

ASEAN IN TRANSFORMATION



International
Labour
Organization

HOW TECHNOLOGY IS CHANGING JOBS AND ENTERPRISES

SINGAPORE EXECUTIVE AND MEDIA BRIEFING

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SNEF

SINGAPORE IN TRANSFORMATION: HOW TECHNOLOGY IS IMPACTING JOBS AND ENTERPRISES

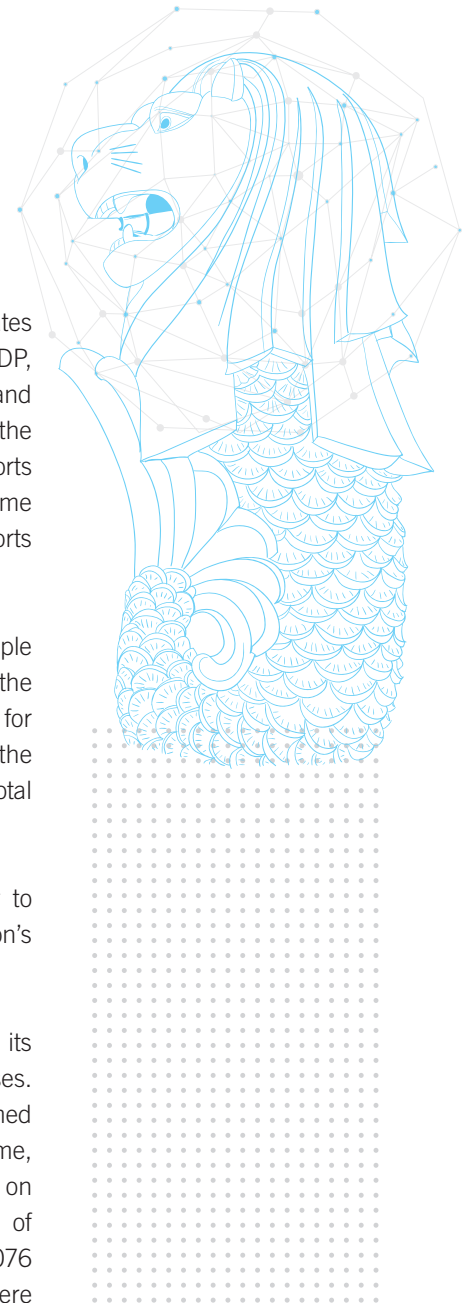
Introduction

In 2014, Singapore's gross domestic product (GDP) totalled to 307.9 billion United States dollars (US\$). Services and manufacturing comprised 75 per cent and 25 per cent of GDP, respectively.¹ Singapore's exports totalled US\$377 billion in 2014, of which electronics and electrical (E&E) exports accounted for 41.7 per cent.² Among ASEAN countries, Singapore is the regional leader of E&E exports. The E&E sector is significant for Singapore both in terms of exports and per cent of manufacturing employment (see **figure 1**). Less significantly, within the same year, auto parts exports accounted for US\$4.3 billion; textile, clothing and footwear (TCF) exports accounted for US\$3.4 billion.

The Singapore economy has a total labour force of 3.6 million people.³ Over 2.5 million people (71 per cent) work in the services sector and 1 million people (29 per cent) work in the manufacturing sector.⁴ In the services sector, retail is the largest employer, accounting for 489,000 people and representing 19.4 per cent of services employment. Moreover, in the manufacturing sector, E&E employs 167,000 people, accounting for 39.4 per cent of total employment in manufacturing.

This national brief has been prepared for the Singaporean business community in order to summarize the findings relevant to Singapore from the International Labour Organization's (ILO) research, *ASEAN in transformation: How technology is changing jobs and enterprises*.

This research examines the unprecedented acceleration in technological advancement, its speedy implementation, and the profound shift that these are having on jobs and enterprises. Entire sectors are accommodating these innovations, rendering several human-performed occupations redundant and revising the skillsets traditionally required. At the same time, other jobs are being created. In order to fully understand the impact technology is having on the Association of Southeast Asian Nations (ASEAN), and to address the current lacuna of knowledge on this topic in the region, a sector specific approach was taken. Initially, 4,076 survey responses from ASEAN enterprises in the manufacturing and service industries were



¹ World Bank, 2016. GDP is expressed in current US\$.

² UNCTAD, 2016.

³ ILO, 2015.

⁴ Ibid.

gathered, of which 301 responses were from Singapore (about 7.5 per cent of enterprise survey sample size), with the majority (224 responses) from the services sector. Additionally, survey responses from over 2,700 university and technical vocational education and training students were also collected, providing insight on the career aspirations and expectations of the next generation of workers, of which 206 student responses were collected from Singapore (about 7.5 per cent of student survey sample size). The student sample was composed of 122 women and 84 men, almost 90 per cent of whom studied in the Nanyang Technological University or the National University of Singapore. Subsequently, further research – in the forms of interviews and case studies – was conducted on five major, labour-intensive and/or growth manufacturing and services sectors: automotive and auto parts, E&E, TCF, business process outsourcing (BPO) and retail.

