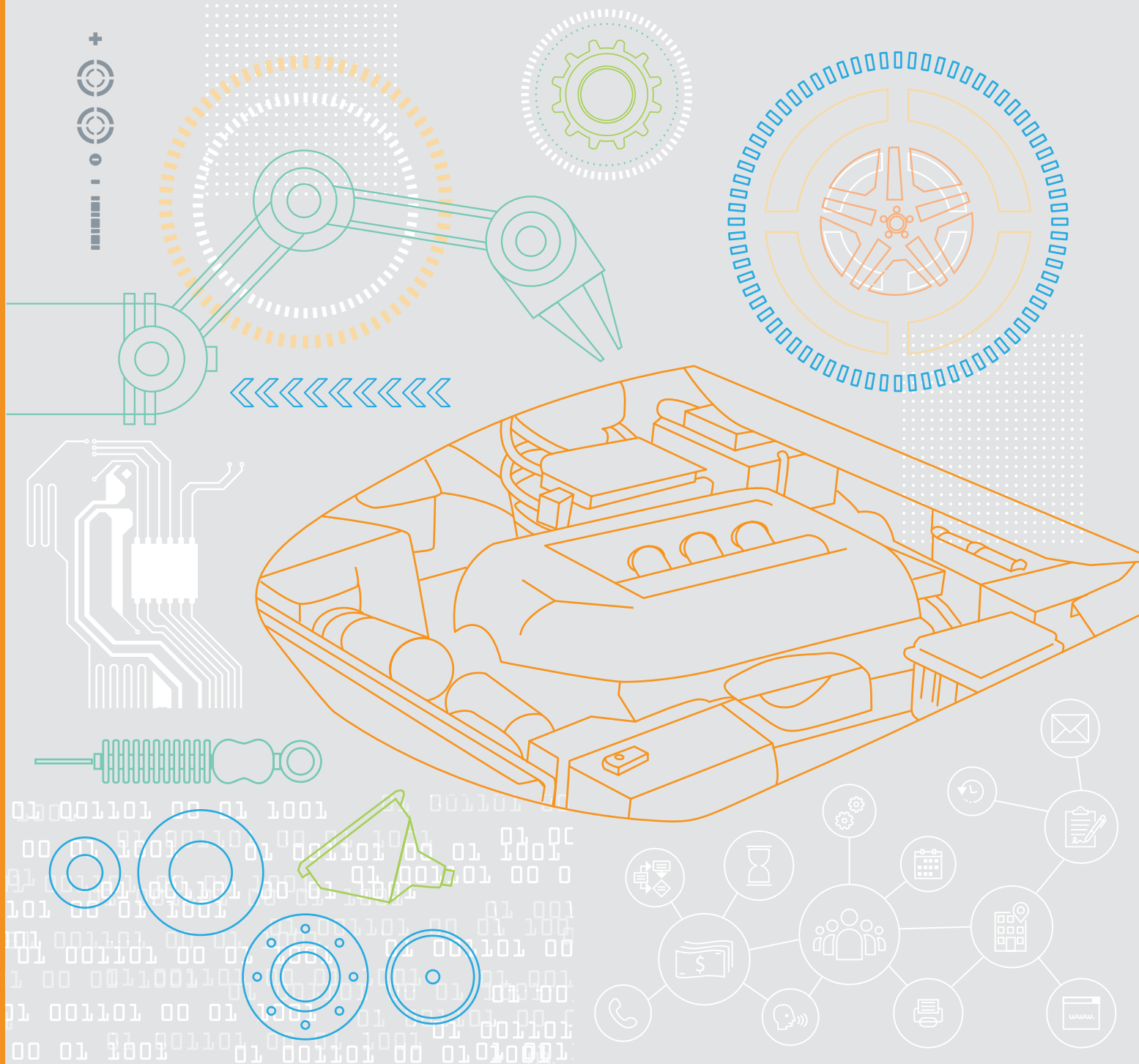
ANALYSIS OF THE ECONOMIC DEVELOPMENT ROLE OF SECTORAL BUSINESS ASSOCIATIONS

IN THE RUBBER, ELECTRONICS AND ELECTRICAL, AND AUTOMOTIVE SECTORS IN MALAYSIA, THAILAND AND VIET NAM

International Labour Organization



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PREFACE

Business membership organizations (BMOs) are increasingly faced with a wide range of challenges posed by profound economic, political, social and technological developments. These forces are changing the traditional functions of such organizations as social partners and a bargaining agents.

BMOs are also responding to other factors, such as increasing membership diversification, newly emerging policy fields and new policy actors, innovative ways of doing business and managing production and employment relationships, new pressures and opportunities and increasingly transparent environment, among others. In response, BMOs are adapting and transforming their roles and organizational models to meet the expectations of their members.

Today, a multiplicity of political, economic and social demands calls for a better understanding of the role of business organizations in social and economic development, and an analysis of the evolving institutional roles and organizational functions of BMOs. The Bureau for Employers' Activities (ACT/EMP) of the International Labour Organization has intensified its research efforts on how BMOs are changing and reacting to these challenges. The focus of this sector-specific working paper on countries in South-East Asia is sensitive to significant regional differences and responds to the need for more research on organized business in Asia.

We hope the findings from this paper acts as a stimulus to on-going discussions on the wider role that sectoral associations can play in the development of the economy, sector, individual enterprises and ultimately workers and their families.

Deborah France-Massin

Director
Bureau for Employers' Activities
International Labour Office

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ACKNOWLEDGEMENTS

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To the individuals who participated in the field interviews we are enormously grateful. The full list is cited in the appendix. Collectively here we thank you for your insights.

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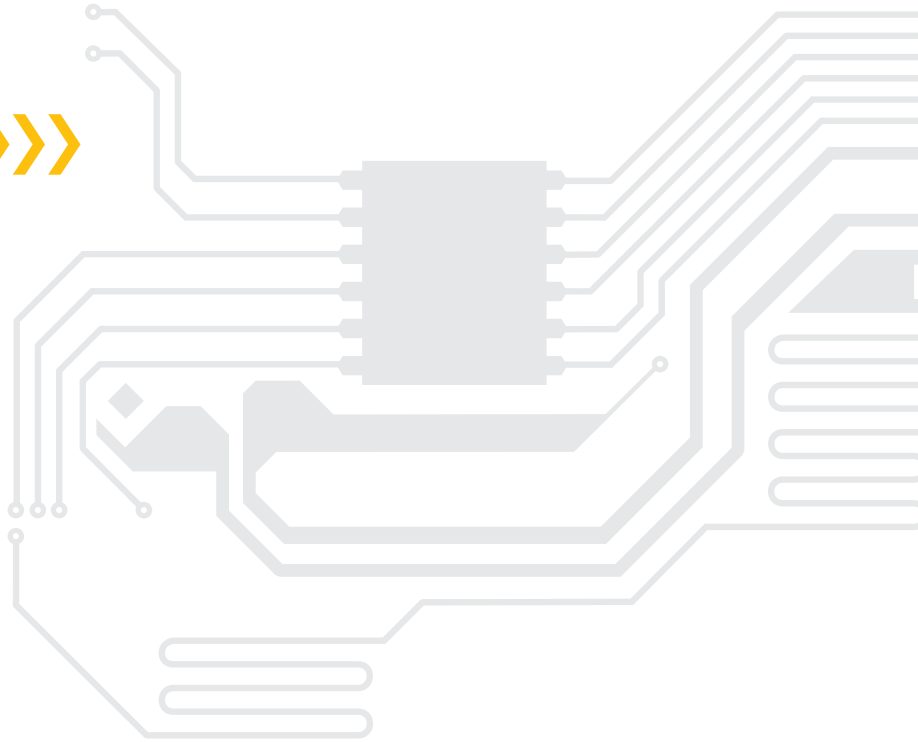
ABBREVIATIONS

AHRDA	Automotive Human Resources Development Academy
ASEAN	Association of Southeast Asian Nations
BMO	business membership organization
BOI	Thai Board of Investment
E&E	electronics and electrical
FCB	flexible circuit board
FTI	Federation of Thai Industries
FMM	Federation of Malaysian Manufacturers
ICT	information and communications technology
IDEMA	International Disk Drive and Equipment and Materials Association (Thailand)
HDDI	Hard Disk Drive Institute
HRDC	Human Resource Development Council (Malaysia)
JACTIM	Japanese Chamber of Trade and Industry Malaysia
JTC	Joint Technical Committee for Local Content
LED	light emitting diode
MAI	Malaysian Automotive Institute
MACPMA	Malaysian Automotive Component Parts Manufacturers
MARGMA	Malaysia Rubber Glove Manufacturers' Association
MITI	Ministry of International Trade and Industry (Malaysia)
MNE	multinational enterprise
MRB	Malaysia Rubber Board
MREPC	Malaysian Rubber Export Promotion Council
MRPMA	Malaysia Rubber Products Manufacturers' Association
NATIF	National Technology Innovation Fund
NR	natural rubber
OEM	original equipment manufacturer

PCB	printed circuit board
PEMANDU	Performance Management and Delivery Unit
PIKOM	National ICT Association of Malaysia
RPIC	Rubber Products Industry Club (Thailand)
RRIV	Rubber Research Institute of Viet Nam
R&D	research and development
SBA	sectoral business association
TAI	Thailand Automotive Institute
TAPMA	Thai Auto-Parts Manufacturers Association
TEEAM	The Electrical and Electronics Association of Malaysia
TEMCA	Thai Electrical and Mechanical Contractors Association
TSR	Technically Specified Rubber
VCCI	Viet Nam Chamber of Commerce and Industry
VRA	Viet Nam Rubber Association
VEIA	Viet Nam Electronic Industries Association
VBH	Viettronics Binh Hoa Joint Stock Company
VPA	Vietnam Plastics Association



INTRODUCTION

Business membership organizations (BMOs) include employer, trade or other types of business associations, and these entities are critical catalysts for economic growth, especially in the context of developing countries. Yet this has not always been understood or acknowledged, and systematic research is lacking on the contribution of BMOs to positive sectoral outcomes. This neglect is partly a function of the fact that BMOs in developing countries have not traditionally played the kinds of visible and productive roles seen in the industrialized countries.

There has been little systematic investigation into and theorizing about the positive contributions of BMOs in developing countries for at least two other reasons. One is the presumption that special interest groups focus solely on distributive objectives and unproductive rents rather than activities that would enhance the collective or public good (Doner and Schneider, 2000a and 2000b). Another reason is the general focus on overcoming market imperfections in areas such as property rights, education and judicial services. These areas are typically addressed by the Government, not by collective, non-state institutions such as BMOs.

Fortunately, attention has begun to shift towards this topic. Empirical analyses have highlighted the ways in which even allegedly autonomous political and bureaucratic actors promoted growth through systematic engagement with private actors, including BMOs (Haggard, 2015; Doner, 2009; Schneider, 2013). Largely independent of the literature on state-business relations, researchers have explored the ways in which enterprise and sectoral performance reflected the strength of innovation systems in which intermediaries, such as associations, were important in driving better economic performance (Intarakumnerd and Chaoroenporn, 2013). In addition, research on clusters in developing countries has highlighted the ways in which BMOs, particularly sectoral business associations (SBAs) have contributed to improved enterprise performance in specific sectors (Clarke and Ramirez, 2013).[1] This is not to imply that the roles of SBAs in developed and developing countries are equivalent. The reality is much more nuanced, and the potential contributions of SBAs may be even more important in economies that encounter market imperfections and failures.

This paper builds on the above literature in a comparative exploration of SBAs in three sectors, namely rubber, electronics and electrical (E&E) and automotive in Malaysia, Thailand and Viet Nam. SBAs are potentially relevant for addressing the challenges of improving sector-specific performance. They represent the wider needs of all enterprises in the sector at the policy level in a fashion that individual enterprises cannot. Many functions of SBAs are sector-specific, at least in part. The key functions of effective SBAs are as follows:[2]

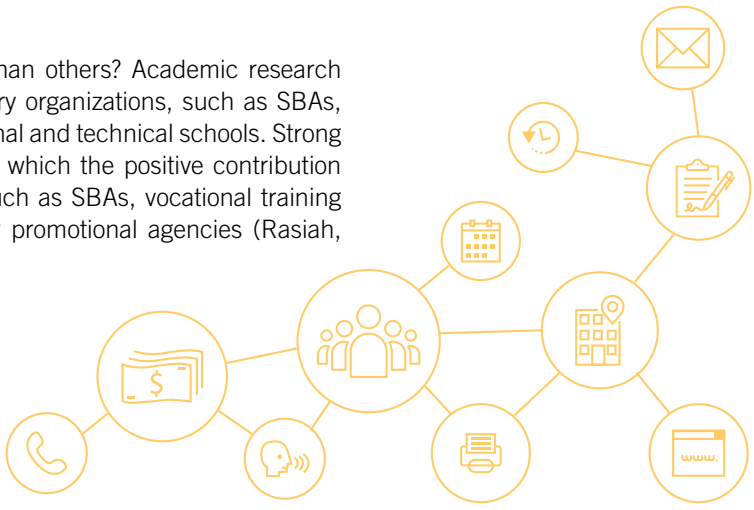
1 Doner and Schneider (2000a) explain cases of SBAs contributing to improved enterprise performance in the textile and clothing sector in Turkey, footwear and E&E sector in Taiwan, China, and coffee sector in Colombia, among others.

2 ILO (2010); Doner and Schneider (2000a), p. 265; Schneider (2004); Doner (2015); Intarakumnerd and Chaoroenporn (2013).

- attract policy-makers' attention to member perspectives and concerns (investment incentives, macroeconomic stability, infrastructure, migration management and wages, among others);
- discuss sector specific policy issues with decision-makers and create channels of communication and close working relationships with them;
- engage in policy by voicing members' concerns and propose specific policies in order to develop collective policy positions for the sector;
- provide inputs for technical and vocational training programmes/curricula;
- support and improve linkages between different actors across the supply chain;
- promote innovation and research and development (R&D), as well as standard setting (product quality-assurance, workers' safety);
- support market promotion and development (e.g. trade fairs, trade negotiations);
- promote property rights;
- contribute to preventing frequent changes to enterprise-related legal and regulatory frameworks so that investors are not deterred (taxes, customs, administration charges, etc.);
- monitor the implementation of policies to ensure fairness and consistency, thereby solidifying the rule of law; and
- publicize successes to promote the reputation of SBAs as active agents of positive change.

This paper focuses on functions that drive economic, enterprise and employment growth as well as skills development in terms of managing technological change. Such change, central to improved performance, requires that enterprises absorb, customize and disseminate technology as reflected in better processes and higher value-added products, among other things. The need for better performance has only increased with the pressure to export as local producers strive to meet standards required in global value chains as final producers devolve greater responsibility to suppliers.

Why do some associations fulfil these roles more effectively than others? Academic research points to the strength of network linkages between intermediary organizations, such as SBAs, and high technology infrastructure institutions including vocational and technical schools. Strong network linkages can result in institutional complementarity in which the positive contribution of one institution is a function of the strength of the others, such as SBAs, vocational training institutes or, even more important, public sector regulatory or promotional agencies (Rasiah, 2006).[3]



[3] The notion of complementarity is central to the literature on varieties of capitalism and related approaches (Hall and Soskice, 2000).

Even assuming favourable macroeconomic conditions, market imperfections and failures inherent in technological change are numerous, especially for developing countries. This may include obstacles as follows: a shortage of information about sources of technology appropriate to local contexts; the need to adapt technology to contexts different from those in which it was originally developed; the need for experiential knowledge; high fixed costs and scale economies of many technological initiatives; a shortage of technical personnel; a lack of complementary goods and services such as physical infrastructure; difficulties in accessing finance; and the tendency of multinational enterprises to transfer the innovation rather than innovation processes (Rasiah and Pietrobelli, 2012; Hausman and Rodrik, 2002).

In the context of these challenges, the support SBAs provide to enterprise members can play a major role in stimulating connectivity and coordination between enterprises, organizations and government agencies. In so doing, SBAs can improve enterprise performance, an issue of particular important as Malaysia, Thailand and Viet Nam confront what has been labelled the 'middle-income trap'.[4]

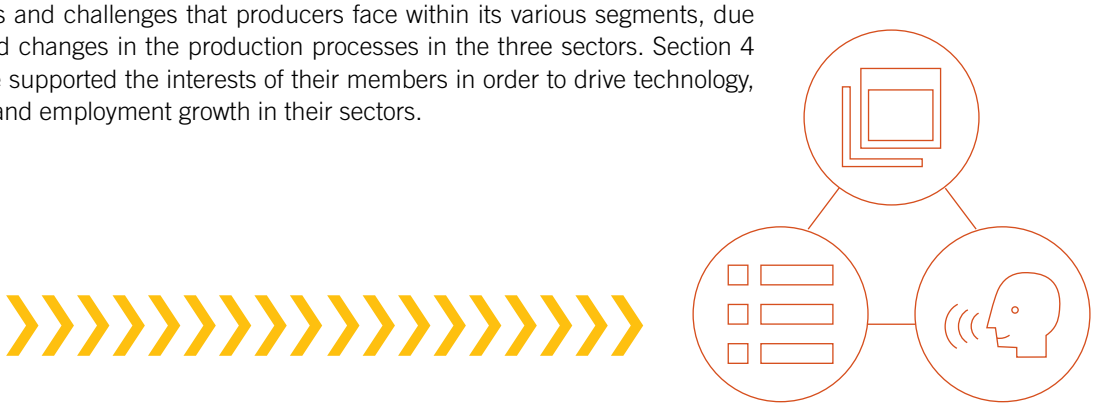
Methodology

A total of 85 semi-structured interviews with key stakeholders from the rubber, automotive and electronics and electrical sectors were conducted in Malaysia, Thailand and Viet Nam between November 2015 and April 2016. The interviewees included government officials and advisors, representatives of SBAs, directors and chief executive officers of private sector companies, university professors among others.

Additionally, further investigation was undertaken by consulting secondary sources including official reports and statistics, academic articles, newspapers and textbooks.

Structure of the report

This paper is divided in four sections. Section 1 examines the role of SBAs and argues that SBAs can effectively represent sectoral interests and respond to enterprise needs by acting as agents for economic development and growth. Section 2 provides an overview of the rubber, E&E and automotive sectors in Malaysia, Thailand and Viet Nam, showing employment, exports and production trends in past years. This analysis aims to show the economic importance of these three sectors and changes in their economic development and growth. Section 3 analyses the technological innovations and challenges that producers face within its various segments, due to technology uptake and changes in the production processes in the three sectors. Section 4 analyses how SBAs have supported the interests of their members in order to drive technology, economic development and employment growth in their sectors.



[4] Generally, the middle income traps refers to a country's inability to attain the economic development and growth of high income countries. Barbour-Lacey (2014); Berliner, Thanh and McCarty (2013); Cherif and Hasanov (2015); Flaeen, Ghani and Mishra (2013); Jitsuchon (2012); and Srilert (2014) argue that Malaysia, Thailand and Viet Nam have fallen into the middle income trap (see Doner and Schneider, 2016).

2 OVERVIEW OF THE RUBBER, ELECTRONICS AND ELECTRICAL (E&E), AND AUTOMOTIVE SECTORS IN MALAYSIA, THAILAND AND VIET NAM

This section provides an overview of the rubber, E&E and automotive sectors in Malaysia, Thailand and Viet Nam, along with employment, exports and production trends in the past years. This analysis aims to show the economic importance of these three sectors for the three countries and to explain the factors that have influenced their development and growth. Moreover, the value chain structure of the three sectors is presented and their intrinsic challenges are analysed. A key challenge for economic development across all three sectors under consideration is that multinational enterprises (MNEs) have a tendency to "go it alone".

2.1 Rubber sector

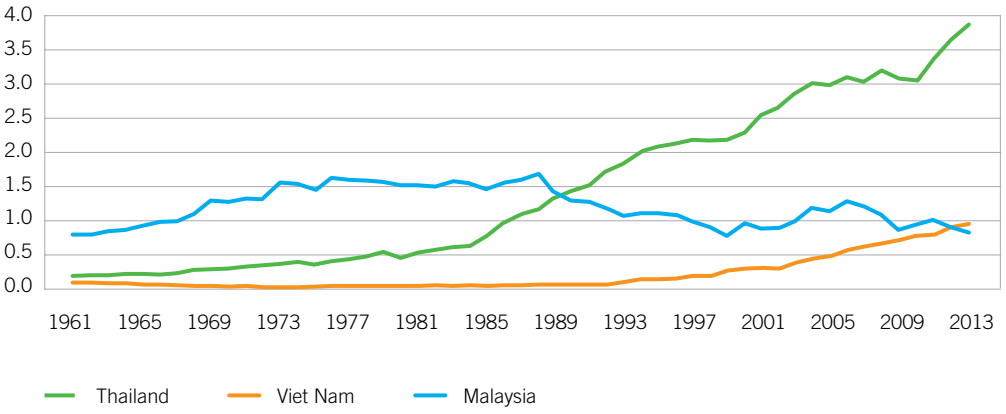
2.1.1 Economic importance

Employment and Production

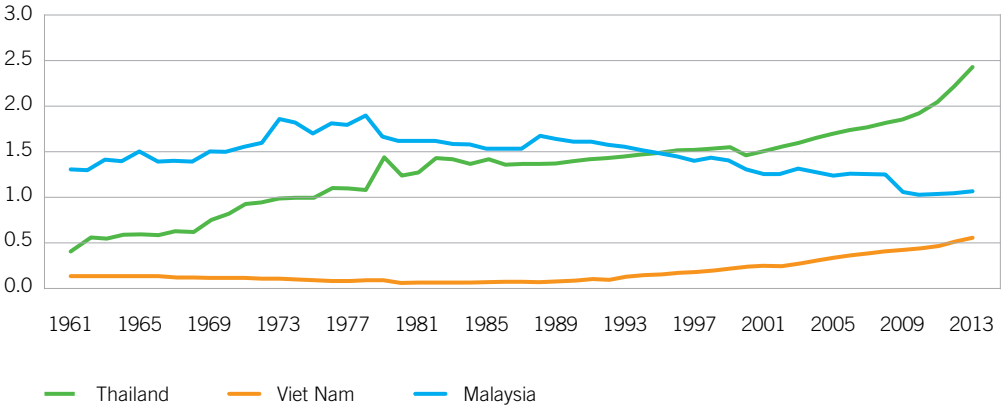
The rubber sector supports approximately one million families in Thailand, over 124,000 workers in Viet Nam and about 68,000 workers in Malaysia (MGCC, 2016; The Rubber Economist, 2013; VCCI, 2014). Annual production of natural rubber (NR) has expanded greatly in Thailand and Malaysia since the 1960s (Figure 1., panel A). Malaysia dominated global production in the 1960s and 1970s, but Thailand has become the top producer of NR, having made steady and rapid gains from around the mid-1980s through to 2013. Viet Nam started producing vast quantities of NR during the 1990s and surpassed Malaysia in 2013, producing 950,000 tonnes. The area harvested for NR closely mirrored these trends during the same period (Figure 1., panel B). While Malaysia and Indonesia were relatively closely matched during the 1960s and 1970s, Thailand's planted area made the most rapid gains. While the area planted in Malaysia declined after around 1985, Thailand, and Viet Nam increased the area used for plantations of NR.

Figure 1. Natural rubber production (panel A, millions of tonnes) and area harvested for natural rubber (panel B, millions of hectares), Malaysia, Thailand and Viet Nam, 1961–2013

Panel A



Panel B



Notes: Data are compiled from official sources plus FAO estimates.

