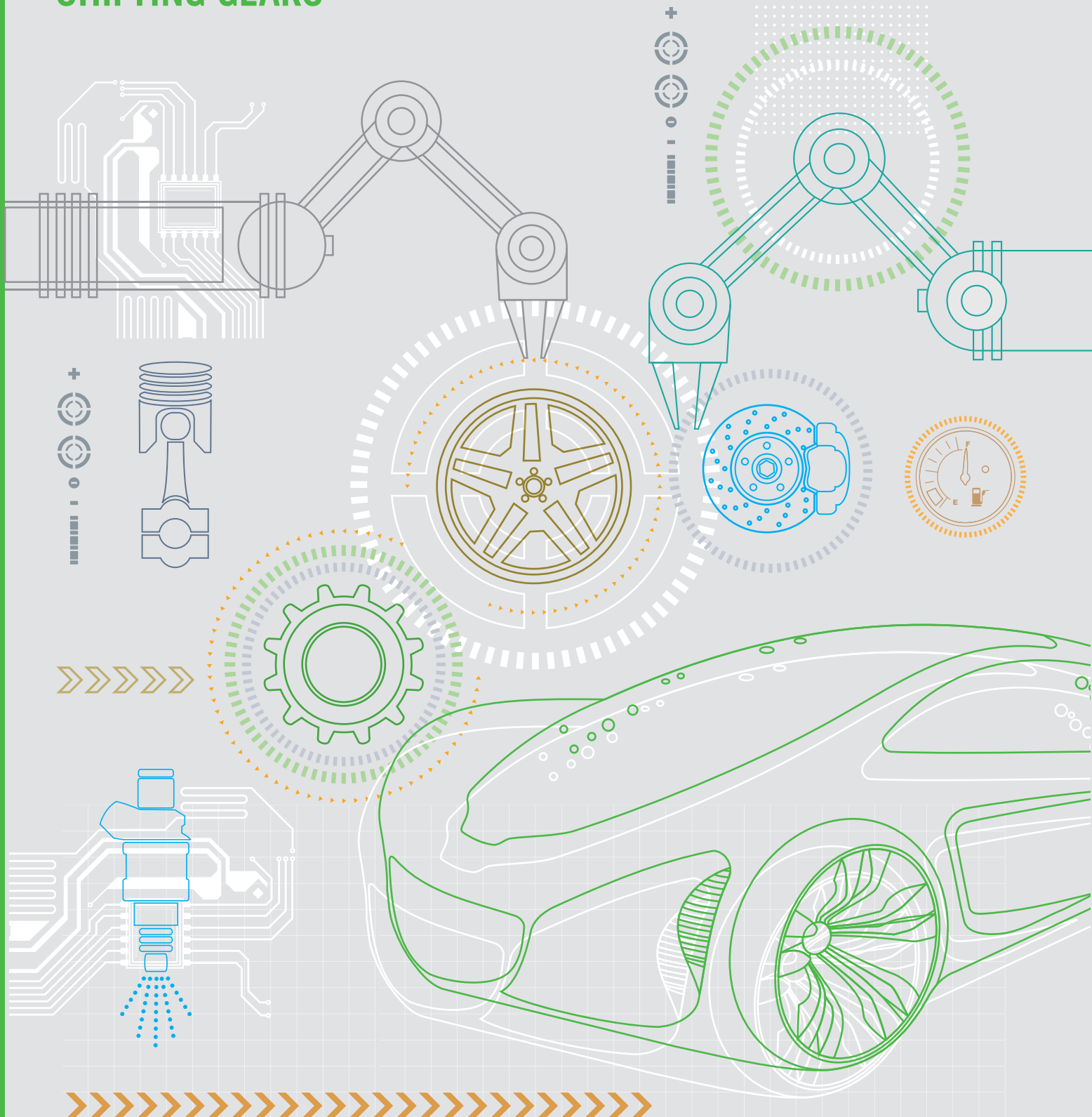


ASEAN IN TRANSFORMATION



International
Labour
Organization

AUTOMOTIVE AND AUTO PARTS: SHIFTING GEARS



ASEAN IN TRANSFORMATION



AUTOMOTIVE AND AUTO PARTS: SHIFTING GEARS

July 2016

Jae-Hee Chang, Gary Rynhart and Phu Huynh

Bureau for Employers' Activities (ACT/EMP), Working Paper No 12

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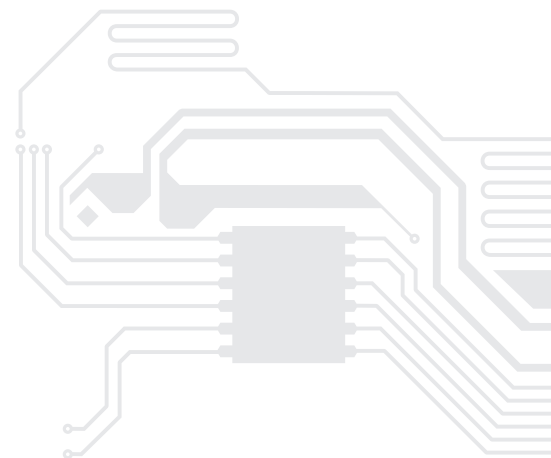
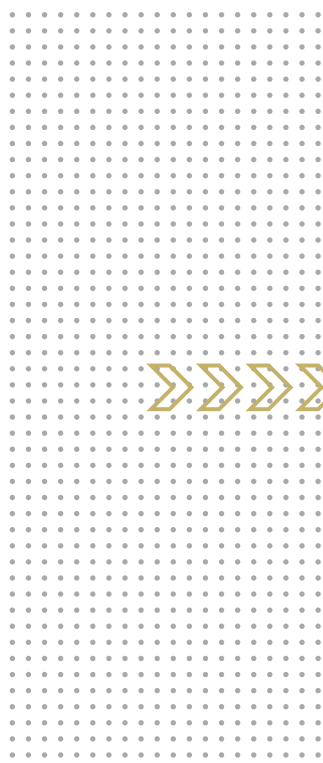
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PREFACE

This paper, *ASEAN in transformation: Automotive and auto parts – Shifting gears*, examines how technology is transforming the automotive and auto parts sector in the Association of Southeast Asian Nations (ASEAN). ASEAN’s automotive and auto parts sector is being significantly impacted by technology trends from electric vehicles to advances in material science, the most significant of which is robotic automation. Driven by an impetus to improve quality and consistency in production, ASEAN enterprises are swiftly moving towards greater adoption of technology. Technology is also creating a safer and cleaner working environment. However, as a result of greater technology adoption, the skills needs within the sector are changing, requiring more technical skills of greater variety and depth. To stimulate further growth in this important sector, the skills pipeline needs to be strengthened and the capacity of local automakers developed.

The findings of this paper are based on over 90 interviews, five site visits to automotive manufacturing facilities in Asia, and in-depth enterprise case studies in the automotive and auto parts sector conducted in mainly in Indonesia, Malaysia, Thailand and the United States. Secondary research was also conducted to ground the research more broadly in the ASEAN context.

The paper forms part of the ILO Bureau for Employers’ Activities (ACT/EMP) research project on the future of work and how technology is transforming jobs and enterprises in the ASEAN region. Drawing from numerous interviews and case studies, the team examined current technological trends in ASEAN and how they impact enterprises and workers within five major labour-intensive and/or growth manufacturing and services sectors: automotive and auto parts; electronics and electrical parts; textile, clothing and footwear; business process outsourcing and retail.



The wider research effort has culminated into a collection of separate papers, of which this study forms a part, each providing an in-depth examination on different aspects of how technology affects the ASEAN region.

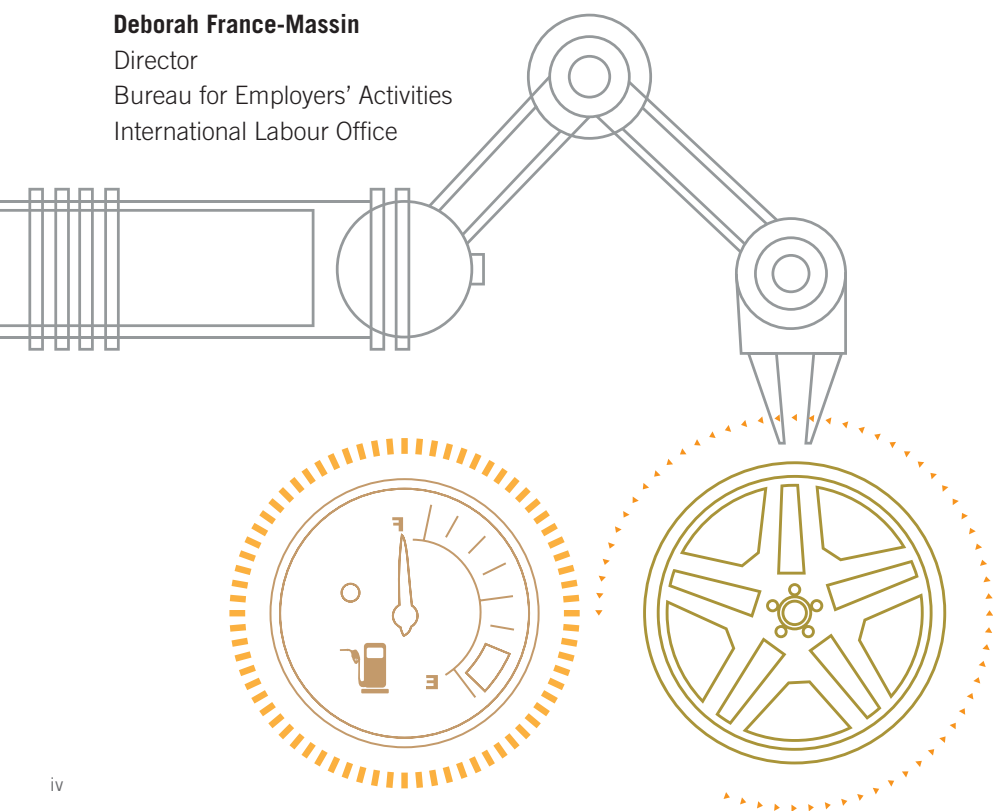
1. ***ASEAN in transformation: The future of jobs at risk of automation***
2. ***ASEAN in transformation: Perspectives of enterprises and students on future work***
3. ***ASEAN in transformation: Automotive and auto parts – Shifting gears***
4. ***ASEAN in transformation: Electrical and electronics – On and off the grid***
5. ***ASEAN in transformation: Textiles, clothing and footwear – Refashioning the future***

The findings for the documents above are synthesized in a master document titled, *ASEAN in Transformation: How technology is changing jobs and enterprises*.

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

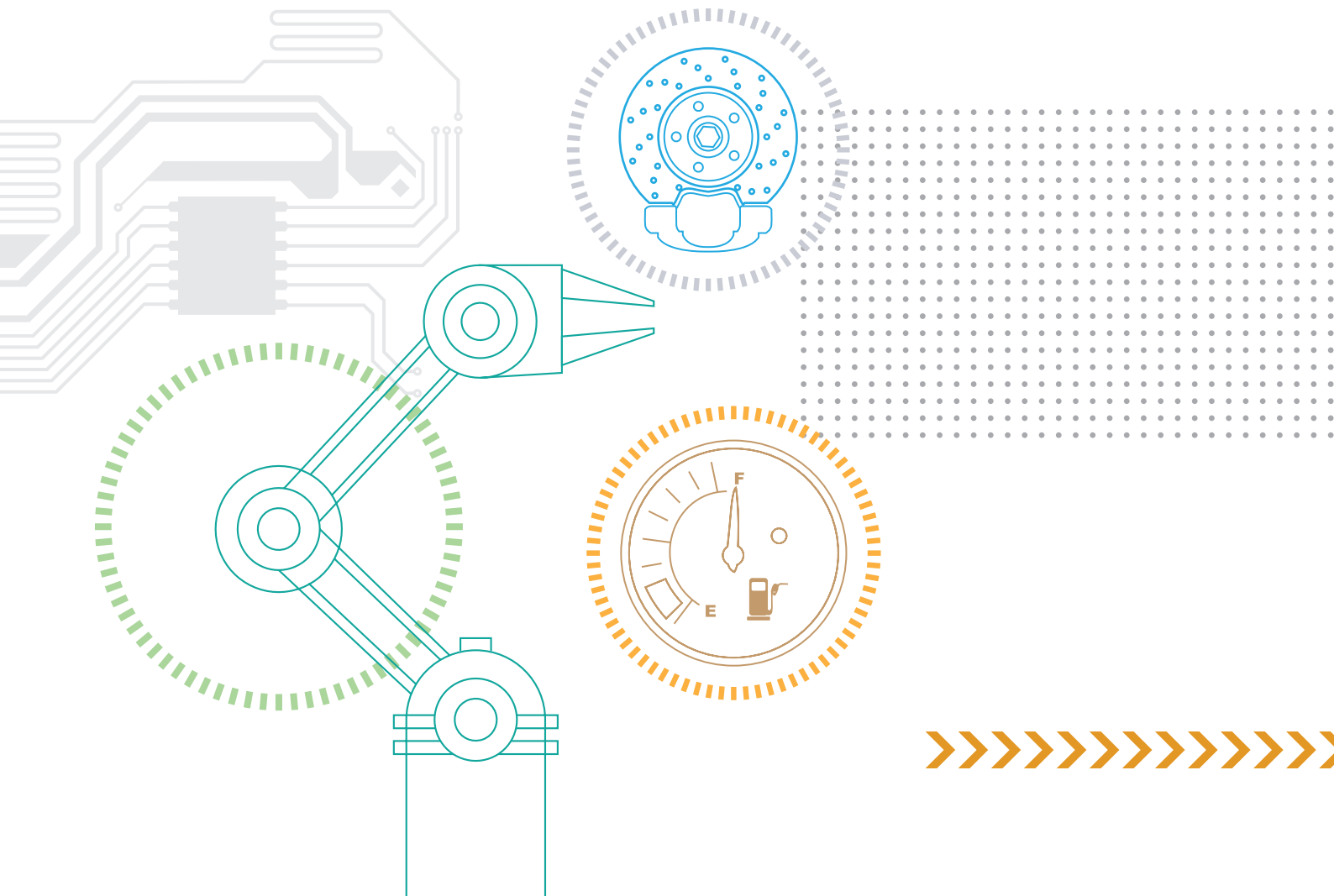


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In particular, we are deeply appreciative of the partnership with the University of California, Los Angeles (UCLA) Anderson School of Management through its Applied Research Management Program.

