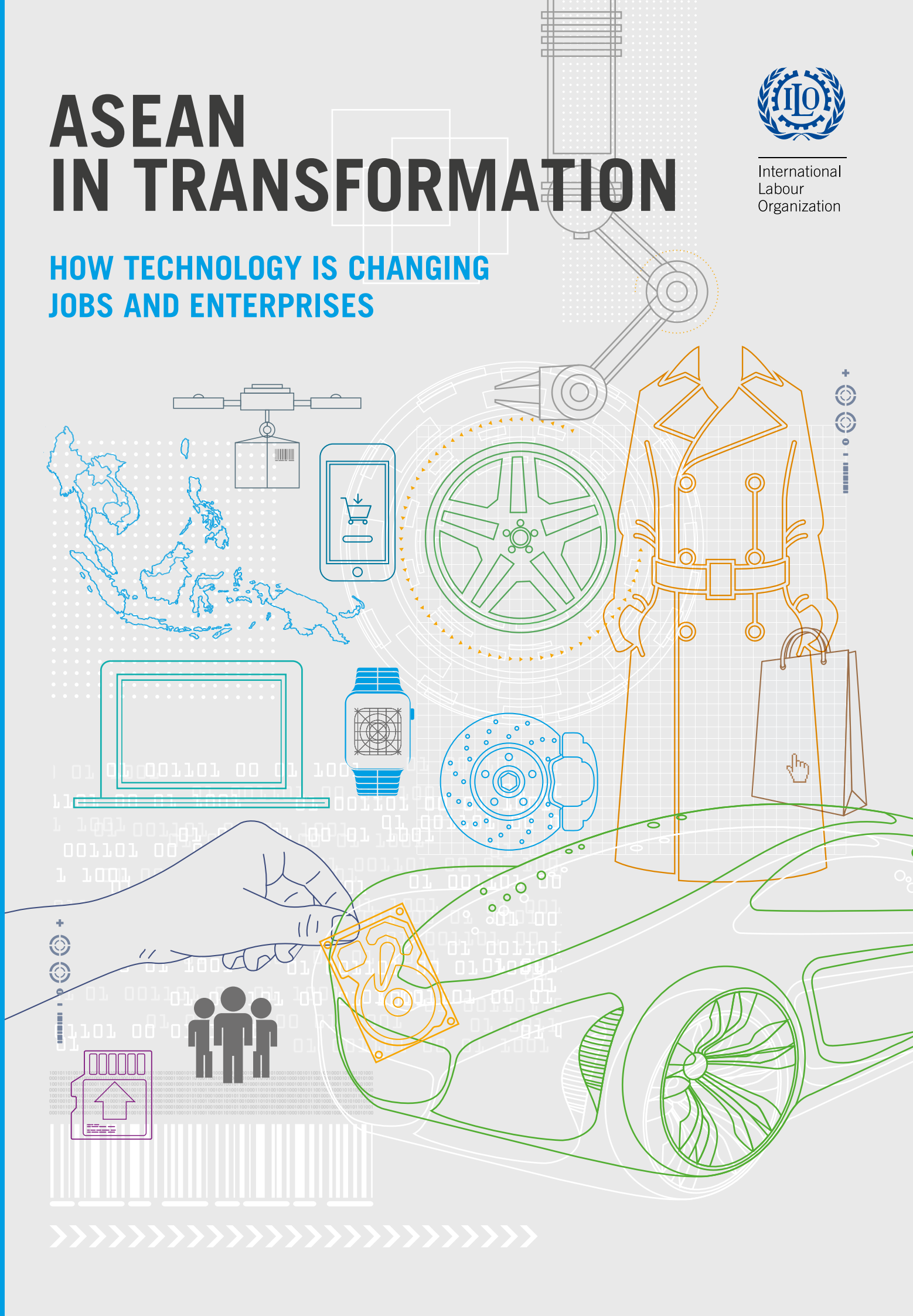


ASEAN IN TRANSFORMATION



International
Labour
Organization

HOW TECHNOLOGY IS CHANGING JOBS AND ENTERPRISES



ASEAN IN TRANSFORMATION



**HOW TECHNOLOGY IS CHANGING
JOBS AND ENTERPRISES**

July 2016

Jae-Hee Chang, Gary Rynhart and Phu Huynh

Bureau for Employers' Activities, Working Paper No.10

International Labour Office

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PREFACE

The apocryphal conversation that took place in the 1950s between Henry Ford II, then chairman of Ford Motor Company, and Walter Reuther, union leader of the United Automobile Workers, while showing him around a highly automated car plant is illustrative of the continual debate on jobs and technology. Ford asked, “Walter, how are you going to get those robots to pay your union dues?” to which Reuther responded, “Henry, how are you going to get them to buy your cars?” The exchange illustrates the symbiotic relationship that exists between technology on one hand and enterprises and people on the other.

Discussions surrounding the rise of technology are often polarizing. Proponents advocate that technology enables people to be freed up from monotonous, routine tasks to perform value added work that is more innovative, improves workplace productivity, and enhances product quality. On the other hand, critics voice grave concern regarding the possible massive displacement of jobs. However, such generalizations do little justice to this topic. The reality is much more complex – the impact of technology on a society varies according to the maturity of its economy as well as the key sectors that constitute its makeup. The impact even varies at an individual level – technology can be perceived as either a threat or an opportunity, depending on one’s unique skill set.

Research into the relationship between technological advancement and jobs has thus far focused on developed economies. To date, no comprehensive study has been conducted for the ten Member States of the Association of Southeast Asian Nations (ASEAN), a region that, in fact, could be particularly susceptible to technological disruptions, due to the high concentration of labour-intensive manufacturing and service jobs which are at risk of being replaced through automation and digital technologies that are already available today or expected to come into play in the near future.

It is critical for employers, governments, workers and other key stakeholders to actively prepare and respond to the changes taking place in workplaces. In addition, constructive engagement between social partners and educational and training institutions is critical to ensure that the workers of today continue to find meaningful employment tomorrow. Coordinated dialogue at a regional level is also necessary to ensure that the opportunities presented by an integrated economy, connectivity, sector cooperation and dynamism are maximized through the ASEAN Economic Community (AEC), enabling freer movement of goods, services, investment, skilled labour and capital.

We have prepared this working paper to address a sizeable knowledge gap – to assess the impact of emerging technologies on five key manufacturing and services sectors in the ASEAN region. The sectors were chosen because they are significant contributors to growth and employment in the region. In manufacturing, we look at: (1) automotive and auto parts, (2) electrical and electronics, and (3) textile, clothing and footwear. In services, we review: (4) business process outsourcing, and (5) retail. Throughout the report, major technological trends permeating and transforming each sector are identified and the implications for enterprises and the workforce over a ten-year time period are analysed.

While globally, innovative technologies are being adapted for workplaces at accelerated speeds and for much wider applications, trends in ASEAN are mixed. While some sectors in ASEAN are capitalizing on modern technology, placing them at their very core to enhance their operations, others have been laggards, continuing to heavily rely on the region's vast pool of manual labour.

This study highlights the benefits and opportunities of embracing technology as evidenced by deep sectoral analyses. At the same time, we also address specific labour market concerns and challenges relating to encroaching technologies. In particular, automated technology is already displacing certain jobs in ASEAN and is showing a strong likelihood of replacing low-skill jobs that are currently the backbone of ASEAN's labour-intensive manufacturing and services sectors. Simultaneously, it has enhanced the complexity and skills-intensity of existing jobs, while also creating new ones of a higher skill level.

Our research indicates that in the long term, the price advantage associated with mass production in low-cost, export-oriented regions like ASEAN will be challenged by increasingly affordable technologies and by the push from developed economies to bring manufacturing near the point of sale or assembly. This fundamentally shifts the attractiveness that some labour markets have long held as low-cost production bases for manufacturers. The development route that a number of East Asian economies like China, Japan, and the Republic of Korea used for growth through low-skilled and labour-intensive manufacturing, is no longer the standard formula for emerging economies to achieve rapid economic growth.

The countries that are likely to be more significantly impacted are the ones where drivers for growth and employment are highly vulnerable to technological takeover. Throughout the report, we highlight potential dangers that key labour-intensive sectors could encounter if a passive approach of business as usual is taken. In addition, we lay out critical opportunities that players in each sector should consider in their organizational and human resource strategies moving forward.

Technological disruption is not a new phenomenon and it does not have to be devoid of choice, direction or policy. Society's cultural values and social structure do not have to be defined by the technology it possesses. Rather they should emanate from how that technology is applied.

At the World Economic Forum in Davos, Switzerland in January 2016, the ILO's Director-General, Mr Guy Ryder, noted:

“Progress is not to be measured in technological advancement or innovation, it is to be measured by what we make of the application of that technology and innovation.”

This paper aims to assist social partners, policy-makers, educational and training institutions and others to make those choices. We examine how technology is impacting enterprises and workers and highlight specific issues that require attention from policy-makers at the national and regional level. Our aim is to provide policy-makers with information useful to them in managing the threats and maximizing the opportunities presented by transformative technologies in the workplace. Policy-makers must effectively assess and map key sectors and identify vulnerabilities and opportunities. Robust policy frameworks will be needed to support the transformation of key economic sectors and ultimately in creating high value add jobs.

We hope this paper and its associated research provide enterprises, workers and their representative organizations, governments and other stakeholders with useful empirical evidence and a rich knowledge base from which they can initiate national level policy dialogues and actions to address the future of work. Finally, it is our hope that this research makes a constructive contribution to the ILO's on-going efforts related to the Centenary Initiative on the Future of Work, as well as the 16th ILO Asia-Pacific Regional Meeting, to be held in December 2016.



Deborah France-Massin

Director

Bureau for Employers' Activities

International Labour Office

MESSAGE FROM THE ASEAN CONFEDERATION OF EMPLOYERS

Understanding the impact of emerging technologies in the ASEAN region is of key importance to its success, particularly as the region continues to develop and economically integrate. We believe representative employers' organizations need to be at the forefront, providing greater policy leadership to inform, guide, and prepare enterprises and society at large on the profound changes that the region's workforce is set to undergo. As leaders of the private sector, it is imperative for us to provide guidance and to be heavily engaged in policy discussions that lead to constructive and sustainable growth. This report has been developed through close engagement between ASEAN employers' organizations and their members and will be used as a key reference point during the 16th Asia and the Pacific Regional Meeting (APRM), which takes place in December 2016. Beyond the 2016 APRM, the evidence garnered through the research will help bring a more forward-looking approach to policy discussion and formation, both at the national and ASEAN levels.

Matthew Rendall

Deputy Secretary General
Cambodian Federation of Employers and Business Associations (CAMFEBA)
ASEAN Confederation of Employers

MESSAGE FROM THE SINGAPORE NATIONAL EMPLOYERS FEDERATION

In Singapore's tripartite system, our Government works closely with employers and the trade unions to develop and build future-ready skills for the workforce through the SkillsFuture initiatives. The Singapore National Employers Federation plays key roles in rallying employers to support SkillsFuture and also actively conducts training for companies. As a member of the ASEAN Confederation of Employers, the Federation also cooperates with our employers' organization partners to address the challenges in workforce skills arising from the integration of the ASEAN community. The report provides useful inputs in our efforts to transform our economy and jobs in the wave of technological advancements, new business models and disruptions in the labour market.

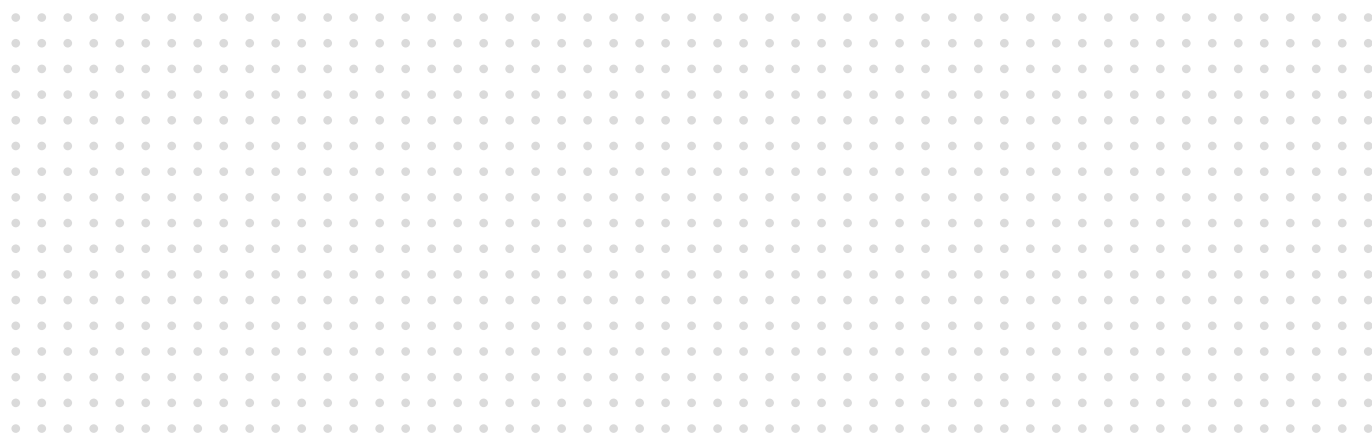
Dr Robert Yap

President
Singapore National Employers Federation

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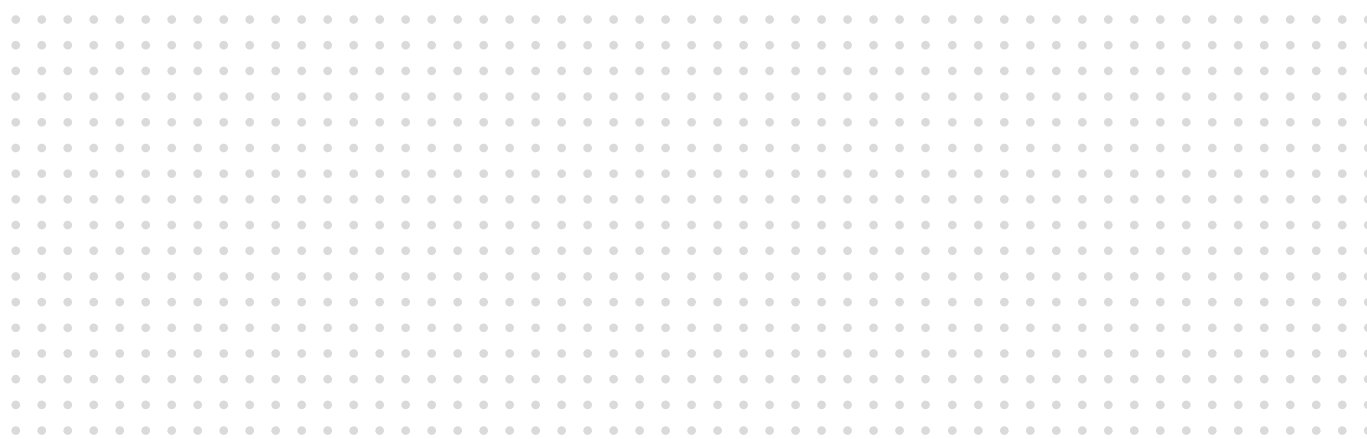
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- Cambodian Federation of Employers and Business Associations (CAMFEBA),
- Indonesian Employers' Association (APINDO),
- Lao National Chamber of Commerce and Industry (LNCCI),
- Malaysian Employers Federation (MEF),
- Republic of the Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI),
- Employers Confederation of the Philippines (ECOP),
- Singapore National Employers Federation (SNEF),
- Employers' Confederation of Thailand (ECOT), and
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The research involved collecting on-the-ground information and carrying out fieldwork to understand specific technological trends and related workplace impacts at the sectoral level. In this regard, we are grateful to partner with the University of California Los Angeles (UCLA) Applied Management Research Team consisting of Yen-An Cho, Matt Inouye, Sam Lin, Thanachai Kongthaisereekul, and Andy Wang who carried out in-depth research on the automotive and auto parts sector. Additionally, the UCLA-National University of Singapore (NUS) Global Executive Team, consisting of Dagnis Dreimanis, Ljupco Fidanovski, Jennifer Harmon, Juan Pablo Larach, Nitin Pawa, and Sarthak Seth examined the retail sector and contributed substantially to the related chapter. Additional sectoral research was conducted by David Birnbaum, Richard Brubaker, Richard Doner, Ngoc Pham Quang, William Morris and Rajah Rasiah.

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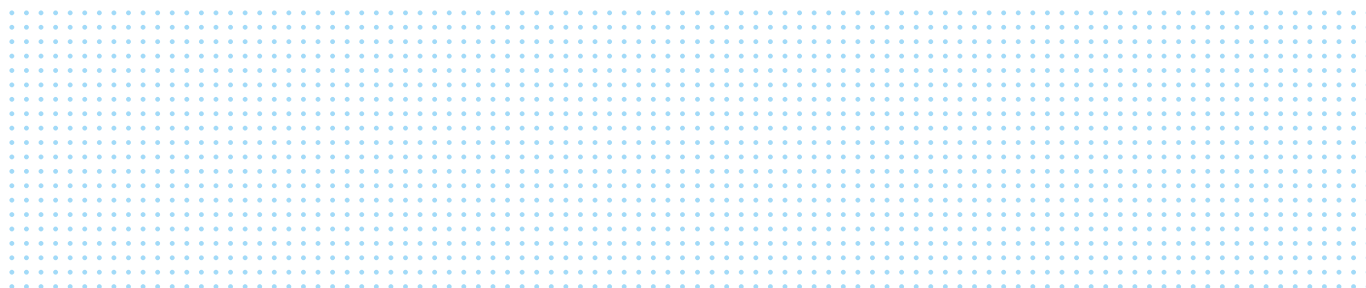
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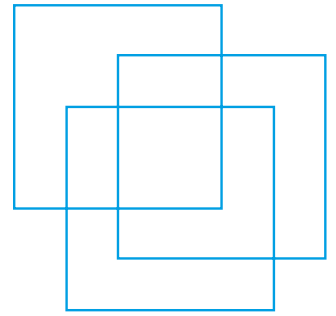
ABBREVIATIONS

3C	computers, consumer and communications
ASEAN	Association of Southeast Asian Nations
ASM	automated sewing machine
BCG	Boston Consulting Group
BPaaS	Business Process as a Service
BPO	business process outsourcing
BSP	Bangko Sentral ng Pilipinas (Central Bank of the Philippines)
CAD	computer-aided design
CCAP	Contact Center Association of the Philippines
CIO	chief information officer
CEO	chief executive officer
COO	chief operating officer
DIY	do it yourself
E&E	electrical and electronics
ERP	enterprise resource planning
EU	European Union
EV	electric vehicles
FDI	foreign direct investment
GDP	gross domestic product
GPS	Global Positioning System
HEV	hybrid electric vehicles
IBPAP	Information Technology & Business Process Association
IFR	International Federation of Robots
IC	integrated circuits
ILO	International Labour Organization

IoT	Internet of Things
ISCO	International Standard Classification of Occupations
ISIC	The International Standard Industrial Classification of All Economic Activities
IT	information technology
IVR	interactive voice response
KPO	knowledge process outsourcing
M2M	machine-to-machine
MNE	multinational enterprises
OECD	Organisation for Economic Co-Operation and Development
OEM	original equipment manufacturers
PCB	printed circuit board
R&D	research and development
RFID	radio frequency identification
ROI	return on investment
RPA	robotic process automation
SITC	Standard International Trade Classification
SME	small and medium-sized enterprises
SMS	short messaging service
STEM	science, technology, engineering and mathematics
TCF	textiles, clothing and footwear
TPP	Trans-Pacific Partnership
TVET	technical vocational education and training



EXECUTIVE SUMMARY



New developments in technology are transpiring at an increasingly rapid rate. The speed with which innovations move from “the lab” to the market is accelerating. Consequently, with each advancement, the effects on consumers and the labour market worldwide are being felt more quickly than during previous technology revolutions. While many anticipate the promise of added convenience and efficiency from these new technologies, others worry about its impact on jobs.

To date, discussions on the impact of technology on enterprises and workers have centred mostly on developed and advanced economies. Yet, enterprises and workers in the Association of Southeast Asian Nations (ASEAN) are also facing a technology transformation. ASEAN is a politically and economically diverse region, boasting a population of over 632 million people, a swelling middle class, growing amounts of disposable income and an increasingly educated workforce. Technology presents tremendous potential for ASEAN, but sound information and analyses of how these technologies will concretely impact the workplace remain limited.

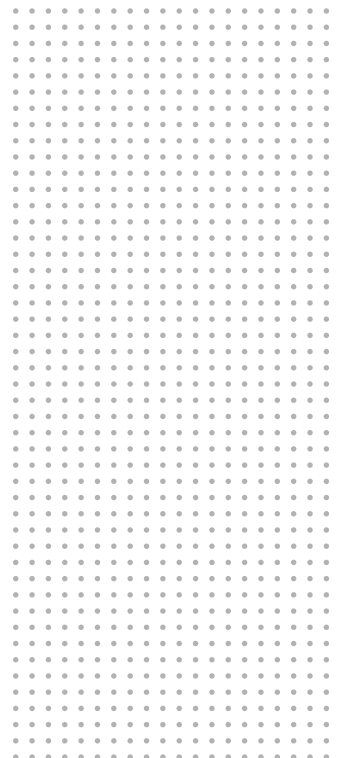
To address this knowledge gap, the International Labour Organization (ILO) conducted more than 330 interviews (in ASEAN and beyond), 4,000 enterprise surveys and 2,700 student surveys across ASEAN, as well as extensive secondary research to better understand how disruptive technologies may reshape the landscape of labour in the region. This study presents a detailed analysis of technology impacts in five key sectors within the region:

1. **Automotive and auto parts**
2. **Electrical and electronics (E&E)**
3. **Textiles, clothing and footwear (TCF)**
4. **Business process outsourcing (BPO)**
5. **Retail**



We identify the disruptive technologies relevant to each sector and detail how they can not only displace workers in the future, but also generate demand for other skills, influence the hiring practices and operations of enterprises, and present new opportunities for growth within the ASEAN region. Our analysis considers both sector- and region-specific factors, such as government incentives, ASEAN enterprise culture, shifting consumer habits, and the rise of millennials, as well as external forces (such as dynamics in China).

Overall, across all five sectors, it is clear that technologies – both current and forthcoming – will increase productivity, render some occupations obsolete and create new ones. The real question lies in whether ASEAN can take advantage of the benefits technology offers and if it can also adequately prepare its workforce. A lack of action by ASEAN actors at all levels – policy-makers, social partners, educationalists and other stakeholders – could lead to missed opportunities to expand markets and boost competitiveness, bringing negative consequences for the economy. It is our hope that this report will serve as important contribution to national dialogues on these issues and help facilitate important policy choices.



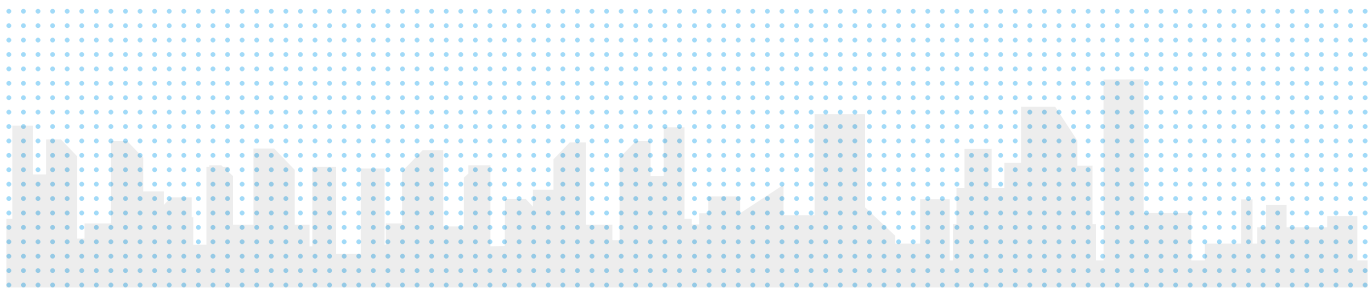
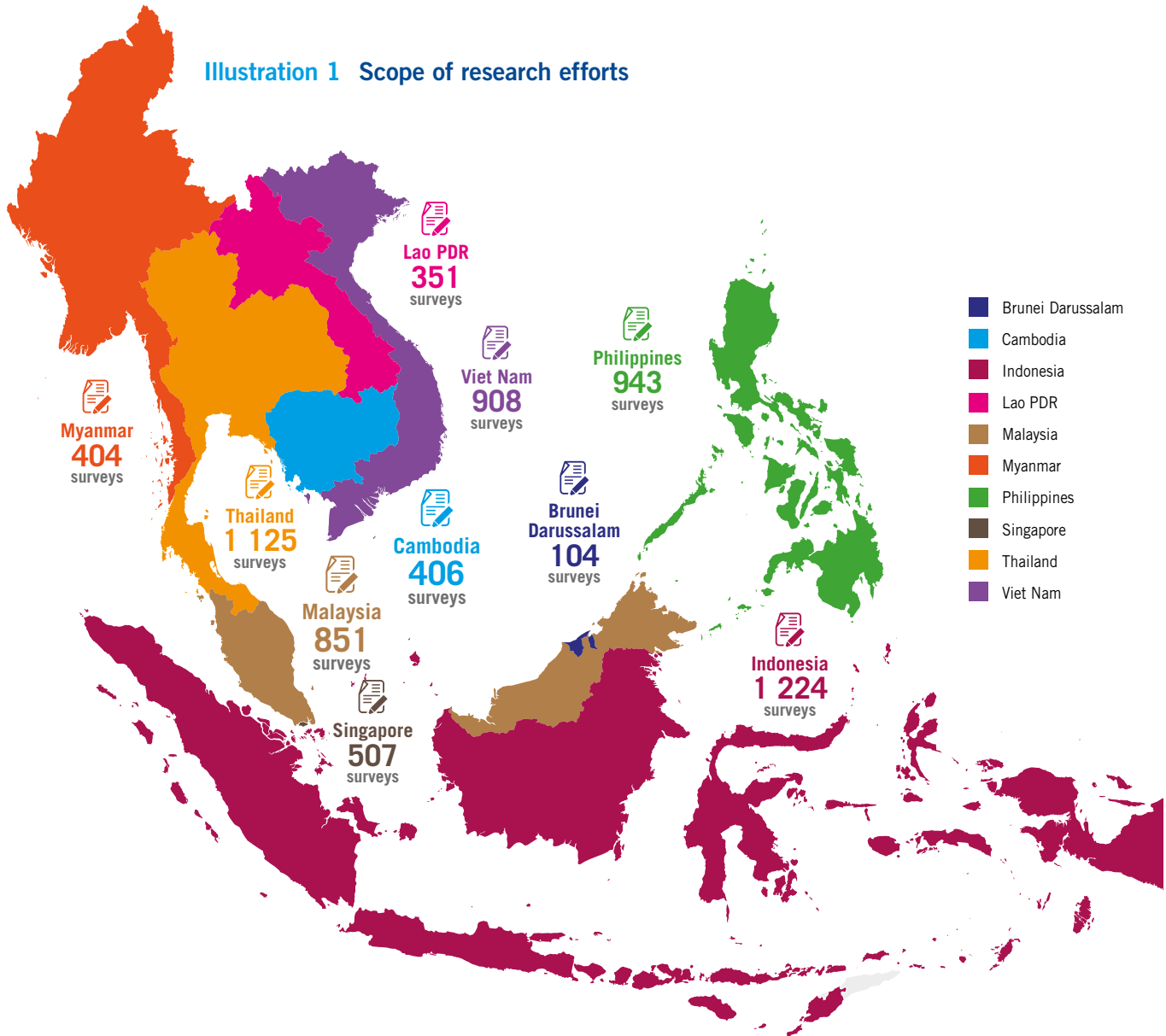
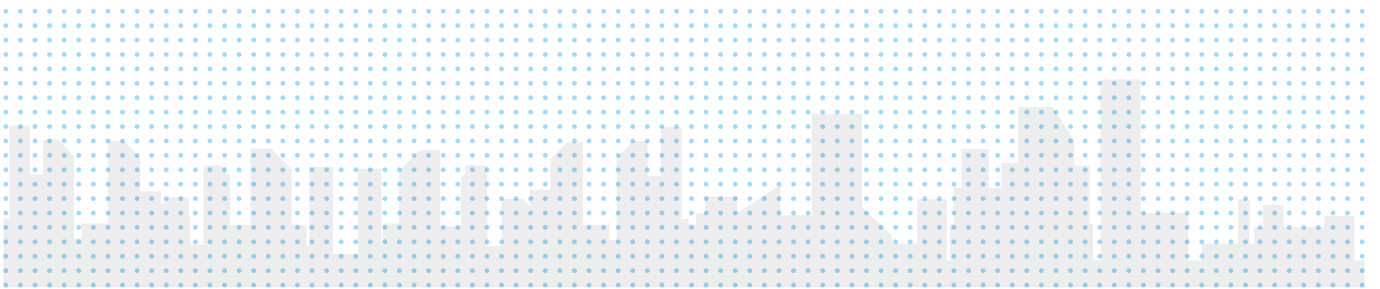


Illustration 1 Scope of research efforts





**Over 50
stakeholder
interviews**



**6 expert
and national
consultations**



Automotive and auto parts

91 interviews **5** site visits



Electrical and electronics

73 interviews



Textiles, clothing and footwear

55 interviews **8** site visits



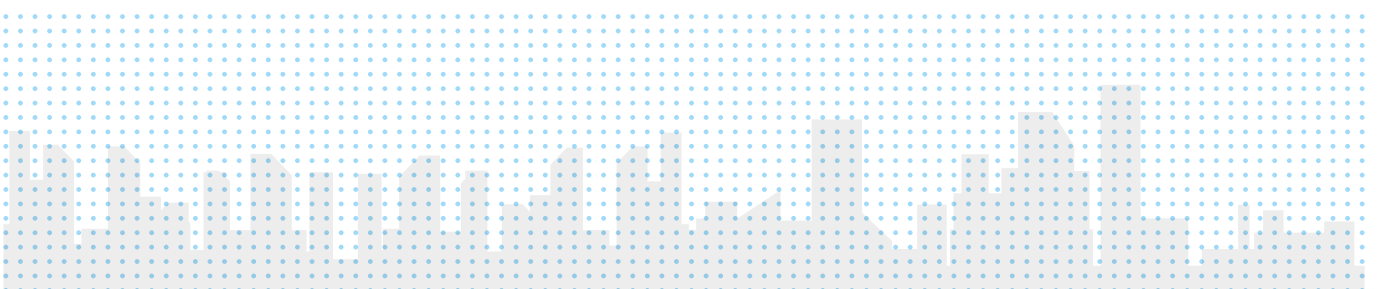
Business process outsourcing

14 interviews



Retail

43 interviews



Automotive and auto parts

ASEAN has become a dominant player in the automotive industry. Collectively, the region was the seventh largest producer of vehicles in 2015 globally, boasting a compound annual growth rate of 10 per cent since 2009. Over the past decade, automotive exports from ASEAN have consistently increased, partly due to an expanding middle class within the region. The industry employs more than 800,000 workers in ASEAN. The automotive sector is one of the sectors most receptive to adopting available technologies.

Four major technologies are shaping the automotive sector: the electrification of vehicles and vehicular components, advancements in lightweight materials, autonomous driving, and robotic automation.

We expect enterprises to accelerate research and development (R&D), with a focus on electric vehicles (EVs), hybrid electric vehicles (HEVs), lightweight materials and autonomous vehicles. As consumer demand for technologically capable cars with less environmentally harmful effects rises, governments across ASEAN will be compelled to implement policies incentivizing R&D activities and the purchasing of EV/HEVs. The pressure to innovate and bring to market technologically advanced vehicles will be substantive. However, in the near term, we expect these technologies to be integrated into the higher end car market segment first, followed by an encroachment into the mass consumer market.

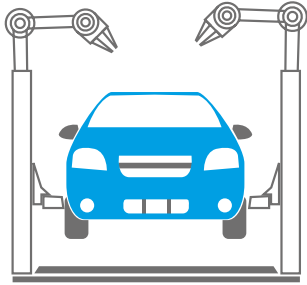
Our research indicates that automation and robotics will have the largest impact on jobs in the industry throughout the region. Robots are becoming better at assembly, cheaper and increasingly able to collaborate with people. They are also critical in making firms more productive and workplaces safer. One key driver for robotic and automation deployment is the common practice of including “cost down” agreements, in which suppliers enter a contractual agreement to either reduce the overall price of an auto part or increase productivity without increasing the resources expended. To meet these agreements, automation has become an attractive and likely alternative, especially within countries with rising labour costs.

These trends have a twofold effect on the labour force. Firstly, Low-skill workers will find themselves displaced in favour of automation, and indeed, over 60 per cent of salaried workers in Indonesia and over 70 per cent of workers in Thailand face high automation risk. Secondly, manufacturers will increasingly seek higher skilled talent with R&D competencies, ranging from analytical experts to autonomous driving engineers and sustainability integration experts.

Recruiting higher skills remains a challenge for employers, necessitating efforts on several fronts to address this skills gap. Education and vocational training institutions must revamp their curricula and build stronger alliances with the sector to provide a pipeline of highly skilled workers. The automotive sector and educational institutions need to adapt and increase the sector’s image as a gender-neutral employer of sophisticated talent. Equally important would be investing in the production capacity and technological capabilities of local automakers and strengthening their market position to ensure sustained domestic growth.



Illustration 2 ASEAN automotive and auto parts overview



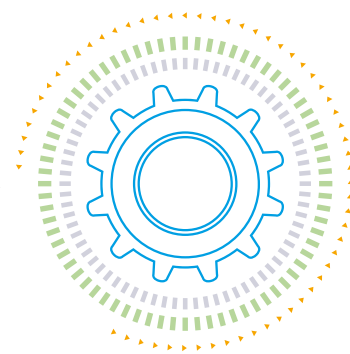
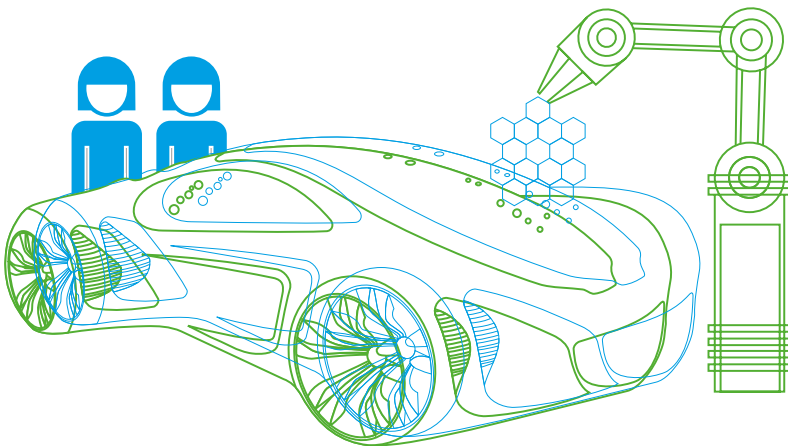
In 2015, ASEAN was the seventh largest producer of vehicles globally, with a compound annual growth rate of 10% since 2009

Electric vehicles, lightweight materials, self-driving cars, and robotic automation are disruptive technologies globally

In ASEAN, **ROBOTIC AUTOMATION** is having the greatest impact AND replacing lower-skilled jobs



ASEAN employs over **800,000 workers** in the sector



Over **60%** of salaried workers in Indonesia and **73%** in Thailand face high risk of automation

60% of tier one suppliers have seen significant increases in automation



Electrical and electronics (E&E)

E&E manufacturing is one of ASEAN's most prominent sectors and a mainstay of economic growth, especially as the region moves up the value ladder and shifts away from low-cost production. Through rapid economic development and a rising middle class, the ASEAN region has also developed a broad industrial and consumer market for E&E machinery and goods. The sector directly employs an aggregate of more than 2.5 million workers in ASEAN.

Looking ahead, three disruptive technologies are likely to shape the E&E sector: robotic automation, 3D printing (also known as additive manufacturing) and the Internet of Things (IoT).

Robotic automation in this sector is “human centric,” occurring in the form of collaborative robots, or “cobots”, able to perform repetitive, high precision and difficult tasks. This technology – also seen in the automotive sector – aids workers rather than replaces them. Currently, people exceed the capabilities of robots in overall assembly, perception, flexibility, dexterity and adaptation to new duties, which means human workers are (for now) more cost-effective. However, this is changing. Compounded with predicted uptakes in 3D printing, displacement – particularly of lower skilled packaging and assembling jobs – is possible.

Opinions vary as to how quickly 3D printing can become cost-effective and useful for mass deployment. While its potential is undeniable, with some believing it could be deployed within the next ten years, 3D printing will primarily be used for highly customized, low-volume production. The key variance in our research participants’ assessment of this technology was not “if”, but “when” it will be prevalently adopted.

Unlike robotic automation and 3D printing, which threaten to displace workers, the IoT offers an important growth opportunity for ASEAN's E&E players. The IoT's ability to connect disparate operations, synchronize machines and generate insightful data presents exciting possibilities for enterprises to improve their efficiency in almost every sector. Because ASEAN's E&E sector and subsectors possess a formidable and established nexus of producers and suppliers, the world's high demand for IoT devices and components presents a significant growth opportunity.

China's actions are also critical in how the E&E sector will develop in ASEAN. As China advances up the E&E value chain and enters higher skilled tiers of production, ASEAN countries are well positioned to absorb much of the lower skilled E&E jobs from which China is moving away, but mostly in the short term. Even though wages are rising in ASEAN, the region's lower labour costs are still more attractive.

Currently, over 60 per cent of salaried workers in Indonesia, the Philippines, Thailand and Viet Nam occupy E&E positions at high risk of automation. To capitalize fully on the sector's growth opportunity and foreign direct investments, policy-makers across the region urgently need to raise skills levels and innovatively connect skills providers to enterprise needs. In particular, more efforts are specifically needed to encourage women to pursue studies in science, technology, engineering and mathematics (STEM) disciplines to spur the availability of higher skilled labour.

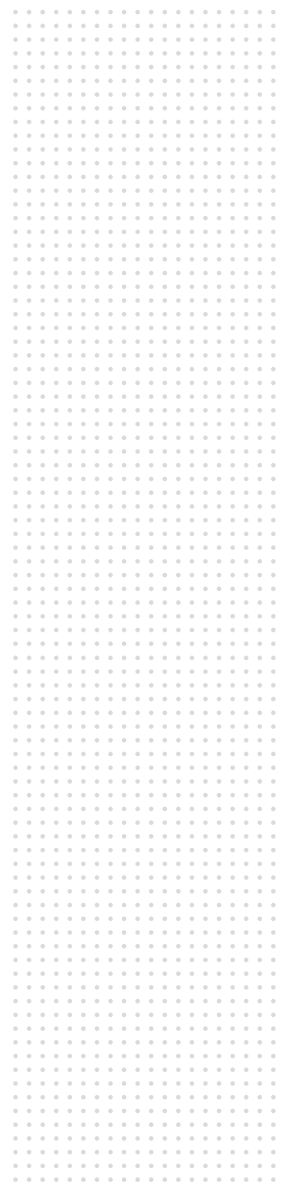
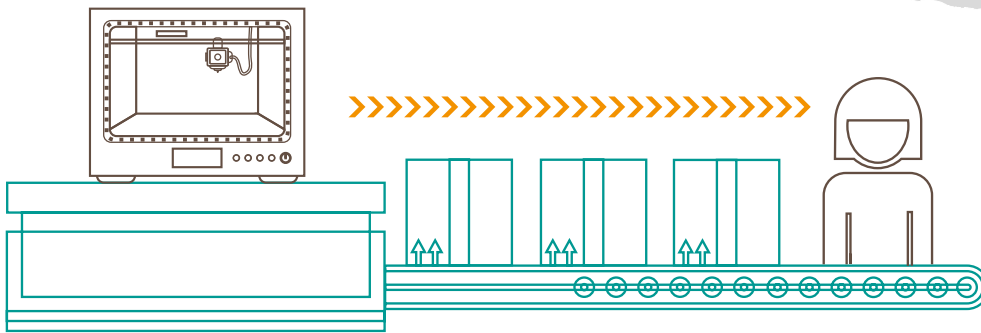


Illustration 3 ASEAN E&E overview

ASEAN's E&E exports **almost tripled** over the past decade, reaching **US\$382.1 billion** in 2014

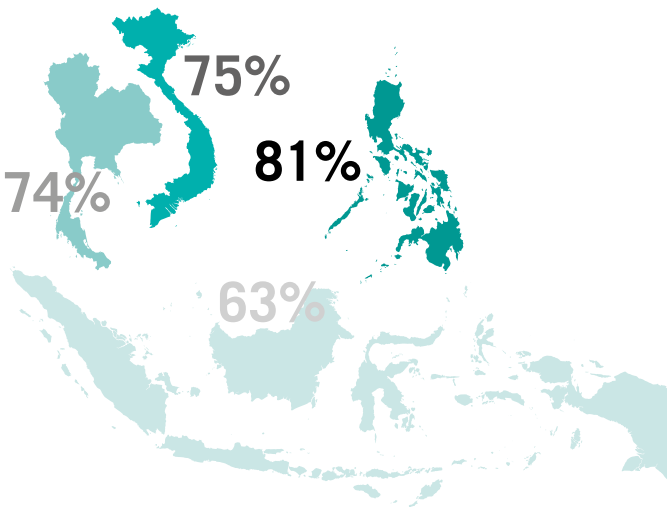
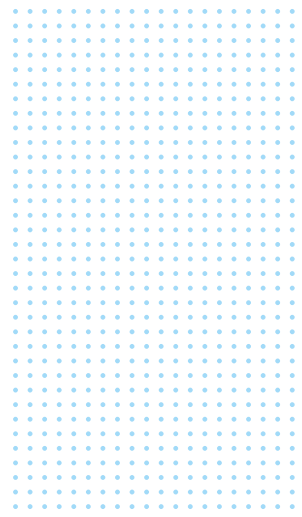


ASEAN directly employs an aggregate of **over 2.5 million workers** in the sector



Robotic automation, 3D printing and the Internet of Things are disruptive technologies globally

In ASEAN **ROBOTIC AUTOMATION** is currently replacing simple assembly, lower-skilled tasks



Over 60% of salaried workers in Indonesia, the Philippines, Thailand and Viet Nam occupy E&E positions at high risk of automation



China

is both an opportunity for ASEAN to scoop up lower-skilled jobs

and a reason to

invest more in technology to become more competitive

Textiles, clothing and footwear (TCF)

TCF is a highly competitive sector. In ASEAN, TCF is predominately shaped by large multinational brands and retailers, acting as a conduit for transitioning economies to shift from informal agricultural jobs to formal wage employment. It is also one of the most labour-intensive industries, assisting countries with moving into their secondary economic cycle. Collectively, TCF provides over 9 million jobs in ASEAN, mostly for young women.

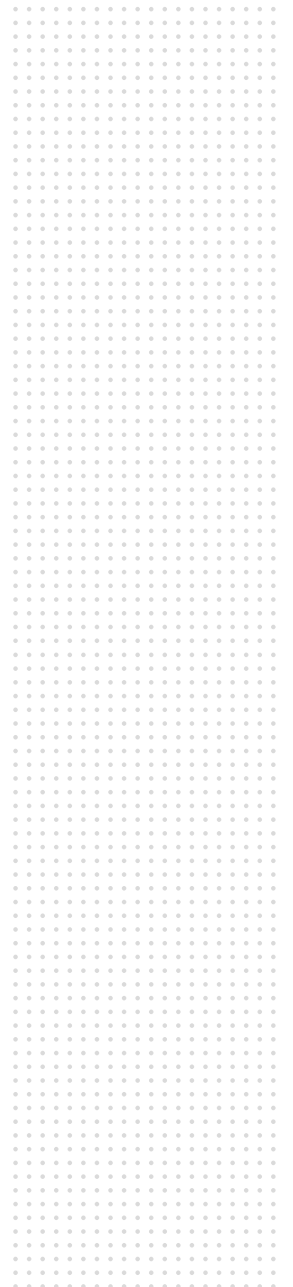
Of all the sectors analysed in this report, the TCF sector seems to be the most vulnerable to the extensive technological displacement of workers. A number of technologies stand to disrupt this sector: 3D printing, body scanning technology, computer-aided design (CAD), wearable technology, nanotechnology, environmentally friendly manufacturing techniques, and lastly, robotic automation.

Combined, body scanning sensors and CAD can not only provide the perfect fit to the consumer, but also permit extremely fast delivery, which is further accelerated through 3D printing. Because 3D printing does not require as much human input, it enables production to move closer to the markets in which products are sold. Indeed, there are early indications that the need for mass production footwear factories in ASEAN is being dissipated: The footwear industry has begun using 3D printing techniques to open automated shoe factories in key destination markets. If these operations prove profitable, such automated shoe factories will no doubt reduce the need for ASEAN workers.

Recently, researchers successfully prototyped smart clothes, or apparel enhanced with electronic and digital capabilities (e.g., smart shoes that provide health metrics and measure distances travelled). Moreover, advancements in nanoparticle research have introduced nanoparticle-infused clothes that are waterproof, stain-proof, UV protecting and/or odourless. In addition, larger TCF brands are implementing more environmentally friendly manufacturing techniques to reduce the amount of water consumed, chemicals used and material waste produced. When the price point becomes favourable, an increasing number of consumers will demand these improved and sustainably manufactured goods *en masse*. Overall, these technologies present a different kind of challenge: a lack of skilled talent.

Automated cutting machines are now becoming a widely available technology, and robots capable of sewing – called “sewbots” – will soon change the calculus of TCF production. Sewbots are unlikely to displace current workers in ASEAN garment factories, but more likely to be deployed in destination markets such as China, Europe and the United States. The disruptive impact on the sector in ASEAN could be very substantial, as robotic automation poses a significant threat of job displacement. The implications of technologically induced upheaval for the TCF sector in ASEAN are profound and likely to disproportionately affect female workers, who currently serve as the backbone of the TCF sector. The female share of TCF employment exceeds 70 per cent in Cambodia, Lao People’s Democratic Republic, the Philippines, Thailand and Viet Nam. An additional concern for ASEAN’s TCF sector is the continued and improved production growth of China’s TCF activities: China currently produces more with less workers, and this production gap will increase as it deploys more automotive processes.

ASEAN’s TCF workforce needs will drastically change. The region will encounter both a displacement of lower skilled workers and an increase in the demand for higher skilled technicians and engineers to serve niche apparel producers. Significant shares of TCF workers in ASEAN are at high risk of automation, from 64 per cent in Indonesia, 86 per cent in Viet Nam and 88 per cent in Cambodia. To remain competitive, industry players must accelerate partnerships with educational and training institutions to groom the next generation of TCF workers who have stronger technical qualifications, expertise and the ability to work seamlessly with multiple strands of emerging technologies.



Business process outsourcing (BPO)

ASEAN's BPO activities predominantly take place in the Philippines. This sector has seen extraordinary growth over the past decade and now employs approximately 1 million people in the Philippines. It was an industry born out of technological advancement that is now on the cusp of major changes due to technology.

Cloud computing, software automation and knowledge process outsourcing are three technologies that are impacting this sector.

Strong cloud computing products offer an opportunity to expand enterprises' client pool and continue the sector's growth. Cloud computing, specifically Business Process as a Service (BPaaS), allows BPO enterprises to store software and data over the Internet. Cloud computing also enables enterprises to select services personalized to their needs, as opposed to purchasing an entire outsourcing package. Moreover, it decreases overhead costs by reducing the need for hardware and software installation, maintenance and upgrade. These advantages make BPO services accessible to small- and medium-sized enterprises (SMEs) – a previously untapped market segment – and allow BPO enterprises in the Philippines to target a massive new market segment.

While cloud computing promises growth for the Philippines, software robots pose a threat. Also referred to as robotic process automation (RPA), they are not only able to perform tasks quickly, but can also learn from experience and improve their execution after each operation. In addition, they can work around the clock, are less error prone, and also present a solution to high worker turnover problems, which are characteristic of the sector. Some BPO clients have already begun purchasing RPA licenses to reduce their outsourcing dependence, relocating their operations closer to home. RPA's accelerated adoption will have considerable impacts on the Philippines's BPO workers, especially those working in call centres.