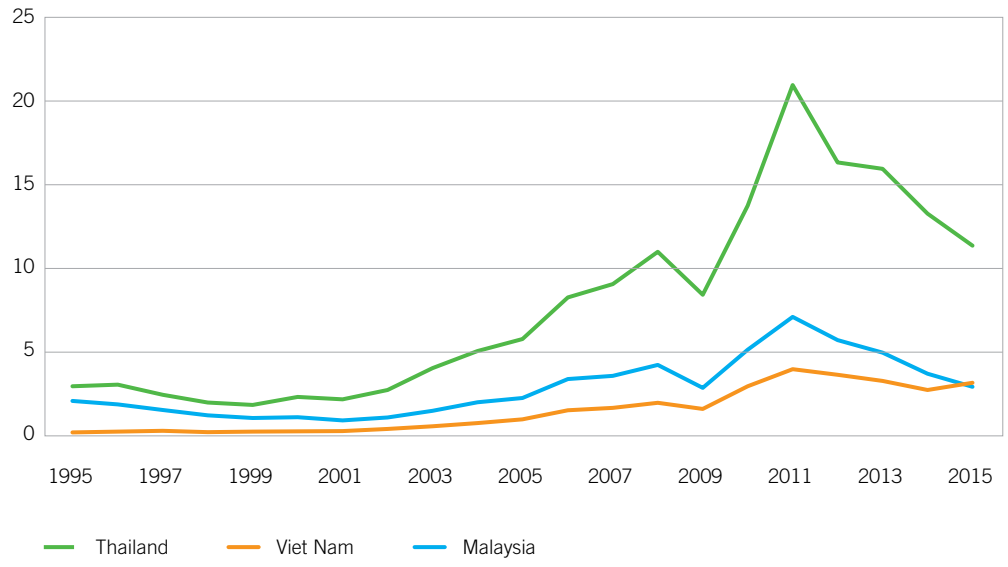
Source: FAO (2016).

Exports

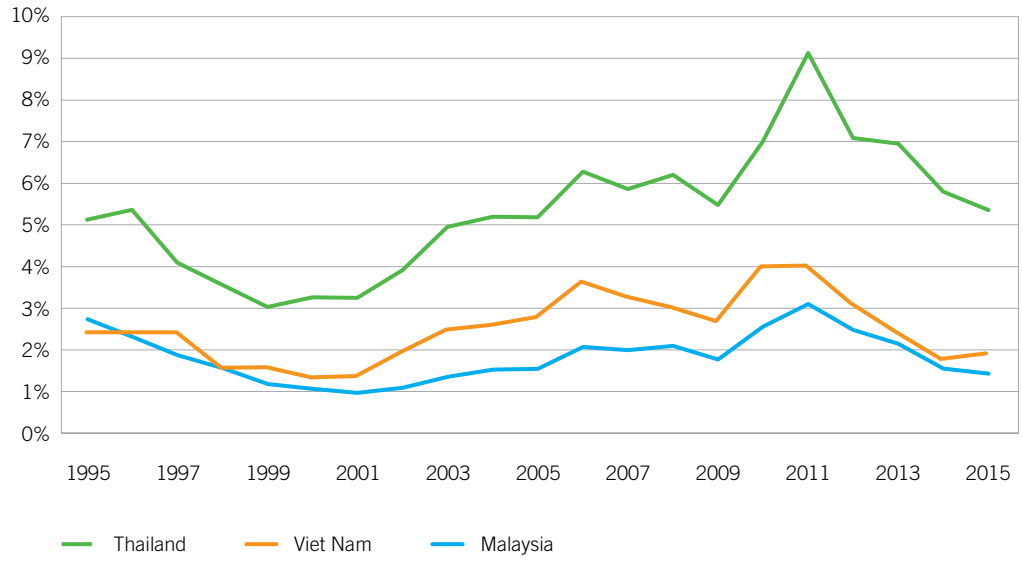
In 2014, four South-East Asian countries –Indonesia, Malaysia, Thailand and Viet Nam – accounted for 79 per cent of the world's natural rubber exports (UNCTAD, 2016). Thailand accounted for 33.2 of the world's total exports, followed by Indonesia (26.2 per cent), Viet Nam (11.9 per cent) and Malaysia (7.7 per cent). In 2015, exports of rubber in Thailand, Malaysia and Viet Nam accounted for US$11.2 billion, US$2.8 billion and US$3.0 billion, respectively, as shown in figure 2 (panel A). Thailand's exports climbed to US$20.9 billion in 2011, but have been decreasing gradually since then. The rubber shares of total exports decreased in Malaysia, Thailand and Viet Nam since 2011 (figure 2, panel B). However, in Viet Nam, the share has gradually increased since 2014.

Figure 2. Rubber exports (panel A, total in billions of current US$) and rubber share of total exports (panel B, percentage), Malaysia, Thailand and Viet Nam, 1995–2015

Panel A

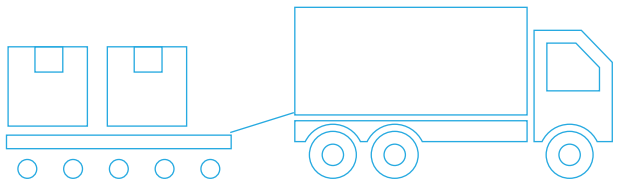


Panel B



Notes: Standard International Trade Classification (Rev. 3), rubber products include those under Divisions 23 and 62.

Source: UNCTAD (2016).



Malaysia

NR accounts for 25.5 per cent of Malaysian commodity export revenue and the Government identified it as one of 12 key national economic areas in its 2011 Economic Transformation Programme (PEMANDU, 2011). Malaysia is the world's largest producer of rubber gloves, accounting for over 50 per cent of the global market and almost 73 per cent of the country's rubber product exports in 2015, compared to under 5 per cent for tyres (MREPC, 2016).

Malaysia pioneered the development of higher value-added products. While Thai NR production and exports far exceed those of Malaysia, higher value added products play a much more significant role in Malaysian NR. The sector's importance has declined significantly in recent years as total rubber exports fell to 1.4 per cent of all exports in 2015. This is partly related to the 270 per cent decrease in the international price of rubber between July 2011 and December 2015.[5] However, the industry has been an important cushion in times of overall economic decline and offers an opportunity to move beyond an economic model dependent on exports (such as E&E, petroleum and palm oil).

Thailand

Rubber is Thailand's single largest agricultural export accounting for roughly 5.4 per cent of total exports in 2015. The Thai rubber sector is significant to the national economy for at least two reasons. First, Thai NR export earnings exceeded those from rubber products by 25 per cent in 2009 and by 52 per cent in 2013 (TRA, 2015). Second, tyres accounted for roughly two thirds of rubber product revenues (Sumormo, 2010a, p. 41; TRA, 2015). This relative emphasis on producing higher value products reduces incentives to upgrade lower value products, a tendency that is only exacerbated by the fact that vehicle tyres are the primary downstream rubber product for export and production is dominated by large MNEs.

Moreover, Thailand is the world's second largest glove producer, and almost all Thai enterprises can produce low-protein gloves. However, Thailand tends to export lower quality glove categories than Malaysia.[6] Much of the growth of Thailand's glove production has occurred under foreign owned enterprises, in contrast to Malaysia where glove production features locally owned enterprises cooperating with national testing and research facilities.[7]

Viet Nam

Most of the NR production in Viet Nam is exported. Between 1995 and 2008, NR exports achieved continuous moderate growth. From 2009 onwards, the Government introduced rubber production as one of its strategies to reduce rural poverty and reforest existing forests and woodlands. During the latter phase, Viet Nam became the third world's largest exporter of NR. However, since 2014 the value of Viet Nam's NR exports has declined with the fall of global prices.

5 The international price of rubber smoked sheets was US$214.64 per pound in July 2011 and reached a low of US$56.59 per pound in Dec. 2015 (Index Mundi, 2016).

6 Somsak (2009); Interview with manager, Thai Rubber Latex Corp., 15 July 2010.

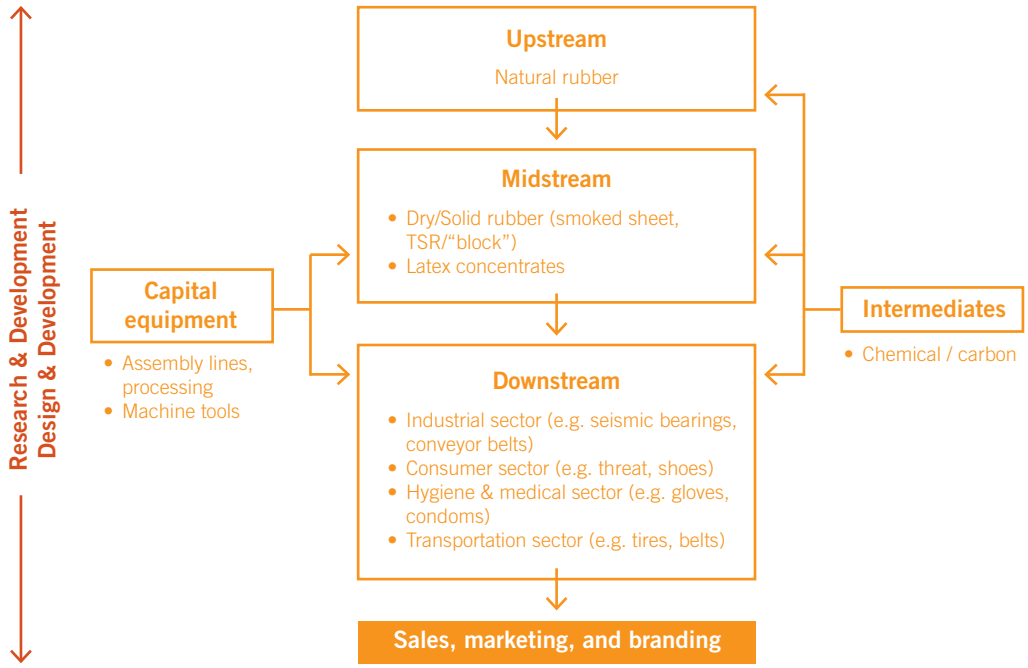
7 There are roughly 20 Thai glove producers, including four large enterprises, along with 16 or so smaller, Thai-owned producers that focus primarily on examination gloves (Interview with officials of Thai Glove Manufacturers' Association, July 16, 2010).

Three main factors account for Viet Nam's improvement in NR production and exports. First, Viet Nam has historically benefited from its natural condition for weather and soils of the traditional areas.[8] In 2013, after almost century of cultivation, Viet Nam traditional areas of rubber cultivation in the central and south-east regions still accounted for over 80 of total cultivation area. Second, NR production benefits from low labour costs. Third, Viet Nam has improved NR yield through effective use of innovative cloning, disease control and more effective planting. The key agency has been the Viet Nam Rubber Association (VRA) and the Rubber Research Institute of Viet Nam (RRIV), which play a key role in developing high-yield clones and helping its members to plant and to apply new cultivation processes.

2.1.2 Rubber value chain structure and challenges

The NR value chain consists of a number of stages, namely, upstream, midstream and downstream (figure 3).[9] The upstream segment involves NR cultivation and the most important consideration at this stage is yield (namely the quantity and quality of latex produced per hectare). The midstream segment involves the processing of NR into two types of rubber - latex concentrate and dry or solid rubber – as inputs for downstream producers. The production of latex products, such as gloves and condoms, involves the use of chemicals and capital equipment. The downstream segment of the NR value chain covers a diverse array of rubber-based products ranging from transportation (tyres, belts), industrial products (plates, sealing devices), consumer products (threads, balls, footwear) and hygiene and medical products (condoms, surgical gloves).

Figure 3. Natural rubber value chain



8 Interview with an officer of the Viet Nam Rubber Association, November 2015.

9 This value chain analysis focuses largely on NR than synthetic rubber, much of which is produced from nitrile and derived from petroleum products.

1. Upstream production: Malaysia's decline in NR production and export volumes resulted from the decline in planted areas as large estates converted acreage to other crops, especially oil palm, and to housing (Sumormo, 2010a and 2010b; Mohammad and Sarijman, 2007). A related problem has been low yields relative to Malaysia's competitors. This is in part due to the inefficiencies of Malaysian smallholders who produce over 90 per cent of the country's NR. This contrasts significantly with Viet Nam's NR producers, as Vietnamese smallholders and large holders own equal proportions of NR plantations.

Unlike Malaysia, Thailand has had the advantage of an expanding production area. Data from the Rubber Research Institute of Thailand indicate national rubber cultivation increased from 1.8 million hectares in 2000 to 2.67 million in 2008 (Kittipol, 2008; Chantuma et. al, 2012). Correspondingly, Thai NR production rose from 2.9 million tonnes in 2005 to 3.5 million tonnes in 2011, while Malaysia's output declined from 1.1 million tonnes to 1 million tonnes over the same period (Pornthep and Wongsurawat, 2013). Thailand has also historically benefited from greater access to labour than Malaysia. Migrant workers in Malaysia have been critical in overcoming labour shortages estimated to reach more than 90,000 workers by 2009 (Nobnorb and Fongsuwan, 2014). Finally, Thai growth in NR production owes much to Malaysia's pioneering development of high-yield clones, subsequently adopted by Thailand and others (Stifel, 1973, p. 126).

2. Midstream processing: Malaysia led key innovations that improved the quality of both dry and liquid latex for use by downstream producers. The first and most important was the development of technically specified rubber (TSR), commonly known as "block" rubber in 1965. Before this innovation, rubber as produced largely in the form of smoked sheets. This process had several disadvantages because it was difficult for both downstream customers and smallholders to visually assess the quality of the rubber. In addition, the product was expensive to transport. These problems led to NR losing competitive advantage to synthetic rubber.

Thailand followed Malaysia by developing its own version of TSR, known as Standard Thai Rubber.[10] However, the process has been much slower than in Malaysia. Whereas TSR constituted over 70 per cent of Malaysian NR exports and ribbed smoke sheets 0.3 per cent in 2012, it accounted for 42 per cent of Thai export revenues, with ribbed smoke sheets around 20 per cent (TRA, 2015).

3. Downstream: As noted, an important motivation for upstream improvement was the need to provide high quality feedstock for downstream rubber-based manufactured products. This has been a successful effort. Malaysia is the world's largest producer of medical rubber gloves, the second largest producer of condoms and rubber thread (MREPC, 2016). Given its dominant global position (accounting for 80 per cent of latex goods exports), the case of medical rubber gloves merits special attention.

The growth of Malaysian rubber exports was stimulated by demand generated by HIV/AIDS outbreak in the 1980s. But the industry was challenged in the early 1990s by the prevalence of allergies to latex protein. The threat to this growing sub-sector prompted responses by Malaysian public and private institutions to reduce the protein content in the latex and improve the manufacturing process. The challenge was overcome by developing allergy-free latex and increasing the automation and efficiency of production lines through Malaysian design innovation (MRB, 2012).[11]

10 TSR is a type of rubber block developed in Malaysia in the 1970s and 1980s, which allows accurate quality control, easier transport and storage.

11 Increasing automation is reflected in the fact that in 2009, the ratio of workers to product was ten per 1 million; by 2015 the level is 5.2 per million and the larger enterprises are down to 2 per million (Interview with MARGMA officials, 25 Nov. 2015, Kuala Lumpur).

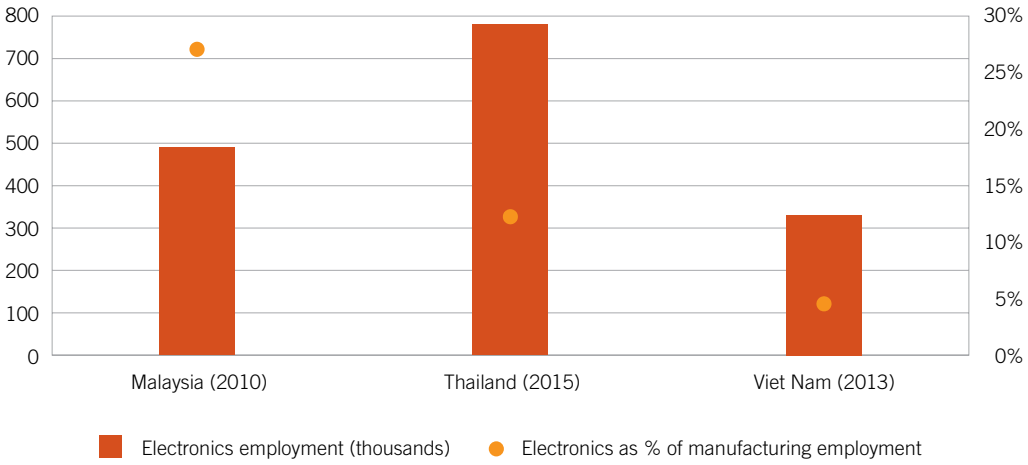
2.2 E&E sector

2.2.1 Economic importance

Employment

The electronics and electric (E&E) sector is an important source of employment for Malaysia, Thailand and Viet Nam. In 2015, about 780,000 workers were employed in manufacturing of E&E products in Thailand. In 2013, there were about 490,000 E&E workers in Malaysia in 2010, and 330,000 in Viet Nam. As a share of total employment in manufacturing, employment in the E&E sector accounted for 27 per cent in Malaysia, 12 per cent in Thailand and 4.5 per cent in Viet Nam (figure 4).

Figure 4. Total employment in manufacture of electronics and electrical products and share of total manufacturing employment, Malaysia, Thailand and Viet Nam, latest available year (thousands)



Notes: International Standard Industrial Classification of All Economic Activities (Rev. 3), electronics and electrical products include those under Divisions 26 ('Computer, electronics and optical products'), 27 ('Electrical equipment'), and 28 ('Machinery and equipment'). Total manufacturing refers to Section C, Divisions 10–33.

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

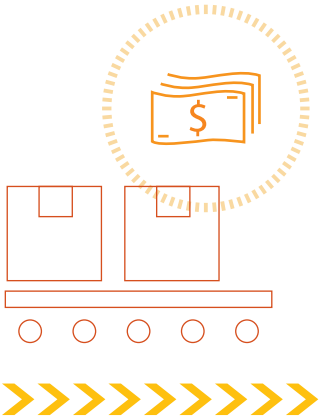
Exports

Malaysia and Thailand are the second and third largest E&E exporters in South-East Asia, after Singapore. Viet Nam is the fifth largest after the Philippines. In 2015, the E&E exports of Malaysia, Thailand and Viet Nam accounted for US$78.1 billion, US$53.7 billion and US$47.8 billion, respectively (figure 5, panel A).[12] Exports from Malaysia and Thailand saw significant growth between 1995 and 2014, increasing by more than double over this period. However, in Malaysia and Thailand, the nominal value of electronics exports has only risen slightly since

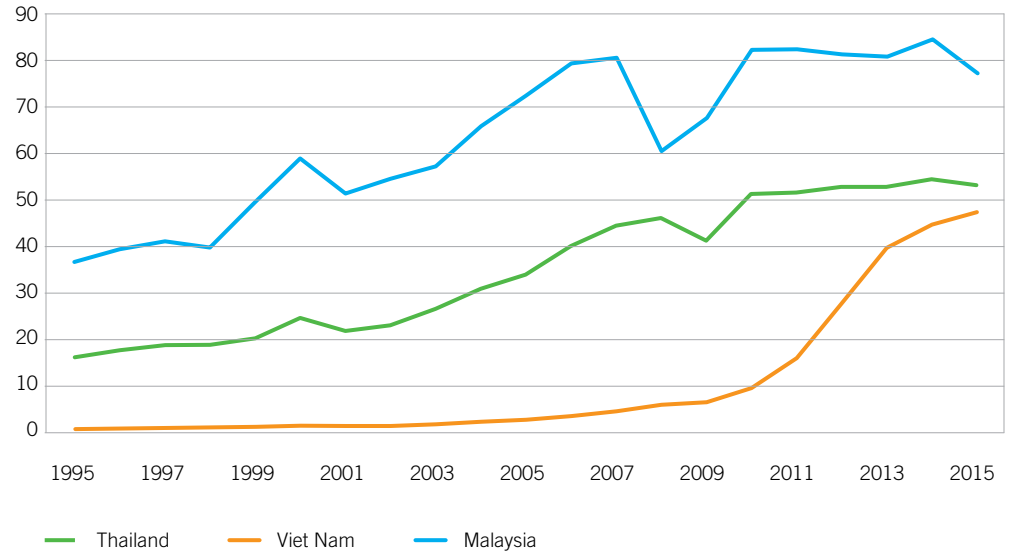
12 UNCTAD (2016).

2007. From 2009, E&E exports from Viet Nam have emerged very strongly due to increases in exports of telecommunications equipment and parts, which accounted for US$20 billion in 2014 compared to US$578 million in 2008. Major export markets of Malaysia, Thailand and Viet Nam include the China, Japan, Singapore and the United States.

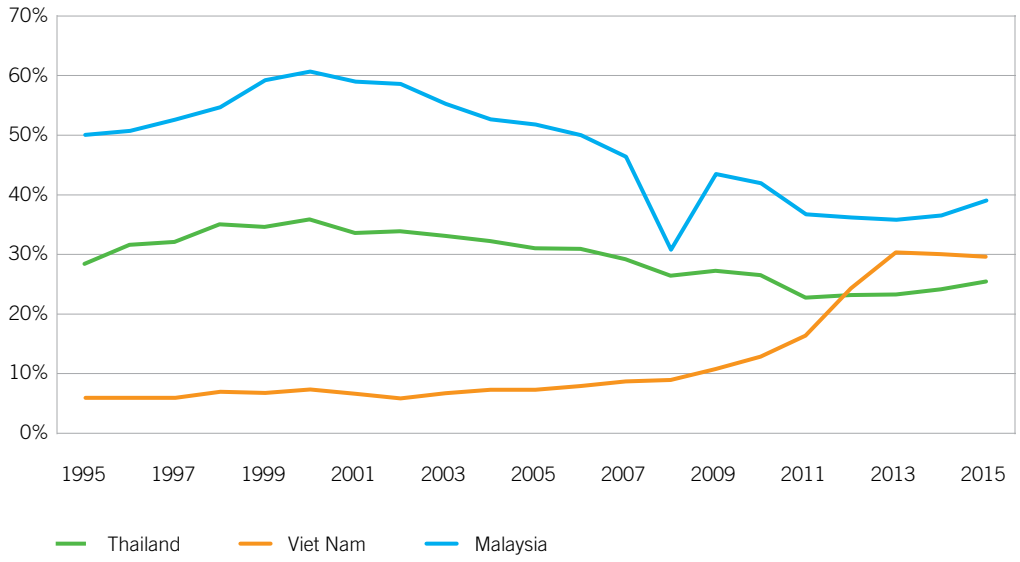
Figure 5. Total E&E exports (Panel A, in billions of current US$) and E&E as a share of total exports (Panel B, percentage), Malaysia, Thailand and Viet Nam, 1995–2015



Panel A



Panel B



Notes: Standard International Trade Classification (Rev. 3), Electronics and electrical products include those under Divisions 75-77, 87 and 88, manufactured goods refer to products under Sections 5-8 less Group 667 and Division 68.

Source: UNCTAD (2016).

Figure 5 (panel B) shows the contribution of E&E exports to total national exports. Between 1995 and 2015, the share of E&E exports in Malaysia and Thailand declined from 50 per cent to 39 per cent and from 28 per cent to 25 per cent, respectively. In the meantime, the E&E share of total exports in Viet Nam increased significantly from 6 per cent in 1995 to 27 per cent in 2015, despite decreasing E&E contributions to total exports.

In 2014, Malaysia, Thailand and Viet Nam ranked among the top 15 economies for exports of electronic data processing and telecommunications equipment and electronic components. Exports of the mentioned E&E products have been globally dominated by China. Between 2010 and 2014 shares of global exports of electronic data processing and telecommunications equipment from Malaysia and Thailand declined, while the share of global exports from Viet Nam increased. For Malaysia and Thailand, the share in global exports declined because labour reserves were exhausted and technological upgrading was insufficient (Rasiah and Yap, 2016).

Exports of electronic components from Malaysia and Viet Nam increased between 2010 and 2014. In Malaysia, this expansion resulted from growth in capital-intensive fabricated wafers since 2005, despite an overall saturation of its labour reserves (Rasiah and Yap, 2016). Overall increases in E&E exports from Viet Nam are explained by its capture of much of the lower skilled packaging and assembling work from China. More significantly, it secured major investments from mobile phone producers such as Samsung.

2.2.2 E&E value chain structure and challenges

Using the global value chain framework advanced by Gereffi, Humphrey and Sturgeon (2005), it is possible to identify lead enterprises in the sub-component electronics industries as shown in table 1.

