Co-funded by the Erasmus+ Programme of the European Union

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

1.2 UNITED Gap Report

Gap Report

WP 1

The GAP report summarizes the differences between the EU automotive industry development agendas and efforts and the Indonesian, Malaysian and Thai automotive industry and their understanding of the importance of laboratories/test bays.

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

Table of Contents

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

1. Aims & Objectives of the Gap report

The objective of the GAP report is to summarise the GAP analysis. The GAP Analysis is aimed to show differences between the EU automotive industry development agendas and efforts and the Indonesian, Malaysian and Thai automotive industry and their understanding of the importance of laboratories/test bays.

Generally, the GAP analysis supports the UNITED project and the SEA partners from Indonesia, Malaysia and Thailand in determining **what steps need to be taken in order to internationalise the national automotive industry and to focus more on innovation and development to increase the reputation of the national automotive industries**.

Gap analysis consists of (1) listing of characteristic factors (such as attributes, competencies, performance levels) of the present situation ("what is"), (2) listing factors needed to achieve future objectives ("what should be"), and then (3) highlighting the gaps that exist and need to be filled in the area of automotive and mechanical engineering. The GAP analysis within the UNITED project forces all partners to reflect on who the country is currently in terms of automotive and mechanical development and engineering efforts and ask who they want to be in the future.

The findings are **value-free and just a review of the current situation** – this is an essential fact as the project **should not judge the participating countries** in terms of their efforts taken.

2. Description of Methodology

This section describes how the GAP analysis was performed. It lists the sections included in the gap analysis and the methodology how the information and feedbacks were gathered.

How this methodology was adopted?

We decided to use this methodology in kick off meeting in Graz. The preliminary draft was agreed between the partners and Politecnico di Torino (PTT). The initial form of the document was proposed by Grant Holder (Hanna) and PTT and FHA modified the proposed document.

List sections included in GAP analysis

- Degree programs
- Competences & Skills of professors and Students in such areas
  - Vehicle design
  - Control systems & Autonomous and Connected Vehicles
  - Industrial Processes
- Availability of testing bays in the universities
- Hands-on training offered for students in the universities
- University – Business Cooperation
- Employability of Graduates
- Trends in Automotive Engineering, Offer/Response of the universities

Where did the information come from?

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

Information is gathered from all the Academic and Industrial Partners, Industrial partners of the universities not involved in UNITED project

Who was asked for input and giving feedback?

All the partners are asked to give a feedback on the Gap analysis to be implemented in the final version of the report and in the Comparative report.

3. Development of Automotive Industry in European and SEA countries

3.1 Development of AE industry in European countries ["what is"]

Italy

Automotive Industry in **ITALY** accounts for more than 100 bln euros of industry turnover, i.e. with 4.3 % of GDP of Italy. More than 1.2 mln people are employed in Automotive Industry related companies. The industry exported product equal to 45 bln euros in 2017. Annual investment in R&D accounts approximately 1.8 bln euros, i.e. 12.7% of R&D spending of manufacturing sector in Italy. Around 5700 companies are involved in production of automotive related components and parts.

Germany

Automotive Industry in **GERMANY** accounts for more than 423 bln euros of industry turnover. More than 820,000 people are employed in Automotive Industry related companies. The industry is export oriented with 78% of products exported in 2017. Annual investment in R&D account approximately 22 bln euros in 2017. R&D personnel accounts around 114,000 people. Around 945 companies are involved in production of automotive related components and parts.

SOURCE: https://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Industry-overviews/industry-overview-automotive-industry-en.pdf

Austria

Automotive Industry in **AUSTRIA** accounts for more than 19 bln euros of industry turnover, i.e. 5.16% of Austrian GDP. Approximately 35,000 people are employed in Automotive Industry related companies. The industry is export oriented with 88% of export quota. Annual investment in R&D account approximately 1bln euros. Around 222 companies are involved in production of automotive related components and parts.

3.2 Development of AE industry in SEA countries ["what is"]

Indonesia

Automotive Industry in **INDONESIA** accounts for more than 10% of Indonesian GDP, which is around 1 trillion euros. Approximately 1.2 mln units of vehicles are produced in Indonesia, including joint companies with seven Japanese car makers. The industry produces vehicles and components for mainly local market, only

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

small portion is exported. Around 42,000 companies are involved in production of automotive related components and parts.

Malaysia

Automotive Industry in **MALAYSIA** accounts for more than 8 bln euros of industry turnover, i.e. 4 % of Malaysian GDP. Approximately 800,000 people are employed in 667 Automotive Industry related companies. Around 1 mln. vehicles are produced in the country, from which approximately 20,000 were exported (2%). Annual investment in AE R&D account more than 1.6 bln euros. Around 641 companies are involved in production of automotive related components and parts. Several Governmental initiatives are ongoing to support the R&D in AE industry.

Thailand

Automotive Industry in **THAILAND** is the biggest among SEA countries and accounts for more than 26 bln euros of industry turnover, i.e. around 6-10 % of GDP of Thailand. Nine OEMs are operating in AE industry and more than 2 million cars produced in 2018. Annual investment in R&D account approximately 1 mln euros.

3.3 Differences between the development of AE industry in European and SEA countries

AE industry in European countries includes mainly local companies, whereas SEA countries have the joint companies established with other foreign countries. The European companies are mainly export oriented and includes all the stages of production process (starting from raw material to complete automobile). High percentage of investments on R&D of AE related products can be highlighted. Instead, in SEA countries the AE industry is based on a vehicle assembling with relatively high component production localization. The AE industry produces vehicles for local markets, with low percentage of exports to SEA countries, mainly. Based on Status-Quo Analysis, it seems that the R&D in product development and innovation is relatively high in Malaysia.