Thank you to those who provided extensive review and provided comments to this paper including Richard Doner, Emory University, and Bill Seeger, Faculty Adviser to UCLA.

ABOUT THE RESEARCH TEAM

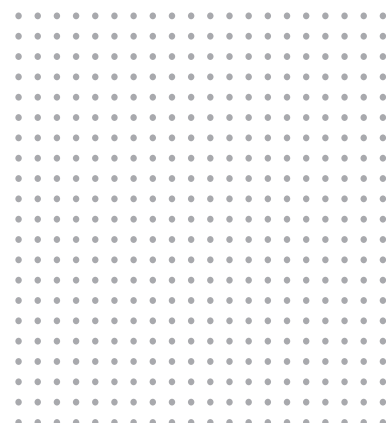
Yen-An Cho, Matt Inouye, Sam Lin, Thanachai Kongthaisereekul, and Andy Wang are from the Master of Business Administration programme at the UCLA Anderson School of Management. They conducted over 1,000 hours of strategic work over a 20-week period and executed the interviews and primary research that forms the basis of this report.

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ABOUT THE BUREAU FOR EMPLOYERS' ACTIVITIES

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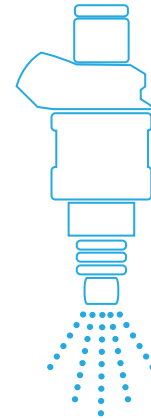
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ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
EV	electric vehicle
FTI	Federation of Thai Industries
GDP	gross domestic product
HEV	hybrid electric vehicles
IFR	International Federation of Robotics
ILO	International Labour Organization
ILO-ACT/EMP	ILO Bureau for Employers' Activities
ISIC	International Standard Industrial Classification of All Economic Activities
NSTDA	National Science and Technology Development Agency
OECD	Organisation for Economic Cooperation and Development
OEM	original equipment manufacturer
OICA	International Organization of Motor Vehicle Manufacturers
R&D	research and development
SITC	Standard International Trade Classification
STEM	science, technology, engineering and mathematics
TVET	technical vocational education and training
UCLA	University of California, Los Angeles



EXECUTIVE SUMMARY

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.

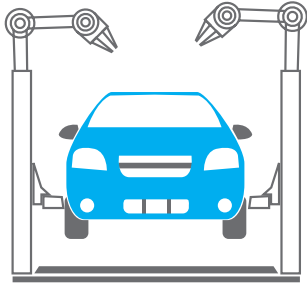
Our research indicates that automation and robotics will have the largest impact on jobs in the industry throughout the region. Robots are becoming better at assembly, cheaper and increasingly able to collaborate with people. They are also critical in making firms more productive and workplaces safer. 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 1. ASEAN automotive and auto parts overview



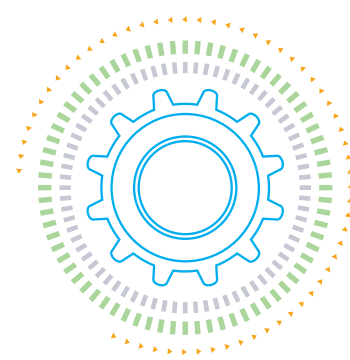
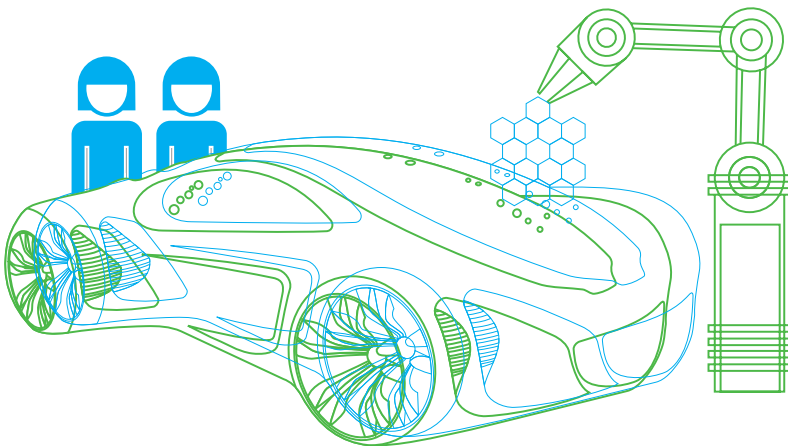
In 2015, ASEAN was the seventh largest producer of vehicles globally, with a compound annual growth rate of 10% since 2009

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

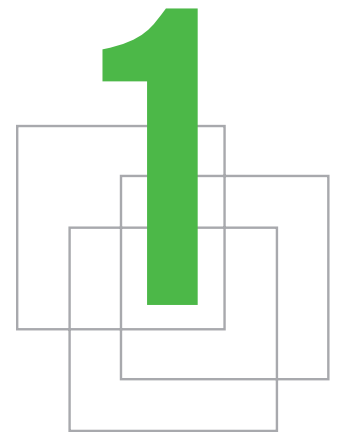


Over **60%** of salaried workers in Indonesia and **73%** in Thailand face high risk of automation

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

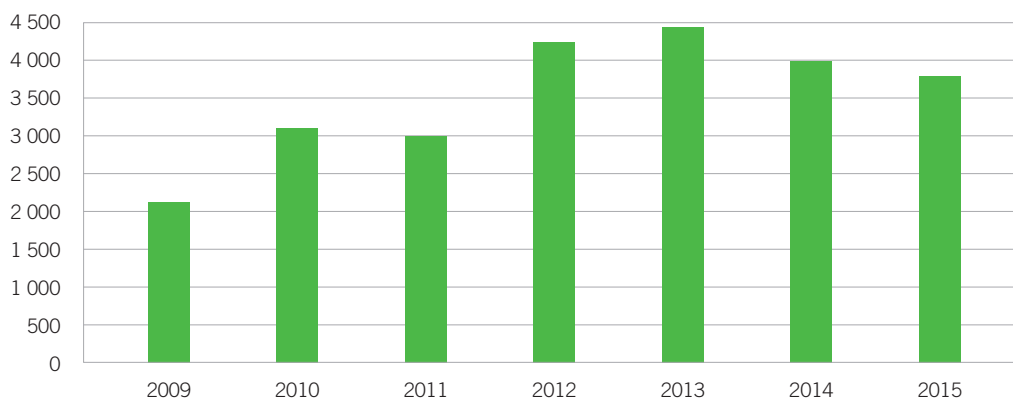


SECTOR OVERVIEW



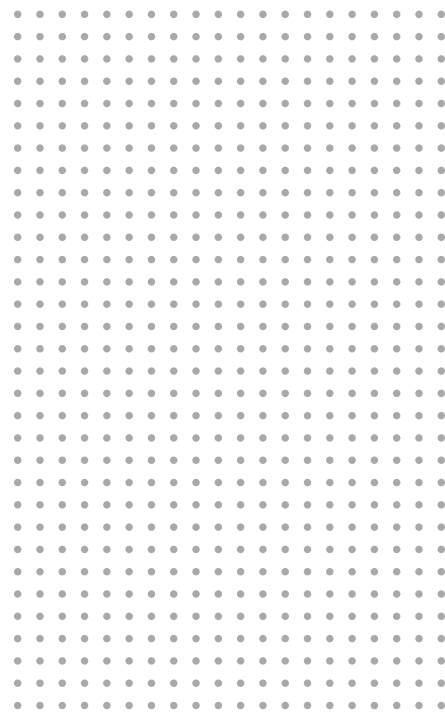
The ASEAN automotive market has become a dominant market for both original equipment manufacturers (OEMs) and auto parts suppliers and a major assembly hub due to the rapidly growing consumer market and comparatively low labour costs to that of developed countries.¹ ASEAN positioned itself as the seventh largest producer of vehicles in 2015, with a compound annual growth rate of 10 per cent since 2009.² In some countries, such as Indonesia and the Philippines, production has more than doubled during that period.³ Figure 1 provides an overview of production in the ASEAN region.

Figure 1. Passenger and commercial vehicle production in ASEAN (thousand units), 2009-15



Source: International Organization of Motor Vehicle Manufacturers (OICA) (2016).

The total employment in automotive manufacturing among selected ASEAN Member States is shown in figure 2. As a key example, Thailand’s automotive sector – which is the regional leader in production and sales – employed about 417,000 workers in 2015, representing 6.5 per cent of the total employment in manufacturing and accounting for roughly 10 per cent of the country’s gross domestic product (GDP).⁴



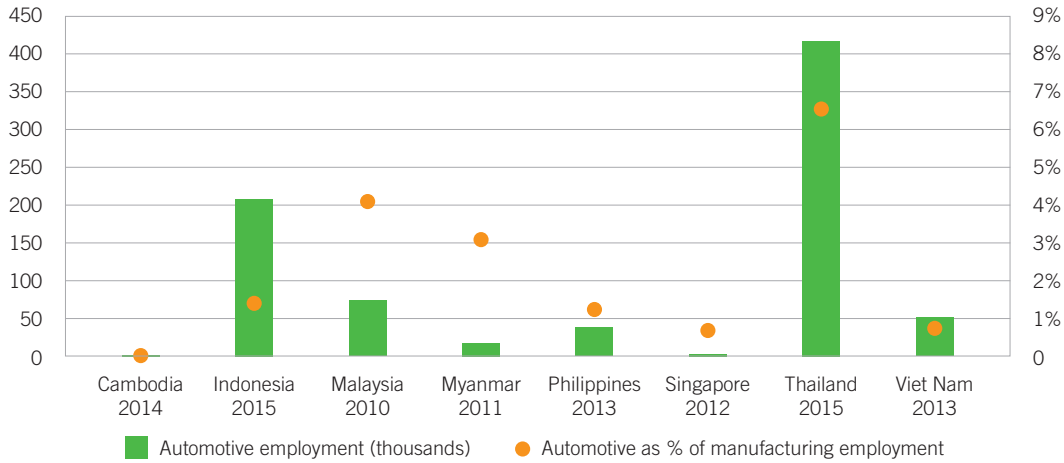
¹ Original equipment manufacturers (OEM) pertains to the original producer of a vehicle’s components like Toyota, Honda, Ford, General Motors, Hyundai, and Renault, among others.

² OICA, 2016.

³ Ibid. For the Philippines annual production grew from 45,311 units in 2005 to 112,493 units in 2015. For Indonesia, production grew from 494,551 units in 2005 to 1,098,780 units in 2015.

⁴ ILO estimates from official labour force surveys; Thailand Automotive Institute and Ministry of Industry, 2012.

