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UNITED

Engineering Knowledge Transfer Units to Increase Student´s Employability and Regional Development

Work Package 1 – Comparative analysis of the automotive industry and trainings needs for the engineering knowledge transfer units in Indonesia, Malaysia, Thailand and the EU

1.1 UNITED Common Status-quo Report

Common Status-quo Report on the Automotive Industry in Southeast Asia
WP 1

The status-quo report on the automotive industry in Southeast Asia summarizes the findings from the desk research and the focus groups implemented by the UNITED partners in Indonesia, Malaysia and Thailand.

Universitas Sumatera Utara

Universiti Putra Malaysia

Mahasarakham University

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1. Introduction

The objective of the Status-quo analysis is to understand the national automotive industry and the automotive and mechanical engineering efforts, which are currently undertaken in Indonesia, Malaysia and Thailand but also in participating EU countries (Italy, Germany, Austria). The status-quo analysis focusses on the national automotive industry and training needs for laboratories/testing bays in Indonesia, Malaysia and Thailand.

In depth information from all 6 participating countries on national and regional specialization in the automotive industry and also governmental and labour market needs and aims are gathered to generate this report. The methodology for the status-quo analysis is based on desk research at each of the participating universities, focus group guidelines, which helped to implement focus group interviews in all the partner countries.

The participants of these focus groups are industry professionals and academics with a focus on automotive and mechanical engineering. The participants are from world leading companies and universities in automotive engineering (AE) in EU and Southeast Asian (SEA) partner countries, such as Altair, CRF, Denso, Eldor, FEV, Ford, IKA RWTH Aachen, Magneti Marelli, Magna, Proton, Perodua, Sonictron, Cenergi Sea, MIROS, DreamEDGE, Honda Malaysia, TAPMA, Vera Automotive, Bosch Thailand and several other research institutes and ministries.

Topics included are:

- Current situation of automotive and mechanical engineering industries in SEA countries
- Current situation of automotive / mechanical engineering education in SEA countries and university-business relations
- Future trends in automotive industry in SEA countries
- Summary - Proposed training topics for future UNITED trainings

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2. Current situation of automotive and mechanical engineering industries in SEA countries

2.1 Indonesia

Automotive Industry in Indonesia was started since 1970 by using conventional engine (2W and 4W). Today, Indonesia automotive is known as the biggest market in ASEAN Country. The total sales in 2017 was 1,079,534 followed by Thailand with 871,650 total sales. However, the biggest producer in this region is Thailand with car production of 1,988,823 and followed by Indonesia 1,216,615 (Data of 2017). The present condition of automotive industry in Indonesia can be summarized as follows. Over the next five years, the passenger vehicle segment will remain very attractive, while growth of the commercial vehicle segment will be slower. Passenger vehicle (PV) growth is estimated at Compound Annual growth rate (CAGR) 6.8% until 2020, motorcycle (MC) growth is estimated at CAGR 4.8% to 2020, truck growth is estimated at CAGR 3.5% to 2020, bus growth is estimated at CAGR 1.9% to 2020. Greater Jakarta will remain the key region driving PV and CV growth, while demand from medium and smaller-sized cities is expected to increase over the next decade. In the PV segment, the low-cost green car segment (LCGC) is expected to experience the fastest growth at CAGR 8.1% to 2020. In the truck segment, the gasoline light-duty truck segment (GLDT) is expected to experience the fastest growth at CAGR 4.6% to 2020. In the bus segment, the medium-duty bus segment (MDB) is expected to experience the fastest growth at CAGR 3.2% to 2020. These facts show that Indonesia automotive market is still growing. The national increasing market due to increasing middle class. Along with national market, the export market is also increasing. The expansion in export will leverage the quality and the quantity. However, Indonesia's export competitiveness is still low.

2.2 Malaysia

Malaysia has become one of the emerging car manufacturers since an inauguration of the first national car, PROTON in 1983 followed by PERODUA in 1993. Through the formation of these companies, it has enabled the country to significantly develop its automotive capabilities in research and development, prototyping, testing and manufacturing. Apart from that, the Malaysian automotive industry includes a joint venture with foreign car company to set up an assembly line capability for complementing the imported complete knock down (CKD) kits. As a result, the industry has able to create a number of job opportunities mainly in engineering field, as well as business opportunity in vehicle service and repair, and component supply.

