu.ac.id/

In India, leading academic institutions have begun to collaborate with foreign universities and governments, mainly in the area of research. For example, IISc Bangalore has signed ten Memoranda of Understanding with foreign nations, IIITM Gwalior has established numerous partnerships with foreign universities including Cambridge University in the United Kingdom, and IIT Bombay has signed a Memorandum of Understanding with ETH Zurich in Switzerland.

In Indonesia, a double degree system, in which students can obtain a bachelor's degree both in Indonesia and overseas, has been created to help students acquire experience abroad.

3.2. Migration incentives

3.2.1. Overview of incentives for emigration

According to the neoclassical theory of migration, individuals make rational decisions when choosing a location where they want to work. Employment prospects, wages and the costs of migrating are taken into account and migrants then travel to the country with the highest expected return on investment (Massey, et al 1993). The potential migrant thus compares employment opportunities and wages or family income in the country of origin with those in destination countries. When this is applied to the migration of ICT specialists, factors considered include prospects for career development, working conditions and the nature of the work he or she will do. Migration literature commonly distinguishes between push and pull factors. Push factors exert an incentive to leave a country, while pull factors attract migrants to a specific destination.

Newer approaches in migration theory have emphasized expectations and assessments of job opportunities. Cultural factors or perceptions of amenities in the country of origin and the country of destination also affect migration decisions. It should be noted, however, that, as confirmed by interviews conducted during the research mission, perceptions of what constitutes a good quality of life differ from one culture and individual to another. Furthermore, migration theory now considers not only an individual's personal income but also his or her household income, including wages and work opportunities for accompanying partners, as well as costs, such as those associated with health care and children's education. Motivational approaches suggest that social networks and a feeling of stability are also considered in the migration decision (see for an overview in Reichlova 2005).

Key push factors that promote the international migration of ICT specialists include unfavourable economic and social environments and a poor quality of life in their countries of origin, while higher incomes, greater job satisfaction, improved career prospects or a clear career path, opportunities to learn and access to information regarding industry trends, and new challenges are typical driving (pull) factors. Those factors were confirmed by research mission interviews in all three countries. More generally, a survey carried out by JobsDB, a recruitment agency operating internationally in seven countries, showed that, for ICT specialists, the three most attractive factors for job applicants included company reputation, colleagues, and company values, while the three most unfavourable factors included lack of career development, lack of training, and lack of job security (research mission interview with Jobs DB, Bangkok).

For Indonesians, high salaries in countries such as Brunei, Malaysia and Singapore were a key factor motivating ICT specialists to seek employment abroad, although promotion opportunities may be limited overseas (interview during research mission at Telkom University, Jakarta). According to Telkomtelstra, there is an increasing focus on job quality and quality of life, because wages in Indonesia are not much lower than wages in other Asian countries. Emigrating ICT specialists from Indonesia, for example, believe that experience gained from working, even for just a few years, in an environment like Silicon Valley can enhance their skills and human capital, and can boost their earning potential when they return home.[12]

A study published in 2013 analysed the overall satisfaction of highly-skilled Indian migrants in France, Germany, the Netherlands and Switzerland, 34.6 per cent of whom worked in the ICT sector. When asked about their satisfaction with local conditions, the highest scores in all four countries were in the category of amenities and social welfare systems. Satisfaction with income was rated somewhat lower, with the exception of Switzerland. Overall, the lowest satisfaction ratings were for work permit regulations (CODEV-EPFL, IDSK, JNU, ILO, 2013).

[12] See for example the views of Thomas Aquinas expressed in an online discussion entitled "As Indonesian, what are some advantages working abroad?" Available at www.quora.com/As-Indonesian-what-are-some-advantages-working-abroad

More broadly speaking, the decision to emigrate is often linked to a desire for human capital accumulation and access to fulfilling and interesting jobs. The aforementioned survey, which was based on interviews conducted in 2010 and 2011 with 246 highly-skilled employed Indian migrants, showed that some 43.5 per cent of respondents were working in their respective destination countries because they had studied there. According to this "two-step migration process," skilled migrants first arrive in a destination country as international students and then enter the national labour market as skilled professionals. Having studied in a destination country does not require a process of qualification recognition, and this facilitates labour market access. Many OECD countries have implemented measures to facilitate that process (OECD, 2010).

Furthermore, a recent survey of highly-skilled Indian migrants and international students in Germany suggested that Indian female migrants to Germany may see emigration as an opportunity to distance themselves from patriarchal structures in India (Faist et al, 2017).

3.2.2. Incentives and other reasons for return migration

India

The phenomenon of return migration to India has attracted considerable attention in recent years. Since the early 2000s, increasing numbers of highly-skilled ICT professionals have returned to Bangalore, Hyderabad and other cities with a high concentration of IT companies and research institutions. In the mid-2000s, 95 per cent of international companies located in Software Technology Parks in Bangalore were run by Indians who had lived and worked abroad, mostly in the United States (Chacko, 2007). However, return migration remains limited in scope and, according to a study conducted by NASSCOM and McKinsey, only 25,000 migrants returned to India between 2000 and 2004.

A number of factors have been driving return migration to India. Like emigrants, return migrants make a decision on where to live based on individual cost-benefit assessments. Wages, interesting job opportunities and career paths, family reasons, including the possibility of providing greater support for older relatives and accessing high quality childcare services, as well as other factors that affect migrants' overall quality of life, are likely to be considered. Smaller wage differentials, if measured in terms of purchasing power parity, as well as increased start-up opportunities, may also factor into the decision making process (research mission interviews with NASSCOM, IIT Delhi, IIIT Bangalore and IISc Bangalore). Those findings are confirmed by various researchers, who have highlighted the role of narrowing wage differences and growing employment opportunities in ICT in India on return migration patterns (see, for example, Giordano and Terranova, 2012).

Such findings are partly disputed by the results of a survey of Indian professionals, the majority of whom had been working in the ICT sector or academia, and who were returning to India from four European countries (CODEV-EPFL, IDSK, JNU, ILO, 2013). Half of the respondents had stayed abroad for less than two years, and more than half of return migration is driven by the temporality of work contracts. Family was found to be the third most important factor in determining return, although only 17 per cent indicated this as a decisive factor for returning. Better career options and employment opportunities in India were cited by only 6 per cent of respondents as a primary reason for returning to India, and higher real earnings (due to the relatively low cost of living in India) was a reason cited by only 0.38 per cent of respondents. Problems integrating into the society of the destination country were named only rarely as a reason for returning to India. Moreover, a survey of more than 500 highly-skilled return migrants employed in five key sectors, including ICT, in five major hubs in India,[13] confirmed that the largest share of highly-skilled Indian returnees (58 per cent) come back because their contract has expired or because their project assignment has ended. The desire to move closer to family members was the second most common reason given (Kumar, Bhattacharya and Nayek, 2014).

Due to their international work experience, return migrants are in demand by many companies operating in India, including companies operating in the telecommunications industry – an industry in which large initial capital investments are required and significant financial returns accrue only at a later stage. Companies adopting new technologies do not wish to experiment with new talent and would rather pursue the lateral hiring of individuals who have already worked at multinational companies (research mission interview with Cellular Operators Association of India (COAI), Delhi).

[13] Bengaluru, Delhi NCR, Hyderabad, Kolkata, Mumbai and Pune

Small and medium-sized ICT firms in India have found it particularly difficult to hire return migrants (research mission interview with NASSCOM, Bangalore). Consequently, they would need to increase the salaries they offer to ICT specialists in order to attract the talent they are looking for (research mission interview with IIIT, Bangalore), particularly as many return migrants would prefer to run their own start-ups (research mission interview with IIIT, Bangalore; Meil and Salzman, 2017).