Ultimately, these efforts have culminated into a collection of standalone papers, each providing an in-depth examination on different aspects of how technology affects the ASEAN region in the five sectors.

Technology uptake and student future outlook in Singapore

While ASEAN enterprises on the whole are not leaders in terms of innovation, in Singapore there are a number of examples of companies that continually upgrade production processes in order to remain at the forefront of the industry. The ILO survey found that Singapore enterprises reported above average performance on aspects related to innovation and technology adoption. Among the Singapore enterprises, about 50 per cent of enterprises currently delegate responsibility for both upgrading technology and protecting data; 34.2 per cent invest in research and development (R&D); and 32.3 per cent protect intellectual property (see **figure 2**).⁵

Cost and skills are key barriers to enterprises adopting technology in Singapore

Despite significant indications of innovation and technological progress, enterprises in Singapore reported that costs and skills are the biggest barriers to upgrading technology, with lack of skills reported more frequently in Singapore than on average in ASEAN (see **figure 3**). Similarly, Singapore identified lack of high-skilled staff as one of the key threats businesses will face over the decade (see **figure 4**). High-skilled workers are of particular importance to the Singapore economy, as Singapore accounts for half of ASEAN's high-skill and technology-intensive manufacturing exports, followed by Thailand (19.6 per cent) and Malaysia (15.7 per cent).⁶

According to the ILO survey, technological advances (as well as increased ASEAN exports) are perceived as the biggest opportunity for Singapore's enterprises (see **figure 5**). Similarly, as potential drivers of technology uptake, rising labour costs were cited as the biggest perceived threat facing enterprises in the next decade.⁷

⁵ ILO, 2016a.

⁶ ILO and ADB, 2014.

⁷ ILO, 2016a.

Students in Singapore are studying science, technology, engineering and mathematics (STEM) subjects, and they are optimistic about future opportunities

Singapore-based students in the sample came from a variety of academic disciplines. The three most common fields of study were engineering, building or architecture (36.4 per cent), followed by business, commerce, or finance (20.4 per cent), and science and mathematics (10.7 per cent). More men were studying engineering, building or architecture (52.3 per cent compared with 25.4 per cent of women) and more women were enrolled in business, commerce and finance programmes (23.7 per cent compared with 15.5 per cent of men). Over 52 per cent of students in Singapore were studying STEM programmes. This proportion is significantly higher than STEM enrolment in the rest of ASEAN (35.8 per cent) (see **figure 6**).

Students in the survey were asked how their own opportunities might change by 2025. Over 50 per cent of students in Singapore believed that 2025 will provide them with opportunities to start their own businesses and that there will be opportunities for young women to have good work. More than 40 per cent of students in Singapore expressed that 2025 will also bring opportunities for stable and reliable work, productive and well-paid work, and honest and fair career advancement.

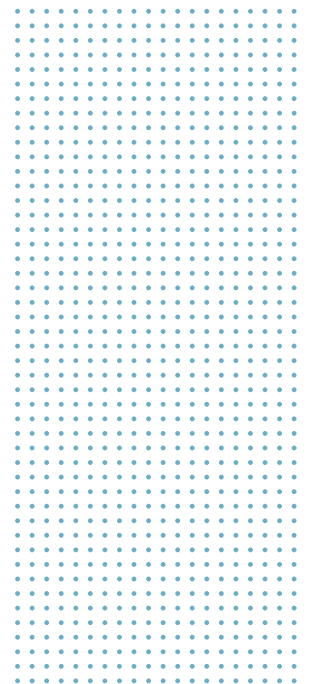
Technology impact: How is Singapore faring

Technology could drive growth in Singapore's already competitive E&E sector

Singapore is the region's forerunner in terms of E&E exports: Singapore's exports totalled over 40 per cent of the ASEAN region's exports and have grown strongly since 2000. The sector's major exports markets are China, Hong Kong (China) and Malaysia.⁸

The strength of the sector is in part due to the presence of large E&E component manufacturers and electronics manufacturing service providers. Singapore's manufacturing strengths lay in integrated circuits, semiconductor devices and printed circuit boards. Given a number of technology trends, this sector is increasingly connected to every economic industry directly and indirectly, placing Singapore in a position to not only strengthen this sector, but others as well. Currently, exports to ASEAN do not feature prominently in Singapore's E&E sector, but the ILO survey found that rising exports to ASEAN are perceived as an opportunity. As this sector expands in other ASEAN countries such as Thailand and Viet Nam, an opportunity exists for Singapore to export components within the ASEAN region.