Table 1. Main E&E product categories and products in Malaysia, Thailand and Viet Nam

Broad product category	Examples of products
Integrated circuits	Microprocessors, microcontrollers, memories, logic chips
Computers	Desktop, notebook and netbook
Office equipment	Printers, fax machines, copiers, scanners
Consumer appliances	Game consoles, television, home audio and video, portable audio and video, mobile phone handsets, musical equipment, toys
Telecommunications	Public telecommunications, private communications networks, Internet, mobile phones
Server and storage devices	Portable, internal, external, backup systems, storage services
Automotive electronics	Entertainment, communication, vehicle control (braking, acceleration, traction, suspension), command navigation
Medical electronics	Consumer medical, diagnostics and testing, imaging, telemedicine, meters and monitoring, implants, fitness
Industrial electronics	Security and surveillance, factory automation, building automation, military systems, aircraft, aerospace, banking and ATM, transportation

Source: Adapted from Sturgeon and Kawakami (2011).

By this classification, there are largely three types of linkages involving electronics enterprises operating in Malaysia, Thailand and Viet Nam, namely:

- MNE subsidiary linkages;
- contract enterprises that undertake considerable design and R&D in the components and fully disassembled parts they produce; and
- enterprises that assemble parts for export.

The integrated circuit industry supplies components to other electronics industries, including the military and aerospace industries. However, there are no lead enterprises in these industries in Malaysia, Thailand and Viet Nam. Lead enterprises are operating in the three countries, but are not dominant in the value chains. The three linkages in the E&E value chain are explained below.

MNE subsidiaries of lead enterprises undertake the assembly and design of components and fully disassembled items for their parent plants abroad. Of the three countries, MNE operations in the integrated circuit industry is most sophisticated in Malaysia where supportive R&D, design and wafer fabrication activities are conducted. However, the lack of human capital has restricted the potential for further expansion of production in Malaysia.

The prime linkage for the national economies from their activities are employment, income generation opportunities and learning through working in the enterprises. Buyer-supplier relationships between the MNEs and national enterprises in machine fabrication, tooling and plastic injection moulding grew in the 1980s and 1990s in Malaysia (Rasiah, 1994). However, such activities have declined since the end of 1990s owing to production shift by MNEs to China, and scarce designers in the country. A different framework has stimulated supplier links between Samsung and national suppliers in Viet Nam.

Within modular value chains, lead enterprises contract out the design and R&D of particular components and fully disassembled items to **modular contract manufacturers** (such as Apple to Foxconn) (Sturgeon, 2002). Significant opportunities for technological upgrading exist in modular chains as the suppliers undertake design and R&D activities of the components or disassembled items they produce. Both national enterprises and contract MNEs subsidiaries are engaged in such activities in sub-industries with varying intensity of technological sophistication, such as printed circuit boards (PCBs), flexible circuit boards (FCBs),[13] monitors, and components (including integrated circuits).

While there is certainly a shift to modular operations, most **contract manufacturers** in all three countries function without significant participation in design and R&D activities. Several national and foreign subsidiary enterprises produce PCBs and FCBs, and resistors, capacitors and light emitting diodes (LEDs) with little design or R&D. While considerable adaptations take place in these enterprises they have few R&D staff and lack a department to undertake design and R&D activities.

13 PCBs are rigid electronic circuits consisting of thin strips that connects electronic components. FCBs are similar to PCBs, but are mounted on flexible plastic substrates.

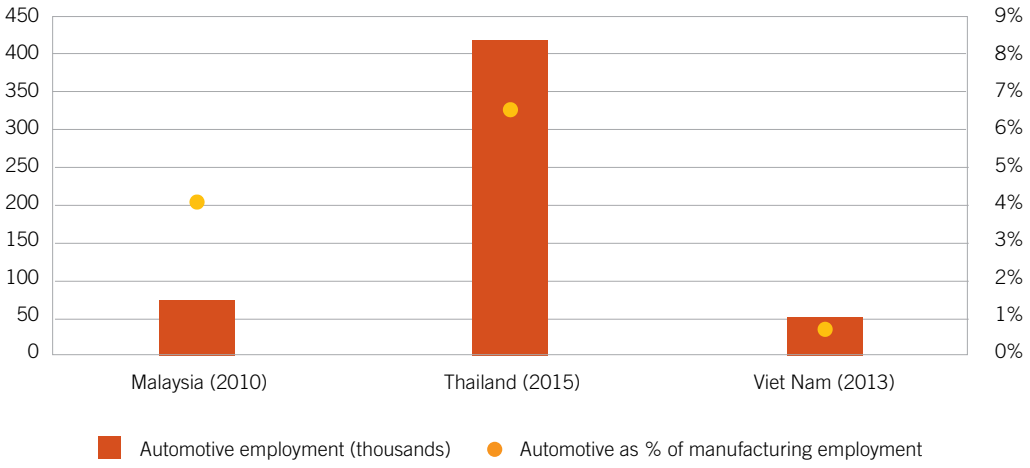
2.3 Automotive sector

2.3.1 Economic importance

Employment

In 2015, there were about 417,000 workers in motor vehicles and parts manufacturing in Thailand. By comparison, there were 73,900 in Malaysia in 2010 and 51,200 in Viet Nam in 2013, according to the latest labour force surveys and censuses (figure 6). As a share of employment in all manufacturing, employment in the automotive sector accounted for 6.5 per cent in Thailand, 4.0 per cent in Malaysia and 0.7 per cent in Viet Nam.

Figure 6. Total employment in manufacture of motor vehicles and parts and share of total manufacturing employment, Malaysia, Thailand and Viet Nam, latest available year (thousands)



Notes: International Standard Industrial Classification of All Economic Activities (Rev. 4), motor vehicles and parts include production under Division 29 ('manufacture of motor vehicles, trailers and semi-trailers'), total manufacturing refers to Divisions 10–33.

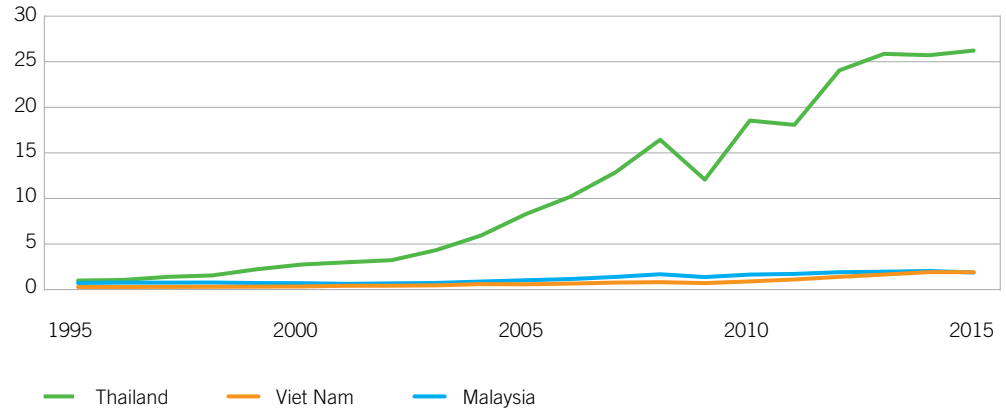
Source: ASEAN 2015, ILO estimates from official labour force surveys (various years).

Exports

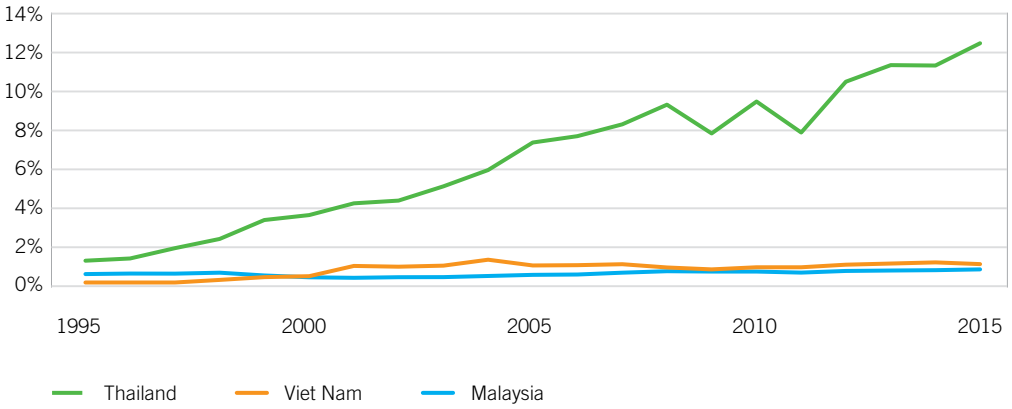
Thailand is the largest exporter of automobiles and auto parts among Member Countries of the Association of Southeast Asian Nations (ASEAN). Thailand's automotive exports have grown from around US$3 billion in 2002 to around US$26 billion in 2015, measured at current prices (figure 7, panel A). In comparison, automotive exports from Malaysia and Viet Nam have been relatively low over the past 20 years. In 2015, automotive exports accounted for under US$2 billion in Malaysia and Viet Nam. In 2013, Thai automotive exports accounted for 11 per cent of its total exports (figure 7, panel B).

Figure 7. Automotive exports (panel A, total in billions of current US$) and automotive share of total exports (Panel B, percentage), Malaysia, Thailand and Viet Nam, 1995–2015

Panel A



Panel B



Notes: Standard International Trade Classification (Rev. 3), automotive products include those under Division 78, manufactured goods refer to products under Sections 5-8 less Group 667 and Division 68.

Source: UNCTAD (2016).

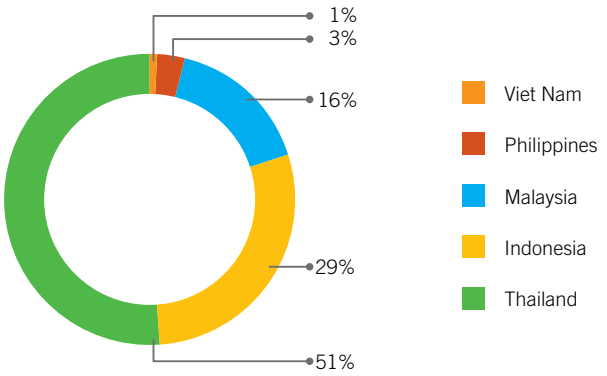
Malaysia, Thailand and Viet Nam offer quite contrasting pictures of automotive industrialization. Malaysia has unsuccessfully promoted an integrated auto industry modelled after the Republic of Korea. By contrast, Thailand has eschewed protection and efforts to produce an indigenous "national car" and has more successfully become a hub for foreign assemblers and their "follow source" component producers.[14] Viet Nam's automotive industry has been recognized as one of the "spearhead industries" to achieve industrial upgrading.[15] As can be seen in figure 8, Thailand accounted for 51 per cent of ASEAN car production in 2015 compared to only 16 per cent for Malaysia and 1 per cent for Viet Nam.

14 The Thai Government has provided special incentives for foreign enterprises to produce vehicles – 1-tonne pickup trucks and "eco-cars" – with significant scale economies owing to their popularity in both domestic and export markets (Doner, 2009).

15 According to Hansen (2015), the Vietnamese Government has also targeted other "spearhead industries" including textile and E&E manufacturing.

Not surprisingly, these contrasting performance levels translate into structural positions for the automotive sector in the three economies. A final indication of the relatively weak position (and potential) of the Malaysian automotive sector is the fact that, unlike rubber, automotive is not one of the country's 12 key national economic areas targeted as part of the Economic Transformation Programme (PEMANDU, 2011). The Government of Viet Nam increased automobile taxes and fees to reduce urban congestion and generate public revenue, and this also restricted the domestic automobile market (Hansen, 2016).

Figure 8. Car production in selected ASEAN Member States by share, 2015



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

Malaysia's automotive strategy aimed at using government-supported industrialization to redress ethnic inequalities between *bumiputera* (ethnic Malay) and ethnic Chinese investors, while promoting better economic performance.[16] This has principally taken the form of support for the largely government-owned automobile production company, Proton. Regional liberalization pressures, especially the ASEAN Free Trade Area, resulted in a number of government moves to liberalize the industry, including awarding "national car" status to three other companies, each of which involved substantial foreign participation, and revising a 2006 National Automotive Policy.[17] But the Government's support of Proton has enabled it to continue to dominate Malaysia's auto industry and has influenced the challenges and opportunities in the sector.

2.3.2 Automotive value chain structure and challenges

The automotive value chain is complex, dynamic and decentralized. Finished vehicles begin upstream with (product and process) design and many raw materials (see figure 9). The design process has become more rapid due to the use of computers, which has enabled heightened competition and shifting, differentiated consumer tastes. Raw materials include rubber, glass, steel, plastic and aluminium. Plastic and aluminium are increasingly replacing steel to reduce weight and increase fuel efficiency (Sturgeon, Biesebroeck and Gereffi, 2009). Equally important are the supporting industries, such as moulding, tool and die operations, as well as the production of capital equipment that help to convert raw materials into intermediate goods.

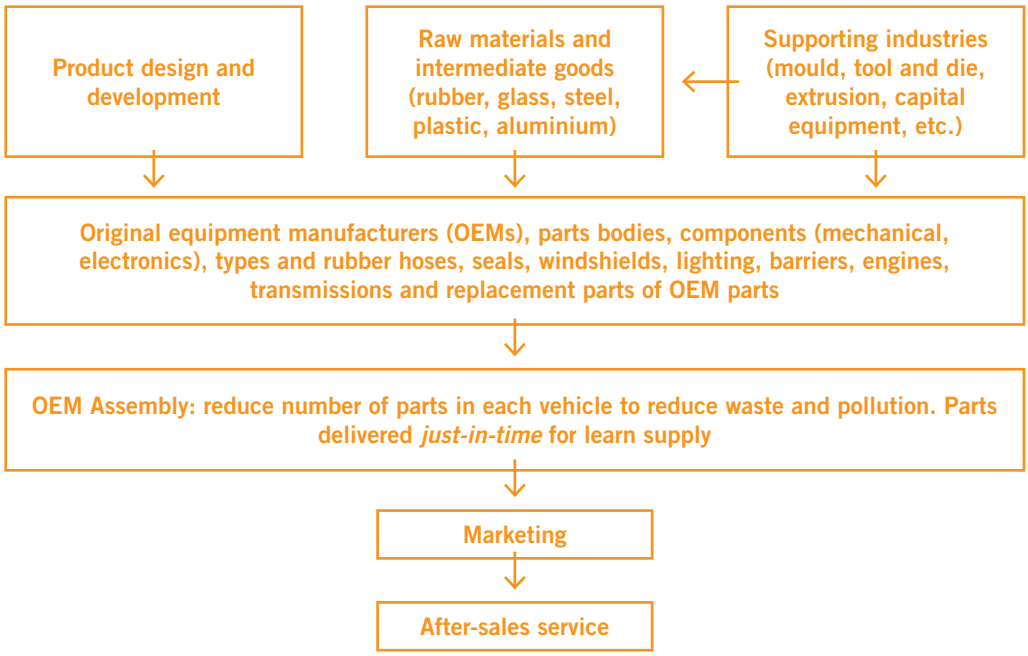
16 In 1971, the Malaysian government established the New Economic Policy (NEP) which gave preferential treatment to *bumiputera* (ethnic Malay) in all aspects of public life, including positions in the national automotive project Proton in order to balance participation of diverse ethnicities.

17 See The Star (2014), on recent revisions in the Malaysian National Automotive Policy, first drafted in 2006, designed to attract more export-oriented FDI.

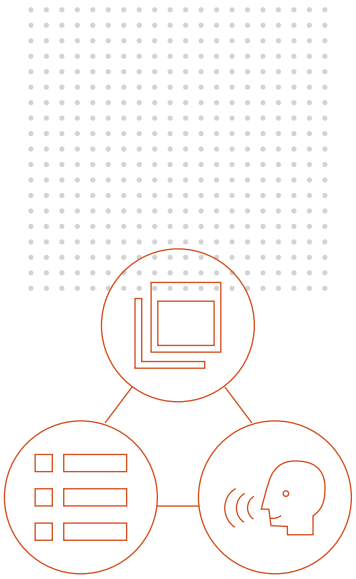
According to Humphrey and Memedovic (2003), the automotive value chain encompasses at least six actors, who have different requirements and capabilities. Their roles and functions are summarized as follows:

- **Assemblers** are in charge of assembling finalized auto products, and are required to distribute costs of vehicle design and branding. Innovation and creativity in design are critical to staying competitive in the global market.
- **Global mega-suppliers** are sometimes referred to as "tier 0.5" suppliers. They provide major systems to assemblers and they need design and innovation capabilities to provide solutions for assembler requirements.
- **First-tier suppliers** require design and innovation capabilities and they supply directly to assemblers.
- **Second-tier suppliers** require process-engineering skills to meet cost and flexibility standards and they must obtain quality certification. Often they supply just one market, but some are international. They typically work with designs provided by assemblers or global mega-suppliers.
- **Third-tier suppliers** require rudimentary engineering skills and they supply basic products. They compete predominantly on price, and must meet quality standards. Skill levels and investments in training are relatively limited.
- **Aftermarket segments** compete predominantly on price. Access to cheaper raw materials and although innovation is not required, process engineering skills are important to translate designs into detailed drawings. The potential for growth in aftermarket products is reflected in the dominance of enterprises in Taiwan, China.

Figure 9. Automotive supply chain



Source: Sturgeon, Memedovic, van Biesebroeck and Gereffi (2009).



Most indigenous enterprises in developing countries lack the means to engage in the assembly and production of sophisticated parts and components. Building an assembly plant typically requires large investments and the capacity to coordinate inputs from diverse suppliers. While upstream raw materials and intermediates offer some possibilities, few developing countries can meet the very high standard of quality that is required. Indonesia and Thailand, for example, have attempted to produce steel for the automotive industry, but in general these efforts have not met the standards for automotive exports. Rubber for tyres is, of course an exception, but OEM tyre production tends to be dominated by MNEs.

The supporting industries, aftermarket products, and the production of parts and components – especially in midstream segments – in principle hold the greatest potential for local enterprises (Humphrey and Memedovic, 2003, pp. 43–46). This is where entry barriers are somewhat lower and where market opportunities are significant as some two thirds of the value of a vehicle actually comes from parts and components. Indeed, it is SBAs in these areas that have been the most active in Malaysia and Thailand. However, even in auto parts, the entry barriers are high, as evidenced by the accelerated influx of automotive FDI and a very distinct reduction of Thai OEM producers after the 1997 crisis (Doner, 2009).

Several features of this shift to production for export have raised entry barriers for local producers which SBAs must overcome. First, this shift accelerated the change in MNE strategy from a 'horizontal' approach of independent, protected national production sites to a 'vertical' approach in which countries specialize in particular products and parts of value chains. Some parts, such as tyres, wheels and batteries, are relatively independent of the design of the overall vehicle. But most are tightly integrated. Auto assemblers, component suppliers and lower-level parts producers are thus enmeshed in complex networks that balance cooperation and competition. As a result, local clusters are nested within national production systems which operate within intra-regional exchanges that themselves overlap to varying degrees with global buyer-supplier relationships (Sturgeon, Biesebroeck and Gereffi, 2009, p. 304).

Second, several features of these value chains imposed performance requirements that most local enterprises were not able to meet.[18] One is the move to common platforms. Since the mid-1990s, assemblers have moved increasingly to producing a range of cars off the same product platform. Initial investment costs for developing these platforms are very high—themselves a barrier to entry to new producers. But once established, platforms offer assemblers an opportunity to realize substantial economies of scale and scope as parts are standardized across a number of models. For aspiring first-tier parts suppliers the use of platforms poses challenges. They have to work closely with assemblers in the development of products that will function across a range of vehicles and often need a global presence to supply to the various plants that use the same platform. Finally, they have to be able to produce in substantial volumes.

Related to the move to common platforms is modularization. Instead of ordering and assembling the various parts that go into an automobile, global automakers provide first-tier suppliers with rough specifications to produce the modules cheaply and reliably, invest in new product innovation, and work on cooperative development of new vehicles. For the assemblers, this particular form of outsourcing reduces capital requirements and forces others to share risks. For parts producers, modularization can facilitate a move up the value chain and enables them to develop technologies that can be applied across several manufacturers. But it also involves very substantial investments, since it is now suppliers who are responsible for design.

18 The findings draw from Doner, Noble and Ravenhill (2007).

RECENT TECHNOLOGICAL INNOVATIONS AND CHALLENGES

This section outlines the technological innovations and challenges that producers face within the various segments, due to upgrades in technology and changes in the production processes in the three sectors, as well as its past and future implications on economic and employment growth.

3.1 Rubber sector

Thailand has remained strong in upstream production but it is dominated by foreign enterprises in the downstream segment and has lagged behind its competitors in overall innovation. Malaysia, in contrast, has lost its top spot as an NR producer and exporter, but it has pioneered a number of innovations and local Malaysian enterprises have excelled in downstream production. Viet Nam, on the other hand, largely produces upstream rubber and a relatively small proportion of its rubber is downstream. However, downstream rubber production in Viet Nam remains underdeveloped as financial constraints and the lack of human capital have impeded technology uptake.

3.1.1 Upstream segment

The upstream segment encounter relatively minor technological challenges. Farmers must select appropriate fertilizer and use it correctly; they must master efficient tapping techniques, a process that typically requires extensive experience; they must effectively manage pests and diseases; and in some cases they must plant other crops among rubber trees, at least until trees become sufficiently mature to begin tapping (typically five to seven years). However, raising yield also depends on a range of factors that are typically beyond the capacity of farmers or even extension agents. The most relevant innovations in the upstream segment of rubber production are explained below:[19]

- The Automatic Rubber Tapping System involves a mechanized tapping device attached to the tree that automatically taps without the presence of workers. The device can be programmed to automatically tap at the programmed time, powered by solar energy (e.g. around 2:00 a.m. to 3:00 a.m. when latex pressure inside the tree is at its highest levels) (The Prospect Group, 2012). It was developed in response to low yield in Malaysian smallholder rubber plantations due to the old age of trees, dependence on foreign workers

[19] These innovations have mainly been adopted in Malaysia due to its focus on higher added value of rubber production.

and a small number of tapping days. Requirements to implement the system are easy to meet and include software programming and provision of a power source. As of 2012, the Automatic Rubber Tapping System was under pre-commercial trials (Rubber Journal Asia, 2012), nevertheless, based on interviews conducted as part of this study, the success of the System is not certain.

- The Low-Intensity Tapping System combines a shorter tapping panel length, less frequent tapping schedule and yield stimulus through either gas or chemical stimulation. This technology both reduces the number of tapping days and increases the area that workers can tap in a given time, increasing productivity. According to the Malaysian Rubber Board (MRB), the Low-Intensity Tapping System has "effectively solved the problem of the shortage of skilled tappers without harming estate or smallholding/farm production."[20]

- The development of high yield clones consists of identifying rubber genome sequences involved in important traits including quality, yield and disease resistance and genetically improving rubber clones. This technique faces technical challenges that result from the shortage of geneticists and polymer scientists. It also faces logistical challenges related to ensuring that farmers actually adopt cloned varieties that they are not familiar with.

3.1.2 Midstream segment

Rubber produced in the midstream segment can take two forms. The most basic (and first developed) is 'sheet' rubber, a type that can be produced by individual farmers with little or no capital equipment.[21] The second form is TSR or block rubber, and its production requires more complex, factory-based processes. This innovation was a huge success as reflected by the fact that Malaysia switched almost totally to TSR from sheet rubber by the mid-1980, by the adoption of TSR schemes by almost all other rubber-producing countries and global tyre manufacturers.

The innovations for the midstream segment are as follows:

- TSR/ block rubber was developed by the Rubber Research Institute of Malaysia in the 1970s and 1980s and subsequently the MRB piloted and tested TSR. The Institute demonstrated the feasibility of its production through one of its pilot plants. Subsequently a related institution worked with smallholders to improve the quality of their product and meet TSR quality requirements. It also established processing factories to provide them with a stable market outlet.

- Specialty rubber was developed for specific applications and environmental benefits. For Malaysia, the goal was to move away from block rubber to specialty rubber. This technology upgrade illustrates the effort to transform rubber from a commodity into an advanced polymer feedstock for midstream and downstream producers and the role of public institutions in research and testing.[22] Its development and application require knowledge of polymer chemistry and applied engineering.