The Ministry of External Affairs, Division of Overseas Indian Affairs[14] seeks, inter alia, to "connect the Indian diaspora community with its motherland". The Ministry has, moreover, established Overseas Indian Centres Abroad[15] in Abu Dhabi, Kuala Lumpur and Washington, D.C. with a view to reaching out to Indian diaspora populations and engaging with them to create knowledge networks (Testaverde et al, 2017). The Centres function as Ministry field organizations and provide economic, social and cultural support to Indians overseas. Return migrants have emphasized that "networks established overseas" have facilitated their career development on their return to India (CODEV-EPFL, IDSK, JNU, ILO, 2013) and recruiters and universities in India, as well as in Indonesia, make extensive use of those and other relevant social networks to reach out to return migrants (research mission interviews with Michael Page and SGU, Jakarta).

Indonesia

Although return migration to Indonesia takes place on a much smaller scale than return migration to India, it has also attracted attention in recent years. Many Indonesian workers return to their country because of favourable labour conditions and remuneration packages, but also because they want to contribute to the country's development (research mission interviews with AINAKI, Michael Page and Telkomtelstra, Jakarta). Michael Page recruits expatriate Indonesian ICT specialists and many Indonesian companies prefer to hire Indonesian employees with international experience because those workers have a deeper understanding of both domestic and global markets. According to the Chairman of Wantiknas, the Indonesian national ICT council, many returning Indonesian ICT workers cite their desire to live closer to family members and the potentially higher quality of life that they can enjoy in Indonesia as having contributed to their decision to return home. Many Indonesian start-up companies, such as Go-jek, have hired large numbers of Indonesian professional workers who have previously worked abroad. Interestingly, there are few concerns raised about brain drain issues in research mission interviews, Indonesia. While not all those who leave Indonesia will return, the role of return migrants who have global experience is perceived to be an important element in meeting the demand for highly-skilled ICT specialists in the country.

One possible way that countries can promote brain circulation is to strengthen ties among their academic institutions and nationals of that country working at academic institutions abroad. To that end, the Ministry of Research, Technology and Higher Education has introduced a professor diaspora programme, which invites Indonesian specialists from overseas to take part in seminars and lectures in Indonesia.

3.3. Migration barriers

3.3.1. Recognition of skills and qualifications

Migration barriers include financial constraints and other factors that impede entry to prospective destination countries. Migrants may, for example, find it difficult to acquire work permits. Other factors that hamper migration include unfavourable environments for migrants' families and complicated administrative procedures for migration, such as the failure of prospective destination countries to recognize migrants' educational qualifications or their acquired skills. Indeed, more than one fifth of respondents in a recent survey of highly-skilled Indian migrants working in four European countries felt that they were over-qualified for their present job. The most frequent reasons for feeling over-qualified included: not working within their field of expertise, not being able to transfer Indian degrees and work experience to Europe, and feeling that their aspirations were being curtailed because of language barriers (CODEV-EPFL, IDSK, JNU, ILO, 2013). The recognition of qualifications is less of an issue for those who graduate from well-known and highly-ranked universities. Mutual agreements on recognition of study programmes may help address that barrier and facilitate further migration. An important mutual recognition framework relevant to the ICT sector, is the International Engineering Alliance Washington

[14] For further information, see https://www.mea.gov.in/overseas-indian-affairs.htm.

[15] For further information, see https://www.mea.gov.in/overseas-indian-centres-abroad.htm.

Accord, which has been signed by 20 countries, including Canada, China, India, Japan, Singapore, the United Kingdom and the United States. The Accord is a multilateral agreement among bodies responsible for accreditation or recognition of tertiary-level engineering qualifications that facilitates the mobility of professional engineers, including in the area of ICT.[16] In addition, a number of Asia-Pacific Economic Cooperation (APEC) countries, including Indonesia and Thailand, have concluded an agreement on the recognition of "substantial equivalence" of professional competences in engineering. Among ASEAN member countries, regional mutual recognition arrangements have been approved in a number of fields, including accountancy, architecture, engineering, medicine and nursing.

3.3.2. Language and intercultural skills

In research mission interviews, interviewees identified the lack of relevant technical and soft skills as a barrier impeding employment overseas and, as discussed in chapter 2, employers in all three countries have complained that prospective employees often lack sufficiently developed soft skills. A lack of language skills is also a common impediment preventing migrants from finding employment. Several individuals interviewed during the research mission, including staff members of Microsoft Bangkok and the Bangkok office of the recruitment agency JobsDB, underscored that, while Indian ICT specialists often have a good command of English, Indonesian ICT specialists often possess an inadequate command of that language, while the English language skills of Thai ICT specialists are often even poorer. In general, the local language skills required to take up a position abroad are less important in the field of ICT than in other professional fields, as English is the commonly used working language in that sector. Nonetheless, although migrants in non-English speaking countries may use English at work, they still need to acquire a knowledge of the destination country's local language in order to communicate effectively outside the work environment on a day-to-day basis. In Japan, Japanese language skills are critical even in a work setting (research mission interview with Adecco, Bangalore).

Cultural factors have also been cited as challenges by multinational companies operating in the ICT sector. For example, interviewees at Microsoft in Thailand stated that the current job performance feedback system, in which colleagues are able to give anonymous feedback and advice, is not effective in the case of workers from ASEAN countries, who are often reluctant to speak frankly and are not adept at handling constructive criticism. In an attempt to mitigate this and other cultural issues, Microsoft has tried to promote a global mind-set and cross-cultural understanding with a view to minimizing international barriers to migration for the Microsoft workforce (research mission interview with Microsoft, Bangkok).

3.3.3. Visa regulations in destination OECD countries

A tightening of the eligibility requirements for H-1B work visas[17] in April 2017 resulted in an increase in the number of H-1B visa application denials, from 19.1 per cent in the first quarter of 2017 to 22.4 per cent in the second quarter of that year (National Foundation for American Policy (NFAP), 2018). In mid-2018, it was stated that the United States was considering taking action to revoke the 2015 legal provision that allows spouses of H-1B visa holders to take up employment in the United States. Such action, if taken, may further reduce the attractiveness of H-1B visas. The United States has also reduced the number of temporary work visas it issues, and international student admissions have fallen sharply. The number of students from China and India decreased by 61 per cent and 39 per cent, respectively, between 2015 and 2017. A proposal to raise minimum salary requirements for visas to take up employment in the United States may make the employment of Indian workers in the United States uneconomical for employers and make it even more difficult for potential migrants to take up employment in the United States (OECD, 2018c). It is difficult to assess how many potential immigrants would be affected, as the wage elasticity of ICT specialist jobs is not well understood.

Australia has also tightened its immigration policy, and it is very probable that the country's more stringent immigration requirements will have a significant impact on the migration of Indian workers to Australia (OECD, 2018c). Applicants must now be under the age of 45 at the time of their application

[16] For more information see http://www.ieagreements.org/accords/washington/

[17] The H-1B visa allows United States employers to employ highly-qualified foreign workers, including ICT specialists, in a narrow range of occupations. Further information is available at www.uscis.gov/working-united-states/temporary-workers/h-1b-specialty-occupations-dod-cooperative-research-and-development-project-workers-and-fashion-models)

and have at least three years of work experience. Applicants must pay a contribution to the Skilling Australians Fund, and their employers must pay market rate salaries with a base rate of pay that is at least equivalent to the country's Temporary Skilled Migration Income Threshold. In 2017, Australia implemented a number of reforms to temporary and permanent employer sponsored skill migration programmes. The recently introduced Temporary Skill Shortage (TSS) visa reflects several policy changes. In order to be eligible for a TSS visa, immigrants must possess a very good command of English and have at least two years of relevant work experience. The Government has drawn up a list of occupations affected by skills shortages, which is updated on a biennial basis. Mandatory labour market surveys are carried out, and employers are required to contribute to the Skilling Australians Fund. To migrate to Australia, engineers must possess the skills set forth in guidelines formulated by the Australian Computer Society and undergo a rigorous migration skills assessment.