Figure 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

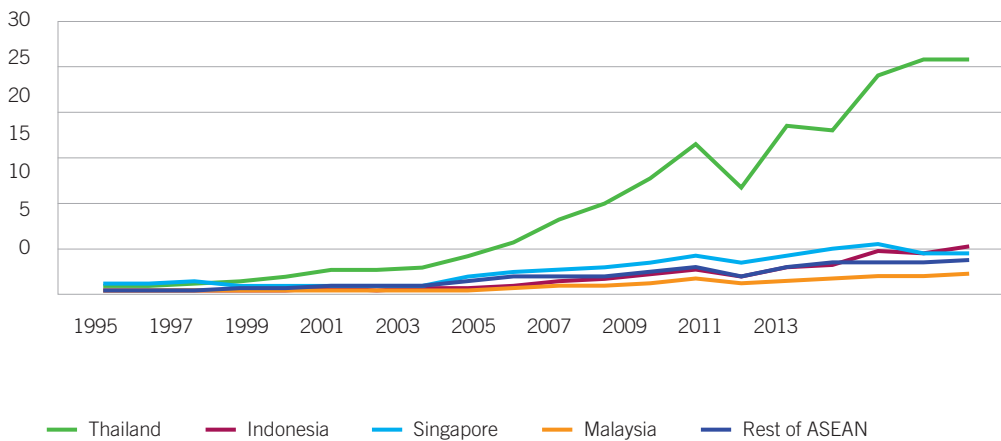


Note: Motor vehicles and parts include production under the International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4, divisions 29 ('Manufacture of motor vehicles, trailers and semi-trailers'). Total manufacturing refers to ISIC, Rev. 4, divisions 10-33.

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, with Thailand exporting 25.8 billion US dollars (US\$) in automotive goods in 2014, and Indonesia and Singapore each totalling approximately US\$5 billion in automotive exports in the same year (see figure 3).

Figure 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.

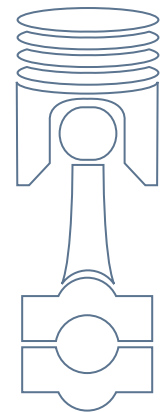
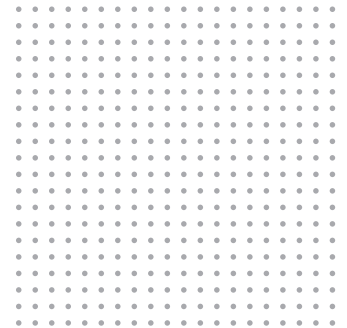
Source: UNCTAD (2016).

A considerable amount of cars produced in ASEAN end up in the region. About one third of Thailand’s automotive trade in 2014 was exported to other ASEAN Member States.⁵ For the same year, this ratio increases to 40 per cent for Malaysia and to 44 per cent for Indonesia. Outside of the region, major export markets for ASEAN automakers include Australia, Arab States, China, Japan and the United States.⁶

ASEAN’s automotive industry witnessed consistent growth due to its growing middle class which almost tripled over the past 20 years and the up-and-coming consumer markets from both within and beyond the region, expansion of foreign OEMs and automotive producers, and a strong pipeline of abundant, low-cost, trained workers.⁷ However, as consumer preferences become more sophisticated, OEMs continue to upgrade their production requirements to make higher performing cars, innovation for enhanced productivity remains a strong push factor, and as labour costs rise in ASEAN, the sector and its players, both big and small, will need to thoroughly examine how they can effectively navigate regional and global markets.

It is important to note that the growth of ASEAN’s automotive sector came from foreign OEMs with their “follow source” suppliers. Overall, research shows that these suppliers (mostly tier one) have succeeded in embracing modern technology and utilizing their cross-national relationships to OEMs.⁸ Moreover, there has been significant global consolidation of suppliers that enable larger economies of scale. Further up the supply chain, for example tier three, truly local auto parts enterprises do not have abundant capital or direct relationships with foreign OEMs, constituting rising barriers for local producers to build technological expertise and production capacities.

This paper investigates the regional and global changes impacting the economics of the automotive sector in the ASEAN region. The main findings are based on primary research which includes over 90 interviews from tier one suppliers who supply directly to OEMs, OEMs, industry experts, academics, as well as site visits to five tier one manufacturing facilities in Asia.⁹



1.1 The disruptors

Globally, technological innovation in the automotive sector is driven by consumer preferences, their income levels and government regulation. Customers are constantly demanding cars that are more affordable, faster, richer in terms of features, and more fuel efficient. These consumer demands translate into technological innovations that allow for lighter materials, improved energy efficiency and intricate electronic systems. Additional demands for comfort, convenience, and advanced technology push car makers to invest heavily in research and development (R&D) to stay competitive in the market.

⁵ UNCTAD, 2016.

⁶ Ibid.

⁷ 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, 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, 2015b).

⁸ An example of a tier one supplier would be Sensata Technologies who is a supplier of 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).

⁹ Eight interviews were conducted with enterprises 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 types of cars that are bought and sold also depend heavily on the disposable income of the population. Currently, vehicles that use new technology are significantly more expensive, and their adoption is low outside the most mature economies with higher per capita income. As an example, the base price for Tesla’s electric vehicle (EV) starts at US\$80,000, which is approximately four times more expensive than the most popular car sold in Thailand in 2015.¹⁰

Finally, government regulations play an important role in many decisions made by automotive companies. Some of the key regulations that impact automakers globally are the requirements on fuel efficiency and limits on greenhouse gas emissions. These regulations force companies to constantly innovate car performance and production with green technology.

These forces of innovation have resulted in the following most significant and relatively recent technological advancements in the global automotive industry: electrification, fuel efficiency, and autonomous driving. In addition to these, automation has been a long-standing technological contributor to the industry. Some technologies obviously have a more profound and immediate impact on jobs than others.

The electrification of vehicles. The first innovation on electrification of vehicles refers to both the electrification of the powertrain and components inside the vehicle.¹¹ As an example of the former, over the years growing interest in EVs and hybrid electric vehicles (HEVs) have been seen due to volatile gasoline prices and increasing environmental awareness among the consumers and regulators. Aside from the powertrain, electronic components have also become an increasingly important part of vehicles due to the rising demand for performance, safety, and infotainment features. As such, continuous progress in electrification will significantly grow the industry’s need for electrical engineers, web programmers and other high skilled technicians.

In the near term, the effect of electrification on the ASEAN OEMs and suppliers is expected to be limited due to lack of market demand (because EVs are more expensive) for OEMs to localize production and absence of an integrated local supply chain for key EV and HEV components.¹² Moreover, increased consideration needs to be made for improving infrastructure, which is essential to adopting EV technology. However, in the longer term industry predictions are being made that cost of EVs will dip below conventional cars by 2022.¹³

Advances in material science. Secondly, automotive technology is heavily focused on increasing fuel efficiency driven by regulatory requirements on gas mileage and carbon footprint. Weight reduction is one key contributor to enhancing fuel efficiency, and car makers are investing in switching completely to lighter materials (for example, from steel to aluminum), or improving current material (for example, plastic composite). Lightweight materials like aluminum and carbon fiber are currently channeled into high-end models as they are significantly more expensive than steel. For example, reinforced steel offers weight advantage of 20 per cent over traditional steel but comes with a 15 per cent price premium, aluminum is 40 per cent lighter but 30 per cent more expensive, and carbon fiber is 50 per cent lighter and almost five times



¹⁰ Groden, 2015. Thailand’s best-selling car in 2015 was Toyota Hilux, which is sold at THB569,000 or US\$15,900 (Focus2move, 2015; Toyota, 2015). Tesla Motors is one 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).

¹¹ In a motor vehicle, the term powertrain describes the main components that generate power and deliver it to the road surface, water, or air.

¹² In addition to Tesla Motors, EVs available in the market range from US\$21,750 to US\$125,000 (Consumer Reports, 2016).

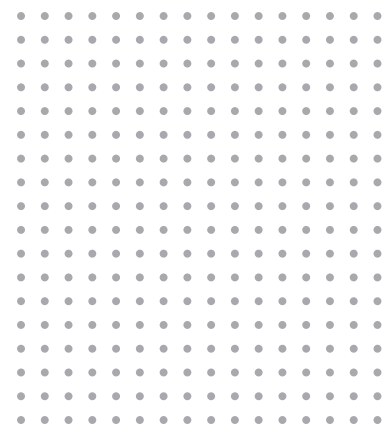
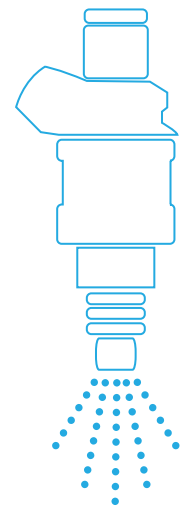
¹³ Carrington, 2016.

more expensive.¹⁴ Advances in materials science in automotive production brings a greater possibility of using additive manufacturing and 3D printing to print car parts and accessories. 3D printing also brings enhanced flexibility in design, enabling manufacturers to develop more customized features.

In relation to greater attention made to improve fuel efficiency and better designed cars, the sector will be pressured to recruit material engineers, sustainability integration experts, and design engineers who can introduce ways to use less but more effective and cheaper resources throughout the production process.

In the ASEAN region, traditional steel-based vehicles are likely to remain most popular for the time being until the price premium attached to low carbon, light-weight cars is removed or a considerable jump is seen in disposable income for middle class ASEAN consumers.

Autonomous driving. The final technological emergence that has garnered considerable attention is autonomous driving. Self-driving technologies are under development by companies like Audi, BMW, Ford, General Motors, Honda, Mercedes-Benz, TATA, Toyota, and Volkswagen; new entrants such as Cruise Automation and Tesla Motors; and those from technology sectors including Apple, Baidu, Google, and Uber.¹⁵ Potentially considered the most disruptive technology for the automotive sector in terms of design, legal and physical infrastructure and commercialization of the car, autonomous cars have already created new jobs for the industry such as analytical experts, autonomous driving engineers, and interaction designers.



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 MIT study on Singapore estimated that only 300,000 driverless – roughly one third of the total in operation today – could be shared to serve the entire population's needs.

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

Bullish projections indicate that another four to five years will be needed for driverless cars to hit the road in the United States as legal and insurance issues need to be resolved first. The ASEAN environment is relatively more challenging for autonomous vehicles as infrastructure and enforcement regulations remain poor and motorcycles as well as street vendors dominate the streets, increasing the variability of conditions for which technology needs to monitor and



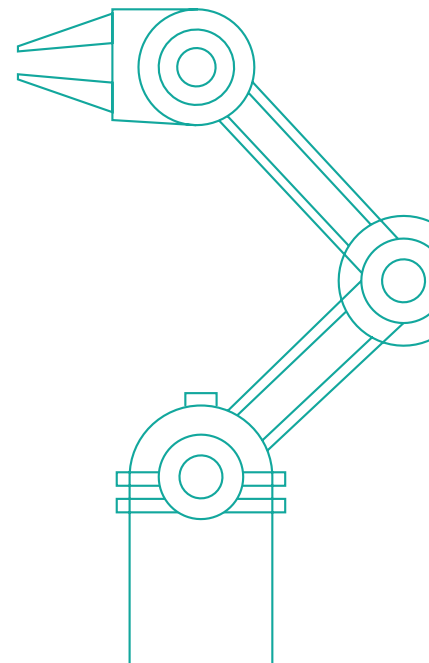
¹⁴ McKinsey and Company, 2012.

¹⁵ CB Insights, 2015; De Looper, 2015; Pocket-lint, 2016.

control. But driverless cars could surface within the next ten years in ASEAN if trial and error experienced by early adopters are skipped. Singapore – the region’s economic leader – is already testing autonomous vehicles in the city, focusing on applying driverless technologies to public buses, freight carriers, taxis and utility operations such as road sweepers.¹⁶ While autonomous cars in wider ASEAN may not become immediately universal, successes in Singapore as well as neighbouring countries like China, where the Chinese firm Baidu has established a five year plan to implement driverless cars in the city of Wuhu, may result in a leapfrog effect from motorcycles to autonomous vehicles for some developing ASEAN nations.¹⁷

While electrification, fuel efficiency and autonomous driving are developing rapidly in the global auto industry, their implications to OEMs and suppliers in ASEAN are somewhat restricted in the short term for various reasons highlighted above. There is no disputing that the demand for more powerful, connected and versatile cars will grow. The question is not if but when these three trends will fully penetrate the production of ASEAN automotive industry and exert effects on the workforce and manufacturing operations.

Robotic automation. Our research shows that the most significant technology that is widely penetrating the sector’s production and impacting the ASEAN region most directly is automation, more specifically standardized robotics resulting from incremental upgrades in automated technology.¹⁸ Automation is not new to the automotive industry. Early adoption of assembly line manufacturing – perhaps most notably by the Ford Motor Company in the 1910s – and the pioneering use of industrial robots – first introduced by General Motors in 1961 have led to unparalleled efficiencies in large-scale production.¹⁹ As an indicative example, 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.²⁰



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

Source: ILO interviews, 2015.

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 in particular shown a 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 2014.²¹

¹⁶ Tan, 2015.

¹⁷ BBC, 2016.

¹⁸ Automation refers to use of various control systems to operate equipment and machinery in order to reduce human physical involvement.

¹⁹ History, 2016; IFR, 2012.

²⁰ Bloomberg News, 2013.

²¹ IFR, 2015.