A key technology that will likely drive growth in the E&E sector is that of the Internet of Things (IoT). The IoT comprises of everyday devices and industrial equipment connected to facilitate data collection, data exchange, remote monitoring and better decision-making. Given Singapore's production focus on semiconductors, the IoT could bring significant opportunities by stimulating demand for sensors, connectivity and memory devices. The IoT may even fuel the semiconductor industry to surpass its global annual revenue increase of 3 to 4 per cent over the last decade.⁹



⁸ Singapore Economic Development Board, 2016a.

⁹ Bauer, Patel and Veira, 2015.

Well-positioned to capitalize on e-Commerce growth

Retail consumer trends depend heavily on personal income levels, consumer confidence and interest rates. ASEAN consumption has grown by 5 per cent between 2000 and 2014.¹⁰ 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 2025.¹¹ However, the share of e-Commerce in ASEAN is still currently very low: It comprises less than 1 per cent of total retail sales in six economies – Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam.¹² Even for Singapore, ASEAN's most connected and developed economy, only 3.4 per cent of total retail sales come from e-Commerce. This is quite low compared to China, Europe and the United States, for whom online transactions range between 6 to 10 per cent. Yet, some of the ASEAN region's leading online marketplaces, such as Lazada and Zalora, are based in Singapore. Thus, Singapore is duly placed to benefit from the anticipated growth in e-Commerce facilitated by increasing Internet connectivity, which grows a consumer base waiting to be activated. Notably, within Singapore, 74 per cent of the total population owns a smartphone – a very promising e-Commerce consumer base.¹³

Investment in R&D will drive innovation

Singapore is also becoming a hub for automotive R&D. Large companies such as Delphi and Continental have an R&D presence in Singapore.¹⁴ While not a significant sector in terms of employment in Singapore, automotive and auto parts exports totalled US\$25.8 billion in 2014, and there is potential for growth in the sector, especially with the presence of original equipment manufacturers regional headquarters, the presence of tier one suppliers, the availability of technical expertise, investments in R&D and Singapore's competitive E&E industry upon which the automotive sector is increasingly relying.

Singapore's R&D budget for 2011–15 increased by 20 per cent from the previous five years, and, in 2016, this budget increased again by 18 per cent, with funds earmarked for spending on four categories, including advanced manufacturing and engineering.¹⁵ This will create opportunities to integrate modern and advanced machinery into its operations. For example, investment in R&D could help Singapore compete even more competitively with China in the E&E sector.

Driving up skills needs across sectors

The research shows that skills needs across all sectors will be raised significantly. Within the E&E sector, strong technical and engineering skills will be necessary to absorb technology such as the IoT or nanotechnology. Many low-skill operations can now be automated.¹⁶ On the other hand, increased automation will also create considerable, high-skilled work, as optimized robots and machinery will need capable technicians and engineers. This need for high-skilled workers is echoed in the auto sector, in which engineers with specialized knowledge of automated process design and robotic programming will be necessary – particularly as vehicle technology increases.

¹⁰ ILO estimates based on World Bank, 2016. The compound annual growth rate, between 2000 and 2014, of regional household final consumption expenditure was calculated. Data for Myanmar was not available.

¹¹ HV, Thompson and Tonby, 2014.

¹² DBS Group Research, 2015.

¹³ HV, Thompson and Tonby, 2014.

¹⁴ Singapore Economic Development Board, 2016b.

¹⁵ Fai and Kek, 2016.

¹⁶ One such example is 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 produces an estimated 200,000 phones per day (Wakefield, 2016).



Within retail, which accounts for almost 20 per cent of employment in services (see **figure 1**), the research found that the sector's overall workforce requirements will be reduced. Highly skilled workers, such as those with technical data management skills, will be required, as well as workers with sophisticated soft skills necessary for customer service. As e-Commerce grows, workers with mobile and web skills will be required.

The Government of Singapore is rising to the occasion with two new initiatives, both falling under the existing SkillsFuture initiative, announced in the 2016 budget. The first, Adapt and Grow, will help the workforce to adapt to the changing skills needs of industries.¹⁷ The second, TechSkills Accelerator, is designed to provide training on information and communication technology (ICT) to young people and to further the skills of mid-career ICT professionals. Already, from the E&E sector, five wafer fabrication companies are participating in the Adapt and Grow initiative given the high technology environment and the growing need for highly skilled workers.¹⁸

Capitalizing on technology trends and disruptors

Optimizing production with robotics and automation

In 2014, Singapore, along with other ASEAN countries, all increased their robotic purchases.¹⁹ The research has showed that robotic automation has the potential to significantly impact production in the E&E and automotive sector.²⁰ The E&E sector is the second largest consumer of industrial robots, and this trend is likely to continue.²¹ Globally robot sales to the E&E sector increased by 34 per cent in 2014, establishing a new high.²² Similarly, robotic automation is the most significant technology impacting the automotive sector.