Over the past decades, the Malaysian automotive industry has been one of the key players in stimulating the economic growth of the country, which contributes up to 4% from the overall Malaysia's Gross Domestic Product (GDP). With the latest review of National Automotive Policy (NAP) in 2014 since its inception in 2006, the future direction of automotive industry in Malaysia is focusing into a holistic development of green technology and human capital, including enhancement in automotive industrial ecosystem and market expansion. This policy is headed by the government agency under the Ministry of International Trade and Industry (MITI) in order to ensure the Malaysian automotive industry to stay competitive in both domestic and global market. MITI has established Malaysia Automotive, Robotics and

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IoT Institute (MARii) to provide assistance in ensuring the growth of Malaysia Automotive Industry. From the data gathered by MARii, the export of the parts and components has been gradually increases from RM9.8B in 2015 to RM12.10B in 2018 with increments of almost 25%. Meanwhile, the export of (Complete Built-Up) CBU vehicles increases from RM1.2B in 2015 to RM2.08B in 2018. In terms of the energy efficient vehicle (EEV), it has been recorded that more than 50% market penetration of new vehicles has been sold in Malaysia. Therefore, since the announcement of NAP 2014, the key objectives as stated in the policy has been well undertaken and the revised NAP should be expected in this near time.

2.3 **Thailand**

The global automotive industry is shifting focus towards electric vehicles (EVs), partly due to tightening regulations as tougher emission duty guidelines are set in major economies like the US, Europe and China. Several countries including Germany, Norway and India, are planning to phase out sales of diesel and gasoline powered vehicles. While oil price in 2019 is expected to linger at a relatively high level, government bodies are encouraging EV production via incentives and tax reductions.

In alignment with this wave, the Thai Finance Ministry reduced excise tax rates for EV cars since 2017, driving domestic sales of hybrid electric vehicles (HEVs), battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). This trend will likely continue into 2019 despite the expected decline in the overall domestic automotive sales. Figure 1 shows Thailand's domestic automotive market between 2018 – 2019.

Domestic automotive market — 2019 projections

	2018		2019	
Vehicle types	Sales Volume (vehicles)	%yoy	Sales Volume (vehicles)	%yoy
EV	21,000	75%	37,000 - 38,500	76% - 83%
- HEV	12,200	270%	25,100 - 26,050	106% - 114%
- PHEV	8,745	1%	11,500 - 12,000	32% - 37%
- BEV	55	104%	400 - 450	627% - 718%
Eco Cars (ICE)	171,000	37%	152,000 - 157,000	(-11%) - (-8%)
Others	838,000	14%	791,000 - 814,500	(-6%) - (-3%)
Total domestic automotive sales	1,030,000	18%	980,000 - 1,010,000	(-5%) - (-2%)

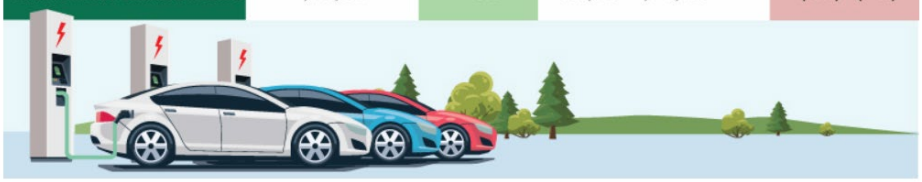

Figure 1 Thailand's domestic automotive market [Credit: kasikornbank 2019, [1]]

In 2019, Thailand's domestic automotive market is expected to contract by 2% to 5% while EV sales growth is projected to remain impressive between 76%-83%. Reasons for the market contraction include high household debt and stricter credit policy set by financial institutions to tackle higher non-performing car loans. Uptrend in policy rates and the delay in general election may also slow down demand to purchase vehicles. However, high growth in the EV segment, particularly the PHEVs and HEVs, will continue to support the industry.