Some BPO players in the Philippines are indeed responding to these challenges and shifting their services towards knowledge process outsourcing (KPO). KPO services are of higher value than BPO services, and they include: fraud analytics, data integration, project management, R&D, mergers and acquisitions valuation, and medical image analysis. In addition, BPO enterprises in the Philippines are also improving customer experiences by offering omni-channel services, which provide clients with access to services through non-voice platforms such as short messaging services, online chat and social media. Diversification is critical to BPO enterprises, as they must maintain their attractiveness to clients and expand their market in the face of increased software automation.

These technologies have significant implications for workers. While RPA software still needs to become more "intelligent" before it can fully takeover back-office tasks and replace the human speaking components of BPO services on a large scale, RPA software will become increasingly attractive as their price decreases in tandem with labour cost increases. The 600,000 workers in call centres face high risk of automation at 89 per cent. In addition, increases in the provision of KPO services will further raise the skills requirements of the sector. Credentials in medicine, business, law, finance, accounting, and data analysis, among others, will be sought to provide higher value and sector-specific solutions.

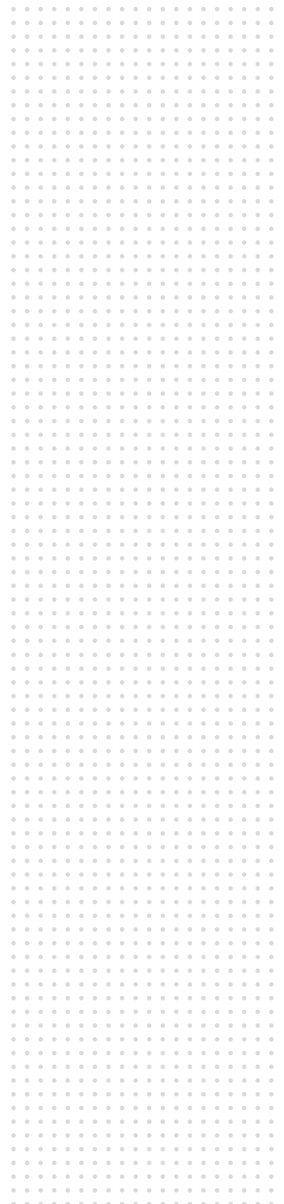
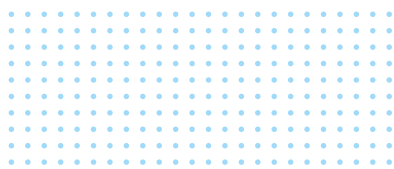


Illustration 5 ASEAN BPO overview

In 2014, BPO employed **over 1 million workers** in the Philippines



Women make up **59%** of the Philippines' BPO workforce



Cloud computing and software automation are disruptive technologies.

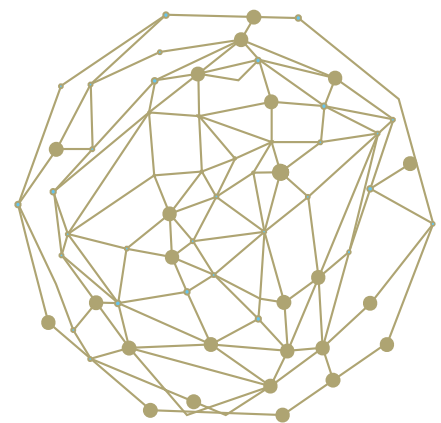


SOFTWARE AUTOMATION forms the greatest risk to workers in the Philippines working in call centres

Call centres (voice work) comprise **60%** of BPO employment



89% of salaried workers in the Philippines' BPO sector are at high risk of automation



Software automation can reduce costs by **40-75%** for BPO clients

Retail

ASEAN's retail sector is primed for growth. The sector's sales growth in the region has outperformed the rest of the world, with the region's consumer market numbering 632 million and a growing middle class with increased disposable income. In 2013, retail sales in major ASEAN countries reached US\$767 billion, with projected increases to US\$1.3 trillion in 2018. In terms of employment, retail stands as one of the largest sources of jobs. It employs an aggregate of 44.6 million workers in the region, representing 16 per cent of its total employment and 44 per cent of jobs in the services sector.

Of all the sectors analysed, ASEAN's retail industry appears to be the least threatened by up-and-coming technologies. Disruptive technologies in retail – such as mobile and e-Commerce platforms, the IoT, cloud technology, and big data analytics – are still yet to achieve mainstream usage in the region.

Theoretically, mobile and e-Commerce platforms could massively displace ASEAN's more conventional “brick-and-mortar” retail establishments. Products can increasingly be sold online more cheaply, especially because rent and overhead expenses are rising, consumers are becoming more tech-savvy, and Internet infrastructure is improving. However, e-Commerce currently makes up a very low share of the ASEAN retail market – less than 1 per cent of all sales regionally. Even in Singapore, e-Commerce accounts for only 3.4 per cent of total retail sales. One explanation for this is that ASEAN consumers generally do not trust online and mobile shopping. Moreover, the region's retail outlets – wet markets, street vendors, traditional stores, department stores and supermarkets – continue to be popular.

Cloud technologies, big data analytics and the IoT promise to improve enterprise operations by optimizing inventory management, product tracking and shopping intelligence. Classic retail challenges, such as producing too much or too little of a product, can be solved through an effective, Internet-connected system.

In the short term, we expect ASEAN retailers to focus their efforts on improving business logistics. However, our primary research indicates that enterprise culture and senior management commitment play a strong role in determining if the promise they hold will be realized. Unlike the export-oriented sectors analysed, ASEAN's retail activities largely remain local, and so external pressures to innovate are not as high as the four other sectors examined. Rather, the pressure to innovate is being exerted by customers.

Technology in ASEAN's retail sector is not yet set to displace workers widely. However, as more modern and large retail outfits with greater capital and drive for technology implementation become pervasive in the region, the sector's need for human workers will be reduced. Moreover, significant shares of salaried retail workers in ASEAN are at high risk of automation: 68 per cent in Thailand, 71 per cent in Cambodia, 85 per cent in Indonesia and 88 per cent in the Philippines.

For enterprises seeking to intensify their e-Commerce and mobile shopping presence, we expect them to increasingly recruit individuals with strong digital marketing and social media skills. Additionally, an increase in the use of cloud technologies, big data analytics and the IoT will intensify hiring demands for technically capable workers in areas such as data analysis, programming and supply chain management. ASEAN's workforce requirements in the retail space will therefore change, asking for those who have the ability to keep up with the digital age to enhance customer's overall retail experience.

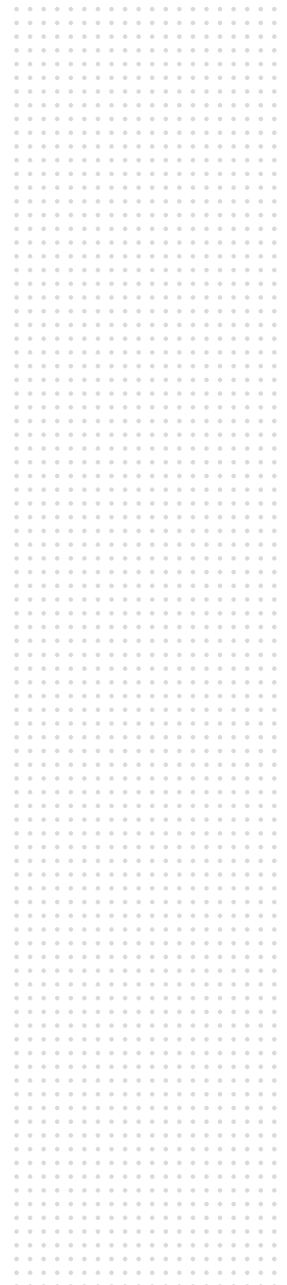


Illustration 6 ASEAN retail overview

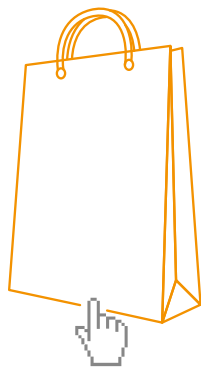


Retail
is at the lowest
risk of automation
out of the five sectors analysed



Mobile and e-Commerce platforms, the Internet of Things, cloud technology and big data analytics could have **transformative impacts on jobs in ASEAN**
This is yet to come

Retail in major ASEAN countries reached **US\$767 billion** in 2013



44.6 million workers are employed in ASEAN's retail sector

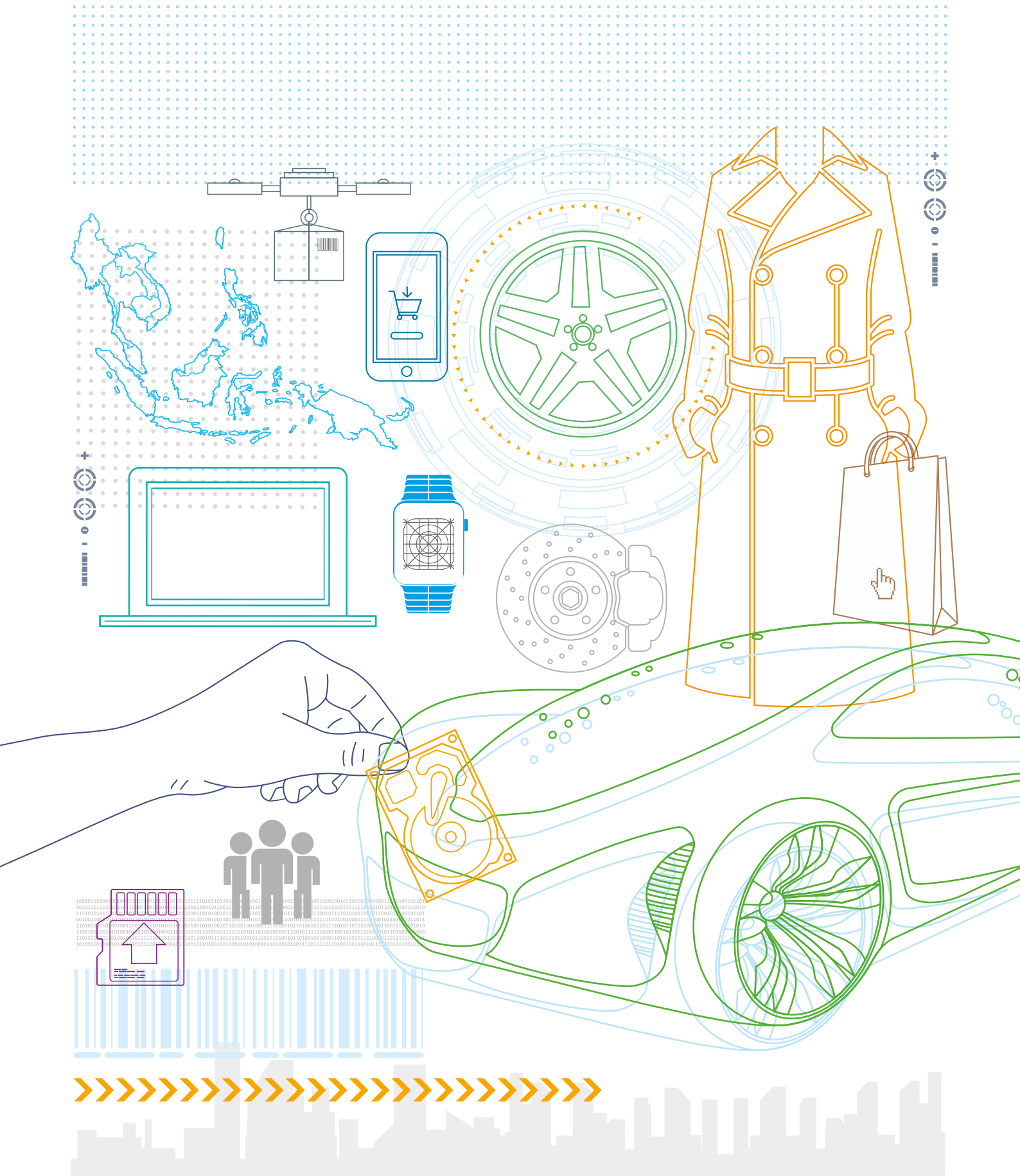
Local and traditional retail are the biggest barriers for technology's advancement in ASEAN



Significant shares of retail salaried workers in ASEAN are at high risk of automation:
68% in Thailand, **71%** in Cambodia
85% in Indonesia and **88%** in the Philippines



50% of the retail workforce are women



INTRODUCTION



Technological change is imminent

The Association of Southeast Asian Nations (ASEAN) is on the cusp of a major change. With the rapid emergence, deployment and increased affordability of sophisticated and disruptive technologies across all sectors, enterprises and workers will experience substantial transformations.

ASEAN is a diverse region, comprised of more than 632 million people. The region's attractiveness as a destination for investment thrives due to ASEAN's growing middle class, increasingly better-educated workforce, emerging consumer markets and expanding infrastructure and logistics network. While agriculture remains the largest employer in many countries' economies, contributing a significant percentage to their gross domestic products (GDP), the manufacturing and services sectors are rising in their importance, especially as countries make structural transitions and seek ways to accelerate development and growth through international trade. In a globally connected world that is increasingly interdependent, the impetus for this will only hasten with time. The growth models devised by most countries to facilitate this transition are not new. Rather, they are based on the creation of industrial structures, a method pursued by other East Asian countries to ensure fast track development.

As enterprises transform their operations by incorporating modern technology and digitized processes to deliver better quality products and services, their impact on labour markets is of increasing concern to policy-makers. Policy-makers should focus on the opportunities inherent in these trends and attempt to mitigate their negative impacts on jobs.

The challenges imposed by technology on this region are both companies' reduced reliance on low-skilled human labour as well as the creation of jobs that require higher skills. These challenges, if not managed in advance and prepared for at the policy and industry levels, are likely to usher in a future whose repercussions will far outweigh the opportunities they create. Worryingly, our research finds a lack of urgency amongst policy-makers in responding to the enormity of these challenges.

This paper serves principally as a resource base for policy-makers, employers' and workers' organizations, and others for deeper national and sectoral conversations. The report examines technological trends and their associated labour market impacts on five major sectors in the ASEAN region that are either labour-intensive or key contributors to growth. We examine specific sectors, as technological change and workplace impacts vary, sometimes widely, from sector to sector.

In manufacturing, we examine three sectors that constitute almost 35 per cent of manufacturing employment in the region. The first is the automotive and auto parts sector, where we review the technology movements in the major automotive assembly hubs in Indonesia and Thailand from a higher-value manufacturing lens. Secondly, we review the electrical and electronics (E&E) sector, which has pronouncedly contributed to the economic growth and development of Malaysia, Singapore, Thailand, and more recently, Viet Nam. The third is the textiles, clothing, and footwear (TCF) sector, which forms the backbone of a number of ASEAN Member States

and has played a crucial role in transitioning developing countries from agriculture to manufacturing economies. The TCF sector contributes significantly to manufacturing employment in countries like Cambodia, Indonesia, the Lao People's Democratic Republic, and Viet Nam.¹ For the E&E and TCF sectors, the research also aims to understand production and technological trends in China – if China's era of low-cost manufacturing has come to an end, production and assembly may shift to ASEAN where labour costs are lower.

In terms of services, two sectors are reviewed. First is the retail sector. While it largely serves the local market, retail is by far the largest employer in most ASEAN countries: It accounts for almost 44 per cent of services employment across the region. In every country, retail is a substantive generator of employment. Secondly, we review business process outsourcing (BPO) in the Philippines, where it is a significant contributor to GDP and employment. The BPO sector is of particular interest to us as an example of an industry that was created by technology, yet quickly challenged by it as well.

Technology trends transforming manufacturing and services

We have identified three main technological trends that are impacting enterprises and workers in these sectors, currently and into the future.

Robots and automation

Robots and automation are being increasingly adopted in manufacturing and services, particularly in the automotive and electronics sectors. They enhance productivity and speed, offer consistent quality, make the workplace safer, use fewer materials, stabilize production costs, and overall, make production more competitive. Across the sectors we see the following trends:

- The automotive and E&E sectors will need higher skilled technicians and engineers capable of managing new automation processes, as workers increasingly work alongside collaborative robots.
- The TCF sector will need fewer and fewer low-skilled workers as automated sewing machines (ASMs) are installed in export economies, reducing the need for sewing machine operators.²
- Workers in the Philippines' BPO sector, particularly at call centres, will compete with software robots that are capable of processing complex algorithms and act as cognitive agents.

¹ The TCF sector is interchangeably used with apparel sector in this report. However, when specifically discussing China, the discussion only includes apparel.

² While the ILO defines low-skill occupations as consisting of International Standard Classification of Occupations (ISCO) group 9 (elementary occupations), for the purpose of this study, low-skill occupations extend to those that are labour-intensive and routine such as machine operators.

Additive manufacturing

Globally, additive manufacturing, or 3D printing, is being deployed across numerous sectors, from (mostly) high-tech industries – such as aerospace for building jet engines – to back garden sheds for manufacturing gardening equipment. The technology has evolved to the extent that it can produce almost any component using metal, plastic, mixed material and even human tissue. Between 2012 and 2013, the global market for additive manufacturing products and services grew 29 per cent to over US\$2 billion at compounded annual growth rates. Clearly, it is an up-and-coming technology, with worldwide sales values projected to be over US\$10 billion by 2021.³ The use of additive manufacturing for the production of parts for final products continues to grow. Between 2003 and 2013, additive manufacturing has gone from almost nothing to 28.3 per cent of the total product and services revenue from additive manufacturing worldwide.⁴

In the sectors analysed herein, additive manufacturing is expected to impact ASEAN's production and employment in two principal ways:

- In the E&E sector, the ability to digitally print electrical components will transform how jobs are performed.
- In the TCF sector, 3D printing is expected to revolutionize product delivery by enabling production at points-of-sale or closer to market. The coming years will see the proliferation of highly localized production due to this technology, with major implications for current production models.

Internet of Things

The Internet of Things (IoT) allows electronic devices to communicate with each other without human assistance. For example, a fault in production machinery can be communicated directly to a supplier. The IoT will be used to optimize production processes by collecting and exchanging data, thereby improving monitoring and decision making. Analysts predict that connected devices embedded with electronic sensors will grow from the current 10 billion to as many as 30 billion devices by 2020 — a growth of about 3 billion new devices per year.⁵ A number of critical advancements are contributing to the rise of the IoT. These include steep declines in the cost of sensors, bandwidth and information processing the larger availability of big data; the rise of data analytics; and increased smartphones usage and connectivity.⁶

Our research shows that the IoT will have a profound impact on jobs in ASEAN:

- The retail sector will more frequently use sophisticated sensors and tags to track goods and manage stock. As a result, the demand for higher skilled workers who can service IoT technology and run data analytics will grow.

³ Royal Academy of Engineering, 2013.

⁴ Ibid, p.5.

⁵ IDC, 2014.

⁶ McKinsey & Company (2013a) notes a price decline of 80-90 per cent in microelectromechanical systems sensors from 2008 to 2013. Bandwidth cost has declined nearly 40-fold over the past 10 years. Processing cost has declined nearly 60-fold over the past 10 years. Goldman Sachs, 2014.

- The E&E sector, especially semiconductor companies, will have significant production opportunities, due to the increased demand for sensors, connectivity and memory. In addition, skilled workers in this sector will have a role in embedding IoT technologies and infrastructure across various other sectors. This role will be critical in adding convenience to all our lives, through for example wearable electronics, intelligent cars that are practically a “computer on wheels”, and connected homes stocked with smart domestic appliances.⁷

There are different perspectives as to how technology will impact jobs. There are those who believe technology will not lead to fewer jobs because it creates new occupations and even new sectors. The alternative view is that technology eliminates more jobs than it creates. In ASEAN, the latter possibility has a greater chance of actualizing, due to ASEAN's higher percentage of low-skilled workers.

There will of course be increased demands for workers with relevant skills and greater technical competencies. However, because only 13 per cent of ASEAN workers occupy high-skilled jobs such as managers, professionals or technicians, our findings indicate enormous challenges lie ahead, and they certainly merit consideration for policy action.⁸

The importance of a higher skilled labour force is repeatedly reinforced in the study's survey responses, interviews and in-depth sectoral studies.

Perspectives of enterprises and students on technology and future work

Prior to our sectoral research, we conducted a general survey to establish a baseline understanding on how enterprises and the future workforce of ASEAN view technology and its impact on the working environment along a ten-year horizon. The results of this survey provided the basis for a more granular analysis of each sector. In total, we collected over 4,000 responses from manufacturing and services enterprises and 2,700 responses from students across 480 universities and vocational colleges.⁹ The surveys provided initial insights on technology and its current and potential impact on enterprises and the workplace. The results provided the following findings, which were then used as the basis for this report's sectoral analyses.

1 Enterprises are not at the forefront of technological innovation

The responses indicate that ASEAN enterprises tend to be followers, adopters and imitators of technology as opposed to being innovators themselves. By and large, respondents said that their businesses relied on technologies and ideas developed mostly overseas.

⁷ IndustriAll European Trade Union, 2015.

⁸ While the ILO defines high-skill occupations as ISCO-08 major group 1 (legislators, senior officials and managers), major group 2 (professionals), and major group 3 (technicians and associate professionals), for the purpose of this report, high-skill occupations are extended to cognitively intense and non-routine jobs.

⁹ Detailed research methodology is included in the report's appendix.

Respondents' perception, on the whole, was that ASEAN was a “taker” of technology, rather than its “maker”, lacking the necessary skills or initiative to compete on research and development (R&D). Less than 16 per cent of the enterprises surveyed sought protection for their intellectual property (such as through copyrights and patents), and only around 20 per cent said they invested in any sort of R&D. Less than 27 per cent had specific responsibility for upgrading technology (see figure 1).¹⁰ Respondents across several sectors said that their equipment came from foreign investors in Germany, Japan, the United States, and increasingly, China.

However, it would be inaccurate to conclude that, overall and across all industries, the region lags technologically. As this study demonstrates in subsequent chapters, ASEAN's key sectors, such as automotive and E&E, are very much at the forefront of technological deployment.

2 Enterprises appreciate technology as a critical positive enabler to their businesses

When asked specifically about the impact of technology, more than half of the enterprises surveyed felt technological advances by 2025 would increase their domestic sales, labour productivity, profits, and the number of high-skilled workers they employ. Only one third of all respondents said that technology would increase their enterprises' total employment by 2025, compared with over 22 per cent who thought it would reduce it. The remaining 28 per cent felt unsure of its exact impact.

3 Affordability and skills shortages are the biggest obstacles to technology implementation at the enterprise level

ASEAN enterprises, by and large, named cost as the single largest barrier to implementing new technology: 29 per cent of respondents reported fixed capital costs as the greatest barrier, while 12.5 per cent said they lacked high-skilled workers to use new technologies. Almost 10 per cent reported licensing costs were too high (see figure 2). Indeed, these three factors were most frequently cited by both manufacturing and service enterprises, and by both small and large enterprises. Individual results from each Member State also revealed similar results. Our findings at the sector level further reveal widespread application of technologies, particularly in certain sectors such as E&E and automotive. It also revealed costs are a key determinant in whether technology will replace existing workers or not. However, respondents they also found that the decision to replace workers with technology is a complex one that cannot be reduced to a matter of price.

4 Technology is driving up demand for technically skilled workers, who are increasingly difficult to source

“Changes to the type of jobs on offer and the way we work are inevitable, but their impacts on employment can be managed and controlled. It is up to us to get used to a different paradigm and focus on upgrading our skills and maintaining our versatility and adaptability.”

Alan Owens, Director of Chartered Institute of Personal Development, Asia

Source: ILO interview, Singapore, 2015.

¹⁰ While the numbers related to intellectual property protection, R&D investment and technology upgrading were slightly higher among the manufacturing enterprises compared with services, they remained below one third in every case for the sample as a whole.

Challenges with finding skilled workers constantly recurred throughout the research. Enterprises in the survey were asked to identify the skills they currently thought of as most critical, in terms of both their overall importance and their availability in the workforce.

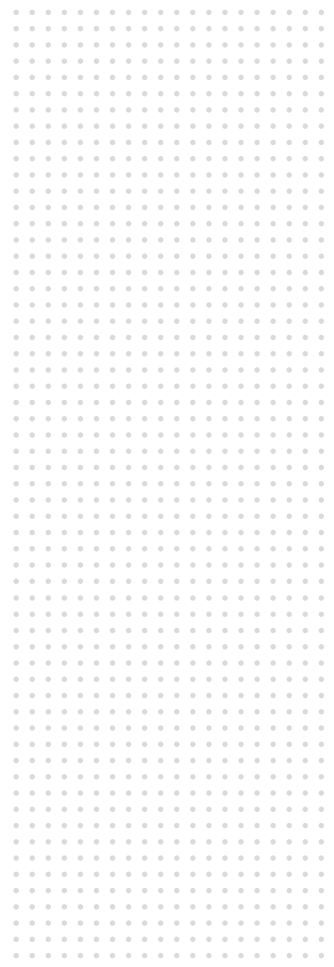
Among the skills considered the most important, the most frequently cited was technical knowledge: named by almost 40 per cent of respondents. Teamwork and communications skills were also viewed as highly important. Among the skills considered the most difficult to find, topmost were strategic thinking and problem solving, followed closely by foreign language skills, technical knowledge, and soft skills such as creativity and innovation (see figure 3).¹¹

5 Young people’s choice of study does not indicate they are targeting employment in key growth sectors

As economies become wealthier and reach middle-income status, manufacturing’s share of GDP usually peaks at about 20 to 35 per cent. From that point, the services sector tends to increase its share of the economy. Employment (and students’ preferred courses of study), naturally, follow a similar pattern.¹² Currently, many ASEAN economies are attempting to make this transition from a manufacturing-based economy to a services-based one. In most Member States, this transition is still in progress and will need to be a focus of policy efforts.

In terms of their career choices, young people could better align their skill sets with job market demands. The survey indicates that the largest shares of students were studying business, commerce or finance (29.5 per cent). Only 28 per cent of male and 17 per cent of female students were pursuing a science, technology, engineering and mathematics (STEM) subject, courses which are relevant to growing manufacturing sectors (such as automotive and E&E, which are increasingly implementing technology in their operations).¹³ The top three sectors among male students were information communications technology (14.3 per cent), finance or insurance (8.9 per cent), and manufacturing (8.3 per cent). The top three sectors among female students were finance or insurance (11.1 per cent), information communications technology (10 per cent), and arts, entertainment and recreation (7.6 per cent).

Of deep concern are the academic choices of female students. The following chapters demonstrate the TCF sector has a high concentration of women workers. In addition, the BPO and retail sectors provide substantial employment for women. Yet, these three sectors are prone to technological disruption due to robotics and automation. Occupations such as sewing machine operators, call centre operators and sales assistants carry high automation risks. Therefore, major efforts are required to promote STEM and other technical fields to female students.



¹¹ Foreign language skills showed the greatest variation among the most critical skills identified for enterprises in different Member States. While around one third or more of those in Cambodia, the Lao People’s Democratic Republic, and Viet Nam listed foreign languages among their most important skills, only a tenth or less did so in Brunei Darussalam, Singapore, Myanmar, and the Philippines. Thailand, Indonesia, and several other Member States also listed foreign language skills among the most difficult to find.

¹² Manufacturing’s share of United States employment declined from 25 per cent in 1950 to 9 per cent in 2008. In Germany, manufacturing jobs fell from 35 per cent of employment in 1970 to 18 per cent in 2008, and the Republic of Korea’s manufacturing went from 28 per cent of employment in 1989 to 17 per cent in 2008 (McKinsey & Company, 2012).

¹³ If information and technology (IT) is added to STEM (STEM and IT), the survey shows that 49.4 per cent of men and 27.1 per cent of female students are engaged in these studies.

Interestingly, among the students surveyed, almost 63 per cent perceived their country was on a positive trajectory for young women having good jobs, compared with only 9.6 per cent who felt their country was moving in the right direction.

6 Young people in ASEAN want what young job seekers have always wanted – money, security and interesting work

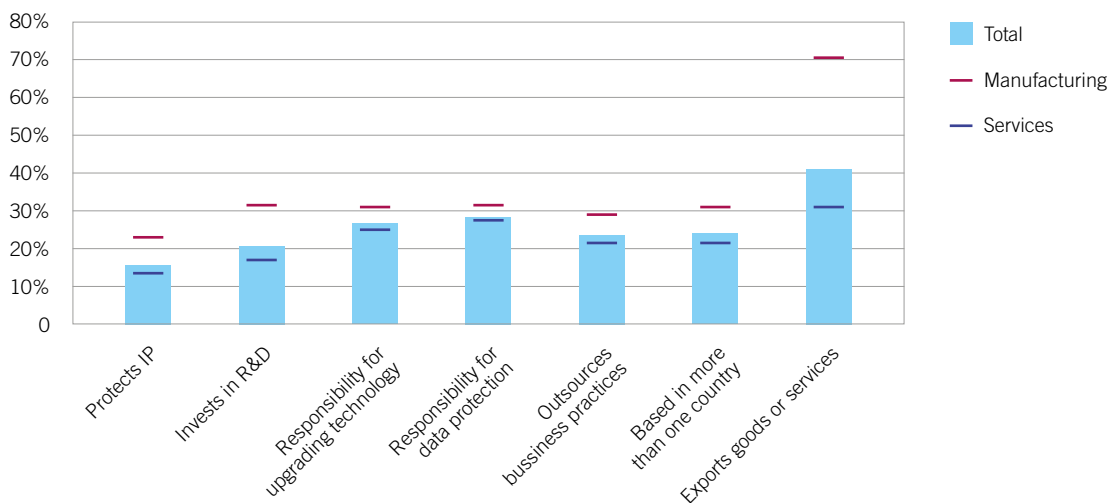
Students were surveyed on their immediate career goals in the first six months after they graduate and on their longer-term goals over their entire working lives. In both cases, they identified their main priorities as follows: stable and secure employment and a high income.

7 Enterprises and young people are generally optimistic

Enterprises surveyed felt very strongly that their business performance in a number of key areas would improve by 2025. Over 60 per cent of respondents felt they would increase their domestic sales, labour productivity, profits and the number of high-skilled workers they employ. Around 49 per cent also felt they would increase their spending on R&D (see figure 4).

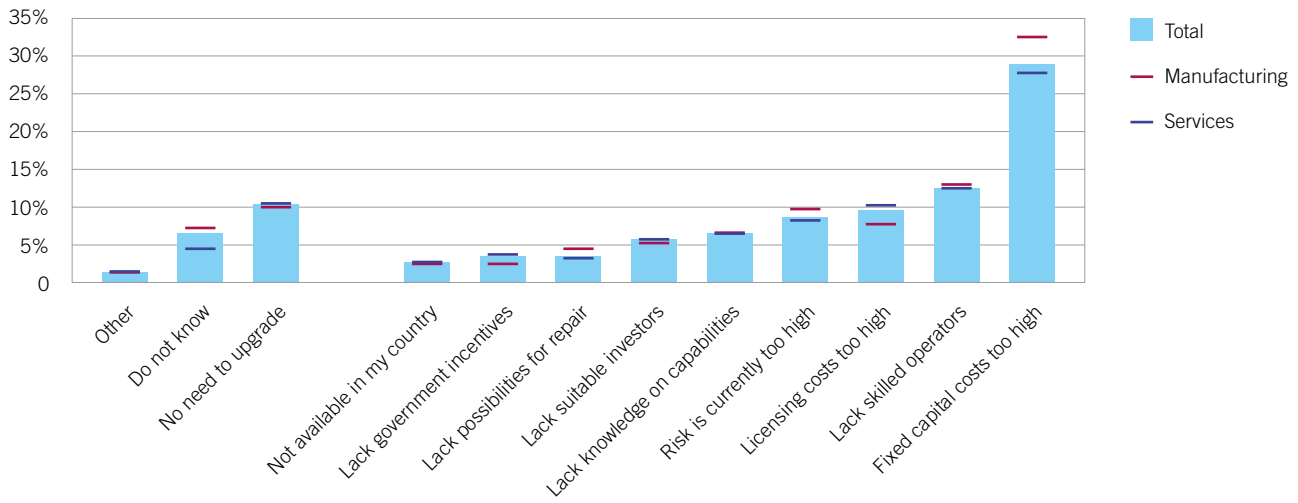
Young people across the region also have an optimistic view of the future. They seemed very aware of the opportunities technological change offered. The majority of students felt there will be more opportunities in 2025 for starting a business (58.4 per cent), interesting and rewarding work (57.7 per cent), productive and well-paid work (56 per cent) and maintaining relevant skills (53.5 per cent). They showed the least optimism with regards to stable and reliable work (48.7 per cent) (see figure 5).

Figure 1 Which of the following does your enterprise currently do?



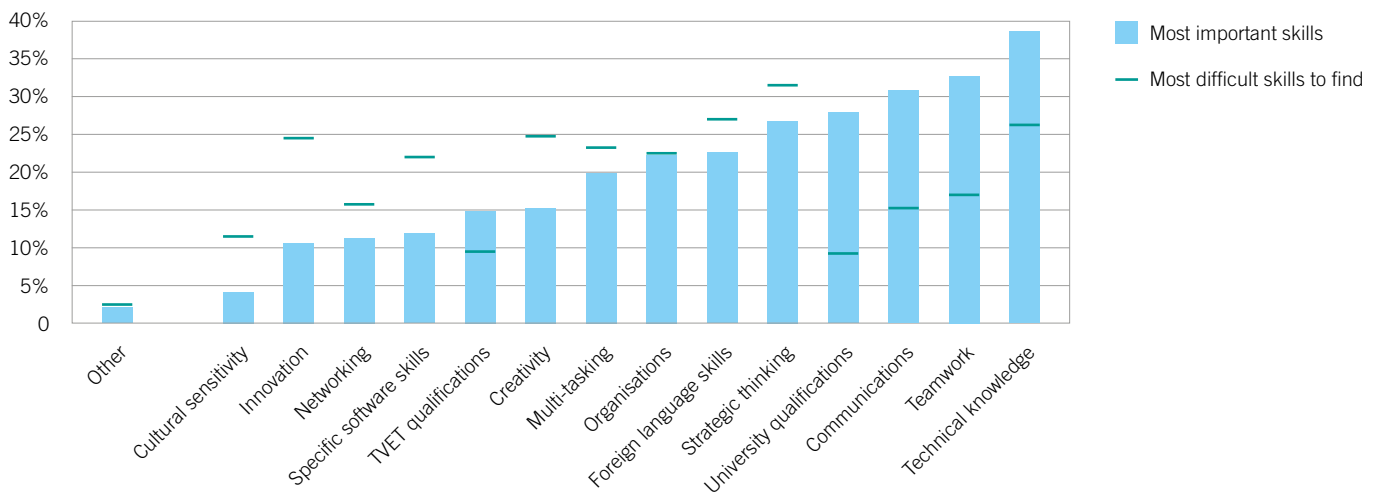
Source: ILO, 2016b.

Figure 2 What is currently the single biggest barrier your enterprise faces to upgrading its technology?



Source: ILO, 2016b.

Figure 3 Which types of skills are currently the most critical for your enterprise?



Source: ILO, 2016b.

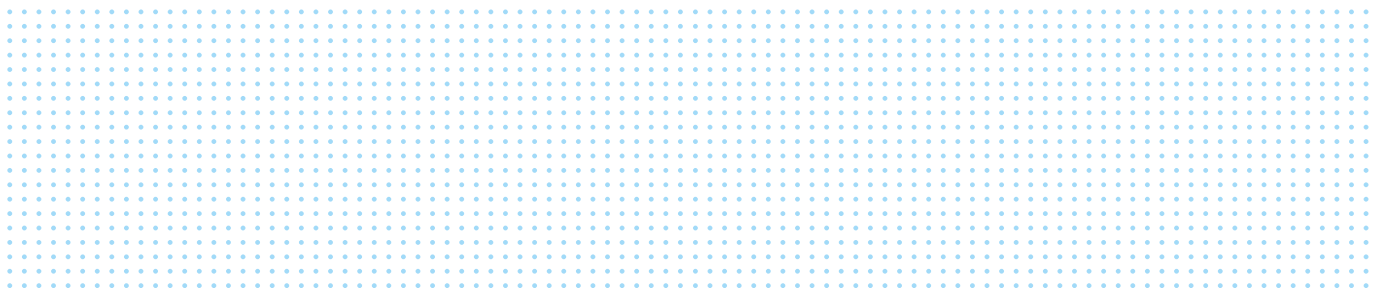
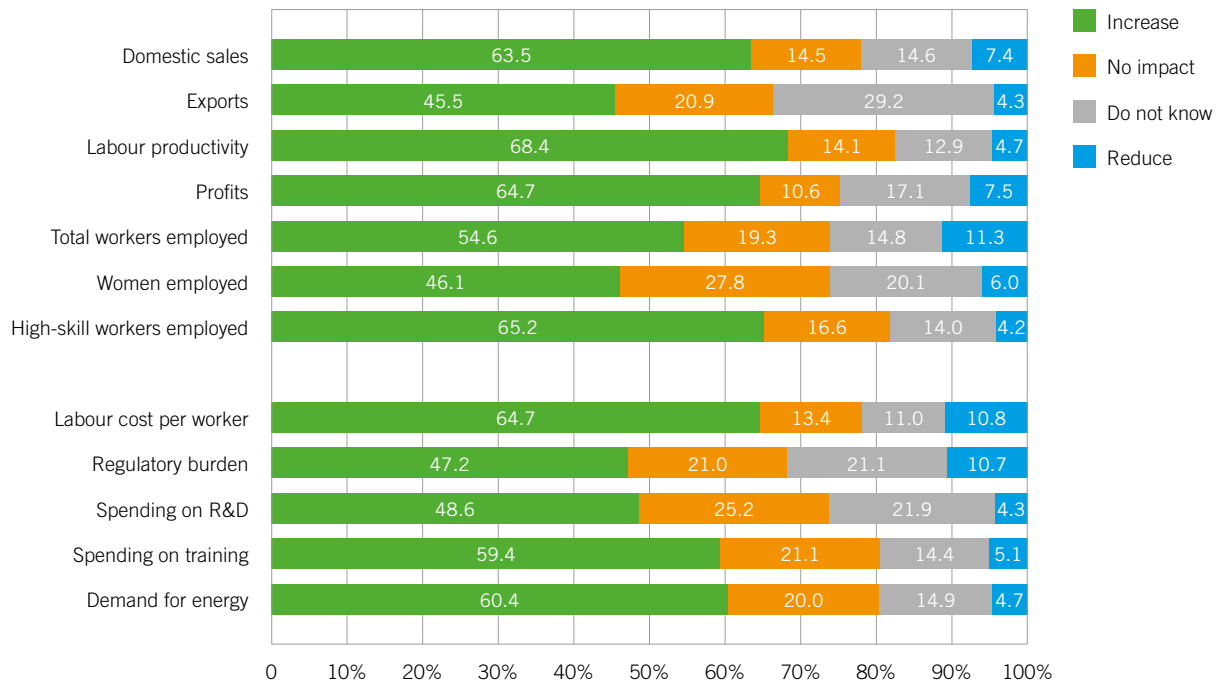
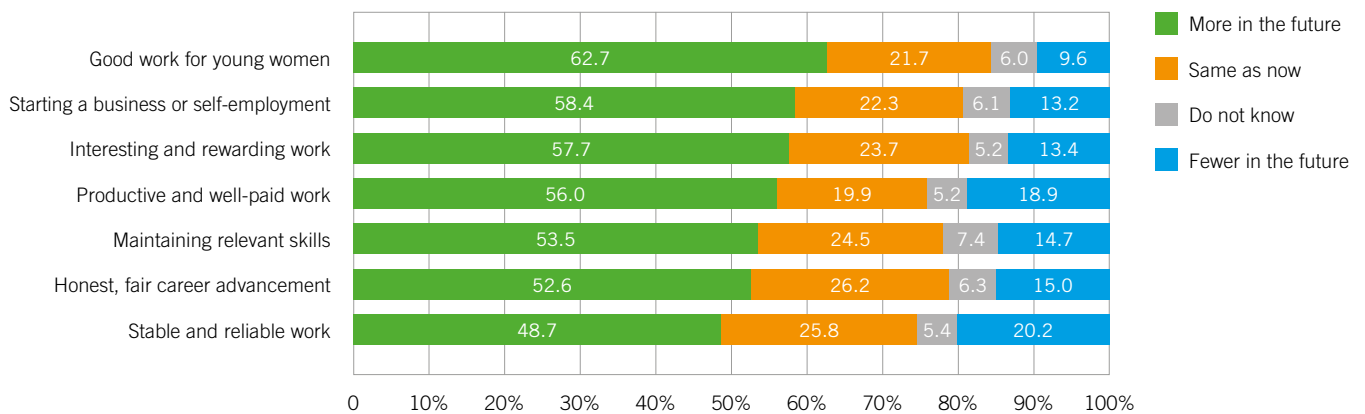


Figure 4 How will your enterprise performance be impacted by 2025 in each of the following areas?

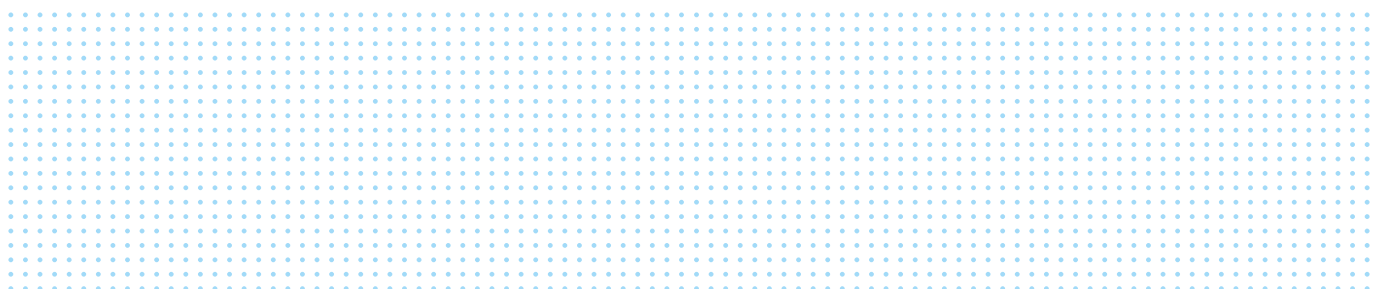


Source: ILO, 2016b.

Figure 5 Thinking about what things might be like in 2025, compared to today, how do you think opportunities will change for young graduates in your country in the following areas?



Source: ILO, 2016b.



While optimism found throughout the survey is certainly warranted, especially with frequent warnings of technology threatening jobs, the survey informed us that sector analyses focused on growth opportunities was necessary. Overall, our research findings from the sector analyses indicate that ASEAN's enterprises across the five sectors are either only piloting disruptive technologies or incrementally introducing them. In other words, disruptive technologies have not gained critical mass usage across all economic sectors. Although, they are in an advanced stage within two sectors: automotive and E&E.

In addition, for most sectors, foreign-owned enterprises supplying goods to foreign manufacturers are the players that are mostly implementing advanced technologies. Worryingly, many local, ASEAN-owned firms are lagging behind in technology uptake, and these firms provide substantial employment throughout the region. However, there are signs that small and medium-sized enterprises (SMEs) are taking advantage of the rapidly declining price points of smart machines, digitization, robotics and other advanced technology.

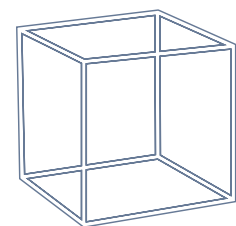
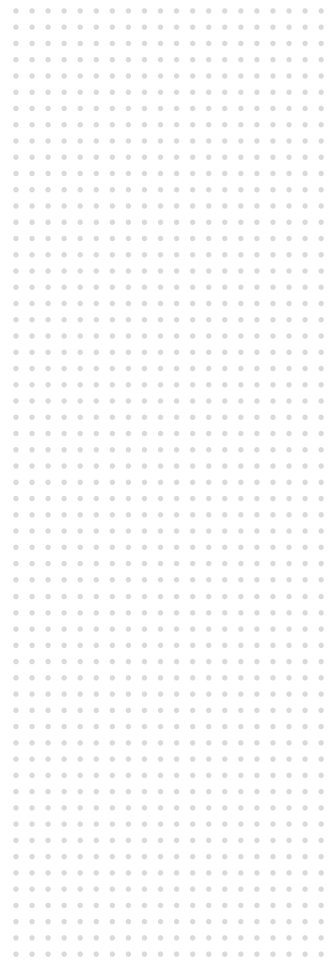
The world of work is not new to technological changes, concerns about temporary unemployment and skills challenges. However, the fundamental difference between previous technology revolutions and the current period is the sheer pervasiveness of the new technologies and the accelerated speed with which they are being implemented. The gap between the invention and commercialization (from patent to operation) has narrowed considerably. Technologies are diffusing much faster now than they have in the past.¹⁴ As a result, the ASEAN region could encounter considerable employment challenges if enterprises are not globally competitive and if the workforce is not equipped with the skills to adapt to forthcoming changes.

Report structure

Based on the results of the enterprise and the student survey findings, the research analysis for the five sectors is guided by the following questions:

- What are the most significant technology trends in a given sector?
- What are the main forces driving technological advancement?
- What is the status of technological uptake in ASEAN?
- What does today's technology ultimately mean for enterprises, their operations, skills demand and ASEAN's workforce?

More than 330 interviews were conducted across the five sectors to answer the above questions. Additionally, six national and regional consultation meetings – including an expert meeting consisting of industry leaders, academics, international experts, employers' representatives and labour economists – were held to guide the research process. The main findings from the sector analyses are presented here, supplemented by data from two accompanied ILO studies examining the impact of technology on jobs in ASEAN (one study comprising of surveys and interviews with stakeholders and students, as well as a study that assesses the number and types of jobs at risk of automation in ASEAN, applying a research methodology developed by Carl Frey and Michael Osborne of the University of Oxford).¹⁵

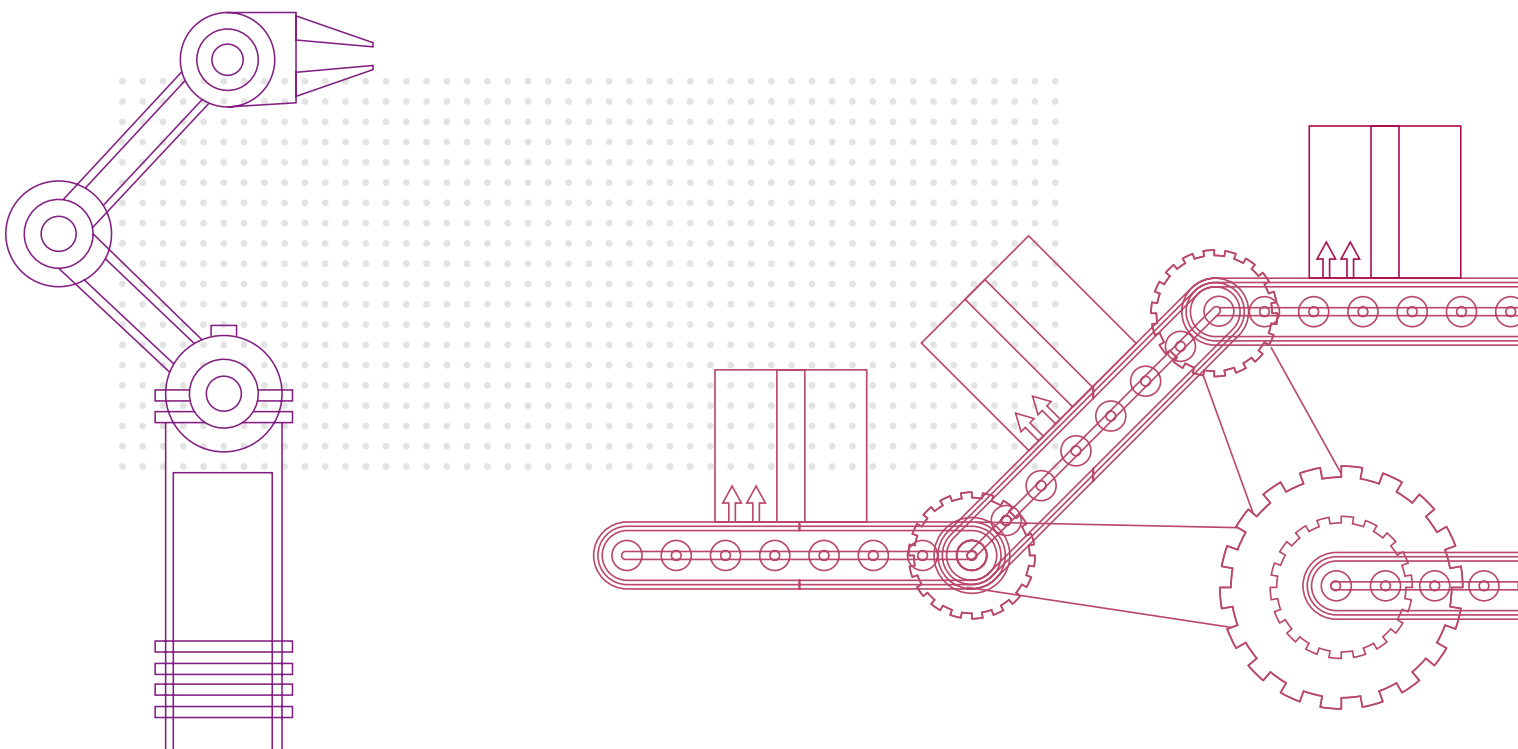


¹⁴ Aeppel, 2015.