“[Robotics technologies] will lead to a less labour-intensive and more productive future, with less resources and time used to produce more goods at a high and consistent quality.”

Lim Say Leong, Assistant Vice President of Marketing, ABB

Source: Shah, 2015.

The Government of Singapore recently pledged 400 million Singaporean dollars (SGD) over the next three years to scale up its national robotics programmes.²³ In addition, in the recent budget, the Government announced an automation support package that will support businesses plans to automate and increase productivity by providing a grant of up to 50 per cent of the project cost (up to SGD1 million).²⁴

¹⁷ Sengupta, 2016a.

¹⁸ Seow, 2016.

¹⁹ IFR, 2015.

²⁰ See: ILO, 2016a.

²¹ IFR, 2015.

²² Including computers and equipment, radio, TV and communication devices and equipment and medical, precision and optical instruments.

²³ Sengupta, 2016b.

²⁴ Government of Singapore, 2016; Sengupta, 2016c.

Making industries safer, cleaner and more attractive for workers

Advances in materials science in the automotive sector, driven largely by a need to increase fuel efficiency, may also see 3D printing being used to print auto parts or accessories. While not yet taking hold in the E&E sector, mass additive printing (as opposed to additive manufacturing) of integrated electronic components, such as circuit boards, will likely comprise the next stage of this technology. 3D printing, as with automation and robotics, can help to reduce drudgery, intricate work, and create cleaner working environments for workers in the automotive and E&E sectors. 3D printing is becoming increasingly widescale in Singapore. For example, in 2015 Singapore, Ultra Clean Asia Pacific, an enterprise that develops systems for the semiconductor industry, opened the largest 3D printing facility in South-East Asia.²⁵

“Technological changes are welcomed because it replaces mundane tasks and enables the organization to upskill its workforce for higher value-add contributions.”

Source: Kelly Sofian, Senior Director of Quality and Human Resources, Silicon Manufacturing Company: Statement at ILO Experts Roundtable Consultation Meeting on Technology Transforming People and Jobs in ASEAN, Singapore, 18 Nov. 2015.

Collaborative robots are also being used to aid workers, particularly in the automotive and auto parts sector. “Cobots” can be taught to work alongside workers and can replace more repetitive tasks and difficult-to-reach processes.

Resolving manpower shortages

Several stakeholders in Singapore felt that, given its small size and ageing population, the country faced unique labour shortages in manufacturing compared with other ASEAN Member States. Many Singaporean enterprises are, in turn, reportedly relying on technology to automate rudimentary business processes and tasks.

Technology can be used to alleviate some of these shortages. For example, Singapore is likely to lead the movement for autonomous vehicles in ASEAN given its potential to resolve land and manpower constraints. One recent study from the Massachusetts Institute of Technology on Singapore estimated that only 300,000 driverless cars – roughly one third of the total in operation today – could be shared to serve the entire population’s needs.²⁶ Autonomous vehicles have already begun to be used for public buses, freight carriers, taxis and utility operations such as road sweepers.²⁷

²⁵ Weizen, 2015.

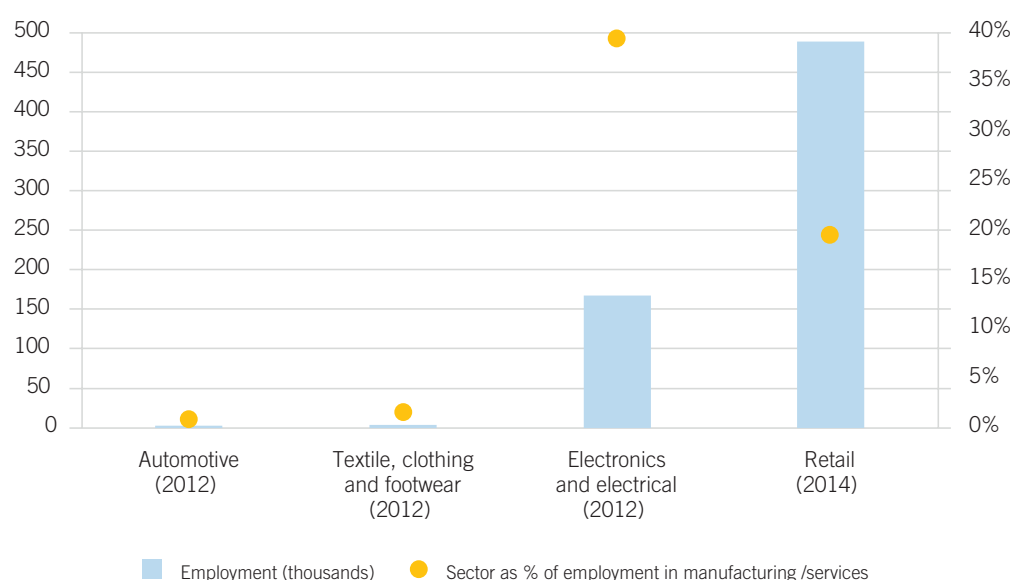
²⁶ Spieser et al, 2014.