Industrial robots were previously large and dangerous, and engaged in indelicate processes, narrowly defined and repeatable tasks. They were found in the paint or body shops of automobile factories, and were kept separate from humans. Decades later, a new generation of automated machines are surfacing: they are smaller, getting better at assembly, becoming cheaper and easier to install, more adaptable and increasingly collaborative with people. As a recent example, Renault SA's plant in Cleon, France, integrated robots that drive screws into engines, especially those that go into hard to reach places. The machines contribute to increased precision and quality of final products as they employ a reach of more than 50 inches, verifies that parts are properly fastened, and that the correct parts are being used.²²

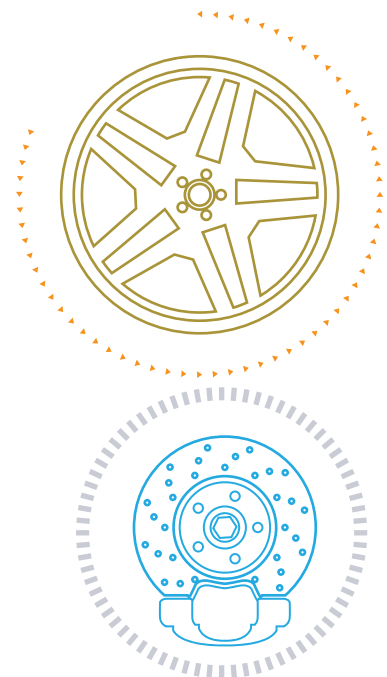
The qualitative interviews conducted throughout our research show that automation and robotic technology will by far have the largest impact on jobs for the automotive industry across the ASEAN region until 2025. Most importantly, accelerated adoption of robotics will significantly change enterprise employment and skills needs and bring major changes to the factory floor in the ASEAN region.²³ The next section synthesizes the key findings on why ASEAN automakers and suppliers are using automated processes in their factories.

1.2 Forces at play

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

Source: ILO interviews, 2015.

We can already see several forces at play that are influencing the sector. First, there is the demand for improved product quality. This factor increasingly pushes ASEAN automotive players to automate their manufacturing processes. To point, a Bangkok-based tier one automotive part supplier producing injection-molded parts indicated that automation allowed the factory to produce high-quality parts with much lower variances in quality.²⁴ Certain injection molded auto parts require metal parts (e.g. nuts) be inserted to the mold prior to the injection of plastic. Previously, this insertion of metal parts was done manually by line workers, making the process highly unreliable. The company decided to automate the process with a robotic arm that could place a metal nut into the mold and remove the completed part. As a result, not only did precision increase but cycle time also became accurate to the millisecond. This ensured a level of quality and consistency that were not possible with manual labour.



²² Hagerty, 2015.

²³ In this report we define skill levels according to the ILO/ISCO-08 standard. High skill occupations are defined as ISCO groups 1 (managers), 2 (professionals) and 3 (technicians and associate professionals); medium-skill occupations include ISCO groups 4 (clerks), 5 (service and sales workers), 6 (skilled agricultural and fishery workers), 7 (craft and related trade workers) and 8 (plant and machine operators and assemblers); and low-skill occupations consist of ISCO group 9 (elementary occupations).

²⁴ This is a large company with over 600 employees.

Another Shanghai-based tier one supplier with strong ties with General Motors and other American car makers also highlighted the importance of robotics in their operations, especially as they see electronics parts becoming more pervasive in cars.²⁵ More specifically, electronics have become so small for some parts that only robots can perform the work for long hours and maintain consistent quality. This supplier also indicates that robots have increased efficiency by 30 to 40 per cent as robots can take three shifts and work 24 hours a day and seven days a week. Robotic automation further decreased the number of accidents at the supplier's factory by 70 per cent.

This leads to the next reason for ASEAN automotive industry to absorb automation: a safer working environment. Robots are credited with cutting overall fatal accidents in factories because more people could have been injured if dangerous work was not replaced with automation.²⁶ Aligned with recent trends in the automotive sector to produce EVs with batteries – production of which involves high voltage environments – the use of robots serves to keep workers out of harm's way. Furthermore, robots do not get tired and thus are not prone to accidents or 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 the direct correlation for reduced industrial accidents and uptake on technology for the ASEAN region, a quick glimpse into occupational injuries in Thailand between 2010 and 2013 show that there has been a steady decrease (by over 20 per cent) of accidents in the automotive sector.²⁷ The decline could be a result of various factors, however, what is clear is that vehicle production increased during that period as well as the estimated stock of multipurpose robots.²⁸

One of the most influential factors in the sector is the common practice of including “cost-downs” in contracts between OEMs and suppliers. Cost-downs refer to agreements where 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 can play a key role in those savings. For example, an



²⁵ While this supplier is not based in ASEAN, a glimpse into China-based suppliers and their automation journey could provide a glimpse into the future of ASEAN's automotive industry.

²⁶ Financial Times, 2015.

²⁷ ASEAN-OSHNET, 2016.

²⁸ IFR, 2015. Additional reasons for decrease in occupational injuries could be for example due to increased labour inspection.

Indonesia-based auto parts company specializing in interior components and insulation that we interviewed, indicated that successful integration of automated processes has doubled their water-jet efficiency and increased capacity in cutting automobile parts by more than threefold.²⁹

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

Source: ILO interviews, 2015.

On one hand automotive suppliers in the ASEAN region face continued cost reduction pressures from OEMs and on the other hand they can be challenged by significant increases in operational cost due to unpredictable and, on occasion, large spikes in minimum wages. Thailand is a prime example where the minimum wage increased by over 60 per cent during the past decade from 184 Thai Baht (THB) in 2006 to THB215 in 2011 and then to THB300 in 2013.³⁰ The estimated share of wage employees that earned less than the legislated THB300 minimum wage in Thailand's automotive industry in 2013 was statistically significant at over 20 per cent.³¹ 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 2014.³² As a result, many enterprises that were dependent on manual workers earning less than 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 cost 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 cost.”

Owner, Auto parts manufacturer, Thailand, ILO interview, 2015.

On the consumer side, a wealthier ASEAN population with more disposable income is pushing companies to produce more cars. Most ASEAN Member States are currently in the US\$3,000 -US\$10,000 bracket of GDP per capita, a category in which car ownership typically grows at about twice the rate of the economy.³³ Driven by robust GDP growth, middle class households with disposable income are expected to almost double from 67 million to 125 million by 2025.³⁴



²⁹ The company introduced a water-jet cutting robotic arm which is used to cut automobile internal parts, to cut holes or trim the edges.

³⁰ Bank of Thailand, n.d.

³¹ If the minimum wage threshold is increased by 10 per cent to 330 THB, almost 30 per cent of the wage employees are at or below the threshold (ILO Labour Force Surveys, 2016).

³² ILO, 2015a. Based on estimates by the Indonesian Central Bureau of Statistics (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”.

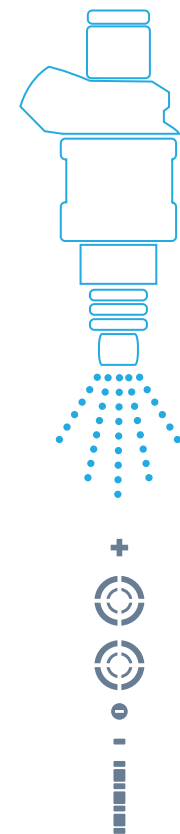
³³ The Economist Intelligence Unit, 2014.

This wealthier consumer base will translate into a greater need for ASEAN’s automotive industry to produce more of both high-end, luxury cars (for upper middle class consumers) and cheaper, more economic models (to win the pockets of the emerging middle class).

Because car ownership in ASEAN is still far lower than Organisation for Economic Co-operation and Development (OECD) member countries, and automotive manufacturing remains a largely regional activity, the near-term priority for a majority of ASEAN manufacturers will likely focus on increasing regional motorization rate by producing affordable cars.³⁵ 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, resulting from increased consumer demand.

Stronger government regulations to lower carbon emissions and rising consumer consciousness will also push ASEAN 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 use of EVs or HEVs. For example, Thailand’s Eco-Car programme offers tax incentives over eight years to large investors in the manufacture of cars to meet specific size and efficiency requirements.³⁶ Indonesia’s Low Cost Green Car programme mirrored the Thai scheme since its launch in 2013.³⁷ It offers incentives for cars to qualify under certain efficiency specifications and seeks to boost local manufacturers through a specification that 85 per cent of the parts must be locally sourced.³⁸ Malaysia recently provided some key grants and incentives for developing smaller, more environmentally friendly city cars through its National Automotive Policy and provides tax exemptions to automakers in that manufacture or assemble HEVs.³⁹ Industry projections suggest that the HEV market is expected to play an increasingly material role in the ASEAN automotive market with Malaysia and Thailand competing to be the manufacturing hub.⁴⁰

EVs on the other hand could have a mixed impact in the next ten years due to considerable improvements required to establish appropriate infrastructure and implement government policies. In Thailand, the Bangkok Mass Transit Authority announced concrete plans in 2016 to regulate cost of EVs so that they don’t exceed natural gas vehicles, run electric buses, and build EV charging networks for passenger cars. Between 2020 and 2036, the Thai government projects 1.2 million EVs running with 690-800 charging stations.⁴¹ Thailand’s governmental body focused on technology development – National Science and Technology Development Agency (NSTDA) – is also focused on supporting the industry to produce energy-saving automotive parts by developing prototypes and designing technologies for EVs.⁴²



³⁴ HV et al., 2014.

³⁵ 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.

³⁶ Thailand Board of Investment, 2007.

³⁷ Thueanmunsaen, 2013.

³⁸ Leclair, 2015.

³⁹ Ibid.

⁴⁰ Surender, 2016.

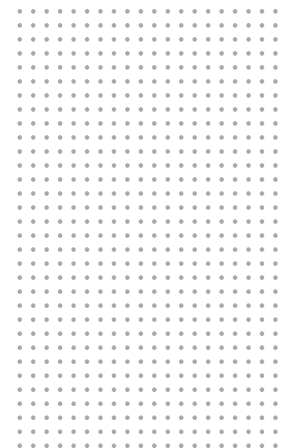
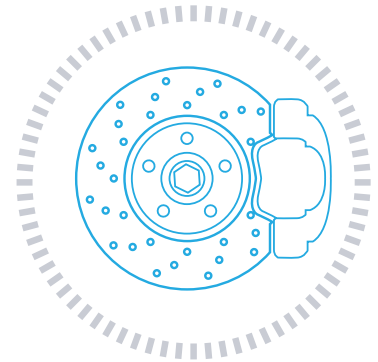
⁴¹ Therapat, 2016.

⁴² NSTDA, 2016.

However, even with established government policies, unforeseen administrative bottlenecks could decrease consumer purchasing. For instance, the Government of Singapore fined an owner of Tesla Model S – an EV – for excessive emission via “upstream emissions”, the environmental impact of producing electricity to power the car.⁴³ Decreased consumption could then result in a lowered demand for materials engineers, automation analysts and other related occupations.

Regarding EVs effects on workers, because EVs have almost two-thirds fewer individual parts than traditional gasoline vehicles (11,000 individual parts compared with 30,000), their simpler manufacturing processes coupled with greater standardisation of parts could considerably lower the need for manual workers in an assembly line.⁴⁴

Recent research suggests that globally the automotive sector is undergoing significant transformation as a result of accelerated technological innovation that spans from producing cars with collaborative robots to enhancing its features with electronic gadgets. Big car makers are also racing to fully implement driverless cars by entering into strategic alliances with technology companies. Take General Motor’s plans to launch autonomous vehicles at their technical centre in Detroit in late 2016 and their US\$1 billion acquisition of Cruise Automation, a San Francisco-based start-up making sensors that turn regular vehicles into ones that drive themselves, as an example.⁴⁵ As such, ASEAN auto makers and those engaged in the sector need to assess and respond to the types of technologies that are penetrating the market, and from a labour market perspective understand how adoption of technology will shape the configuration of jobs and employment.



“I believe the auto industry will change more in the next five to ten years than it has in the last 50.”

Mary Barra, CEO and Chairman of General Motors.

Source: Barra, 2016a.

Moving forward, the future of ASEAN’s automotive sector will be increasingly shaped by enhanced robotics and automated processes to meet growing regional demand, ensure consistent quality, and whether increasing labour costs which were once conceived as a critical value proposition for the region.



⁴³ Passary, 2016.

⁴⁴ Goldman Sachs, 2016.

⁴⁵ The Economist, 2016; Wright et al, 2016.