In the United Kingdom, approximately 60 per cent of recipients of foreign skilled worker visas in 2016 were Indian nationals. However, the United Kingdom has since tightened its entry requirements by raising the salary thresholds for employing foreigners. It has also become more difficult for Indian students to extend their visas through employment.

Singapore, another popular destination for upwardly-mobile Indian middle-class professionals, has mandated that Singaporean companies advertise any vacancy for two weeks domestically before seeking employment permission for job seekers from overseas.

In contrast to those countries, the European Union (EU) has eased visa regulations for ICT specialists through its Blue Card work permit system, established in 2009 in order to meet market demand for highly-skilled labour in EU countries by reducing bureaucratic barriers to immigration (EU, 2009; Satija and Mukherjee, 2013). With the exception of Germany, where 17,630 Blue Cards were issued in 2016, the number of Blue Cards issued in the rest of the EU remains very low. This is mainly due to the following: inconsistencies in the entry requirements for highly-qualified immigrants because of different national level regulations applicable to the Blue Card work permit system; differences in terms of the implementation of EU rules and processes at the national level; high minimum income thresholds; and limited labour rights for EU Blue Card holders (Sitteneder, 2018).

With the tightening of United States immigration policy, Canada is emerging as a popular destination for highly-skilled workers, including ICT professionals. Under the country's Global Skills Strategy[18], short-term researchers and highly-skilled workers with short-term contracts no longer require work permits. Furthermore, work permits and visas for highly-skilled individuals are processed within two weeks. The June 2017 changes to the Express Entry programme for economic migrants have also accelerated the movement of highly-skilled Indians to Canada (OECD, 2018a). Research has shown that the programme applicants who are most likely to be granted permanent residency have received job offers for the following positions: system analyst, software engineer or designer, computer programmer and university lecturer (Kably, 2018).

3.3.4. Impacts of restrictive migration policies

Indian IT firms have developed a number of strategies in response to the adoption of more restrictive immigration policies by the United Kingdom and the United States, which are having a significant impact on Indian companies and highly-skilled professionals. An outline of some of those strategies is provided in Table 3.1.

Any further restrictions placed on immigration by the Governments of the United Kingdom and the United States, may result in a labour surplus in the Indian domestic market, which may eventually depress wages in India. However, restrictive migration policies could also motivate Indian companies and skilled ICT workers to relocate to the ageing economies of Europe and Japan. A number of stakeholders expect that the migration of workers to traditional overseas markets might decline by between 25 and 30 per cent, while new markets for Indian labour are expected to open up (research mission interview with IIIT Bangalore).

In Indonesia and Thailand, as stated above, removing migration barriers that impede foreign ICT specialists from working in these countries would help them address ongoing skills shortages and promote broader development. In the long term, however, those countries must address ICT skills shortages through domestic capacity-building and skills development programmes.

[18] For further information about the Strategy, see www.canada.ca/en/immigration-refugees-citizenship/services/work-canada/hire-foreign-worker/temporary/global-skills-strategy.html.

Table 3.1. Responses to global migration challenges faced by Indian IT firms

Company	Response
Infosys	• Over a two-year period beginning in 2017, Infosys hired an additional 10,000 United States nationals to work in the United States (Karnik, 2017) • In response to changes to United States visa policies, the company fast-tracked the hiring of 12 executives from Cognizant, 13 from Capgemini, five from TCS, and eight each from Wipro, Accenture and IBM in the fiscal year ending March 2017. Additional employees were hired from HCL Technologies, Zensar, Tech Mahindra and ITC Infotech (Mendonca, 2017)
Mindtree	• Reduced dependence on work visas through project and staffing model changes • Establishment of a delivery centre in Poland • Expansion of business operations in other geographical areas
Mphasis	• A specialized internal team hired a number of external consultants to strengthen the company's compliance with relevant laws • Periodic immigration compliance reviews, and ongoing training and awareness-raising programmes to ensure full compliance with immigration requirements have been implemented
Tata Consultancy Services (TCS)	• Applied for two-thirds fewer visas for Indians to move to the United States in 2017 than it had in 2015 • Increased outreach to legislative and regulatory stakeholders, important trade bodies, think tanks and research institutes • Showcased investments, employment generation and innovation capabilities to relevant stakeholders • Actively engaged in STEM initiatives designed to enhance the availability of engineering talent in major markets
Tech Mahindra (Americas)	• Will apply for visas proportionate to business needs, and not in multiples, as was done previously.
Wipro	• By December 2017, Wipro had localized 55 per cent of its employees from offshore locations and currently has more than 1,000 employees in each of the following states: California, Florida, Georgia and Texas.

Source: Annual Reports of Infosys, Mindtree, Mphasis, TCS, Tech Mahindra (Americas) and Wipro for the 2017 fiscal year.

3.4. Migration policies of India, Indonesia and Thailand

The migration policies of the three countries examined in this report focus, primarily, on the protection of low- and semi-skilled migrants and on combating human trafficking. To that end, the Indian Ministry of External Affairs has established a set of policy objectives with regard to the legal protection of low-skilled and semi-skilled Indian migrants, while Thailand has adopted measures to limit illegal immigration from poor South-East Asian countries. The three countries have not, however, concluded any agreements with destination countries with regard to the migration of highly-skilled workers.

India, Indonesia and Thailand have all put in place visa procedures for highly-skilled workers, but those procedures are often complicated and may take considerable time to complete. This places a significant administrative burden on immigration authorities and impedes the migration of professionals.

India

Employment visas in India[19] are issued to highly-skilled and qualified professionals who are offered jobs as technical experts, senior executives or managers and who will be working in India for an organization or company registered in the country. Employment visas are usually granted for one year and can be extended, although for highly-skilled IT professionals the visa may be valid for up to three years and allow for multiple entries into the country. To qualify for an employment visa, the employee's salary must be equal to or greater than $25,000 per year. Individuals holding Overseas Citizen of India or Persons of Indian Origin cards are also eligible to take up employment in India.

[19] For further information, see https://boi.gov.in/content/employment-visa-e.

Indonesia

Indonesia has relatively strict regulations regarding the hiring of non-Indonesian nationals. Multinational companies are not permitted to hire foreigners without obtaining a special permit from the Ministry of Manpower as well as other important documents that must be signed by several government officials within the Ministry. Responsibilities for migration are not clearly assigned to national institutions, leading to conflicts among those institutions and creating a sense of uncertainty among migrants. To facilitate legal migration to Indonesia, it is critical to enhance coordination among those institutions (Testaverde et al, 2017).

Thailand

In most cases, highly-skilled workers who immigrate to Thailand receive a temporary work permit. Those workers have usually completed a high-level of education and are employed in senior positions in their fields of work. Work restrictions mean that they can take up employment only in occupations stipulated by the relevant regulations.[20]

Visa requirements and the need for work permits for ICT specialists in Thailand have been cited as a key employment barrier for those seeking to work in Thailand (research mission interview with JobsDB, Bangkok).