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20 The key obstacle to the scheme's adoption is funding, so the MRB proposed funding and technical coordination/monitoring arrangements. See for example MRB (2011). Dangers in improper tapping include excessive tapping, improper latex stimulant usage, tapping young trees, and tapping during flushing period or dry season.

21 Liquid latex is collected and coagulated in large tanks; with the coagulum sheeted. The sheets are smoked or dried with hot air in closed buildings or, in the case of small producers, the sheets are dried in the open air or smoked individually or collectively.

22 Note also that these specialized rubbers are not for tyres, which typically include only 15 per cent NR (as opposed to synthetic rubber).

- Low-protein latex was developed by MRB researchers and latex processors in the private sector to address latex protein allergies. The process makes use of various types of leaching.
- Compounded rubber is created from a precise combination of different kinds of rubber, additives and fillers. Compounds give different properties to the rubber for downstream applications including tyres, auto parts, convey belts, seismic bearings, among others. Compounders require good knowledge of polymer science with extensive experience and knowledge of specific applications.
- Nitrile latex is a form of synthetic rubber used extensively in tyres and automotive components as well as shoes and gloves to an increasing degree. Petroleum and polymer chemists and engineers can develop nitrile latex.

3.1.3 Downstream segment

Because products from the downstream segment are typically exported, they must meet global quality standards, a point that is especially obvious for products such as tyres and surgical gloves (Sumormo, 2010a; Somsak, 2009; Kulwant, 2014). As such, these products require high-quality capital equipment and midstream inputs, including various intermediates.

The NR value chain is not generally characterized by cutting edge technology.[23] Malaysian and Thai producers face significant challenges in absorbing technology that is new to them. For example, Malaysia has been especially active in developing the production of civil engineering products including seismic bearings for earthquake protection. The technology required to produce seismic natural rubber bearings was developed by and can be 'imported' from Western Europe. However, the actual use of such technology in Malaysia is far from automatic. Different climatic conditions and uses require adaptation of specific compounds and the development of new types of testing equipment.[24]

Past innovations in the downstream segment of rubber production include allergy-free latex medical gloves during the 1970s and 1980s, which required the development and modification of assembly lines. Malaysia Rubber Glove Manufacturers' Association (MARGMA), which also helped to develop a national brand – the Standard Malaysian Glove – was a key player in these developments in conjunction with public institutions, especially the MRB. Innovations have continued, especially with regard to volume processes. A MARGMA official reported that in 1989, Malaysian glove producers produced roughly 3,000 gloves per hour; and at present, the enterprises regularly produce 45,000 per hour – all with increasing levels of automation on Malaysian designed and built production lines.

3.2 E&E sector

Large scale electronics production in Malaysia and Thailand began during the labour-intensive phase of assembly and test operations in the 1970s and 1980s. However, from the 1980s, electronics enterprises and knowledge-based chip assembly relocated out of Thailand following the introduction of automation and flexible production systems driven by just-in-time schedules.

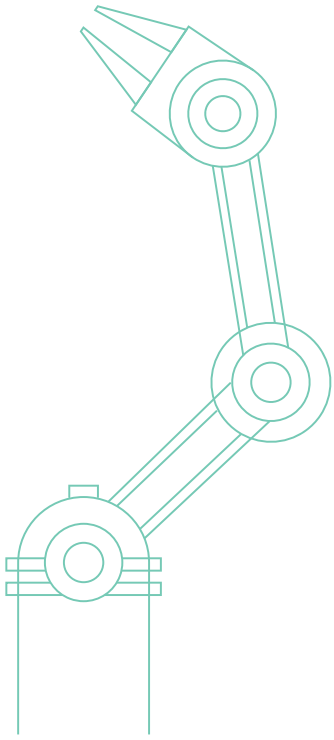
23 One exception is the genetic research, carried out by Malaysia, required to reduce the allergy-causing proteins in latex examination and surgical gloves in the late 1980s.

24 Interview with the Director of Doshin Rubber Products in Malaysia, 23 Nov. 2015.

Malaysia managed to retain such activities but the extent of production expansion in such activities has declined since 2010 due to its inability to meet the demand for specialized technical personnel. Viet Nam has kept a small presence of chip enterprises while expanding sharply in electronic data processing (EDP), office and telecommunications equipment. Viet Nam, nevertheless, is still largely driven by labour-intensive E&E production.

Knowledge-based activities have become important in high value-added activities, such as chip assembly and test operations. This section explains the major technological changes that have impacted E&E production in Malaysia, Thailand and Viet Nam.

3.2.1 Malaysia



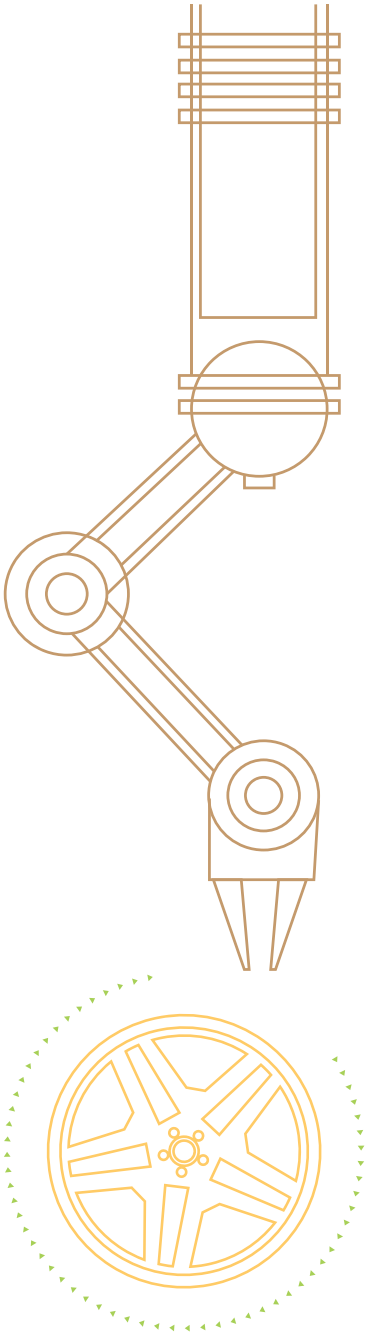
Increasing automation and demand for knowledge-based activities, such as design and R&D, have shaped electronics production at host-sites globally since the late 1980s. By 2000, electronics manufacturing in Malaysia became strongly capital- and knowledge-intensive, and technical, statistical and cognitive activities became the major driver of employment. Engineering personnel also became important as design and the peripheral aspects of R&D are not handled by suppliers of components and parts (for example, Foxconn is not involved in Apple's R&D efforts). Thus, the capacity of foreign host sites to retain electronics production has very much depended on its ability to generate the human capital essential to support technological upgrading, which itself often depends on the extent of institutional change that has taken place.

The electronics industry has undergone two major technological developments in Malaysia over the last 5 to 15 years (Rasiah and Yap, 2015).[25] The first relates to a shift to supportive design and R&D, which started off strongly during the 1990s among semiconductor enterprises but has weakened in recent years. Two American enterprises, interviewed in this study, reported that high value-added manufacturing in Malaysia is now shifting to China and Viet Nam owing to both the lack of process engineers and the cost of hiring them. The second relates to the expansion in low value-added assemblies, such as PCBs and FCBs, using large numbers of lower skilled foreign workers. In interviews for this study, representatives of five MNEs and six national enterprises raised concerns at the need to improve Malaysia's human capital development policies. Finally, other developments in the E&E sector include the adoption of automated processes and increasing government support for technology uptake for E&E production.

E&E Design and supportive R&D

Since the 1980s, linkages between foreign electronics enterprises and national enterprises appeared promising when demand for proximate sourcing increased (Rasiah, 1988). Indeed, significant supplies of precision tools and semi-automated machinery were established between MNEs and national enterprises in Penang over the 1980s and 1990s. But Malaysian suppliers did not upgrade design and R&D activities due to a lack of human capital and weak university-industry R&D linkages (Rasiah, 2010). The upgrade to supportive R&D has been primarily conducted by foreign companies.

25 Based on interviews conducted in 2016.



Three American MNEs interviewed as part of this study highlighted that the inability to locally source enough qualified process and R&D engineers was a significant obstacle to their plans of making Malaysia a global design base. Instead, they established R&D centres. Two of them established design centres in Penang, while the third, located in Selangor, is planning to build one by 2017. These three enterprises have hired foreign experts from India and the Philippines to provide technical support. Shortages of highly skilled staff led some of the interviewed enterprises to hire both low and high skilled foreign workers to integrate both their operational and technical abilities into the production line.

Low value assembly

Interviews conducted with more than ten MNEs and national Malaysian enterprises showed that the increased deployment of less skilled foreign labour since 2005 has revived growth in the industry but with a specialization in low value added activities. This pattern has emerged from a lack of effective human capital development policies in Malaysia. Firstly, even semiconductor enterprises that have retained assembly and test operations in Malaysia have increasingly hired less skilled foreign workers. Based on data gathered by the Department of Statistics, foreign labour accounted for almost 35 per cent of operators in the semiconductor industry in Malaysia in 2013.[26] Secondly, skill shortages contributed to increasing relocation of E&E manufacturing outside of Malaysia. In 2015, Intel, for example, relocated assembly and test operations to China and Viet Nam from Malaysia because of the availability of better human capital endowments (Tan, 2015).

Automation

The lack of adequate supply of designers and technicians combined with increasing automation of production processes has resulted in two distinct trends. Enterprises are either separating tasks of both high skilled and low skilled workers into independent production processes or combining them in integrated production process. A representative of one enterprises interviewed for this study said that their engineers were increasingly required to undertake design while others operated automated machines on the shop floor.[27] By contrast, other enterprises reported integrating the know-how of highly skilled technicians, maintenance supervisors and operators to function as a highly technical node in the production line.

Automation and the introduction of continuous improvement (*kaizen*) work practices have overall come along with the substitution of dexterous skills with cognitive and technical.[28] Since the 1980s, process engineers in semiconductor enterprises, for example, adopted preventive maintenance and total quality management processes such as the Electron Beam Induced Current technique to measures currents that flow in a semiconductor in order to identify production defects or buried connections (Graz University of Technology, 2016). This technological innovation optimized the semiconductors production process.

26 Unpublished data supplied by the Department of Statistics, Malaysia.

27 Interview in Malaysia, Apr. 2016.

28 *Kaizen* is a Japanese work improvement practice used in assembly lines and enterprises in general.

Government support and technological progress

In 1985, the Government attempted to directly support technological upgrading in the E&E industry when it launched the Malaysian Institute of Microelectronics Systems. The Institute was moved from the Prime Minister's department in 1993 and corporatized. Despite attempts to attract participation by MNEs, only national enterprises have adopted technologies developed at the Institute. Among its achievements are the creation of the national wafer fabrication plants of the Silterra factory. While Silterra has R&D and design operations, it has a very low market share (Rasiah and Yap, 2015).

Further support from the Government consisted of founding the Human Resource Development Council, the Malaysian Technology Development Corporation, Multimedia Development Corporation and Malaysia Industry-Government High Technology in the early 1990s. The establishment of these institutions aimed to support the transformation of the E&E industry from low to high value-added activities. Of the mentioned institutions, only the Human Resource Development Council has stimulated training among industrial E&E enterprises with over 50 employees by providing and partly financing training courses. The rest have yet to produce significant results.

Government grants, such as the Long Run Grant Scheme administered by the Ministry of Higher Education since 2010, explicitly encouraged R&D through university-industry linkages. The Ministry of Higher Education requires researchers of at least three institutions and soft and hard sciences to work together on grants proposals (Nor, 2012). The provision of such grants has helped Malaysian universities to significantly increase the number of publications in scientific journals and patent applications (Rasiah, Yap and Govindaraju, 2014). However, interviews with E&E enterprises show that researchers at national universities have been reluctant to carry out what is at enterprises disposal thereby making such links marginal to their operations.

3.2.2 Thailand

Generous incentives from the Board of Investment (BOI) and the other government agencies, especially related to tax holidays and tariff-free operations, attracted the first major influx of electronics assembly and test operations in the 1980s. The BOI has led the development of several initiatives and programmes to support E&E production. However, without R&D grants, Thailand lacked sufficient interventions to solve collective action problems in critical areas including skills and value added to manufacturing, as well as in design and R&D in the development of integrated circuits.

Government support

In 1992, the BOI also developed the Unit for Industrial Linkage Development to strengthen linkages and help small and medium-sized contract manufacturers improve their productivity and facilitate cooperation between foreign and domestic enterprises. It is estimated that the Unit facilitated about $148 million worth of transactions in 2001 (UNCTAD, 2005). The National Science and Technology Development Agency launched a Software Park and the Government promoted technology diffusion and innovation of technology in the E&E sector. The Agency also established the Industrial Technology Assistance Programme to support SMEs and start-ups by facilitating the formation of alliances and the adoption of technology based products and processes.

In addition, in 2004, the BOI exempted import tariffs from wafer fabrication enterprises, though there has been no relocation of foreign wafer fabrication plants to Thailand. This is because wafer fabrication is highly capital-intensive and involves upfront capital investment. The lack of research universities and grants to attract such activities are the main reasons why wafer fabrication has yet to emerge in Thailand (Rasiah, Yap and Yap, 2015). Hence, labour-intensive operations, such as disk drive assembly, still dominate Thai production of electronics for export.

Collaborative partnerships for R&D initiatives

The lack of adequate supply of technical and engineering human capital, the absence of R&D grants to stimulate designing and R&D, and the lack of electronics-based research in universities and other laboratories began to drive American chip manufacturing from Thailand in the 1980s (Rasiah, 2009). Thailand became a major platform for the assembly and test of automotive-based integrated circuit design, and industrial and consumer electronics products and disk drives from the late 1980s.

Nevertheless, substantial technological upgrading from acquisitions by MNEs and learning by doing have enabled improvements in process technology in Thailand (Hobday and Rush, 2007). In addition, some amount of design, including in integrated circuit-related automotive systems, has emerged in Thailand as some MNEs have established collaborative links with Chulalongkorn University, King Mongkut University of Technology, Ladkrabang and Chiang Mai University (Patarapong, Chairatana and Chayanajit, 2015).

The founding of the Hard Disk Drive Institute (HDDI) helped provide scientific infrastructure for the hard disk drive industry by establishing a central laboratory and a networks of government laboratories. The Institute was created with strong support from hard disk drive manufacturers and it functioned well as a resource provider and a broker because it kept pace with rapidly changing technologies in manufacturing. However, the actual impact of the HDDI seems modest (Intarakumnerd and Chaoroenporn, 2013).

Technological uptake in E&E MNEs and national enterprises

Both MNEs and national contract manufacturing electronics enterprises still operate in Thailand. Although MNEs in Thailand prefer to use the capabilities of their parent locations for core R&D activities in the electronics industry, they are engaged in intensive incremental engineering activities, including design (Hobday and Rush, 2007). For example, Seagate, which employed 16,400 people in Thailand in 2015, can design and re-engineer machinery and equipment in the subsidiaries in Thailand (Temphairojana, 2015). Other players, such as Toshiba Semiconductor Thailand, participate in incremental engineering activities.

Thai national enterprises, including Hana Microelectronics, Stars Microelectronics Thailand and Silicon Craft Technology, began designing customised integrated circuit packaging (Patarapong, Chairatana and Chayanajit, 2015, p.14). Hana Microelectronics acquired the Ohio (United States) factory of S-Vision in 1999, which provided the enterprise with the technology and facilities to assemble the “video monitor on a chip” for reflective “liquid crystal on silicon” micro displays (UNCTAD, 2005, p. 24). This allowed Hana Microelectronics to produce micro displays, which have a high potential as a key component in large-screen television and computer monitors, multimedia projectors, viewfinders for digital and video cameras, video headsets and handheld devices.

Hana Microelectronics and Stars Microelectronics Thailand have also evolved capabilities to train their suppliers and recent graduates from Thai universities. National enterprises have also established innovation research linkages with Thai universities to support improved enterprise performance through the National Electronics and Computer Technology Center, though the scale of their support is not comparable to the synergies evolved in Taiwan, China. Interviews with a Thai expert from a national enterprise showed that E&E enterprises in Thailand are lagging behind the Republic of Korea and Taiwan, China because of the lack of cutting edge R&D facilities in the country.[29] Indeed, research conducted in Thai universities is not at the technological frontier of electronics innovation.

3.2.3 Viet Nam

While several advanced integrated circuit enterprises, such as Intel, relocated operations to Viet Nam, the bulk of E&E enterprises in the country have remained in labour-intensive activities. In particular mobile phone assembly in Viet Nam has expanded since 2013. Big international players such as Samsung and Nokia have relocated their mobile phone production from China to Viet Nam. In 2015, LG Electronics announced plans to relocate its television factory from Thailand to Viet Nam (Reuters, 2015). The primary motivation driving these relocations was to benefit from scale advantages, to access Viet Nam's large and low-cost but well-educated workforce and take advantage of a number of government investment incentive measures (Armstrong, 2011).

Even though Viet Nam is ASEAN's fourth largest exporter of electronics products (after Singapore, Malaysia and Thailand), the electronics sector in Viet Nam is confined to final assembly production. High-technology products such as microprocessors and mobile phones are produced mainly by foreign-invested enterprises, such as Intel and Samsung. In fact, Samsung produces 50 per cent of its mobile phones in Viet Nam (Jin-young, 2015). Mobile phones and associated items accounted for 67 per cent of Viet Nam's E&E exports in 2014, which contributed to 16 per cent of total national exports.

Government support

The National Technology Innovation Fund (NATIF) was founded in 2011. NATIF lends capital for R&D and to pursue scientific and technological projects proposed by enterprises or individuals (NATIF, 2015). According to the Minister for Science and Technology NATIF aims at "supporting Vietnamese businesses renovate their technologies so that they can compete with foreign businesses" and focuses on providing funding for the high technology sector, information technology, new material technology, biotechnology and automation technology (Viet Nam News, 2015). Moreover, it also supports enterprises by lifting tariffs and commercial barriers.

Since its establishment, with an initial capital of US$47 million, NATIF has supported the scientific community and enterprises developing new products and improving productivity. Through these efforts, NATIF ultimately enhances both the added value of the manufacturing and services industries and the competitiveness of the Vietnamese economy. In 2015, there were about 80 proposals for financial support from enterprises, institutions and individuals totalling about US$14 million.

29 Interview in Bangkok, Dec. 2015.

Weak linkages between foreign and domestic enterprises

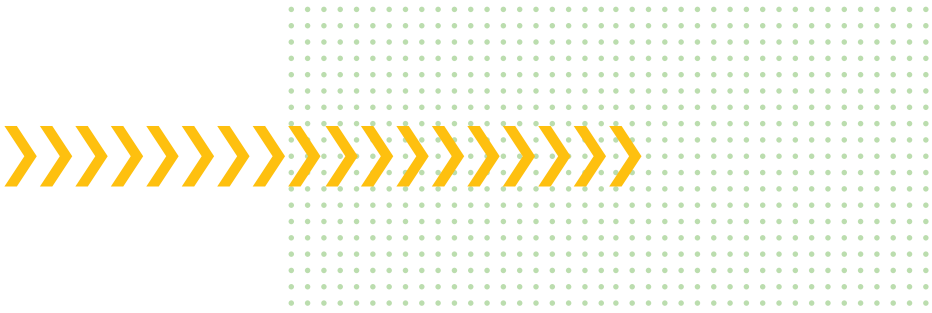
Linkages between foreign-invested enterprises and domestic enterprises are limited. Less than 10 per cent of the domestic inputs of these enterprises come from Vietnamese enterprises, while none of these inputs are electronics-based. Local procurement is dominated by low value-added inputs, such as carton boxes and packaging material. Research has already indicated this weakness in the industrial structure of Viet Nam (Ohno, 2009). Interviews with domestic electronics enterprises show that weak technological capabilities have inhibited the capacity of local enterprises to increase supplies to foreign electronics enterprises. Since its establishment in 2002, the Saigon Hi-Tech Park has attracted 90 projects from global corporations, including Intel, Samsung, Canon, LG, and Panasonic. In the late 2000s, the Government offered tax breaks to these enterprises with the hope that their operations would stimulate linkages with local enterprises, but this has not had a significant impact on local procurement (Saigon Giaiphong, 2016).

Among national enterprises, Viettronics Binh Hoa Joint Stock Company (VBH) was established in 1979 as a state-owned enterprise. Until 1986, the company produced resistors, capacitors ceramic caps using technology transferred from European companies. VBH specialized in the assembly of products using imported inputs and its export markets were mainly Eastern European countries. From 1991, VBH switched to assembling transformers and electronic modules for audio video products for the Vietnamese market. VBH cooperated with the Japanese TDK-Lambda Corporation and its production technology for PCB was upgraded using "through-hole mounting" and "surface mounting" methods.

Competition from technologically superior Korean and Japanese enterprises has significantly reduced VBH's competitiveness.[30] Nevertheless, the Government has supported the technological upgrading of national enterprises. VBH is eligible for financial support of up to 30 per cent of total investment from NATIF and it aims to upgrade technology in transformer and microchip production processes.

LED chip technology and skills improvement

United VietMy Photonic Technology R&D Co. Ltd is a Vietnamese E&E enterprise located in Saigon Hi-Tech Park. It produces high-power LED chips for both export and domestic markets. According to the director of the enterprise, the LED chip is considered a high-technology product in Viet Nam, although it is no longer at the technological frontier. With institutional support from the local government for R&D activities, United VietMy Photonic Technology undertook a US$3 million upgrade to produce LED chips (Pham and Stoler, 2009).



30 According to Mr Nguyen Van Thanh, director of VBH, under the high rate of technological change in the world's electronics market the mean of life circle of a new technology is about 10 years. Hence, the profit from new products should enough to cover the depreciation of the initial investment.

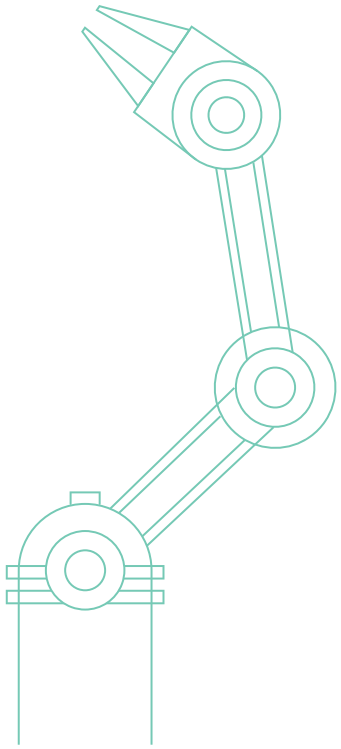
3.3 Automotive sector

3.3.1 Malaysia[31]

Technological uptake of Malaysia's flagship vehicle

Unlike in the rubber industry and, to a lesser degree, the electronics industry, technological upgrading in the Malaysian automotive industry has been disappointing. The core fact is that the Malaysian-controlled automobile industry "has not become internationally competitive" (Wad and Govindaraju, 2011, p. 154), due in part to the performance of the country's National Car Project, Proton, which has been the dominant force in sharping the sector's technological competencies. Although the National Car Project has generated local employment and enhanced pride of national ownership, it also produced weak local parts manufacturers, trade deficits in automotive products and, most critically for present purposes, a "lack of technological development" (Wad and Govindaraju, 2011, p. 167).

Proton was central to the Government's goal of establishing core industrial capacities, initiated in the 1980s with the creation of a state-owned heavy industries corporation. This strategy was part of a policy modelled on the Republic of Korea's experience. But Proton's competitiveness, as reflected in export performance, has not substantially improved. With a domestic car market of just over 500,000 vehicles, less than half of that of the Republic of Korea and under 3 per cent of that of China, the prospects of attaining economies of scale depended upon success in penetrating export markets. Yet in 2011, over 20 years after beginning production, export sales were less than 25,000 vehicles, not substantially higher than when Proton began exporting in 1989. Two years later, they had collapsed to one tenth of that value. In comparison, by 1986, ten years after Korean car maker Hyundai launched its flagship vehicle, the Pony, exports exceeded 150,000 vehicles. Capacity use in assembly plants in Malaysia at the end of the 2010 was only slightly over 50 per cent, below the international average of 70 per cent. Proton never was able to overcome negative associations with obsolete technology and quality problems. While R&D as percentages of sales is comparable to other auto producers, Proton's small sales value means that its absolute investment in R&D is insufficient to keep pace with other producers.