¹⁵ See: ILO, 2016b and Chang and Huynh, 2016.

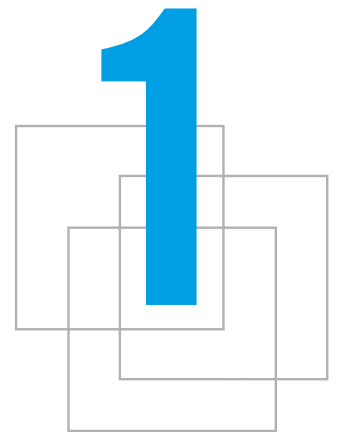
This report is organized into two parts, manufacturing and services sector analyses, each of which examine labour-intensive and key growth sectors within ASEAN. Each of the five sector analyses are structured as follows:

- **Sector overview** provides background information on the industry, including its significance to the ASEAN region in terms of growth, jobs and major markets. The sector overview also dedicates a section to the industry's major disruptors, or technologies that are emerging. The disruptors section describes how specific technologies change workforce requirements, increase productivity or influence market demand, thereby influencing enterprise demand for certain skills. Also contained in the sector overview is an extended discussion of the forces at play, which describes macroeconomic and societal trends that may affect enterprise practices. Factors that accelerate, or decelerate, the adoption of technology are also reviewed.
- **Impact on enterprises** is a focused discussion on how the forces at play and the disruptors collectively affect enterprises. Included in this section is an analysis of how, moving forward, the forces at play and disruptors will effect operations and skills. Effects on operations examines how enterprises may grow or slow down due to the confluence of market demands and advancements in technology. Effects on skills describes how these interacting dynamics will increase demand for certain skills while decreasing demand for others.
- **Impact on people** discusses how trends will affect current and future workers, specifically jobs that will be created and yet other that will be made redundant. Where relevant, we also analyse the impact on female workers.
- **Looking ahead** summarizes the main points of the overall sector analysis in terms of key considerations for ASEAN's stakeholders – governments, employers and workers – and what can be expected by 2025.



PART I MANUFACTURING SECTOR ANALYSIS

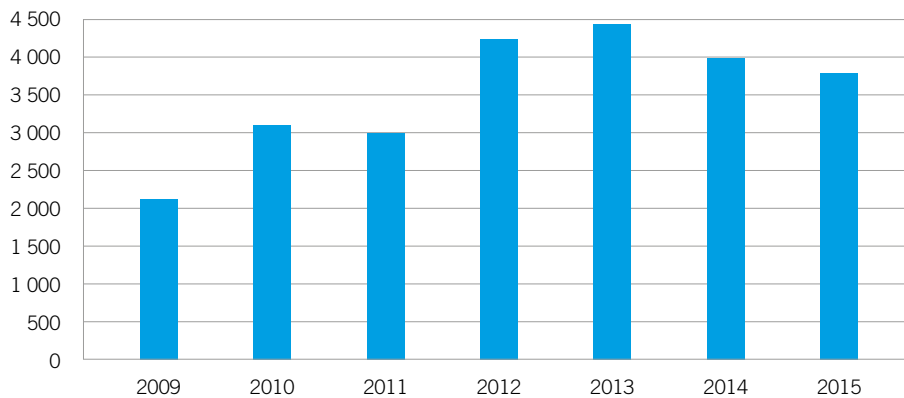
Automotive and auto parts: Shifting gears



1.1 Sector overview

Because of its rapidly growing consumer market and relatively lower costs of labour (compared to that of other developed countries), ASEAN has become a dominant supplier of both original equipment manufacturers (OEMs) and auto parts, as well as a major automotive assembly hub. Indeed, the ASEAN region was the seventh largest producer of vehicles in 2015 globally, boasting a compound annual growth rate of 10 per cent since 2009. In Indonesia and the Philippines, production more than doubled during that period.¹

Figure 1.1 Passenger and commercial vehicle production in ASEAN (thousand units), 2009–2015



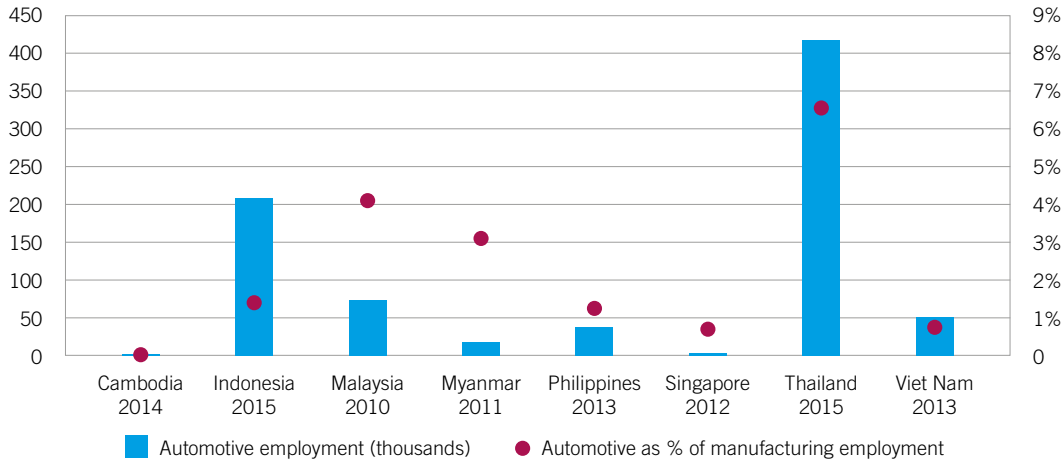
Source: OICA, 2016.

The region’s active role in the automotive market has resulted in a substantial number of people being employed in this sector. For example, Thailand, the regional leader in production and sales, employed approximately 417,000 automotive workers in 2015, representing 6.5 per cent of total employment across all manufacturing industries and accounting for roughly 10 per cent of the country’s GDP.² The industry also plays a prominent role in the Malaysian and the Philippines economies (see figure 1.2).

¹ OEMs the original producer of a vehicle’s components like Toyota, Honda, Ford, General Motors, Hyundai and Renault, among others. The Philippines annual production grew from 45,311 in 2005 to 112,493 in 2015. For Indonesia, production grew from 494,551 in 2005 to 1,098,780 in 2015 (OICA, 2016).

² ASEAN, 2015; TAI and Ministry of Industry, 2012.

Figure 1.2 Total employment in manufacturing of motor vehicles and parts (thousands) and share of total manufacturing employment (per cent), selected ASEAN Member States, latest available year

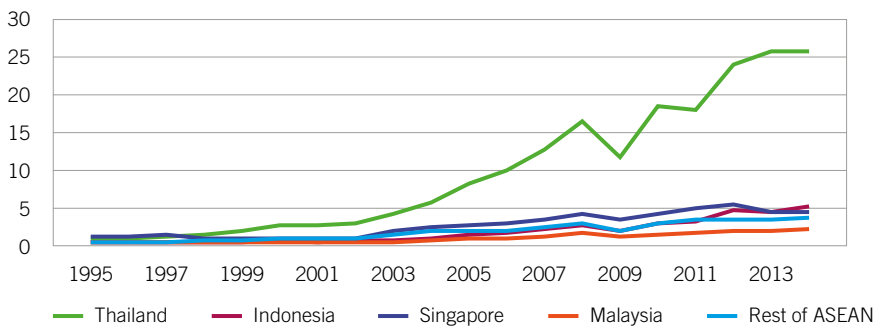


Note: Motor vehicles and parts include production under ISIC, Rev. 4, divisions 29 ('Manufacture of motor vehicles, trailers and semi-trailers'). Total manufacturing refers to ISIC, Rev. 4, divisions 10-33.

Source: ASEAN, 2015; ILO estimates from official labour force surveys (various years).

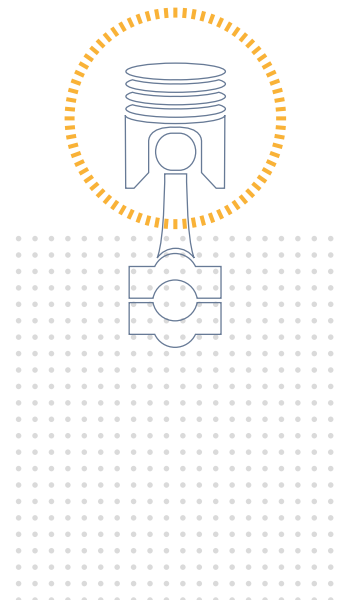
Regional activity in this sector is only expected to grow. Over the past decade, ASEAN's automotive exports have consistently and steadily increased. In 2014, Thailand exported US\$25.8 billion in automotive goods, while Indonesia and Singapore exported approximately US\$5 billion each (see figure 1.3).

Figure 1.3 Automotive exports (current US\$ billions), selected ASEAN Member States, 1995–2014



Note: Automotive products include those under the Standard International Trade Classification (SITC, Rev.3) Division 78. Manufactured goods refer to products under SITC, Rev.3, Sections 5-8 less Group 667 and Division 68.

Source: UNCTAD, 2016.



Overall, this growth can be attributed to the enormous demand generated by ASEAN's rising middle class, which has tripled in size over the past 20 years as well as demand for automotive and auto parts from a growing market outside of the region, particularly from Australia, China, the Arab States, Japan and the United States.³ A considerable amount of the cars produced in ASEAN end up in the region. Approximately one third of Thailand's automotive trade in 2014 was exported to other ASEAN Member States.⁴ For Malaysia and Thailand the respective ratios were 40 per cent and 44 per cent.

In addition, the expansion of OEMs, the increases in the number of automotive producers, and a strong pipeline of abundant, low-cost, trained workers are further fuelling ASEAN's automotive manufacturing activities.

However, as consumer demand grows, their preferences are also becoming increasingly sophisticated, pushing OEMs to upgrade their production requirements in order to make higher performing cars. Suppliers providing parts to OEMs are also hard-pressed to innovate their processes and enhance productivity. These forces are coming head-to-head with ASEAN's rising labour costs, and consequently, ASEAN nations will need to build a stronger competitive advantage to sustain their automotive manufacturing industries. Thus, the sector and its players, both big and small, will need to examine how they can effectively navigate regional and global markets.

It is especially important to note that it was the foreign OEMs and their follow source suppliers that spurred the growth of ASEAN's automotive sector. These mostly tier one suppliers have succeeded in embracing modern technology and utilizing their cross-national relationships with OEMs.⁵ However, going down the supply chain, to tier three suppliers for example, they are primarily local auto parts enterprises without abundant capital or direct relationships with foreign OEMs. As such, there are barriers for local producers to build technological expertise and production capacities. In short, local development is not really happening in ASEAN.

This chapter summarizes the changes impacting the economics of the automotive sector in the ASEAN region. It also describes technologies that are currently influencing and will continue to influence the labour market. The findings are based on primary research, which includes over 90 interviews with tier one suppliers who directly supply to OEMs, OEMs, industry experts and academics, as well as site visits to five tier one manufacturing facilities in Asia.⁶

1.1.1 The disruptors

Four major technologies are shaping the sector and its labour landscape: the electrification of vehicles and vehicular components, advances in lightweight materials, autonomous driving, and robotic automation.



³ The growing middle class can be defined as people with purchasing power parity between US\$5 and US\$13. In six ASEAN countries – Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, the Philippines, Thailand and Viet Nam – where data are available, the middle class grew from 24.6 to 95.1 million people between 1990 and 2013 (ILO, 2015).

⁴ UNCTAD, 2016.

⁵ An example of a tier one supplier would be Sensata Technologies, which supplies exhaust gas sensors to automotive OEMs. Tier two companies are the key suppliers to tier one suppliers, without supplying a product directly to OEM companies (Sarokin, 2016).

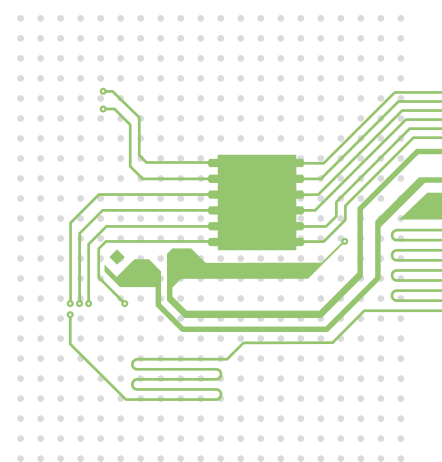
⁶ Some interviews were conducted with firms in China. Although China is not a part of ASEAN, a glimpse into the Chinese landscape helps to understand further the future of ASEAN's automotive industry.

The electrification of vehicles. This disruption refers to the electrification of the powertrain and other vehicular components.⁷ Over the years, interest in electric vehicles (EVs) and hybrid electric vehicles (HEVs) has grown due to volatile gasoline prices and increasing environmental awareness among consumers and regulators. Electronic vehicular components have also become increasingly important due their superior performance, safety and infotainment offerings. Continuous progress in electrification will significantly increase the industry's need for electrical engineers, web programmers and other highly skilled technicians. However, these labour demands will be tempered by two major factors: (1) the cost differentials between EVs/HEVs and traditional gasoline vehicles and (2) government regulations that may, or may not, pressure enterprises to meet certain fuel efficiency and greenhouse gas emissions requirements. Cost differentials indirectly affect the demand for these new workers – if the market lacks consumers willing to buy EVs/HEVs, then enterprises will not recruit for these occupations as actively. To illustrate the cost differential, the base price for Tesla's EV starts at US\$80,000, almost four times more expensive than the most popular car sold in Thailand.⁸ Government regulations, depending on their nature, can either exert or relieve the pressure to develop more advanced EVs and HEVs. At the moment, consumer demand for EVs/HEVs in ASEAN is low, and so the effects from this standpoint are limited.

Advances in materials science. Automotive enterprises are expending efforts to increase fuel efficiency due to regulatory requirements on gas mileage and carbon footprints being legislated all over the world. Weight reduction plays a major role in achieving these goals. Thus, carmakers have been heavily investing resources in R&D of novel, lighter materials (for example, from steel to aluminium), as well as improving current materials (for example, plastic composites). However, the current costs associated with these material alternatives are quite high, making their development and deployment heavily tailored to higher-end vehicles. For example, reinforced steel may offer a weight advantage of 20 per cent over traditional steel, but it comes with a 15 per cent price premium. Similarly, aluminium is 40 per cent lighter than steel but 30 per cent more expensive. Carbon fibre is 50 per cent lighter and almost five times more expensive.⁹ Materials advancements in automotive production bring with them a greater chance of using additive manufacturing or 3D printing to print car parts and accessories. This new manufacturing technology allows manufacturers to customize products to a far greater degree.

In relation to labour demands, greater attention given to improving fuel efficiency and better designed cars will pressure the sector to recruit more material engineers, sustainability integration experts and design engineers who can introduce ways to use less materials, more effective fabrication methods and cheaper production processes.

Autonomous driving. This technology has gained considerable attention in the industry. Self-driving technologies have been under development by numerous players: well-established automotive enterprises such as Audi, BMW, Ford, General Motors, Honda, Mercedes-Benz, TATA, Toyota and Volkswagen; newer entrants such as Cruise Automation and Tesla Motors; and several technology enterprises that, in the past, have not been associated with automotive manufacturing (Apple, Baidu, Google and Uber).¹⁰ Autonomous driving is widely considered the



⁷ For motor vehicles, the powertrain describes the main components that generate power and deliver it to the road surface, water or air.

⁸ Groden, 2015. Tesla Motors is one of the world's leading companies in the production of EV. In 2012, the company launched the world's first premium electric sedan, and as of 2014, it had sold more than 50,000 EV (Tesla Motors, 2016). Thailand's best-selling car in 2015 was Toyota Hilux, which is sold at THB569,000 or US\$15,900 (Focus2move, 2015; Toyota, 2015).

⁹ McKinsey and Company, 2012.

Singapore’s Permanent Secretary for Transport, Pang Kin Keong, said “Self-driving vehicles can radically transform land transportation in Singapore to address our two key constraints – land and manpower”. The Singapore Government is making significant investments in autonomous vehicles to solve the country’s labour shortage of bus drivers and also reduce the number of vehicles congesting the roads.

One recent Massachusetts Institute of Technology study on Singapore estimated that only 300,000 driverless vehicles – roughly one third of the total in operation today – would be needed to serve the entire population’s needs, provided they are shared.

Source: Tan, 2015; Spieser et al., 2014.



most disruptive technology for the automotive sector because of how it challenges automotive design, legal regulations and physical infrastructure. In terms of labour, the competition among these players to introduce market-ready autonomous vehicles have already impacted the job market. New jobs, particularly analytical experts, autonomous driving engineers and interaction designers, have been created at notable rates. Currently, the consumer demand for autonomous vehicles in ASEAN is not expected to be very influential, as many Member States have terrains that are challenging for autonomous vehicles. Motorcycles and street vendors also dominate the streets in many countries and enforcement regulations for traffic rules and road safety are often poor. Singapore stands as the exception, and it has already begun testing autonomous vehicles in the city.¹¹ While autonomous cars within ASEAN may not become immediately universal, successes in Singapore and China (in which the Chinese firm, Baidu, has established a five-year plan to implement driverless cars in the city of Wuhu) may contribute to leapfrogging from motorcycles to autonomous vehicles in some developing ASEAN nations.¹²

While electrification, fuel efficiency and autonomous driving are developing rapidly, their influence in ASEAN is somewhat restricted in the short term. However, there is no question that consumers want more powerful, connected and versatile cars, and this desire will only grow. The question is not if, but when these three trends will fully permeate across the ASEAN automotive industry and exert effects on recruitment and manufacturing operations.

Robotic automation. Meanwhile, ASEAN policy-makers must pay particular attention to a more immediate disruption: robotic automation. Our research shows that automation is the most significant technology affecting sector production in the ASEAN region.¹³ Given its long history in the automotive industry, it is easy to see what robotic automation has to offer: Early adoption of assembly line manufacturing – most notably by the Ford Motor Company in the 1910s – and the use of industrial robots – first introduced by General Motors in 1961 – led to unparalleled

¹⁰ CB Insights, 2015; De Looper, 2015; Pocket-lint, 2016.

¹¹ Tan, 2015.

¹² BBC, 2016.

¹³ Automation refers to use of various control systems to operate equipment and machinery in order to reduce human physical involvement.

efficiencies in large-scale production.¹⁴ Robotic automation helped boost United States factory output by 53 per cent in the past two decades, even as manufacturing employment declined 28 per cent.¹⁵

The dependence on robotics is only expected to grow. Today, the automotive industry is by far the largest user of robotic technology. The International Federation of Robotics (IFR) states that globally, the automotive sector consumed about 43 per cent of robotics in 2014, and robot sales to the industry increased by 27 per cent on average per year. Among ASEAN countries, Thailand has shown an especially strong reliance on robots, ranking eighth in the world for its annual consumption in 2014. Indonesia, Malaysia, Singapore and Viet Nam also increased their robot purchases in 2014.¹⁶

Over 60 per cent of tier one suppliers interviewed have seen significant increases in automation in recent years.

Source: ILO interviews, 2015.

This technology is disruptive for numerous reasons – robots are getting smaller, better at assembly, cheaper, easier to install, more adaptable and increasingly able to collaborate with people. The accelerated adoption and sophistication of robotics will significantly change enterprise employment and skills needs, bringing major changes to the factory floor in the ASEAN region. Our interviews and research show that automation and robotic technology will have the largest impact on jobs in the automotive industry across the ASEAN region until 2025.

1.1.2 Forces at play

We can already see several forces at play that are influencing the sector. Firstly, there is demand for improved product quality. This factor pushes ASEAN automotive players to increasingly automate their manufacturing processes. Case in point is one Bangkok-based tier one supplier of injection-moulded parts, who indicated that automation allowed for high-quality parts with much lower variances in quality.¹⁷ These injection-moulded parts require metallic components to be inserted in the mould prior to injecting plastic. Previously, inserting the metallic components was completed manually, making the process highly unreliable. This tier one company chose to automate the process with a robotic arm. As a result, not only did precision increase, but cycle time became more accurate – down to within a millisecond. These levels of consistency and predictability were previously not possible with manual labour.

Over 45 per cent of tier one suppliers interviewed see quality as a significant driver of automation.

Source: ILO interviews, 2015.

¹⁴ History, 2016; IFR, 2015.

¹⁵ Bloomberg News, 2013.

¹⁶ IFR, 2015.

¹⁷ The enterprise was large, with over 600 employees.



“Before, you had to check the quality of a wiring harness by pressing all sorts of buttons. Now, after the product has been assembled, it is put onto an inspection table, and you just have to press the inspection machine, and you know straight away which are correct and which are faulty. All of this has been developed gradually over the years. It has reduced significantly the amount of time it takes to make the product and it has improved competitiveness drastically.”

Renato Almeda, Vice President, Yazaki-Torres Manufacturing

Source: ILO interview, the Philippines, 2015.

A Shanghai-based tier one supplier with strong ties to General Motors and other American car makers also highlighted the importance of robotics in their operations, especially as electronics become increasingly miniaturized and integrated into cars. Some electronic components have actually become so small that only robots can assemble them for prolonged hours, yet maintain a consistent quality and in faster time. This supplier also indicated that robots had increased their efficiency by 30 to 40 per cent, as they can take three shifts and work 24/7. The number of accidents at the factory had also decreased by 70 per cent.

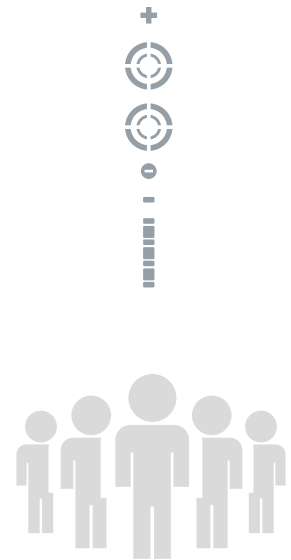
This leads us to the next reason for automation’s increasing prevalence in the ASEAN automotive industry: safer working environments.¹⁸ Not only do robots keep workers out of harm’s way in traditional machined processes, but they also protect workers developing new technologies, as they often involve the manufacture of new parts that are dangerous to fabricate. For example, EV batteries are created in harmful, high-voltage environments. Furthermore, robots do not get tired, and therefore, are not prone to accidents and human error.

LOCOBOT are mobile robots which could make their debut at assembly lines of car manufacturers within three to four years. The anticipated benefits for the industry and its workers include higher efficiency, safer working conditions and ability to quickly adapt production processes to demand.

Specifically LOCOBOT improves working conditions for people by reducing their need to lift heavy items, avoiding potential injuries.

Source: European Commission, 2014.

While more research is required to ascertain direct correlations between reduced industrial accidents and automation increases in ASEAN, a quick glimpse into occupational injuries in Thailand between 2010 and 2013 show that indeed, there has been a steady decrease of over 20 per cent in automotive sector accidents.¹⁹ This decline, of course, could be a result of other factors.²⁰ However, what is clear is that vehicle production and the stock of multipurpose robots increased during this period, while simultaneously, occupational injuries decreased.²¹



¹⁸ Financial Times, 2015.

¹⁹ ASEAN-OSHNET, 2016.

²⁰ Additional reasons for decrease in occupational injuries could be for example due to increased labour inspection.

²¹ IFR, 2015.

One of the most influential factors for greater technological integration in the sector is the common practice of including “cost-downs” in contracts between OEMs and suppliers. Cost-downs refer to agreements that the same parts must be made more cheaply, or the quantity produced must increase with the same resource intensity. This cost reduction is generally accomplished through process improvements, and automation plays a key role in achieving these savings. For example, an Indonesia-based company that specializes in interior components and insulation shared that automated processes have doubled their water-jet efficiency and more than tripled their ability to cut auto part pieces.²² This allowed the company to remain competitive and meet its cost-down targets.

Over 70 per cent of tier one suppliers interviewed believe that cost is a major driver of automation.

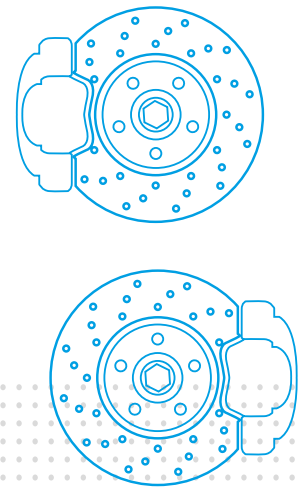
Source: ILO interviews, 2015.

The advantages of automation and the common practice of cost-down agreements are confronting another significant force at play: significant increases in operational cost due to unpredictable and large spikes in minimum wages, which especially affect lower paid wage earners. In Thailand, the minimum wage has almost doubled during the past decade, increasing from 184 Thai baht (THB) in 2006 to THB215 in 2011, and later to THB300 in 2013.²³ An estimated one in five wage employees in Thailand’s automotive industry earned the legislated minimum wage or less in 2013, representing a sizeable workforce that is lowly paid and lower skilled.²⁴ Indonesia has also witnessed considerable increases in the national average minimum wage for full time employees, rising by over 50 per cent from 988,800 Indonesian rupiah (IDR) in 2011 to IDR1,494,100 in 2014.²⁵ As a result, many enterprises dependent on manual workers earning the required minimum wage indicated they were unable to compete, experienced financial difficulties and looked towards automation to weather further increases in operational cost. Moreover, nearly all automotive and auto part makers interviewed perceived automation as a solution to increased labour costs and growth in local demand.

“The minimum wage increase in 2012 was really a wake-up call to integrate automation which offers better longer term visibility and shields businesses from the variability of labour costs.”

Owner, Auto parts manufacturer, Thailand.

Source: ILO interview, 2015.



²² The enterprise introduced a water-jet cutting robotic arm, which could cut automobile internal parts, cut holes and trim edges.

²³ Bank of Thailand. (n.d.).

²⁴ ILO estimates based on Thailand Labour Force Survey Quarter 3, 2013. Moreover, estimates indicate that if the minimum wage were increased by 10 per cent to THB330, almost 30 per cent of the wage employees would be at or below the threshold.

²⁵ ILO 2015 was based on estimates by the Indonesian Central Bureau of Statistics in 2014, which calculated the simple national average of provincial minimum wages in nominal prices, using IDR-constant 2000 prices. This estimate includes employees defined by the Indonesian Central Bureau of Statistics as a “person who works permanently for another person or institution/office/company and gains some money/cash or goods as wage/salary. Workers who have no permanent employer are not categorized as an employee but casual labourer”.

On the consumer side, a wealthier ASEAN with more disposable income is pushing enterprises to produce more cars. Most ASEAN Member States are currently in the US\$3,000 to US\$10,000 bracket of GDP per capita, a category in which car ownership typically grows at about twice the rate of the economy.²⁶ Driven by robust GDP growth, middle class households with disposable income are expected to almost double from 67 million in 2014 to 125 million by 2025.²⁷ This wealthier consumer base will create the need for ASEAN's automotive industry to produce more cars, both for the high-end, luxury segment (for upper middle class consumers) and the mass consumer segment (for the emerging middle class consumers).

Because car ownership in ASEAN is still far lower than in the Organisation for Economic Co-operation and Development (OECD) countries, and automotive manufacturing remains a largely regional activity, the near-term priority for a majority of ASEAN manufacturers is to focus on increasing the regional motorization rate by producing affordable cars.²⁸ However, some will cater to the growing middle class consumers who are able to buy higher performing vehicles. It is clear that a strong boost in vehicle production, sales and car ownership within ASEAN is imminent, due to increased consumer demand.

Stronger government regulations to lower carbon emissions and rising consumer consciousness will also push ASEAN's automakers. At the moment, Indonesia, Malaysia, Thailand and Singapore have all aimed to boost the production of small, affordable, fuel-efficient cars by introducing policies that encourage using EVs and HEVs. For example, Thailand's Eco-Car programme offers tax incentives over eight years to those investing large amounts in manufacturing efforts that meet specific size and efficiency requirements.²⁹ Indonesia's Low Cost Green Car programme, launched in 2013, offers incentives for those who buy cars that meet certain efficiency specifications; it also seeks to boost local manufacturing activities and consumer demand by mandating 85 per cent of the parts be locally sourced.³⁰ Malaysia recently provided grants and incentives for developing smaller, more environmentally friendly city cars through its National Automotive Policy and provides tax exemptions to automakers that manufacture or assemble HEVs.³¹ Industry projections suggest that the HEV market will play an increasingly material role in the ASEAN automotive market, with Malaysia and Thailand competing to be major manufacturing hubs.³²

However, even with established government policies, unforeseen administrative bottlenecks could decrease consumer purchasing by lowering demand. For instance, the Singapore government fined an owner of a Tesla model S – an EV – for excessive emissions via “upstream emissions” – environmental impact due to the electricity production process needed to power the car.³³ Such high profile exposures would, by dissuading consumer demand in innovative new products, result in reduced need for materials engineers, automation analysts and other occupations relating to the production of EVs.



²⁶ The Economist Intelligence Unit, 2014.

²⁷ HV, Thompson, and Tonby, 2014.

²⁸ The OECD consists of 34 Member States including mostly advanced economies. This provides a useful comparison to the ASEAN region in terms of how much vehicle ownership has the potential to grow as economies advance.

²⁹ Thailand Board of Investment, 2007.

³⁰ Leclair, 2015.

³¹ Ibid.

³² Surender, 2016.

³³ Passary, 2016.

Regarding EVs effects on workers, because EVs have almost two-thirds fewer individual parts than traditional gasoline individuals (11,000 compared to 30,000), their simpler manufacturing processes could considerably lower the need for manual workers at an assembly line.³⁴

Overall, the latest research suggests that, globally, the automotive sector is undergoing significant transformation. Accelerated technological innovation resulting from collaborative robots in the assembly line, new electronic gadgets featured in cars and the race to fully implement driverless cars are changing the industry.

1.2 Impact on enterprises

1.2.1 Effects on operations

ASEAN's automakers are forming task forces to improve their operational competitiveness

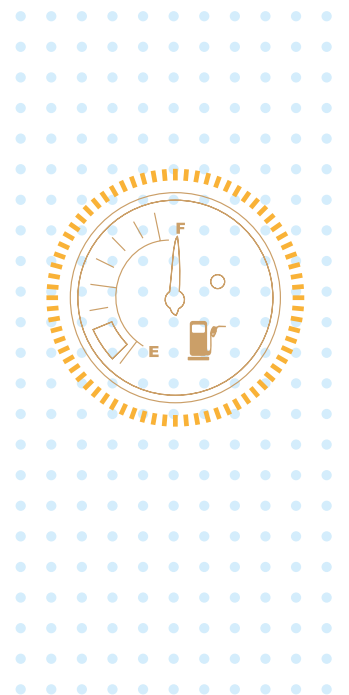
We found that automakers in ASEAN are actively establishing internal company task forces to remain competitive. These task forces monitor new automation technologies and assess how these technologies can improve the firm's manufacturing efficiency. In some instances, separate production engineering teams were created to optimize production. To meet growing regional demand and government initiatives to produce eco-friendly vehicles, automotive suppliers are also ramping up their production processes to incorporate green technology.

OEMs could seek lower operational costs by moving production to elsewhere in ASEAN

Some OEMs that remain married to traditional business models are moving to low labour-cost countries (rather than using automation and innovative technologies to enhance their total performance). This potentially means moving the production of labour-intensive components from Indonesia, Malaysia and Thailand to countries like Cambodia, the Lao People's Democratic Republic and Myanmar. This shift could result in a hollowing out of the domestic parts and components industry in the more established markets and the creation of a drastically different auto component supply system throughout ASEAN.³⁵

Firms are optimizing production through automation

Our research and interviews reveal that automotive and auto part suppliers are assessing which functions would benefit most from machinery and are increasingly automating them. In contrast to OEMs, parts manufacturers are more likely to automate tasks that are relatively simple, repetitive and low-skilled. For example, one Indonesia-based company that has a longstanding relationship with Daihatsu – a subsidiary of Toyota – discovered that a Japanese factory similar in size and production employed only five workers for die-cutting, compared to the 17 workers they employed. After conducting a cost-benefit analysis, the company decided to automate a significant portion of its mundane and repetitive tasks. This preference for automation of low-skilled tasks is expected to persist and grow throughout the ASEAN region.



³⁴ Goldman Sachs, 2016.

³⁵ Kobayashi, 2014.

1.2.2 Effects on skills

Robots are replacing lower skilled jobs

Our fieldwork illustrates that manual, less-skilled workers are being replaced by robots and machinery in ASEAN's automotive sector. In Thailand for example, nearly three in five jobs in the industry consist of plant and machine operators and elementary workers.³⁶ Furthermore, ILO estimates indicate that 60 per cent and 70 per cent, respectively of salaried occupations in Indonesia and Thailand's automotive industry are at high risk of being automated.³⁷

The industry needs new types of workers who are unfortunately difficult to find

Enterprises are creating new jobs that require greater technical knowledge to operate/service machines and interpret production statistics. For example, an Indonesia-based auto parts supplier indicated that automation changed their job requirements – workers are now expected to perform basic troubleshooting when machines malfunction. This requires more critical thinking and problem-solving skills, which were not necessary before. Similar skills needs were indicated in the ILO survey, where over 30 per cent of ASEAN enterprises highlighted that strategic thinking was by far the most difficult skill to find.³⁸

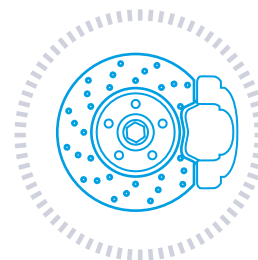
Over 70 per cent of tier one suppliers interviewed believe that it is difficult to attract and retain talent.

Source: ILO interviews, 2015.

Many interviewees commented that they face great challenges in attracting talent due to poor local technical vocational education and training (TVET) and education systems, fierce competition from global enterprises as well as other growth industries where similar sets of strong technical skills are needed. Thai-based auto assemblers and component producers have indicated shortages of skilled workers for over a decade. In 2013, an official from the Thailand Automotive Institute noted that the automotive industry faced a manpower shortage of approximately 900,000 workers.³⁹

The Federation of Thai Industries (FTI) has expressed considerable concerns regarding Thailand's weakened automotive workforce. Thavorn Chalassathien, Vice Chairman of FTI, said the workforce cannot "adjust to the pace of change in production technologies" and that Thailand is experiencing a nutcracker effect since it can no longer compete against low-cost labour. He stressed that Thailand's only options are to upgrade skills and standards.

Source: ILO, forthcoming.



³⁶ These occupations correspond to ISCO-08 groups 8 and 9. Source: Authors' estimates based on Thailand Labour Force Survey Quarter 3, 2013.

³⁷ Chang and Huynh, 2016.

³⁸ ILO, 2016b.

³⁹ ILO, forthcoming.

ASEAN enterprises also indicated a greater need for engineers with specialized knowledge of automated process design and robotic programming. The pressure to accelerate improvements in electrification, fuel efficiency and autonomous driving are intensifying the competition for talented skilled workers. Reinforcing this point, General Motors recently identified electrical engineers, analytical experts, customer care experts and industrial engineers as the key to becoming a global automotive leader.⁴⁰

To ensure that there is adequate supply of skilled talent in these areas, OEMs like Mercedes-Benz are offering technical apprenticeships using a dual-education system. To this end, the company partners with a vocational school accredited by the Ministry of Education in Thailand and has also established a training centre in Indonesia. This training programme helps ensure Mercedes-Benz obtains the skills it needs to raise its production quality and integrate new technology. This helps the company meet standard requirements established by the corporate regional headquarters.⁴¹

“As of today, over 600 qualified technicians were already [trained] for the Thai auto industry from our current partnership with Samutprakan Technical College.... The New Milestone of Mercedes-Benz Technical Apprenticeship under German-Thai Dual Excellence Education is a great advancement for us... especially in an enlarging automotive segment in which skilled labour is in need.”

Michael Grewe, President and CEO of Mercedes-Benz, Thailand

Source: Mercedes-Benz, 2014a.

In addition to the above, ASEAN's automotive sector needs to build a sector-wide arrangement for education and training. Our research shows that much training occurs within the OEMs, as opposed to being available to a holistic range of industry players. The overall growth of the automotive workforce, including workers for tier two and tier three suppliers, would be critical to further enhancing the sector's growth.

1.3 Impact on people

The auto sector in ASEAN will demand more workers with strong technical backgrounds and with degrees in STEM subjects

An in-depth analysis of the proportion of students pursuing STEM degrees in ASEAN paints a somewhat concerning picture. As of 2014, the most popular field of studies in all ASEAN countries were social sciences, business and law, constituting more than 50 per cent of tertiary



⁴⁰ Barra, 2016.

⁴¹ Mercedes-Benz, 2014a and 2014b. Other examples include partnerships forged between auto players and government bodies such as: Thailand's National Science and Technology Development Agency to create automobile technology and develop the sector's incoming workforce, and the Ministry of Education's Office of the Vocational Education Commission to provide young technicians with internship programmes with OEMs like Isuzu, Toyota, General Motors and Robert Bosch (NSTDA, 2011).

graduates in Cambodia and Thailand.⁴² The ILO survey confirms this, finding that the biggest share of students were studying business, commerce or finance.⁴³ On the other hand, tertiary enrolment in engineering, manufacturing and construction is below 10 per cent for Cambodia, Indonesia, the Lao People's Democratic Republic and Thailand.

“Education quality is not good enough in lower-tier schools. Some engineering graduates cannot perform basic engineering tasks and lack basic math and [Microsoft] Excel skills. We end up spending lots of time and energy training these workers.”

OEM, Thailand

Source: ILO interview, 2015.

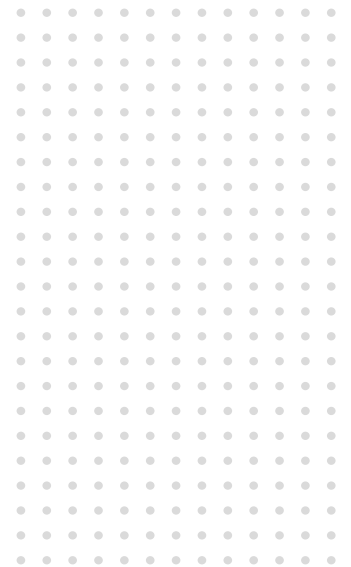


However, an analysis of this area would not be holistic if we just consider the percentage of STEM graduates. It is also important to review the quality of the education that STEM graduates receive. Indeed, many interviewees commented that they face great challenges in recruitment, due to poor local education systems, fierce competition from global employers and growth in other industries that also demand strong technical skills. In particular, research shows that there is a lack of incentive for students pursuing engineering to focus on technology, as opposed to administration.⁴⁴ Moreover, many graduates lack interest in working within an industry perceived to be old, low paying and physically intense. Research also reports that recent graduates do not consider the automotive sector to be rewarding and lack confidence in its future.⁴⁵

A major recruitment issue noted globally is the sector's difficulty in hiring women. For example, while women represent 45.4 per cent of the total employment in the Thailand, they comprise less than 40 per cent of the automotive workforce. In Indonesia, women only make up 7.2 per cent of automotive workers while accounting for 37.7 per cent of total employment.⁴⁶ A research conducted by McKinsey and Company labelled the automotive and industrial manufacturing sector as being inaccessible to women in all ranges from entry-level to senior-executive level.⁴⁷ The ASEAN region would also be subject to similar hurdles, especially due to the skewed tendency of female students to pursue education, health welfare and humanities, with STEM uptake remaining relatively low at 17 per cent.⁴⁸

The idea of working in the automotive industry [for women] suffers from a perception problem.

Source: Deloitte, 2015b.



⁴² UNESCO-UIS, 2016.

⁴³ ILO, 2016b.

⁴⁴ ILO, forthcoming.

⁴⁵ Deloitte, 2009.

⁴⁶ ILO estimates from official labour force surveys.

⁴⁷ Krivkovich, Kutcher, and Yee, 2016.

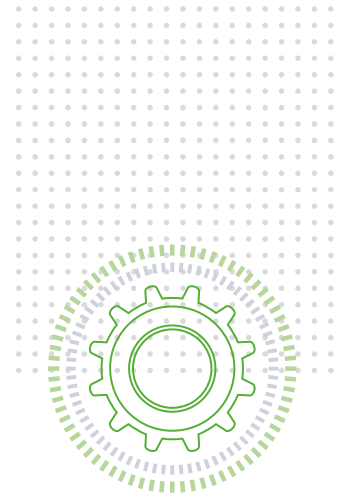
⁴⁸ UNESCO-UIS, 2016. In countries like Singapore and the Philippines, more than 70 per cent of tertiary enrolment in education consists of female students. For studies in health and welfare, six ASEAN countries show that more than 70 per cent of enrolment is female.

Overall, ample opportunities exist for technically skilled people who want to pursue a career in ASEAN's growing automotive industry. The industry's image of being dirty and unsafe contradicts the advanced technology being adopted and the greater demand for skilled workers. The future workforce – both men and women – in ASEAN should consider career paths in the automotive sector by investing time in STEM subjects, acquiring technical skills and staying abreast of new technology trends.

1.4 Looking ahead

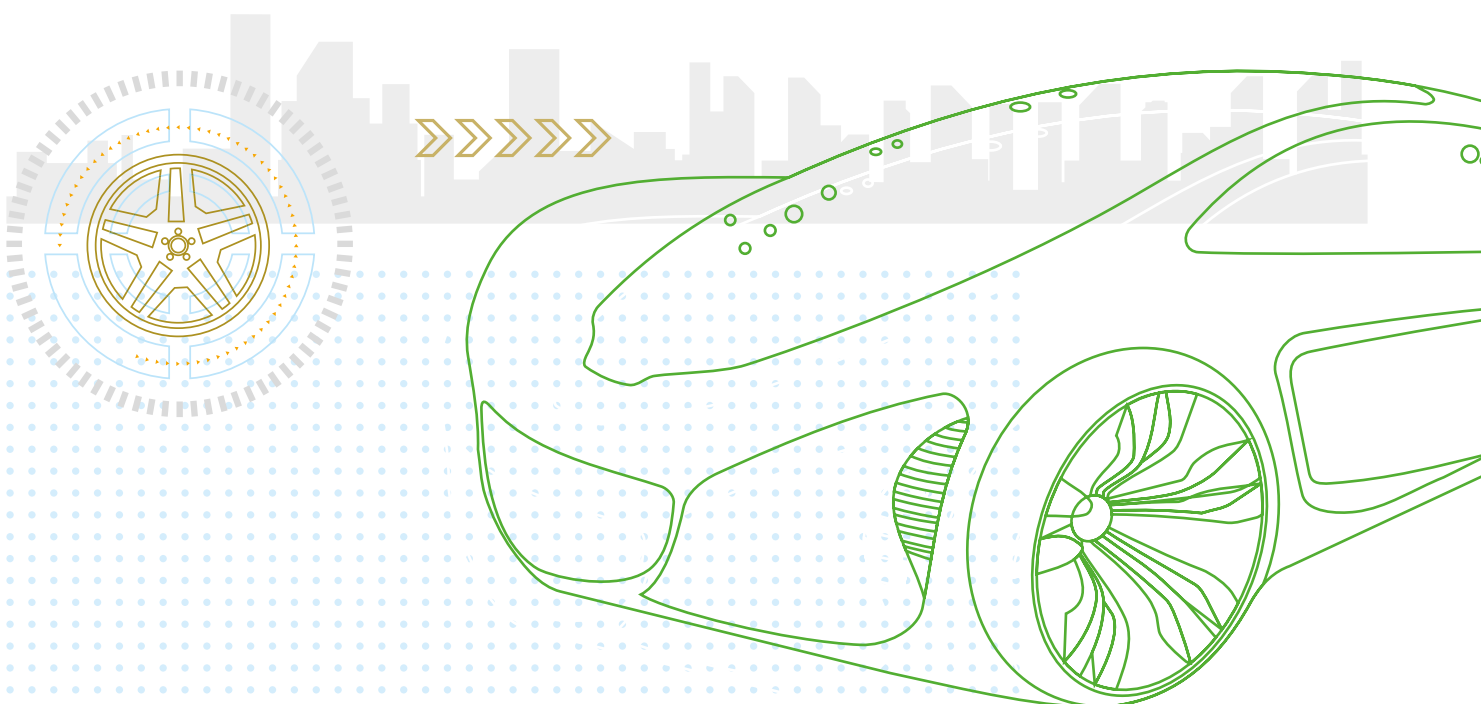
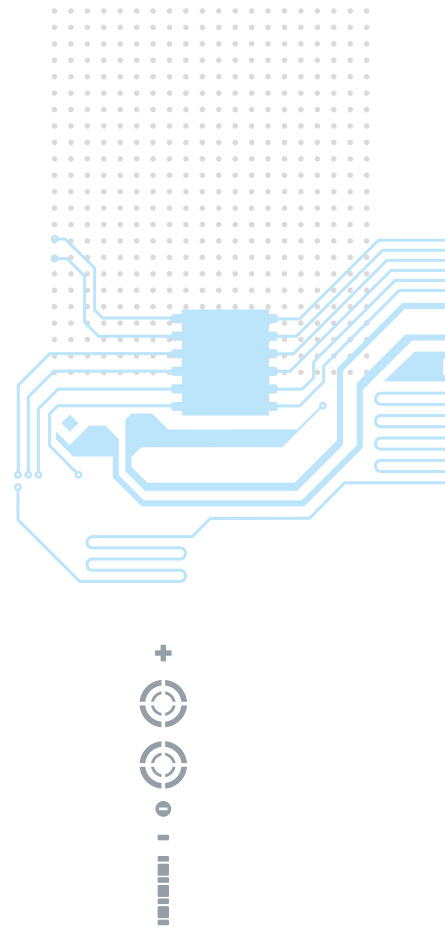
ASEAN's automotive sector will be invigorated: Expect more automation and production of tech-savvy cars to serve the expanding market

- In the short term, ASEAN's automotive sector is expected to accelerate its adoption of automation. The workplace will become more efficient and safer. Robots will increasingly work collaboratively with people.
- The growing middle class will result in increased demand for cars. Preferences will also emerge for tech-savvy vehicles, along with cars that meet increasingly stringent government standards on carbon emissions.
- By 2025, we anticipate advancements such as electrification and fuel efficiency to become a greater consideration for ASEAN's automotive manufacturing. In addition, increased testing and experimentation of autonomous driving could take place in some advanced ASEAN Member States.
- To remain competitive, ASEAN's enterprises will need to seek collaborative opportunities with OEMs to accelerate the integration of advanced automotive technologies. Equally important would be investing to increase the capacity of local auto makers (for example, tier two and tier three manufacturers) to ensure that domestic growth is sustained.
- Moving forward, ASEAN automakers should prioritize forging partnerships with technology and electronics firms, as electronics and gadgets have become indispensable to making smart vehicles. General Motors' acquisition of Cruise Automation and Google's joint venture with Ford to build autonomous cars are two prominent examples. ASEAN provides ample opportunities for carmakers to work closely with the electronics industry, due to the region's growing electronics ecosystem with manufacturing hubs in Malaysia, the Philippines, Thailand and Viet Nam.