IMPACT ON ENTERPRISES

2.1 Effects on operations

ASEAN automakers are making technology task forces core to their operational structure

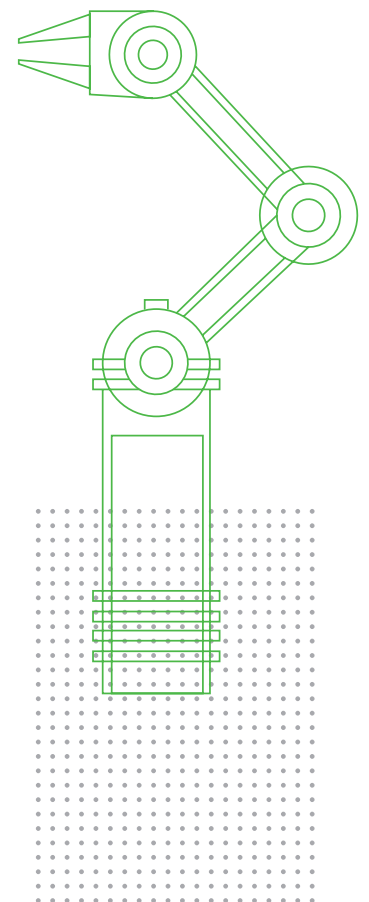
Zooming into operative decisions for increased automation and robotics in the ASEAN region, our research found that automakers, in particular those in tier one that supply for foreign OEMs, are making conscious efforts to establish internal company task forces or teams to monitor new automation technologies and assess how these technologies can be utilized to improve the manufacturing efficiency of each process. 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 in the region and reorganize production centres in ASEAN

OEMs who remain married to the traditional business model of moving to operational countries rather than implementing automation and innovative technologies to enhance total performance may consider establishing and expanding their presence where labour costs remains comparatively low in the region. This potentially means moving the production of labour-intensive components from Indonesia, Malaysia and Thailand to countries like Cambodia, Lao People's Democratic Republic and Myanmar. Such shift could result in hollowing out of domestic parts and components industry in the more established markets and a drastically different auto component supply system could surface in ASEAN.⁴⁶

Firms are optimizing production with automation

To implement and operationalize automation and robotics, our research and accompanied interviews show that automotive and auto part suppliers conduct an initial assessment on which functions or tasks would benefit most from machinery. In contrast to OEMs, part manufacturers in the region are more likely to automate tasks that are relatively simple, repetitive and low skilled. For example, one Indonesia-based enterprise that has a long-standing 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 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 for low-skilled tasks is expected to persist and grow throughout ASEAN.



⁴⁶ Kobayashi, 2014.

2.2 Effects on skills

Robots are replacing low-skilled jobs

The fieldwork conducted illustrates that manual, less-skilled workers are currently being replaced by robots and machinery in ASEAN's automotive sector. Furthermore, our simulations on employment changes in the sector shows that occupations in Indonesia and Thailand's automotive industry face high automation risk at nearly 60 per cent and over 70 per cent, respectively.⁴⁷

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

Source: ILO interviews, 2015.

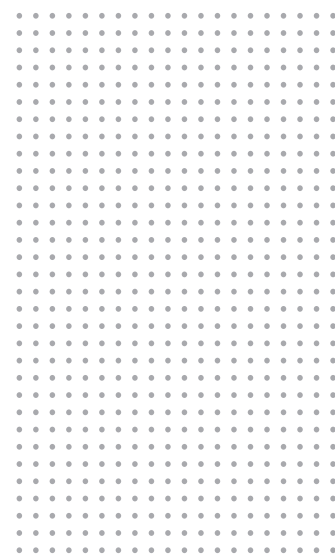
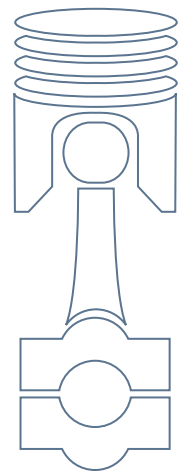
The industry needs new types of skills which are increasingly difficult to find

At the same time, enterprises are creating new jobs that require greater technical knowledge to operate and service machines and interpret production statistics. For example, an Indonesia-based auto parts supplier indicated that automation has resulted in a change in job requirements and workers are expected to perform basic troubleshooting when machines malfunction. This requires a different set of skills such as critical thinking and problem-solving skills that were not necessary before. Similar skills needs are confirmed in the accompanied ILO enterprise survey where over 30 per cent of ASEAN enterprises highlighted that strategic thinking was by far the most difficult skill to find.⁴⁸

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.⁴⁹

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 option are to upgrade skills and standards.

Source: ILO, forthcoming.



⁴⁷ Chang and Huynh, 2016.

⁴⁸ ILO, 2016.

⁴⁹ ILO, forthcoming.

Moreover, the general lack of interest from millennials to work in, what is perceived to be, an old, low paying and physically intense industry makes it difficult for the ASEAN automotive industry to attract workers with higher skills who can adapt to new technology in the fast paced environment. Other research conducted for the automotive sector also emphasizes the fact that millennials do not consider careers in the industry as rewarding and that they also lack confidence in the future of quality employment in manufacturing.⁵⁰

Globally, the automotive industry is charged with similar skills challenges. For example, in 2016 the UK automotive industry announced that 5,000 jobs in the sector could be left vacant due to skills shortages, in particular roles in engineering, design and production.⁵¹

To build and supply for more technology driven vehicles, ASEAN auto makers will need to find workers with suitable skills and provide skills upgrading to their existing workforce. With robotic technology increasing, ASEAN enterprises indicated greater need for engineers with specialized knowledge of automated process design and robotic programming. Acceleration of technology in the auto industry to make improvements with electrification, fuel efficiency and autonomous vehicle technology will no doubt intensify the competition for talented skilled workers. Recently, General Motors identified jobs that would be critical to lead the global auto industry, including electrical engineers, analytical experts, customer care experts and industrial engineers.⁵²

To build a stronger skills pipeline, foreign OEMs like Mercedes-Benz are offering technical apprenticeships using a dual-education system in partnership with vocational schools accredited by the Ministry of Education in Thailand and establishing training centres in Indonesia to raise the quality of production and integrate advances in technology to meet the standard requirements established by the corporate regional headquarters.⁵³



“As of today, over 600 qualified technicians were already shaped for 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.

Other examples include partnerships forged between auto players and government bodies such as Thailand’s NSTDA 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

⁵⁰ Deloitte, 2009.

⁵¹ SMMT, 2016.

⁵² Barra, 2016b.

⁵³ Mercedes-Benz, 2014a, 2014b.

Motors and Robert Bosch.⁵⁴ It is important to mention that foreign OEMs, not Thai firms, have thus far been at the forefront of skills development initiatives. Only in 2015 did an automotive workforce development programme entitled the Automotive Human Resources Development Academy emerge for Thai actors. Additional efforts to establish relationships between local educational and technology promotion institutions and automotive firms will be necessary to offer a forward-looking curriculum infused with the latest technology machinery so that the region has a competitive workforce.

Governments also recognize the growing need for a skills-intense workforce. For example, Malaysia's National Automotive Policy 2014 highlights the need to develop specific skilled labour in automated production systems to enable the industry to raise levels of automation and mechanization.⁵⁵ The Malaysian Automotive Components Parts Manufacturers' Association has also worked with the Japan External Trade Organization to improve the technical skills of Malaysian automakers since the early 2000s by facilitating business development programmes designed to match Malaysian producers with Japanese OEMs.⁵⁶

Overall, ASEAN's automotive sector needs to improve sector-wide infrastructure for education and training. The research shows that much training occurs within the OEMs as opposed to being available to a holistic range of industry players. The growth of the automotive workforce, including workers for tier two and tier three suppliers will be critical to further enhance the sector's growth.

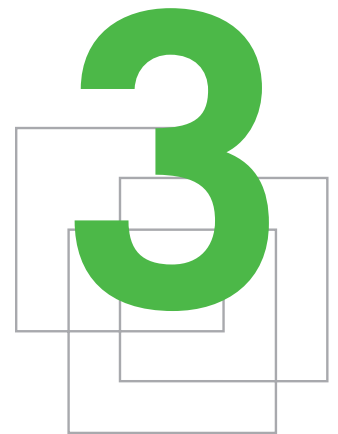


⁵⁴ NSTDA, 2011. Thailand's National Science and Technology Development Agency (NSTDA) is tasked with research and development, technology transfer, human resources development and infrastructure development (NSTDA, 2011).

⁵⁵ MAA, 2014.

⁵⁶ ILO, forthcoming.

IMPACT ON PEOPLE



“Education quality is not good enough in lower-tier schools. Engineering graduates cannot even carry out basic engineering tasks and lack basic math and excel skills. We end up spending lots of time and energy training these workers.”

Source: OEM, Thailand, ILO interview, 2015.

Finding talent and the right skills is hindered by a number of factors. Education is perhaps the most significant. ASEAN’s incoming workforce need to be made constantly aware that opportunities for interesting and rewarding work are ample in the automotive industry and take up relevant training and education to make themselves relevant for employers. As noted in the previous section, the auto sector in ASEAN will demand for more workers with strong technical backgrounds and with degrees in science, technology, engineering and mathematics (STEM).

An in-depth look into students graduating with 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, reaching over 50 per cent of tertiary graduates in Cambodia and Thailand.⁵⁷ The ILO student survey confirms this large uptake by showing the biggest share, nearly 30 per cent, of ASEAN students are studying business, commerce or finance.⁵⁸ On the other hand, tertiary enrolment in engineering, manufacturing and construction is below 10 per cent for Cambodia, Indonesia, Lao People’s Democratic Republic and Thailand.⁵⁹



However, when analyzing the future supply of ASEAN workers with the relevant technical degrees, it is not only the absolute percentage of STEM graduates that one must consider, but also the quality of education they 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.⁶⁰



⁵⁷ UNESCO-UIS, 2016.

⁵⁸ ILO, 2016.

⁵⁹ UNESCO-UIS, 2016.

⁶⁰ ILO, forthcoming.

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 labour force in 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 they account for 37.7 per cent of total employment.⁶¹ Research conducted by McKinsey and Company also labels the automotive and industrial manufacturing sector “unable to enter” for women in all ranges of roles from entry-level to executive.⁶² The ASEAN region would also be subject to similar hurdles, especially due to the skewed tendency for female students to pursue education, health welfare and humanities and STEM uptake remains relatively low at 17 per cent.⁶³

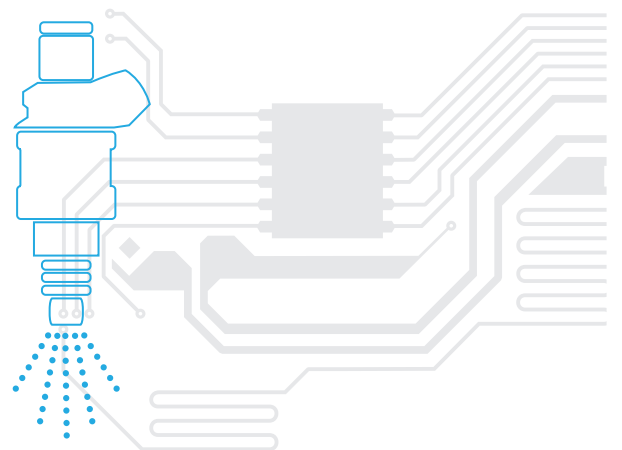
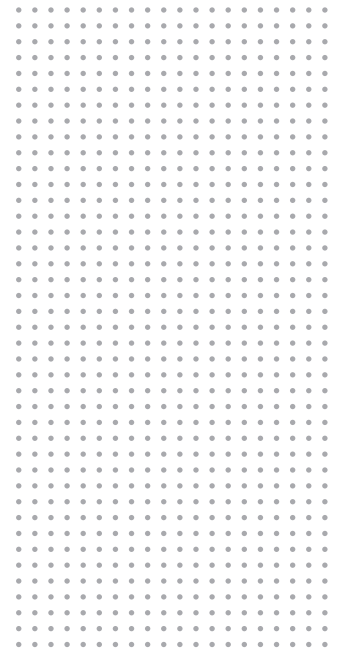
“The idea of working in the automotive industry (for women) suffers from a perception problem.”

Senior executive participant in the Automotive News 100 Leading Women in the North American Automotive Industry Executive Roundtable, July 2015.

Source: Deloitte, 2015.

Furthermore, to win the increasing purchasing power of ASEAN's female consumers, car manufacturers should consider tailoring production so that their heightened need for comfort and convenience in urban life is met. One way to understand female clients is to ensure their presence in production and design. More aggressive recruitment from the auto sector targeted at female students should be considered.

Overall, ample opportunities exist for skilled workers who want to pursue a career in ASEAN's growing automotive industry. 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 with new technology trends.



⁶¹ ILO estimates from official labour force surveys.

⁶² Krivkovich et al, 2016.