²⁷ Tan, 2015.

In summary

While it was found that technology is increasingly driving up the skills needs across sectors, and many jobs are at risk of automation in the ASEAN region, the Government of Singapore appears to be taking an active approach in embracing technology disruptors and trends, using these to resolve manpower shortages, mitigate rising labour costs and grow key sectors.²⁸ However, workers in Singapore are not immune to rising skills needs brought on by technology, and students need to be encouraged to focus on STEM subjects to meet the future needs of enterprises in Singapore.

Figure 1. Total employment in manufacturing for motor vehicles and parts, E&E products, TCF, and retail services (thousands) and share of total manufacturing / services employment (per cent), Singapore, latest available year

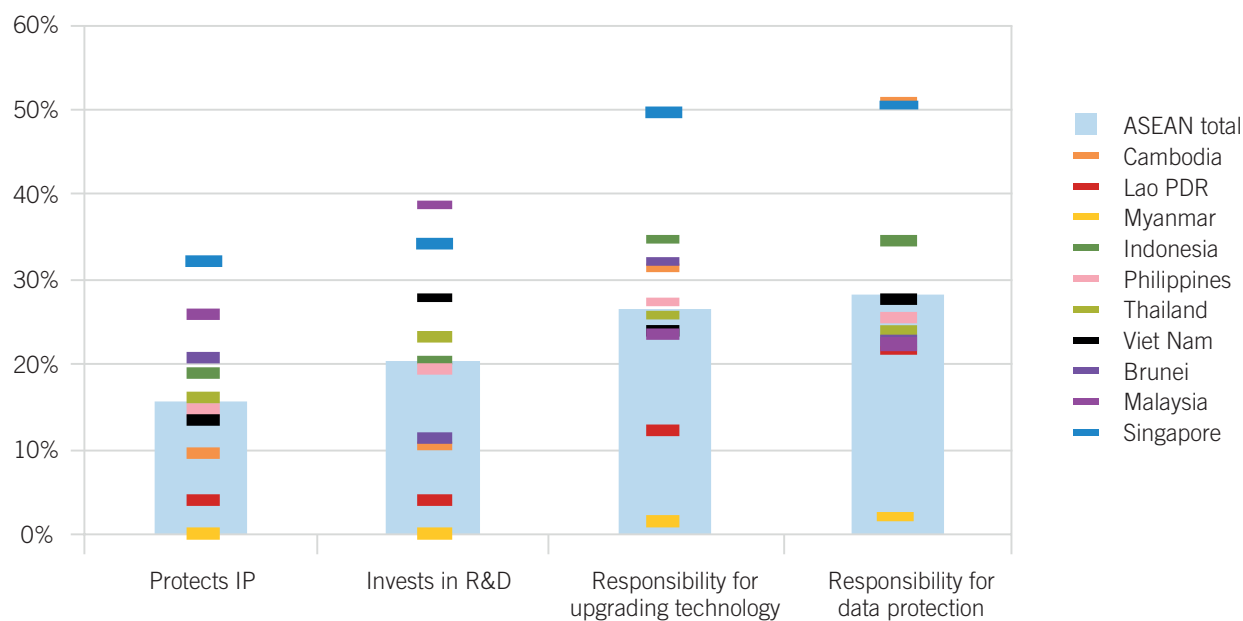


Notes: Motor vehicles and parts include production under International Standard Industrial Classification of All Economic Activities (ISIC, Rev. 4), division 29 ('Manufacture of motor vehicles, trailers and semi-trailers'). E&E products include those under ISIC, Rev.4, divisions 26 ('Computer, electronics and optical products'), 27 ('Electrical equipment'), and 28 ('Machinery and equipment'). TCF include products under ISIC, Rev.4, divisions 13 ('Manufacture of textiles'), 14 ('Manufacture of wearing apparel') and 15 ('Manufacture of leather and related products'). 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 manufacturing refers to ISIC, Rev. 4, divisions 10-33. Total services refer to ISIC, Rev.4, sections G-U.

Sources: ASEAN, 2015; ILO, 2015.