In 2019, the government will also try to incentivize eco car makers to launch more eco EVs, especially the hybrid type. These eco EVs will also get excise tax reduction like other EV models, making retail prices

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more affordable. Meanwhile, PBEV and BEV eco cars are unlikely to take off soon due to high lithium battery costs. Another driver for EV production is attributed to more transfer of advanced technology to local manufacturers from forming joint ventures with overseas manufacturers.

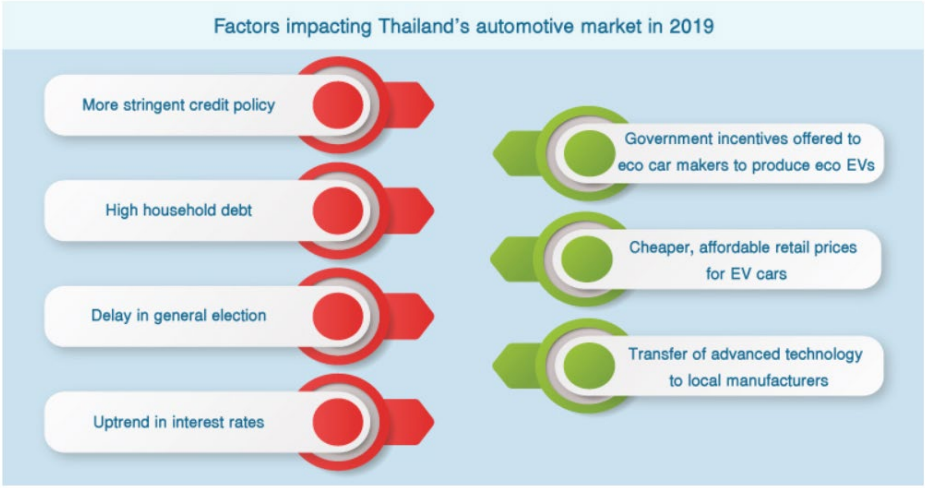

Figure 2 Factors impacting Thailand's automotive market in 2019 (positive vs negative points of view) [Credit: kasikornbank 2019, [1]]

Thailand's auto export growth has outpaced domestic sales, making up approximately 60% of Thai automotive sales. In 2019, Thailand's auto export volume growth is projected to grow gradually by 1-4% pressured by global economic slowdown and relocation of production base to countries in Europe. However, auto export volume to Vietnam is expected to grow notably by 14-22% in 2019, spurred from high demand for Thai automobiles and it is considered a high potential market in 2019 due to:

- The ease of import restricting regulation imposed under Decree 116
- Relocation of passenger cars manufacturing base into
- Thailand for auto products to be re-exported back to Vietnam
- Higher average income among the Vietnamese population
- More affordable small engine eco cars, amid high oil price in Vietnam.

On the contrary, Thai auto export to Europe will be pressured by the relocation of production bases to countries in the region, nearer to end consumers, in an effort to reduce logistics and transportation costs. These include countries like Hungary, Netherlands, France and Finland, for instance. Emission controls in Europe will also contribute to the reduction in Thai auto exports to the region. Lastly, the United States-Mexico-Canada Agreement (USMCA) will come into effect from 2020 onwards, which will tighten control over where the vehicles are originally manufactured from. This would potentially slow down Thai auto export to the membership countries. Thailand can limit the negative impacts by ramping up production and exporting EVs to Europe and USMA member countries, which heavily promotes EV adoption.

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Automotive export market — 2019 projections

Countries	2018 Sales Volume (vehicles)	2018 %yoy	2019 Sales Volume (vehicles)	2019 %yoy
Vietnam	53,400	44%	61,000 - 65,000	14% - 22%
Europe	123,000	-14%	118,000 - 123,000	(-4%) - (0%)
Overall	1,135,000	-1%	1,150,000 - 1,180,000	1% - 4%

Figure 3 Automotive export market -2019 projections [Credit: kasikornbank 2019, [1]]

Car (units)	Production	Domestic Sales	Export
Passenger Cars	60,077	35,086	25,673
Commercial Vehicles	94,011	44,213	49,512
Total	154,088	79,299	75,185

Motorcycle (units)	Production	Domestic Sales	Export
	171,799	135,458	31,277

Figure 4 Thailand Automotive Statistics in November 2019 [credit: www.taia.or.th/, [2]]

3. Current situation of automotive / mechanical engineering education in SEA countries and university-business relations

3.1 Indonesia

In Indonesia, the education system starts from elementary school, to junior high school, senior high school, and higher education. The senior high school can be divided into general and vocational one. In the vocational one the automotive study program is offered, where graduate students are expected to fulfil the automotive labour market's needs. They are projected to become junior mechanics in automotive industry. The higher education is also divided into general and vocational one. In the general higher education, the automotive study program is not provided. Instead, mechanical engineering study program is the closest study program that supports the automotive industry. In addition, vocational higher education is also offering an automotive study program. The graduates are expected to become senior mechanics in automotive industry.