Technological progress will drive the sector's need for higher skills

- We will likely see tier one suppliers of foreign OEMs emerge to be at the forefront production automation. This will result in fewer and fewer workers on factory floors in the near term. Moreover, automation will shift the industry's labour needs from low-skilled, assembly line workers to technically equipped workers with a variety and depth of skills.
- The automotive sector should build a pipeline of high-skilled engineers, technicians, data analysts and others with critical thinking and innovative skills. A sector-wide skills development strategy that incorporates anticipated technological advancements would help project relevant industry skills needs.
- It is imperative for the sector to forge stronger strategic alliances with educational and vocational training institutions so that new entrants to the workplace are endowed with relevant skills. The role of the government and incentive schemes are also important to build skills and to encourage investments in specific areas – for example for the development of infrastructures for EVs and driverless cars – to facilitate accelerated adoptions of new technology.
- The sector should also collaborate with educational partners to encourage female students to enrol into degree and certification tracks, with a view to being recruited by the auto industry. This will help strengthen the skills pipeline.
- The region's automotive leaders like Thailand should consider building a centre of excellence to facilitate better coordination with automotive industry players across all tiers for the harnessing and promotion of design and manufacturing skills. This could put ASEAN in a different category on the global stage for automotive and electronics.
- If ASEAN's automotive industry succeeds in becoming more competitive and is supported by the right talent pool, there are opportunities for it to scale up its capabilities, produce value added cars and strengthen its position, the net effect of all of which would be to fuel further economic growth.



Electrical and electronics: On and off the grid



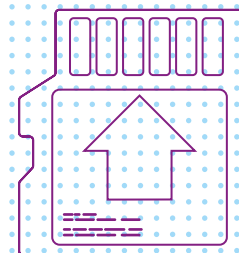
2.1 Sector overview

The electrical and electronics (E&E) manufacturing sector is a significant player in the production of goods. Its products vastly enhance human productivity and stimulate innovation across entire economies.

It would perhaps be more accurate to describe the E&E sector as a set of subsectors, yet even that fails to do justice to its enormity. From “white goods” (televisions and household appliances) to “3C” electronics (computers, consumer and communications), these products shape most people’s daily lives.

E&E is characterized by an integrated and diverse supply chain: both small manufacturers and global titans participate in this industry.¹ The sector’s supply chains are more geographically extensive and dynamic than in any other goods-producing sector. A single product can be the result of labour carried out by dozens of firms across multiple countries. One factor that makes this possible is the high value-to-weight ratio of electronic components and most final products, which makes long-distance shipping relatively inexpensive. For high-value components and some final products, such as notebook computers and mobile phone handsets, air shipment is common, thereby permitting supply chain integration from multiple locations.

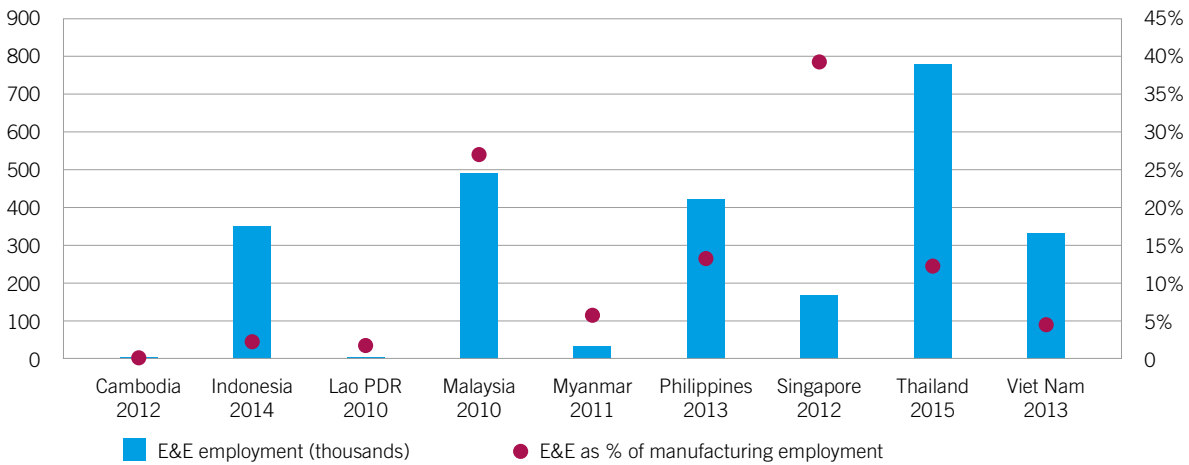
E&E manufacturing is one of the region’s most prominent sectors and a mainstay of economic growth, especially as the region moves up the value chain in manufacturing, away from low-cost production. Through rapid economic development and a rising middle class, the ASEAN region has also developed a broad industrial and consumer market for such E&E machinery and goods. The sector directly employs an aggregate of more than 2.5 million workers in ASEAN (see figure 2.1). Thailand’s E&E employment was the biggest in 2015, encompassing approximately 780,000 workers and representing 12.2 per cent of the total employment in manufacturing. The industry encompassed the biggest share of total manufacturing workers in Singapore, accounting for 39.4 per cent of the total manufacturing workforce in 2012. E&E’s prominence is observable in other ASEAN Member States: Malaysia, at 27 per cent in 2010 and the Philippines, at 13.3 per cent in 2013.² Mostly, E&E production in ASEAN focuses on components such as integrated circuits (ICs), semiconductor devices and printed circuit boards (PCBs).



¹ The E&E sector includes three principal types of actors, sometimes referred to as “lead firms”, “contract manufacturers”, and “platform leaders”. Lead firms produce the final E&E products consumers will commonly buy, typically sourcing their components and parts from a range of downstream manufacturers. Contract manufacturers operate further downstream and either provide components and modules to lead firms or deliver services to them such as design, software design, testing, supply chain management, distribution and assembly. Platform leaders might be lead firms or contract manufacturers but are distinguished insofar as their technologies – either hardware, software, or both – are widely adopted by others. Apple and Microsoft, for example, are both a lead firms and platform leaders. Intel, on the other hand might be considered a contract manufacturer but is also the computer industry’s dominant platform leader.

² Among enterprises larger than 20 workers.

Figure 2.1 Total employment in the manufacture of E&E products (thousands) and share of total manufacturing employment (per cent), selected ASEAN Member States, latest available year

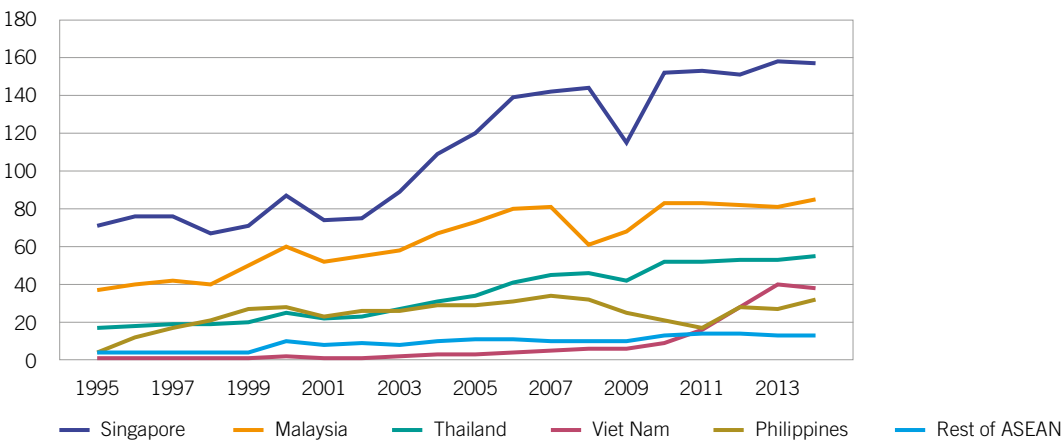


Note: E&E products include those under the International Standard Industrial Classification of All Economic Activities (ISIC, Rev.4) Divisions 26 ('Computer, electronics and optical products'), 27 ('Electrical equipment'), and 28 ('Machinery and equipment'). Total manufacturing refers to ISIC, Rev.4, section C, divisions 10-33.

Source: ASEAN, 2015; ILO estimates from official labour force surveys (various years).

Impressively, ASEAN's E&E exports almost tripled over the past decade, reaching US\$382.1 billion in 2014.³ Singapore is the region's clear frontrunner: the sector's total exports grew strongly throughout the 2000s, reaching US\$157.5 billion in 2014 (see figure 2.2). Singapore's success has been partly driven by the rise of several giant E&E components manufacturers and electronics manufacturing services providers. For Malaysia and Thailand, E&E exports also saw significant growth over this time, reaching US\$85.6 billion and US\$55.0 billion respectively, in 2014. It is worth noting that Viet Nam's exports increased rapidly between 2000 and 2014. Its compound annual growth rate accounted for 29 per cent, compared to that of Malaysia and Thailand of 3 per cent and 6 per cent, respectively.

Figure 2.2 Exports of E&E products (current US\$ billions), selected ASEAN Member States, 1995-2014



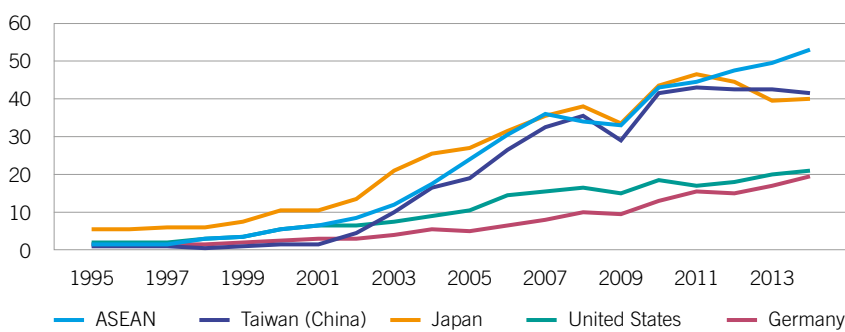
Note: E&E products include those under the SITC, Rev.3, Divisions 75-77, 87 and 88. Manufactured goods refer to products under SITC, Rev.3, Sections 5-8 less Group 667 and Division 68.

Source: UNCTAD, 2016.

³ In current US\$.

And so, where do these E&E goods end up? Over 70 per cent of ASEAN E&E exports are shipped to Asia. In 2014, ASEAN E&E exports to Hong Kong (China), China and Japan accounted for 15 per cent, 14 per cent and 8 per cent of total E&E exports, respectively. Apart from Hong Kong (China), ASEAN dominates E&E exports to China, which is an assembly base importing several parts and components (see figure 2.3). After Asia, the United States stands as the next largest importer of ASEAN's E&E goods, accounting for over 11 per cent in 2014. Major ASEAN producers, including Singapore and Malaysia, only exported 23 per cent of their respective E&E products to the ASEAN region (this does not account for domestic consumption).⁴

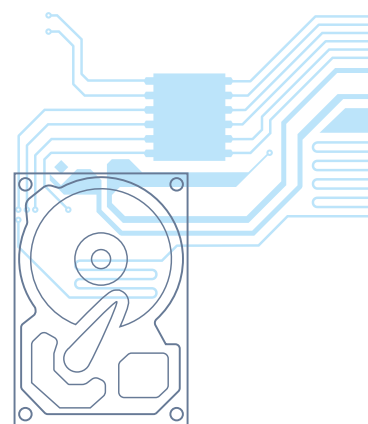
Figure 2.3 E&E part exports to China (current US\$ billions), selected economies excluding Hong Kong (China), 1995–2014



Note: E&E products include those under the SITC, Rev.3, Divisions 75-77, 87 and 88. Manufactured goods refer to products under SITC, Rev.3, Sections 5-8 less Group 667 and Division 68.

Source: UNCTAD, 2016.

ASEAN's diverse E&E activities make it an extremely attractive destination for manufacturers and investors. From high-tech design research and innovation to low-skilled assembling and packaging, each Member State brings to the table its own strengths and specialties, allowing the region as a whole to cater to different E&E subsectors. For example, Thailand's National Science and Technology Development Agency was set up to better align the skills needs with those in the sector.⁵ Viet Nam's advantage lies in its low labour costs. With regards to this last point, it should be noted that ASEAN's competitive labour costs remain the primary attraction for many electronics manufacturers and a key pull for investment. Table 2.1 provides an overview of each ASEAN Member States' E&E specialties.



⁴ UNCTAD, 2016.

⁵ Thailand Board of Investment, 2015a; NSTDA, 2011.

Table 2.1 ASEAN E&E overview

Country	Indonesia	Malaysia	Philippines	Singapore	Thailand	Viet Nam
Key production	IC, semi-conductor, PCBs	Semi-conductors, microchips, conductors, valves, household appliances, radio equipment, solar cells, PCBs	IC, semi-conductor, electronic data processing (PCBs, printers, hard disk)	Semi-conductors, silicon wafers, hard-disk components	Hard-disk drives, ICs, microchips, air conditioning units, refrigerators	IC, semi-conductor, PCBs
Contribution to GDP (%)	2.1 (2014)	9.8 (2014)	13.8 (2013)	5.3 (2013)	15 (2015)	23.4 (2014)
Contribution to total exports (%) (2014)	7.0	36.5	52.2	41.2	24.1	25.4
Major export markets	China and Japan	China, Singapore, Hong Kong (China), United States, Japan	Hong Kong (China), China, Japan, Republic of Korea and Taiwan (China)	Hong Kong (China), China and Malaysia	United States, ASEAN, Hong Kong (China), Japan, China	China, Malaysia, Singapore
Major players	Toshiba, LG, Sony, Panasonic, Samsung.	Bosch, Fairchild, Hewlett Packard, Hitachi, Silterra, and Intel	Texas Instruments, Fairchild, Amkor, Toshiba, Epson, Fujitsu	Avago, Fairchild, Micron, Seagate, Hitachi, Flextronics, Sanmina, Lite-On, Wistron	Fujitsu, LG Electronics, Samsung, Seagate, Sony, and Western Digital Bosch, Daikin, Electrolux, LG, Panasonic, Samsung, Siemens, and Toshiba	Intel, Microsoft, LG, Panasonic, Samsung, Hitachi, Active-Semi, Hanel, Fuji Xerox

Source: ASEAN, 2015; Brown, 2015; GBG Indonesia, 2013; HKTDC, 2015; Hidayat, 2016; MATRADE, 2016, Philippines Board of Investment and Department of trade and Industry, 2011; Thailand Board of Investment, 2015a; Thailand Board of Investment, 2016; Singapore Economic Development Board, 2016; ILO estimates from official labour force surveys (various years), Oxford Business Group, 2016; UNCTAD, 2016; VIETRADE, 2015; World Bank, 2016.



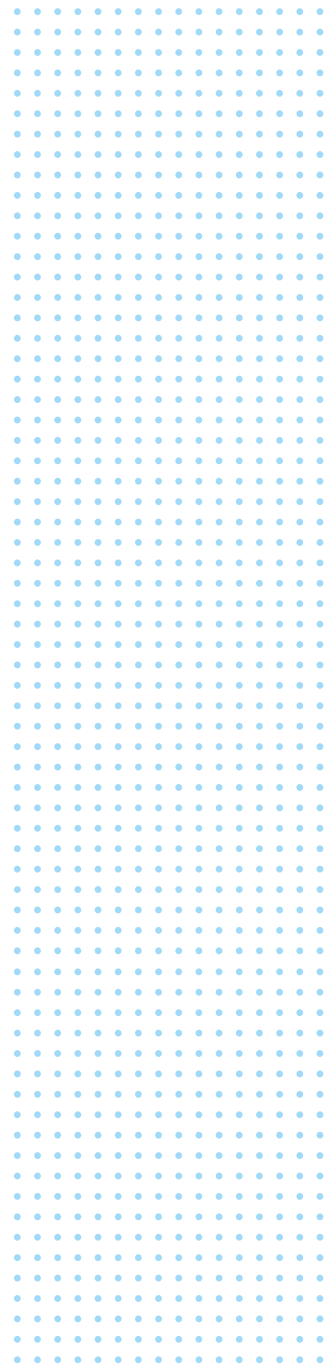
Table 2.1 also depicts the widespread manufacturing presence of major E&E multinational enterprises (MNEs) who are global leaders in patent filing and the protection of technological innovations. More specifically, of the top 30 international patent applicants worldwide, 23 came from the E&E sector (and of that 20 from MNEs in the Asia and Pacific region), including from Panasonic (Japan), Canon (Japan), Samsung Electronics (Republic of Korea), LG Electronics (Republic of Korea), Huawei (China), ZTE (China) and Sony (Japan), among others. Globally, the World Intellectual Property Organization (WIPO) reports that the E&E sector has the most patent activity compared to other sectors with “computer technology”, and “electrical machinery, apparatus and energy” as the two fields that experienced the largest numbers of patent filing in 2013.⁶

This chapter examines how technological innovation impacts the E&E sector in ASEAN and how enterprises and the workforce are impacted as a result. Our findings are based on 73 industry interviews conducted across four ASEAN countries and expert consultations.

2.1.1 The disruptors

Robotics and automation. According to the Boston Consulting Group (BCG), there are four industry groups that will account for 75 per cent of global robot installations in 2025: (1) computers and electronic products; (2) electrical equipment, appliances and components; (3) transport equipment; and (4) machinery. More surprisingly, the BCG indicates that at least 85 per cent of the production tasks in these industries are automatable. It is expected that countries with heavy concentrations of automatable industries, comparably higher labour costs and limited employment protection from job cuts will aggressively implement automation technology. BCG also notes that a country’s motivation to adopt robots is partially influenced by desires to achieve international standards for product quality as has been the case in Indonesia.⁷

The widespread application of robotics in the E&E sector is also being witnessed in China’s Henan province, which is the third largest global mobile phone producer, thanks to the construction of the Foxconn factory. Foxconn’s Zhengzhou factory in Henan produces 70 per cent of all iPhones, employs 300,000 people and pushes out an estimated 200,000 phones per day.⁸ In 2011, the Terry Gou, chief executive officer (CEO) of Foxconn, announced a company-wide plan to replace a significant number of human labour with robots to better manage rising labour costs and unsafe working conditions.⁹ Within five years, Foxconn is reported to have replaced 60,000 human workers with robots in a single factory.¹⁰ While most automation is not as disruptive as the Foxconn example, our research indicates that enterprises in ASEAN are looking into automated solutions to weather continued increases in labour cost.



⁶ WIPO, 2015.

⁷ Sirkin, Zinser and Rose, 2015.

⁸ Epstein, 2013; Chang, 2015.

⁹ The Economist, 2011.

¹⁰ Wakefield, 2016.

“Many enterprises in Malaysia’s electronics manufacturing sector didn’t see a need to invest in productivity-enhancing automated technologies within the short term given such competitive wages. However, the national minimum wage introduced in Malaysia in 2013 provided a greater incentive to invest in precisely those kinds of technologies.”

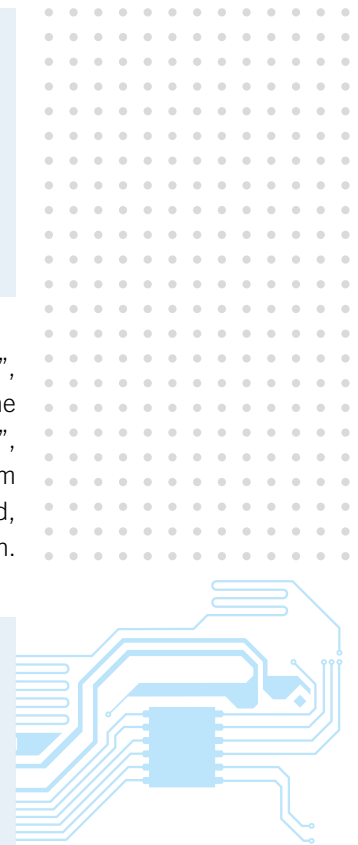
Dato’ Palaniappan, Director, Panasonic Appliances Air-Conditioning, Malaysia

Source: ILO interview, 2015.

Our interviews show that when automation occurs in the E&E sector, it is often “human centric”, also referred to as “autonomation” or semi-automation. This technology – also seen in the automotive sector – aids workers rather than replace them. Collaborative robots, or “cobots”, can be taught to work alongside humans, accomplishing more repetitive and difficult-to-perform processes. This symbiotic relationship may however end as cobots become more sophisticated, but in the meantime, human worker do have advantages in terms of adaptability and perception.

Rethink Robotics, a Boston-based company produces a cobot named Sawyer with a base price of US\$29,000. Sawyer is designed for machine tending, circuit board testing, and other precise, repetitive tasks, specifically those that take place in the middle of a long assembly line of electronics products. There’s a huge need for cobots that can do tasks like these, especially in Asia, and that’s the market Rethink is going after with Sawyer.

Source: Tobe, 2016.



It is important to emphasize that within the E&E sector, current robot deployment consists primarily of low-cost robots, for simple assembly tasks that do not require high precision.¹¹ Our interviewees stressed that for some tasks, particularly those that involve greater product complexity, robotic implementation is still difficult and incorrect implementation can be very costly.

Additive manufacturing (3D printing). This technology is much less prominent in the E&E sector compared to other manufacturing industries. Nano-scale computer parts, such as processors, are difficult to assemble with additive manufacturing, as they require combining several electronic components together and furthermore, numerous components are synthesized from multiple materials. Therefore, mass additive printing (as opposed to additive manufacturing) of integrated electronic components, such as circuit boards, will likely be the next stage in this technology.

As for the swiftness with which 3D printing will disrupt, opinions vary. Some analysts believe that manufacturing will be fundamentally altered in a relatively short period of time. Proponents of this view assert that the traditional approach of manufacturing different components and then assembling them separately would be quickly replaced by printing everything at one specific point. Indeed, reports show that 3D printed circuits will be commercially available by 2018, with 3D-printed electronics becoming more widespread as PCB production solutions.¹²

¹¹ IFR, 2015.

¹² Rasmussen, 2015.

Those who do not believe that 3D printing will have as great an impact cite that the technology will likely be implemented in very low-volume prototyping environments, or deployed to perform unsophisticated tasks (for example, the method by which antennae are added to mobile phones).

Overall, this is a technology that will take time to drive significant change.¹³ There are many hurdles to overcome before 3D printing is fast and cost-effective enough to replace robotic or manual assembly. In ten years, things might start to look different, as multi-material objects may become printable. However, even then, some predict they will be in low-volume batches and limited to customized, complex products. Moreover, deploying 3D printing throughout ASEAN's E&E sector will require a supply of highly skilled workers. Therefore, the disruptive impact of this, especially for ASEAN, is currently up for debate.

“There are still too many significant technological hurdles to overcome before volume 3D electronics manufacturing is either fast or cheap enough to serve as a replacement technology. In ten years things might start to look different with the ability to print multi-material functional objects, but still this will be low volume, customized, complex products. In summary it's [3D printing] a new technology that will take some time to drive any significant change in the ways things are done.”

Simon Fried, Chief Brand Officer and Co-Founder, Nanodimension

Source: ILO interview, 2016.

In any case, 3D printing's future adoption should not be a surprise – there is no dispute about whether it will become prevalent or not. The real debate is when.

2.1.2 Forces at play

“Exports will definitely increase to meet the growing demand coming from different fields. Currently, the demand is coming from consumer application, which will saturate soon and the new demands will come from automotive, renewable and power sectors.”

Arjun Kanthimahanti, Vice President for Technology Development, Silterra, Malaysia

Source: ILO interview, 2016.

The E&E sector is becoming increasingly connected to every economic industry, either directly or indirectly, and advances in these industries' products are driving further activity within E&E. In the case of the automotive sector for example, electronic devices such as power control systems, security devices, advanced safety mechanisms, smart driver assistance technology, diagnostic programmes, information technology and in-car entertainment have

¹³ Ibid.

become indispensable elements of the modern automobile. Because the automotive sector increasingly integrates electronic gadgets into its products, more production is demanded from the E&E sector.¹⁴

“The demands for ICs are expected to grow at a faster pace. Demand for consumer devices might reduce, but regular appliances are turning into smart devices which will drive the market of ICs in the coming years.”

Mulia Ali Akbar, Engineering and Technology Development Manager, PT. Unisem, Indonesia

Source: ILO interview, 2016.

Other sectors are similarly upgrading their products. The garments and footwear sector, for example, offers a huge array of advanced goods, from smart bras that monitor users’ fitness to electronic shoes that provide navigation instructions.¹⁵ Examples from retail include “smart packaging” and new possibilities for interactive advertising.¹⁶ These advances are sure to drive activity – and therefore, employment – in E&E.

Related to this is the rise of the Internet of Things (IoT). The IoT has been identified as one of the most disruptive innovations by numerous reports. For enterprises, the IoT promises to connect objects across the value chain in order to facilitate data collection, data exchange, remote monitoring and better decision-making. It can optimize production processes, enhance workers’ productivity and even reduce global rates of workplace injuries in manufacturing.¹⁷ A critical component of an IoT device is an electronic sensor, and analysts predict that devices connected by electronic sensors will grow from around 10 billion today to as many as 30 billion devices by 2020.¹⁸ Other advancements are triggering the rise of the IoT. These include: the steep decline in the cost of sensors, along with increasing bandwidth and processing speed; big data analytics; and connectivity of smartphones to home appliances and consumer devices.¹⁹

The Internet of Things connects devices such as everyday consumer objects and industrial equipment onto network, enabling information gathering and management of these devices via software to increase efficiency, enable new services, or achieve other health, security or environmental benefits.

Source: Goldman Sachs, 2014.

¹⁴ For example, Ford teamed up with Amazon to connect its cars to sensor-laden smart homes. BMW, Daimler and Volkswagen’s Audi division jointly purchased “Here”, a mapping service to make sure that carmakers have an independent provider and do not depend on Google Maps. General Motors also announced a \$500 million investment in Lyft, a ride-sharing service (The Economist, 2016a). In addition, Apple, which is understood to be planning an electric car, may try to outsource production to a contract manufacturer in order to have the vehicle and its various components made, as it currently does with its iPhones (ibid).

¹⁵ For example, OMSignal (2016) and Lechal (2015).

¹⁶ For example, Evrything (2016) and Ambasna-Jones (2015).

¹⁷ CEA, 2015; Bank of America Lynch, 2015.

¹⁸ IDC, 2014.

¹⁹ Sensor prices have dropped to an average US\$0.60 from US\$1.30 in the past ten years, while bandwidth and processing cost have declined by nearly 40 times and 60 times, respectively, during the same period (Goldman Sachs, 2014).

Research shows that the IoT is expected to create significant opportunities for semiconductor companies, by stimulating demand for sensors, connectivity and memory. The IoT may spur the semiconductor industry to surpass its global annual revenue increase of 3 to 4 per cent over the last decade.²⁰ This represents a direct growth opportunity for semiconductor players in ASEAN who currently dominate global production. Indeed, ASEAN itself is becoming better connected to take advantage the IoT. The ASEAN Smart Network Initiative, has pledged to invest US\$13.6 billion towards building a smart grid infrastructure across the region by 2024.²¹

Overall, as advanced products such as self-driving cars, smart clothing and IoT-integrated consumer devices are introduced, production in E&E will be catalysed, and this will encourage the creation of more innovative products, creating new jobs opportunities. However, assembling these more complex, higher-value products will require higher skill levels.

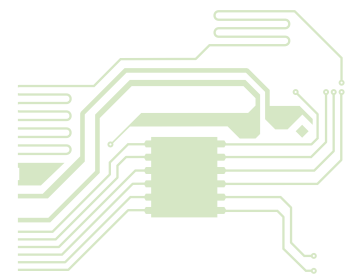
Unfortunately, there is enough evidence to indicate that ASEAN's insufficient investment in education and skills can limit the growth of the E&E sector in the region, particularly for high value added activities.²² The lack of strong human capital development policies, including weak frameworks for both schools and universities, discourage the industry's structural transition from low to high value added activities. For example, in Malaysia, inflows of migrant workers have helped keep wages from rising and helped maintain much of the country's lower skilled assembling and packaging work. However, this policy, coupled with a weaker investment in human capital, has also restricted Malaysia's growth in higher-value activities and constrained technology upgrades.²³

Moreover, opportunities to increase production, and thus employ more workers, may arrive due to China's move up the value chain. As figure 2.4 shows, China currently outpaces ASEAN in terms of E&E exports by a large margin. From white goods to consumer electronics, production increases and market growth over the past 20 years have helped China establish itself as the largest, most developed production ecosystem in the world. In 2014, China's electronics sector contained 34,034 industrial enterprises that produced over 1.6 billion mobile phones and exported a total of US\$859 billion in E&E products.²⁴

“With technology adaptation growing in the Philippines, more and more high-value items are being produced. Japanese manufacturers are also starting to look at [the] Philippines as a viable supplier base.”

Rick Modina, Senior Vice President for Operation, Ionics EMS, Inc., the Philippines

Source: ILO interview, 2016.



²⁰ Bauer, Patel and Veira, 2015.

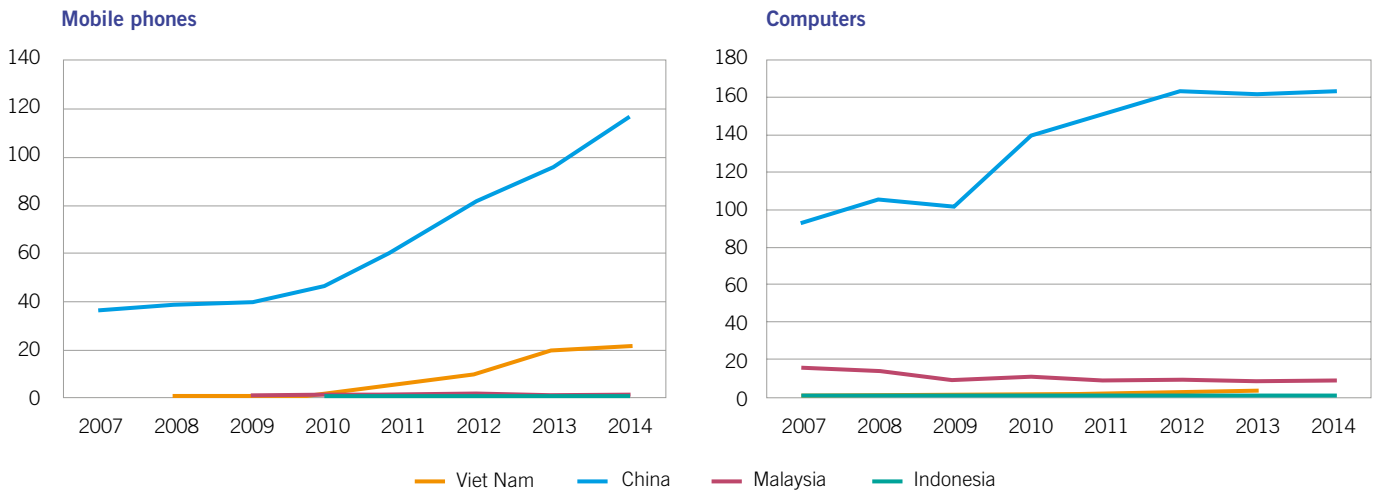
²¹ Glan, 2015. Smart grids apply digital processing and communications to power grids on a large scale, merging data flow and information management with traditional power supply. They also automate key functions of existing grids to make them more efficient and reliable over time. Smart grids are widely seen as an enabler for consumer appliances and industrial machines making up the IoT.

²² Cheong, Selvaratnam and Goh, 2011.

²³ Rasiah, forthcoming.

²⁴ National Bureau of Statistics of China, 2016; ICP, 2016; UNCTAD, 2016. This includes enterprises for the manufacture of electrical machinery and apparatus, and computers, communication and other electrical equipment, as defined by the National Bureau of Statistics of China (2016).

Figure 2.4 Exports of mobile telephones and computers (3C) (current US\$ billions), selected ASEAN countries and China, 2007–2014

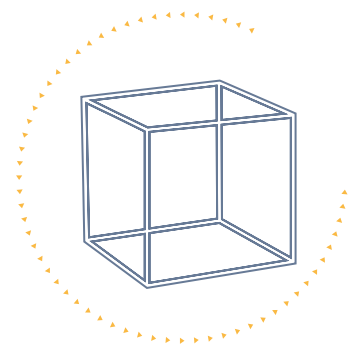


Note: Mobile telephone data were not available for the Philippines. Mobile telephones and computers include those under the SITC, Rev. 3 Divisions 7641 and 7522.

Source: UN Comtrade, 2016.

However, as China moves up the value chain towards higher skilled jobs, opportunities may be provided in the short term for ASEAN’s E&E enterprises. Many analysts and industry leaders have suggested “the end of cheap China” is arriving, and because of this, ASEAN can scoop up the lower skilled work. In the medium term, ASEAN can also invest in sophisticated production processes. Proximity to China in terms of producers, suppliers and their consumer market is a critical opportunity that ASEAN can capitalize on.

There is some evidence of ASEAN positioning itself to tap these opportunities already. Singapore’s R&D budget for 2011–15 increased by 20 per cent over the previous five years, setting the stage for the integration of modern and advanced machinery into its operations.²⁵ Seven of Thailand’s provinces consist of the electrical appliances, electronics and telecommunication cluster, an ecosystem of manufacturers, suppliers, supporting industries, research institutions, academic institutions and public organizations.²⁶ Similarly, in Viet Nam, the Saigon Hi-Tech Park houses major electronics manufacturers such as Intel, Samsung, Canon, LG and Panasonic; these manufacturers are given preferential treatments regarding land leases and taxations. Viet Nam has also instituted stimulus programmes, such as its National Technology Innovation Fund.²⁷ Such ASEAN clusters and financial investments have created a constructive infrastructure that can be further strengthened, contributing to E&E’s growth in the region.



²⁵ Singapore Economic Development Board, 2016.

²⁶ Thailand Board of Investment, 2015b.

²⁷ Viet Nam’s National Technology Innovation Fund provides grants and lends capital to implement scientific and technological projects proposed by enterprises and individuals.

“Ninety-nine per cent of parts for 3C goods can be sourced in Guangdong province, let alone China.”

Former Director, Electronics Hardware and Software MNC, Shanghai, China

Source: ILO interview, 2016.

However, even as ASEAN strengthens its E&E infrastructure, several challenges should simultaneously be recognized.

First, the E&E industry is a high-tech manufacturing sector, and therefore, requires a large amount of capital investment for initial development, resulting in relatively higher entry and exit costs than others like the garment industry. Additionally, E&E’s expensive equipment cannot be easily relocated. Thus, with China’s available skilled labour pool, established E&E ecosystem, and the power of its domestic market, relocation decisions from China will be complex, meaning ASEAN will really need to posture itself attractively if it wishes to attract work from China.

The interviewees from the E&E sector also voiced that poorly executed automation can result in significant losses for the factory. For example, if people are working on an assembly line and a problem occurs, the process can be easily stopped and adjusted. However, if there is a small programming error in a machine, then the whole production run can be ruined, leading to a vast number of defective goods and large amounts of material waste.

Additionally, short product development cycles and product lifespans need to be accounted for. Because many enterprises release a new version in a product series every one to two years (and discontinue old ones), there exists little incentive to invest in automation equipment for specific models. This is particularly the case within the 3C industries. Taking mobile phones as an example, product turnover is so high that the return on investment (ROI) would have to be guaranteed to purchase technology that cannot be reused in newer models. An enterprise must be assured of a long-term gain to implement automation – something difficult to achieve with short product lifespans. With larger, less complex items such as white goods, the levels of automation are higher due to the consistency of the core components. In these cases, automation investment makes more sense.

Electronics assembly is a very intricate process and cannot be mimicked perfectly by full automation. Moreover, human perception, flexibility, dexterity and adaptability to new product rollouts make them preferable over machines for now. As a result, low-cost labour continues to drive ASEAN’s E&E sector currently. Still, infrastructural efforts, such as government incentives and skills upgrading, should be pursued to keep the industry competitive.



2.2 Impact on enterprises

2.2.1 Effects on operations

Incremental technological advancements have not yet reached a tipping point

For the most part, technology advances incrementally, and sectors absorb it at different speeds until a critical point is reached, whereupon significant labour displacement occurs. For E&E, technology is well developed and it is feasible to automate many tasks. However, it is clear, based on interviews with many enterprises, that the cost matrix has not reached a tipping point to elicit wider labour displacement yet. This cost matrix is influenced by factors such as short product lifespans, the difficulties of relocating machines, the risks of large-scale errors from machines and human superiority over robots in assembly processes. Thus, in ASEAN, manual work will likely continue in the short and medium terms. Enterprises should be proactive and prepare for the inevitable tipping point, though.

Goods are increasingly showcasing more electronic capabilities, which will stimulate E&E activity

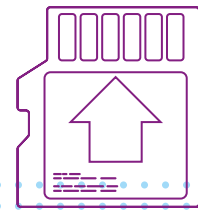
As aforementioned, other sectors are increasingly incorporating advanced technology in their products. With the rise of goods such as wearable devices and the IoT, E&E activity in ASEAN is likely to continue growing, and increased job opportunities can be expected. Enterprises should keep an eye out for new product releases, consumer demands for such products and the associated labour market demand for workers skilled enough in the production of such advanced and complex goods.

2.2.2 Effects on skills

Research respondents responded unanimously: Higher skills will be in demand increasingly. As consumer products and robotics technology for enterprises become more advanced, E&E sectors in ASEAN will need to accommodate higher-value production and higher skilled assembly work.²⁸

In Malaysia, for example, increased automation and demands for knowledge-based activities since the late 1980s have created a capital- and knowledge-intensive E&E sector, with a higher demand for employees with relevant technical skills. However, this demand was not met, and as a result, the sector has suffered a reduction in knowledge-based chip assembly since 2010. Malaysian-based enterprises interviewed in this study emphasized the need for higher skill sets and reported that high-value manufacturing has moved to countries like China and Viet Nam as a result of both a lack of skilled engineers and the relatively high cost of hiring them. As a result, E&E manufacturers in Malaysia today are focused on low-value production and the employment of low-skilled assembly workers.²⁹

In the coming years, we can expect strong technical, engineering, and science fields as well as other skills relevant to manufacturing to become even more sought after as the sector evolves and absorbs new technologies such as the IoT. In addition, there will be an increased demand for management and operational skills relevant to these new sophisticated processes, as they are implemented.



²⁸ A prime example is Viet Nam, where most E&E factories are focused on low-value production and low-skilled assembly work.

²⁹ Malaysia has relied on low-skilled foreign labour for the past 10 years to boost E&E growth. In fact, in 2013, foreign workers accounted for almost 35 per cent of operators in the semiconductors industry in Malaysia (according to unpublished data supplied by the Department of Statistics of Malaysia).

2.3 Impact on people



As the E&E sector continues to expand in the ASEAN region, we can expect the demand for employment in this sector to grow. In the short term, developing and emerging economies will continue to attract investment in lower skill activities such as packaging and assembling; however, in the medium to longer term, these jobs will become automated.

Our research does indeed indicate that occupations in ASEAN's E&E sector are at high risk of being automated. For Indonesia, the Philippines, Thailand and Viet Nam, respectively 63 per cent, 81 per cent, 74 per cent and 75 per cent of salaried workers in the sector face this high risk of automation, as these positions consist of repetitive, non-cognitive tasks.³⁰ It is imperative for the current workforce therefore to be open to skills and capabilities upgrading. Carrying out this recommendation, admittedly, may prove difficult, as the current quality of TVET and of other institutions with similar courses is of concern. In general, we see rote learning, outdated curricula and a lack of certification frameworks. Overall, this culminates into education systems that are unresponsive to a fast-changing sector. Consequently, young people are emerging from institutions without the skills to meet enterprises' changing needs. Technical education in ASEAN must evolve if it is to keep up.

Furthermore, more female students studying STEM subjects and pursuing employment in the E&E sector could help drive creativity and innovation. As mentioned in the automotive and auto parts chapter, the top three subjects that women in ASEAN countries are enrolled in are education, health welfare and the humanities. Science (including engineering) was a male-dominated subject of study in all ASEAN countries except Brunei Darussalam, Malaysia, Myanmar and Thailand.³¹ Although a higher proportion of women may be found in certain disciplines such as pharmacy, medicine and biology, they remain underrepresented in others such as computer science, physics and engineering.³² It is in these last three areas that future employment opportunities are expected to increase. Efforts should be made to make these fields more attractive to all to be able to make the most of the opportunities they present to the future workforce.³³

2.4 Looking ahead



Automation and robotics will increasingly pervade the industry, and low-skilled jobs in assembling and packaging will face risk of displacement

- Automation and robotics are, and will continue to, increase across the E&E sector.
- Incrementally, low-skilled workers will be required less and less as robots become more efficient and advanced. Eventually these workers will encounter the risk of being displaced.

³⁰ Chang and Huynh, 2016.

³¹ But encouragingly, female enrolment in tertiary education was relatively high in Brunei Darussalam, Malaysia, Myanmar, Singapore and Thailand, accounting for more than 50 per cent of average gross enrolment in tertiary education. Notably, Cambodia had the lowest rates of female enrolment in tertiary education (UNESCO-UIS, 2016).

³² UNESCO, 2015.

³³ For example initiatives such as the Higher Engineering Education Alliance Program in Viet Nam are helping update the country's engineering and technical vocational schools (HEEAP, 2016).

- Additive manufacturing or 3D printing could become a major disrupter to the industry, with many predicting wider use by 2025. The implications for employment are large, as the ability to print multi-material objects will streamline production. Nobody disputes 3D printing's future importance to the industry.

Targeted policy focus on education and skills is essential to climb the value chain

- As more factories move to automation and robotics, the availability of higher skilled labour is becoming more important, as it will drive investment decisions.
- Failure by governments in the region to invest sustainably and innovatively in skills and education polices will result in foreign direct investment (FDI) going to other countries.
- When governments have strong, basic infrastructure and bureaucratic coordination, the economy becomes extremely attractive for FDIs seeking low-wage labour. To scale up the value chain, investment is needed in the fields of science and technology in related electronics specializations and frontier research. Science parks (for incubation) and research universities (for basic R&D) are important corollaries to support new generation technologies that can spur new cycles of innovation.
- Competing on price (for example, low wages), has been a useful investment and development strategy. However, it is not a sustainable one. The calculus has changed. Policy-makers need to look through longer development lenses, especially in skills and education.
- Traditionally, education and skills are slow moving policy areas. It can take years to see demonstrable changes in behaviour and outcomes. New ways of thinking and new delivery mechanisms are needed.



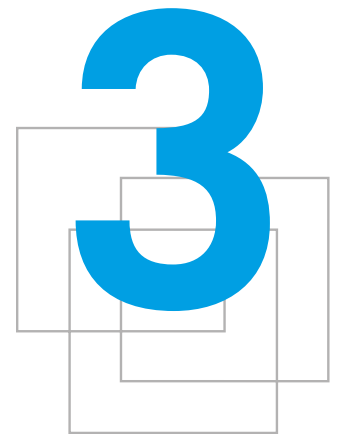
The industry will grow and become more sophisticated with increased employment opportunities

- In the short term, there will be a marked increase in machine-to-machine (M2M) communication, which refers to interactive connectivity and interoperability between machines. M2M will operate across the wider manufacturing sector and in consumer products.
- There will be market growth in new consumer electronic devices, such as wearable technology and increased connectivity between homes, cars and other products. Wider sectoral impacts in healthcare and transport will be observed.
- The interconnectedness between some E&E and other growth sectors in the region, especially the auto sector will accelerate. The automotive industry is seeing a huge level of growth in the amount of electronic input within vehicles.³⁴ The demand for automotive electronics will continue to be a strong driver as demand for vehicles with enhanced performance, comfort, safety and other features increases.



³⁴ Automotive electronics are a subsystem that primarily consists of semiconductor devices. It basically functions in three steps to incorporate different features in the car, in other words sense, compute and actuate. While safety would not be possible without electronics, development of infotainment segments (for example, navigator, in-car multimedia, Bluetooth and Global System for Mobile communication, or GSM) has played a vital role in driving the demand for E&E items.

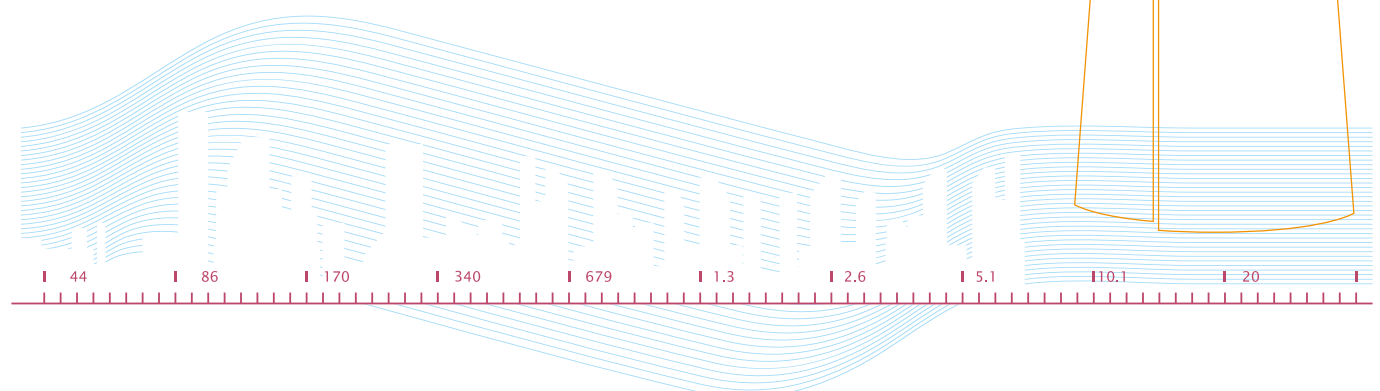
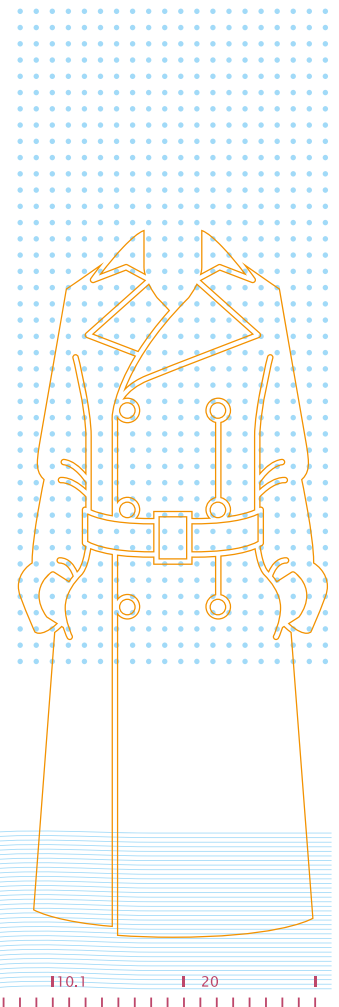
Textiles, clothing and footwear: Refashioning the future



3.1 Sector overview

The textiles, clothing and footwear (TCF) sector is a highly competitive sector predominated by large enterprises (both multinational brands and retailers) that decide what to produce, where to produce them and by whom it is to be produced. Production is easily shifted from one country to another, depending on competitive labour costs, trade agreements and other factors.¹ Characterized as one of the first sectors a country adopts when transitioning to its secondary economic cycle and standing as one of the most labour-intensive industries, this sector is a conduit for transitioning from informal agricultural jobs to formal wage employment.² TCF contributes significantly to poverty alleviation and economic growth for developing regions. The sector, collectively, provides over 9 million jobs in ASEAN, mostly for young women.

Globally, TCF is monopolized by China, which has a dominant market leadership: it accounts for over 31 per cent of global textile exports, 37 per cent of clothing exports and over 39 per cent of footwear exports.³ China aside, a number of ASEAN countries, including Indonesia and Viet Nam, join the world's top rankings for TCF exports. In 2014, Viet Nam made an impressive mark by becoming the world's third largest footwear exporter (world market share: 7.6 per cent) and fifth largest textile and garment exporter.⁴ Figure 3.1 highlights the sector's success in Viet Nam, with export figures adding up to US\$36.9 billion. Cambodia, while not yet a global leader, is also experiencing very high growth in TCF, accounting for over 87 per cent of the country's total manufactured exports in 2014.⁵



¹ ILO, 2014a.