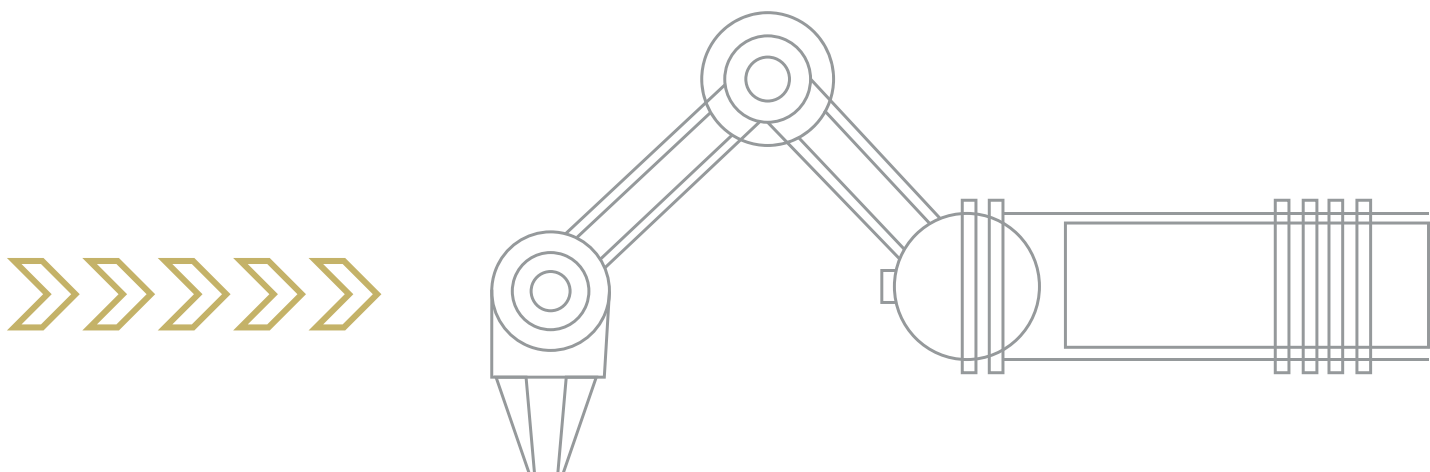
⁶³ UNESCO-UIS, 2016. In countries like Singapore and the Philippines, over 70 per cent of tertiary enrolment in education consists of female students. For studies in health and welfare, six ASEAN countries show that over 70 per cent of enrolment is female.

LOOKING AHEAD



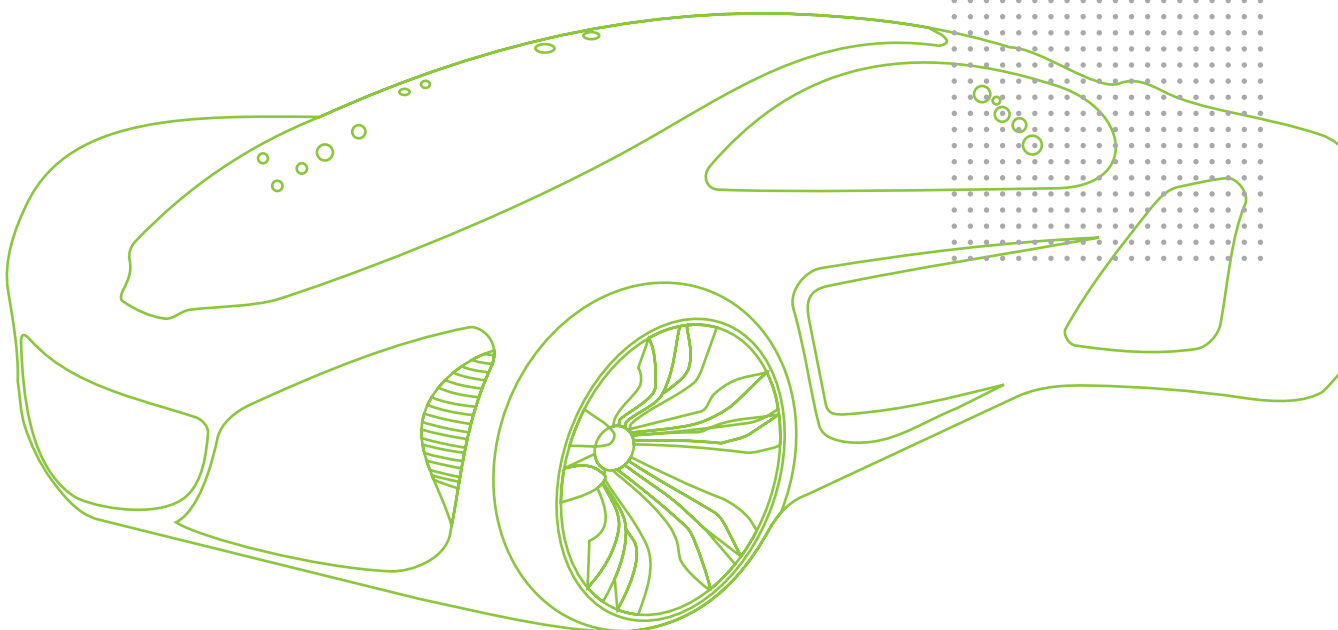
ASEAN's automotive sector will be invigorated: Expect more automation and production of tech-savvy cars to serve the expanding market

- In the short term, ASEAN's automotive sector will accelerate its adoption of automation. The workplace will become more efficient and safer. Robots will work collaboratively with people.
- The growing middle class will translate into increased demand for cars. Preferences will also emerge for tech-savvy vehicles, which will be coupled with increasingly stringent government policies 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 enterprises will need to seek collaborative opportunities with OEMs to accelerate the integration of advanced automotive technologies. Equally important would be investing in capacity development of local auto makers (for example, tier two and tier three) and strengthening their market position and competitiveness to ensure 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 car makers to work closely with the electronics industry due to the region's growing electronics ecosystem in countries like Malaysia, the Philippines, Thailand and Viet Nam, which are also considered manufacturing hubs for the automotive industry.



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

- We will likely see tier one suppliers of foreign OEMs emerge as the frontrunners in automating production. 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 needs to aggressively build a pipeline of high-skilled engineers, technicians, data analysts and others with critical thinking and innovative skills.
- It's imperative for the sector to have stronger strategic alliances with education and vocational training institutions so that relevant skills are provided by the incoming workforce. The role of government and incentives are equally important to build skills and encourage investment in specific areas – for example developing an infrastructure for EVs and driverless cars – that enable accelerated adoption of new technology.
- The sector should also collaborate with educational partners to encourage female students to enter degree and certification tracks for recruitment in the auto industry. This will undeniably help strengthen the skills pipeline.
- The region's automotive leaders like Thailand should consider building a centre of excellence where better coordination with automotive industry players across all tiers is harnessed and design and manufacturing skills are further promoted. This could put ASEAN into a different category on the global stage in automotive and auto parts manufacturing.
- If ASEAN's automotive industry succeeds in becoming more competitive and is powered by the right talent pool, there is an opportunity to step up capabilities, produce value added cars, strengthen its position and fuel further economic growth.



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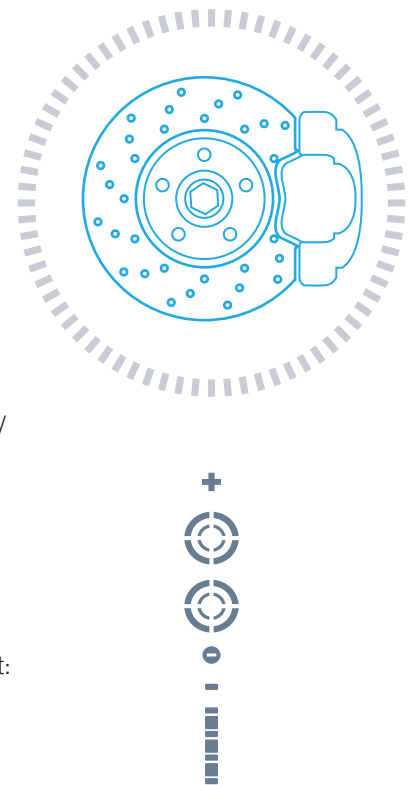
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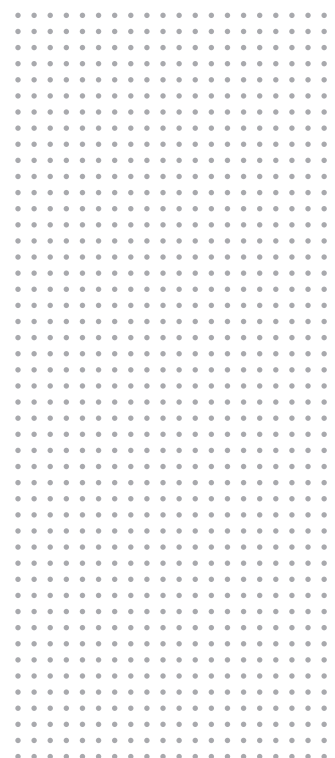
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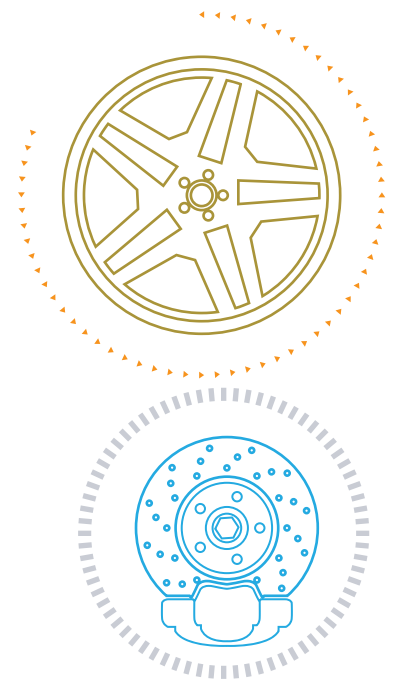
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APPENDIX: CASE STUDIES

Three sets of enterprise case studies were conducted in 2015 to understand how adopting technology and automation impacts automotive enterprises and workers. These three enterprises operate in different Asian countries and are in different stages of automating their production lines.

In general, an enterprise completes an automation process through three stages: preparation, implementation and optimization. In the preparation stage, the enterprise evaluates the cost-benefit of the automation project, including estimating future market demands for the products to be produced by the new machines, reviewing the factory floor plan to streamline workflow and finding suppliers who sell the robots or even customize them. Once the robots are purchased, the enterprise moves into installation. Concurrently, the enterprise begins training its employees on operating the new technology. This could be done in-house or by sending employees to external training institutions. After the new robots begin operating, the enterprise begins optimizing their new operations. At this stage, data gathering plays a key role in accelerating the process. Additionally, how well the preparation phase is executed will heavily influence the subsequent optimization. Even though the three case study subjects differ in size, products and geographic locations, their processes for implementing automation are generally comparable.



1 Company A

1.1 Company A information

Company A is one of the largest tier one suppliers to automotive OEMs; it has strong ties with General Motors, as well as other American automakers. Company A's Shanghai office serves as the company's headquarters for Asia and the Pacific, as well as one of two R&D centres in Asia (the other is in Mumbai, India). Company A's main product is automotive electric parts, including the engine, mounting, charging, starting, braking and lighting parts.

ASEAN's automotive production is currently characterized by low-value added, labour-intensive tasks, similar to China in the 1990's. Company A was chosen because it could offer insight into the future of the ASEAN automotive industry. Because of China's increasingly educated workforce and rapidly increasing wages, the combination of these factors have triggered a push towards automation in China. China no longer competes on low-cost production, but instead on capabilities and value.

Table 1. Summary of Company A information

Location	Employees	Capabilities	Major products	Major automation initiatives
Shanghai, China	>1 000	Plastic housing, copper and steel, wiring	Electrical systems and connectors	Integrating robotics into injection moulding manufacturing processes, and Automated Storage and Retrieval System

1.2 Automation in Company A

60 per cent of the production lines have already been automated

Company A's Shanghai plant specializes in electrical system components. In contrast to OEMs, parts manufacturers are more likely to automate their production because tasks performed in their factories are relatively simple and repetitive. However, Company A was determined that automation would answer many of its challenges and has, since 2009, been intensifying automation in its production lines. Currently, 60 per cent of the plant's production lines have already been automated, and the enterprise is eagerly pursuing automation of the remainder, limited only by the capability of robotic technologies.

What can be achieved: Injection mouldings

One relevant example of a process automation implemented by Company A has been the use of robotics for insert, injection moulding. Certain injection-moulded auto parts require metal parts (such as metallic nuts) to be added to the mould prior to the injection of plastic. Previously, line workers added metallic parts manually. The use of human labour made the process highly unreliable. When moulding plastic parts, the cycle time is incredibly important: The longer the mould is open, the more the mould can cool, introducing temperature variations that impact the characteristics of the resulting parts. Company A implemented robotics to add inserts to moulds, instead of relying on line workers. With the robots, the injections cycle time is fixed and can be done continuously. Also, since the arm can remove the completed part from the mould after adding the insert, the amount of labour required is reduced.