In order to lower immigration barriers for highly-skilled workers and enhance the ability of Thailand to attract science and technology experts, senior executives, investors and start ups, the Government of Thailand launched the "Smart Visa" programme in February 2018. Highly-skilled professionals who work or invest in what are known as the "S-Curve industries" may apply for a work permit under the programme.[21]A Smart Visa provides more benefits and privileges than any other type of visa issued by Thailand: it is valid for up to four years rather than the usual one year, the requirement that the Smart Visa holder must report to the Immigration Bureau is eased and the holder must only report annually instead of every 90 days, and the legal dependents of the Smart Visa holder may live and work in Thailand with the same rights as the Smart Visa holder.[22] Moreover, the Strategic Talent Center, established by the Thailand Board of Investment, identifies suitably qualified science and technology specialists and researchers from both inside and outside Thailand who can support private-sector research and development. The Center has developed procedures to facilitate recognition of the qualifications of non-Thai experts so that they can fill positions for which no suitably qualified Thai nationals can be found. Special arrangements have, moreover, been established to expedite the issuance of visas and work permits to non-Thai experts whose expertise and qualifications have been recognized.

3.5. Impact of migration

For many years, research in the area of migration focused mainly on how the so-called "brain drain" and resulting loss of human capital has affected countries. In the case of India, the debate has now shifted to assessing the contributions made by migrants to the domestic economy through knowledge transfer and remittance payments from the Indian diaspora and returning migrants (Breinbauer, 2007; Tejada and Bhattacharya, 2014; CODEV-EPFL, IDSK, JNU, ILO, 2013). The contribution of United States-based Indian IT specialists to the growth of the software industry in India has helped India to develop as a knowledge economy. Outsourcing and the development of the high-tech sector in India are both closely related to migration and globalization in general. In particular, migrants returning to India have founded companies that provide IT-services to companies abroad (Tejada and Bhattacharya, 2014). India has successfully taken advantage of the cutting-edge skills of its highly-skilled workers abroad and the entrepreneurial networks that they have established there. Furthermore, the success of Indians abroad and the economic evolution of India have boosted the confidence of overseas investors. While many highly-skilled Indians who have specialized in subjects such as engineering and information technology leave India to take up employment abroad, they have also facilitated the establishment of a significant knowledge base within the country. A growing number of well-known companies, including Cisco Systems, General Electric, Hughes Software, IBM, Intel, Microsoft and Oracle have established research and development centres in India. Investment flows are now two-way as the biggest companies from

[20] Article 9 of the Aliens Working Act, B.E. 2551, 2008.

[21] The S-Curve industries are defined as follows: (a) next-generation automotive, (b) smart electronics, (c) affluent, medical and wellness tourism, (d) agriculture and biotechnology, (e) food for the future, (f) automation and robotics, (g) aviation and logistics, (h) biofuels and biochemical, (i) digital, and (j) medical hub.

[22] For further information, see http://www.thaiembassy.sg/visa-matters-/-consular/types-of-visa/smart-visa

India invest abroad (Buga and Meyer, 2012). As for Indonesia, interviews conducted in that country for this study confirmed the view that the international migration of Indonesians has facilitated capacity-building, as many of those migrants have been able to attain advanced degrees abroad.

Thus, labour flows may lead to knowledge sharing and the dissemination of information among countries (Blitz, 2005). This phenomenon, namely the temporary movement of skilled or highly-skilled workers between home and host countries, has been dubbed "brain circulation" (Daugeliene and Marcinkeviciene, 2009). Furthermore, students and emigrants may engage with their home countries through business visits or short-term stays, a phenomenon that has been dubbed "brain linkage." The two phenomena are very closely related. Indeed, a study that looked at migration in China, India, the Republic of Korea and Taiwan revealed that an initial brain drain of highly-skilled labour (or of students) facilitates, in the longer term, both brain circulation and brain linkage through the establishment of strong social networks. The study revealed that a brain drain can be transformed into brain circulation and brain linkage if governments implement strategies to strengthen tertiary scientific education, short-term and long-term economic development, as well as diaspora engagement. The concepts of brain circulation and brain linkage are likely to become increasingly relevant for other emerging economies (Shin and Moon, 2018).

Nevertheless, there seems to be no irrefutable evidence proving that migration has a positive effect on domestic development in general (CODEV-EPFL, IDSK, JNU, ILO 2013), and emigration might still lead to skills shortages if the domestic demand for ICT workers is greater than the number of IT workers in training (Findlay and Lowell, 2001). Certain research mission interviewees were of the opinion that the brain drain impedes the economic development of a country. A representative of ECOT cited "human capital flight" as one of the main ICT challenges facing Thailand today. According to that representative, ICT specialists are motivated to leave the country because of a lack of cutting-edge technology at local companies. This is a significant problem because young ICT workers are looking for both high-paying jobs and supportive work environments that foster skills development and professional growth. When this combination is lacking it makes it difficult for small and medium-sized companies to recruit young, talented workers and means that they must buy technology from abroad instead of developing that technology locally (research mission interview with ECOT, Bangkok). The phenomenon of the brain drain remains a critical concern in both the public and private sectors in Thailand (research mission interview with the Office of the National Economic and Social Development Council, Bangkok).

Chapter 4

Key findings and **possible** policy **responses**

Key Findings

Opportunities and challenges – digitalization in economies and labour markets

In the countries examined here, India, Indonesia and Thailand, there are important opportunities for future growth in the ICT sector, for the ongoing digitalization of economies and society, and for an expansion of ICT specialists into other sectors. A precondition for utilizing this potential is the acceptance and adoption of digital technologies both by companies, including SMEs, and by the majority of those populations, as workers and as consumers. Areas of potential growth for the digital economy in the domestic markets include e-banking, e-education, e-commerce, e-medicine, e-governance, and e-agriculture. In some of those areas, including agricultural technologies and health technologies, there may be opportunities to develop or co-develop solutions for other countries, be they advanced or emerging economies. The primary challenge is to meet global demand in terms of skills rather than in terms of volume. The promotion of skills development is a critical component of meeting the current and future demand for ICT specialists and will require investment in education, training, reskilling and upskilling and lifelong learning initiatives.

Skills shortages, skills gaps and skills development

As digitalization continues, ICT skills will need to become increasingly more universal. To have a good basis for the skills development needs of the future, education at all levels must be modernized. Schools need to equip young people with solid foundations in numeracy, literacy and digital skills. It is important to prepare both girls and boys for the pursuit of vocational training and studies in science, technology, engineering and mathematics subjects, in addition to other topics that make a well-rounded education.

Furthermore, early on in a pupil's development, it is important to build logical thinking skills, creativity and communication skills. Basic skills including numeracy and literacy skills, soft skills and job-related technical skills are the foundation for lifelong learning and adaptability and must be taught at all educational levels.[1] In addition, a strong command of the English language specialists is crucial for ICT specialists, and the willingness and ability to learn additional foreign languages is certainly an advantage. In all three countries examined it was notable that the education systems, including both vocational and higher education institutions, are often insufficient in their teaching of soft skills to their students. It can be expected that with the ongoing spread of digitalization, this skill set will become even more important. Certain institutions in India have identified the lack of soft skills among students and are working to incorporate programmes to address this lack.

In addition, employers in all three countries noted the digital technology skills gaps of workers. Although there seems to be a sufficient number of graduates with bachelor degrees, in the opinion of employers, many of those graduates are not employable since they lack both the soft and technical skills required by a company.

[1] There is a large body of literature that discusses different skills and competencies within the area of soft skills. According to ILO (2015), they may be categorized in four broad groups: learning to learn, communication, teamwork and problem solving. See Gibb (2014) for a literature review in reference to the following categories of soft skills: communication, interpersonal, leadership, organization, self-motivation and creativity.