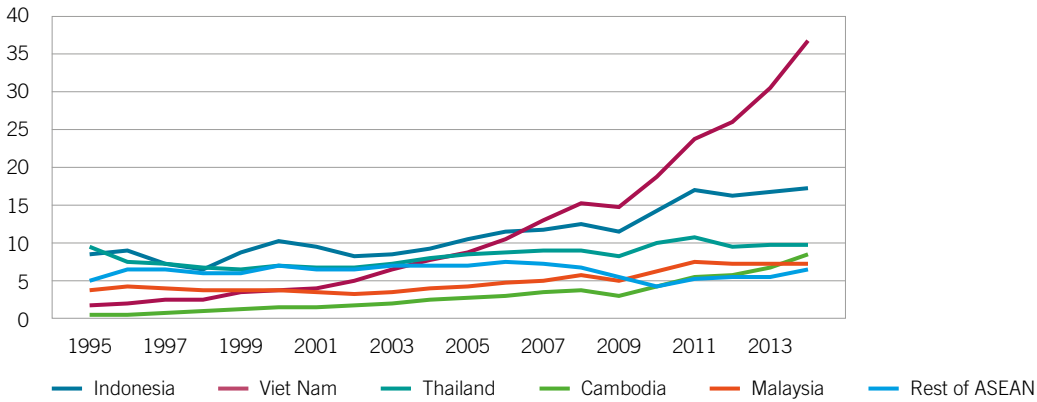
² It is theorized that economies go through three “cycles”, or phases of economic activity: the extraction of raw materials (primary), manufacturing (secondary) and lastly, services (tertiary).

³ UNCTAD, 2016.

⁴ UNCTAD, 2016; VIETRADE, 2014.

⁵ UNCTAD, 2016.

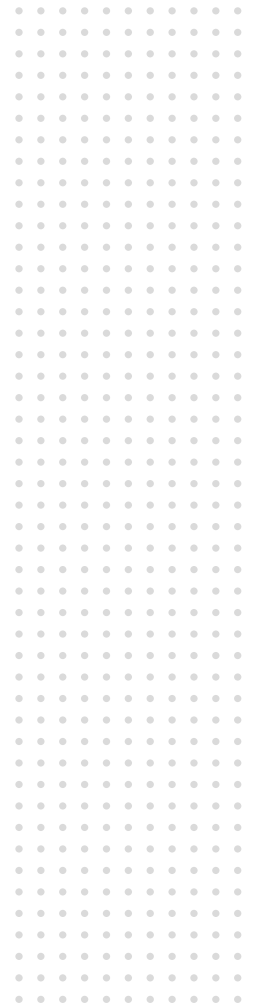
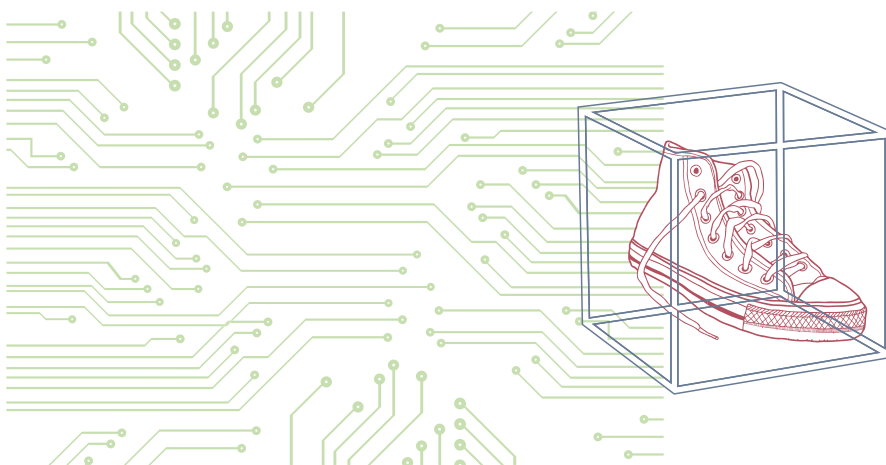
Figure 3.1 Exports of TCF (current US\$ billions), selected ASEAN Member States, 1995–2014



Note: TCF include products under the Standard International Trade Classification (SITC, Rev.4) Divisions 26, 65, 84 and 85.
 Source: UNCTAD, 2016.

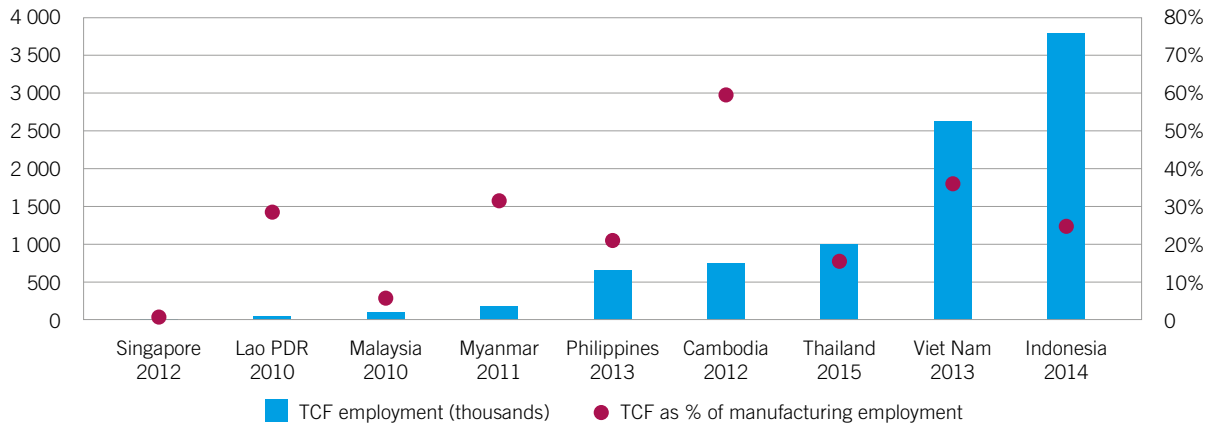
The main markets for ASEAN's TCF exports are Europe and the United States, with notable demand from China and Japan as well. ASEAN's total TCF exports to the United States and Europe accounted for 32 per cent and 22 per cent of total export value in 2014, respectively. The United States was the largest market for Viet Nam's TCF, representing over 39 per cent of the country's export value in 2014.⁶ Around 30 per cent and 22 per cent of Indonesia's TCF exports were to the United States and Europe respectively.

Figure 3.2 illustrates ASEAN's total TCF employment among selected Member States. The sector's total employment in Indonesia was approximately 3.7 million in 2014, accounting for almost 25 per cent of total manufacturing workers. Total employment in the sector in Viet Nam was 2.6 million in 2013, accounting for 36 per cent of total manufacturing employment.⁷ TCF in Cambodia accounted for 749,000 workers and almost 60 per cent of total manufacturing employment in 2012.



⁶ Ibid.
⁷ ILO estimates from official labour force surveys.

Figure 3.2 Total employment in the manufacture of TCF (thousands) and share of total manufacturing employment (per cent), selected ASEAN Member States, latest available year



Note: TCF include products under the International Standard Industrial Classification of All Economic Activities (ISIC, Rev.4) Divisions 13 ('Manufacture of textiles'), 14 ('Manufacture of wearing apparel') and 15 ('Manufacture of leather and related products'). Total manufacturing refers to ISIC, Rev.4, divisions 10-33.

Source: ASEAN, 2015; ILO estimates from official labour force surveys (various years).

Notably, the sector employs a high concentration of women.⁸ Women's share of TCF employment exceeded 70 per cent for five ASEAN countries: the Lao People's Democratic Republic (86 per cent), Cambodia (81 per cent), Thailand (74 per cent), Viet Nam (77 per cent) and the Philippines (71 per cent).⁹ Furthermore, the workforce consists of relatively young people. The average age for six ASEAN countries where the sector has a strong presence is 31.2 years, with Cambodia having the most youthful workforce of 24.5 years.¹⁰ The workforce is also characterized by low productivity and low education levels.

The growth in the ASEAN region's TCF sector can be attributed to a number of factors. Strong competition within this region led to the offshoring of retailers and brands to ASEAN nations.¹¹ Growth will be further fuelled by waves of preferential trade agreements that promote global free trade. The most recent example of such an agreement is the Trans-Pacific Partnership (TPP), which – if passed – will provide Viet Nam with tariff-free access to the United States. Additionally, the ASEAN region's abundant, low-cost, young workforce was especially attractive to the clothing sector, where labour costs comprise over 60 per cent of total production costs in some instances.¹² Moreover, internal changes within China – such as rising labour costs and demographic changes made the country less attractive to certain types of TCF production, thereby compelling companies to relocate their operations to the ASEAN region.¹³

⁸ Industry experts indicate that women are concentrated in junior roles. The majority of senior positions for the sector are held by men.

⁹ Huynh, 2015.

¹⁰ Ibid.

¹¹ Large retailers, for example, are Marks and Spencer, Target and Walmart. Clothing brands that are fashion-oriented for example are H&M, Gap and Zara. Footwear brands include the likes of Adidas, Nike and Reebok.

¹² Gereffi and Memedovic, 2003. Other available research suggests that labour costs can be lower. For example, AT Kearney (2011) indicates that in China, labour consists of about 35 per cent of total cost.

¹³ As young Chinese become better educated and the service sector grows in China, they are seeking alternative jobs rather than the tedium of the factory line. Cut-and-sew operations are the first part of textile production to relocate; they are highly mobile given the simplicity of factories and low capital investment.

Today, the TCF sector is a key segment of overall ASEAN manufacturing. However, most Member States are leaning towards less labour-intensive production and the sector's prominence in overall manufacturing is declining as wages increase, as living standards rise and as businesses move to more productive activities.¹⁴ Recent incidences of political instability could also make the region less attractive for TCF manufacturers. As such, a conscious decision needs to be made by ASEAN governments and stakeholders on whether to maintain the TCF sector as an engine for growth or to seek opportunities in other sectors.

This chapter examines the regional and global changes in technology impacting TCF in ASEAN. The findings are based on expert commentaries, interviews with 55 industry leaders in the TCF sector and eight company site visits.¹⁵

3.1.1 The disruptors

Product customization technology: additive manufacturing, body scanners and computer-aided design (CAD). We expect these technologies to play an increasingly dominant role in the TCF industry in the years to come. Consumers nowadays are not only fashion conscious, but also increasingly looking for the perfect fit. Increasingly, they are buying customized clothing items.¹⁶ This trend is further propelled by higher consumer purchasing power, especially in primary export markets to which ASEAN nations deliver goods and services.

3D printing and robotic technology “will help us set the scene for large-scale commercial production so each consumer can locally get what they want, when they want it, faster than ever.” Speedfactory was set-up “to propel a network of automated production, which brings cutting-edge technology to cities around the world.”

Gerd Manz, Vice President of Technology Innovation for Adidas

Source: Sport Techie, 2015.

While online retail currently offers some level of apparel customization, the footwear sector in particular is experiencing especially greater levels due to recent advancements in 3D printing and additive manufacturing.¹⁷ German sportswear manufacturer, Adidas presents a case-in-point.¹⁸ Adidas predominantly sources from the ASEAN region: collectively, Cambodia, Indonesia, the Philippines and Viet Nam represent 55 per cent of the company's overall source market.¹⁹ In 2016, Adidas successfully tested a fully automated shoe factory (also known as

¹⁴ Myanmar would be an exception to this trend. As an economy starting to grow and offering lowest labour costs in ASEAN, Myanmar could see large growth.

¹⁵ The interviews were conducted in the first quarter of 2016.

¹⁶ For example, custom suits made to fit the client's body shape and athletic shoes that provide optimal fit and support.

¹⁷ This refers to the machining process that lays out thin layers of materials to build three-dimensional products in the exact form of a digital model. In the case of footwear, the accurate 3D measurement of the customer's feet is combined with height, weight and activities they engage.

¹⁸ Adidas is a German MNE designing and manufacturing sports shoes, clothing and accessories. It is the largest sportswear manufacturer in Europe and the second biggest in the world.

¹⁹ Adidas, 2015.



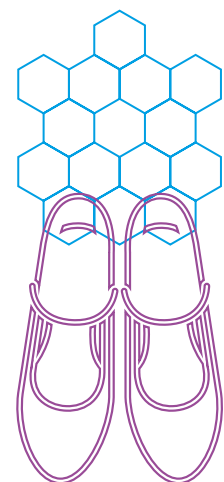
“Speedfactory”) using 3D technology and robotics in Germany. Adidas plans to open the second Speedfactory in the United States in 2017.²⁰ Speedfactory is part of Adidas’ efforts to individualize sportswear, to be able to react quicker to consumer needs by bringing manufacturing closer to its clients and speeding up delivery.²¹ While time will tell if Speedfactory is successful, the positive impact that this model will have on profitability could prompt other footwear companies to follow in Adidas’s footsteps.

The clothing sector has also been able to capitalize on CAD for pattern making, body scanning for measurements and digital printing to achieve accurate and rapid production.²² Body scanning is an especially attractive technology, as it customizes clothes in ways that Internet ordering and off-the-shelf purchases cannot accomplish. Body scanning will only become more commonplace.

For instance, Brooks Brothers, an early industry adopter of body scanners, indicates that their costs declined by 60 per cent from 2001 to 2010.²³ The efficiency and continuous cost reductions of this technology will fundamentally shift production models and supply chains. Body scanning, combined with rapid production processes, will permit manufacturing centres to move closer to major markets, making next day delivery possible for consumers. Because of this potential to please consumers in ways previously not possible, big players are re-evaluating their supply chains to cope with faster product design, personalization and production cycles.²⁴ ASEAN factories utilized by the current off-shored supplier model may be increasingly less needed.

Brooks Brothers introduced customized suits using body-scanning machines at their New York retail store in 2001. Using 16 sensors, the body scanner produces 600,000 to 700,000 data points accurate to two-tenths of a millimetre. Brooks Brothers continues to work with large electronic companies like Intel to improve accuracy and perfect the made to measure experience to improve customer satisfaction.

Source: Crease, 2010; Intel, 2016.



²⁰ Meyer, 2016.

²¹ Reuters, 2015.

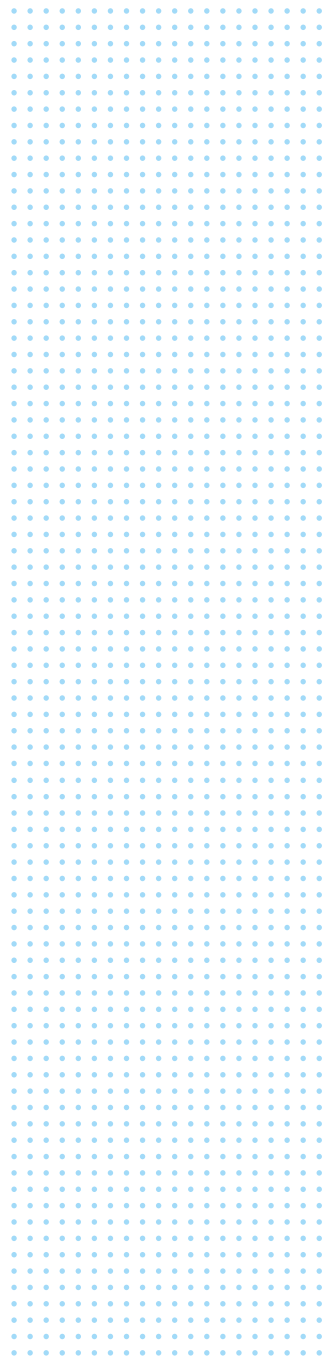
²² Bhatia and Asai, 2007.

²³ Crease, 2010.

²⁴ Kaltenbrunner, 2014.

Wearable technology, nanotechnology and more sustainable, environmentally friendly manufacturing techniques. Advancements in these technologies are taking TCF to new frontiers. Smart clothes now integrate medical, fitness and wellness features that monitor heart rate, calories burned and other biometric data. Indeed, market experts predict that the wearable electronics business will increase from US\$20 billion in 2015 to US\$70 billion in 2025.²⁵ Furthermore, the textile industry is now enhancing consumer experiences by applying nanotechnology to clothes. Nanoparticles that can render clothing odour-free, waterproof, UV-blocking or antistatic are some of the newer developments.²⁶ In addition, consumer and enterprise consciousness over environmental sustainability and zero-waste products is increasing. TCF is well known for its high consumption of material, water and energy to produce, pack and ship merchandise across the globe: The cotton required for a single t-shirt consumes up to 2,700 litres of water; dyeing and printing requires vast amounts of water and chemicals and releases volatile agents; and footwear manufacturing uses difficult-to-recycle, petroleum-based material and hazardous chemicals.²⁷

Advances have been made to reduce such waste, with knit technology being an exemplary case. First pioneered by Nike (“Flyknit”) and Adidas (“Primeknit”) in 2012, the computer-controlled knitted technology enables a shoe piece to be produced using a single thread.²⁸ It relies on precise yarn measurement rather than cut-and-glued bulk materials. Reportedly, Nike’s Flyknit running shoe is made with 80 per cent less waste than the typical Nike design.²⁹ If this becomes widespread, knit technology will quickly reduce material, labour and overheads. Like 3D printing, efficient zero-waste production allows manufacturing to be localized, cutting global shipping time and increasing production for knitted footwear in strategic markets.³⁰



“What’s different about the Water<Less collection is that we’re still using the same materials and techniques to create finishes for our jeans but we’ve substantially reduced water’s role in the equation.”

Carl Chiara, Director of Brand Concepts and Special Projects, Levi’s

Source: GreenBiz, 2010.

Other green manufacturing efforts relate to integrating biodegradable materials, non-harmful chemicals and water-saving processes during production. Overall, these trends will demand that manufacturers equip their facilities with technologies to improve efficiency and compliance. This will, in turn, create a demand for skilled operators, engineers and others with relevant skills.



²⁵ Harrop et al., 2015.
²⁶ NANOBusiness, 2015.
²⁷ WWF, 2013.
²⁸ The price for knit technology varies from US\$5,000 to US\$18,000 for small-scale production that knits the shoes upper (Alibaba, 2016).
²⁹ Nike, 2013.
³⁰ Tsui, 2014.

Computerized TCF manufacturing processes, namely automated cutting machines and sewbots. Automation is also disrupting the sector. In clothing and footwear, automated cutting machines are increasingly prevalent across ASEAN's factories. Hung Wah Garment Manufacturing (Cambodia) reported that its automated garment machines eliminated manual labour from the cutting process.³¹ Adidas (Indonesia) also mentioned automated cutting as a key innovation strategy, and targets are set to lower manual cutting down to 30 per cent. In addition to increasing productivity through reduced time and labour input, automated cutting “deskills” the task, as manual cutters – who are considered relatively higher skilled workers at factories – are no longer needed. With automated cutting, only non-trained operators are required and there is a reduced need for higher skilled workers.³² Other examples of improved productivity through automated cutting have been cited in factories within Myanmar, a country currently looking into the TCF sector as a first step to climb the development ladder.³³

When it comes to sewing, numerous reports from 2015 highlight the entire configuration of apparel manufacturing could potentially be redefined through what are known as “sewbots”. In 2015, Softwear Automation Inc. launched LOWRY, a robot built with machine vision and computing technologies that automates fabric handling.³⁴ Working in parallel with LOWRY, Softwear Automation will introduce an automated sewing machine (ASM) that can run on a continuous basis without a human operator by the end of 2016. Innovative sewing technologies are transforming apparel production techniques in ways that once seemed impossible – sewing robots are automating the more difficult and labour-intensive tasks in garment making.

“Our machines can run 24 hours straight – which is much longer than a traditional shift by a sewer.... Additionally, the precision is much greater so there is less wasted product.”

KP Reddy, CEO, Softwear Automation

Source: Barrie, 2015.

The deployment of sewbots could be disruptive. Besides labour costs, offshoring also entails costs in terms of shipping, duty and reputational risks. If the total cost of using sewbots proves to be more economical than offshoring, a strong case can be made for reshoring garment production to places like California (the most populous state in the United States) rather than Ho Chi Minh City, Viet Nam.³⁵ Given the additional benefits of sewbots, which include reduced human error, increased workplace safety, consistent quality and stability in output quantity, industry followers are cautioning that sewbots will “throw garment workers in low-cost countries out of a job.”³⁶ Sewbots could usher in large-scale retrenchments across the ASEAN region.

³¹ Hung Wah supplies for brands such as H&M, Adidas, A&F, among others. Cutting is a garment manufacturing operation that can be fully automated (Byrne, 1995).

³² Tukatech, automated fabric cutting machine (Tukatech, 2016).

³³ Kyaw, 2016.

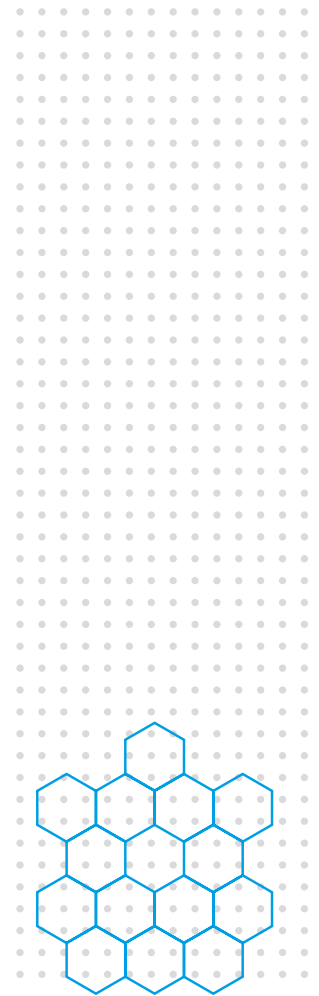
³⁴ Softwear Automation, 2016.

³⁵ Large brands and retailers are sometimes associated with malpractices in their supply chain with regards to unfavourable working conditions.

³⁶ The Economist, 2015.

To better understand the disruptive nature of sewbots, we experimented with a couple of scenarios in three countries – China, Thailand and the United States – to determine if and when sewbots will become a profitable investment for apparel manufacturers.³⁷

In the United States, clear results were immediately apparent after investments in 2016. In fact, by the end of five years of a machine’s life, a saving of more than US\$180,000 can be realized by replacing three sewers in the United States with a pair of sewbots. Moreover, if purchases are delayed until 2020, sewbots could be more than four times cheaper than their human counterparts.³⁸ Further investigations need to be conducted to ascertain if the final cost of using sewbots would have a positive impact on the bottom line of US brands and retailers vis-a-vis offshoring as labour in the ASEAN region could still be a more cost-effective option, given the considerably lower wages.³⁹ However, apparel production involves more than just sewing; it also includes the textile business, an industry that is reviving in the United States thanks to modern technology and an extensive material base.⁴⁰ Again, the sector’s competitiveness lies in its being able to deliver to consumers on time – a key benefit attached to sewbots.



Parkdale is a US cotton-spinning mill that closed down in the 1990s and re-opened in 2010. There is a fundamental difference in the company’s production after its revival: The factory produces 1.1 tonnes of yarn per week with 140 employees. That same production would have required over 2,000 people in 1980. Large-scale automation has been the key to the mill’s revival.

“With all the challenges that we’ve had with cheap imports, we knew in order to survive we’d have to take technology as far as we could.”

Anderson Warlick, CEO, Parkdale.

Source: Clifford, 2013.

In both China and Thailand, sewbots are likely to be more economical if investments are made after 2020. Our estimates show that human labour can be up to 50 per cent more expensive than sewbots in China, and a break-even point could be reached in Thailand by 2025 (see figure 3.3).

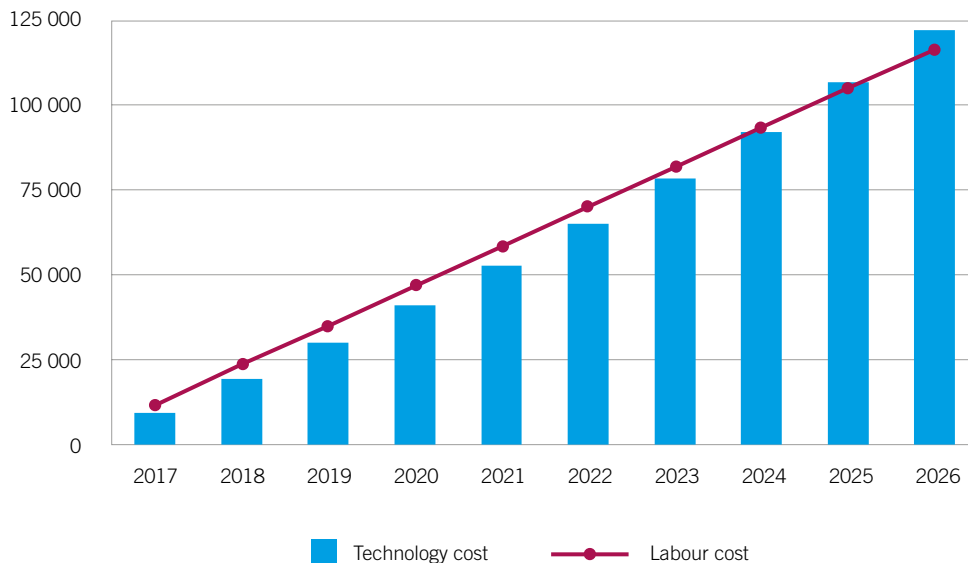
³⁷ China was chosen for the exercise because it remains the largest exporter for the TCF sector to developed economies. In addition, China has its own internal consumer base, which is by far the largest in the world and expanding. China’s average nominal monthly wages were US\$491 in 2013 (ILO, 2015). Thailand was selected for the exercise as it is considered the most advanced TCF economy in ASEAN. Thailand’s average nominal monthly wages (US\$277 in 2013) and labour productivity (US\$8,178) are the highest for manufacturing TCF in ASEAN (ILO, 2015). United States was selected for the exercise due to its predominant position as the largest export market for ASEAN’s TCF sector. The federal minimum wage per hour is US\$7.25 in 2016 and the monthly minimum wage is calculated based on an eight-hour workday (USDOL, 2016). The exercise assumes that LOWRY and ASM replace three workers considering that each sewer has an eight-hour shift.

³⁸ We assume that technology will become cheaper and estimate a 5 per cent annual price reduction for sewbots.

³⁹ For example, average apparel manufacturing labour costs in Cambodia are only 12 per cent of the United States.

⁴⁰ Clifford, 2013.

Figure 3.3 Estimated cumulative technology costs of LOWRY and ASM and real wage costs of three sewing machine operators (US\$), Thailand, 2017–2026



Note: Estimated technology costs of sewbots are based on 2016 prices for two units (US\$90,000) with equal yearly installments at an annual interest rate of 5 per cent. Projected wage costs are based on average nominal monthly wages of three sewing machine operators in Thailand in 2015 (US\$706.8), adjusted by historical inflation and real wage growth trends.

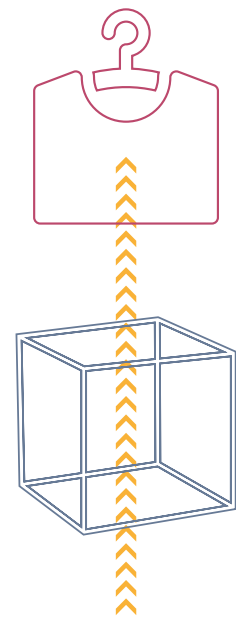
Source: Authors' estimates.

The key concern here is not in fact over ASEAN countries using sewbots, which is considered a longer-term possibility, but over sewbots entering the factory floors of China – ASEAN's largest competitor for apparel exports as well as an increasingly important export destination. The estimates sketch a favourable and tempting scenario for Chinese apparel factories to purchase sewbots. These purchases could enable the country to maintain, and even raise, its dominance in TCF manufacturing. China already exports more apparel with less workers and shows a huge appetite for robotics, consuming 25 per cent of the world's robots in 2014 and with determination for more.⁴¹ As such, China's decision to automate sewing and replace other labour-intensive processes with technology will impact ASEAN's apparel factories, which may no longer be able to compete with China whether they are "making for the world" or "making for China".

3.1.2 Forces at play

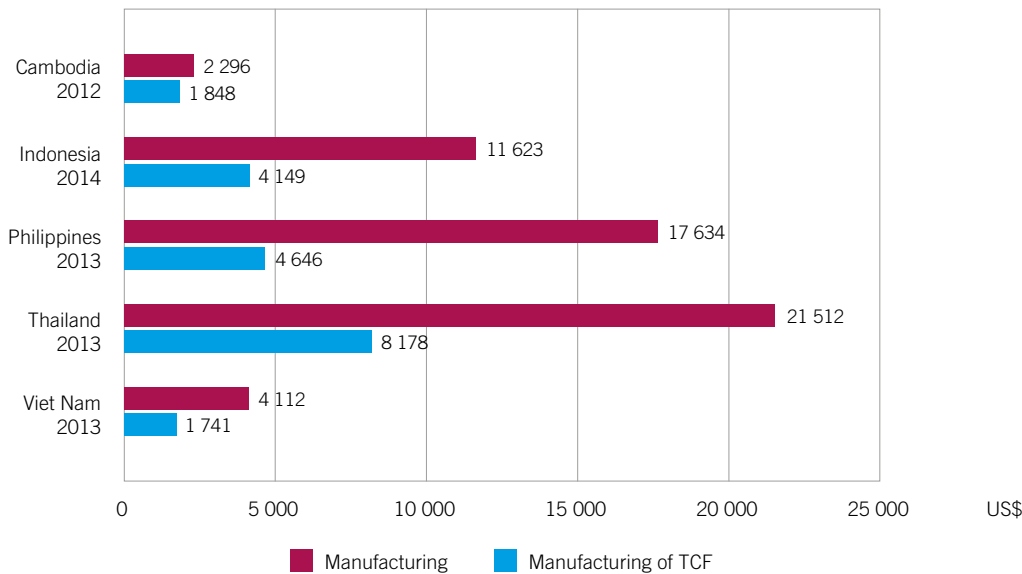
Technology transfer is made to increase labour productivity, product quality and reduce waste

Overall, the data show that major productivity gains can be made in ASEAN's TCF sector through the implementation of technology. Across the region, productivity gaps between TCF manufacturing and overall manufacturing remain wide (see figure 3.4). Take the Philippines and Thailand, for example, where labour productivity in overall manufacturing is, respectively, 3.5 times and 2.7 times greater than in the TCF sector. Differences within major TCF economies are also large. For example, Viet Nam's labour productivity for the TCF sector is alarmingly low – only 20 per cent of Thailand's.



⁴¹ IFR, 2015.

Figure 3.4 Labour productivity in the TCF sector and manufacturing for selected ASEAN countries (current US\$), latest year



Source: Huynh, 2015.

Outdated technology and a lack of machine maintenance have long held back ASEAN's TCF productivity. Indonesia's Ministry of Industry estimates that 70 per cent of all machinery in use is outdated (on average between 10 to 25 years old).⁴² Viet Nam's TCF sector also struggles with old technology. Moreover, the low skills upon which many ASEAN countries rely limits overall productivity.⁴³ These factors must be addressed going forward, even as other forces at play are threatening ASEAN's TCF industries. The lack of local development in R&D and upgrading technologies may put the region in a challenging position, especially as other TCF players continually improve their processes.

Our research shows that innovation in TCF has largely been driven by major brands and transnational manufacturers investing targeted proportions of their returns in R&D. For example, in 2015, Adidas invested around 0.8 per cent of net sales in R&D (around 139 million euros).⁴⁴ Nike, while it does not publicly disclose R&D information, was included in the world's top 50 innovative companies in 2015, indicating heavy R&D investment.⁴⁵ Esquel, a transnational apparel manufacturing company is also known for investing millions in R&D, recruiting top-level engineers and making technology key to competitiveness.

While TCF industry leaders who source from ASEAN countries are spending millions on R&D and are continuously introducing new and transformative technologies, adoption of global innovations appears to be somewhat limited in the region's factories due to constraints in skills and economics, as the region largely trades on low-cost labour. However global brands and transnational manufacturers who source or produce in the region are integrating incremental technological processes to improve efficiency and increase compliance with vendor requirements to meet product quality and environmental sustainability standards.

⁴² GBG, 2012.

⁴³ Vietnam Chamber of Commerce and Industry, 2016.

⁴⁴ Adidas, 2016.

⁴⁵ Nike's R&D ranking was retrieved from BCG (2015).

China matters: The big giant may accelerate automation

China remains the global giant for TCF, and its actions will influence ASEAN's TCF competitiveness. Despite the region's growing stature within TCF production and its lower wages, there are still a number of critical areas that makes China much more competitive.

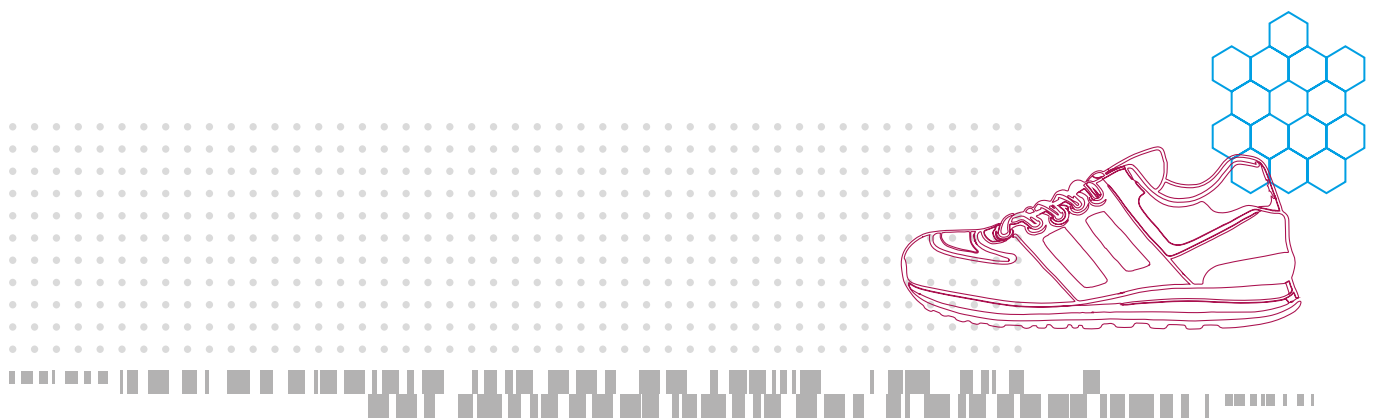
First, China's extensive material base is unrivalled in Asia. Other countries in ASEAN simply cannot provide the full vertical supply chain that China offers. Second, China has a long history of manufacturing and of extensively investing in highly efficient and specialized ports, roads, bridges and services to support the movement of goods. Third, lower wages in ASEAN are not only offset by inferior infrastructure, but also worker productivity. Interviewees stressed that Chinese workers are higher skilled and more experienced.⁴⁶ Additionally, the major focus in China's TCF sector has been to sustain competitiveness through investment, individual training and lead-time reduction.

"If you look at top European machinery suppliers, may be 80 per cent of sales are to China. There is a huge investment in this sector to help textile suppliers improve their efficiency and quality. So the textile side is no longer considered labour intensive."

John Cheh, CEO, Esquel Group

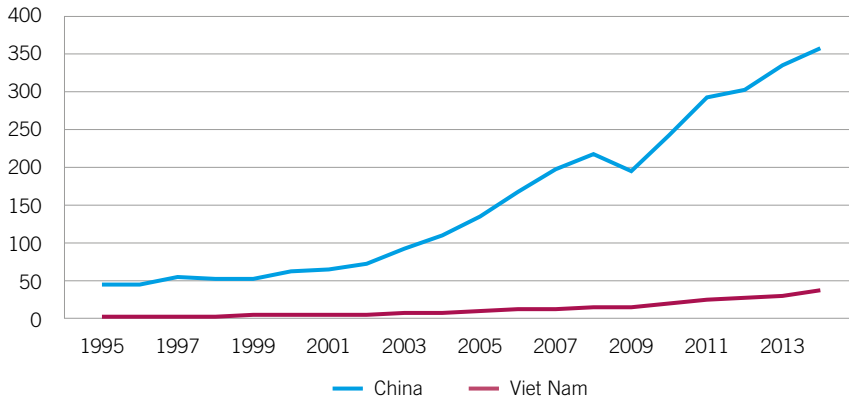
Source: Fangqing, 2015.

Figure 3.5 compares China's exports with Viet Nam, ASEAN's leader in clothing and textile exports. Clearly, China has a powerful grip on the TCF sector. Moreover, statistics show that China has been able to increase exports despite the declining number of workers employed in the TCF sector since 2008 (see figure 3.6). While numerous factors can be attributed to this trend (such as an enhanced ability to produce higher-value products and a better trained workforce), a growing number of TCF manufacturers have cited technology as their new engine of growth.



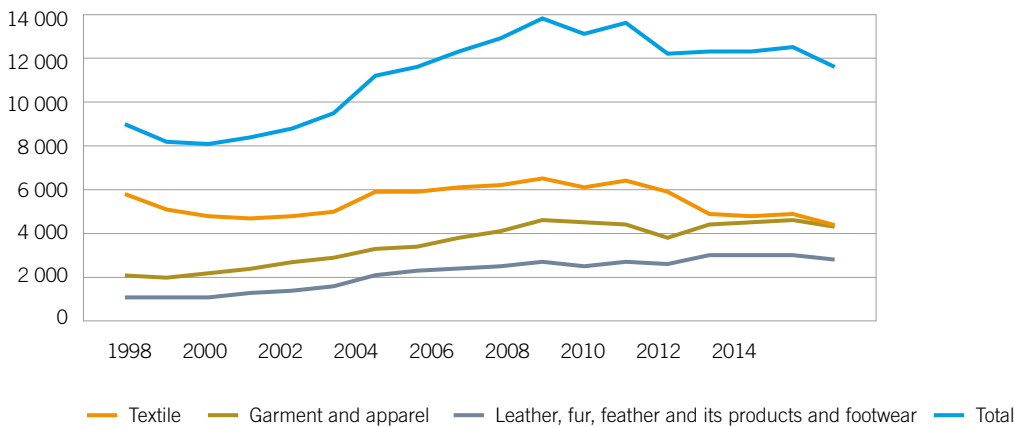
⁴⁶ Note that there is lack of reliable labour productivity data for China's TCF sector that could be directly compared to ASEAN countries.

Figure 3.5 Export value of TCF products (current US\$ billions), China and Viet Nam, 1995–2014



Note: TCF include products under the SITC, Rev.3, Divisions 26, 65, 84 and 85.
 Source: UNCTAD, 2016.

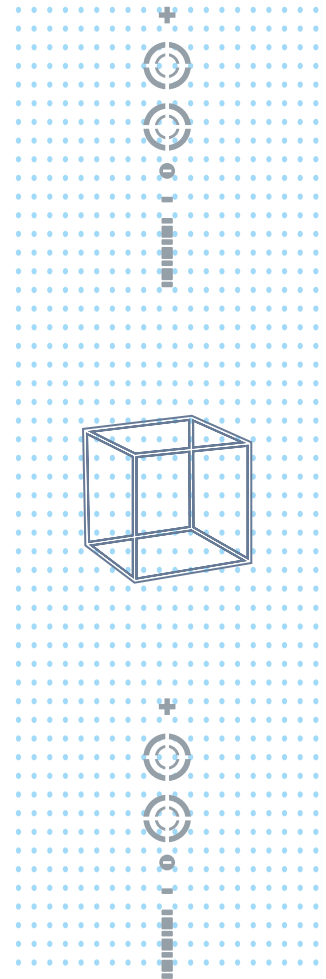
Figure 3.6 Employment in the apparel sector and subsector (thousands), China, 1998–2015



Note: Employment in the apparel sector and subsectors refers to the number of people employed in urban units.
 Source: National Bureau of Statistics of China, 2016.

Thus, the major force at play here is not that China is a TCF leader; it is the fact that China is aggressively trying to improve its competitiveness, with technology forming a critical component of this effort. One Chinese company reports that it developed a digital printer with an investment of US\$500,000 that can print 30 metres of cloth in one minute. The printer reduced the number of workers from eight to three and allowed sales of US\$161 million to be achieved with a maximum 300 workers – roughly 20 times more productivity per capita.⁴⁷ If other companies in China make similar investments, particularly through sewbots, the ASEAN region’s apparel makers will be heavily impacted. ASEAN will need to rigorously follow China’s movements and continually evaluate how the region should use TCF as a vehicle for growth.

⁴⁷ Middlehurst, 2015.



TCF manufacturers can still chase cheaper needle

Moreover, increasing labour costs in the region reduce the appeal of apparel manufacturing in ASEAN. Interviewees stated that their factories are considering strategies to reduce dependence on human labour through new machinery. At the same time, they also expressed that financial and resource constraints were making it challenging for them to incorporate technology.

Therefore, if labour costs become too high in ASEAN, this could trigger transnational apparel manufacturers to move out of the region in search of new low-cost production sites. While it is difficult to strike the right balance for sourcing locations because criteria such as cost, quality, compliance, speed, productivity and risks need careful measurement, some industry leaders – albeit with mixed opinions – are suggesting expanding into Africa. The continent is seen to have the ingredient that can make it a global force in apparel exports – abundant, low-cost labour – as well as natural resources like cotton, water, energy and land.⁴⁸ As aforementioned, raw material supply is considered to be one of ASEAN’s core weaknesses. For instance, in 2013, Viet Nam’s domestic cotton production satisfied only 1 per cent of the industry.⁴⁹ However, Africa comes with its share of challenges, such as poor infrastructure, corruption and red tape. If movements to Africa gathers pace, through government policy to attract investment, build regional value chains and continent-wide free trade agreements, ASEAN could lose its competitiveness and its TCF industry would diminish.

Rather than shifting to Africa to take advantage of lower labour costs, the future will be driven by innovative technology such as 3D printing, which Puma is already using for prototype shoes.

Source: Thomasson, 2014.

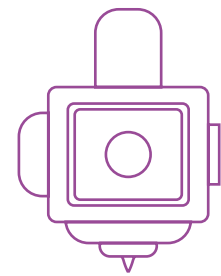
Mass customization coming at a grand scale

Advances in mass customization technology could also make ASEAN’s factories redundant. Currently, body-scanning technology is limited to upper mid-range products for which consumers pay a premium. What is yet to come is mass customization offered by large retailers

“Custom-made clothing is going to be a big thing. Consumers will be able to scan their own body at home and send a scan to their favourite brand and make custom clothing from it. This I definitely see happening by 2030.”

Roger Lee, CEO, TAL Apparel Group

Source: Just-style, 2014.

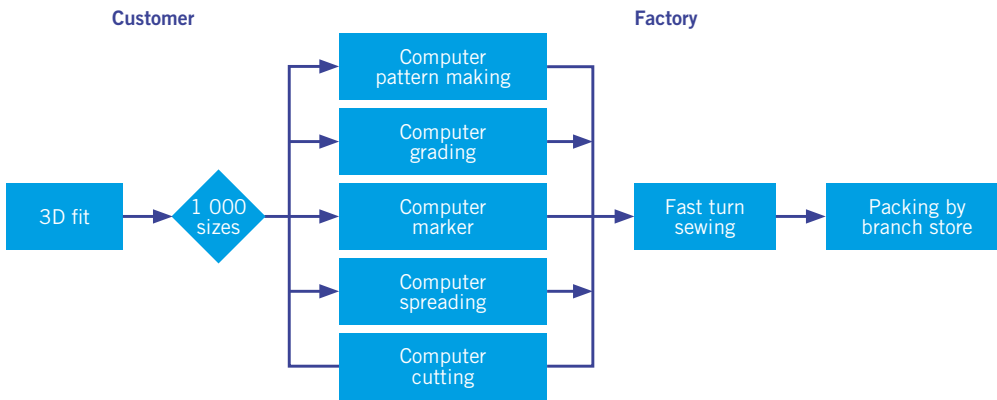


⁴⁸ Just-style, 2016.

⁴⁹ EOS intelligence, 2015.

such as Wal-Mart, Tesco or Carrefour at no additional cost. However, the technology to make large-scale retail customization a reality exists.⁵⁰ Once a cost-effective combination of technologies is achieved for 3D body scanners, and computerizations in pattern making, size grading, spreading, cutting, and packing, along with fast-turn sewing, and localized production, the time between consumer purchase and delivery will be drastically reduced, offering enormous efficiency.

Figure 3.7 Flow chart for mass customization



Source: ILO, 2016c.

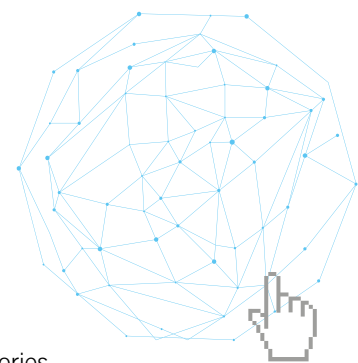
In order to remain relevant in this scenario, ASEAN factories will need to quickly upgrade technology and team up with retailers and brands that have a bigger consumer base in the region, since localized production (intra-regional trade) is a precondition to mass customization success. At the same time, export flows from ASEAN towards Europe and the United States will decline if these technologies trigger nearshoring or reshoring. Ultimately, mass customization could considerably impact the sector’s prominence in ASEAN – the number of TCF factories and people employed will decline unless sales (or production demand) within ASEAN is sufficient to recover anticipated export losses.

3.2 Impact on enterprises

3.2.1 Effects on operations

Technology-rich production can become widespread across the ASEAN region but today there are noted differences in adoption

Our fieldwork shows mixed results regarding technology upgrading in the region’s TCF factories. While respondents agree that technology enhances operations at all levels, expensive capital investments may prove to be unprofitable, especially because the sector generates thin profit margins. A long-term agreement would have to be made with buyers purchasing large quantities of stock. The fieldwork also reveals insufficient skills to manage advanced technology. Some interviewees stressed that factories could not adopt automation because they did not have adequate workers who could operate and maintain new machinery.



⁵⁰ Based on commentaries provided to the ILO by industry leaders.

Despite these constraints, ASEAN's suppliers need to keep in mind both the export market and domestic market. Consumers are becoming more sophisticated with their apparel selection. With this comes a vendor requirement that is ever more demanding. Embracing technology is one way companies in the ASEAN region can maintain a competitive position and produce higher-end apparel. Such movement was noted in Thailand, which is considered the higher-end producer in ASEAN: ECCO (Thailand) shared that they are introducing new technology to make shoes that have quick drying features suitable for European countries.⁵¹

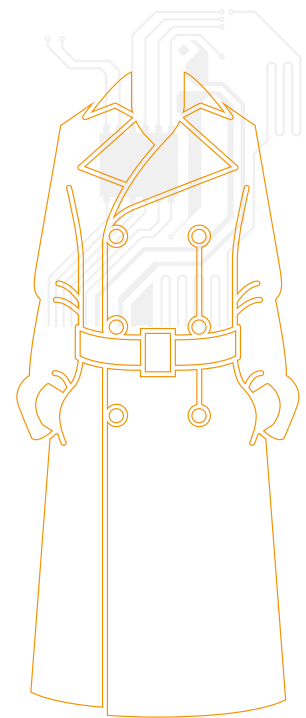
Localized production in major markets and heightened need to target domestic consumption

As aforementioned, 3D printing, body scanning and sewbots help bring manufacturing closer to markets and to a great extent, sever the link between production costs and wages.⁵² How can the ASEAN region's apparel factories prepare for the forthcoming changes? One strategy would be to reduce dependence on exports and to focus on local and regional markets. Domestic consumption and disposable income from a young, fashion-oriented population is growing in the region. In Indonesia alone, the consumer class is growing by 5 million every year – nearly equivalent to Singapore's population.⁵³

“In our 2015 benchmarking study, 53 per cent of members said they source from the United States. Meanwhile, 39 per cent of members expect to increase sourcing from the US in the next two years, with 80 per cent of those already sourcing from the US expecting to do more...There is an interest in making it [apparel] in America especially when it comes to “smart” apparel and accessories and technical textiles, as well as samples and products that need to hit the market immediately.”

Julia Hughes, President, United States Fashion Industry Association

Source: Barrie, 2016.



A number of surveys also highlight a key advantage upon which ASEAN's manufacturers could reap: strong consumer preference to buy local brands.⁵⁴ However, our research shows that most local apparel suppliers do not have their own brands. Rather, they simply fill orders from outside buyers. Overall, ASEAN's apparel makers can weather forthcoming changes in global apparel manufacturing by serving domestic and regional markets. In doing so, they need to track the changing lifestyles of ASEAN consumers and produce apparel that meets their needs.