Proton's weaknesses spilled over to the country's parts suppliers, especially the *bumiputera* (ethnic Malay) enterprises that Proton was designed in part to nurture. Under government requirements, Proton established its own supplier network rather than taking advantage of the capacity of existing producers, most of which were owned by ethnic Chinese. Further, in the mid-1990s, Proton decentralized parts procurement with the goal of involving vendors more closely with platform design. This might have helped nurture the capacities of new component enterprises, but Proton appointed different enterprises to supply the same component for different models which led to a proliferation of vendors. This excess, which ran counter to the trend of supplier consolidation in the global auto industry, took place as Proton's market share and production volume were shrinking. Finally, government protection has persisted despite the need to comply with tariff reductions under the ASEAN Free Trade Agreement, and this too has discouraged the improvement in supplier technology. A shifting combination of tariffs, excise taxes and restrictions on automobile import licenses allowed Proton to operate without meeting foreign competition and without requiring improved technology and efficiency from its suppliers.[32]

31 Unless otherwise noted, this section is drawn from a economy of East Asian automotive industries by Doner, Noble and Ravenhill (forthcoming).

32 Tariffs were to be cut to 20 per cent by 2002 under ASEAN Free Trade Agreement, but the Government successfully received ASEAN approval to exempt the industry from these cuts until 2005.

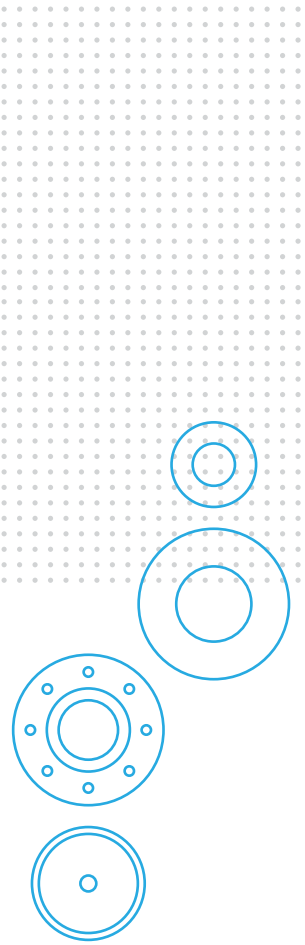
Challenges

Efforts to improve technology in the Malaysian automotive industry must address several related sets of challenges. One is protection. Although tariff protection has declined as a result of pressure from ASEAN trading partners, bilateral trade partners, especially Japan, the World Trade Organization and domestic consumers frustrated over high prices and low quality, other forms of protection have persisted as noted above.

A second obstacle involves the lack of incentives for foreign assemblers and parts producers. With foreign ownership limited to 51 per cent at least until 2003, a small domestic market, weak exports and high excess capacity, and other measures favouring domestic producers, foreign enterprises have tended to favour Thailand and more recently Indonesia over Malaysia as a base for regional production. As a result, foreign sources of new technology are limited. A third problem is the weakness of technology-promoting institutions devoted to the auto industry. In contrast to the strength of research organizations in agriculture and commodities, such as rubber, the Government established the Malaysian Automotive Institute (MAI) in 2010, almost 25 years after Proton began producing cars, to improve the industry's overall competitiveness.

A fourth set of challenges involve state officials and their ties to key private actors, which result in a lack of automotive expertise within key government agencies, such as the Ministry of International Trade and Industry (MITI), and centralization of decision-making within the Prime Minister's office. Underlying the latter set of challenges is the broader political issue of ethnic preferences. The National Car Project was, at its core, an effort to nurture *bumiputera* economic interests. Regardless of claims to the contrary, the project's technological benefits were secondary. This is reflected in the contrast with the experience of the Republic of Korea, because "the Malaysian Government saw exporting in terms of utilizing surplus capacity rather than as a means of forcing the domestic company into internationally competitive levels of efficiency" (Doner, Noble and Ravenhill, forthcoming).

Finally, underlying the Government's willingness and ability to protect the National Car Project was its access to commodity, especially oil revenues. The Project was initiated in a period of rising commodity prices. And in 2000, after a short period of privatization that left Proton with insufficient resources, Proton sold an almost 44 per cent stake to Petronas (the state-owned oil company) and Khazanah (the Government's investment arm).



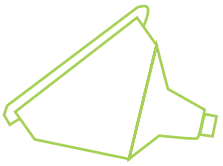
3.3.2 Thailand

Technological uptake

The technology and performance requirements of parts and components have increased. First, the powertrain and components of vehicles have undergone ever-higher levels of electrification. Second, demands for greater fuel efficiency have translated into a demand for new, lighter weight materials. Finally, manufacturing and assembly processes have become increasingly automated, which was illustrated by the fact that Thailand ranked eighth worldwide in robot consumption in 2014.

The same conditions of increasingly stringent product and process requirements also impacts supporting industries. Thailand's long history of automotive industrialization resulted in large numbers of mould and die operations, but as of 2007 less than 5 per cent of them had the personnel and equipment necessary to meet the industry's export requirements. The weakness of local mould and die production is also reflected in a trade deficit that grew significantly with the expansion of vehicle exports, a problem that industry participants expect to grow as Chinese imports enter the market. The status of local capacity to produce capital equipment does not look any better.

This has a number of implications for local parts producers and workers. It means that only the most capable – and typically the largest – can play. This is reflected in: 1) the high level of consolidation among global parts and components producers; and 2) the increasing tendency for assemblers to encourage colocation by "follow sources," specifically the components producers with whom they have cooperated around the world. It also means that, at best, "opportunities for locally owned component manufacturers are largely confined to the second tier" of such producers. But even in lower-tier and aftermarket segments, the pressures for cost reduction, standard product quality and quick delivery translate into the need for process innovation and basic engineering skills.



Challenges

There is a growing concern within the Thai automotive sector that Thai enterprises will not survive, much less grow, given the industry's growing product and process requirements. The Federation of Thai Industries (FTI) has lamented the fact that the country's workforce cannot "adjust to the pace of change in production technologies"; that Thailand can no longer enjoy the advantage of cheap labour in the face of competition from Viet Nam; that Thai enterprises are unable even to test their products; and that in the face of these conditions, Thailand must improve skills and standards. [33]

The Thai-based auto assemblers and component producers have complained of shortages of technical personnel for over a decade. In fact, a 2007 survey of enterprises in eight sectors found that auto parts enterprises were the only ones to assess the shortage of skilled workers as more important than the shortage of unskilled workers. In 2013, a Thailand Automotive Institute (TAI) official said that the auto industry faced a manpower shortage of roughly 900,000 workers. As part of its successful efforts in the mid-1990s to encourage General Motors to set up operations in Thailand rather than the Philippines, the Thai Government committed itself to establishing a US$15 million automotive training institute, but it was never implemented.

Other efforts include automotive degree programmes initiated by three universities. The impact of these programmes has been limited by their relatively small scale, a lack of emphasis on process and incremental R&D, a lack of incentives for engineers to emphasize technology as opposed to administration and to develop innovative curricula relevant to industry needs. In addition, some technical institutes have attempted to transform themselves into degree-granting institutions.

33 The following is drawn from Thavorn (2015a) and (2015b).

The shortage of technicians has been addressed by the Japanese in cooperation with TAI, one of ten sectoral institutes established under the Ministry of Industry. From 2003 to 2005, the industry initiated the "Skill Certification System for the Automotive Industry". This was followed between 2006 and 2011 by the Automotive Human Resources Development Programme, designed to expand the supply of trained personnel in basic operations competencies based on particular areas of expertise of Toyota, Honda, Nissan and Denso. In 2012, the industry extended this effort in the form of the Automotive Human Resources Institute Project to expand the number of trainers in value analysis and value engineering, materials testing and basic manufacturing. These programmes led to an increase in the number of trainers and trained personnel, as well as improvements in quality and productivity in over 200 small and medium-sized enterprises.

But Japanese, not Thai enterprises, were the core of these efforts, and the continued need for technical training was reflected in prominence of training in the TAI Automotive Master Plans. Although the Thai Auto-Parts Manufacturers Association (TAPMA) contributed to both these plans and the two automotive human resource development projects, its relationship to the TAI and the programmes was not central. One indication of the relative lack of local role in the automotive human resources development projects is the fact that an evaluation of the programme was not conducted, at least to the knowledge of former and present TAI leaders.[34]

3.3.3 Viet Nam

Scarce technological uptake

For many years, the Vietnamese automobile industry has benefited from various protectionist measures. Between 1991 and 2005, tariffs on imported cars remained at 100 per cent whereas tariff rates on imported component and parts ranged only from 5 to 25 per cent. Despite government policies protecting domestic automotive manufacturers, over 90 per cent automotive parts and components are still imported (Truong and Nguyen, 2011). The Government targets of 40 and 60 per cent of domestic procurement in 2005 and 2010, respectively, were not achieved.

Researchers have indicated that Viet Nam's industrial structure is weak due to the lack of local support to enterprises across several sectors, including the automotive sector (Ohno, 2009). There are 18 foreign automobile manufacturers recognized as leading global enterprises,[35] however, there are only 33 direct suppliers and 181 sub-direct suppliers engaged in parts and components manufacturing (compared to 709 direct suppliers and 1,100 sub-direct suppliers in Thailand). Indeed, the remaining 10 per cent of domestic procurement is limited to simple and low value-added inputs, such as auto-carpets, car-seats and tyres. Most local procurement is controlled by foreign enterprises, such as Japanese and Korean suppliers, who established their production in Viet Nam through foreign invested enterprises or joint-ventures with local enterprises.

Since most auto parts are imported and the automotive sector is dominated by foreign companies, the decision to upgrade technology is not taken by Vietnamese stakeholders.[36] Instead, the parent company is the decision-maker. Product innovations, if any, are performed internationally rather than domestically, while the participation of automobile manufacturers in Viet Nam is limited to labour-intensive and low-value added production.

34 Interviews with TAI officials, Nov. 2015.

35 These foreign manufacturers include Toyota, Honda, Mitsubishi, Mazda, Suzuki, Isuzu, Kia, Hyundai, Daewoo, Mercedes, BMW and General Motors, among others.

36 Interview, Dec. 2015.

The technology, hence, is limited to assembling automobiles, arranging frames (by folding, rolling or pressing steel plates), painting and so on. Some enterprises have used robots in their assembly lines but apart from initial setup, there have not been any technological changes in the last ten years. Interviews with Toyota and Honda (Viet Nam) confirm that technological changes happen slowly and as a result skilled workers and technicians are not in demand. In fact, these enterprises reported conducting training sessions on other issues than technology just once after employees were recruited.

There are, however, a few cases of Vietnamese owned automotive companies which have successfully upgraded technology and are now dominant players in the Vietnamese automotive economy. For example, Thaco has a market share of 32 per cent and is the second largest automobile manufacturer in Viet Nam. Established in 2000, Thaco now produces its own automobiles, buses and trucks and is qualified to manufacture leading branded cars such as KIA, Mazda and Peugeot (CafeF, 2012). The Government has played an important role in Thaco's success by providing tax exemptions on imports of machineries, equipment and construction materials.

Challenges to technological upgrades

Given the protectionist context in Viet Nam and the fact that just 10 per cent of auto parts and components are produced domestically. The Vietnamese automotive industry encounters challenges that restrict technological upgrade or limit its ability to adapt to technological upgrades.

Firstly, upgrading in Vietnamese automobile enterprises depends on the local market orientation. Protectionist taxes on imported cars mean that most cars produced in Viet Nam are sold domestically. Interviews with Japanese and Korean automotive manufacturers (Toyota, Honda, Hyundai) reveal that economies of scale are restricted due to the relatively small size of the Vietnamese market. This is because production costs in Viet Nam are relatively high compared to Thailand or Malaysia.

Secondly, opportunities for technological upgrade in local supporting industries have been limited. To avoid high production costs, most of the automobile manufacturers have limited the application of advance technologies on new car models. Low volume as well as less complex and sophisticated product specifications diminished the level of technological upgrade of automotive supporting industries like rubber and plastic.

Thirdly, the Government has attracted big automotive manufacturers to Viet Nam in the last 20 years by providing incentives, but these have not contributed to the development of production linkages with local suppliers. Interviews with Toyota Viet Nam Ltd, show that the company had strong incentives to maintain relationships with its non-Vietnamese suppliers. The domestically produced spare parts or components, such as car chairs, are usually produced by foreign invested enterprises of transitional suppliers.

Finally, it is unclear whether government polices favour expansion of domestic car acquisition in Viet Nam. The Government set up a national target to improve the share of local components in cars manufactured in Viet Nam through import-substitution measures, but also established unfavourable policies to limit domestic acquisition of automobiles. In order to buy a new car, customers have to pay for inspection, road maintenance, registration and insurance, among others, that total about 15 per cent of the price of the car. In fact, the cost to own a car in Viet Nam more than doubles the cost in Thailand. As a consequence, production volume of automotive manufacturers has not increased.

3.4 Conclusions

3.4.1 Rubber

- Thailand dominates upstream segment of rubber production and Viet Nam primarily produces rubber in this segment as well. This segment is the simplest method of cultivation and poses minor technological challenges. Farmers must have sufficient agricultural knowledge to select adequate fertilizer and use it correctly, master efficient tapping techniques and manage pests and diseases, among others.

- Malaysia is strong in the downstream segment, in which rubber is primarily destined for exports (tyres, medical gloves, etc.) and therefore meets global standards. Malaysia also produces rubber in the midstream and upstream segments.

- Malaysia has led the development of most technology innovations in rubber production. In the upstream segment, for example, Malaysia created the Automatic Rubber Tapping System and Low-Intensity Tapping System, which aim to increase productivity by automating processes and reducing the number of workers and tapping time. In the midstream segment, it created TSR to improve quality control, and facilitate storage and transport. In the downstream segment, it developed natural rubber bearings for earthquake protection, and allergy-free latex gloves.

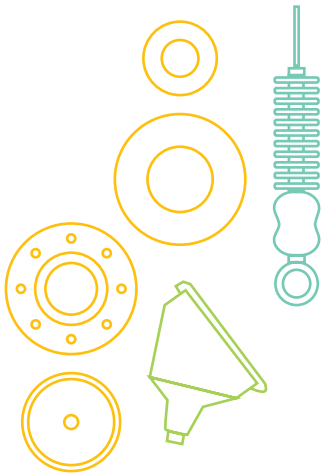
3.4.2 E&E

- In Malaysia, the E&E sector had two contrasting experiences. On the one hand, the Government actively supported R&D and knowledge intensive activities, which increased the need for technical and statistical skills. On the other hand, Malaysia's lack of adequate human capital policies expanded low value-added E&E production and prompted the relocation of high value-added production out of the country.

- In Thailand, the BOI played an important role in attracting E&E foreign investment and promoting E&E innovation through tax exemptions, subsidies and research grants. The Government led the founding of HDDI, which provides scientific infrastructure for the industry through a network of laboratories. Thailand, however, has not managed to address structural challenges related to skills development, and lack of human capital and technical knowledge. Indeed, even with the generous grants from the BOI, the R&D conducted in Thailand is not at the technological frontier of electronics innovation.

- Viet Nam has attracted major foreign E&E players such as Intel, Samsung and Nokia, due to its large and low-cost workforce that acts as a driver of labour-intensive production. In this context, Viet Nam faces two main challenges: despite establishing NATIF as a way to enhance competitiveness in the E&E sector, investment in R&D is low; the Vietnamese E&E sector is dominated by foreign companies who have limited links with domestic suppliers.

- Automation and robotics are increasing across the E&E sector incrementally, and will continue to do so, and low-skilled workers will be required less and less as robots become more efficient and advanced. Eventually these workers will be at risk of displacement.



- The failure of governments in the region to invest sustainably and innovatively in skills and education polices will result in foreign direct investments going to other countries. To scale up the value chain, investment is needed in the fields of science and technology in related electronics specializations and frontier research. Science parks (for incubation) and research universities (for basic R&D) are important corollaries to support new generation technologies that can spur new cycles of innovation.

- Competing on price (for example, low wages), has been a useful investment and development strategy. However, it is not a sustainable one. The calculus has changed. Policy-makers need to look through a longer term development lens, especially for skills and education.

3.4.3 Automotive

- The automotive sector in the three countries will continue to see increased adoption of automation. Advancements such as electrification and fuel efficiency will become a greater consideration for automotive manufacturing in ASEAN Member Countries.

- To remain competitive, enterprises in these sector will need to seek collaborative opportunities with OEMs to accelerate the integration of advanced automotive technologies. Equally important will be investing in the capacity development of local auto makers (for example, second-tier and third-tier suppliers) and strengthening their market position and competitiveness to ensure sustained domestic growth.

- In Thailand, there is growing concern about the ability of national enterprises to adopt new technologies due to skill shortages. There have been attempts to enlarge the pool of technicians, engineers through government-led trainings and university degree programmes. Nevertheless, these programmes have not eliminated the human capital shortages in the Thai E&E sector, due to their relatively small scale, lack of emphasis on R&D applied to processes (not only products) and overall lack of innovative processes which do not match industry needs.

- In Viet Nam, the automotive sector is dominated by foreign players who have limited links with local suppliers. In fact, technological upgrade in the Vietnamese automotive sector is not led by domestic enterprises, rather it depends on decisions of foreign players who generally are not interested in creating technological partnerships with Vietnamese enterprises.

- 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 is imperative for the sector to have stronger strategic alliances with education and vocational training institutions so that the incoming workforce has relevant skills. The role of Government and incentives are equally important to build skills and encourage investment in specific areas – for example developing an infrastructure for electric vehicles 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 for automotive and electronics.

THE ROLE AND ABILITY OF SBAS IN DRIVING TECHNOLOGY UPTAKE, ECONOMIC DEVELOPMENT AND EMPLOYMENT GROWTH

SBAs have played important roles in stimulating connectivity and coordination between enterprises, organizations and government agencies in Malaysia, Thailand and Viet Nam. Their role is critical as they help enterprises address a wide range of issues in general, and those related to the provision of public goods (Rasiah, 2007). However, problems of information imperfections and asymmetries have often reproduced a lack of connectivity and coordination for the establishment of organizations and links between them and enterprises. Researchers have articulated this role well in different industries to demonstrate that co-location does not guarantee the creation and appropriation of collective action synergies (Ganiatsos, Ernst and Mytelka, 1998; Deyo, Hershberg and Doner, 2001; Rasiah, 2007). SBAs established to support the interests of members can play a major role in stimulating connectivity and coordination between enterprises, and organizations and government agencies in order to drive technology, economic development and employment growth in their sectors. Hence, this section examines the role that SBAs have played in driving these changes in the rubber, E&E and automotive sectors in Malaysia, Thailand and Viet Nam.

4.1 Rubber SBAs

SBAs in the Malaysian and Thai rubber sectors are both are concerned with national standards, but they differ in two important and related ways. First, Malaysian downstream SBAs are distinctly stronger than their Thai counterparts. Second, Malaysian SBAs are much more engaged with productivity and technology issues. These differences reflect two critical factors: the institutional context in which the SBAs operate; and the broader pressures on political leaders with regard to the relative importance of upgrading.

4.1.1 MARGMA

Supporting and strengthening the development of the rubber industry

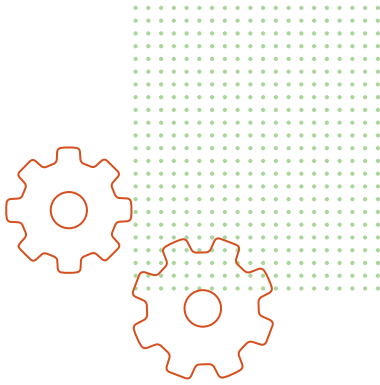
MARGMA was established in 1989 and has 53 ‘ordinary’ members, including actual glove producers, and 100 ‘associate’ members ranging from raw material suppliers to equipment producers. In the words the association’s leaders, ordinary members constitute part of an efficient ecosystem within which glove producers operate. Given Malaysia’s position as the largest producer of rubber gloves in the world, it is not surprising that MARGMA is influential.

MARGMA has been involved in a wide variety of activities to strengthen the sector, including design and R&D initiatives backed up by efforts to establish standards and support continuous improvement in testing and research (table 2). The association advocates to expand investment incentives and improve access to natural gas and other resources. It widens upstream-downstream and horizontal linkages by offering association membership to equipment manufacturers and supporting the growth and certification of local suppliers of high-quality latex. MARGMA has also focused on reducing reliance on imported, mostly Thai, latex by strengthening and certifying domestic sources of this critical input. Moreover, MARGMA also supports the strengthening of testing capacities, through certification of testing equipment and improved testing of chemical penetration.

Table 2. Concrete functions, activities and partners of MARGMA

Functions	Activities	Partners
Investment incentives	Advocate to ensure extension and expansion of investment incentives	-
"Hard" Infrastructure -hard (e.g. roads, power, energy)	Promote improved access to natural gas; encourage development of solar	Tripartite negotiations with government agency and gas producers
Market development (e.g. trade fairs, trade negotiations)	Organize large-scale, biannual conferences; gathers market / production data	MRB; Malaysian Rubber Export Promotion Council (MREPC); relevant ministries
Upstream-downstream and horizontal linkages (i.e. ensure stable supply of raw materials, intermediates; strengthen links with capital equipment producers) downstream)	Support expansion and certification of local supplies of high-quality latex; incorporate equipment producers as association members	MRB; multiple ministries via the Performance Management and Delivery Unit (PEMANDU)
Labour: Migration management	Advocate and work to ensure access to migrant labour	MRB
Design, R&D	1. Facilitate improvement of glove production process to address challenge of latex allergies 2. Promote and support genetic research on latex proteins 3. Promote new product development (e.g. insulated gloves for electricians) 4. Promote research on accelerator-free nitrile gloves	1. MRB 2. MRB; MREPC 3. MRB 4. MRB
"Quality" infrastructure (standards, testing)	1. Establish Standard Malaysian Glove 2. Advocate for strengthening of testing capacities, e.g. through certification of testing equipment, improved testing of chemical penetration	1. MREPC; MRB 2. Member of MRB Joint Technical Committee

Overcoming latex allergies and setting new rubber standards



Two MARGMA activities merit more attention owing to their impact on the sector. The first involves the association's contribution to overcoming the challenge of latex allergies. The market for rubber gloves expanded as a result of the HIV/AIDS epidemic in the 1980s and then almost collapsed at the end of that decade. The expansion initially involved the shift of glove production to Malaysia by MNEs; but after several years foreign enterprises were replaced by a large number of local enterprises. In the late 1980s, the industry was threatened by an outbreak of allergies to latex proteins. This triggered the establishment of MARGMA which began working closely with MRB.

MARGMA and MRB focused on reducing the protein content in the latex. This began with studies of proteins and allergies in conjunction with medical researchers in Finland where some of the earliest studies on protein allergies had been conducted. The process then expanded to developing and testing new approaches to latex and glove production, which involved obtaining and adapting assembly lines from Taiwan, China. As these lines were unsuitable for high-quality production, MARGMA worked with equipment fabricators and MRB pilot lines and testing facilities in a combination of process and product innovation and in cooperation with enterprises that allowed their facilities to be used for testing.

MARGMA also led the creation of a new "Standard Malaysian Glove", akin to a similar standard for locally produced block rubber, designed to distinguish Malaysian products from lower-quality competitors, especially from China. MARGMA was compelled to navigate successfully among its members who supported the Standard Malaysian Glove and those who had failed the certification requirements. Although not all producers have signed on to the Standard Malaysian Glove programme, it has largely succeeded as reflected in the fact that the standards have undergone their third revision. This comprised the entire certification and testing process governed by a joint technical committee, involving the MRB and MARGMA, along with the Malaysia Rubber Products Manufacturers' Association (MRPMA) and the Malaysia Rubber Export Products Council (MREPC).