Overall, the quality of teaching and level of skills acquired at the undergraduate level was questioned by employers in all three countries during the research mission, although differences in the education level between different universities within each country were also noted. Surveys among education institutions showed that those institutions considered the employability of their students to be greater than employers did. As a consequence, a perceived lack of consistent quality results in vertical skills mismatch: employers prefer to employ graduates with a master's degree for roles which could theoretically be filled with a bachelor's degree graduate with the appropriate skill set. Mismatches in hiring exacerbate the shortage of highly-skilled professionals with master's degrees, a situation that is also observable among graduates from the vocational stream being overlooked in favour of graduates with a bachelor's degree. To improve the level of general vocational education, all three countries have announced initiatives to promote TVET, but none of those initiatives are aimed ICT vocational training.

Although employers and employers' associations are involved in skills governance, in partnership with education and training institutions and governments, there could be room for improvement. Firstly, workers' voice and views should also be taken into account. Secondly, skills gaps are notable, since although workers may have had a formal education, they often lack the skills required for performing their work tasks. Therefore, they may be at risk of under efficiency in the tasks they perform, thus under-qualification is also an important issue. Thirdly, workers may not have a high-level formal qualification, but instead they may have acquired the necessary qualifications through non-formal learning. An official recognition of non-formal learning is important, particularly if that kind of recognition can be combined with upskilling. The creation of educational and occupational standards based on industry involvement, the establishment of certification systems, and increased transparency in education and certification could help strengthen national qualification systems in all three countries.

There is debate regarding whether ICT education should be more practical and workplace oriented, or should focus, instead, on theoretical foundations. It seems that different types of ICT specialists are in demand including: (i) generalists (ii) highly specialized, highly-skilled professionals with a strong theoretical background and (iii) practitioners. These three types of workers are likely to have different roles and functions and will tend to be employed at different levels of a company hierarchy. Evidence suggests that the first two groups are suffering a labour shortage and the third group is experiencing a skills gap. Indeed, in India, Indonesia and Thailand there is a shortage of highly-skilled ICT workers with either a master's degree or a doctorate. In addition, both the vocational stream and the undergraduate stream in all three countries need to improve education and training systems currently in place.

One major skills gap in Thailand is a lack of English language proficiency, to a somewhat smaller extent, this gap is also noticeable in Indonesia. In contrast, it is widely acknowledged that India's ICT sector has been able to develop successfully due to the English language skills of the population. Given that ICT specialists must be up-to-date regarding trends, and information about these trends and the accompanying training material is often only available in English, language ability is crucial in the ICT sector. Many informal online self-learning courses in ICT are done in English and in addition, language proficiency is a prerequisite for international migration. Increasingly, there is a need to learn languages other than English in order to facilitate migration to other countries in Asia, and to Europe for example.

In all three countries the effect of horizontal skills mismatch is that ICT specialists are assigned administrative and business-related duties at their jobs. It also seems that the guidance provided at vocational schools is inadequate, resulting in many students making the "wrong" choices about their education and their future. Some students graduate in IT and technology related fields because it is prestigious and there is societal pressure, particularly in India, even if they would prefer to work in other sectors, including management and commerce. Conversely, ICT specialists may have studied other academic fields but they have acquired ICT technical skills through autodidactic learning. By integrating ICT modules with social science programmes, Thai higher education institutions could meet the demand for an interdisciplinary skilled workforce possessing ICT skills.

In all three countries, multiple ministries are involved in defining skills development and developing strategies to address this. Unfortunately, cooperation and coordination between various ministries and institutions are often weak and inputs from ICT workers or students are rarely taken into account partly due to the lack of representative organizations.

The role of social partners in the ICT sector is mainly confined to industry associations in skills sector councils, although it is through the councils that social partners can exert influence over curriculum design. Since traditional trade unions do not perceive ICT workers as a group requiring assistance in fighting for decent work and wages, trade unions focused on the ICT sector are only just emerging, and their position is still fragile. Issues that unions seek to address include cases of unfair dismissal and the provision of continuous training by companies.

In addition, there is a general lack of skills forecasting and when such information is available, the analysis of educational data, occupational trends and skills mismatch are not used in policy development. Currently, ICT industry associations are doing analyses of skills needs in the areas of ICT and transformative technologies in India.

Skills strategies of the government are not focused on the impacts of automation, economic and occupational restructuring, even though all of these factors could affect ICT job roles. At the vocational training level, only small upskilling and reskilling programmes exist, and consequently, a large share of the workforce may not be well prepared to cope with future economic restructuring or technological advances.

Gender issues

The gender employment gap among ICT specialists is large in all three countries. Women working in the ICT sector comprise only about one-third of all employees, and women tend to be at a disadvantage in terms of career advancement in the ICT sector. This gap is partly the result of the low number of female students in the corresponding fields of training and study. Skills development for women in science, technology, engineering and mathematics should be considered an opportunity, since current trends indicate there will be an increase in the need for skilled work, and future automation will largely affect low-skilled and semi-skilled jobs. Furthermore, digital technologies should help increase flexibility regarding work and family balance, but in order to make the most of those opportunities, employers will need to adapt their human resource management strategies. Raising awareness regarding the benefits of employing female ICT specialists and improving the career paths of women in the sector is crucial. Employers will need to: adapt workplace policies, change how work is organized, and provide incentives for women to pursue fulfilling careers.

International migration of ICT specialists

International labour migration has played a major role in the Indian economy due to the fact that a large number of ICT specialists have migrated out of the country since the 1990s. Since India was an early adopter of a strategy to focus on the education and training of ICT specialists, one can conclude that at a certain point there was an oversupply of ICT specialists as compared with job opportunities. In addition, wages and differences in career opportunities between India and highly developed countries, and particularly between India and the United States, were huge and these factors influenced migration. Due to recent migration policy changes in the United States, this balance may change, with migration flows being redirected to Europe and Canada. As the IT and ITeS industry developed in India, the country was better able to provide cheap skilled labour as compared to workers in other parts of the world. Recently, the patterns of labour migration from India have been partly linked to its provision of IT and ITeS services to the world. It should be noted that provision of outsourced service work is exported to continental Europe at a greater volume than the labour migrants themselves.

International migration has increased within the internal labour markets of multinational companies for several reasons: increased project work, lack of highly-skilled labour available locally, a need to transfer knowledge and build a corporate identity. The trend towards more project-based work has also driven temporary and circular migration of the external labour market, which includes workers in the labour market at large, and not only workers within a specific company. As a general rule, international migration is driven more by opportunity rather than by necessity among ICT workers. The migration of students is also increasing, with students being attracted by the possibility of pursuing their studies abroad and investing in their own capital. Furthermore, studying abroad offers better opportunities to enter the labour market of the destination country once studies have been completed, and although still relatively infrequent, the exchange between staff and researchers in the context of university cooperation is also on the rise.

Temporary migration is often a means of attracting talent to India, Indonesia and Thailand, where there is a shortage of ICT workers. The possibility of using domestic instead of foreign workers to make up for a lack of highly-skilled individuals is limited, given that there is, in fact, a global shortage of those workers. Since there is global competition for talent,

corresponding wages are comparatively high, but the urban and social infrastructure available in India, Indonesia and Thailand may not be sufficiently attractive to foreign workers. Administrative complexities and rigid immigration procedures also have the effect of further reducing the possibility of attracting foreign ICT workers. The return migration of highly-skilled nationals has served as a substitute for the importation of highly-skilled individuals from developed countries.