⁵¹ ECCO provides comfort footwear for men, women and children. ECCO Thailand has been operating for more than 20 years.
⁵² This happens either through reshoring or nearshoring. There is already growing evidence of nearshoring – the movement of production to lower cost countries closer to market. Expansion in areas such as Central America for the US market and Turkey and Portugal for the European market is developing and a trend observed by a number of actors. One enterprise interviewed is seeing the fastest level of growth in Turkey and Portugal. The advantage is their proximity to market and reduced lead time.
⁵³ McKinsey and Company, 2013b.
⁵⁴ Ibid.

3.2.2 Effects on skills

Technology means both deskilling and upskilling of operations

There is a dearth of technicians and engineers who can operate, service and maintain new TCF technologies. As commented by an interviewee who has served the industry for more than 30 years, “the almost complete lack of qualified garment and textile industry engineers and the fact that ASEAN does not have a single qualified tertiary engineering institution is a sad reality, especially for a region that is dependent on apparel exports”.

In the immediate term, industry experts stress that better skilled production line workers are needed. In addition, skilled engineers are required not just from a simple line efficiency perspective, but also from a holistic sustainability perspective. As demands to be efficient, from both labour and environment perspectives increase, qualified personnel are needed to guide these required changes.

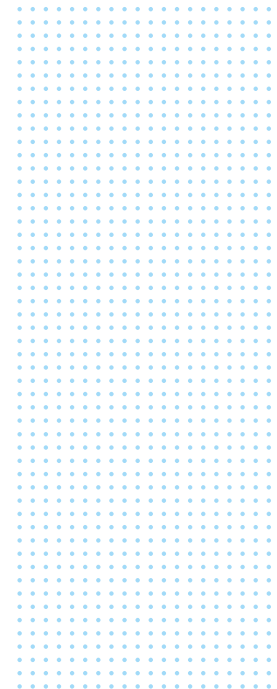
Modern technology such as automated cutting and CAD will increase the demand for skilled workers knowledgeable in operating new machines and in computer software. To produce higher value products that meet heightened consumer demands from export markets, ASEAN’s TCF makers will need to work more closely with other sectors such as electronics, material science and medical science.

Higher education outcomes set the young ASEAN generation apart from previous ones, especially the increasing proportion of ASEAN women in tertiary education. Given this trend, the TCF sector is unlikely to attract better-educated female workers. Indeed, an ILO student survey confirms that female students desire to work in human health or social work rather than in manufacturing. While the apparel sector provides an income stream for many young female workers in the region, as stressed by one interviewee, “as soon as they have an option, they will not choose to be in an apparel factory”. In more advanced ASEAN countries such as Thailand, apparel employers are already flagging challenges in filling factory lines and are considering technology as an alternative.

Manufacturers are deskilling operations through automation, achieving the same production with fewer workers. Deskilling manufacturing is also critical to achieve better quality and to reduce a learning curve that takes up to several weeks, even months, to achieve expected levels. TCF suppliers mentioned that modern technology is in particular replacing medium-skilled or high-skilled workers who may require six to nine months of training. To summarize, deskilling reduces manual labour, training time and worker turnover, while increasing overall product quality.

3.3 Impact on people

Our fieldwork reveals that when technology is introduced and workers become redundant in ASEAN’s TCF factories, they are absorbed and retrained in other departments. Because technology upgrades in ASEAN has thus far been incremental and small-scale, reskilling and redeploying workers have been a common practice.



However, when technologies such as additive printing, the IoT, big data analytics and automation (sewbots) improve and become integrated with one another, ASEAN's TCF sector will look very different. Unless the human workforce could offer a marked improvement in productivity and quality, millions of jobs could be at risk. For some countries like Cambodia, where TCF production dominates an undiversified manufacturing sector and makes up around 60 per cent of manufacturing employment, the impact will be felt more strongly than in others.

An ILO assessment on the risks of automation to jobs in ASEAN provides an indication of the sector's vulnerability. Estimates indicate that a significant share of the TCF sector's wage workers are at high risk of automation, ranging from 64 per cent in Indonesia, 86 per cent in Viet Nam, to 88 per cent in Cambodia. In fact, for most countries examined, the TCF sector showed the highest automation risk compared to other sectors in manufacturing.⁵⁵ Such results suggest that the TCF sector predominantly consists of repetitive and mundane jobs that are replaceable by programmed machinery and engineering advancements.

All of the aforementioned add up to an uncertain outlook for ASEAN's young workers in TCF, who are predominantly women and who often look at this sector as a first step in the job market. The sector may no longer have the capacity to absorb large numbers of low-skilled workers who are typically recruited from rural areas or farms. Rather, ASEAN's factories are likely to turn to graduates from reputable vocational training institutions. Such recruitment will provide factories with higher skills who can work with modern technology and consumer needs.

3.4 Looking ahead

The economics of offshoring will be less attractive: Reduction in ASEAN's TCF sector labour force is inevitable

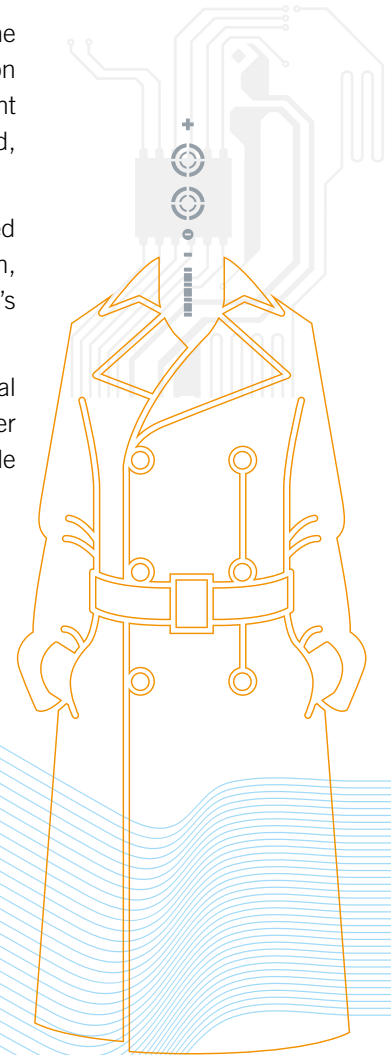
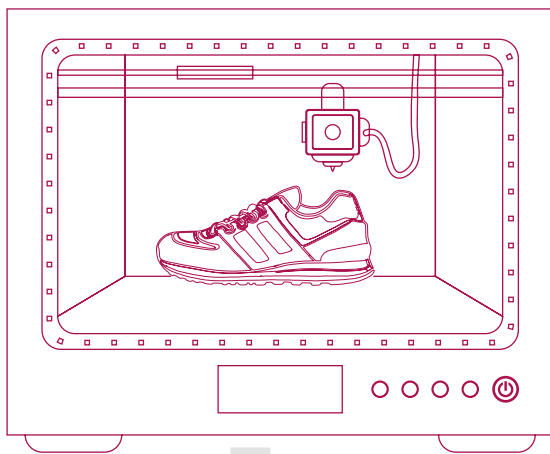
- In the short term, as leading brands and retailers experiment and pilot disruptive technologies such as 3D printing and automated sewing, ASEAN's export growth to Europe and the United States will incrementally decline. Additionally, China's determination to equip factories with the latest machineries could slowly reduce ASEAN's global market share.
- Selected ASEAN countries will reap some benefits through preferential trade agreements like in Viet Nam's case with the TPP. This will boost export demand and create even more jobs. While the sector will continue to be associated with growth in the immediate term, we expect a plateau to be reached at a quicker rate than anticipated due to technological disruptions.
- In the medium term, the region is likely to experience a noticeable decline in export growth. During this time, a number of key disruptors are expected to feed off each other and hit economies of scale, reaching a level of sophistication that allows them to achieve extremely delicate sewing with precision, quality, flexibility and speed. These technologies will hasten multinational brands' and retailers' efforts to bring production closer to markets to reduce lead time and meet consumer demands.

⁵⁵ Chang and Huynh, 2016. The exception is the Philippines, which showed greater automation risk for the electronics and computer sector.

- Ultimately, ASEAN's TCF sector will be forced to downsize at a pace that challenges the development strategy planned by certain Member States. ASEAN's export-led TCF sector will no longer be able to offer jobs to millions who are looking for formal employment opportunities.
- It is imperative for countries that are heavily reliant on the TCF sector to strategize economic diversification and foster additional growth sectors to avoid considerable setbacks in development.

The TCF sector will enter into an intense competition for higher skills

- We expect ASEAN's TCF sector to focus on upgrading production through low-cost automation technologies that will initially assist operators rather than replace them in the immediate term. As labour costs continue to rise and as technology becomes cheaper, more and more factories will introduce mechanized processes. As a result, the region will encounter some displacement of low-skilled workers while facing increasing demand for higher skilled technicians and engineers.
- Eventually, the workforce needs of the region's TCF factories will drastically change. The industry will likely consist of niche apparel producers who will face fierce competition from other sectors – such as automotive and electronics – to recruit competent designers, engineers and technicians. Ultimately, the sector's pursuit for low-skilled, low-educated workers will wane.
- Moreover, ASEAN's expanding middle class will need to be catered to. Increased purchasing power will be associated with enhanced demands for customization, wearable technologies and other needs that are typical of consumers in today's developed markets.
- To remain competitive, industry players must accelerate partnerships with educational and training institutions to groom the next generation of TCF workers with stronger technical qualifications and expertise and the ability to work seamlessly with multiple strands of emerging technologies.



PART II SERVICES SECTOR ANALYSIS

Business process outsourcing: Transforming offshoring



4.1 Sector overview

“The BPO sector was an accident – it was a gift of globalization. Nobody planned it and nobody in government can claim they did it.”

Rene E. Offreneo, Director of the Center for Labour Justice, University of the Philippines

Source: ILO Interview, 2015.

The history of business process outsourcing (BPO) is remarkable. Its birth was the result of enterprises' attempts to reduce costs, and workers were recruited en masse precisely because of advances in connective technology and globalization – the very factors that are often accredited for removing humans from an industry. In particular, the Philippines has attained elite status as a top destination for offshoring in the ASEAN region. In fact, globally, the Philippines is reported to be the second best outsourcing destination, behind India, as it offers talented workers, a beneficial cost structure and operates in a relatively stable socio-political and economic environment.¹

The Philippines' BPO sector, particularly call centres, have multiplied rapidly since the early 2000s.² Benefiting from an abundant pool of service-minded and English-speaking workforce, supportive government policies and established business associations, such as the Contact Center Association of the Philippines (CCAP) and the Information Technology and Business Process Association (IBPAP), the number of call centres grew from four in 2000 with 2,400 employees to 108 call centres in 2005 with 112,000 employees.³ In 2012, figures reached

¹ Tholons (2016) identifies the top 100 outsourcing destinations based on a location assessment framework, which evaluates countries based on the talent of their workers, cost structure and risk.

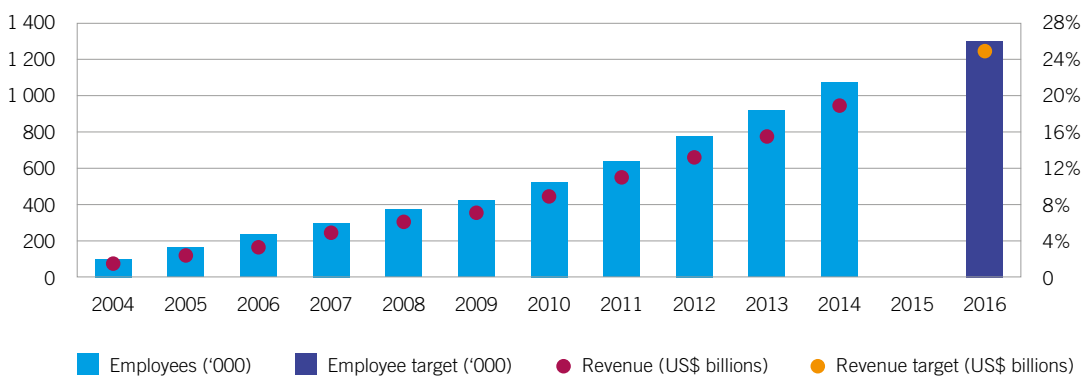
² Call centres are also referred as “voice” BPOs or contact centres.

³ IBPAP is the umbrella organization of the Philippines outsourcing industry. Members include: Animation Council of the Philippines, Contact Center Association of the Philippines, Game Developers Association of the Philippines, Global In-house Center Council Philippines, Healthcare Information Management Association of the Philippines, and Philippine Software Industry Association.

425 call centres with a total of 373,500 employees.⁴ Within a 12-year timeframe, call centres alone increased their manpower by over 180 per cent.

Moreover, as the overall BPO industry continues to include more and more services, such as back office support, data transcription, animation and software development, the number of workers also grows.⁵ In 2014, employment figures in the Philippines reached unprecedented levels: over 1 million workers were recorded, with call centres employing 60 per cent of the workforce.⁶ The BPO sector reportedly recruits young graduates (aged 23 on average) possessing technical, language and soft skills.⁷ Moreover, women make up a significant portion of the BPO workforce, comprising 59 per cent of the sector.⁸ Additionally, around 80 per cent of the women employed are college graduates with degrees in social sciences, engineering and business.⁹ The latest official figures from the Philippine Statistical Authority (2015) indicate that the sector is very attractive to jobseekers, as workers in BPO earn considerably more than other sectors. In 2012, the average monthly wage in BPO ranged between US\$675 and US\$1,321.¹⁰ This rate is competitive against the 2013 average monthly wage of US\$215.¹¹ To place this differential in another light: BPO workers earn between 2.7 and 5.4 times more than the average worker in the country.

Figure 4.1 Total employment (thousands) and annual revenues (US\$ billions) in the BPO sector, the Philippines, 2004–2014 and targets for 2016



Note: Targets based on IBPAP, 2012.

Source: IBPAP, 2012.

⁴ Lee Kuan Yew School of Public Policy, 2014; Philippine Statistical Authority, 2015; Philippine Statistical Authority, 2016.

⁵ The overall categorization of types of BPO services was sourced from Teodoro (n.a.). Back office is also known as “non-voice” services which include finance and accounting (for example bookkeeping, accounts maintenance), human resource administration (payroll processing, HR data management). An example of a transcription service is that offered for dictations of health professionals and legal proceedings. Animation is defined as offering the illusion of movement to unanimated objects through 2D and 3D, among others. Software development is defined as providing analysis and design, prototyping, programming and testing, customization, reengineering and conversion, installation and maintenance and training of systems software.

⁶ Oxford Business Group, 2015; World Bank, 2013. Other sources suggest that the BPO sector in the Philippines employed almost 800,000 people as of 2013 (World Bank, 2013) and was expected to employ about 1.3 million people by 2016 (Vidaurre, 2015).

⁷ Vidaurre, 2015.

⁸ ILO, 2013.

⁹ ADB, 2013.

¹⁰ Average monthly wages in the BPO sector were calculated by converting wages expressed in Philippine Peso to United States Dollar (using historical exchange rate from the BSP as of 20 December 2012).

¹¹ ILO, 2014b.

The sector shows no signs of slowing down as of yet. In fact, by the end of 2016, it is expected to achieve an impressive US\$25 billion in revenue, constitute 7.3 per cent of the country's GDP and hold over 13 per cent of the global market share.¹² Moreover, the Bangko Sentral ng Pilipinas (Central Bank of the Philippines, or BSP) reported in 2015 that BPO revenues would soon surpass remittances of approximately US\$24 billion (almost 10 per cent of GDP) brought in by the 10 million overseas Filipino workers.¹³ Indeed, as long as the United States (the Philippines' second largest export market, with a share of 27 per cent of total exports in 2014) maintains its business strategy to offshore operational functions, the future of the BPO sector in the Philippines looks sunny.¹⁴ The sector should be able to live up to its dubbed image of being the country's "sunshine industry".

Thus, it is unsurprising that our interviewees conveyed a relaxed, if not optimistic attitude towards BPO's future, with some representatives stating they saw "no particular disruptive technology". This confidence could be attributed to the continuous growth observed and current efforts to remain competitive through higher valued, more specialized, knowledge-based BPO services.¹⁵ With respect to this last point, the industry in general is expanding its service offerings, accommodating more complex tasks such that a new term has been coined to capture this expansion: knowledge process outsourcing (KPO). KPO operations include fraud analytics, data integration, project management, R&D, mergers and acquisitions valuation, and product profitability analysis. These functions require a highly skilled workforce, with specialized trainings in areas such as business, law, engineering and medicine.¹⁶

However, even with such growth, particularly in job creation, we are witnessing early warnings that the sector is at the verge of significant transformation in the coming years. Technological advancements and changing client preferences are perceived to be driving change in the outsourcing landscape. These disruptive advancements are predicted to optimize business efficiency, and improve costs, risk management, scalability and compliance.

New technologies are poised to abolish many call-centre jobs and transform others. At best, jobs will be created more slowly in the Philippines and India; at worst they will vanish.

Source: The Economist, 2016b.

This chapter illustrates how new, digital solutions could have a dramatic impact on the BPO sector, specifically focusing on the Philippines. The main findings are based on expert commentaries and interviews carried out with 14 industry leaders.



¹² Oxford Business Group, 2015.

¹³ Montecillo, 2015.

¹⁴ Oxford Business Group, 2015.

¹⁵ BPO's emergence through targeted government policies is reported to have increased domestic employment opportunities and lessened the country's need for remittances to provide unemployment relief and help drive domestic consumption (Metriyakool, 2011). Without the BPO sector, it is likely that the Philippines would have witnessed a greater flight of human capital, in particular skilled labour, seeking greener pastures abroad. The country's well known "brain drain" challenges, in which highly skilled and talented workers leave the country, would most likely have been aggravated if the BPO sector had not flourished.

¹⁶ Business World Online, 2014.

In 2013, a humanoid named Eliza was created by IPsoft as a virtual service desk employee to enable back-office process automation with no human intervention deployed in the cloud. Organizations hire her as a call centre operator tasked with responding to customer questions and service requests. Some reports say it could answer up to 100,000 emails and 67,000 phone calls per day.

Source: Deloitte, 2015.

RPA has clear economic advantages over human agents. Its cognitive agents can process information three times faster than the average human, work 24/7, eliminate manual error and also do not present the high turnover rates typically associated with human workers in the BPO sector.²¹ For instance, call centres in India and the Philippines both have attrition rates of over 55 per cent.²² AT Kearney (2016) suggests that RPA can cut down back office costs between 25 and 50 per cent for selected processes.

Early adopters of RPA like Telefónica O2 are sharing their business success with the BPO world. Using a “do it yourself” (DIY) approach with direct purchasing of RPA licenses, Telefónica deployed over 160 robots that process 400,000 to 500,000 transactions each month, yielding a three-year ROI of over 650 per cent as of April 2015. More surprisingly, Telefónica O2 reached this scale by training only four people.²³

The interviews we conducted in the Philippines illustrate that advanced forms of technological automation such as RPA that use cognitive and intelligent automation is still on the drawing board for future commercial deployment. Rather, incremental improvements are being made in interactive voice response (IVR), which is the primary and basic automation technology used by call centres in the Philippines.²⁴

4.1.2 Forces at play

Higher value services offered by KPOs promise continued growth for BPO enterprises in the Philippines. Interviews from the Philippines and reports show that KPO capacity is increasing. Indeed, IBPAP’s Philippine IT-BPO Road Map 2012-2016 highlights growth opportunities in industry-specific KPOs and also noted in 2014 that non-voice services, including KPO and engineering, would grow by 20 per cent.²⁵

²¹ AT Kearney, 2016.

²² Lee Kuan Yew School of Public Policy, 2014.

²³ Lacity, Willcocks and Craig, 2015.

²⁴ IVR allows customers to interact with a enterprise’s host system via a telephone keypad or by speech recognition, after which they can service their own inquiries by following the IVR dialogue. IVR systems can respond with pre-recorded or dynamically generated audio to further direct users on how to proceed. IVR applications can be used to control almost any function where the interface can be broken down into a series of simple interactions. IVR systems deployed in the network are sized to handle large call volumes.

²⁵ Ibid.

The push for more sophisticated services is coming from not only BPO and KPO direct clients but also from customers. Improving customer experience through omnichannel services is a critical component of current BPO efforts. Interestingly, the BPO sector has recently made significant investments to enhance the interface for millennials, as this demographic is expected to shape the BPO industry's future.²⁶ Having an estimated spending power of US\$2.45 trillion in 2015 and bred in a digitally intertwined world, millennials often demand instantaneous information.²⁷ They increasingly do so through non-voice platforms like short messaging services (SMS), online chat, and social media, unlike traditional consumers who use telephones. Numerous articles confirm that millennials are “talking less” and services targeted at them should be customized to accommodate behavioural traits such as this. One study highlights that the percentage of people using Twitter for customer service increased 70 per cent from 2013 to 2014.²⁸ Millennials in the ASEAN countries growing up hinged to their smartphones further reinforce this trend.²⁹ In fact, a global study conducted with 60,500 millennials across 50 countries revealed that millennials in six ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam) use their mobile phones an average of 3.2 hours every day.³⁰ Our research shows that BPOs in the Philippines are already capitalizing on this young market by using omnichannel services to engage with customers.

Accenture (2015) indicates that 69 per cent of high performing BPOs believe technology to be an important priority. The benefits of automating transaction-based work are numerous, including increased processing speed, accuracy with automated computation, standardization and productivity.³¹ Automating BPO operations are only further incentivized as workforce costs continues to increase in the Philippines and other BPO providing countries. According to KPMG (2016), the cost benefits of BPO labour arbitrage (the moving of jobs to low-cost countries) is around 15 to 30 per cent. However, this figure will be outmatched by the 40 to 75 per cent cost reduction that can be achieved through automation. They further predict that 100 million workers globally can be impacted by RPA by 2025.

Despite this incentive, one key barrier that impedes greater technology adoption is: long-term contracts signed with clients. Because BPO services are contracted for a substantial period, BPOs tend to focus on improving existing services rather than replacing them with new technologies.

However, what is increasingly clear is that call centres – which represent the lower end of the BPO industry – still dominate the Philippines' BPO sector in terms of exports, revenue and employment. These industries will have to consider that technologies like RPA and automated processes are likely to reduce the need for United States-based organizations to outsource functions like back-office tasks. If more and more enterprises in the United States or other countries procuring BPO services from the Philippines decide to purchase RPA licenses and opt for DIY back-office processes in the next ten years, a sharp decline in contracts for BPO services from the Philippines is inevitable. This will create large employment cuts in an industry that has seen nothing but growth for the past two decades.

²⁶ Datamark, 2015.

²⁷ Barnes and Lescault, 2013. We define millennials as those born between early 1980s and early 2000s.

²⁸ Masri et al., 2015.

²⁹ For example, the number of smartphone users in Indonesia is expected to grow 33 per cent annually between 2013 and 2017 (Indonesia Investments, 2015).

³⁰ TNS, 2015. Millennials in Thailand spend about 4.2 hours every day using their phones, which is higher than the global average of 3.2 hours per day. Globally, millennials spend twice the amount of time using their mobile phones than people aged 45 to 65 (TNS, 2016).

³¹ Accenture, 2015.

While not all BPO workers will be displaced, workers in the lower value BPO jobs may be, such as the reported 600,000 working in call centres in 2015 and others performing back-office tasks. Under such scenarios that could become a reality by 2025, the Philippines' labour market could become more challenging if sufficient domestic employment opportunities do not open up for the country's young graduates.

Overall, these technological advances may reverse the possibility of the BPO sector exceeding remittances by overseas Filipino workers, which could introduce challenges to the country's overall employment landscape. As the BPO sector grew over the years, domestic employment opportunities received a boost while at the same time decreasing the country's dependence on remittances, which provided unemployment relief and drove domestic consumption.³² It is also likely that without the growth of the BPO sector, the Philippines would have witnessed a greater flight of human capital, especially skilled labour.

4.2 Impact on enterprises

4.2.1 Effects on operations

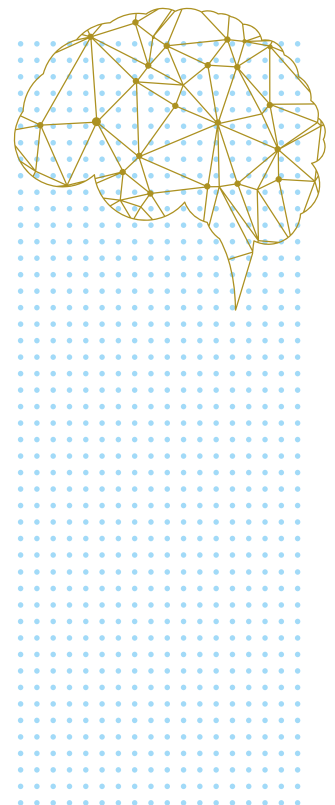
Shifting into KPO is critical

Our interviews confirm that clients are key influencers in whether BPOs adopt technology or not. While BPOs in the Philippines have embraced multi-channel services such as social media to interact with customers, there appears to be a lack of proactivity and ambivalence in anticipating forthcoming changes in clientele needs, especially with respect to RPA. With technology advancements anticipated to reduce the demand for back office support, it is critical for actors in the Philippines' BPO sector to diversify and expand their services into knowledge-intensive and sector-specific areas.

“We conduct research to understand technological improvements made in the sector. But nobody is in a hurry to do things right now. It is primarily because a lot of our business is discussed with the client. It is not just on our end... It is also what the client can do.”

Director, BPO enterprise, the Philippines

Source: ILO interview, 2016.



The Philippine IT-BPO Road Map 2016 highlights KPOs and other industry-specific opportunities in banking, healthcare and design as critical growth opportunities for the sector. Some interviewees indicated, however, that transitioning from BPO to KPO is a rather challenging process, as the workforce skill set requirement, processes and systems are drastically different. For example, KPO services for the financial sector, such as insurance and banking, may require personnel to have graduate degrees and professional certifications, such as a Certified Public Accountant. Therefore, successful expansion into KPOs requires ongoing talent development programmes

³² Metriyakool, 2011.

designed by industry players and the government, supplying a steady stream of skill-based professionals. BPO actors in the Philippines will need to flexibly respond to technology changes and use this opportunity to strengthen their capabilities to move up the value chain.

The sector may lose appeal among young graduates

As noted earlier, the BPO sector provides competitive salaries and careers for young people in the Philippines. However, as the country continues to develop and other opportunities emerge, the appeal of the industry may weaken due to the requirement for workers to perform night shifts to serve customers in different time zones.

While working hours in the BPO sector are not particularly long, and overtime work only accounts for an average of 1.12 hours per week per employee, there are numerous reports that indicate the BPO sector is associated with high health risks such as stress, fatigue and sleep disorders.³³

4.2.2 Effects on skills

BPO recruitment will increasingly require higher skills

Automation and other technological innovations discussed in this section are likely to reduce the availability of “easy BPO” work, in which English proficiency and the ability to handle routine processes are deemed to be sufficient for employment.³⁴ Interestingly, one of the strongest traits that the Philippines offers – English proficiency – may not be as important for BPO clients in the future, as labour-intensive, language-based call centre processes can be automated. BPO clients will increasingly source from countries where labour arbitrage opportunity is combined with other critical operating factors, such as a highly skilled workforce that caters for specific industries. Once a customer exhausts automated options such as Eliza, web-based robots and interactive voice recognition, the customer will still need a highly skilled person trained to handle complex situations.³⁵

“Innovations and automations which will require less English-language proficiency will likely become prevalent in the next 10 to 20 years. What will remain in the Philippines would be services requiring sector specific skills and knowledge in engineering, finance and health.”

Operations Supervisor, BPO enterprise, the Philippines

Source: ILO interview, 2016.



³³ Messenger and Ghosheh, 2010.

³⁴ AT Kearney, 2016.

³⁵ Datamark, 2013.

4.3 Impact on people

Our research and industry trends indicate that tertiary students in the Philippines need to make their academic choices based on prospects that the BPO sector presents. The transition towards KPO and specialized non-voice BPO services suggest English proficiency and a service-oriented personality will not be enough to be assured of gainful employment in this sector. Industry representatives have already voiced concerns over the lack of core skills, such as critical thinking, as a significant challenge for the sector.³⁶ Moreover, as more technical qualifications are required in IT, finance, engineering, health and others, the Philippines' BPO sector will need to compete with China and India, which are known to have a stronger technical skills base.³⁷ Statistics show that enrolment in relevant, value added BPO areas such as health and welfare (6.4 per cent) and engineering, manufacturing and construction (12.9 per cent) is considerably low among tertiary students in the Philippines.³⁸

“Filipinos are famous for their sense of empathy, which bodes well for all service industries like customer care and tourism, but they are for the time being less math and science inclined (compared to China and India).”

Cyril Roche, CEO, DataOne Asia

Source: Oxford Business Group, 2015.



Our research on the automation risk of jobs in the ASEAN region reinforces the message that call centres will no longer offer a viable career for Filipino workers in the future.³⁹ An alarming 89 per cent of call centre workers could be replaced with computerized processes as the tasks these jobs require are repetitive in nature.

4.4 Looking ahead

Technology, once an enabler, is now a disruptor for the Philippines

- In the immediate term, growth and employment projections for the Philippines' BPO sector will either meet targets or experience minor shortfalls. The sector will continue to attract a sizeable proportion of the country's young graduates who will be the voice transcribers and data processors for the world's BPO clientele.
- However, we believe the current period of “early adoption” of technologies like BPaaS and RPA will slowly transition to a phase of mass adoption in the next few years. Even the most risk-averse technological adopters are likely to recognize the efficiency, accuracy and cost reductions enabled by cloud technology and automation. Unsurprisingly, enterprises will want to bring back previously offshored tasks. In-house management of back office tasks will not only make economic sense but will enable companies to protect leakage and potential abuse of internal data.

³⁶ National Competitiveness Council of the Philippines, 2012.

³⁷ Oxford Business Group, 2015.

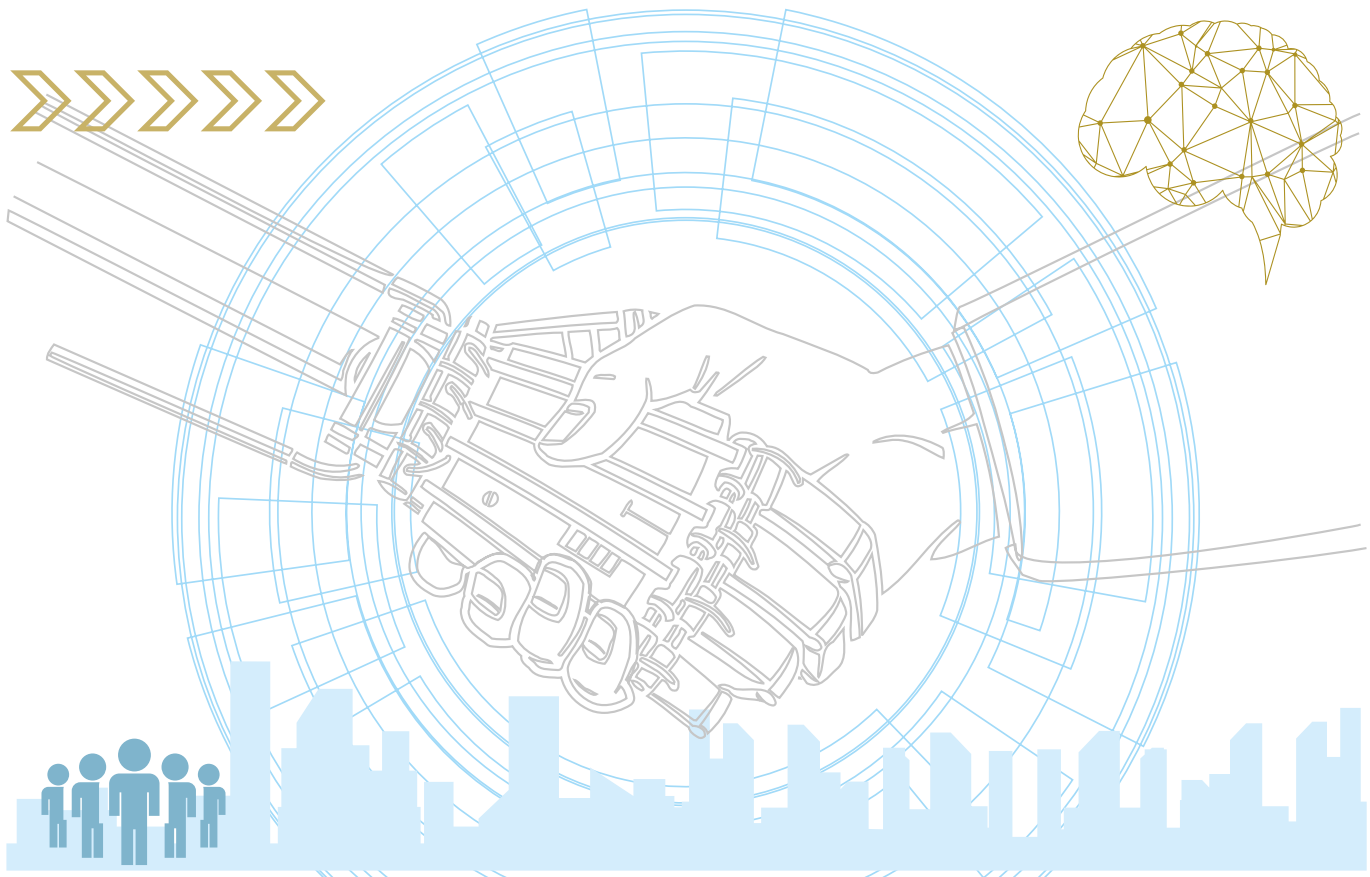
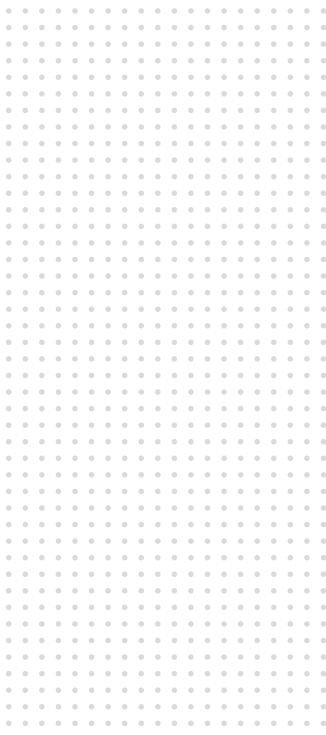
³⁸ UNESCO-UIS, 2016.

³⁹ Chang and Huynh, 2016.

- Given these anticipated trends, significant numbers of call centres and other back-office tasks in the Philippines are likely to be affected. The country could encounter increased levels of unemployment and also face a new peak in the exodus of its people seeking better opportunities abroad.

Creating a new competitive edge through KPOs and associated skills

- One way to counter such disruptive changes, in particular large-scale voice automation, is to reshape and transform the sector. The Philippines has already shown some level of determination to advance into higher value added processes such as KPOs. However, the present lack of internal awareness among industry players of technological disruptors is concerning. Where currently BPO is used in conversations, it needs to be quickly substituted with references to KPO (and all that it entails) to maintain the competitiveness of the sector, as both a service provider and an employer.
- The enterprises that are able to offer highly specialized support and which are able to respond to new clientele demands will be the ones to survive the coming transformation in the BPO sector. As already indicated by many experts, proficient English skills alone will not be enough to secure employment in this sector. More than ever, competent skills-based professionals in engineering, finance, IT, medicine and others will be required so that sector-specific solutions can be provided at high quality and at effective price points.



Retail: Buying into the hype



5.1 Sector overview

ASEAN's retail sector is primed for growth.¹ Currently, ASEAN's consumer market numbers 632 million people, and the region has also been experiencing a rapid increase in trade and investment. ASEAN's growing middle class is also seeing increases in its disposable income. This augurs well for the region's retail sector, for which healthy growth has been projected well into the future. The retail sector's sales growth in the region has outperformed the rest of the world. Retail sales in major ASEAN countries accounted for US\$767 billion in 2013 and are projected to increase to US\$1.3 trillion in 2018: Indonesia accounted for the largest share of the region's retail sales (43 per cent), followed by Thailand and the Philippines (15 per cent each), Malaysia (11 per cent), Viet Nam (9 per cent) and Singapore (5 per cent).²

In terms of worldwide employment, retail stands as one of the largest sources of jobs in most countries. The ASEAN region is no exception. The retail sector employs an aggregate of 44.6 million workers in the region, representing 16 per cent of its employment and 44 per cent of jobs in the services sector (see figure 5.1). Indeed, in most ASEAN countries, retail is the biggest employer within the services sector and second overall, after agriculture.³ Additionally, the sector provides a critical employment opportunity for women, as it is gender balanced, with female workers making up 50 per cent of ASEAN's retail workforce.



Figure 5.1 Total employment in retail (thousands) and share of total services employment (per cent), selected ASEAN Member States, latest available year



Note: Retail services include those under ISIC, Rev.4, Divisions 45 ('Wholesale and retail trade and repair of motor vehicles and motorcycles'), 26 ('Wholesale trade, except of motor vehicles and motorcycles'), and 47 ('Retail trade, except of motor vehicles and motorcycles'). Total services refer to ISIC, Rev.4, sections G-U.

Source: ILO, 2016a; ILO estimates of official labour force surveys (various years).

¹ Retail enterprises operate a range of stores from major hypermarkets, shopping centres and super markets through to small convenience stores. Retail involves the selling of goods and services through various channels for a profit.

² UNDESA, 2015.

³ The retail sector is the largest employer within the services sector in all ASEAN countries except Brunei Darussalam, where retail employment comes second after employment in public administration and defence services. The retail sector is the overall second largest employer in ASEAN among all sectors, after agriculture, excluding Brunei Darussalam, Singapore and Viet Nam.

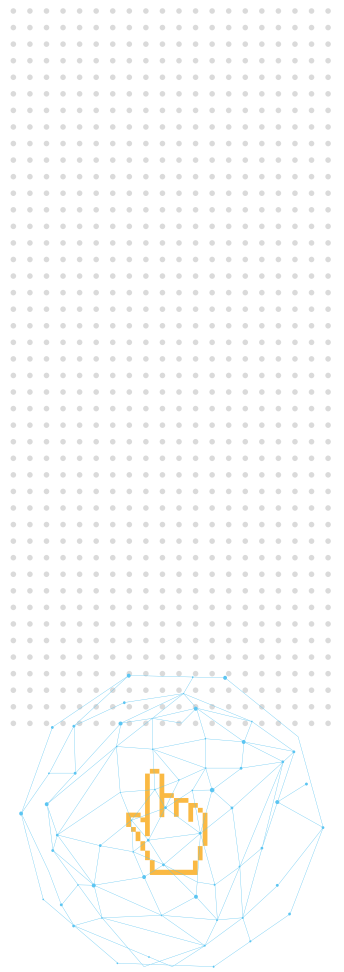
Retail consumer trends depend heavily on personal income levels, consumer confidence, and interest rates. The region's consumption grew by 5 per cent between 2000 and 2014.⁴ This growth is expected to continue, primarily driven by economic development and by middle class households whose disposable income are expected to almost double from US\$67 million in 2014 to US\$125 million by 2025.⁵

It is important to highlight that local and traditional retail outlets, such as wet markets and small, family-owned shops, are the largest channel for retail sales in ASEAN cities like Ho Chi Minh City and Jakarta, where they account for greater than 70 per cent of all retail sales.⁶ In Thailand, where retail employs more than 6 million workers, both multinational and national conglomerate retail players (such as Tesco Lotus, 7-Eleven, Siam Makro, Big C, Villa Market, Central Group and Mall Group) are estimated to employ less than 400,000 workers. This accounts for less than 7 per cent of Thailand's total employment in retail today.⁷

This chapter looks at current and forthcoming changes impacting ASEAN's retail sector, as well as its implications for the enterprise and the workforce. The findings are based on 43 industry interviews along with a survey of retail experts. Because retail is multifaceted, and is the final point in the supply chain of products for a myriad of other industries, this chapter attempts to address technological trends as a general retail concept rather than drilling down to ancillary industries related to the retail sector.

5.1.1 The disruptors

Mobile and e-Commerce platforms. Increased demand for digital platforms in the retail space is likely to disrupt more conventional outlets such as “brick-and-mortar” establishments. e-Commerce and online retailing are methods of buying and selling of goods and services online. Globally, online shopping is known to be cheaper, with one study showing that 80 per cent of shoppers say the best prices are found online.⁸ In addition, because the operating cost of a brick-and-mortar store is generally greater than online stores due to rent and overhead, online retailers are able to offer better deals.⁹ Earlier studies showed that expanding online retail can have a positive impact in generating employment and heighten the need for workers with skilled talent in e-Commerce systems and web site design.¹⁰ Specifically, the demand for certain occupations such as computer and information systems managers, data analysts, engineers, designers, writers, editors, and customer service representatives could grow. In addition, e-Commerce has led to increased female presence in paid employment, as it provides entrepreneurship opportunities, the ability to overcome certain gender barriers and increased flexibility to work from home.¹¹ On the other hand, requirements for low-skilled workers such as those in supermarkets and showrooms, will decrease as less manual labour will be required.¹²



⁴ ILO estimates based on World Bank (2016). The compound annual growth rate, between 2000 and 2014, of regional household final consumption expenditure was calculated. There were not available data for Myanmar.

⁵ HV, Thompson and Tonby, 2014.

⁶ Nielsen, 2015a.

⁷ Based on ILO estimates calculated from secondary research.

⁸ Rigby, 2011.

⁹ Montaldo, 2016.

¹⁰ Singh, 2008.

¹¹ UNCTAD, 2002.

¹² Singh, 2008.

However, the share of e-Commerce is still currently very low – it comprises less than 1 per cent of total retail sales in five economies – Indonesia, Malaysia, the Philippines, Thailand and Viet Nam.¹³ Even in Singapore, ASEAN's most connected and developed economy, only 3.4 per cent of total retail sales are facilitated by e-Commerce. This is quite low compared to China, Europe and the United States, where online transactions range between 6 and 10 per cent. ASEAN's comparative lag in the e-Commerce landscape could be due to the numerous locations of retail outlets across major urban and residential areas, highly convenient store hours such as 24/7 outlets, and the sheer number of traditional stores, hyper markets and department stores. Moreover, consumers in the ASEAN region have embraced retail stores for recreational pursuits, as many offer air-conditioned comfort, hygienic environments and user friendly layouts.¹⁴

Due to the small scale of e-Commerce in the region today, we do not expect it to have a significant impact on employment in the coming years. However, it is prudent for the region to learn from the experience of economies with larger e-Commerce markets and to prepare for a time when the use of e-Commerce becomes more prevalent.

The IoT converging with other technologies. As aforementioned in this report, the IoT promises to improve overall businesses operations, such as optimizing inventory management, product tracking and shopping intelligence through increasingly connected devices across many locations.

Notably, 84 per cent of survey respondents cited the IoT as a technology disruptor in the retail sector.

Source: ILO retail survey, 2016.

In particular, tags and sensors will substantially reduce the “out of stock” challenge in retail. Globally, it is estimated that retailers lose the equivalent of 4 per cent of sales annually due to items desired by the consumer that are not in stock. Using sensors and tags to tighten supply chains and predict where stock-outs could recapture about 35 to 50 per cent of this value.¹⁵ With sensors becoming smaller and cheaper, increased computing power and enhanced M2M learning, a well-functioning IoT retail system is poised to have transformational impacts on retailers.

Building on the IoT infrastructure, some apparel retailers are using radio frequency identification (RFID) to attach individual identification information to each garment.¹⁶ The system provides information on products (with detail such as their sizes) that require replenishing to enable better stock management; it also provides customers with an enhanced retail experience as scanning a garment shows whether the item is available in stores, at nearby stores or online.¹⁷

¹³ DBS Group Research, 2015.

¹⁴ KPMG, 2006.

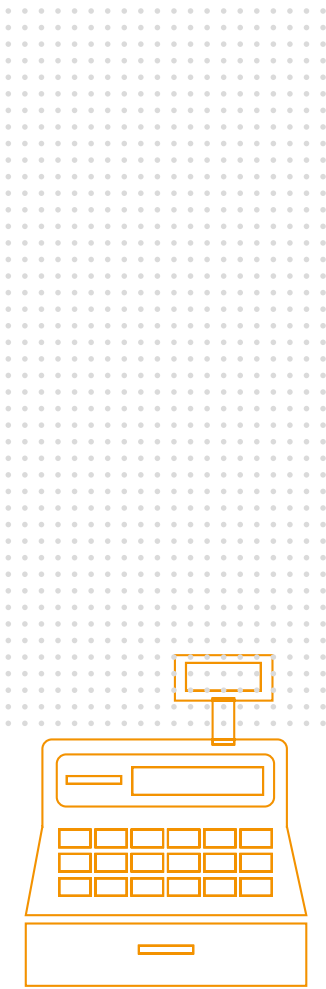
¹⁵ Manyika et al., 2013.

¹⁶ RFID uses radio waves to read and capture information stored on a tag attached to a product.

¹⁷ Inditex, 2014.

One study shows that retailers are realizing improvements in inventory accuracy by almost 95 per cent by using RFID tags that cost under half a US dollar. Japan's AEON retail group – which already has a prominent footprint in Indonesia, Malaysia and Viet Nam – is the world's leading adopter of RFID.¹⁸

Cloud technology and big data analytics. The IoT will realize its real value when it is combined with other disruptive technologies. For example, cloud technology will improve retailers' supply chain operations, as it captures real-time status information, streamlines inventories, and tracks deliveries to enhance visibility, from order to destination.¹⁹ Additionally, big data analytics is being seen as a game changer due to the potential they offer for monitoring customer behaviour, predicting consumption trends, forecasting demand and optimizing pricing. There is a great deal of untapped data for retailers coming from social media, customer feedback comments, video footage, and locational global positioning system (GPS) data that could be churned into useful business insights.²⁰



Inditex SA – the leading apparel retailer – announced that it would deploy RFID to 1,000 of its 2,000 stores worldwide by the end of 2016. Before implementing RFID, store employees conducted storewide inventory count once every six months because it would require a team of 40 people to complete the task. With RFID, a team of ten can execute the process in half the time. That's a 75 per cent reduction in manpower to perform a critical task in the retail space.

Implementation has been concentrated in European countries since its roll out in 2014. However, the forecast for 2016 is full operation in all Zara stores. In ASEAN, Zara has about 50 stores in Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

Source: Bjork, 2014; Inditex, 2014.

Our interviews show that ASEAN retailers are at a nascent stage in making the IoT a core operational component; however, it is certainly being seen as the most significant technological disruptor. Multinational retailers are likely to be the first movers in this space. Once they start, the impact on the workforce can be significant. For example, Zara's connected systems have reduced the need for the company's workers to perform analytics manually.

However, to maximize the IoT's benefits, a number of foundational technical capabilities are required, such as investments in big data analytics and other in-store technology. Retailers, especially large ones targeting the ASEAN region's massive middle class, will need to invest in technologies that furnish better data.



¹⁸ Appricity, 2016.
¹⁹ Revensencio, 2015.
²⁰ Marr, 2015.

5.1.2 Forces at play

The ASEAN region is increasingly connected to the Internet, building an e-Commerce consumer base waiting to be activated. ASEAN countries, on average, have 242 million active Internet users, or a 38 per cent penetration rate.²¹ Mobile connections total 776.3 million users, exceeding the total population of the ASEAN region.²² Moreover, smartphone penetration in the region is also high, with 74 per cent of Singapore's total population possessing a smartphone.²³ In 2014, 30 to 40 per cent of the population in Indonesia, Thailand and Viet Nam owned a smartphone, a significant increase from 13 to 30 per cent in 2013.²⁴ Furthermore, when looking only at the ASEAN region's urban areas, smartphone ownership is even more remarkable – almost 90 per cent of urban Indonesians own a smartphone.²⁵

Notably, 70 per cent of survey respondents cited mobile and e-Commerce as technology disruptors in the retail sector.

Source: ILO retail survey, 2016.