4.1.2 MRPMA

Supporting and strengthening the development of the rubber industry

MRPMA was established in the early 1950s and has 67 ordinary members and 29 associate members,[37] including producers of equipment, chemicals and compounds. Like MARGMA, the MRPMA recognizes that small and medium-sized enterprises are key to improving the overall value chain and linking rubber parts producers with related sectors, especially automotive. Indeed, a key motivating factor for the MRPMA is the need for Malaysia's rubber industry to diversify its product mix and reduce its heavy reliance on glove exports. This is exemplified by the association's efforts to support the production of new industrial rubber products, such as the seismic bearings discussed in section 3.1. Table 3 sumarises MRPMA's functions, specific activities and partners, through which it supports its members and the development of the Malaysian rubber industry.

37 Information for this section is drawn from the MRPMA 2014; and interviews with MRPMA officials, 17 and 23 Nov. 2015; officials of the Malaysian Automotive Components and Parts Manufacturers Association (MACPMA) July 2012 and 17 Nov. 2015.

Although most of its members are users of dry or hard rubber, the group has established a subcommittee devoted to condom producers that focuses on developing national standards for imported items. A second subcommittee serves to support compounders and the large number of local tyre enterprises, mostly retreaters, who required the establishment and enforcement of standards to protect the market from low-quality imported products.[38] A third subcommittee aims to strengthen linkages with automobile assemblers and suppliers, many of whom use rubber-based products. Part of this effort focuses on coordinating with MAI to establish testing and research facilities to help producers of rubber parts develop the capacity to produce modular parts that require combining rubber with metal and other materials.

The improvement of testing capacities is an especially important focus. In addition to the need for testing of automotive components, the MRPMA is actively pursuing improvement of testing equipment for large seismic bearings. The MRB itself has been able to meet some of these needs, but a larger, much more expensive press is now needed. The association has pushed, so far unsuccessfully, to establish a seismic testing centre within the largest member enterprises. The centre's equipment would be financed in part by the MRB and would serve the entire industry.

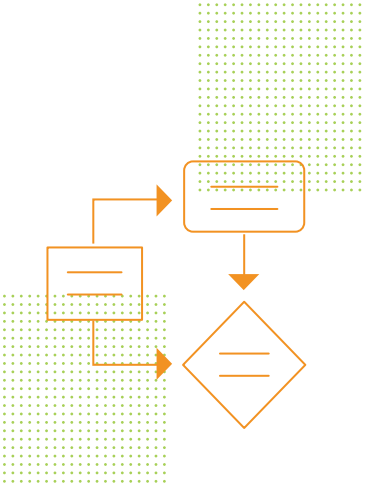


Table 3. Concrete functions, activities and partners of MARPA

Functions	Activities	Partners
Investment incentives	Promote extension and expansion of investment incentives	-
Market development (e.g. trade fairs, trade negotiations)	Organize export / marketing trips	MRB; MALCORP
Upstream-downstream and horizontal linkages (i.e. ensure stable supply of raw materials, intermediates; strengthen links with capital equipment producers) downstream)	Offer membership to suppliers of chemicals, compounds and equipment.	-
Labour: technical and vocational training	Organize training, especially on compounding, mixing, extrusion, injection moulding	Some (minimal) links with local universities.
Labour: Migration management	Encourage adequate migrant labour supply	-
Design, R&D	1. Encourage development of seismic bearings through improved testing 2. Expand production of rubber-based auto parts to meet needs of modular components	1. MRB 2. MRB; MAI

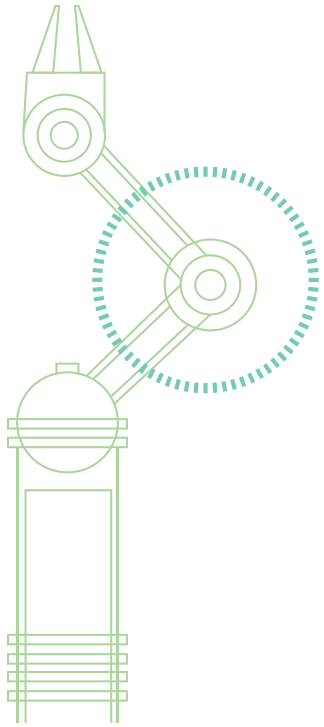
38 Large glove enterprises are backed by the MREPC which is funded in part by a 0.5 per cent MRB on rubber product exports. Because the smaller tyre enterprises are not included in the MRB, they lack the broader support of the MREPC. To address this, the MRPMA worked with the Ministry of Land Transport to monitor and enforce standards on imported goods.

Functions	Activities	Partners
"Quality" infrastructure (standards, testing)	1. Advocate to establish and enforce standards for condoms, retreated tyres, automotive products, seismic products 2. Support strengthening of testing capacities in both MRB and through establishment of a "king" – national testing centre within large private enterprise	1. MREPC; MRB; SIRIM 2. MRB
Environmental standards (and reputational risk	Reduce pollutants (e.g. Zinc effluents)	Tripartite committee of MRB, MREPC, MITI

4.1.3 MARGMA and MRPMA: Facilitating work for foreign migrant workers

Both MARGMA and MRPMA have worked with the Government to better facilitate the migration process as access to labour has remained a problem.[39] In addition to a diversified migrant labour force (safety instructions have to be printed in multiple languages), MRPMA's enterprises also suffer from a lack of well-trained local supervisory and technical workers. MRPMA has responded to these challenges by working to stabilize migration requirements, support automation and organize collective and on-the-job training sessions for shop floor and supervisory employees, often led by retired supervisors. In addition, MRPMA has established subcommittees that deal with technical issues. MARGMA aims to ensure its members have access to migrant workers and are able to reduce turnover.[40]

Both MARGMA and the MRPMA have provided workshops, but much of the training for technicians occurs on the job. Conversely, both SBAs have been heavily involved with the MRB and the MREPC in training to diffuse new innovations and have been quite active in developing curricula with the MRB. Nowadays, a lot of the training is in-house for glove producers, whereas in the past when the enterprises were smaller, training was more collective.



4.1.4 Thai Rubber Products Industry Club (RPIC): Maximizing productivity

The RPIC is the most active downstream association (and a member of the encompassing FTI).[41] Table 4 shows the functions and activities of the RPIC. Established in 1977, the RPIC has about 80 enterprises as members who produce hoses, conveyers, fenders and various types of tyres for both the original and the replacement market. The Malaysian SBA examples presented above contrast significantly with the emphasis of Thai authorities on NR as an export commodity. Indeed, the Rubber Research Institute of Thailand has suffered from budget shortfalls and, most critically, a shortage of technically qualified staff to replace those who retire.

39 Despite increasing automation, the size of the required labour force has remained relatively constant due to expansion of production (the largest enterprise now runs 16 production lines).

40 Interviews with MARGMA officials, Nov. 2015.

41 Information on the RPIC is drawn from interviews with association leaders in Nov. 2012 and 2015.

Table 4. Concrete functions, activities and partners of RPIC

Functions	Activities	Partners
Investment incentives	Advocate to access soft loans for equipment upgrading	Coordination with Thai Glove Manufacturers Association
Market development (e.g. trade fairs, trade negotiations)	Organize export / marketing trips	-
Labour: technical and vocational training	Provide limited, short-term training courses; linkages with university	Minimal links with local universities
Labour: Migration management	Advocate to Ministry for improved migration processes	-
Design, R&D	-	1. MRB 2. MRB; MAI
"Quality" infrastructure (standards, testing)	1. Promote the establishment and enforcement of national standards for tyres and related products 2. Advocate for strengthening of testing capacities, including test track	1. Thai Standards Agency; Ministry of Industry 2. Ministry of Industry – Office of Industrial Economics

The vibrant downstream sector in Thai rubber produces large volumes of condoms and rubber gloves. But these products are largely under the control of foreign producers who play little if any role in local associations, which to a certain extent contrasts with the Malaysian rubber SBAs. The largest and most powerful members of the Thai Rubber Glove Manufacturers' Association are joint ventures. The main focus of the group has been access to soft loans for equipment modernization. The Thai Condom Association is dominated by six MNEs. Finally, tyre producers are now represented by two groups, one of which, the Thai Automobile Tyre Manufacturers' Association, is dominated by foreign producers who split off from the older association over the imposition of national standards. Unlike local producers, the foreign enterprises opposed national standards as an obstacle to their ability to import tyres to complement Thai-based production.[42]

4.1.5 VRA

The VRA was established in 2004 and operates as a voluntary organization of enterprises in the Viet Nam rubber sector. VRA aims to assist in the business-related activities of its 143 members, protect its members' legal rights and contribute to the national development of the rubber sector (VRA, 2016). VRA provides recommendations to governmental agencies on strategies and policies to promote the rubber sector. According to interviews with the VRA, there are three critical factors that impact Viet Nam's NR yield, namely the varieties of rubber trees, effective cultivation techniques and methods of collection. The VRA has actively encouraged innovative cloning techniques, disease control, effective planting and improving rubber collection methods through different initiatives explained below.[43]

42 Information on these two associations is drawn from interviews with officials of the RPIC, Nov. 2015.

43 Interviews with VRA, Nov. 2015.

Building capacity on innovative cloning techniques

The VRA seeks to stimulate interactive learning between RRIV and other member institutions of the International Rubber Research and Development Board. RRIV conducts research projects on rubber cultivation, planting, soil nutrition and classification, fertilizer application, as well as management of diseases, insects and weeds. Annually, the VRA organizes scholar exchange trips for RRIV staff to join the R&D activities of rubber research institutions in Thailand, Malaysia, Indonesia and other laboratories throughout the world. These training sessions are available to International Rubber Research and Development Board participants and cover subjects such as innovative cloning, disease control and effective planting, among others. The VRA also invites members of International Rubber Research and Development Board to join the R&D projects of RRIV.

Partnerships between VRA, RRIV, educational institutions and universities create opportunities for interactive learning on agronomy, biotechnology, chemical technology and environmental engineering, and the division of labour. The VRA also coordinates with institutions/universities working on rubber research projects to organize training courses on cloning techniques, soil nutrition, crop protection, latex harvesting, quality control of natural rubber, wastewater treatment from rubber processing factories, among others.[44] Ho Chi Minh City University of Technology and Hanoi University of Industry support VRA's member to apply new chemical technology and environmental engineering.

Disseminating information on effective cultivation practices

Together with rubber clones, density of plantation is another factor that contributes to the high yield of NR cultivation in Viet Nam. According to the VRA, for years, the density of plantation of the Vietnamese's rubber farms has improved. That partly explains why the yield of Viet Nam's NR is among the largest in the world. The VRA regularly organizes consultation workshops for its members and local farmers to provide guidance on effective plantation methods.

The re-plantation cycle of the rubber tree is about 25 years, and this can be costly for farmers. However, domestic demand for rubber wood is increasing and the sale of timber could help to compensate farmers for the cost of re-plantation. The VRA could take on the role of networking to bridge local farmers and domestic wood manufacturers in Viet Nam, which would enhance performance in effective planting.

Promoting relatively innovative rubber collection methods

The manual method of collection has been used in Viet Nam for years, and tapping normally takes place in the morning when the internal pressure of the tree is high. This method enables collection from three hectares per day. In recent years, the RRIV developed a more productive method for rubber collection, in which a chemical is used to increase the internal pressure of the rubber tree, facilitating tapping and increasing productivity to six hectares per day. This method is similar to the Malaysian Low-Intensity Tapping System. According to the VRA, this new collection method could help rubber farms to increase wages of rubber workers. Considering that the global price of NR is declining, improving tappers' productivity and income could be a crucial factor to keep them in the rubber industry. Nevertheless, it is worth highlighting that

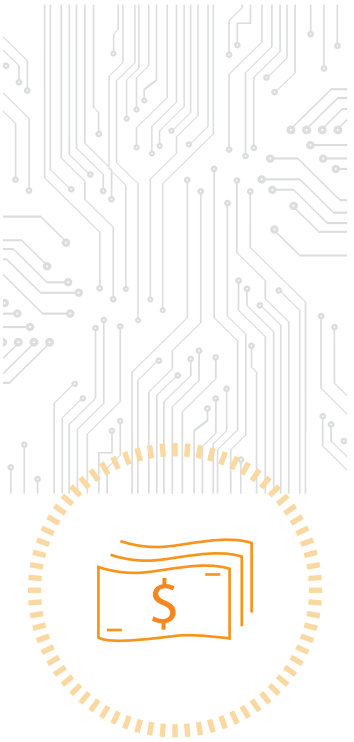
44 These universities include Tay Nguyen University, Hue University, Agriculture and Forestry University and University of Agriculture.

technology uptake in the Vietnamese rubber sector is less developed and innovative than that of Malaysia and Thailand.

Setting up research centres and disseminating rubber guidelines

The lack of public testing and research centres[45] has allowed smallholders, dealers and traders to misreport rubber quality. Large holders currently rely on their in-house testing services, which result in heterogeneous NR quality. Smallholders have no means of assuring the quality of their product. The VRA said that it has proposed to the Government to set up public testing and research centres, but the Government has postponed the establishment of such centres due to limited financial capacity. The VRA responded by proposing the establishment of a public testing and research facility in 2017.

Every three years, the Viet Nam Rubber Group in cooperation with the VRA issues guidelines for its members on species of rubber plantation as well as all disease control method and effective planting. This guideline must be strictly followed by all members of VRA, and non-members also greatly appreciate the guidelines. VRA also advises its members on international and minimum price levels. This information helps to strengthen farmers' incomes particularly when prices on the international market decline and induce famers to drop their prices.



Reducing the impact of international price volatility, export taxes and other unexpected shocks

In 2006, the VRA established the Viet Nam Rubber Export Insurance Fund (VREIF) in order to manage the risks involved in NR exports. Members voluntarily participate in the Fund, and contribute up to 1 per cent of their NR revenues to it. The fund aims to financially support VRA's members affected by unexpected calamities (pests, diseases, natural disasters) and export losses (VRA, 2016).

The establishment of the Fund was a timely financial initiative to reduce risks involved in rubber production and export activities of members, which became larger as global NR consumption declined with the tyre industry (Wenas, 2001). For example, in the first half of 2001, imports of tyres to the United States declined by 25 per cent compared to previous years. Moreover, the global financial crisis in 2008 impacted on the automotive and tyre industries. These external shocks reduced Viet Nam's NR export price between 2008 and 2009. Since 2010, global rubber consumption has sharply declined, which resulted in falling NR export prices in Viet Nam since 2012. As a consequence, although the volume of NR exports keeps rising, Viet Nam's NR export value declined 28 per cent in 2014.

According to, Mr Le Quang Thung, former president of the VRA, the first trial of the Fund happened when the world price of NR declined sharply from US$3,237 per tonne in July 2008 to US$1,494 in January 2009. In order to prevent prices from falling further, agreements were made with top NR exporting countries (such as Thailand, Indonesia and Malaysia) not to reduce the price. The VRA proposed to use the Fund to buy NR reserves of 100,000–200,000 tonnes for the country in case the world price fell below US$1,000 per tonne. These measures helped to increase the global NR price to US$2,622 per tonne by the end of 2009.

45 Interviews with VRA, Nov. 2015.

The VRA also liaised with government entities, including the Ministry of Finance, to reduce NR export taxes. For example, in February 2011, the world price of NR reached US$4,562 per tonne, and the Government raised the taxes from 0 per cent to 3 and 5 per cent on a variety of NR exports. In 2013, concerned with the impact of export taxes on the comparative advantage of NR producers, the VRA proposed an export tax reduction to the Ministry of Finance. Eventually, in 2014, the Government agreed to reduce NR export taxes back to 0 per cent.

4.2 E&E SBAs

4.2.1 Malaysian American Electronics Industry and Japanese Chamber of Trade and Industry Malaysia (JACTIM): Supporting E&E American and Japanese enterprises

Interviews with both foreign and local enterprises revealed that links between SBAs and the Federation of Malaysian Manufacturers (FMM) are largely limited to Malaysian enterprises, though, some foreign enterprises did participate in both organizations. The needs of American enterprises appear to be met by the Malaysian American Electronics Industry, and hence, they found no need to be part of FMM and the Electrical and Electronics Association of Malaysia (TEEAM).[46] Likewise, Japanese enterprises relied primarily on JACTIM and were not members of either FMM or TEEAM. However, six national E&E enterprises highlighted the importance of TEEAM and FMM.

As stated above, two American enterprises in this study reported that all key national and international issues are settled through the Malaysian American Electronics Industry in coordination with MITI and the Ministry of Finance. These enterprises are located in Penang where they have solved infrastructure and security problems through the support of the Free Industrial Zone Penang Companies Association. They have benefited from their strong relationship with the Malaysian Government which offered to extend financial incentives in 1986, provided grants in 2005 and supported the recruitment of foreign experts, among others.

These enterprises have not seen the need to become members of FMM and TEEAM as they enjoyed direct access to government agencies through the government of Penang until 2008. Since their manufacturing output is exported, they found little need to network with the members of FMM and TEEAM. Nevertheless, they networked with other foreign and national enterprises in Penang to address collective actions problems related to basic infrastructure provision and training because those issues are easily solved through the Free Industrial Zone Penang Companies Association and the Penang Skills Development Centre, respectively.[47]

Three of the Japanese enterprises interviewed reported that both JACTIM and the Japanese Embassy are their main platforms for cooperation to address issues of concern that include support for free trade arrangements. Indeed, initial links provided by JACTIM led one Japanese enterprise to link directly with MITI to access supplier privilege arrangements with domestic electronics enterprises and car assemblers. They have always enjoyed good relations with MITI when seeking incentives, grants and support in general. Officials of JACTIM noted that it had offered services to the Malaysian Government in key areas such as training to solve problems of skills supply in electronics and automotive manufacturing.

46 The officials from American enterprises also noted that they have always had excellent support from the Penang government since their relocation in the country in 1972 and 1974 to address basic infrastructure issues that include roads and transport, accommodation for their production operators, security, labour issues. Since the 1980s, their concerns have also included poaching and skills shortages.

47 Issues of basic infrastructure include power and water supply, and customs and security issues.

4.2.2 TEEAM and the National Information and Communication Technology (ICT) Association of Malaysia (PIKOM): Providing trade benefits, preferential interest rates and training to both national and foreign enterprises

TEEAM was established in 1952 and represents over 1,700 E&E companies and associations. This SBA promotes growth and development of the E&E sector by representing its members in front of government agencies to solve issues related to regulations and standards. Three national PCB enterprises and one Japanese enterprise in the study reported being members of TEEAM. Enterprises said that their membership helped strengthen their links with MITI (including the Malaysian Productivity Corporation), and Small and Medium Industry Development Corporation, as well as, their national buyers in Malaysia. The benefits that national enterprises enjoyed included training to access free trade privileges under regional trade agreements, and access to preferential interest rates. Moreover, the Japanese enterprise said that links with TEEAM were important to promote linkages and solve coordination issues with Malaysian national enterprises, including enterprises purchasing its products.

PIKOM represents the ICT sub-sector of Malaysia's broader electronics sector and includes both hardware and software producers as well as ICT service providers. PIKOM was established in 1986, currently has over 1,400 members. Its members comprise suppliers of equipment in computing and telecommunications, software developers and suppliers, providers of professional and educational ICT services, network operators and suppliers of value-added services in ICT. PIKOM undertakes annual seminars, and runs exhibitions to promote products of these companies and networking among members. The members of the TEEAM and PIKOM, interviewed as part of this study, reported that these SBAs are important platforms to network to connect with buyers and suppliers, and to pool the cost of training modules at the training institutes in the country.

Some enterprises have accessed R&D funds through Collaborative Research in Science and Technology to undertake joint research using employees of universities and enterprises. But none of the enterprises interviewed reported that they have participated significantly in the activities of Malaysian Technology Development Corporation, Multimedia Development Corporation, and Malaysia Industry-Government High Technology. However, initiatives were taken by Malaysian government agencies, including the Ministry of Science, Technology and Innovation to establish linkages. While FMM, TEEAM and PIKOM officials reported that the Malaysian Institute of Microelectronics Systems and Human Resource Development Council have supported their activities strongly, not much is directed at supporting design and R&D. The lack of coordination between foreign MNEs and national electronics enterprises suggests that leveraging strategies to compel grant recipients to work with universities and national enterprises may be necessary to establish strong technological and pecuniary linkages between these enterprises.

4.2.3 Thai Embedded Systems Association: Promoting technology uptake and E&E training

Thailand has lacked sufficient interventions to solve collective action problems in critical areas, such as design and R&D in the development of the E&E industry. Recognizing the lack of upgrading, the Thai Embedded Systems Association emerged following efforts by the Ministry of Industry to launch the Thailand Electrical and Electronics Institute in 1998 to check a slowdown in the electronics industry. The Association was founded in 2001 by a group of academics and local private industrialists as an initiative that aimed to increase coordination among developers and technology users in the field of embedded computing technology.

Among its other functions, the Thai Embedded Systems Association established a platform to train university students to handle embedded electronic systems. Interviews showed training has largely been successful, especially in the development software systems for automotive components. These programmes have the support of a wide network of members that includes electronics enterprises, universities and customers. By 2015, it had developed eight technology road maps related to the embedded systems industry for three ministries, provided testing services and certified electronic products and matched new start-ups with investors (Patarapong, Chairatana and Chayanajit, 2015).

4.2.4 Thai Electrical and Mechanical Contractors Association (TEMCA): Supporting the creation of new national standards

TEMCA was founded in 1977 as an 'Electrical Group' under the Thai Construction Industry Association to represent Thailand in the then-newly-formed ASEAN Federation of Electrical Engineering Contractors. In 1985, it gained momentum by transforming into a stand-alone body called the Thai Electrical Contractors Association for promoting cooperation among the sector's enterprises. In 1994 it changed into TEMCA upon opening up to related sectors including air conditioning, plumbing, fire safety, and communications.

TEMCA serves its enterprises members to obtain contracts for the installation, manufacture, and distribution of electrical appliances, electronics, communications instruments, and mechanical devices. It supports its members in negotiations and helps facilitate trade and investment. TEMCA has some technical exchange activities and promotes relevant R&D, training and education.

TEMCA recently helped create national skills standards for a degree in 'electrical grounding and lightning protection systems' to fill an important skills gap in Thailand. The new standard is expected to improve consumer safety standards within the sector and help enterprises hire suitable staff. TEMCA also provides a number of scholarships of THB 300,000 (US$9,200) each year to the children of its member technicians to study for a career within the sector.

4.2.5 International Disk Drive and Equipment and Materials Association (IDEMA), Thailand

Securing disk drive operations and expansion

Sub-sector international business associations have also evolved in Thailand to play influential roles in promoting collaborative links between domestic enterprises and foreign MNEs, universities and government agencies to stimulate technological upgrading. A Thai branch of IDEMA, was founded in 1999 following the association's success in Singapore (McKendrick, Doner and Haggard, 2000). It was created to promote business networking, information sharing through educational programmes and technical symposiums and conferences, and it fostered global discussions about technical problems in the industry. Its committee members comprised foreign hard disk drive MNEs, including Fujitsu, Gem City Engineering, Hitachi, KR Precision, Magnecomp, Seagate and Western Digital, representatives from BOI, the Asian Institute of Technology and the National Electronics and Computer Technology Center (Intarakumnerd and Chaoroenporn, 2013).

IDEMA cooperated closely with HDDI to promote networking activities between industry, academia and policy-makers, particularly developing the infrastructure for human resource development and automation. IDEMA started working closely with BOI to advocate for special investment

incentives for the hard disk drive sector in 2004. According to interviews with officials from both BOI and Penang Development Corporation, this resulted in several drive manufacturers expanding production operations in Thailand rather than Malaysia.[48] Informal links were also critical in forging strong ties within this network because they helped to disseminate information and build trust (Intarakumnerd and Chaoroenporn, 2013).

Linking MNEs with Thai universities for E&E academic programmes

IDEMA and HDDI played an important role in linking MNEs with local universities and research institutes. HDDI worked with three universities to establish specialized Industry/University Cooperative Research Centres, namely:

- advanced hard disk drive manufacturing at the Institute of Field Robotics at King Mongkut University of Technology, Thonburi;
- hard disk drive components at the Engineering Faculty at Khon Kaen University;
- data storage technology and applications at King Mongkut Institute of Technology, Ladkrabang.