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The automotive industry expects that higher education system can support and develop the industry mainly in the following issues:

- Development of electric and hybrid vehicles
- Development of biofuel mandatory vehicles
- Development of fuel cell vehicles
- To produce all of the vehicle components locally

3.2 Malaysia

At the moment, there is no specific degree program for automotive engineering that is offered at both UPM and UTeM. Nonetheless, automotive engineering topics are also taught as part of the Mechanical Engineering degree program: Bachelor of Mechanical Engineering with Honors (UPM) and Bachelor of Mechanical Engineering Technology (Automotive Technology) (UTeM). In addition, the field of automotive engineering study is also offered for Master degree by research at both universities. It should be noted that UTeM is planning to offer a specific degree program in automotive engineering in future (expected to start in September 2019).

The numbers of students, academic staff and researchers in the field of mechanical engineering and/or automotive engineering at both UPM and UTeM are tabulated in the following Table 1.

Table 1

Institution	Students	Academic Staff	Researcher
UPM	211	29	29
UTeM	60	135	135

COMPETENCIES. Based on the collected data from the desktop research, the level of competencies and skills among the current professors and students at UPM and UTeM in certain areas of automotive engineering can be summarized as tabulated in Table 2.

Table 2

Automotive Engineering Topic	Level of Competencies	
	Professors	Students
Vehicle Design	Middle to Strong	Middle
Control System & Autonomous Vehicles	Middle to Strong	Middle
Industrial Processes	Middle	Middle
Testing Laboratories	Middle to Strong	Middle

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TESTING BAYS. In short, based on the currently available equipment and testing bays structures in UPM and UTeM, it can be said that the facilities are partially complete. There is a few essential equipment needed to better conduct hands-on training for the students with regards to automotive study. The laboratory or hands-on training activities are now only partially done as part of several courses within the curriculum.

COOPERATION. The current level of cooperation between the universities and industrial companies and government agencies in local automotive industry can be considered as good, as stakeholders in the educational degree program, representatives from the automotive industry and related governmental institutions are continuously engaged in improving the program curriculum.

LABOUR MARKET. Based on the employment data of the students after they graduated from the degree program at the universities, it can be concluded that the level of graduate employability within automotive industry is between average to high. Most of the graduates are able to get an employment within 3 months after their graduation.

Automotive industry in Malaysia has several great attributes and has a big potential for future growth, not only in areas of manufacturing and assembly but also in areas of R&D and innovation. A career in the automotive industry can be very diverse, with opportunities for a range of skill sets from sales to accounting to engineering. This means that the industry attracts diverse groups of people, creating a rather interesting work ecosystem. Narrowing on engineering employment, the technological changes in automotive engineering system can be quite complex and they involve a lot of fundamental area of development or knowledge that can be subsequently in other industries like rails, defence, aerospace and others. Furthermore, since transportation industry can be considered as one of the current basic necessities to enable human mobility from one place to another, there are lot of innovations can be seen to be coming into realization such as flying car, autonomous vehicles and electric vehicles. Hence, apart from the excitement of working on something that will directly benefit the society, automotive industry also remains as one of the attractive industries to have a working career due to its interesting evolutionary nature. Along with changes in the industry, the skill sets that are expected for engineers to work in automotive industry have also evolved. Apart from necessary technical engineering knowledge, many employers have also considered some essential soft skills in the hiring process. Among others, these include good problem-solving skills, technical reporting, project planning and management, practical hands-on skills and information technology skills. However, as indicated by many employers, they believe that many graduates still lack those soft skills and this situation can make it difficult for them to fulfil the current work demands and professional expectations from the industry, particularly for R&D works. Some of the possible reasons for this situation include lack of self-initiative of the graduates to explore new set of skills or new emerging technologies, and the lack of hands-on activities during their study. To tackle this issue, the universities have started vast cooperation with few automotive companies and regional municipalities for the establishment of new educational facilities and laboratory centres, and also for the development of educational study programs that are created to simulate real production to enable students to learn under real conditions and hence prepared practically for real life in companies. It is noted that the hands-on exposure to the students within their degree program will depend on the type