1.3 The road to automation

Deciding to automate

For Company A, the driving factors behind the decision to intensify automation came down to:

- 1 **A pursuit of higher and more consistent quality:** As the electrification of vehicles continues to surge in the automotive industry, OEMs are putting more and more electronic parts into cars. This means two things: (1) the electronic parts have to be smaller and (2) quality has to be consistent, as all parts are interlinked. The electronic parts have become so miniaturized that, for some parts, only robots can perform the work for long hours and maintain the same quality.
- 2 **Rising minimum wage:** China has seen the fastest growth of minimum wage level over the past decade. From 2004 to 2014, average nominal minimum monthly wages increased from 567 Chinese yuan renminbi (CNY) to CNY1,272, a rise of over 220 per cent.⁶⁴ Increased wages became a major issue, especially because of thin profit margins, and this eventually triggered Company A to look for technology-oriented solutions.

⁶⁴ Based on ILO estimates, which calculated the simple national average of provincial minimum wages in nominal prices, using CNY constant 2010 prices. These calculations are based on data from the National Bureau of Statistics of China.

- 3 Increased market demand:** Not only does automation reduce manufacturing costs by decreasing the number of workers employed, it also enhances production capacity to help the enterprise meet growing market demand. Today, Company A is looking to convert current production processes to a single platform system, which enables one production line to build different parts for different clients, optimizing the operational efficiency even further.

Preparing for change

Cost-benefit analysis is a key consideration

Company A began by building teams of engineers and sending them to exhibitions and seminars in the Europe, Japan and the United States to learn about advanced technology. They also initiated discussions with their suppliers to find the best solutions in order to formulate a plan and focus on automating its production. Today, the enterprise has more than 400 engineers, an independent department established in 2012 that closely watches the latest technology trends, and more than 60 per cent of their production lines are already automated.

Cost-benefit is the most important calculation for every automation plan. The rule for automation is that the more complex the task to be performed is, the more expensive the robots. In some cases, the required motion for some tasks is so delicate and complicated that no existing robots can perform it.

Company A spends two to three months drafting a financial feasibility plan. Afterwards, the company works with both domestic (China) and foreign suppliers to find the best solutions to their automation plan. Usually, demand is generated from an internal group that specializes in observing and developing new technologies. While market demand sometimes pushes Company A to make quick changes, usually the internal department initiates the process. Depending on the complexity of the robots required, it takes between one to seven months to find a supplier and create the needed robots.

Not all processes can be automated yet

The capabilities of robotic technology are continually advancing, but still pose a limitation to the automation of some processes. During the interview, a Company A manager highlighted “harnessing”, the process of assembling cables and wires into their plastic housing in order to connect terminals, has yet to be automated because of the complex nature of the work. Currently, 30 per cent of total employees in the factory are performing the harnessing task, and half of them would be replaced by robots if this task were to be automated. Nevertheless, Company A is very optimistic about the development of new technology.

Rolling out and optimizing automation procedures

Operational proficiency and employee training are paramount

After robots are received, Company A installs them into the production line and simultaneously starts employee training. As the level of operational proficiency is the key to optimizing the operation, engineers who will be responsible for the new production line are required to join the planning process and learn about the new robots beforehand. Once the robots are on-site, setup time needs to be shortened as much as possible. Sometimes, installation can be done without a major change of floor plan; other times, a total refurbishment or a new cleanroom is required. The process takes from one to three months.

Optimization: Targeting a 30 to 40 per cent increase in efficiency

Company A takes approximately less than a month to optimize the new automated process. The targeted increase of efficiency is between 30 to 40 per cent. Company A also provides an in-house training programme for its workers to transition to the new production line and achieve full optimization.

1.4 What was achieved**Increased efficiency, product quality and reduction in accidents**

According to Company A, robots can take three shifts a day and one human worker can monitor 10 robots. Since the worker does not need to handle the assembly and merely watches the robot's operations, this leads to an increased efficiency from between 30 per cent to 40 per cent, increased consistency of product quality, and a decrease of the number of accidents in the factory by 70 per cent.

Significant reduction in the number of workers required

Company A found that, once the automation process is finalized, the required number of workers in the factory could be significantly reduced. On average, one robot replaces at least three workers. Although automation creates new jobs such as maintaining, repairing and monitoring robots, one to two workers can usually complete these jobs. Robots actually replace more line workers, and, in essence, less workers are required overall.

Automation brings new job requirements

While Company A provides in-house training to upgrade skills requirements, some employees remain uncomfortable with technology or do not possess the basic capabilities to work with computerized machines or programming. These workers eventually face displacement.

For new recruits, Company A looks for people who have the skills to analyse data, understand the basic concept of machine operation and have the capability to provide solutions to problems that happen on the production line. In most instances, workers with tertiary education or above are able to meet these skills requirements.

Increased focus on R&D

Through transforming its production with automation, Company A has also become more than a manufacturing centre. It is now recognized for its R&D as more and more engineers of different backgrounds are recruited. Company A has the capacity to create its own models and OEMs have begun to let the company conduct independent R&D. This further promotes Company A to the core group able to directly implement technology innovation in automotive industry, making it better equipped to deal with changes in the market.



2 Company B

2.1 Company B information

Company B is a leading tier one automotive part supplier in Thailand with more than 600 employees. It has three main lines of manufacturing operations: plastic injection moulding, aluminium die-casting, and rubber tire and inner tube production for motorcycles and bicycles. Each line roughly accounts for 75 per cent, 10 per cent, and 15 per cent of the company's revenue, respectively. Company B primarily serves the major OEMs' domestic assembly factories such as Toyota, Kawasaki, Suzuki, and Yamaha. Since 2006, Company B has been steadily increasing the use of automation in its factory.

Table 2. Summary of Company B information

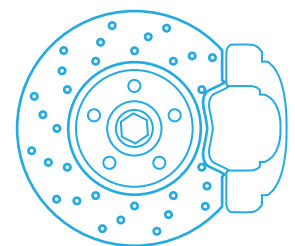
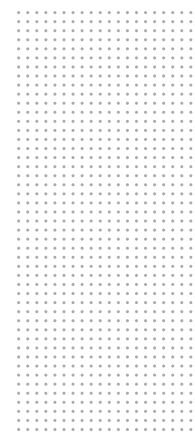
Location	Employees	Capabilities	Major products	Major automation initiatives
Bangkok, Thailand	>600	Plastic (12 000 m ²), aluminium and zinc die casting (4 000 m ²), rubber (5 000 m ²)	Automotive interior and exterior parts	Integrating robotics into injection moulding manufacturing processes, Automated Storage and Retrieval System

2.2 Automation in Company B

Automation in Company B has been focused on the production line of injection moulded plastic parts to respond to increasing wage and stringent quality requirements. Plastic injection moulding refers to a manufacturing process where melted thermoplastic is injected into a mould cavity where it cools and hardens to the configuration of the cavity. The technique is widely used for various plastic auto interior and exterior parts such as headlamp covers, engine covers and dashboard covers. Process automations typically look at single-step processes, particularly those where manual labour introduces an unacceptable amount of variability. While automation opportunities are always under consideration, exogenous factors in recent years have hastened these decisions.

Company B has been focusing on automating steps of the process that are relatively easy, specifically the insertion of certain parts into an injection mould and the removal of moulded parts after cooling. They use existing employees to programme, install, and fine-tune the robotic arms added to the process.

One relevant example of a process automation implemented in recent years has been the use of robotics for insert, injection moulding. Certain injection moulded auto parts require metal parts (such as metallic nuts) be inserted to the mould prior to the injection of plastic. Previously, line workers manually inserted these metal parts, making the process highly unreliable.



2.3 The road to automation

Deciding to automate

Driving the decision to automate further in Company B, were the following factors:

- 1 An increased demand for product quality:** As a tier one supplier to a major Japanese OEM, Company B places great emphasis on the quality of its products.
- 2 Rises in minimum wage, implying automation should be a longer term plan to shield business from unpredictability:** Another major factor that has driven the adoption of assembly automation at Company B is increasing minimum wages. In the past decade, the daily minimum wage in Thailand almost doubled, increasing from THB184 in 2006 to THB215 in 2011, then to THB300 in 2012. The owner of Company B commented, “The minimum wage increase was really a wake-up call.” Largely, it was the unpredictable nature of the increase, as opposed to the increase itself that was troubling to Company B as it made it difficult to plan and develop forecasts.

3 The maturity and affordability of robotic technology: Over the years, robotic technology has become more standardized, allowing robot manufacturers like ABB Group to mass produce robotic arms in scale and effectively reduce their production cost and selling price. The fact that robotic arm systems have become more standardized also means that it is becoming easier for businesses to hire engineers to programme them and shortens their installation and ramp up period.

Preparing for and rolling out automation procedures

In-house teams are important for identifying and adapting robotics

Company B has a task team consisting of five engineers who continuously monitor new automation technologies available on the market and how these technologies can be utilized to improve the efficiency of each manufacturing process. Sources of information on new robotic technologies and products include trade magazines, exhibitions and organizations.

The internal taskforce works closely with the robotics vendor to integrate the robotic arms with the plastic injection-moulding machines. Initially the company procured robotic arms from Japanese vendors expecting better system integration with the existing Japanese injection moulding machines. However, upon closer evaluation, the internal team discovered that the robots manufactured by a German vendor offered greater flexibility, which could significantly reduce the cycle time. Specifically, the German robotic arms could be more precisely programmed to manoeuvre, even when injection-moulding machines were only partially done with certain steps. Because of the aforementioned advantage and the relative aggressive pricing offered by the German robotic arm vendor, Company B eventually procured the majority of their equipment from this particular vendor.

Throughout the testing process, the robotic arm vendor provided the company with assistance in terms of system integration and basic training for machine operation. However, the in-house implementation team executed the robotic arms' modification.

2.4 What was achieved

Precision control improves consistency and quality

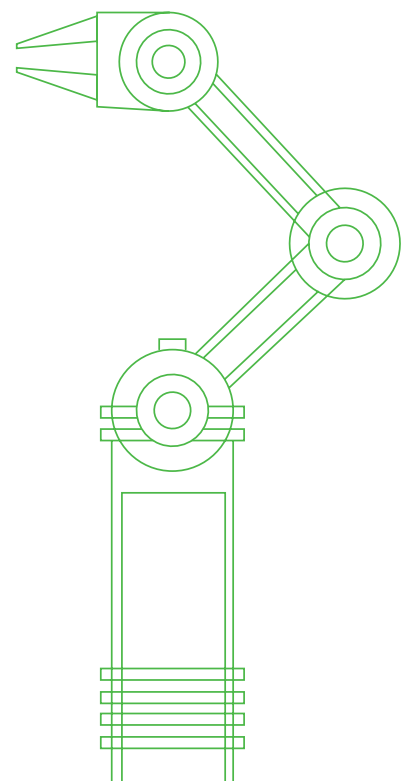
Implementing the automated robotic arms has been a tremendous success at Company B. By replacing workers, Company B is able to precisely control the cycle times down to the millisecond level, maintain consistent quality, minimize the percentage of defects, increase the yield of the manufacturing process and ultimately lower the per-unit production cost and increase the manufacturing line's efficiency.

Increased demand for engineers

Company B's increased adoption of robotic technology also increased its demand for engineers with specialized knowledge of automated process design and robotic programming. As more enterprises start to understand the benefits of automation and start to adopt it, the need for talent with this specialized knowledge is expected to grow significantly. However, interviewed experts in the industry stress that there is currently a lack of such talent.

Cost and maturity of robotic technology is an important consideration for further automation

After witnessing the positive impacts of automating the insertion and removal steps of the injection moulding process, Company B has evaluated other areas for further automation, especially those involving single-step processes, in which workers introduce an unacceptable amount of variability. Automating processes that require more steps, or those that have more inherent complexity, will depend on the maturity and the cost of implementation.



3 Company C

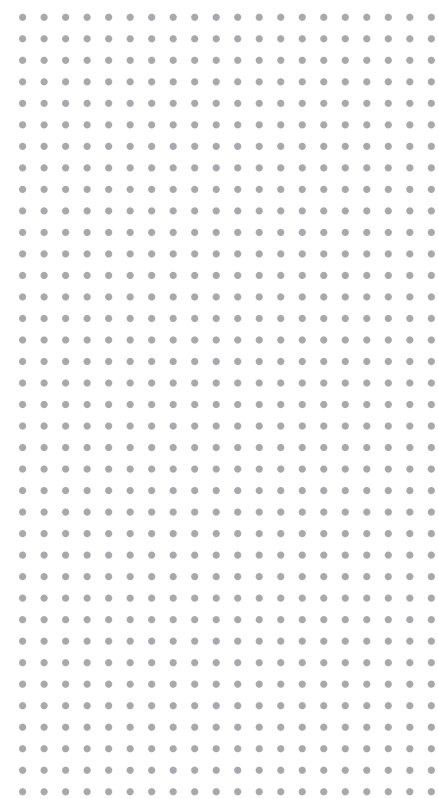
3.1 Company C information

Established in 1978 and located just outside Jakarta, Indonesia, Company C is a family-owned manufacturing business specializing in the automotive applications of plastics and polyurethane. The company’s main products are interior headlining and insulation. Company C also produces numerous interior components such as armrests, fasteners and steering wheels. The company essentially has the capability to produce all non-mechanical parts of a car. Company C has enjoyed respectable revenue growth in recent years due to Indonesia’s increased demand for cars and because OEMs have started sourcing auto parts from local suppliers (as opposed to importing).