The international labour migration of ICT specialists provides clear benefits for the destination country and can have an important effect on the development of industries in the destination country, although benefits for the country of origin may be less visible, at first. In cases where the country of origin is not able to provide a sufficient number of spots for students at the master's or doctorate levels, migration is likely to benefit those students. Although some of the students going abroad to pursue degrees will not return, others may, and those returning may find positions at higher education institutions or in ICT fields in their country of origin. In India, investments in educating ICT specialists have had long-term benefits. Although the issue of brain drain was previously a concern due to high emigration rates of ICT specialists, the reverse has also been true in that IT companies have been able to establish themselves in India and expand rapidly to serve the global market. The return migration of highly-skilled ICT specialists has supported this development: these individuals return to India with experience and skills acquired in the global marketplace as well as with a professional network abroad. In the cases of Indonesia and Thailand, the same process of forging connections may yield positive benefits. In conclusion, for all three countries investigated, international migration is beneficial to the individual, since it offers the opportunity to accumulate human capital, acquire enriching experiences abroad and pursue individual goals.

Possible policy responses

For governments

a) Enhance efforts to assess the impact of digitalization on the labour market, including the risk of automation, the changing nature of jobs and tasks, an assessment of in-demand occupations and skills and the potential for overall economic growth.

b) Further develop data collection systems and discuss future skills need with stakeholders; conduct skills anticipation assessments and invest in education and skills development programmes for ICT jobs according to those assessments.

c) Strengthen cooperation and coordination between ministries and agencies in the development of education and training strategies, and for upskilling and reskilling initiatives at all levels in order to prepare the entire workforce, and ICT specialists in particular, for the digital era.

d) Close the skills gap between skills acquired at universities or vocational institutions and skills demanded by the industry, by promoting cooperation among education and training institutions and employers' and workers' organizations.

e) Promote continuous training in ICT and digital skills at all educational levels and develop labour market programmes, including upskilling and reskilling and lifelong learning, for workers who are unable to keep pace with digitalization and are at risk of losing their jobs due to automation.

f) Update occupational and qualification standards in response to rapid technological changes.

g) Encourage women to study STEM fields and promote the employment of women in ICT by raising awareness about careers in the field of ICT and offering incentives for education and training institutions.

h) Simplify and expedite visa regulations and administrative procedures in destination countries and develop a mutual recognition system for qualifications in order to ease the migration of ICT specialists from abroad.

For education and training institutions

a) Improve the quality of VET and promote a higher level of social recognition for VET including the vocational stream in higher education by raising awareness regarding the benefits and value of VET.

b) Provide continuous training for teaching staff at vocational schools and higher education institutions.

c) Improve vocational and career guidance to reduce mismatches in fields of study.

d) Modernize school and higher education through the following: promote the teaching

of ICT, digital skills and transversal skills, adapt teaching methods to improve soft skills at all levels of education, and provide pupils and students with the ability to learn by themselves to prepare them for lifelong learning and adaptability.

e) Promote English language teaching in Thailand and Indonesia, and additional foreign languages in all three countries at schools, TVET institutions and universities.

f) Promote interdisciplinary research, including in the following areas: ICT, business, social sciences, engineering/technology, health, natural sciences and agriculture, and encourage cooperation between the faculties of universities and vocational schools.

g) Promote cooperation with foreign universities through student and staff exchanges and shared research projects.

For social partners

a) Facilitate cooperation, or strengthen existing cooperation, with education and training institutions in order to close skills gaps.

b) Establish networks and training for SMEs in order to increase their capacity to utilize new technology and hire ICT specialists.

c) Raise awareness regarding equal opportunities for men and women in the labour market and, where necessary, adapt working conditions to the specific needs of women to allow them to combine work and family life and enable them to participate in continuous learning.

d) Facilitate work-based learning at TVET and higher education institutions and ensure high quality workplace learning.

e) Establish or increase the active engagement of industry associations and workers' organizations, regarding developing skills standards and curricula in the VET and higher education system.

f) Continue to support lifelong learning, and promote the implementation of continuous training in light of rapid technological change, including in the areas of technical ICT/digital skills, soft skills and language skills.

g) Continue and strengthen social dialogue between social partners to promote decent work in the ICT sector.

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Annexes

Annex 1

Definitions

Table A1.1. Definition of the ICT sector based on International Standard Industrial Classification (ISIC) Rev.4

ICT manufacturing industries 2610 Manufacture of electronic components and boards 2620 Manufacture of computers and peripheral equipment 2630 Manufacture of communication equipment 2640 Manufacture of consumer electronics 2680 Manufacture of magnetic and optical media
ICT trade industries 4651 Wholesale of computers, computer peripheral equipment and software 4652 Wholesale of electronic and telecommunications equipment and parts
ICT services industries 5820 Software publishing **61 Telecommunications** 6110 Wired telecommunications activities 6120 Wireless telecommunications activities 6130 Satellite telecommunications activities 6190 Other telecommunications activities **62 Computer programming, consultancy and related activities** 6201 Computer programming activities 6202 Computer consultancy and computer facilities management activities 6209 Other information technology and computer service activities **631 Data processing, hosting and related activities, web portals** 6311 Data processing, hosting and related activities 6312 Web portals **951 Repair of computers and communication equipment** 9511 Repair of computers and peripheral equipment 9512 Repair of communication equipment

Annex 1

Definitions

Table A1.2. Definition of ICT specialists according to International Standard Classification of Occupations (ISCO) – 08, OECD and Eurostat

133 Information and Communications Technology services managers
215 Electrotechnology engineers 2152 Electronics engineers 2153 Telecommunications engineers
25 Information and Communications Technology professionals **251 Software and applications developers and analysts** 2511 Systems analysts 2512 Software developers 2513 Web and multimedia developers 2514 Applications programmers 2519 Software and applications developers and analysts not elsewhere classified **252 Database and network professionals** 2521 Database designers and administrators 2522 Systems administrators 2523 Computer network professionals 2529 Database and network professionals not elsewhere classified
35 Information and communications technicians **351 ICT operations and user support technicians** 3511 ICT operations technicians 3512 ICT user support technicians 3513 Computer network and systems technicians 3514 Web technicians **352 Telecommunications and broadcasting technicians** 3521 Broadcasting and audiovisual technicians 3522 Telecommunications engineering technicians
742 Electronics and telecommunications installers and repairers 7421 Electronics mechanics and servicers 7422 ICT installers and servicers
2166 Graphic and multimedia designers 2356 Information technology trainers 2434 ICT sales professionals 3114 Electronics engineering technicians

Annex 1

Statistics

Table A1.3. ICT workers by economic area, field of study and company size – Thailand, 2017

Economic area	ICT workers	Number of workers with ICT degrees	Percent of workers with ICT degrees
Business trade and services	270 635	87 190	32
Construction	10 247	3 177	31
Land transport and storage	11 692	2 652	23
Hospital activities	8 232	2 141	26
Communication activities	21 133	18 714	89
Total	**321 939**	**113 874**	**35**
Company size	**ICT workers**	**Number of workers with ICT degrees**	**Percent of workers with ICT degrees**
1-10 people	200 117	55 588	28
11-15 people	17 353	5 422	31
16-25 people	19 344	7 128	37
26-30 people	8 223	2 736	33
31-50 people	16 104	6 740	42
51-200 people	35 427	18 147	51
More than 200 people	25 371	18 114	71
Total	**321 939**	**113 874**	**35**

Note: Only limited companies and public limited companies were asked questions regarding ICT specialist shortages.
Source: Establishment Survey on the Use of ICT - Ministry of Information and Communication Technology, 2017; author calculations.