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of university that they are studying at. For a research-based university such as UPM, the undergraduate students are only exposed to the related hands-on skills through integrated laboratory testing as part of the theoretical courses. In contrast, for technical university like UTeM, more hands-on contents are adequately incorporated into their curriculum in comparison to the conventional university. In general, most universities in Malaysia have a good relationship with the industries. While a number of collaborations exist, there is still an ongoing need to have more collaborations between universities and business entities in areas such as contract internship for graduates, industrial training placements and also joint researches. To have a better partnering between the university and the industry, several things have to be considered. One of the primary aspects to be taken into account is the mismatched expectations between the university and the industry partner within a collaborative project. Secondly, there is also an issue of trust that acts as a stumbling block for potential cooperation and collaboration, especially in relation to development of new invention or intellectual property. Further initiatives are needed in order to bring both parties to a common understanding for mutual benefits. On a positive note, encouraging feedbacks have been obtained from the representative participants who have been involved in the focus group regarding the readiness of their institution or organization to support and cooperate with the activities within this UNITED Erasmus+ project.

4. Future trends in Automotive Industry in SEA countries

4.1 Indonesia

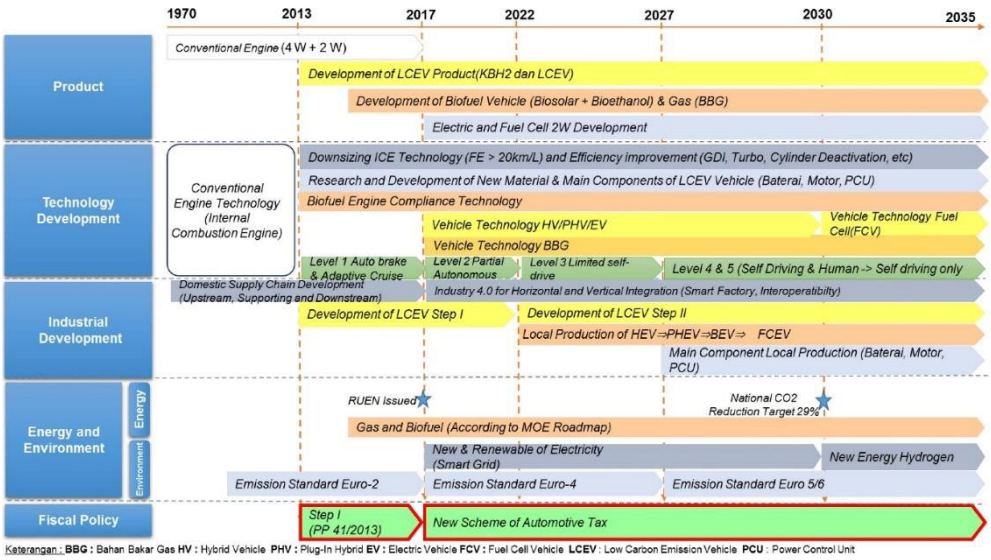

Figure 5 The roadmap of Indonesia's automotive industry

Figure 5 shows the roadmap of Indonesia's automotive industry released by the Ministry of Industry Republic of Indonesia. It consists of five segments: In the product segment, Indonesia is expected to develop Low Carbon Emission Vehicles (LCEV), biofuel vehicles, electric and fuel cell vehicles. In the technology segment, the development includes downsizing ICE technology and efficiency improvement

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through (GDI, Turbo, Cylinder deactivation) research and development of new material & main components of LCEV vehicle (Battery, Motor, PCU), biofuel engine compliance technology, vehicle technology of hybrid, vehicle technology of gas fuelled engine, and vehicle technology of fuel cell. In the industrial development, it is expected to develop industry that can produce main components of LCEV locally. To support these development, a series of supporting regulations such as new schemes of automotive tax will be formulated.