Company C has a long-standing relationship with Daihatsu, a subsidiary of Toyota and the biggest automaker in Indonesia. Company C’s management had previously trained with Daihatsu, and the two companies have a history of cooperation in developing new products. Company C’s long partnership with Daihatsu stands out in the Indonesian automotive industry, as some Indo-Japan joint ventures are short-lived. A much more common outcome is for the Japanese firms to buy out the local partner once they have established a local supplier ecosystem.

Table 3. Summary of Company C information

Location	Employees	Capabilities	Major products	Major automation initiatives
Bekasi, Indonesia	500 full-time, 200 part-time	Plastic, polyurethane, composites	Headlining, insulators, moulded foam, spoilers/fenders	Foam-slicing, water jet robotic arm, die-cutting and press machine



“We asked ourselves ‘can the current process be optimized without any automation while still fulfilling the demand?’ For example, we have a roll-to-sheet cutting process using [a] table and knife. The logical thinking would be to remove that table and change it to an automated slicing or punch-cut machine. However, an automatic line like that could be too efficient that the manpower will only need to process three days out of the week (and we are required by law to pay him for the entire month).

Thus, our solution is to modify the manual cutting table so that the manpower can pull and cut multiple layers in one cycle. We practically multiplied the output of the line with a really small amount of investment.”

Owner of Company C, Indonesia, ILO interview, 2015

3.2 Automation in Company C

Company C began automating their production lines in 2010 and have now automated 75 per cent of their production process. Management and two in-house teams are continuously looking at process improvement and ways to apply lean manufacturing practices.

3.3 The road to automation

Deciding to automate

For Company C, unpredictable minimum wage increases stood as the main motivating factors for increasing automation. In Indonesia average minimum wage has increased from IDR988,800 in 2011 to IDR1,494,100 in 2014.⁶⁵ The uncertainty in labour cost was frustrating for management, and they began to look for innovative ways to mitigate financial risk. In 2010, Company C discovered that a Japanese factory similar in size and production had employed only five workers for die cutting, whereas Company C needed 17 workers to perform the same task. It became apparent to the company that automation was the quick solution to wage inflation.

Preparing for and rolling out automation procedures

Dedicated teams led the installation of new machines

After conducting an in-house cost-benefit analysis, Company C decided to automate a significant portion of its mundane and repetitive tasks. Two dedicated teams within Company C led the implementation of the new machines. These teams included (1) a production engineering team, focused on production line improvements (i.e., cycle time study, movement study, line layout) and (2) a Jishuken (Japanese for “self-learning”) team, focused on enforcing lean manufacturing theories to the operators and other departments.

3.4 What was achieved

Efficiency increased

Water jet efficiency doubled; capacity in cutting went up more than threefold; and the company achieved its goal of producing 2,000 headliners headlining per day.⁶⁶

Automation is not possible (yet) for all processes

Company C’s management acknowledges that robotic technology to perform certain functions may not be feasible in the immediate future. For instance, the process of “sandwiching” requires a human touch to adjust the tension between the many layers of fabric and insulation within the headlining. The initial tension varies for each piece of headlining produced, and though machines are extremely adept at cutting and portioning, they are unable to make adjustments based on “feeling” the material.



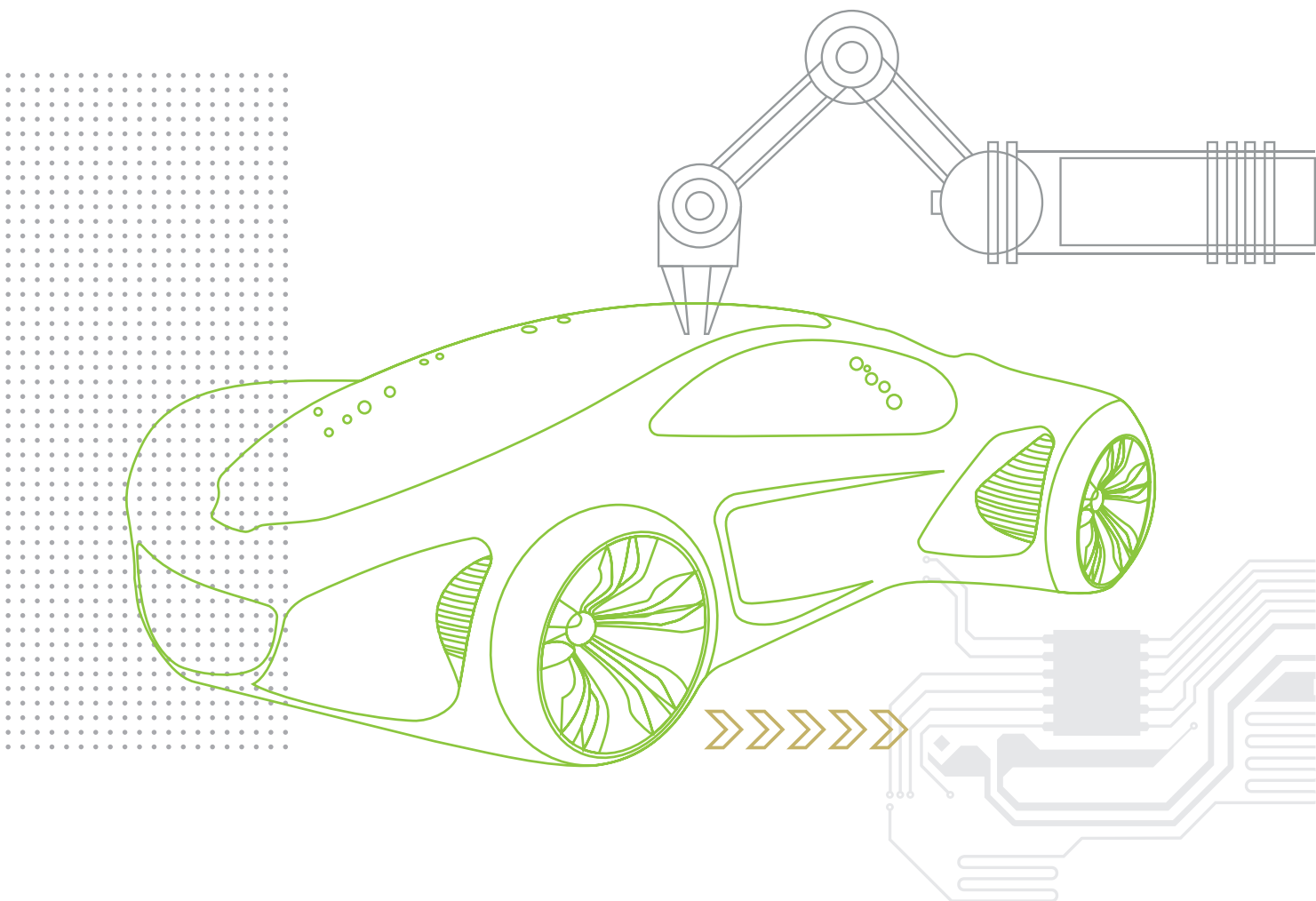
⁶⁵ ILO, 2015a based on estimates by the Indonesian Central Bureau of Statistics (2014), which calculated the simple national average of provincial minimum wages in nominal prices, using IDR constant 2000 prices. This estimate includes employees defined by the Indonesian Central Bureau of Statistics as 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”.

⁶⁶ Material adhered to the inside of the vehicles roof.

New skills requirements for workers

Post-automation, Company C encountered a new challenge related to its workforce. The company had traditionally employed high school graduates to perform labour-intensive tasks. Critical thinking and problem-solving skills were not necessary as long as workers were physically fit. However, automation resulted in a change in skill requirements. Workers are now expected to be able to perform basic troubleshooting when machines malfunction. For example, operators need to know how to differentiate between a software issue and a physical jam in order to remedy the situation by restarting the machine or by removing the clogged piece.

Company C found it necessary to look beyond high school graduates to find individuals with the critical thinking skills required for the new environment. Unfortunately, Company C found it challenging to recruit and retain qualified workers. Millennial college graduates often do not find the automotive industry an attractive place to work. The ones who remain in the industry are employed by multinational firms, who offer candidates globally competitive salaries. Global competitors also have the scale and ability to weather volatile government policies by shifting production location. Even with its deep customer relationships and local expertise, Company C is finding it increasingly difficult to keep up with multinational competitors. Fierce competition in the automotive industry requires companies to continuously add newer features, reduce weight and improve engine efficiency, all without increasing price. Technology innovation has allowed carmakers to produce better cars faster and more cheaply than ever before.

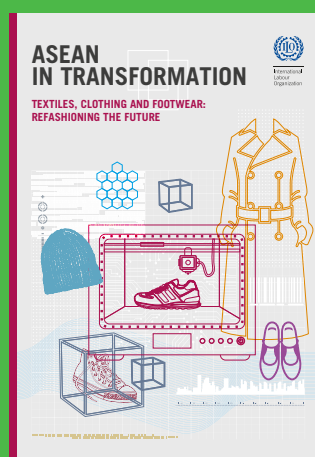
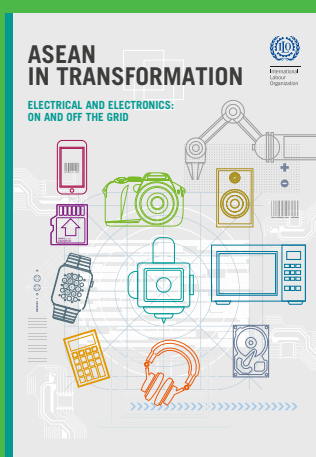
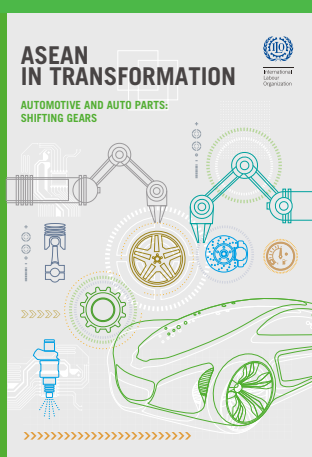
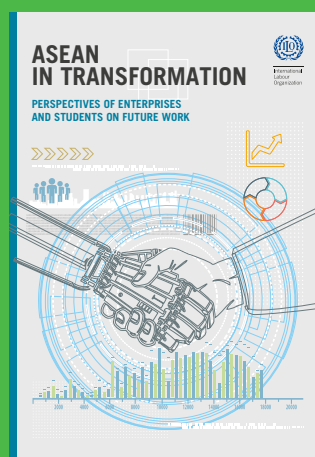
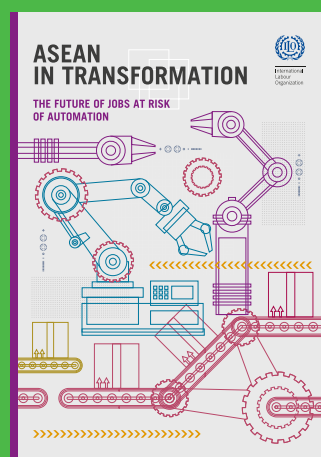
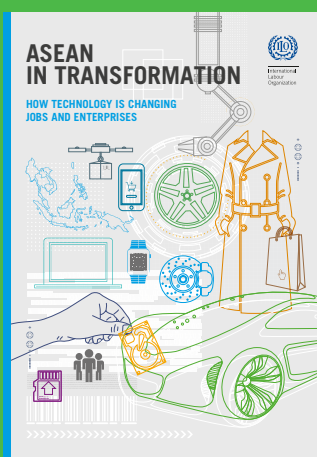


ASEAN in transformation: Automotive and auto parts – Shifting gears

This paper examines the impact of technology and related implications for enterprises and their employment needs for the automotive and auto parts sector in the ASEAN Member States. The main findings of this paper are available in *ASEAN in transformation: How technology is changing jobs and enterprises*, which offers a comprehensive compilation of transformative impacts of technological advancements penetrating five labour-intensive and/or growth sectors in the ASEAN region.

This paper uncovers that ASEAN's automotive and auto parts sector is undergoing significant technological transformation. From intense electrification of cars and advances in material science to the emergence of autonomous vehicles, all sector players are encountering various forces of change. In particular, the most significant technology that has become core to ASEAN automakers' operations is robotic automation.

With increased robotics, this paper finds that production is becoming more efficient with improved quality and consistency. The workplace is also becoming safer with "cobots" that work alongside people. In parallel, automation and robotics are shifting the industry's workforce needs from low-skilled assembly line workers to technically equipped workers with a variety and depth of skills. There is heightened need for the sector and policy-makers to strengthen the skills pipeline and also invest in capacity development of local automakers to ensure domestic growth is sustained and the sector is positioned to fuel further economic growth.



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