Table A1.4. Average monthly wages of ICT workers – Thailand, 2012-2017

Occupation	Average wages of workers in 2012 (Baht)	Average wages of workers in 2013 (Baht)	Average wages of workers in 2014 (Baht)	Average wages of workers in 2015 (Baht)	Average wages of workers in 2016 (Baht)	Average wages of workers in 2017 (Baht)
Software and application developers and analyst	**29 776**	**33 020**	**32 005**	**30 025**	**33 378**	**32 439**
Computer system analyst	39 548	43 663	34 914	34 021	38 313	30 864
Programmer	27 001	29 991	31 018	31 629	33 012	33 620
Database and network professionals	**24 813**	**25 144**	**21 919**	**23 499**	**27 319**	**26 461**
Information and Communications Technology operations and user support technicians	**18 793**	**19 122**	**20 132**	**21 109**	**21 978**	**21 485**
ICT operations technicians	17 679	18 484	19 745	18 258	20 428	19 975
ICT user support technicians	20 825	20 475	19 031	21 836	23 299	22 700
Web technicians	18 397	18 148	22 739	24 811	24 636	23 574
Telecommunications and broadcasting technicians	**19 738**	**18 730**	**20 568**	**22 564**	**25 538**	**28 523**
Broadcasting and audiovisual technicians	19 320	15 996	16 740	19 694	23 522	19 381
Other ICT-related occupations	**22 595**	**21 467**	**21 384**	**20 147**	**20 809**	**21 772**
ICT services managers	51 795	46 467	44 306	43 918	50 197	47 663
Electronics engineers	32 995	30 453	31 911	31 154	31 843	34 576
Graphic and multimedia designers	19 291	22 844	20 521	20 214	20 862	22 440
Medical imaging and therapeutic equipment technicians	17 148	17 050	14 594	16 207	17 175	20 957
Contact centre information clerks	18 362	18 660	14 517	13 870	17 374	17 902
Contact centre salespersons	20 442	15 715	15 983	15 456	16 412	18 877
ICT installers and servicers	14 473	12 568	13 089	13 773	14 246	13 520
Total ICT Employees	**23 130**	**22 832**	**22 872**	**22 440**	**23 761**	**23 845**
Non-ICT Employees	**10 953**	**11 882**	**13 099**	**13 347**	**13 579**	**13 563**
Total Employees	**11 099**	**12 013**	**13 240**	**13 482**	**13 725**	**13 716**

Note: The table only shows data for four digit level occupations, which were statistically estimated from more than 35 non-weighted observations. Source: Labour Force Survey, National Statistical Office 2012-2017; calculations by a national consultant.

Annex 2

Table A2.1. Number of graduates and percent of total by area of study – Thailand, 2008-2017

Panel A. Number of graduates by area of study

Area of study	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
STEM	**69 061**	**70 931**	**64 669**	**70 672**	**61 568**	**58 927**	**66 288**	**69 463**	**56 231**	**74 910**
Science, mathematics and computing	35 259	35 819	33 248	34 874	31 451	30 347	34 896	34 408	26 644	34 283
Engineering, manufacturing and construction	33 802	35 112	31 421	35 798	30 117	28 580	31 392	35 055	29 587	40 627
Non-STEM	**229 693**	**237 026**	**214 539**	**224 999**	**216 025**	**193 309**	**215 927**	**245 842**	**203 125**	**278 422**
Education	20 737	21 850	23 908	21 563	21 217	19 724	28 411	36 168	37 283	40 421
Humanities and the arts	24 864	25 495	23 554	23 124	22 050	24 913	27 771	28 765	24 710	38 096
Social sciences, business and law	146 781	151 454	125 312	120 457	117 360	112 261	114 317	124 168	100 648	145 845
Agriculture and veterinary medicine	9 338	8 485	7 483	8 578	7 591	7 428	7 864	8 347	7 266	10 144
Health and welfare	16 566	18 028	20 547	18 871	18 343	14 847	16 821	19 146	19 287	26 169
Services	11 407	11 714	10 739	11 383	11 088	10 770	10 195	10 392	10 815	17 617
Others	0	0	2 996	21 023	18 376	3 366	10 548	18 856	3 116	130
Total	**289 071**	**307 957**	**279 208**	**295 671**	**277 593**	**252 236**	**282 215**	**315 305**	**259 356**	**353 332**

Panel B. Percent of graduates by area of study

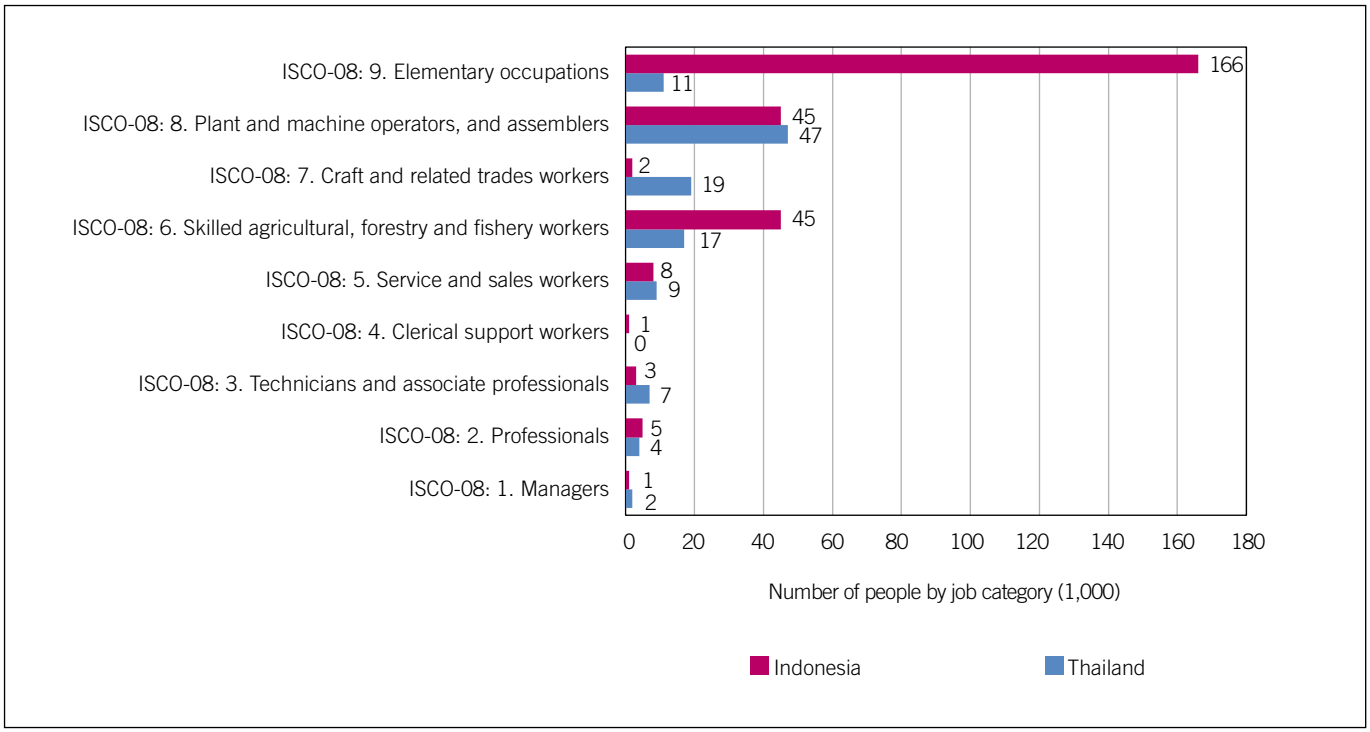
Area of study	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
STEM	**23**	**23**	**23**	**24**	**22**	**23**	**23**	**22**	**22**	**21**
Science, mathematics and computing	12	12	12	12	11	12	12	11	10	10
Engineering, manufacturing and construction	11	11	11	12	11	11	11	11	11	11
Non-STEM	**77**	**77**	**77**	**76**	**78**	**77**	**77**	**78**	**78**	**79**
Education	7	7	9	7	8	8	10	11	14	11
Humanities and the arts	8	8	8	8	8	10	10	9	10	11
Social sciences, business and law	49	49	45	41	42	45	41	39	39	41
Agriculture and veterinary medicine	3	3	3	3	3	3	3	3	3	3
Health and welfare	6	6	7	6	7	6	6	6	7	7
Services	4	4	4	4	4	4	4	3	4	5
Others	0	0	1	7	7	1	4	6	1	0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Office of Higher Education Commission Thailand, 2008-2017; author calculations.