As mentioned above, the total production of four wheelers per year in Indonesia is about 1.1 million. It creates jobs for three million workers in Indonesia. The contribution of automotive industry to the gross domestic product of Indonesia is about 10.4%. As a note, it is the third largest after the food and beverage industry subsector and industrial sub sector of metal, computers, electronics, optics and electrical equipment. According to Indonesian government, the automotive industry is one of the priority sectors to be developed. The automotive industry is still the main destination for investment. The target of automotive production in the years 2020, 2025, and 2030 are 1.5 million, 2.0 million and 3.0 million, respectively. In order to develop the automotive industry in Indonesia, the followings strategies are employed: self-sufficient local production of raw materials and key components, optimized productivity along the value chain, leading automotive export hub, and regional leader in electric vehicles production. The supporting policies are as follows:

- Bring in the investment for component industries
- Increase the capacity of R&D, quality and productivity of suppliers
- Fixing business atmosphere to SME, export and Visa for expatriate in order to bring in the investment
- To create automotive industry line in Northern Java Island
- Development on the factory management and production engineering skills
- Promote investment in R&D&D and transfer capacity of R&D&D to local industry by providing incentive
- Collaboration between university / Polytechnic and automotive industry to provide the needed skills
- Support the expansion service for development of D&D such as CAE and raw material evaluation

One of the main issues in automotive industry is the local content ratio. In other words, which component of the vehicles component can be produced locally in Indonesia. Figure 6 shows the component three of the vehicle. All of the components are divided into three groups. The green coloured components mean they can be produced locally in Indonesia. The yellow coloured components mean cannot be produced fully locally, and the components that must be imported are shown by brown colour.

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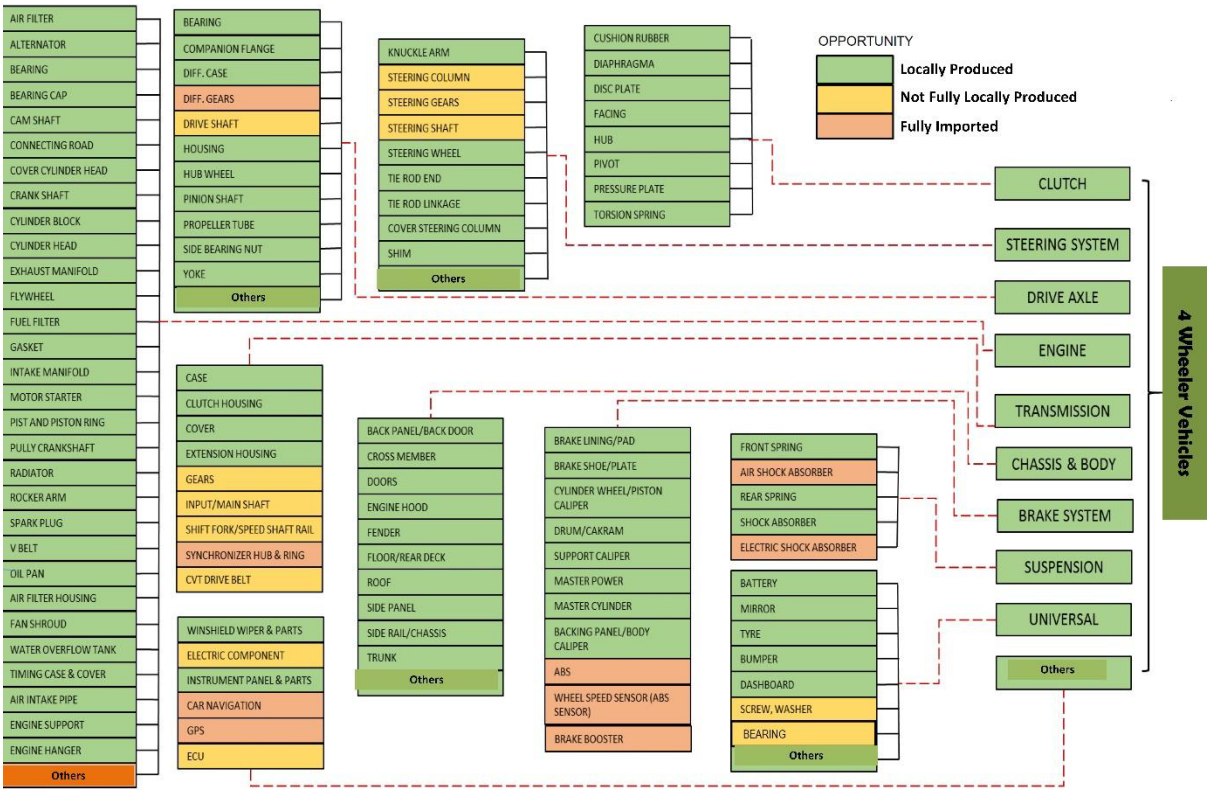