Even though e-Commerce in ASEAN has not “taken off fully”, it holds strong future potential. In 2014, Indonesia surpassed Singapore and Thailand in e-Commerce sales, reaching US\$1.1 billion, a figure three times larger than in the past two years.²⁶ In 2016, two major online retailers, in the region, Lazada and Zalora, were acquired by Alibaba (the Chinese online retail giant) and Central Group (Thailand's conglomerate), respectively. The transaction with Lazada, which sells apparel and electronics via e-Commerce platforms throughout six ASEAN countries, is noted as Alibaba's largest overseas acquisition to date.²⁷ Additionally, it is easy for smaller retail establishments to tap into online retailing, as barriers to entry are low and start-up companies can be created with relatively few employees.

It is important to mention that there is a general lack of trust in online or mobile shopping in the region. One study highlights consumer concerns about transaction security and indicates that the majority of payments for online retail are still made offline through methods like cash-on-delivery.²⁸ Specific examples include Indonesian consumers worrying about payment safety, lack of sales support and unreliable quality.²⁹ Overall, in both our primary and secondary research, the advent of e-Commerce is not viewed as destructive to brick-and-mortar retailers in the immediate future. In fact, it is even seen as a complementary platform in some markets.

²¹ World Bank, 2016.

²² We are social, 2015.

²³ HV, Thompson and Tonby, 2014. Smartphone penetration is calculated as percentage of smartphone devices used by mobile phone users.

²⁴ eMarketer, 2015; Maybank, 2015.

²⁵ PwC, 2015.

²⁶ Ibid.

²⁷ Chen and Wang, 2016.

²⁸ AT Kearney, 2015.

²⁹ McKinsey and Company, 2013b.

A growing urban population with a rising income creates a huge potential for retail demand. It is estimated that 22 per cent of ASEAN's population lives in cities with more than 200,000 inhabitants, and these cities represent more than 54 per cent of the region's GDP.³⁰ In 2015, more than half of the populations of Indonesia, Thailand, Malaysia and Singapore were reported to live in an urban area.³¹ Moreover, it is projected that an additional 64 million people in ASEAN will move into urban areas by 2025.³² Rapid urbanization will not only serve as a significant growth opportunity for the retail sector, but can also trigger faster deployment of modern technologies as increasingly more foreign-owned, technology-conscious retail outlets enter ASEAN cities to expand their footprint and reap benefits from a greater concentration of customers. Additionally, ASEAN's city dwellers, especially those living in mega-cities like Bangkok, Jakarta and Singapore, will lead increasingly faster paced lifestyles and will need convenient, technologically driven solutions like e-Commerce, click-and-collect shopping and home delivery options. As such, we anticipate the urban populations to look for time saving transactional methods, which can be obtained through online and mobile platforms.

Overall, ASEAN's consumers will dictate the pace at which retailers use technology to power their operations. The swelling middle class and growing number of affluent customers will increasingly desire instant gratification, one-of-a-kind merchandises, and customization of products – all of which are trends in developed economies. We have already observed that global players in the TCF sector are using disruptive technologies such as 3D printing and digital body scanning to offer personalized apparel. Retail in ASEAN will certainly follow suit.



The showrooming effect: A growing trend for consumers in Singapore is to visit a physical store to test or try a product before purchasing it online at a cheaper price. A significant 73 per cent of Singapore consumers are known to leave a store if they find the product is at least 5 per cent cheaper through online retail channels.

Source: Competition Commission of Singapore, 2015.

Entrants to ASEAN's middle class may hold on to money-saving habits, leading to behaviours of comparative shopping and purchasing discounted products. It is well known that online shopping can often be less expensive compared to purchasing within a physical store. Essentially, money-saving habits can further drive growth in online retailing in the region.

The majority of workers in the Philippines' BPO sector are on duty at night-time to take calls and provide services to clients in different time zones. These workers tend to order food and groceries from convenience stores with online operations such as Philippine Seven (7-Eleven in the Philippines).

Source: DBS Group Research, 2015.

³⁰ HV, Thompson and Tonby, 2014.

³¹ UNDESA, 2014.

³² Ibid.

Research shows that millennials are most avid in the e-Commerce space and are willing to use more online options.³³ Hence, this young demographic offers huge potential to accelerate online retail provided this sector is able to earn their trust.

Food, safety and well-being are several factors that are likely to contribute to the greater take up of IoT. As is the case with retailers worldwide, ASEAN's grocery retailers are prone to selling contaminated food. In Viet Nam for example, national attention was drawn in 2007 to a variety of contaminated foods, including rice noodles containing formaldehyde, forbidden pesticides in vegetables and fruit, and toxic soy sauce sold in supermarkets.³⁴ There is ongoing effort on the part of manufacturers, processors, and grocery retailers to enhance food safety using the most efficient, transparent and traceable systems. By embedding sensors and other monitoring systems into a functional network, the IoT, for instance, could play a pivotal role in addressing safety issues and making it possible for retailers (and even consumers) to easily monitor manufacturing processes and storage conditions of various raw materials.³⁵ Food safety concepts are likely to gain interest among ASEAN's consumers who are increasingly concerned about their general health. It is therefore in the interest of retailers to invest in technology to keep their consumers safe and happy.

Our primary research shows that labour costs could accelerate technology implementation in the retail sector, albeit with variances across the ten Member States.

The cheaper cost of technology has definitely had a profound impact on the quicker implementation of technology but it is not one of the major reasons. Rising cost of labour is a bigger driver.

Source: ILO retail survey, 2016.

For example, in a developed economy such as Singapore, labour costs are one of the main drivers of technology implementation. Singapore's unemployment rate of 3 per cent and rising labour costs encourage enterprises to increasingly utilize technology to reduce reliance on the human workforce.³⁶ Moreover, Singapore retailers interviewed have expressed that many retail positions are unfilled. As a result, many grocery and food and beverage retailers reported implementing self-checkout technologies to overcome the limitations of the labour market. Self-checkout technologies are also available in Malaysia, in which a pilot was completed by Tesco in 2015.³⁷ Tesco also tested it in Thailand, where it introduced the functionality in 2013 to increase customer convenience and reduce operational costs. This was followed by Central Food Retail, Thailand's largest supermarket chain.³⁸

³³ Nielsen, 2015b.

³⁴ Deloitte, 2014.

³⁵ Fletcher, 2015.

³⁶ Unemployment rate as of 2014 according to ILO, 2016a.

³⁷ Inside Retail Asia, 2015.

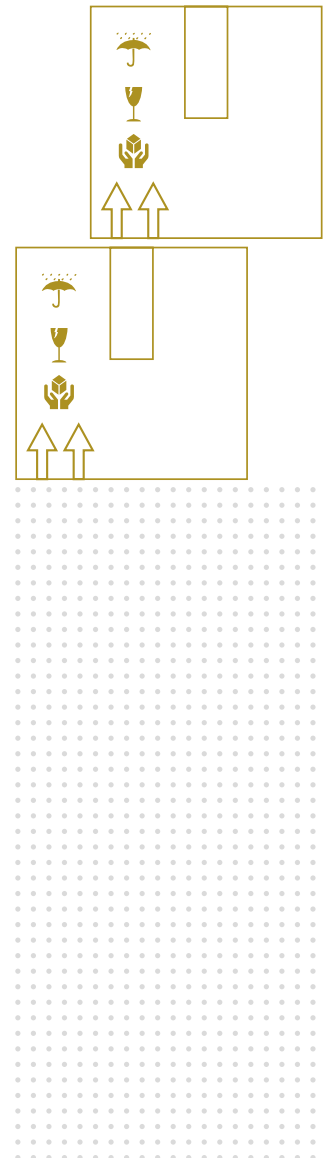
³⁸ Fernquest, 2013.



5.2 Impact on enterprises

5.2.1 Effects on operations

Improved logistics and increased operational efficiency continue to be a top priority for the retail sector. In ASEAN, improving logistics has become a special priority due to geographical challenges coupled with historically low investment in retail infrastructures. Poor transportation infrastructure, lack of warehouse readiness and inefficient “last mile” delivery are key issues facing retail in ASEAN. All this has led to a stifling effect on the development of ASEAN’s e-Commerce infrastructure as a result of general customer dissatisfaction with the logistics, and operations are reorganizing themselves to overcome these bottlenecks.³⁹



One ASEAN business-to-business (B2B) capital equipment retailer reported shutting his e-Commerce arm down as customers preferred invoicing and personalized service.

Source: ILO interview, 2016.

Not all enterprises are excited about the adoption of technology, however. An interesting observation from our primary research is that ASEAN’s retailers have widely differing views and reactions to technology. A number were very optimistic about technology-driven solutions enhancing their operations, with a few citing that they were running their entire businesses from mobile devices alone. On the other hand, a large number also seemed to lag far behind in their technology adoption, exhibiting low awareness on key technological disruptors such as the IoT, big data and others.

AT Kearney released a report in 2015 stating “ASEAN retailers continue to be held back by weaknesses in three areas: products and services, shopping experience, and enabling technologies”.⁴⁰ They attribute the root causes of lagging retail innovation to the retail culture in ASEAN and an immature networking culture. Our research also found culture to be a leading barrier to technology adoption.

Culture was one of the two most cited barriers to adoption of technology in the retail sector.

Source: ILO retail survey, 2016.

Culture is a very broad term – it could refer to enterprise culture, or more generally, to the culture in ASEAN. For instance, retail in ASEAN has an owner-driven culture shaped by low-margin operating environments, thereby allowing short-term gains to take priority over technology investments. Some primary research participants expressed frustration in convincing their senior management to invest in technology, explaining that it was difficult to demonstrate to them returns on investment. They cited that their senior management tended to continually delay investments to later years.

³⁹ AT Kearney, 2015.

⁴⁰ Ibid.

Nevertheless, our research finds that selected retailers in ASEAN, especially multinational establishments, are increasingly using database and software technologies to enhance their operations. The following case study relating to a multinational retailer is illustrative.

Box 5.1 Case study: Technology helping to improve supply chain management and reduce cost

A European high street fashion retailer – with 2015 global sales in excess of US\$25 billion, six fashion brands, 4,000 stores worldwide and an employee base of over 100,000 – had identified ASEAN as a huge growth opportunity. An interview with their chief operating officer (COO) and chief information officer (CIO) provided some clarity about the challenges they faced in labour as well as in supply chain management when trying to scale up their business in ASEAN. Before 2013, one of the biggest and most reputable supply chain companies in the world solely managed their supply chain.

Personnel at their company headquarters, however, highlighted that due to the supply chain's semi-automated infrastructure, it was not as efficient as it could be. This was certain to affect the top line of the business. Furthermore, numerous mistakes were made in the supply chain, resulting in incorrect products being shipped to stores. The COO exclaimed, "Manual picking of garments was proving to be very error prone, which resulted in wrong garments being sent to the stores."

Despite being told that numerous other regions had tried and failed to integrate an enterprise resource planning (ERP) software into their entire supply chain infrastructure, the bold decision was made in 2013 to integrate their warehouse management system with big data mining tools to help make informed decisions on stocks.⁴¹

Due to the CIO's knowledge and years of experience in retail, the team was able to implement the system in under three months for a rather modest investment of around US\$1.5 million. The challenges during this process included:

- Getting buy-in from managers, their entire teams and creating a support system;
- Creating templates and dashboards as per division leads' feedback and requirement;
- Overcoming cultural resistances to technology adoption in countries such as Thailand; and
- Overcoming language challenges, as local consultants were responsible for executing implementation on-the-ground.

Successful implementation brought numerous benefits to the enterprise. The technologically enhanced supply chain infrastructure, hosting data via cloud storage in six Singapore-based servers, resulted in a 30 per cent reduction of staff in the warehouse and a very seamless supply chain. Every aspect was coded and scanned by barcode readers. Their data and analytics algorithm decided which apparel was to be routed to which store and how many of it.

"By implementing the technology, we were able to halve our turnaround time to the store to 12 hours, and as a result our sales doubled!"

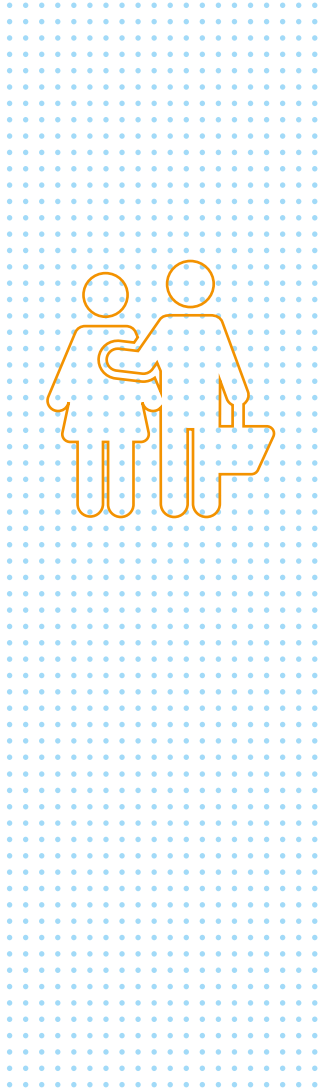
CIO, High Street Fashion Retailer, Indonesia and Thailand

Source: ILO interview, 2016.

⁴¹ A warehouse management system is a software application allowing centralized decision making for tracking inventory levels and stock locations.

5.2.2 Effects on skills

When interviewees were asked to assess the skills needed in the workforce, data management and tech-savvy employees topped the list. The looming potential for increased e-Commerce and the IoT in ASEAN reinforces this need. Employees who can conduct data and web analysis will be increasingly sought after.



In preparation for increased adoption of the IoT in ASEAN, Cisco Systems is developing business partnerships and talent in ASEAN. Considerable talent development needs to be made to meet this new demand. An Industry Talent Consortium has been introduced to address this major skills gap, along with an IoT reference model to help provide developers with a standardized procedure for bringing the IoT on board.

Source: Thongtep, 2014.

Digital marketing and social media skills are also often cited as skills in demand. Given the rise in connectivity of consumers, employees will also need to be skilled in the technologies consumers use to shop as well as the ability to leverage the massive amounts of data being collected. This cannot be left to an IT department.

Respondents also cited the need for soft skills. Despite the proliferation of technology, many consumers are often frustrated with the automated customer service experience and still desire a human touch. Time management, problem solving, and interpersonal communication are all examples of soft skills that can affect job performance.

More than 90 per cent of surveyed enterprises agreed or completely agreed that labour and skills requirements will change with adoption of technology in retail.

Source: ILO retail survey, 2016.

Lastly, participants stated that employees needed to have more in-depth product knowledge. Due to the large amount of information available on the Internet, ease of shopping, as well as the ability to compare prices online, consumers expect retail employees to know more about the product than they do.

Figure 5.2 Changes in skills requirements of ASEAN’s labour force due to the rising use of technology

Can you specify the functional areas where you believe that requirement of labor world change the workplace?



Source: ILO retail survey, 2016.

5.3 Impact on people

Overall, the research indicates there are no imminent, large-scale threats to ASEAN's retail workforce, as the number of traditional retail and informal retail outlets are substantial – an estimated 80 per cent or more of the region's current retail employment is by these outlets.⁴² Contemporary forms of digital and automated technology, such as self-checkout and ERP systems, have only been recently introduced in modern multinational retail outlets and national conglomerates. The IoT, being seen as a disruptor with the potential to impact large swathes of workers in the front and back office, will increasingly be adopted by big establishments.

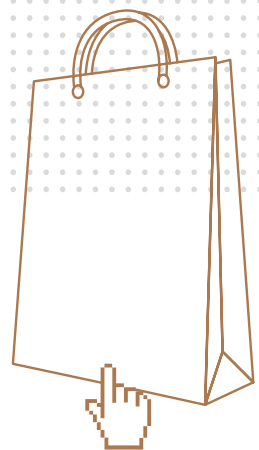
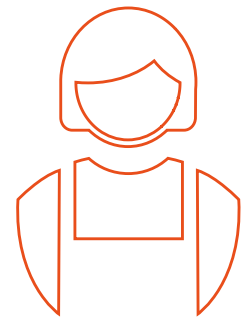
While traditional establishments still dominate ASEAN, it is important to note that modern retail outlets are expanding and increasing their market share. In Viet Nam, for example, where more than 80 per cent of all food retailers were reported as independent grocers in 2013, the Ministry of Industry and Trade aims for modern retail outlets to achieve a penetration of 40 per cent by 2020.⁴³ Similar expansion is expected in Indonesia and Malaysia, where modern retail is expected to reach a market share of over 40 per cent and 50 per cent, respectively, by 2020.⁴⁴ As the retail space in ASEAN changes, becoming more consolidated and modernized, the level of employment it today generates cannot be sustained. A greater part of the employees in warehouse, logistics, sales and other operations of big retail players in ASEAN will be replaced by technology, reducing the need for large-scale human workers.

In addition, our accompanied research, which examined the potential for technological substitution across occupations and sectors in five ASEAN Member States reveal that more than three-quarters of the wage workers in the wholesale and retail sector face high risks of being displaced.⁴⁵ We believe that automated technology can ultimately affect the livelihoods of more than 4 million salaried salespersons and sales assistants in the retail sector. Due to barriers to the take-up of technology, we do not envision massive technological transformation in the retail space as of yet. However, workers and retailers should be mindful of the risks of massive disruption to this sector, as it has translated in other economies. If certain existing structural challenges are resolved, cultural habits change, modern retailers become more dominant in their market share, and macroeconomic drivers provide a further push, the region's retail sector is likely to look very different.

5.4 Looking ahead

ASEAN's retail sector is poised for structural shifts and impact from technology

- Despite strong signals for continued growth in ASEAN's retail sector, we find that the region's take up of new and modern technology is the slowest among all other sectors examined in this report. While various forms of automated and digital technology, including e-Commerce, will eventually be integrated into the operations of multinational



⁴² There is no comprehensive and credible data that provides employment figures according to type of retail outlet. However, in many ASEAN countries, traditional retailers account for over 70 per cent of retail sales, which can be indicative of employment size. A specific example was provided in the "Sector overview" section in which large retailers in Thailand are estimated to employ less than 7 per cent of the retail workforce.

⁴³ PwC, 2015; AT Kearney, 2014.

⁴⁴ AT Kearney, 2014.

⁴⁵ Chang and Hyunh, 2016.

firms and conglomerate retailers, a major technological disruption is not foreseen in the immediate future, due to the enormous share of traditional and informal establishments in ASEAN retail space.

- Regulatory and cultural practices have also been cited as reasons for the slow adoption of technology. Moreover, unlike export-oriented manufacturing sectors, the retail sector largely remains a local activity, resulting in less external pressures for the usage of the latest machinery and digital solutions. Rather, the pressure to innovate is coming from consumers.
- ASEAN's consumers are becoming increasingly more demanding and sophisticated. Retailers, especially large ones, will use technology to better engage with consumers and enhance their shopping experience. In addition, factors such as urbanization, growing demand for convenience, and consumer awareness of personal and environmental health will increase the need for the integration of modern technology into retail operations.
- ASEAN's retail space is becoming more consolidated and modernized as multinational firms and conglomerates increase their market share. All of these factors will result in a structural shift in the region's retail sector with the net effect being a greater diffusion of technology.

The sector will need a skilled workforce to meet consumer demands

- As the aforementioned transformations come to pass, the retail sector's workforce will be forced to adapt.
- Inevitably, overall retail sector employment will need to decrease. However, there will be greater demand for skilled workers with strong technical data management skills to optimize data collected from customers. These data will form the foundation for sales, supply chain, production and back office support. In addition, as more players move into e-Commerce and mobile retail, people with web-based skills will find themselves in high demand. Finally, the sector will have a greater need for personnel with sophisticated soft skills to enhance customer service and to contribute to a better overall retail experience by the customer.
- It is important to note that ASEAN's customers are not limited to the region's population. Business visitors and tourists are an important source of retail revenue. Indeed, tourism is known as a key growth sector for the region, and intra-regional travel reportedly accounted for more than 40 per cent of tourists in 2015.⁴⁶ A more service-oriented and better-trained workforce will be in demand to help ASEAN's retail players tap into the pockets of tourists.
- Eventually, disruptive technologies like the IoT, big data and cloud computing will radically transform ASEAN's retail sector. Computers will become better at collecting data. However, computers will always need humans to ask the right questions, interpret the data and apply it to improve business outcomes. Additionally, consumers will always want a human touch, someone who understands their individual needs and who are able to provide innovative solutions. ASEAN's workforce requirements will therefore change, and the talents of those who are in tune with the digital age and able to think outside-the-box will become more sought after.



⁴⁶ TR Business, 2016.

CONCLUSION

ASEAN is witnessing the introduction of innovations that will transform its workforce, both positively and negatively. However, the confluence of factors such as changing consumer demands, dynamics in large non-ASEAN economies, government regulations, the falling costs of technology, and skills availability, amongst others, make it difficult to predict the exact nature of these impacts.

A number of ASEAN countries, especially those with a heavy reliance on labour-intensive sectors, are particularly vulnerable to disruptive forces and the subsequent social dislocation that would follow. However, the opportunities presented by the new technologies are also considerable, and a number of the sectors examined by this report are well positioned to capitalize on them.

Main findings

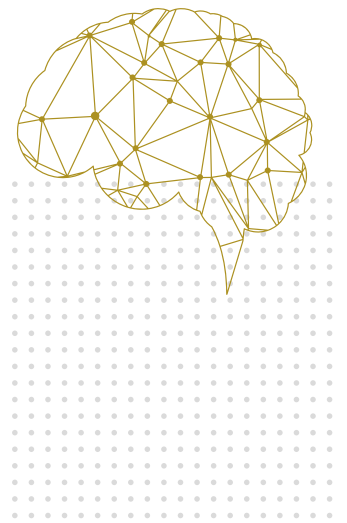
1 Manufacturing production processes are undergoing transformative change

Over the past few decades, technology has enabled supply chains to be scattered across the globe. This has brought substantive investment and job opportunities to many developing economies, facilitating a burgeoning middle class. That business model may now be dissipating. Customization technology, such as 3D printing, is enabling production to be carried out closer to markets, especially in sectors like TCF where speed-to-market matters to consumers. In tandem, rising operating costs in low-wage countries are further pushing manufacturing enterprises to move production closer to home. Mass production in the medium term will increasingly be complemented by more customized production occurring closer to the final consumer.

Additionally, there is a growing interconnectivity across key sectors in the region. For example, the proliferation of technological components in automobiles has resulted in much higher synergy and collaboration between the automotive and E&E sectors. Customized production has potentially major implications for the retail sector, blurring the line between manufacturing and retail services.

2 The technological impact on jobs and enterprises is pervasive, but certain sectors and groups will face particular disruption

The TCF sector, historically a major source of low-skilled mass employment across ASEAN, is transforming. In the coming years, the region is likely to experience a slowdown in total TCF export and employment growth. New and available technologies will increasingly allow multinational brands and retailers to bring production closer to markets. Ultimately, ASEAN's TCF sector may no longer offer jobs to millions who are looking for formal employment opportunities. That is, unless growth in domestic demand accelerates.



In the next few years, the BPO sector will increasingly adopt cloud technology and automation. Another disrupter, the DIY management of back-office tasks, will not only make economic sense, but will also enable companies to protect corporate information from leaking and reduce the risk of internal data abuse. An industry that invented itself on the back of new technology 20-odd years ago and created widespread employment is now facing major restructuring that could result in far less jobs than it once created.

Worryingly, women are more likely than men to be employed in occupations that fall under high risk of automation. Women in the Philippines and Viet Nam face more than twice the probability of being in a high-risk occupation than their male counterparts. In Indonesia and Thailand, the relative probability for women to occupy a high-risk job compared to men is approximately 1.5 times higher.

Labour-intensive sectors highly susceptible to technological change tend to have heavy concentrations of female workers. For example, over 70 per cent of workers in ASEAN's TCF sector are women. Additionally, the retail and BPO sectors provide critical employment opportunities for women; they make up about 50 per cent of the workforce. However, all three sectors face high automation risk, jeopardizing prospective employment opportunities for the region's female workers.

In the E&E sector, automation and robotics are performing more lower skilled packaging and assembling work, currently undertaken by mostly migrant workers in Malaysia (and in Thailand, albeit to a lesser extent). Migrant worker remittances are critical in sustaining families residing in home countries. With today's technological trends, it is uncertain if migrant workers will have the same opportunities in the future in sectors that required numerous low-skilled workers.

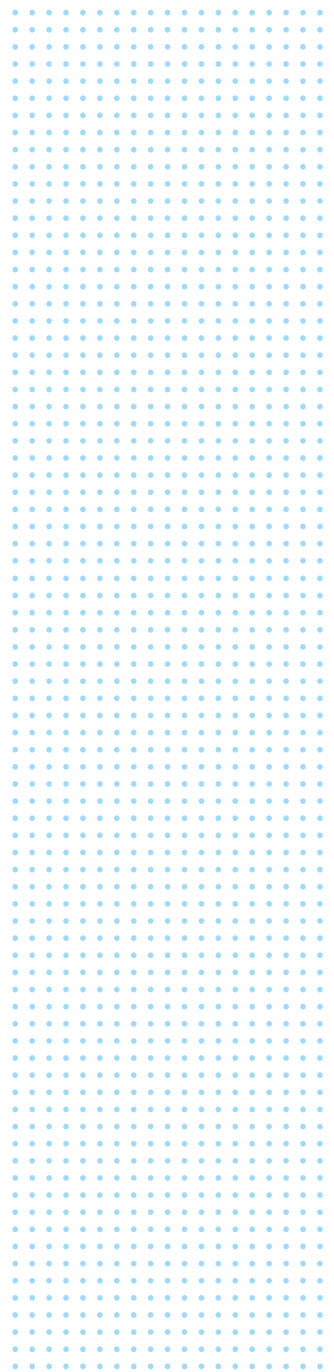
3 In certain sectors in ASEAN, technology has not yet reached the price trigger point, but will inevitably

The decision to introduce an automated process is a complex one and cannot be reduced to only a matter of pricing. Costs of automation and robotics are direct, indirect and continually changing. However, there is certainly a labour price point where that calculus changes. Those price points in ASEAN's main labour-intensive sectors have not yet been reached, but may do in the medium term.

For some manufacturing occupations in the automotive and E&E sectors, automation and collaborative robotic processes, also called cobots, are being deployed in a human centric manner, raising the productivity of existing workers with higher skills (rather than replacing them). This may change as robotic and automation processes utilize more complex algorithms that enable analysis, prediction.

4 Making skills, training and education systems “fit for purpose” will require major effort

In almost all interviews and surveys conducted, the increased skills content of occupations constantly surfaced. Yet, education and training infrastructures have been slow to evolve in ASEAN. Traditionally, it has taken time to determine enterprise and industry skills needs and marry these with institutional frameworks capable of delivering them. Moreover, many educational and vocational training institutions and systems in the region are not capable of responding to the changing needs of enterprises induced by fast-paced technological changes and they lack qualified educators and instructors who can transfer this knowledge. These structures are therefore no longer fit for purpose. New and innovative ways of preparing young people with industry-relevant and forward-looking skills will be required.



Specifically, policy direction needs to be targeted at improving the pursuit of STEM subjects. Key sectors – notably, the automotive and E&E sectors – will see demand for technically capable individuals. Even within other sectors like BPO, retail and TCF, enterprises are increasing their demand for workers with enhanced technical skills and backgrounds in engineering and science. Increased efforts are needed to encourage more students to take STEM-related courses, and in particular, to promote female enrolment.

5 Comprehensive multifaceted growth and investment strategies are now required in the technological age

The export-led manufacturing development model – employed spectacularly by China, Japan, and the Republic of Korea – to facilitate the movement of large numbers of low-skilled workers from the field to the factory, may no longer offer the employment gains that it once did. As manufacturing evolves, policy-makers must adjust their expectations and look at manufacturing not as a source of mass employment in traditional production work, but as a critical driver of innovation, productivity and competitiveness. Countries competing principally or solely on low-wage labour need to reposition themselves. Price advantage is no longer enough.

Our research demonstrates that technology increases the number of operational choices available to enterprises, allowing investment decisions to be made based on a multitude of factors. MNEs are less likely to base their production and investment decisions principally on low labour costs.

Policy-makers need to create a more conducive environment for FDIs, focusing on human capital, transportation and logistics, materials and components, energy, capital, regulation, and trade policy. Countries that do not respond now to these challenges, particularly those with undiversified economies, are at a real risk of backsliding on development gains they have made to date.

Summary

Considerable opportunities for growth exist within ASEAN. Importantly, the local domestic market is expanding, and ASEAN's middle class is expected to grow to 125 million by 2025. This represents a massive and emerging regional market.

However, threats remain, and in some cases, are intensifying. In particular, a range of labour-intensive sectors in a number of less developed countries are susceptible to major technological disruption, leading to potential large-scale job displacement. The consequences for these countries could be profoundly negative if they are unprepared to adapt.

We are witnessing the emergence of new markets, the potential relocation of production, the rise of new hiring trends and the displacement of lower skilled jobs. Supplying workers with the appropriate skills and competencies remains a major challenge. Overall, concerted efforts are required from all ASEAN stakeholders. They should act now to build a future of innovation and growth shaped with better employment opportunities.



REFERENCES



Accenture. 2015. *High performance BPO and the value multiplier effect*. Available at: https://www.accenture.com/t20160112T124201__w_/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Operations_2/Accenture-High-Performance-BPO-POV-Final-Nov-2015.pdf [20 May 2016].

Adidas. 2015. *Adidas sourcing strategy*. Available at: http://www.adidas-group.com/media/filer_public/86/a5/86a53df1-c795-4bf1-8b9a-145842ede91c/01_ir_tutorialsworkshop_sourcing_strategy.pdf [19 Apr. 2016].

—. 2016. *Adidas Group annual report 2015*. Available at: http://www.adidas-group.com/media/filer_public/e9/73/e973acf3-f889-43e5-b3c0-bc870d53b964/2015_gb_en.pdf [22 Mar. 2016].

Aepfel, T. 2015. "It took the telephone 75 years to do what Angry Birds did in 35 days. But what does that mean?", in *The Wall Street Journal*, 13 Mar. Available at: <http://blogs.wsj.com/economics/2015/03/13/it-took-the-telephone-75-years-to-do-what-angry-birds-did-in-35-days-but-what-does-that-mean/> [15 May 2016].

Alibaba. 2016. *Shoe upper knitting machine*. Available at: <http://www.alibaba.com/showroom/shoe-upper-knitting-machine.html> [12 Mar. 2016].

Ambasna-Jones, M. 2015. "Five ways to bring advertising to life in the internet of things", in *The Guardian*, 28 July. Available at: www.theguardian.com/media-network/2015/jul/28/internet-things-advertising-marketing [4 Apr. 2016].

Appticity. 2016. *Retail industry gives RFID technology a second chance*. Available at: <https://blog.appticity.com/2016/02/retail-industry-gives-rfid-technology-a-second-chance/> [22 June 2016].

Asian Development Bank (ADB). 2013. *Gender equality in the labor market in the Philippines* (Manila). Available at: <http://www.adb.org/sites/default/files/publication/31194/gender-equality-labor-market->

Association of Southeast Asian Nations (ASEAN). 2015. *ASEAN statistical yearbook 2014*. (Jakarta).

—. Occupational Safety and Health Network (ASEAN-OSHNET). 2016. *Thailand: Occupational safety and health statistic and situation*. Available at: http://www.aseanoshnet.org/index.php?option=com_k2&view=item&id=42:osh-statistics&Itemid=113 [10 May 2016].

AT Kearney. 2011. *Stop the roller coaster in apparel sourcing*. Available at: http://www.atkearney.de/paper/-/asset_publisher/dVxv4Hz2h8bS/content/stop-the-roller-coaster-in-apparel-sourcing/10192 [24 Mar. 2016].

—. 2014. *The 2014 global retail development index: Full steam ahead for global retailers*. Available at: <https://www.atkearney.com/documents/10192/4600212/Full+Steam+Ahead+for+Global+Retailers+-+2014+Global+Retail+Development+In....pdf/> [15 June 2016].



—. 2015. *Lifting the barriers to retail innovation in ASEAN*. Available at: <https://www.atkearney.com/documents/10192/5540871/Lifting+the+Barriers+to+E-Commerce+in+ASEAN.pdf/d977df60-3a86-42a6-8d19-1efd92010d52> [20 May 2016].

—. 2016. *On the eve of disruption: A new business model threatens established concepts of offshoring and expands the market*. Available at: <https://www.atkearney.com/documents/10192/7094247/On+the+Eve+of+Disruption.pdf/49fa89fa-7677-4ab8-8854-5003af40fc8e> [15 June 2016].

Bank of America Merrill Lynch. 2015. *Thematic investing: Creative disruption*. Available at: http://www.bofam.com/content/dam/boamlimages/documents/articles/D3_006/11511357.pdf [7 Apr. 2016].

Bank of Thailand. (n.d.). *Indicators*. Available at: <https://www.bot.or.th/Thai/Statistics/Indicators/Docs/indicators.xls> [22 May 2016].

Barnes, N., Lescault, A. 2013. *Millennials drive social commerce: Turning their likes, follows or pins into sale* (Centre for Marketing, University of Massachusetts Dartmouth).

Barra, M. 2016. *State of Auto: If you're not in one of these 10 jobs, you should be*. Available at: <https://www.linkedin.com/pulse/state-auto-youre-one-10-jobs-you-should-mary-barra?trk=eml-mktg-inf-m-my-industry-0315-cta-p1> [6 Apr. 2016].

Barrie, L. 2015. "Can robotics redefine the future of apparel manufacturing?", in *Just-style*. 23 Sep. Available at: www.just-style.com [16 Feb 2016].

—. 2016. "Outlook 2016 - What's happening with apparel sourcing?", in *Just-style*, 6 Jan. Available at: http://www.just-style.com/management-briefing/outlook-2016-whats-happening-with-apparel-sourcing_id126923.aspx [18 Mar. 2016].

Bauer, H.; Patel, M.; Veira, J. 2015. *Internet of Things: Opportunities and challenges for semiconductor companies*. Available at: <http://www.mckinsey.com/industries/semiconductors/our-insights/internet-of-things-opportunities-and-challenges-for-semiconductor-companies> [8 Apr. 2016].

BBC. 2016. *Chinese city Wuhu embraces driverless vehicles*. Available at: <http://www.bbc.com/news/technology-36301911> [25 May 2016].

Bhatia, A.; Asai, R. 2007. *Mass customization in apparel and footwear industry – today's strategy, future's necessity (WIPRO)*. Available at: http://www.wipro.com/documents/resource-center/library/mass_customization.pdf [20 Mar. 2016].

Bjork, B. 2014. "Zara builds its business around RFID", in *The Wall Street Journal*, 16 Sept. Available at: <http://www.wsj.com/articles/at-zara-fast-fashion-meets-smarter-inventory-1410884519> [15 June 2016].

Bloomberg News. 2013. "BMW, General Motors among manufacturers using robots for efficiency", 27 Dec. Available at: <http://www.newsday.com/classifieds/cars/bmw-general-motors-among-manufacturers-using-robots-for-efficiency-1.6680097> [13 May 2016].

Brown, M. 2015. *Sparking excitement: Investment opportunities in ASEAN's electronic industry*. Available at: <http://www.aseanbriefing.com/news/2015/10/13/sparking-excitement-investment-opportunities-in-aseans-electronics-industry.html> [14 Apr. 2016].

Business World Online. 2014. *The future of the Philippines' KPO industry*. Available at: <http://www.bworldonline.com/content.php?section=Economy&title=the-future-of-the-philippines&id=95576> [25 Apr. 2016].

Byrne, C. 1995. *The impact of new technology in the clothing industry: Outlook to 2000*. Available at: <http://davidrigbyassociates.co.uk/DRA%20WEBSITE%2003/assets/Impact%20Clothing%20Technology.pdf> [15 Mar. 2016].

CB Insights. 2015. *25 Corporations not named Google working on driverless cars*. Available at: <https://www.cbinsights.com/blog/autonomous-driverless-vehicles-corporations-list/> [5 May 2016].

Chang, C. 2015. *Where iPhone 6S is made. 70% of iPhone production now comes from Foxconn's Zhengzhou plant*. Available at: <http://micgadget.com/26325/70-of-iphone-production-now-comes-from-foxconns-zhengzhou-plant/> [1 Apr. 2016].

Chang, J-H; Huynh, P. 2016. *ASEAN in transformation: The future of jobs at risk of automation* (Geneva, ILO).

Chen, Y.; Wang, S. "Alibaba expands in Southeast Asia with \$1 Billion Lazada deal", in *Bloomberg Technology*, 12 Apr. 2016. Available at: <http://www.bloomberg.com/news/articles/2016-04-12/alibaba-to-pay-1-billion-for-control-of-lazada-e-commerce-site> [10 May 2016].

Cheong, K.C.; Selvaratnam, V.; Goh, K.L. 2011. "Education and human capital formation", In *Rasiah, R. (ed): Malaysian economy: Unfolding growth and social change* (Kuala Lumpur, Oxford University Press).

CIO Insight. 2014. *The growing impact of autonomics*. Available at: <http://www.cioinsight.com/it-management/expert-voices/the-growing-impact-of-autonomics.html> [28 Apr. 2016].

Clifford, S. 2013. "U.S textile plants return, with floors largely empty of people", in *The New York Times*, 19 Sep. Available at: http://www.nytimes.com/2013/09/20/business/us-textile-factories-return.html?pagewanted=all&_r=0 [7 Mar. 2016].

Competition Commission of Singapore. 2015. *E-Commerce in Singapore – How it affects the nature of competition and what it means for competition policy*. Available at: <https://www.ccs.gov.sg/media-and-publications/publications/occasional-papers/e-commerce-in-singapore> [22 June 2016].

Consumer Electronic Association (CEA). 2015. *The Internet of Things: Evolution or revolution? Part 1 in a series*. Available at: <https://www.aig.co.uk/content/dam/aig/emea/united-kingdom/documents/aig-white-paper-iot-june2015-brochure.pdf> [5 Apr. 2016].

Crease, R. 2010. "Invasion of the full body scanners", in *The Wall Street Journal*, 21 May. Available at: <http://www.wsj.com/articles/SB10001424052748704608104575220542781522702> [4 Mar. 2016].

Datamark. 2013. *Top 10 business outsource processing trends to watch for in 2014*. Available at: <https://www.datamark.net/resources/company-news/top-10-business-process-outsourcing-trends-to-watch-for-in-2014> [15 Apr. 2016].

—. 2015. *Six contact center trends to watch in 2016*. Available at: <http://www.datamark.net/call-centers/blog/six-contact-center-trends-to-watch-2016/> [18 Apr. 2016].





DBS Group Research. 2015. *Digital disruption deries, Asia retail sector*. Available at: http://www.dbs.com.sg/treasures/templatedata/article/generic/data/en/GR/042015/150430_insights_digital_disruption_to_asia_retail_sector.xml [15 June 2016].

De Looper, C. 2015. *The complete list of self-driving cars in development*. Available at: <http://www.techradar.com/news/car-tech/the-complete-list-of-self-driving-cars-in-development-130638> [5 May 2016].

Deloitte. 2009. *A new era: Accelerating toward 2020 – an automotive industry transformed*. Available at: <http://www2.deloitte.com/content/dam/Deloitte/in/Documents/manufacturing/a-new-era-auto-transformation-report-online.pdf> [13 May 2016].

—. 2014. *Retail in Vietnam: Emerging market, emerging growth*. Available at: <http://www2.deloitte.com/content/dam/Deloitte/ie/Documents/ConsumerBusiness/2014-deloitte-ireland-retail-vietnam.pdf> [18 May 2016].

—. 2015a. *Autonomics in business process outsourcing: Show me the money*. Available at: <http://www2.deloitte.com/content/dam/Deloitte/us/Documents/process-and-operations/us-operations-autonomics-in-bpo-10020698-02112015.pdf> [15 June 2016].

—. 2015b. *Women at the wheel*. Available at: <http://www2.deloitte.com/content/dam/Deloitte/us/Documents/manufacturing/us-manufacturing-women-at-the-wheel.pdf> [13 May 2016].

eMarketer. 2015. *Asia-Pacific boasts more than 1 billion smartphone users China, the world's no. 1 smartphone market, is beginning to mature*. Available at: <http://www.emarketer.com/Article/Asia-Pacific-Boasts-More-Than-1-Billion-Smartphone-Users/1012984#sthash.Yq74plaR.dpuf> [8 May 2016].

EOS Intelligence. 2015. *Garments and textile in Vietnam – Is the future as bright as the past*. Available at: <http://www.eos-intelligence.com/perspectives/?p=1535> [17 Mar. 2016].

Epstein, Z. 2013. *Daily iPhone 5S production now matches Moto's Q3 entire sales*. Available at: <http://bgr.com/2013/11/27/iphone-5s-production-foxconn/> [12 Apr. 2016].

European Commission. 2014. *Robotic assistants for workers on the factory floor*. Available at: <https://ec.europa.eu/programmes/horizon2020/en/news/robotic-assistants-workers-factory-floor> [13 May 2016].

Everything. 2016. *About us*. Available at: <https://evrythng.com/about/> [12 Apr. 2016].

Fangqing, W. 2015. "Esquel CEO says automation core to competitiveness", in *Just-style*, 1 Dec. Available at: http://www.just-style.com/interview/esquel-ceo-says-automation-core-to-competitiveness_id126642.aspx [13 Mar. 2016].

Fernquest, J. 2013. "Pay for it yourself & avoid waiting in lines", in *Bangkok Post*, 27 Mar. Available at: <http://www.bangkokpost.com/learning/learning-from-news/342644/pay-for-it-yourself-avoid-waiting-in-lines> [19 May 2016].

Financial Times. 2015. "Robot-related deaths are rare and becoming rarer", 2 July. Available at: <http://www.ft.com/intl/cms/s/0/c9851cde-20b3-11e5-aa5a-398b2169cf79.html?siteedition=intl#axzz43WtQCYPi> [13 May 2016].

Fletcher, I. 2015. *Is the Internet of Things the food safety solution of the future?* Available at: <http://www.foodonline.com/doc/is-the-internet-of-things-the-food-safety-solution-of-the-future-0001> [17 May 2016].

Focus2move. 2015. *Thailand best selling cars. The top 50 in the 2015.* Available at: <http://focus2move.com/thailand-best-selling-cars/> [13 May 2016].

Gartner. 2016. *Business Process as a Service (BPaaS).* Available at: <http://www.gartner.com/it-glossary/business-process-as-a-service-bpaas/> [22 Apr. 2016].

Gereffi, G.; Memedovic, O. 2003. *The global apparel value chain: What prospects for upgrading by developing countries?* (Vienna, United Nations Industrial Development Organization).

Glan, Y. 2015. *ASEAN smart network offers IoT opportunities for manufacturers.* Available at www.industryweek.com/expansion-management/asean-smart-network-offers-iot-opportunities-manufacturers [17 Apr. 2016].

Global Business Guide (GBG). 2012. *Manufacturing: challenges in Indonesia's FTG industry.* Available at: http://www.gbgingonesia.com/en/manufacturing/article/2011/challenges_in_indonesia_s_ftg_industry.php [10 Mar. 2016].

—. 2013. *Electronics and home appliances manufacturing in Indonesia; finding its edge.* Available at: http://www.gbgingonesia.com/en/manufacturing/article/2015/electronics_and_home_appliances_manufacturing_in_indonesia_finding_its_edge_11128.php [8 Apr. 2016].

Goldman Sachs, 2014. *The Internet of Things: Making sense of the next mega trend.* Available at: <http://www.goldmansachs.com/our-thinking/pages/internet-of-things/iot-report.pdf> [18 Apr. 2016].

—. 2016. *Cars 2025.* Available at: www.goldmansachs.com/our-thinking/technology-driving-innovation/cars-2025/index.html [12 May 2016].

GreenBiz. 2010. *Levi's new jeans design cuts water use by 96 per cent.* Available at: <https://www.greenbiz.com/news/2010/11/04/levis-new-jeans-design-cuts-water-use-96-percent> [16 Mar. 2016].

Groden, C. 2015. *Here's how much a Tesla Model X will cost you.* Available at: <http://fortune.com/2015/11/24/tesla-model-x-price/> [12 May 2016].

Harrop, P.; Hayward, J.; Das, R.; Holland, G. 2015. *Wearable technology 2015-2025: Technologies, markets, forecasts.* Available at: <http://www.idtechex.com/research/reports/wearable-technology-2015-2025-technologies-markets-forecasts-000427.asp?viewopt=orderinfo> [4 June 2016].

Hidayat, S. 2016. *Manufacturing industry in Indonesia contributes 18.1% to GDP.* Available at: <http://www.indonesia-investments.com/news/todays-headlines/manufacturing-industry-indonesia-contributes-18.1-to-gdp/item6527> [12 Apr. 2016].

Higher Engineering Education Alliance Program (HEEAP). 2016. *HEEAP.* Available at: <https://heep.org/> [14 Apr. 2016].

History. 2016. *Ford's assembly line starts rolling.* Available at: www.history.com/this-day-in-history/fords-assembly-line-starts-rolling [12 May 2016].





HKTDC. 2015. *Indonesia market profile*. Available at: <http://emerging-markets-research.hktdc.com/business-news/article/Asia/Indonesia-Market-Profile/mp/en/1/1X000000/1X00107T.htm> [14 Apr. 2016].

Huynh, P. 2015. Strong export and job growth in Asia's garment and footwear sector, *Asia-Pacific Garment and Footwear Sector Research Note, Issue 1*, November (Bangkok, ILO).

HV, V.; Thompson, F.; Tonby, O. 2014. *Understanding ASEAN: Seven things you need to know*. Available at: <http://www.mckinsey.com/industries/public-sector/our-insights/understanding-asean-seven-things-you-need-to-know> [12 May 2016].

ICP. 2015. *2014 China produced 1.63 billion mobile phones accounted for more than half of the global*. Available at: <http://www.hi3p.com/2015/02/28/2014-china-produced-163-billion-mobile-phones-accounted-for-more-than-half-of-the-global-13634.html> [13 Apr. 2016].

IDC. 2014. *The Internet of Things: Data from embedded systems will account for 10% of the digital universe by 2020*. Available at: <http://www.emc.com/leadership/digital-universe/2014iview/internet-of-things.htm> [23 Feb. 2016].

Inc. 2014. *How cloud is changing BPO*. Available at: <http://www.inc.com/comcast/how-cloud-is-changing-bpo.html> [19 Apr. 2016].

Inditex. 2014. *Inditex deploys RFID technology in its stores*. Available at: http://www.inditex.com/en/media/news_article?articleId=150174 [25 May 2016].

Indonesia Investments. 2015. *Smartphone users in Indonesia to grow sharply in the years ahead*. Available at: <http://www.indonesia-investments.com/news/todays-headlines/smartphone-users-in-indonesia-to-grow-sharply-in-the-years-ahead/item6243> [27 Apr. 2016].

IndustriAll European Trade Union. 2015. *Digitalising manufacturing whilst ensuring equality, participation and cooperation*. Available at: http://www.industriall-europe.eu/Committees/IP/PolBrief/PolicyBrief_2015-07_DigitisationOfManufacturing-EN.pdf [23 Mar. 2016].

Information Technology and Business Process Automation of the Philippines (IBPAP). 2012. *Information technology and business process management road map, 2012–2016*. Available at: <http://www.ibpap.org/it-bpm-industry-road-map-2016-public-version-download> [29 June 2016].

Inside Retail Asia. 2015. *Tesco Malaysia to launch self-checkout lanes*. Available at: <https://insideretail.asia/2015/06/23/tesco-malaysia-to-launch-self-checkout-lanes/> [25 May 2016].

Intel. 2016. *Brooks Brothers perfects 'made to measure'*. Available at: <http://www.intel.com/content/dam/www/public/us/en/documents/marketing-briefs/nrf-2016-brooks-brothers.pdf> [23 Mar. 2016].

International Federation of Robots (IFR). 2015. *Industrial robots statistics*. Available at: <http://www.ifr.org/industrial-robots/statistics/> [20 Feb. 2016].

International Labour Organization (ILO). 2014a. *Wages and working hours in the textile, clothing, leather and footwear industries* (Geneva).

—. 2014b. *Global Wage Report 2014/2015: Asia Pacific Supplement*. Available at: http://www.ilo.org/wcmsp5/groups/public/--asia/--ro-bangkok/--sro-bangkok/documents/publication/wcms_325219.pdf [15 June 2016].