The collaborative networks engaged by HDDI generated links between universities and enterprises among academic, industrial and governmental agents engaged in research and human resource development. Grants for academic research, matching funds for industrial R&D and academic scholarships motivated the universities to collaborate with industry. Hard disk drive MNEs were an important part of the network and they offered international opportunities for national enterprises to catch up. The HDDI collaborative network provided MNEs with a database of small and medium-sized enterprises in Thailand that they can develop into their suppliers. The training provided by HDDI and its members enabled some national suppliers to export directly to MNEs.

4.2.6 Viet Nam Electronic Industries Association (VEIA)

Strengthening collaborative links between foreign and Vietnamese E&E companies

VEIA was established in 2000 as a non-profit organization and is composed of 115 members, which include E&E manufacturing enterprises and ICT trade and service enterprises (VEIA, 2016). This SBA aims to promote the competiveness of the E&E sector in Viet Nam. It does so by promoting cooperation between its members and other partners, suggesting policy changes to the Government, supporting the adoption of international standards and the standardization of Malaysian-made products. Finally, VEIA also supports R&D initiatives on E&E and ICT.

VEIA serves the interests of Viet Nam's electronic industry's domestic companies with a focus on establishing and strengthening collaborative links between domestic enterprises and foreign MNEs and government agencies. Recognizing the importance of the electronics industry in the national economy, VEIA supports the sector's competitiveness through various local and international activities that cover both electronics and ICT.

48 Interview, Nov. 2015.

VEIA has also fostered links with electronics and ICT enterprises internationally through its participation in the ASEAN Electronics Forum beginning in 2003, the Asian Electronics Forum in 2004 and the World Electronics Forum in 2009. Domestic electronics enterprises have used VEIA's network and support to participate in international conferences and related events.

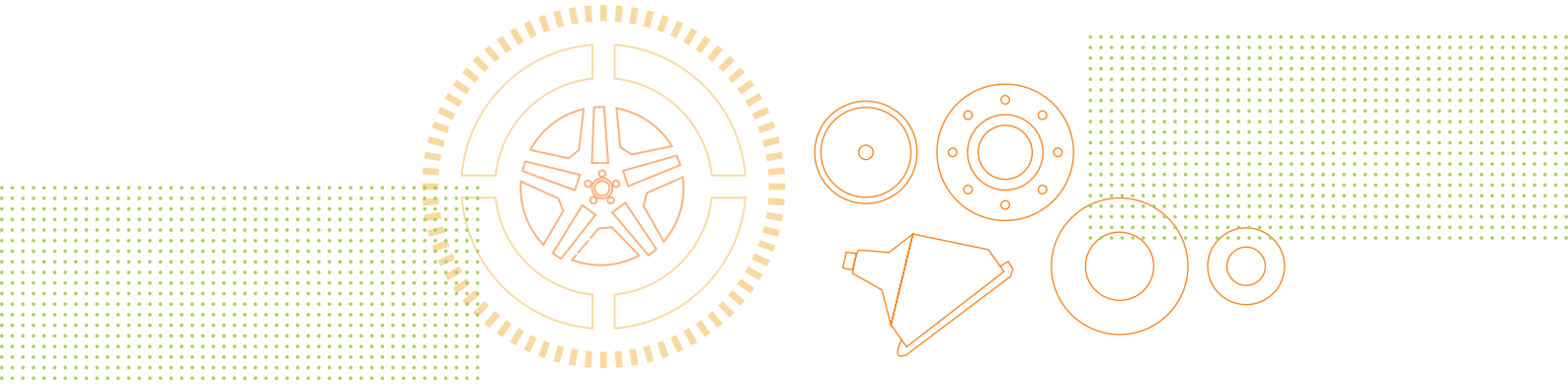
Promoting trade, exports and promotion of international standards

VEIA has promoted E&E trade and exports by providing assistance to its members in international trade fares, such as Electronica 2016 in Munich, Germany, Global Sources Hongkong Fare 2015, BuildTech Asia 2015 and SMART Facilities Management Solution Expo 2016 in Singapore, among others. Participation in such fares not only offers domestic enterprises the opportunity to expand exports, but also provides access to training programmes on trade. VEIA has organized a number of dialogues between MNEs and local enterprises to promote local sourcing in Viet Nam, namely NEPCON Viet Nam 2015, IPA EXPO 2015 and Viet Nam-Indonesia, Viet Nam-Slovakia, Viet Nam-Israel Business forums in alliance with Viet Nam Chamber of Commerce and Industry (VCCI).

VEIA has supported government efforts to raise local standards based on international standards. VEIA recently proposed to the Government to approve the Certificate of Quality issued by VEIA to both local enterprises and MNEs in Viet Nam. This initiative is under discussion with other relevant ministries and government agencies, but no concrete progress has been made so far. Do Thi Thuy Huong, a member of Executive Board of VEIA said:

> "There are two advantages for the endorsement of the Certificate of Quality for electronics products in Viet Nam. Firstly, the Certificate of Quality is a good measure to protect reputational risk of the domestic enterprises. Secondly, the Certificate of Quality can be applied to [MNC] exports so that it shall be recognized as an internationally standard" (VEIA, 2016).

It is worth asking what is necessary for the respective governments to support these organizations to strengthen links between national enterprises, between them and MNEs, and with the relevant government agencies. Greater participation by SBAs and other organizations in apex business activities is required in order to promote innovation aimed at stimulating enterprise-level technological transformation from low to higher value-added activities.

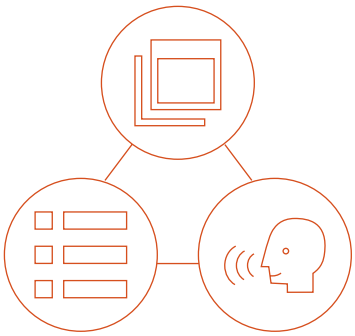


4.3 Automotive SBAs

4.3.1 MACPMA

Strengthening Malaysia's automotive industry through policy interaction

MACPMA was first established in 1965 and now has roughly 100 members. This SBA promotes the development of the automotive industry by supporting favourable automotive policies and acting as a commercial liaison for assemblers, OEMs and component manufacturers. In its initial stage, from 1978 through roughly 1984, MACPMA was a significant source of pressure for localization by virtue of the relatively large size of its membership, strong market position and central role within the apex FMM. The majority of members were ethnic Chinese who had worked for a long time to develop Malaysia's supplier base.[49] MACPMA played a critical role in the adoption of a mandatory deletion programme, which restricts car producers from importing certain automobile parts and components to be assembled locally (Rosli, 2006). In the late 1970s, MACPMA gradually drew support from the Government, especially officials of the Malaysian Industrial Development Authority who were wary of losing out to localization efforts in neighbouring countries.



Public-private coordination grew through the Government's Motor Vehicle Assembly Committee. Problems with implementation, involving the inability of local producers to meet Japanese standards and the lack of support from Japanese suppliers, led to the establishment of a Joint Technical Committee for Local Content (JTC), led by the head of MACPMA, to monitor and nurture local parts producers. The JTC enabled assemblers to raise problems related to local quality and delivery. Despite those efforts, the Malaysian auto industry entered the 1980s with persistent problems of fragmentation and conflict over mandatory deletion. However, MACPMA played a critical role in this period of fairly close public-private engagement.

Additionally, MACPMA has advocated for its members' ability to gain "national industry" status and thus to sell to Proton. This has clearly been a tough battle in the face of opposition by smaller *bumiputera* enterprises represented in the Proton Vendor's Association. Although MACPMA has supporters within relevant government agencies, the political strength of the Proton Vendor's group has been significant by virtue of their ability to appeal directly to the Prime Minister. MACPMA activities are summarised in table 5.

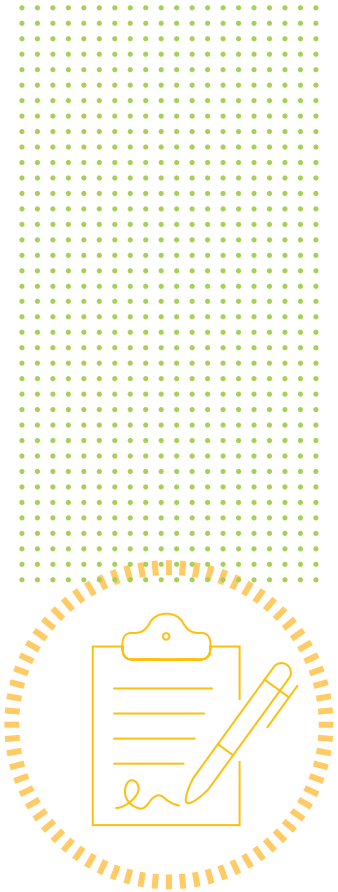
Several general points emerge from the preceding review. First, the Malaysian parts and components association – MACPMA – has been highly active since the late 1970s. Second, its focus has shifted from an emphasis on promoting localization to a broader concern with technology promotion and access to orders from the government-owned enterprise, Proton. Third, over the past two decades, the Government has reluctantly and only partially moved to liberalize the auto industry and to increase consultation with the ethnic Chinese private sector. This has resulted in part from broad frustration over Proton's inefficiency and waste and in part from pressures of regional liberalization and fears of falling behind ASEAN neighbours. Finally, as a result, although MACPMA is clearly a major player in automotive policy discussions, its efforts have borne modest fruit as a result of the auto industry's high level of ethnic politicization. Indeed, although MACPMA has the opportunity to express its views to the Government through

49 The analysis of MACPMA during the early period is drawn from Doner (1991).

time-consuming, MAI-sponsored 'labs', association officials report little sense of whether and how the discussions affect government decisions.[50]

Table 5. Concrete functions, activities and partners of MACPMA

Functions	Activities	Partners
Investment incentives and general sectoral planning	Take an active role in public-private sector consultation to develop and revise the National Automotive Policy; Promote 'end of life' programme to mandate scrapping of older vehicles; Support Automotive Development Fund	MAI; Performance Management and Delivery Unit (PEMANDU); National Automotive Council
Promotion of growth and development of automotive industry	1. Late 1970s to early 1980s: Mandatory deletion programme; 2. Mid 1980s: Encourage consolidation of Proton local procurement organization. 3. 1986–93: MACPMA chair JTC; no technology promotion 4. 2015 - Promote rubber-based auto parts	1. Malaysian Industrial Development Authority; Motor Vehicle Assembly Committee; JTC; FMM 2. Direct appeal to Prime Minister 3. Malaysian Industrial Development Authority 4. MRB
Market development (e.g. trade fairs, trade negotiations)	Promote ASEAN trade liberalization through policy activities	-
Securing collective inputs	Advocate for low costs of tooling	MAI labs
Technical and vocational training; business development	Establish Automotive Skills Training Centre, Business Development Programme	Japan External Trade Organization / MAJAICO; FMM
Wages and benefits	Engage in conversations with Government over minimum wage	MAI labs
Migration management	Advocate for the need to systematize migration system	-
"Quality" infrastructure (standards, testing)	Support need for parts testing facilities	MAI labs
Environmental standards (and reputational risk)	Participate in workshops on development of 'green' cars and materials	MAI labs



Setting quality standards in the automotive industry

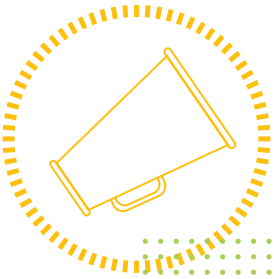
A related effort to reconcile increased localization with assemblers' need for reliable, high quality components access was MACPMA's leadership in the public-private sector JTC.[51] Operating from 1986 to 1993, this mechanism enabled assemblers to import a component when local producers were unable to meet market demand as well as price, quality and delivery standards.

50 Interview, MACPMA officials, Nov. 2015.

51 Based on interview with high-level MACPMA official who chaired the JTC (20 July 2008).

The Government always followed MACPMA's recommendations, but the JTC had limited impact on local capacity development because the committee only ruled on non-Proton requests. As Proton accounted for a significant market share at the time (over 70 per cent), MACPMA officials felt it was not worth the effort to attempt technological change. Moreover, as tariffs were reduced (replaced by excise taxes), the need for such a committee largely disappeared. Indeed, interviews conducted in 2012 indicated that consultation had deteriorated significantly since the end of the JTC.[52]

Promoting more effective and systematic planning for the automotive industry



MACPMA has participated in a number of workshops or labs organized by MAI as part of the Government's Economic Transformation Programme organized under the Performance Management and Delivery Unit,[53] but this consultation has been sporadic at best. In addition, MACPMA participated in an MAI 'road map' session focusing on energy efficient vehicles. Little follow-up was seen in either of these consultations [54] Finally, MACPMA is now participating in a newly established "National Automotive Council" whose actual impact is yet to be seen.[55]

MACPMA has also worked to develop mechanisms, such as an Automotive Development Fund, to strengthen the financial capacities of local enterprises. Precise data on amounts and foci of such funds are not available, one obstacle has been the desire of some in the bureaucracy to favour smaller parts producers rather than the larger enterprises represented in MACPMA.

Improving technical knowledge and skills

Although MACPMA has no technical staff, it has worked to improve the technical capacities of its members since the early 2000s as outlined below.

- MACPMA organized training for members through the Society of Automotive Engineers and through 'buddy' arrangements in which enterprises are paired.
- As of 2012, work with the MAI was only moderately successful owing to a lack of programme details, little MACPMA input into the programme's design, low uptake due to fears of poaching, a lack of compensation and a lack of confidence in the MAI's capacities.[56]
- From 2007 to 2013, MACPMA played a central role in the Malaysia Japan Automotive Industries Cooperation project, an extensive programme with the Japan External Trade Organization.[57] MACPMA has been the key local facilitator of this effort and is especially involved in the business development programme designed to match Malaysian producers

52 Interviews with MACPMA officials, 12 Oct. 2012

53 Information for this section drawn from interviews with MACPMA officials 17 Aug. 2012.

54 MACPMA leaders' levels of frustration with the Government's lack of policy transparency and consistency emerged with increasing intensity in interviews (e.g. 12 Oct. 2012).

55 According to a MACPMA official, the Council "is a relatively new set-up and is able to do a lot for the industry" (interview, 31 May 2016).

56 Interviews with MACPMA officials, Oct. 2012.

57 The project involved the creation of an automotive skill training centre, business development programme, and cooperation in exhibition (Interviews with MACPMA officials, July 2008; JETRO (2016).

with Japanese enterprises. In addition, there is growing, albeit still weak, coordination between MACPMA, its auto parts-producing members and the MRB.[58]

- MACPMA increased its direct involvement with the MRB to advance the opportunities and capacities of member enterprises producing rubber-based auto parts. This involved labs, some of which last two to three weeks, often organized by McKinsey. The association provided extensive input which in principal is sent up to the Prime Minister, but these deliberations are confidential and the results are not at all clear to MACPMA officials.[59]

4.3.2 TAPMA

Supporting the establishment of testing facilities

TAPMA was established in 1978 by Thai enterprises frustrated with assembler resistance to an increase in localization. It is the principal representative of Thai parts and components producers, and the main source of pressure for local upgrading. Its functions and activities are summarized in table 6. With almost 600 members, most of whom are first-tier and second-tier components enterprises, the Association has moved from a focus on localization to strengthening the competitive capacities of its members. One of the most important components of this emphasis was the establishment of automotive testing facilities.

Table 6. Concrete functions, activities and partners of TAPMA

Functions	Activities	Partners
Investment incentives and general sectoral planning	Contribute to Thailand Automotive Institute's Automotive Master Plans	TAI; FTI; Technology Institute (Thai-Japan)
Local content	1970 to late 1990s: Advocate for "efficient" localization;	Automotive Development Committee / Ministry of Industry
Market development (e.g. trade fairs, trade negotiations)	Intermarch 16: a large international machinery and subcontracting exhibition in ASEAN.	Alliance for Supporting Industries Association; Thai-German Institute; Thai Tool and Die Industry Association; Thai Foundrymen's Society; Bureau of Supporting Industries Development
Upstream-downstream and horizontal linkages (i.e. ensure stable supply of raw materials, intermediates; strengthen links with capital equipment producers) downstream)	Support for tool and die and supporting industries	Thai Tool and Die Association; Alliance for Supporting Industries Association

58 Interviews with MACPMA members and MRB officials, Nov. 2013.

59 Interviews with MACPMA members, Nov. 2015.

Functions	Activities	Partners
Technical and vocational training; business development	Automotive human resources development projects and especially the Automotive Human Resources Development Academy (AHRDA)	TAI; Ministry of Labour / Department of Skills Development; FTI
Design, R&D	-	Mahidol University; FTI; Ministry of Industry
"Quality" infrastructure (standards, testing)	Request Automotive Testing Centre (requested 2002, approved 2015)	Mahidol University; FTI; Ministry of Industry

The establishment of a fully equipped local testing facility has been a central aim of Thai parts producers since the early 2000s.[60] Their need for such a facility intensified with as new requirements were put in place to qualify products for the "eco-car" programme,[61] and advocacy efforts for a centre seemed to have paid off when the Government agreed to establish an R&D centre by 2008 to certify products in areas including emissions, lighting equipment, braking, crash tests and engine performance. But the project faltered when the private sector and the Government disagreed over responsibility for the cost of the facility (over $100 million). A new initiative to establish an automotive testing centre was finally approved by the cabinet in June 2015. TAPMA and the FTI provided persistent pressure to achieve that result, while foreign enterprises reportedly had little to do with this effort.[62]

Establishing a locally driven automotive human resources development academy

In 2015 the Automotive Human Resources Development Academy (AHRDA) emerged rooted in the initiatives of Thai stakeholders. The AHRDA was the result of joint pressure by the FTI and TAPMA (whose membership overlaps), with support from the Ministry of Labour Department of Skills Development. The curriculum of the AHRDA suggests that the academy's focus is on basic skills required by modern, "lean" factories (e.g. welding, machinery maintenance, surface preparation and plastic injection moulding). It is not clear precisely who developed this curriculum, and despite rosy reports from the Ministry of Labour, it is too early to evaluate the results of the AHRDA.[63] It is quite clear, however, that this now constitutes an important focus for TAPMA.

The FTI has promoted additional associational initiatives, including an "Industry Roadmap Workshop" for casting industry enterprises in the Thai Foundrymen's Society, support for the Thai Tool and Die Industry Association, as well as support for the Alliance for Supporting Industries Association.

60 A 2016 article announcing the Thai cabinet's final approval for an auto testing centre noted that Thavorn had "pushed for the testing centre for 13 years". Enterprises and officials alike view an existing centre operated by the Ministry of Industry in one of its branch offices as too small and ill-equipped to support significant product testing, certification and learning.

61 The Thai eco-car programme aims to attract foreign investment by providing financial incentives and tax exemptions to automotive manufacturers as a way to meet efficiency requirements.

62 Personal communication, RPIC official, June 2016.

63 According to the Ministry of Labour (2015) the AHRDA had trained 77,000 people as of the end of 2015.

4.3.3 Viet Nam's automotive SBAs

Through informal surveys or annual meetings, the Vietnam Automobile Manufacturers Association (VAMA) collects comments and data on the challenges its members face and communicates those concerns to government agencies. Data and reports are available on the VAMA website and are circulated among its members. This information is rather statistical, but VAMA members have a greater need for business and trade insights that the Association does not disclose. In depth interviews with VAMA members did not find any cases in which technology uptake was directly promoted by the Association. Apart from data collection, VAMA plays a limited role in driving technology upgrade or supporting enterprises with technology adaptation.

SBAs in the automotive sector in Viet Nam help improve sectoral performance by influencing policy. VAMA, for example, has negotiated with the Government the maintenance of high tax rates on imported cars as a way to protect the local automotive industry. Moreover, the Vietnam Plastics Association (VPA) has established strong links among institutions and local supportive enterprises in R&D activities. However, as indicated earlier, local components represent only 10 per cent of all of Vietnamese assembled cars. Therefore, the role of both VAMA and the VPA in terms of managing technological changes or growth of the automotive sector is rather limited.

Interviews with Japanese (Toyota) and Korean (Hyundai) manufacturers reveal that they are not interested in relying on VAMA or strengthening their role in Viet Nam. Indeed, Japanese manufacturers and suppliers founded the Hanoi Plastic Supplier Association to enhance linkages between automotive enterprises and suppliers. However, as an informal association, its role has been restricted to a small number of members located in Hanoi.

4.4 Conclusions

- Overall, SBAs across the three countries retain their distinctive characteristics and identities. This is true throughout the ASEAN region. They can be strong advocates for the interests of their sectors, but they usually operate as stand-alone representative institutions, coming together through the apex organizations or with other SBAs/BMOs on certain issues as they arise.

- Malaysian rubber SBAs raised standards through testing and R&D processes. For instance, MARGMA was key to overcoming latex allergies that affected the rubber sector in the late 1980s and creating the Standard Malaysian Glove, while MRPMA established a subcommittee devoted to condom producers, which focused on developing national standards for imported items.

- The Malaysian rubber SBAs promoted skills development and facilitated work for migrant workers through the dissemination of safety instructions in multiple languages and regular on-the-job training. This experience differs greatly from the rubber SBAs in Thailand and Viet Nam which are not focused on improving skills of national and foreign workers. Nevertheless, the VRA contributed to solving misreporting of rubber quality and actively promoted R&D.

- Thai and Vietnamese rubber SBAs contrast significantly with their Malaysian counterparts. In Thailand, condoms and gloves producers are largely under the control of foreign producers who play little if any role in national associations. In Viet Nam, the VRA promotes the development and growth of the sector through better collection methods, and guidelines, among others. But the VRA is less experienced and developed than Malaysian and Thai rubber SBAs.

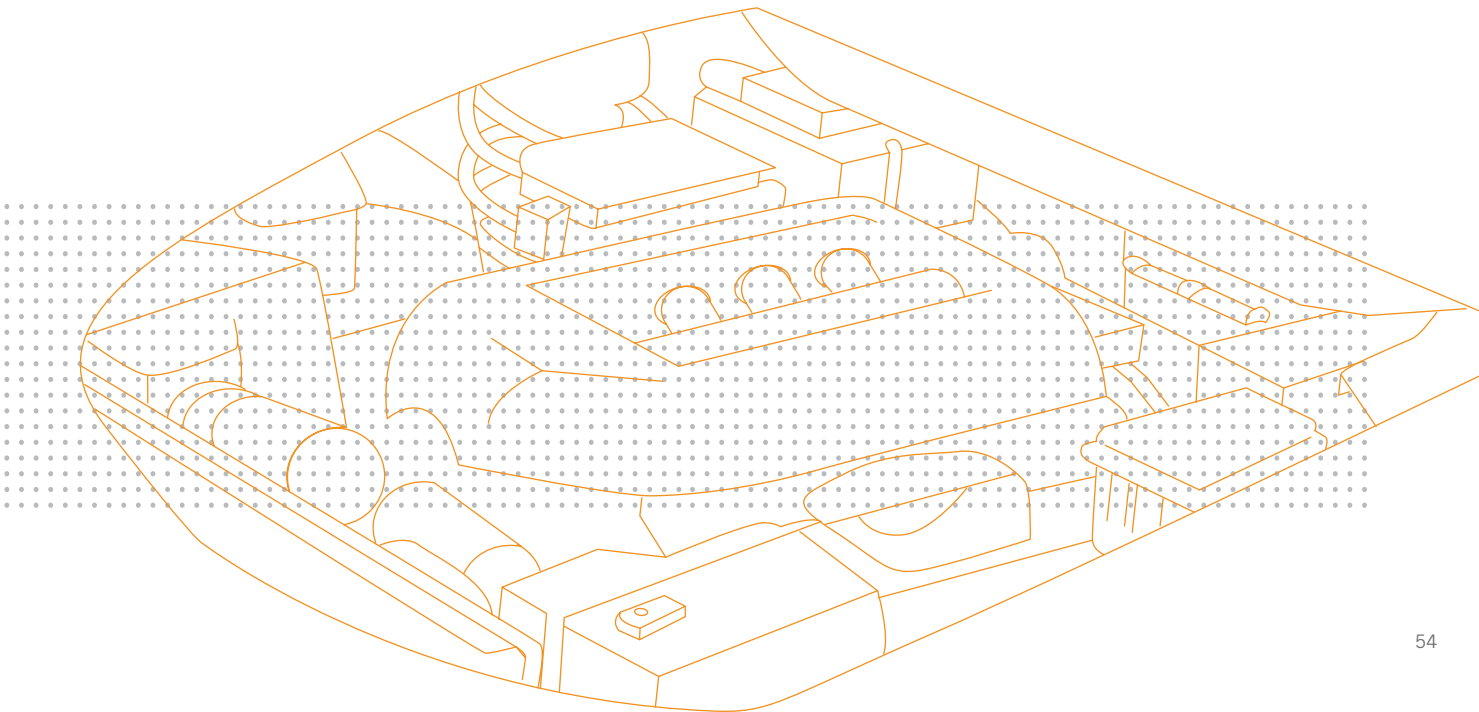
- Governments in all three countries set up E&E related organizations to stimulate the participation of enterprises in training, precision testing, design and R&D activities, including science and technology parks, and platform for raising university-industry linkages. In doing so, E&E SBAs (Malaysia and Viet Nam), apex organizations (Malaysia and Thailand) and foreign organizations (Malaysia) have played important roles to coordinate links between enterprises and government agencies to solve collective action problems. For example, in Malaysia, TEEAM has helped strengthening links with public institutions to promote preferential trade treatment. In Thailand, the IDEMA persuaded disk drive manufacturers to expand production operations in Thailand over Malaysia. In Viet Nam, VEIA acts as a bridge between the Government, foreign and national producers and academia.