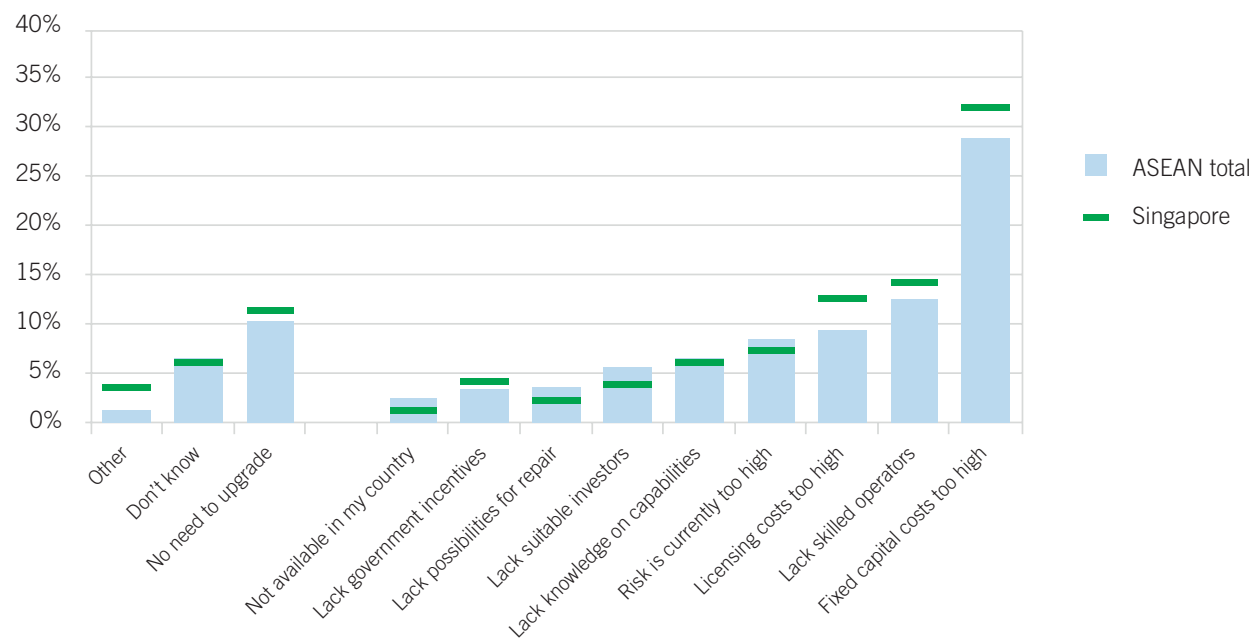
²⁸ Chang and Huynh, 2016. An ILO study found that in five ASEAN countries, Cambodia, Indonesia, the Philippines, Thailand, Viet Nam on average 56 per cent of jobs are at risk of automation.

Figure 2. Which of the following does your enterprise currently do?

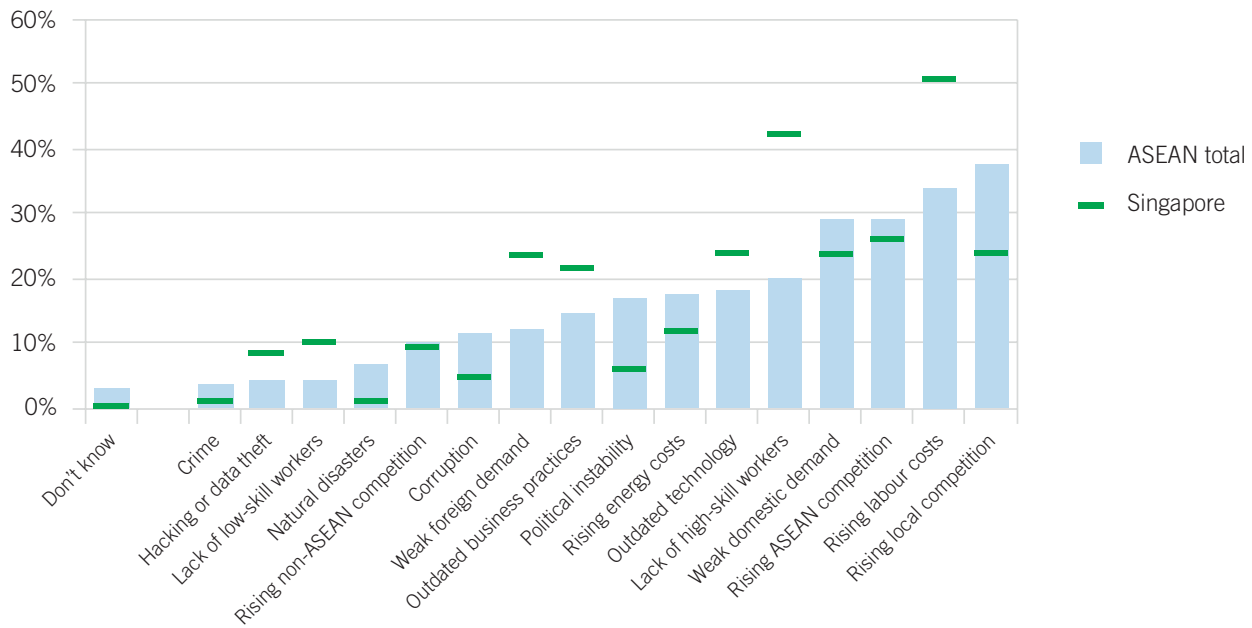


Sources: Adapted from ILO, 2016b.