Annex 3

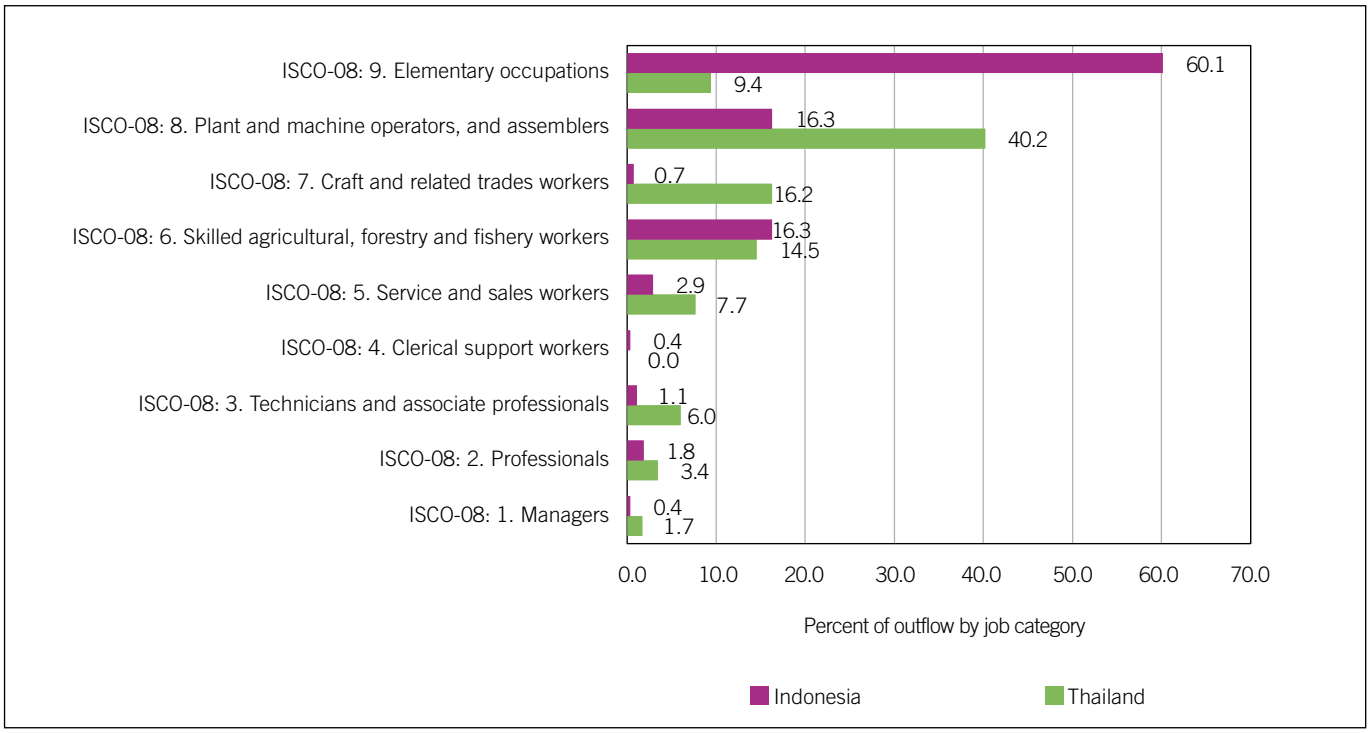
Figure A3.1.

Panel A. Outflow of nationals for employment reasons, 2015



Source: ILOSTAT database, 2015.

Panel B. Outflow of nationals for employment reasons, 2015



Source: Labour Force Survey according to ILOSTAT; author calculations, 2015.

Annex 4

Education and training responsibilities – India, Indonesia, Thailand

India

In India, some of the key functions of the Ministry of Electronics and Information Technology (MEITY) include promoting initiatives that develop the hardware and software industries, and supporting IT education and IT-based education. MEITY oversees a number of autonomous groups that are responsible for carrying out R & D and Human Resource development activities. Those groups include the Centre for Development of Advanced Computing, the Centre for Material for Electronic Technology, the Education and Research Network, the National Institute of Electronics & Information Technology, the Society for Applied Microwave Electronics Engineering & Research.

The Ministry of Human Resource Development (MHRD) is the institution that sets educational standards and establishes educational frameworks in India and is responsible for formulating policies for education, planning investment strategies for higher education institutions, and overall educational administration.

The Ministry of Skill Development and Entrepreneurship (MSDE) administers tertiary level vocational education courses. In 2015, industrial training, apprenticeships and other skills development responsibilities were transferred from the Ministry of Labour and Employment to the MSDE. The process of rationalizing and transferring all vocational courses, including ICT related vocational courses, to the MSDE is currently an ongoing process.

The All India Council for Technical Education (AICTE) is the premiere advisory body for technical education in India, and was established under the provisions of the AICTE Act, 1987. The Council is responsible for the promotion, planning, coordination, regulation and maintenance of norms and standards of technical education in India. AICTE ensures quality levels in technical education through the accreditation of technical institutions or programmes.[1]

Until very recently, the University Grants Commission was the regulatory body for the university system. It provided grants to eligible universities and colleges across India and oversaw the coordination, creation and maintenance of standards in the university education system. In a move to reform the regulatory process of higher education in India, a draft act proposing the repeal of the University Grants Commission and the establishment of the Higher Education Commission of India was prepared by MHRD in June 2018. Rather than focusing on grants, the Higher Education Commission addresses academic issues by establishing academic standards and ensuring that they are implemented in institutions.

Indonesia

In Indonesia, responsibilities for intermediate and upper vocational training as well as academic education in the area of ICT are divided between the Ministry of Education and Culture and the Ministry of Research, Technology and Higher Education. The latter ministry also established a Research Master Plan 2017-2045 that includes ICT as priority area for education in the country (research mission interview with the Ministry of Research, Technology and Higher Education, Jakarta). As discussed before, the Ministry of Manpower has its own vocational education programme for young job seekers in the ICT field.

Wantiknas, or the national information and communication technology council, consists of all ministers in the government cabinet, including the Minister of Education and Culture. Wantiknas is tasked with helping the government formulate policies in the ICT sector, including ICT education and skills development. They also have coordination functions to work with central and regional government agencies throughout Indonesia (research mission interview with the Chairman Wantiknas, May 2018).

Thailand

In Thailand, two types of institutions provide higher education. The first group includes institutions that fall under the Ministry of Education, such as

[1] For further information regarding government bodies and education, see http://mhrd.gov.in/regulatory-bodies.

state universities and private institutions of higher education, technical/professional and agricultural institutions, and teacher training colleges. The second group includes specialized training institutions that are overseen by ministries and government organizations. In an interview, a key stakeholder in Thailand noted that the governance system would be better served through greater integration and streamlining, which would reduce the policy gaps that currently impede the system (research mission interview Department of Skill Development, Ministry of Labour, Bangkok).