- In the E&E sector in Malaysia and Thailand the FFM and IDEMA have created collaborative links with MNEs to promote technology uptake and productivity. In Malaysia, the launch of the Selangor Human Resource Development Corporation in the 1990s was essential to provide training and testing. In Thailand, the HDDI in cooperation with universities founded specialized hard disk drive research centres.

- The automotive SBA landscape differs between Malaysia, Thailand and Viet Nam. In both Malaysia and Thailand, MACPMA and TAPMA initially promoted localization. More recently, they have been very active in efforts to strengthen the technological capacities of their members. There are nevertheless important differences. TAPMA operates within a richer institutional ecosystem than is the case for its Malaysian counterpart. In Viet Nam, VAMA plays a limited role in driving technology upgrade or supporting enterprises with technology adaptation.

- Thai automotive SBAs are extensively linked among themselves and with government agencies. TAPMA, in particular, played an important role in strengthening the competencies of the country's automotive workforce and promoting production relocation to Thailand. In contrast, MACPMA struggled to gain access to the country's assemblers, and tensions between ethnic Chinese and bumiputera (ethnic Malay) members have persisted. Moreover, VAMA's scope of work is limited due to the market dominance of foreign enterprises.

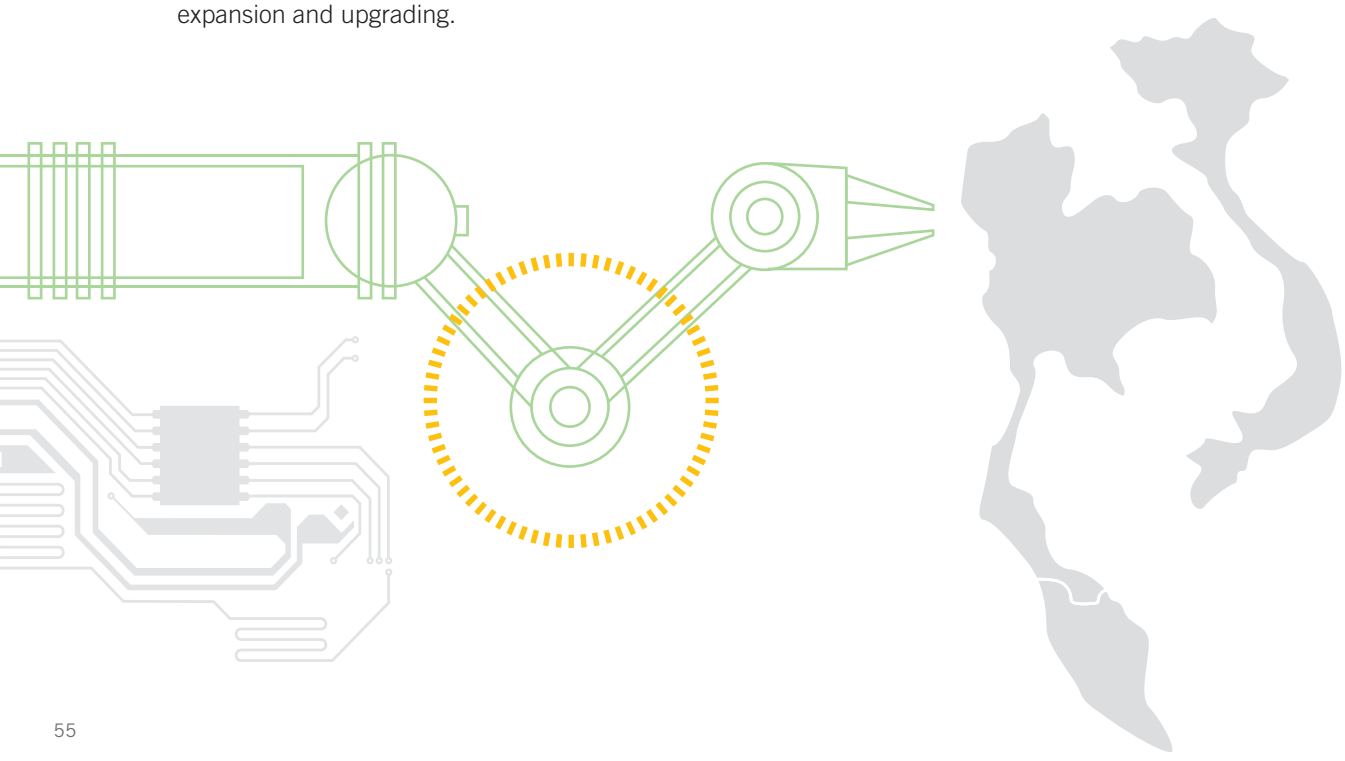
- Malaysian and Thai automotive SBAs have worked towards improving the technical skills of their members through various activities including training sessions, programmes, cooperation with E&E enterprises and the AHRDA.



CONCLUSIONS

This paper analysed the role of SBAs in driving economic development in the rubber, E&E and automotive sectors in Malaysia, Thailand and Viet Nam. These three sectors significantly contribute to employment and exports in the three countries under review and SBAs have evolved and impacted on development in different ways.

- The role of SBAs and institutional landscape is in some ways a reflection of the sectoral level of development and expertise across the three countries.
- Overall, SBAs across the three countries retain their distinctive characteristics and identities. This is true of the ASEAN region as a whole. To varying degrees of strength, they can be advocates for the interests of their sectors.
- SBAs operate mostly as stand-alone representative institutions of their sector. They work with apex organizations or with other SBAs/BMOs on certain issues as they arise, but generally this is a more ad- hoc experience.
- Malaysian rubber SBAs are robust and have collaborated with government at different levels on technology innovations, standards setting and quality control, among others.
- Thai E&E SBAs have received substantive support from the BOI, apex associations and other government institutions to conduct R&D and testing.
- Vietnamese rubber, E&E and automotive SBAs are relatively less developed than their Malaysian and Thai counterparts.
- In both Malaysia and Thailand, automotive SBAs have been very active in strengthening the technological capacities of their members in the face of more liberalized environments that threaten to overtake them. However, Thai automotive SBAs operate within a richer institutional ecosystem than is present in Malaysia. This is reflected in coalitional concerns, the role of the automotive sector in the national economy, alternatives to automotive expansion and upgrading.



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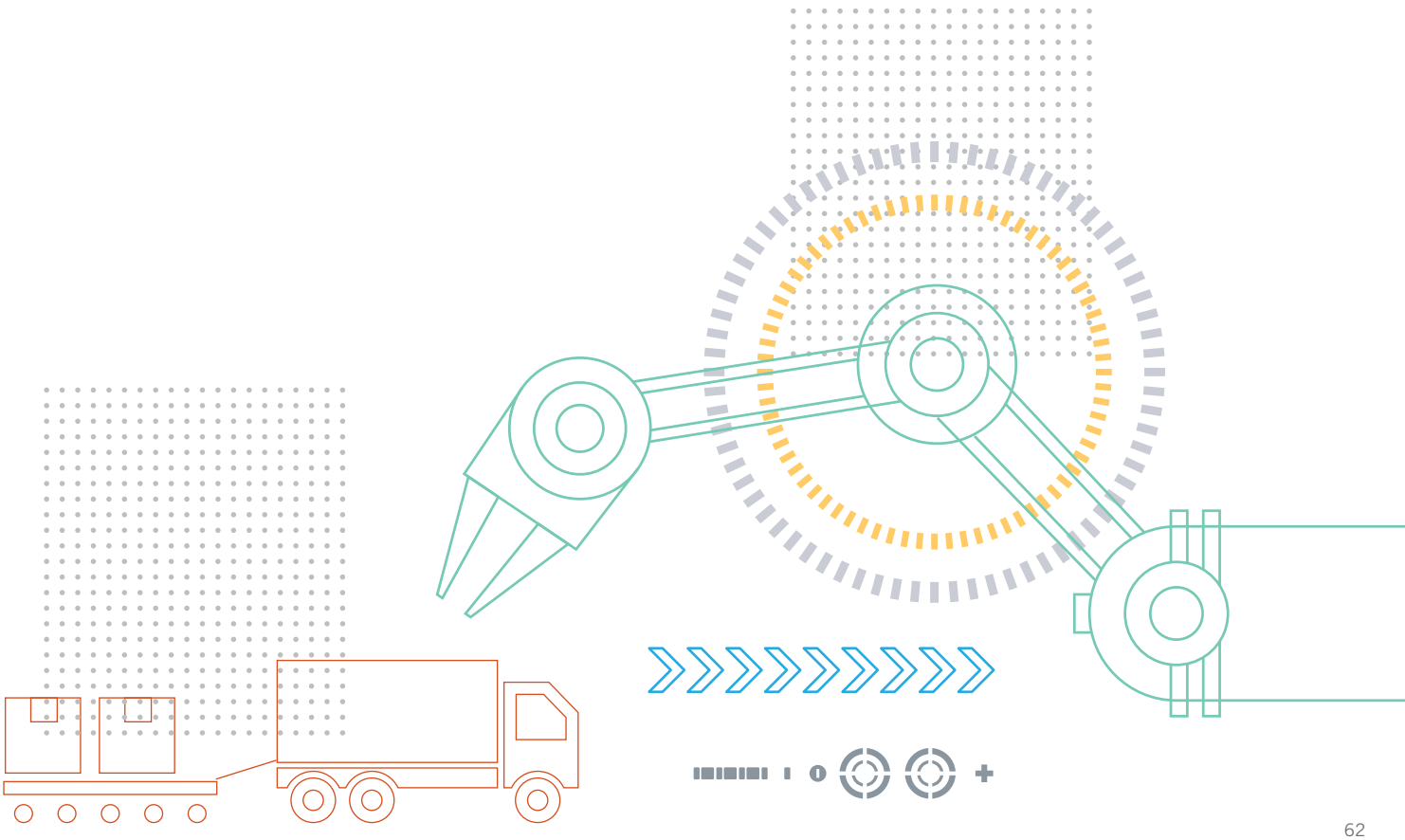
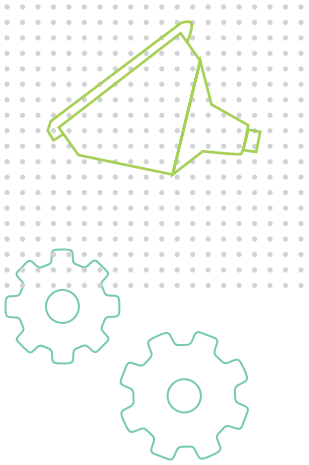


APPENDIX

List of interviews by sector

The following interviews were conducted in Malaysia, Thailand and Viet Nam between November 2015 and April 2016.



Rubber sector

Interview 1	Former Senior Officer, Malaysia Rubber Board (MRB)
Interview 2	Senior Researcher, Malaysia Rubber Board (MRB)
Interview 3	Advisor to Chair, Kossan Industries; President, Malaysia Rubber Products Manufacturers' Association (MRPMA)
Interview 4	Director, Doshin Industries; leader, Malaysia Rubber Products Manufacturers' Association (MRPMA)
Interview 5	Director, rubber compounding enterprises (Malaysia)
Interview 6	Former Official, Malaysia Rubber Board (MRB); Chief Executive Officer, Rubber Research Institute of Malaysia (RRIM)
Interview 7	Deputy Secretary General, Malaysia Rubber Board (MRB)
Interview 8	President, Malaysian Rubber Glove Manufacturers' Association (MARGMA)
Interview 9	Former director, Malaysia Rubber Development Corporation (MARDEC)
Interview 10	Former Malaysia Rubber Board (MRB) Official; Current Advisor to Malaysian Rubber Glove Manufacturers' Association (MARGMA)
Interview 11	Professor and Advisor to Thai Ministry of Industry on rubber
Interview 12	Former Sales Manager, Thai Rubber Latex and Member Thai Latex Association (TLA)
Interview 13	Sales Manager, Bangkok Synthetics Co. Ltd
Interview 14	Professor Polymer Chemistry, Mahidol; Founder and Director, Centre for Rubber Research and Technology
Interview 15	Senior researcher, Rubber Research Institute of Thailand
Interview 16	Chair, Rubber Products Industry Club (FTI) (Thailand)
Interview 17	Former Deputy Finance Minister; Advisor to Minister of Agriculture and Cooperatives (Thailand)
Interview 18	Director, Otani Tire Company; Member, Rubber Products Industry Club (RPIC) (Thailand)
Interview 19	Professor Thammasat University; Former Advisor to the Minister of Agriculture and Cooperatives (Thailand)
Interview 20	Director, BKF-Group; Former Chair, Rubber Products Industry Club (RPIC) (Thailand)
Interview 21	Vice President and Secretary General, Viet Nam Rubber Association (VRA)

Interview 22 Chief, Viet Nam Rubber Association (VRA)

Interview 23 Director International Relation Office, Viet Nam Rubber Association (VRA)

Interview 24 Deputy Office Manager, Viet Nam Rubber Association (VRA)

E&E sector

Interview 25 Vice President, Federation of Malaysian Manufacturers (FMM)

Interview 26 Perak Branch Chairman, Federation of Malaysian Manufacturers (FMM)

Interview 27 Chief Executive Officer, Federation of Malaysian Manufacturers (FMM)

Interview 28 Senior Manager, Federation of Malaysian Manufacturers (FMM)

Interview 29 Chief Executive Officer, Globetronics (Malaysia)

Interview 30 Former Chief Executive Officer, Intel (Malaysia)

Interview 31 Former Chief Executive Officer, Intel (Malaysia)

Interview 32 Former Managing Director, Advanced Micro Devices (Malaysia)

Interview 33 Managing Director, Motorola Solutions (Malaysia)

Interview 34 Chief Executive Officer, Collaborative Research in Science and Technology (CREST)

Interview 35 Head of Research Management, Collaborative Research in Science and Technology (CREST)

Interview 36 Research and Programme Director, Collaborative Research in Science and Technology (CREST)

Interview 37 Former Director, Penang Skills Development Centre and Penang Designing Centre

Interview 38 Director, Malaysian Productivity Corporation (Ministry of International Trade and Industry)

Interview 39 Deputy Chief Secretary, Ministry of Finance of Malaysia

Interview 40 Former Chief Executive Officer, Eng Technology (Malaysia)

Interview 41 Interim Chief Exective Officer, Silterra Corporation (Malaysia)

Interview 42 Former Chairman, Silterra Corporation (Malaysia)

Interview 43 Executive Director, Vitrox (Malaysia)

Interview 44 Senior Equipment Manager, Freescale (Malaysia)

Interview 45 Engineering Manager, Freescale (Malaysia)

Interview 46 Information Technology Manager, Agilent Technologies (Malaysia)

Interview 47 Former Managing Director, Osram (Malaysia)

Interview 48 Managing Director, Motorola Solutions (Malaysia)

Interview 49 Science Advisor to Prime Minister, Prime Minister's Office of Malaysia

Interview 50 Former Staff, Malaysian Institute of Microelectronics Systems (MIMOS)

Interview 51 Former Director, Multimedia Development Corporation (MDec)

Interview 52	Former Director, Malaysian Institute of Microelectronics Systems (MIMOS)
Interview 53	Former Managing Director, Advanced Micro Devices (Malaysia)
Interview 54	Vice President, Malaysian Trades Union Congress (MTUC)
Interview 55	Former President, Malaysian Trade Union Congress (MTUC)
Interview 56	Manager, Hotayi Electronic (Malaysia)
Interview 57	Engineering Manager, Kaltech (Malaysia)
Interview 58	Engineering Manager, Opulent Solutions (Malaysia)
Interview 59	Engineering Manager, Inventec Penang (Malaysia)
Interview 60	Engineering Manager, Opulent Solutions (Malaysia)
Interview 61	Engineering Manager, Inventec Penang (Malaysia)
Interview 62	Director, Viettronic Binh Hoa Join Stock Company (Viet Nam)
Interview 63	President, 4P Company Ltd (Viet Nam)
Interview 64	Manager, Human Resources and Public Relations Department, 4P Company Ltd (Viet Nam)
Interview 65	Director, Songnam Join Stock Company (Viet Nam)
Interview 66	Member of Executive Board, Viet Nam Electronic Industries Association (VEIA)
Interview 67	Director, Hung Dung Company Ltd (Viet Nam)
Interview 68	Director, Hanel PT., Joint Stock Company (Viet Nam)

Automotive sectoc

Interview 69	Nakagawa Rubber Industries, Chair, Malaysian Automotive Component Parts Manufacturers (MACPMA)
Interview 70	Director, ATS Corp; Vice Chair, Malaysian Automotive Component Parts Manufacturers (MACPMA)
Interview 71	Director, Malaysian Automotive Component Parts Manufacturers (MACPMA)
Interview 72	Chair, Automotive Industry Club, Federation of Thai Industries
Interview 73	Secretary General, Automotive Industry Club, Federation of Thai Industries
Interview 74	Director, Thailand Auto Parts Manufacturers Association (TAPMA)
Interview 75	Director, Thai Parkerizing; Deputy Secretary General, Thailand Auto Parts Manufacturers Association (TAPMA)
Interview 76	Former Official, Thai Automotive Institute
Interview 77	Former Director, Thai-German Institute (tool and die); Board Member – Thai Automotive Industry Association
Interview 78	Director, Thai-German Institute
Interview 79	Former Professor, Thammasat University
Interview 80	Manager, Toyota Tsusho Viet Nam Co. Ltd, Toyota Motor Viet Nam

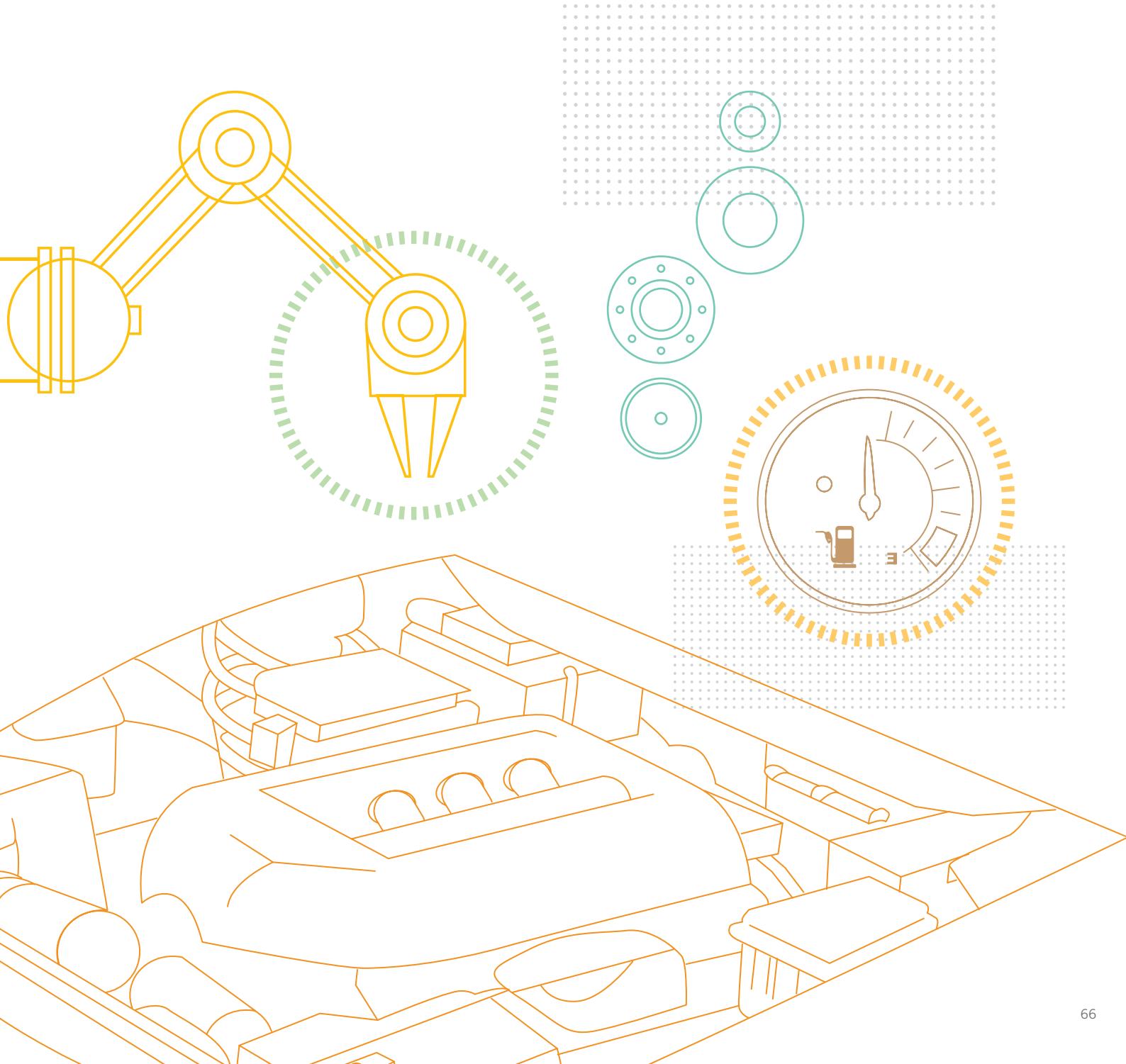
Interview 81 Manager, Automobile Sale Unit, Honda Viet Nam Co., Ltd

Interview 82 Technical Manager, General Motors Viet Nam

Interview 83 Technical and Training Manager, Hyundai Thanh Cong Viet Nam JSC.

Interview 84 Strategic Planning and Business Development Manager, Hyundai Thanh Cong Viet Nam JSC.

Interview 85 General Director's Assistant, Hyundai Thanh Cong Viet Nam JSC.



Analysis of the economic development role of Sectoral Business Associations in the rubber, electronics and electrical, and automotive sectors in Malaysia, Thailand and Viet Nam

The multiplicity of political, economic and social demands calls for a better understanding on the role played by sectoral business associations (SBAs) in stimulating connectivity between enterprises, organizations and government agencies and contributing to improved enterprise performance in specific sectors.

This paper focuses on functions that drive economic, enterprise and employment growth as well as skills development in terms of managing technological change and offers a comparative exploration of SBAs in three sectors, namely rubber, electronics and electrical (E&E) and automotive in Malaysia, Thailand and Viet Nam. The findings reveal that SBAs are relevant for addressing the challenges of improving sector-specific performance as they represent the wider needs of all enterprises in the sector at the policy level in a fashion that individual enterprises cannot.

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Bureau for Employers' Activities (ACT/EMP)
International Labour Office
Route des Morillons 4
CH-1211 Geneva 22
Switzerland
Email: actemp@ilo.org