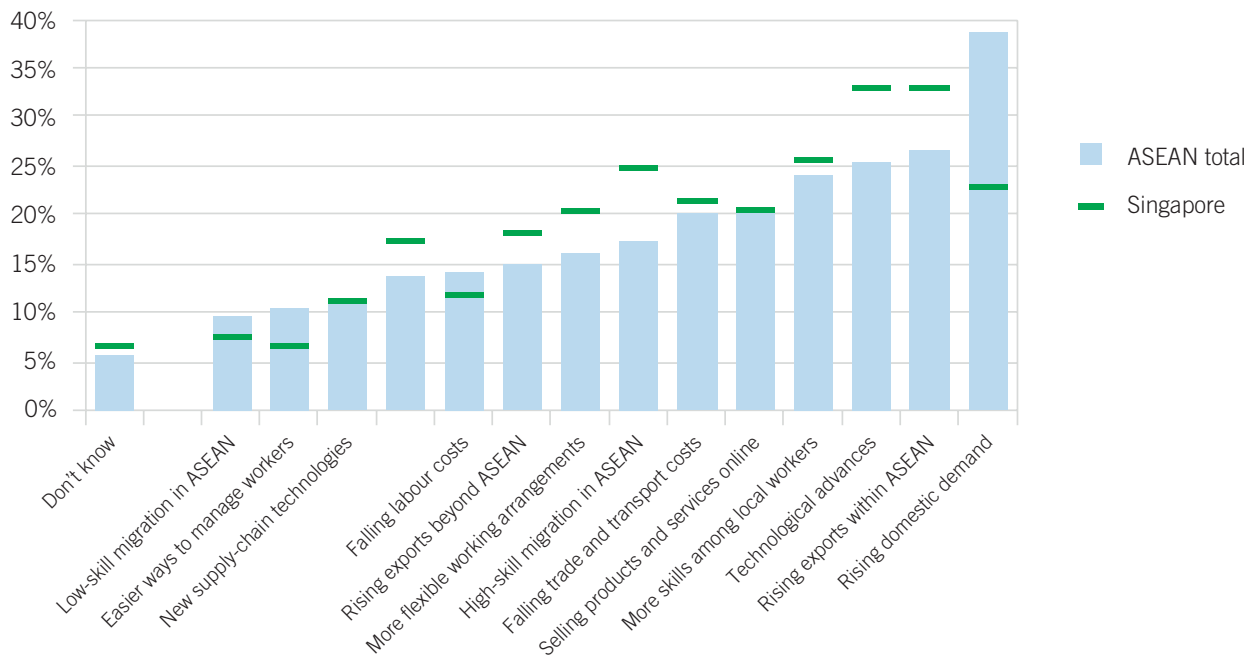
Figure 3. What is currently the single biggest barrier your enterprise faces to upgrade its technology?



Sources: Adapted from ILO, 2016b.

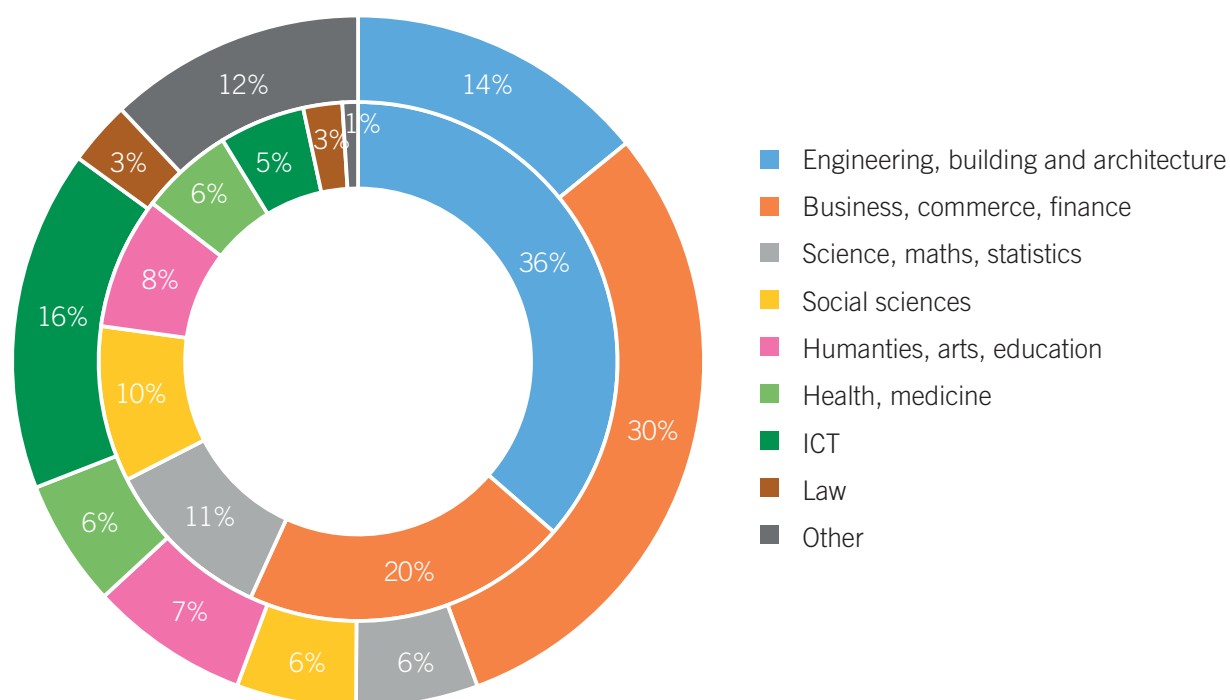
Figure 4. What do you perceive are the biggest threats facing your enterprise up to 2025?