Figure 6 Automotive industry pyramid of Indonesia in producing 4 wheelers

4.2 Malaysia

The current National Automotive Policy (NAP 2014) has clearly stated the focus of Malaysia in future automotive industry. Among others, Malaysia aspires to become the regional hub for EEV, particularly in production of hybrid and electric vehicles (EVs). It is projected that more than 50% of new vehicles sold in Malaysia will be EEVs. Furthermore, efforts are being made to empower the local automotive vendors to become competitive in the market. In the meantime, in 2018, Malaysia has also looked into the intelligent transportation systems with cross-functional applications in advanced manufacturing and advanced IT, with robotics and IoT applications. MARii has been appointed as the focal point for this initiative. The advanced driver-assistance system (ADAS) is an example of safety technology that has been integrated to the vehicles to ensure future road transport is safer as aligned with the NCAP guidelines. Moreover, the third national automotive project has just been initiated in October 2019 with the focus on hybrid electric vehicle. In conjunction to this, internal combustion engine (ICE) with hybrid technology has become the focus of current automotive in Malaysia. In general, these ongoing trends have forced the local automotive industry to become more innovative in making the vehicles to comply with EEV policy and also to attract current and future generation of customers who are more IT savvy and expect more intelligent systems to be integrated within their vehicles. On the other hand, the government regulations, infrastructure and tax incentives will be the key drivers for the growth in this industrial direction. The following provides some of considerations that can be taken into account in order to realize the future direction of Malaysian automotive industry:

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- Government to subsidize certain part/component especially involving local components
- Government to provide incentive for EEV and electric car users like tax rebates or exemption in order to encourage their usage in the society. Subsequently, this can lower the prices of this type of vehicle and make it more attractive in the market
- More grants are required for both industry and academia in order to venture new technology and skills
- Enhancement in human capital and vendor development programs

Research and development (R&D) activities are typically viewed as too risky for most of the automotive players in Malaysia, which has been more focused on manufacturing and assembly. This is because the R&D activities require a high cost of investment. However, with the National Automotive Policy (NAP) 2018 targeting the high technology industry to continue growing to be aligned with the national aim of high income nation by 2020, there will still be some investments on R&D in automotive industry. In line with targeted growth of the industry, the need for engineers is also expected to increase in future. Nonetheless, the required engineers are those with different set of skills as aligned with the Industrial Revolution 4.0 in the areas of IoT, automation, autonomous, robotics and cloud computing. Building this future engineers' expertise is imperative for the automotive industry as the needs in future vehicle or transportation sector are changing drastically. At the moment, the current engineers have geared up towards adapting to changes occurring in the industries but there is a big gap between the current employed engineers in the industries and the fresh graduate engineers. In view of this, the skill changes need to be adequately addressed at the university level to ensure smooth continuity of future trends in automotive industries. Among others, problem solving skills, technical reporting, project planning, project management, technical know-how and innovative development related to autonomous system have been identified as the key critical knowledge domains needed in near future. Most of the industry requires their engineers to attend various courses relevant to the above knowledge.

All in all, human mobility will remain as one of the cores in life and the world population will continue to increase year by year. By developing sustainable industrial ecosystem for the automotive industry including the vendor development in automotive components and R&D, it can increase employment and national GDP growth. Benefits at national level will open the opportunities for local engineers to gain new technical knowledge, experience and career platform. In addition, on the international basis, there will be global technology sharing between countries.