—. 2015. *Key indicators of the labour market (KILM)*, 9th Edition. Available at: <http://www.ilo.org/global/statistics-and-databases/research-and-databases/kilm/lang--en/index.htm> [27 May 2016].

—. 2016a. *ILOSTAT Database*. Available at: https://www.ilo.org/ilostat/faces/help_home/data_by_subject?_afLoop=221316852224975&_adf.ctrl-state=91m7afx9d_4 [10 Mar. 2016].

—. 2016b. *ASEAN in Transformation: Perspectives of enterprises and students on future work*. (Geneva).

-. 2016c. *ASEAN in Transformation: Textiles, clothing and footwear: Refashioning the future*. (Geneva).

—. Forthcoming. *Sectoral business associations and development in Southeast Asia: A cross-sectoral, cross-national analysis* (Geneva).

International Organization of Motor Vehicle Manufacturers (OICA). 2016. *Production statistics*. Available at: <http://www.oica.net/category/production-statistics/> [12 May 2016].

Jain. S. 2013. *Does the cloud come with a silver lining for BPO?* Available at: <http://www.wns.com/insights/articles/articledetail/81/does-the-cloud-come-with-a-silver-lining-for-bpo> [20 Apr. 2016].

Just-style. 2014. *Tomorrow's apparel industry: Roger Lee, TAL Apparel Group*. Available at: <http://www.just-style.com/Lectra-Roger-Lee/> [26 Mar. 2016].

—. 2015. *How will rising costs impact Adidas sourcing strategy*. Available at: http://www.just-style.com/analysis/how-will-rising-costs-impact-adidas-sourcing-strategy_id126814.aspx [18 Mar. 2016].

—. 2016. *Assessing Africa as an alternative apparel source*. Available at: https://www.just-style.com/comment/assessing-africa-as-an-alternative-apparel-source_id127482.aspx [15 Mar. 2016].

Kaltenbrunner, H. 2014. "How 3D printing is set to shake up manufacturing supply chains", in *The Guardian*, 25 Nov. Available at: <http://www.theguardian.com/sustainable-business/2014/nov/25/how-3d-printing-is-set-to-shake-up-manufacturing-supply-chains> [14 Mar. 2016].

KPMG. 2006. *Grocery retailing in Asia Pacific*. Available at: <https://www.kpmg.com/CN/en/IssuesAndInsights/ArticlesPublications/Documents/Retailing-Asia-Pacific-200610.pdf> [5 May 2016].

Kobayashi, H. 2014. "Current state and issues of the automobile and auto parts industries in ASEAN" in *Research Institute Autoparts Industries*, Waseda University (eds): *Automobile and auto component industries in ASEAN: Current state and issues* (Jakarta, Economic Research Institute for ASEAN and East Asia), p.1-24.





Krivkovich, A.; Kutcher, E.; Yee, L. 2016. *Breaking down the gender challenge*. Available at: <http://www.mckinsey.com/business-functions/organization/our-insights/breaking-down-the-gender-challenge> [12 May 2016].

Kyaw, K. 2016. “EU gives Myanmar garment sector a boost”, in *The Nation*, 25 Jan. Available at: <http://www.nationmultimedia.com/business/EU-gives-Myanmar-garment-sector-a-boost-30277643.html> [13 Mar. 2016].

Lacity, M.; Willcocks, L.; Craig, A. 2015. “Robotic process automation at Telefónica O2”, in *The outsourcing unit working research paper series*, paper 15/02.

Lechal. 2015. *The world’s first haptic footwear is here*. Available at: <http://lechal.com/> [5 Apr. 2016].

Leclaire, E. 2015. *Choosing an investment location in ASEAN’s booming automobile industry*. Available at: <http://www.aseanbriefing.com/news/2015/06/18/overview-of-aseans-current-automobile-industry.html> [12 May 2016].

Lee Kuan Yew School of Public Policy. 2014. *Business process outsourcing in the Philippines* (National University of Singapore) Available at: <http://lkyspp.nus.edu.sg/wp-content/uploads/2014/12/Business-Process-Outsourcing-in-the-Philippines.pdf> [28 Apr. 2016].

Malaysian External Trade Development Corporation (MATRADE). 2016. *Electrical and electronics – Industry overview*. Available at: www.matrade.gov.my/en/foriegn-buyers-section/69-industry-write-up--products/557-electrical-a-electronics [9 Apr. 2016].

Manyika, J.; Chui, M.; Bughin, J.; Dobbs, R.; Bisson, P.; Marrs, A. 2013. *Disruptive technologies: Advances that will transform life, business, and the global economy* (McKinsey Global Institute).

Marr, B. 2015. *Big data: A game changer in the retail sector*. Available at: <http://www.forbes.com/sites/bernardmarr/2015/11/10/big-data-a-game-changer-in-the-retail-sector/#74b36162678a> [12 May 2016].

Masri, M.; Esber, D., Sarrazin, H., Singer, M. 2015. “Your Company Should be Helping Customers on Social”, in *Harvard Business Review*, 15 July. Available at: <https://hbr.org/2015/07/your-company-should-be-helping-customers-on-social> [25 Apr. 2016].

Maybank. 2015. *Big ideas: The charts of ASEAN*. Available at: <http://www.maybank-ke.com/media/490183/150212-cap10-asean-ceo-summit-big-ideas-the-charts-of-asean.pdf> [14 May 2016].

McKinsey and Company. 2012. *Manufacturing the future: The next era of global growth and innovation*. Available at: <http://www.mckinsey.com/business-functions/operations/our-insights/the-future-of-manufacturing> [30 May 2016].

—. 2013a. *Disruptive technologies: Advances that will transform life, business, and the global economy*. Available at: <http://www.mckinsey.com/business-functions/business-technology/our-insights/disruptive-technologies> [6 May 2016].

—. 2013b. *The evolving Indonesian Consumer*. Available at: <http://www.mckinsey.com/~media/McKinsey%20Offices/Singapore/Indonesia%20Consumer%20Report%202014.ashx> [17 May 2016].

Mercedes-Benz. 2014a. *Mercedes-Benz takes leading role in ground breaking dual education programme for Thai auto industry*. Available at: http://www.mercedes-benz.co.th/content/thailand/mpc/mpc_thailand_website/enng/home_mpc/passengercars/home/about_mercedes/mercedes_news/2014/technical_dual_education_program.html [12 May 2016].

—. 2014b. *Mercedes Benz: 16 reliable automotive mechatronic training program technicians ready to assist Mercedes-Benz consumers across Indonesia*. Available at: <http://indonesien.ahk.de/news/news-detail/artikel/mercedes-benz-16-reliable-automotive-mechatronic-training-program-technicians-ready-to-assist-mercedes-benz-consumers-across-indonesia/?cHash=335927e339431de1dbec83ee15840507> [12 May 2016].

Messenger, J. and Ghosheh, N. (eds). 2010. *Offshoring and working conditions in remote work* (Geneva, ILO).

Metriyakool, D. 2011. *Continued reliance on remittances stress the need for Philippines to focus on domestic job creation*. Available at: <http://www.economonitor.com/analysts/2011/07/28/continued-reliance-on-remittances-stress-the-need-for-philippines-to-focus-on-domestic-job-creation/> [22 Apr. 2016].

Meyer, D. "Why Adidas is turning to robots in Germany and the US", in *Fortune*, 25 May 2016. Available at: <http://fortune.com/2016/05/25/adidas-robot-speedfactories/> [29 May 2016].

Middlehurst, C. 2015. "Robotics revolution rocks Chinese textile workers", in *Aljazeera*, 16 June. Available at: <http://www.aljazeera.com/indepth/features/2015/06/robotics-revolution-rocks-chinese-textile-workers-150614073735531.html> [30 Mar. 2016].

Montaldo, D. 2016. *Is shopping online really cheaper?* Available at: <http://couponing.about.com/od/bargainshop/a/onlinecheaper.htm> [22 May 2016].

Montecillo, P. 2015. *BPO revenues seen to overtake OFW remittances*. Available at: <http://business.inquirer.net/192259/bpo-revenues-seen-to-overtake-ofw-remittances> [23 Apr. 2016].

NANOBusiness. 2015. *The nanotechnology used in clothes*. Available at: <http://www.nanobusiness.org/the-nanotechnology-used-in-clothes.html> [24 Mar. 2016].

National Bureau of Statistics of China. 2016. *National data*. Available at: <http://data.stats.gov.cn/english/> [5 June 2016].

National Competitiveness Council of the Philippines. 2012. *BPO jobs remain vacant due to lack of skills*. Available at: <http://www.competitive.org.ph/stories/519> [15 June 2016].

National Science and Technology Development Agency (NSTDA). 2011. *NSTDA at a glance*. Available at: <http://www.nstda.or.th/eng/index.php/about/nstda-in-brief> [10 May 2016].

Nielsen. 2015a. *Maximising traditions: The shop. Shopper. Shopkeeper*. Available at: <http://www.nielsen.com/content/dam/niensenglobal/apac/docs/reports/2015/nielsen-traditional-trade-october2015.pdf> [18 May 2016].





—. 2015b. *The future of grocery: E-Commerce, digital technology and changing shopping preferences around the world*. Available at: [http://www.nielsen.com/content/dam/niensenglobal/vn/docs/Reports/2015/Nielsen%20Global%20E-Commerce%20and%20The%20New%20Retail%20Report%20APRIL%202015%20\(Digital\).pdf](http://www.nielsen.com/content/dam/niensenglobal/vn/docs/Reports/2015/Nielsen%20Global%20E-Commerce%20and%20The%20New%20Retail%20Report%20APRIL%202015%20(Digital).pdf) [11 May 2016].

Nike. 2013. *Sustainable business performance summary*. Available at: http://www.nikeresponsibility.com/report/uploads/files/FY12-13_NIKE_Inc_CR_Report.pdf [22 Mar. 2016].

OMSignal. 2016. *The world's most advanced apparel platform*. Available at: <http://www.omsignal.com/> [11 Apr. 2016].

Overby, S. 2012. *IT robots may mean the end of offshore outsourcing*. Available at: <http://www.cio.com/article/2390305/outsourcing/it-robots-may-mean-the-end-of-offshore-outsourcing.html> [25 Apr. 2016].

Oxford Business Group. 2015. *The Philippines' BPO sector creates jobs and is drawing wealth and investment*. Available at: <http://www.oxfordbusinessgroup.com/overview/philippines-bpo-sector-creates-jobs-and-drawing-wealth-and-investment> [21 Apr. 2016].

—. 2016. *The Philippine electronics industry is benefitting from higher global demand*. Available at: <http://www.oxfordbusinessgroup.com/analysis/bouncing-back-local-electronics-industry-bE&Fitting-higher-global-demand> [20 Apr. 2016].

Passary, S. 2016. *Singapore slaps Tesla Model S owner with \$11,000 fine for high CO2 Emissions: Here's why*. Available at: <http://www.techtimes.com/articles/140300/20160312/singapore-slaps-tesla-model-s-owner-with-11000-fine-for-high-co2-emissions-heres-why.htm> [12 May 2016].

Philippines Board of Investment and Department of Trade and Industry. 2011. *The Philippine electronics industry profile*. Available at: http://www.philexport.ph/c/document_library/get_file?uuid=8659b363-97ff-4ffd-b7e8-364fa03c492f&groupId=127524 [6 Apr. 2016].

Philippine Statistical Authority. 2015. *2012 CPBI- Business Process Outsourcing (BPO) activities: Final results*. Available at: <https://psa.gov.ph/content/2012-cpbi-business-process-outsourcing-bpo-activities-final-results> [21 Apr. 2016].

—. 2016. *2013-annual survey of Philippine business and industry (ASPBI) – administrative and support service activities with total employment of 20 or over: Preliminary results*. Available at: <https://psa.gov.ph/content/2013-annual-survey-philippine-business-and-industry-aspbi-administrative-and-support-service> [21 Apr. 2016].

Pocket-lint. 2016. *Self-driving cars: 14 automakers betting on driverless vehicles*. Available at: <http://www.pocket-lint.com/news/136208-self-driving-cars-14-automakers-betting-on-driverless-vehicles> [10 May 2016].

Pricewaterhouse Coopers (PwC). 2015. *2015-16 Outlook for the retail and consumer products sector in Asia*. Available at: http://www.pwchk.com/webmedia/doc/635593364676310538_rc_outlook_201516.pdf [20 May 2016].

Rasiah, R. Forthcoming. "The industrial policy experience of the electronics industry in Malaysia" in Tarp, F. and Page, J. (eds): *UNU-WIDER working paper series* (Helsinki).

Rasmussen, R. 2015. *The tipping point*. Available at: <http://www.magazines007.com/pdf/PCB-Jan2015.pdf> [6 Apr. 2016].

Reuters. 2015. *Adidas aims to open automated shoe factory in Germany in 2016*. Available at: <http://www.reuters.com/article/us-adidas-robots-idUSKCN0SE1RL20151020> [17 Mar. 2016].

Revensencio, J. 2015. "Buying in the cloud: How cloud technology is revolutionizing the retail industry", in *Business.com*, 17 Jul. 2015. Available at: <http://www.business.com/cloud-computing/buying-in-the-cloud-how-cloud-technology-is-revolutionizing-the-retail-industry/> [12 May 2016].

Rigby, C. 2011. *80% say shopping is cheaper online*. Available at: <http://internetretailing.net/2011/07/80-say-shopping-is-cheaper-online/> [15 May 2016].

Royal Academy of Engineering. 2013. *Additive manufacturing: Opportunities and constraints (A summary of a roundtable forum held on 23 May 2013)*. Available at: <http://www.raeng.org.uk/publications/reports/additive-manufacturing> [2 May 2016].

Sarokin, D. 2016. *Difference between tier 1 and tier 2 Companies*. Available at: <http://smallbusiness.chron.com/difference-between-tier-1-tier-2-companies-25430.html> [10 May 2016].

Singapore Economic Development Board. 2016. *Electronics: Industry background*. Available at: <https://www.edb.gov.sg/content/edb/en/industries/industries/electronics.html> [3 Apr. 2016].

Singh, S. 2008. "Impact Internet and e-commerce on the labour market", in *Indian Journal of Industrial Relations*, Vol. 43, No.4, pp.633-644.

Sirkin, H.M.; Zinser, M.; Rose, J. 2015. *Industries and economies leading the robotics revolution*. Available at: <https://www.bcgperspectives.com/content/articles/lean-manufacturing-innovation-industries-economies-leading-robotics-revolution/> [6 Apr. 2016].

Softwear Automation, Inc. 2015. *Home*. Available at: <http://softwearautomation.com> [25 Feb. 2016].

Spieser, K.; Treleven, K.; Zhang, R.; Frazzoli, E.; Morton, D.; Pavone, M. 2014. "Toward a systematic approach to the design and evaluation of automated mobility-on-demand systems: A case study in singapore" in Gereon, M. and Sven B. (eds): *Road Vehicle Automation*, (Springer, Switzerland), pp. 229-245.

Sport Techie. 2015. *Adidas working towards fully automated shoe production with launch of robotic factory*. Available at: <http://www.sporttechie.com/2015/12/15/adidas-working-towards-fully-automated-shoe-production-launch-robotic-factory/> [13 Mar. 2016].

Surender, S. 2016. *2016 outlook for the global automotive industry*. Available at: <http://www.frost.com/sublib/display-report.do?id=MBDB-01-00-00-00> [11 May 2016].

Tan, C. 2015. "Driverless vehicles hit the road in trials around Singapore", in *The Straits Times*, 13 Oct. Available at: <http://www.straitstimes.com/singapore/transport/driverless-vehicles-hit-the-road-in-trials-around-singapore> [11 May 2016].

Teodoro, E. (n.a.) *ICT Sector in the Philippines*. Available at: <http://cacci.biz/wp-content/uploads/2015/01/EmmaTeodoro2009Vol1.pdf> [24 Apr. 2016].





Tesla Motors. 2016. *About Tesla*. Available at: <https://www.teslamotors.com/about> [11 May 2016].

Thailand Automotive Institute and Ministry of Industry (TAI and Ministry of Industry). 2012. *Master plan for automotive industry 2012-2016*. Available at: http://www.thaiauto.or.th/2012/backoffice/file_upload/research/11125561430391.pdf [13 May 2016].

Thailand Board of Investment. 2007. *Thailand investment review*. Available at: www.boi.go.th/tir/issue_content.php?issueid=30;page=0 [13 May 2016].

—. 2015a. *Thailand electrical and electronics industry*. Available at: http://www.boi.go.th/upload/content/BOI-brochure%202015-E&E_67848.pdf [6 Apr. 2016].

—. 2015b. *Thailand moving ahead with cluster development*. Available at: http://www.boi.go.th/upload/content/BOI-brochure-cluster%20area-EN-20151116_53354.pdf [17 Apr. 2016].

—. 2016. *Strategic infrastructure development plan supports Thailand's investment growth*. Available at: http://www.boi.go.th/upload/content/TIR_FEBRUARY_99008.pdf [22 Apr. 2016].

The Boston Consulting Group (BCG). 2015. *The most innovative companies 2015*. Available at: <https://media-publications.bcg.com/MIC/BCG-Most-Innovative-Companies-2015-Nov-2015.pdf> [25 Mar. 2016].

The Economist Intelligence Unit (EIU). 2014. *ASEAN automotive: Looking to 2015*. (EIU, London)

The Economist. 2011. "Robots don't complain", 6 Aug. Available at: <http://www.economist.com/node/21525432> [26 Apr. 2016].

—. 2015. "Made to measure", 30 May. Available at: <http://www.economist.com/news/technology-quarterly/21651925-robotic-sewing-machine-could-throw-garment-workers-low-cost-countries-out> [18 Feb. 2016].

—. 2016a. "The driverless, car-sharing road ahead", 7 Jan. Available at: <http://www.economist.com/news/business/21685459-carmakers-increasingly-fret-their-industry-brink-huge-disruption> [24 Apr. 2016].

—. 2016b. "Call centres: The end of the line, 6 Feb. Available at: <http://www.economist.com/news/international/21690041-call-centres-have-created-millions-good-jobs-emerging-world-technology-threatens> [13 Apr. 2016].

Tholons. 2016. *Tholons 2016 top 100 outsourcing destinations*. Available at: http://www.tholons.com/tholonstop100/pdf/Tholons_Top_100_2016_Executive_Summary_and_Rankings.pdf [29 Apr. 2016].

Thomasson, E. 2014. *Interview – Puma seeks to source goods closer to Western consumers*. Available at: <http://uk.reuters.com/article/puma-sourcing-idUKL6N0LP33P20140220> [14 Mar. 2016].

Thongtep, W. 2014. "Cisco keeps close watch on ASEAN as Internet of Things gains prominence", in *The Nation*, 21 Oct. Available at: <http://www.nationmultimedia.com/business/Cisco-keeps-close-watch-on-Asean-as-Internet-of-Th-30245884.html> [11 May 2016].

TNS. 2015. *Mobile millennials in Asia Pacific*. Available at: <http://www.tnsglobal.com/sites/default/files/Millennials-on-Phone-A4.pdf> [29 Apr. 2016].

—. 2016. *Millennials spend one day every week on their phones – how can brands deal with the digital divide?* Available at: <http://www.tnsglobal.com/press-release/millennials-spend-one-day-a-week-on-their-phones> [24 Apr. 2016].

Tobe, F. 2016. *Why co-bots will be a huge innovation and growth driver for robotics industry*. Available at: <http://www.therobotreport.com/news/co-bots-on-the-move> [14 Apr. 2016].

Toyota. 2015. *Hilux revo standard cab: The revolution of drive*. Available at: http://www.toyota.co.th/en/model/hilux_revo_standard_cab [13 May 2016].

TR Business. 2016. *ASEAN Ministers step up united tourism strategy*. Available at: <http://www.trbusiness.com/regional-news/asia-pacific/asean-ministers-step-up-united-tourism-strategy/100515> [14 Mar. 2016].

Tsui, B. 2014. “The extraordinary future of shoes”, in *The Atlantic*, 22 Jul. Available at: <http://www.citylab.com/design/2014/07/the-extraordinary-future-of-shoes/374657/> [15 Mar. 2016].

Tukatech. 2016. *Automatic fabric cutting machine*. Available at: <http://www.tukatech.com/automatic-fabric-cutter/TUKAcut> [22 Mar. 2016].

United Nations Commodity Trade Statistics Database (UN Comtrade). 2016. *UN Comtrade: international trade statistics database*. Available at: <http://comtrade.un.org/data/> [11 Apr. 2016].

United Nations Conference on Trade and Development (UNCTAD). 2002. *Opportunities rising for women in E-commerce: but glass ceiling remains to be broken*. Available at: <http://unctad.org/en/pages/PressReleaseArchive.aspx?ReferenceDocId=2927> [20 May 2016].

—. 2016. *UNCTAD Stat data center, merchandise: Trade matrix by products*. Available at: <http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=24739> [15 June 2016].

United Nations Department of Economic and Social Affairs (UNDESA). 2014. *World urbanization prospects*. Available at: <http://esa.un.org/unpd/wup/CD-ROM/> [13 May 2016].

—. 2015. *The world population prospects: The 2015 Revision*. Available at: https://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf [20 May 2016].

United Nations Educational, Scientific and Cultural Organization (UNESCO). 2015. *A complex formula: girls and women in technology, engineering and mathematics in Asia*. Available at: <http://unesdoc.unesco.org/images/0023/002315/231519e.pdf> [11 Apr. 2016].

United Nations Educational, Scientific and Cultural Organization – Institute for Statistics (UNESCO-UIS). 2016. *UIS data centre*. Available at: <http://www.uis.unesco.org/datacentre/pages/default.aspx?SPSLanguage=EN> [9 Mar. 2016].

United States Department of Labor (USDOL). 2016. *Minimum wage*. Available at: <https://www.dol.gov/general/topic/wages/minimumwage> [2 Mar. 2016].





Vidaurri, F. 2015. *The Philippines: The new BPO capitol of the world?* Available at: <http://www.aseanbriefing.com/news/2015/10/21/the-philippines-the-new-bpo-capitol-of-the-world.html> [26 Apr. 2016].

Vietnam Chamber of Commerce and Industry. 2016. *Vietnam garment and textile under TPP impact.* Available at: http://vccinews.com/news_detail.asp?news_id=33323 [14 Mar. 2016].

Vietnam Trade Promotion Agency (VIETRADE). 2014. *Vietnam garment and textile export in the first 6 months of 2014.* Available at: http://www.vietrade.gov.vn/en/index.php?option=com_content&id=2214:vietnam-garment-and-textile-export-in-the-q12014&Itemid=363 [12 Mar. 2016].

—. 2015. *Opportunities and challenges for Vietnam's electronic export.* Available at: http://www.vietrade.gov.vn/en/index.php?option=com_content&view=article&id=2388:opportunities-and-challenges-for-vietnams-electronic-export&catid=270:vietnam-industry-news&Itemid=363 [2 Apr. 2016].

Wakefield, J. 2016. "Foxconn replaces '60,000 factory works with robots'", in *BBC*, 25 May. Available at: <http://www.bbc.com/news/technology-36376966> [28 May 2016].

We are social. 2015. *Digital, social, and mobile in Southeast Asia in Q4 2015.* Available at: <http://wearesocial.com/sg/special-reports/digital-southeast-asia-q4-2015> [15 June 2016].

World Bank. 2013. *Philippine Development Report: Creating more and better Jobs.* Available at: <http://www.worldbank.org/content/dam/Worldbank/document/EAP/Philippines/PDRFullReport.pdf> [18 Apr. 2016].

—. 2016. *World Bank data.* Available at: <http://data.worldbank.org/indicator> [17 May 2016].

World Intellectual Property Organization (WIPO). 2015. *World intellectual property indicators* (Geneva).

World Wildlife Fund (WWF). 2013. *The impact of a cotton t-shirt.* Available at: <http://www.worldwildlife.org/stories/the-impact-of-a-cotton-t-shirt> [4 Mar. 2016]



APPENDIX Overview of research methodology



The research is forward looking, taking a ten-year horizon up to 2025 and posing questions to research participants in the context of this timeframe.

Two ASEAN-wide surveys were conducted with enterprises and students from July 2015 to December 2015. In total, 4,076 responses were collected from enterprises in the manufacturing and services sector.¹ Students from universities and TVET institutions were surveyed, resulting in 2,747 responses.² Stakeholder interviews with over 50 individuals from Cambodia, Indonesia, Malaysia, the Philippines, Singapore and Thailand took place between June and November 2015. Stakeholders included representatives from enterprises, employers' organizations, trade unions, government and policy-makers, as well as industry experts and think tanks. While some of this information is summarized in this paper, more detailed information can be found in *ASEAN in transformation: Perspectives of enterprises and students on future work*.

Initial consultation briefings on the survey results were held in Cambodia, Singapore and Indonesia with executives, as well as an experts' roundtable meeting held in Singapore in November 2015, where 23 global, regional and national experts attended. Afterwards, the research was deepened into five sectors: automotive and auto parts; E&E; TCF; BPO and retail. In-depth sectoral reports were commissioned in each of these sectors to provide an overview of the technology trends and the resulting workplace and enterprises transformations. A study on China-ASEAN trends in the textile and clothing sector and E&E parts sector was also completed. Approximately 330 interviews were conducted across all five sectors. In addition, another working paper entitled, *ASEAN in transformation: The future of jobs at automation risk*, was produced through desk research, to assess the probability of automation risks to jobs in five selected ASEAN countries.

Further validation exercises also took place in March and April 2016 at regional meetings of the ASEAN Confederation of Employers (ACE) and ASEAN Trade Union Council (ATUC) organized by ILO ASEAN TRIANGLE project in Bangkok and the ILO Better Work Business Forum of apparel buyers and manufacturers in the Republic of Korea.

This research focuses specifically on how technology trends are displacing, creating and transforming jobs in five specific sectors in the ASEAN region, and what enterprises need to do to maintain their relevance. The sectors were selected based on their importance to ASEAN, in terms of their contribution to the growth and development of the region, their labour-intensive nature, and their susceptibility to technology developments, either positive or negative.

¹ By sector: 1,003 from manufacturing and 3,073 from services.

² While university and TVET students only account for a small portion of all young, future entrants into the labour market in ASEAN, for the purposes of the research due to survey constraints the sample was narrowed.

As ILO marches towards marking its centennial anniversary, there are other units within the organization who are reviewing the impact of technology on non-standard forms of employment, on how it is changing the nature of work as well as on the governance of work, with a view to accelerating policy leadership under the Future of Work Initiative. While non-standard forms of employment were addressed in our ASEAN-wide surveys, significant additional research is required to broaden and further understand these findings in the context of the ASEAN region. In addition, while related issues such as the provision of labour protection, given the new forms of work being created, are beyond the boundaries of this report, they will nevertheless continue to be examined by the ILO at a global and country level.

In-depth methodology

The research evolved incrementally over a one-year period, using a step-by-step approach whereby each component was built on the previous to get as comprehensive a view and perspective as possible.

Phase one

Between August and November 2015, we carried out a ten-country ASEAN-wide enterprise survey as well as a parallel student survey between June 2015 and January 2016.

The enterprise survey involved 4,076 enterprises in ASEAN's manufacturing and services sectors – 1,003 manufacturing enterprises (24.6 per cent of the total) and 3,073 services enterprises (75.4 per cent of the total).³ Over 200 responses were gathered from each Member State except Brunei Darussalam, which had 53 respondents. Some 732 responses were collected from Indonesia, 664 from Thailand, and 575 from the Philippines.

Table A.1 Enterprise survey sample by Member State and broad economic activity

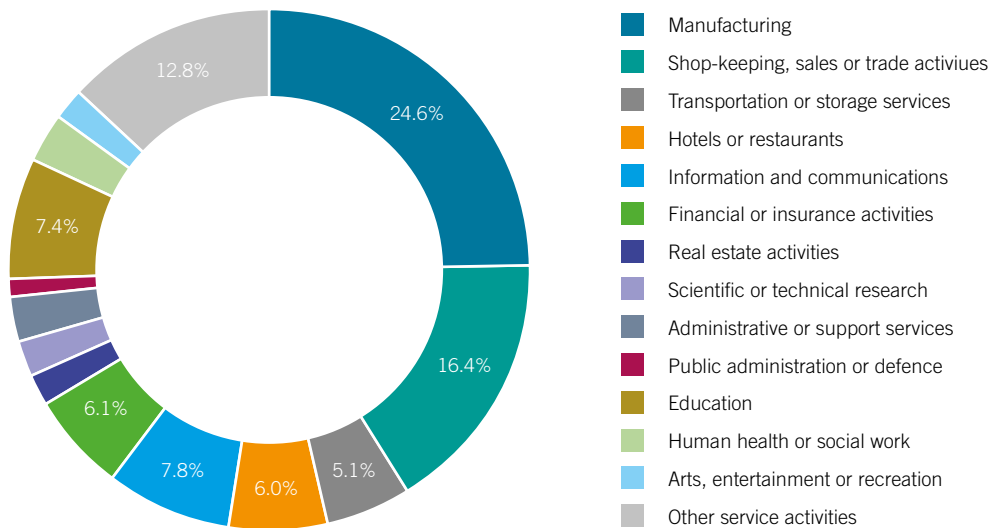
Member State	Total	Manufacturing sector	Services sectors
Brunei Darussalam	53	4	49
Cambodia	304	57	247
Indonesia	732	241	491
Lao People's Democratic Republic	301	90	211
Malaysia	400	126	274
Myanmar	300	99	201
Philippines	575	92	483
Singapore	301	77	224
Thailand	664	171	493
Viet Nam	446	46	400
Total sample	4 076	1 003	3 073

Source: ILO, 2016b.

³ Those operating in the agricultural sector and the non-manufacturing industrial sectors were excluded from the survey.

Among the specific economic activities identified in the sample, the biggest segments of respondents outside of the manufacturing sector came from wholesale and retail trade (16.4 per cent), information communications technology (7.8 per cent), and education (7.4 per cent).

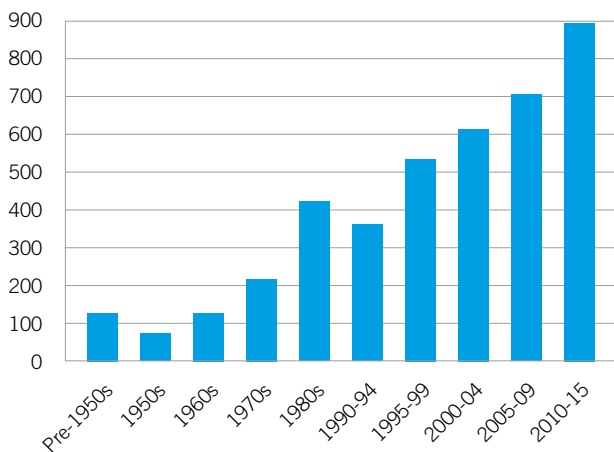
Figure A.1 Enterprise survey sample by economic activity



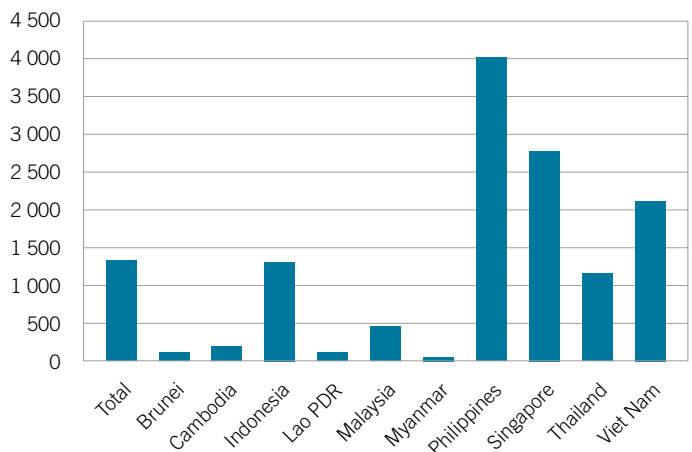
Note: Shares of less than 4 per cent are not labelled.
 Source: ILO, 2016b.

Figure A.2 Enterprise survey sample by year of establishment and by employment size

PANEL A Sample by year established



PANEL B Sample by employment size (mean)



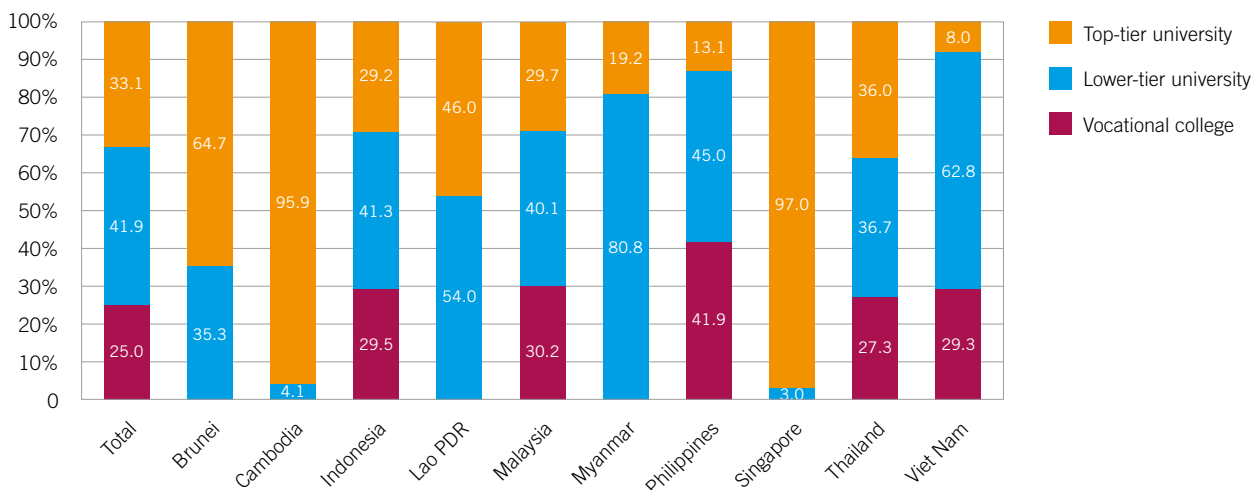
Source: ILO, 2016b.

The student survey involved 2,747 women and men in ASEAN currently pursuing degree, masters degree, technical and vocational diploma or certificate courses. The sample split was 1,529 women and 1,218 men. The largest segments of responses (of about 450 each) came from Indonesia, Malaysia, Thailand, and Viet Nam. The smallest segments of responses of around 50 each came from the Lao People’s Democratic Republic and Brunei Darussalam.

Table A.2 Student survey composition by Member State and gender

Member State	Total	Men	Women
Brunei Darussalam	51	17	34
Cambodia	102	48	54
Indonesia	492	320	172
Lao People's Democratic Republic	50	18	32
Malaysia	451	251	200
Myanmar	104	46	58
Philippines	368	216	152
Singapore	206	122	84
Thailand	461	255	206
Viet Nam	462	236	226
Total sample	2 747	1 529	1 218

Source: ILO, 2016b.

Figure A.3 Student survey composition by Member State and type of educational institution

Source: ILO, 2016b.

The surveys were also supplemented by 55 face-to-face interviews with national policy-makers, business leaders, workers' representatives and other stakeholders to understand their priorities and perceptions around the future of work in ASEAN. The interviews took place between June and November 2015 in Bangkok, Kuala Lumpur, Jakarta, Manila, Phnom Penh and Singapore.

In addition to the impact of technology on enterprises and labour markets, the interviews and surveys focused on gaining an understanding of new working modalities as well as cultures of work. As the research gathered input from enterprises on one hand and students on the other, it helped the researchers to gain a better understanding of how prepared young workers and ASEAN's businesses were with respect to the changing world of work and technological advancements.

Validation of preliminary survey results

Once we had the preliminary findings from the surveys, the results were tested at three executive briefings in Jakarta, Phnom Penh and Singapore in November 2015, with a total of 150 senior managers and business leaders. Subsequently, we consulted with the external research advisory group at an experts meeting in Singapore in November 2015.

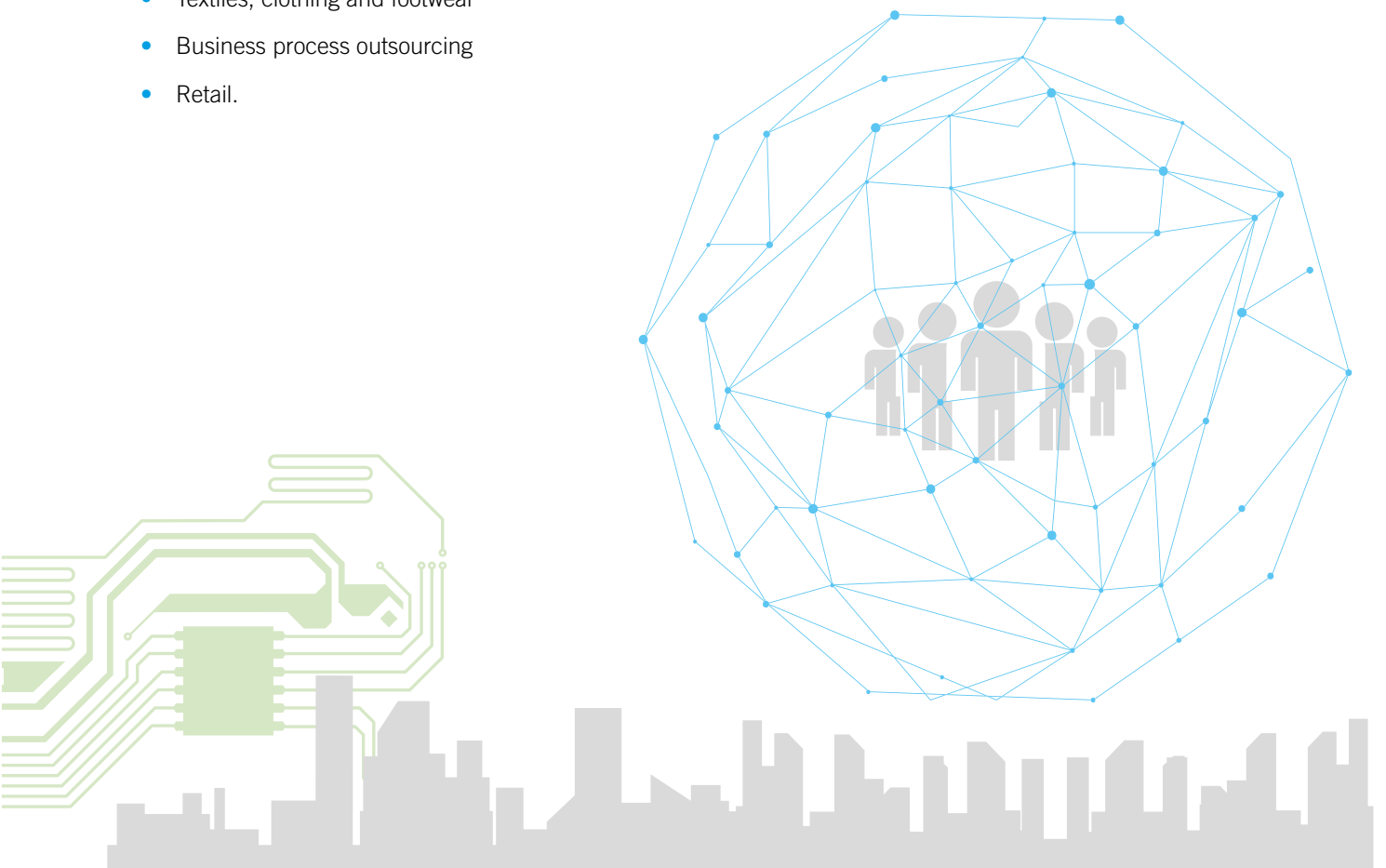
Table A.3 Research phase one summary

Survey	Conducted by	Countries	Sample size	Timeframe
Surveys				
Enterprise survey	Emerging Market Consultants (EMC), Consulting company	10 ASEAN Member States	4 076 responses	Aug. – Dec. 2015
University and TVET student survey	Universum and EMC	10 ASEAN Member States	2 747 responses	June 2015 – Feb. 2016
Stakeholder interviews				
Expert stakeholder interviews	ILO	Cambodia, Indonesia, Malaysia, Philippines, Singapore and Thailand	54 interviews	June – Nov. 2015
Validation of preliminary results				
National executive dialogues	ILO, APINDO, CAMFEBA, SNEF	Cambodia, Indonesia and Singapore	Approximately 150 senior managers and business leaders	16 – 20 Nov. 2015
Experts' roundtable consultation meeting	ILO and SNEF	Held in Singapore (Discussion covered 10 ASEAN Member States)	23 expert participants	18 Nov. 2015
ACE – ATUC bipartite meeting	ILO	Thailand	Representatives of employers' organizations and trade unions	8 Mar. 2016

Phase two

On the basis of the initial primary work which took a broad regional focus, key sectors were chosen based on their importance to ASEAN in terms of their contributions to the growth and development of the region, their labour-intensive nature, and their susceptibility to technological progress (both positive and negative impact). The sector studies were aimed at understanding the trends happening at a sector level, as well as taking a more granular approach to explore how technology was currently and practically being applied or impacting each sector, up to 2025. The following sectors were selected for deeper review:

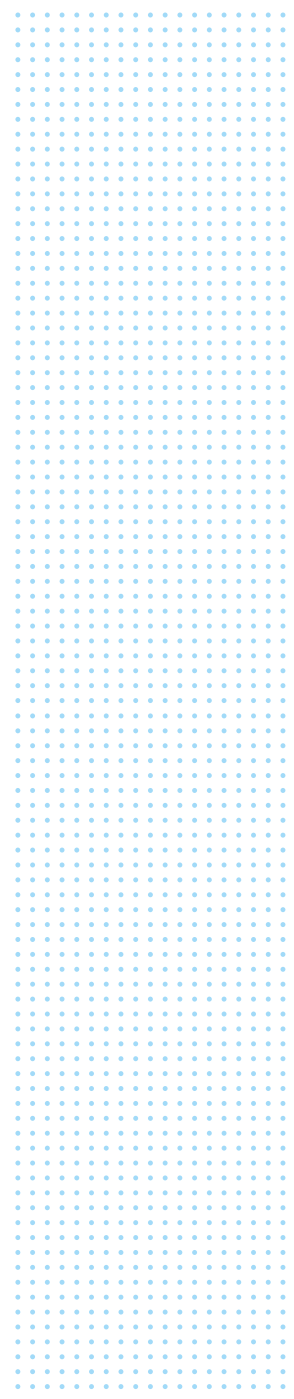
- Automotive and auto parts
- Electrical and electronics
- Textiles, clothing and footwear
- Business process outsourcing
- Retail.



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Table A.4 Research phase two summary

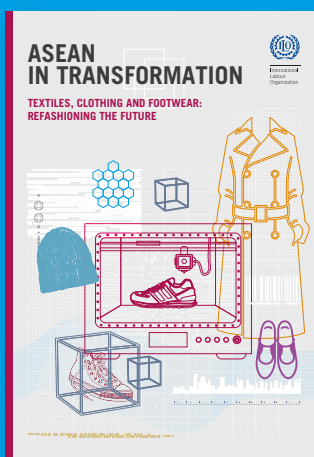
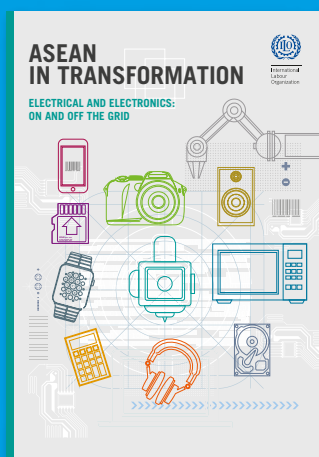
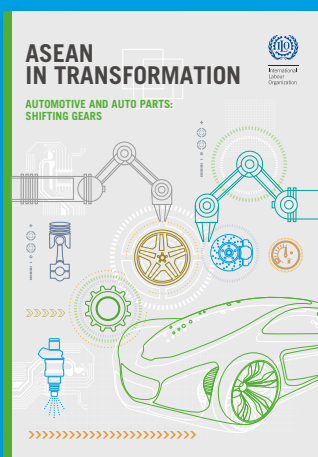
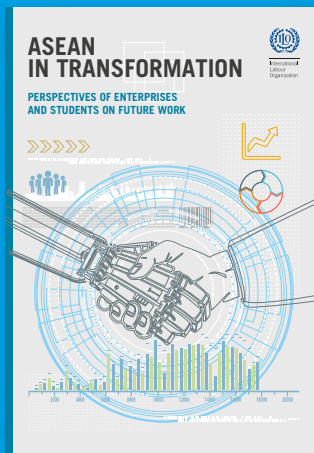
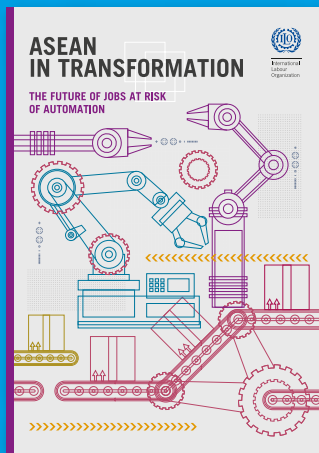
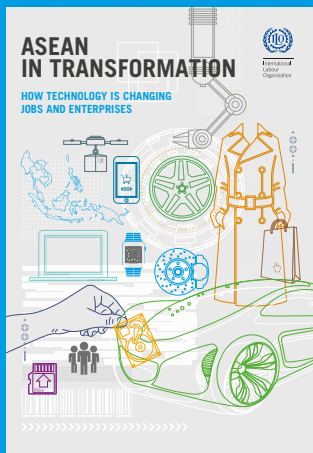
Survey	Conducted by	Countries	Methodology and sample size	Timeframe
Sectoral studies				
Automotive and auto parts	UCLA AMR	Hong Kong (China), India, Italy, Taiwan (China), Thailand and United States	Desk research, 69 interviews	Sep. - Mar. 2016
Apparel	Consulting company	Cambodia, Indonesia, Thailand and Viet Nam	Desk research, 36 interviews	Feb. - May. 2016
Apparel	David Birnbaum	South-East Asia	Desk research	Oct. 2015
Retail	UCLA-NUS Global Executive	South-East Asia	Desk research, 43 interviews	Nov. 2015 - May. 2016
Business process outsourcing	Consulting company	Philippines	Desk research, 14 Interviews	Feb. - May. 2016
Electrical and electronic components	Consulting company	Indonesia, Malaysia, Philippines and Viet Nam	Desk research 15 interviews	Feb. - May. 2016
Electronics and apparel: China-ASEAN Trends	China Europe International Business School	China and South-East Asia	Desk research, 34 interviews	Feb. - May. 2016
Comparative Sectorial analysis of electronics, auto parts sectors	Emory University and University of Malaya	Cambodia, Indonesia, Malaysia, Philippines, Singapore and Thailand and Viet Nam	Desk research 65 interviews	Oct. - May 2016
Comparative Sectorial analysis of electronics, auto parts sectors				
The future of jobs at risk of automation	ILO	Cambodia, Indonesia, Philippines, Thailand and Viet Nam	Desk research (based on Frey-Osborne methodology) and ILO data	Mar. 2016
Technical briefs	ILO	10 ASEAN Member States	Desk research and ILO data analysis	Oct. 2015



ASEAN in transformation: How technology is changing jobs and enterprises

New and advanced developments in technology are transpiring at an increasingly rapid rate. This study explores the technological impacts felt by employers and workers of the ten countries that form the Association of Southeast Asian Nations (ASEAN). ASEAN is a politically and economically diverse region, boasting a population of over 632 million people, a swelling middle class, growing amounts of disposable income and an increasingly educated workforce. Technology presents tremendous potential and challenge for the ASEAN region.

The paper presents a detailed analysis of how technology is transforming five key labour-intensive and economically prominent sectors in ASEAN: the automotive and auto parts; electrical and electronics; textiles, clothing and footwear; business process outsourcing; and retail sectors. It also highlights findings from extensive enterprise and student surveys as well as stakeholder interviews conducted in ASEAN and beyond. It is clear that technologies – both current and forthcoming – will increase productivity, render some occupations obsolete and create new ones. The real question lies in whether ASEAN can take advantage of the benefits technology offers and if it can also adequately prepare its workforce.



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