Sources: Adapted from ILO, 2016b.

Figure 5. What do you perceive are the biggest opportunities facing your enterprise up to 2025?

Source: Adapted from ILO, 2016b.

Figure 6. What is your main field of study?



Note: Rest of ASEAN (outer ring) and Singapore (inner ring)

Source: Adapted from ILO, 2016b.

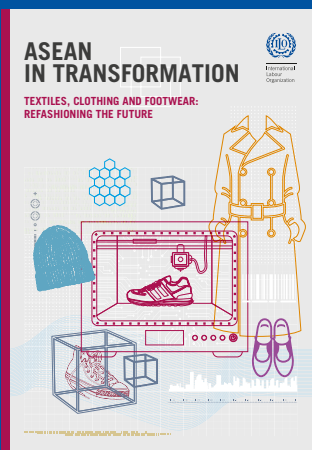
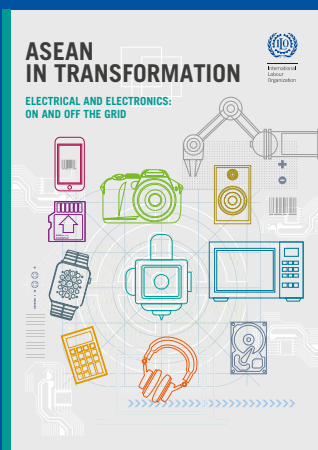
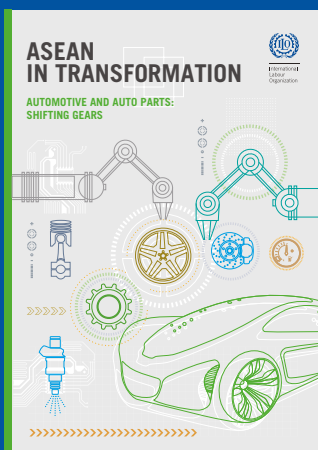
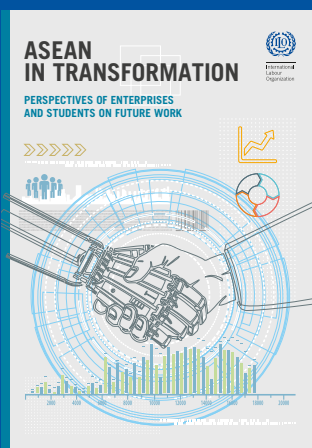
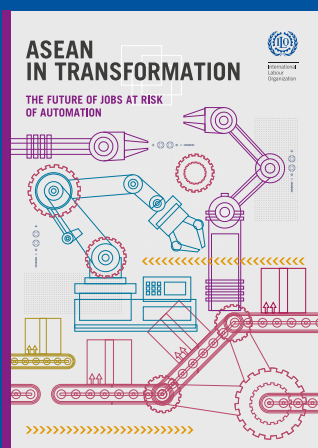
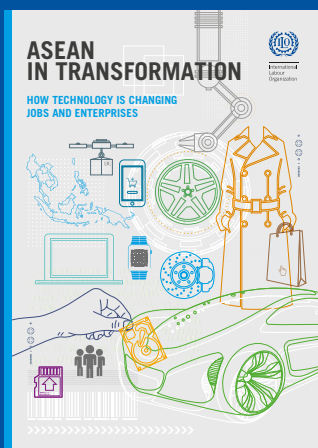


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