4.3 Thailand

Thailand's overall automotive sales are expected to be weak in 2019 from the contraction in the domestic market and the sluggish export volume growth. Meanwhile, high growth in the EV segment will continue to support the industry. Hence, the Thai government is persistently trying to encourage the manufacturing of EVs and high-tech auto parts through promotion of BOI incentive packages. In 2018, the government approved projects to produce HEVs and batteries by Nissan Motor Co and Honda Motor Co valued up to US$888 million (THB 28 billion). Meanwhile Mazda Motor Co was granted investment privilege to manufacture HEVs and has decided to apply for production of full EVs in Thailand. Many other manufacturers also plan to invest and are studying for possible opportunities or are in the process of application for the BOI package. EV segment still contributes very little to Thailand's automotive market, but we can expect a ramp up in production and an increase in adoption over the next few years.

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Figure 7 Automotive manufacturers applying for BOI package to produce EV cars [Credit: kasikornbank 2019, [1]]

Automotive Industry in Thailand has to be changed into 'Global supply chain', which should not be only the manufacturing factory-basis (as in the past) but should be also Research & Development basis (global automotive trends in the future). This should also include energy saving, green energy, safety standards and ASEAN commission. ASEAN commission would provide benefit for Thailand about larger marketplaces for automotive products. However, would have drawbacks about higher competition among Asia countries both investment cost and products. This leads Thai Government to drive national automotive industry to global markets by the following vision "Vision 2021" and drive the Automotive Industry master plan (2012 - 2016) as follows:

VISION 2021

Thailand is a global green automotive production base with strong domestic supply chains which create high value added for the country"

* Environmental friendly & International standard

Strategic Plan

3 Centers of Excellences (COEs) + 2 Environments (ENVs)

COE-1: Technology, R&D

Capability building in technologies and R&D on automotive products (energy saving, green energy products, high standard for safety)

- Alternative and renewable energy
- Light weight vehicle
- Vehicle safety (Action safety, Passive safety and ITS Technology centres)
- Advanced production technology

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COE-2: Human Resources Development

- Integrated AHRD System Development
- Capability upgrading
- AHRD Alliance

COE-3: Entrepreneur Strength Enhancement

- Global sourcing and module

ENV-1: Green Infrastructure

- Supporting COE-1, COE-2 and COE-3

ENV-2: Policy Integration

5. Summary: Proposed Training topics for future UNITED trainings

Summarizing the national status-quo reports the topics suggested for the trainings to be conducted under the UNITED Erasmus+ project can be divided to following topics and subtopics:

Main Topic	Proposed Sub-Topic
ICE to hybrid / electric powertrain	· Electric vehicles integrated with renewable energy sources for sustainable mobility, especially electric engine system architecture
Mechatronic systems in automotive engineering	· Mechatronics aids in embedded system design
Vehicle / body design & safety	· Current development in active safety technology
Vehicle dynamics	· Autonomous vehicle dynamic behaviours and ADAS vehicle dynamic control system

Several other relevant topics that reflect the current needs of industries and SEA universities are summarized as:

- Application of the latest Formula 1 technology to improve new generation of ICE, hybrids and energy recovery for the future
- Application of latest Formula-e technology into electric vehicle
- Autonomous vehicle that drive transportation for the future
- Safety of handling and repair maintenance of modern vehicle i.e. EV, hybrids and autonomous vehicles
- New mobility to transform from own vehicle to shared vehicle
- Green mobility and transport system to reduce effect of greenhouse

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- CAE optimization for virtual development

The installation of testing bays could serve the industry in many ways such as crash test, research on engine performance, development of vehicle subsystem, component testing according to standards, emission standard testing and many others. Among the services that are currently needed by local automotive industries include powertrain testing facilities, engineering service and development, testing facilities and reliability as well as durability testing. Furthermore, some of the expected benefits from having the test bays at the universities to the students are improvement of the knowledge related to automotive engineering, creation of more competent talents, increased practical skills, provision of hands-on experience related to vehicle examination and opening of new researches to the universities 'researchers that will improve in-class teaching with relevant examples taken from the researches.

6. References:

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