4. Education in Automotive and Mechanical Engineering in European and SEA countries

4.1 Education in AE and ME in European countries ["what is"]

Politecnico di Torino (PTT)

PTT offers an Automotive Engineering degree for both BS and MS level students. In total 567 BS and 434 MS students are currently enrolled in courses offered by AE degree program. More than 10 full time and 11 part time professors and researchers teach the courses. More than 100 researchers are involved in different research projects in AE field. Most of the topics mentioned in the GAP analysis are covered in the courses, however some topics related to ADAS and Connected vehicles currently are not covered (planned to be

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

covered partially in the master degree program in ICT For Smart Societies). The extensive research in all the mentioned topics are carried out by different research groups of PTT with vast of experience and competence in the field.

FH Aachen (FHA)

FHA offers an Automotive Engineering degree for both BS and MS level students. In total 387 BS and 93 MS students are currently enrolled in courses offered by AE degree program. 14 full time and 8 part time professors and researchers teach the courses. 5 researchers are involved in different research projects in AE field. All the topics mentioned in the GAP analysis are covered in the courses. The extensive research in all the mentioned topics are carried out, therefore researchers have vast experience and competence in the field.

FH Joanneum (FHJ)

FHJ offers an Automotive Engineering degree for both BS and MS level students. In total 190 BS and 86 MS students are currently enrolled in courses offered by AE degree program. 18 full time and 24 part time professors and researchers teach the courses. More than 20 researchers are involved in different research projects in AE field. Most of the topics mentioned in the GAP analysis are covered in the courses, however some topics related to Industrial processes (powertrain production, Industry 4.0) are not covered. The extensive research in all the mentioned topics are carried out, therefore researchers have vast experience and competence in the field.

4.2 Education in AE and ME in SEA countries [“what is”]

Indonesia

The partner universities in Indonesia do not offer AE degree programs separately, but limited teaching offer on AE related topics are covered within the ME program courses. The topics related to Vehicle dynamics and electrified powertrains (HEV and EV), ADAS and Connected vehicles are not covered. Topics related to Industrial processes (i.e. production processes, Industry 4.0 and production plans) are not fully covered, as well.

Malaysia

The partner universities in Malaysia do not offer AE degree programs separately (planned to offer from upcoming Academic year), but limited teaching offer on AE related topics are covered within the ME program courses. The topics related to Vehicle dynamics and electrified powertrains (HEV and EV), ADAS and Connected vehicles are not covered. Topics related to Industrial processes (i.e. production processes, Industry 4.0 and production plans) are not fully covered, as well.

Thailand

The partner universities in Thailand offer Mechanical and Automotive Engineering programs for BS and MS students (CKU offers Automotive Engineering and MSU offers Mechanical engineering courses). Vehicle design part of the AE courses is offered in both universities. Professors of two universities have advanced knowledge and experience in the part of Control Systems & ADAS and interconnected vehicles. However, the teaching of the topics of included in this part is not foreseen in teaching plans. Topics related to Industrial

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

processes (i.e. production processes, Industry 4.0 and production plans) are covered in CKU, but the topics are not foreseen in teaching plans for MSU students.

4.3 Differences between the education in AE and ME in European and SEA countries

In all three EU partner universities the AE degree program is offered separately from ME, instead in SEA partner universities AE degree programs are not run separately. The topics listed in the GAP analysis form are partially offered within ME degree program courses. In some SEA universities, a lack of competences in Vehicle dynamics and Electrified powertrains (HEV and EV) can be highlighted. While competences in ADAS, connected vehicles and current trends in Industrial processes seems to be lacking in all the partner SEA universities.

5. Implementation of laboratory concepts / testing bays in European and SEA countries

5.1 Implementation of laboratory concepts / testing bays in European countries ["what is"]

Politecnico di Torino

In PPT several testing bays related to AE are currently running to provide hands-on learning for students. The testing bays include such test beds like: Front Engine Accessory Drive test bed for testing the Mild and Micro HEV, Virtual Test Simulator for ADAS, Engine test beds, Shaker test stand, Transmission test beds, Brake test beds, Vehicle dyno, Dynamic testing machine for ICE and others. From 2020, the university is seeking to establish new test bays to enhance research and education in Connected Cars and Advanced Driver Assistance Systems, electrified and alternative powertrains. Such test bays will allow performing experimental tests of complete vehicles and the experimental characterization of HEV/EV powertrain components. Racing teams of different completions like Formula Student HEV, Electric, Alternative Powertrain and Formula Student ADAS allow students to have more hands-on learning of the offered courses.

FH Aachen

In FHA different testing bays related to AE are running to provide hands-on learning for students. Battery test stand, Climate test stand, Shaker test stand, Crash-Sledge Facility, Vehicle Assembly Area, Quasi-Static crusher and Chassis dyno 2WD are some of the test bays currently present in the university. The universities test bays are planned to be equipped with 4WD chassis dyno with emission measurement device EU6d conform and portable emission measurement system (PEMS) starting from 2020. Racing teams composed of students allows them to enhance hands-on training.

FH Joanneum

In FHJ, there are 14 testing bays, used for Student's project and thesis work, cooperation with companies and universities' R&D. The test beds include Acoustics laboratory, drive train test beds, Engine test beds, Chassis Dyno and others. The university is seeking to cover alternative powertrain development through the testing bays. Internships, Project works (group of 3-4 students) and Racing teams are used to enhance hands-on training of the students.

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

5.2 Implementation of laboratory concepts / testing bays in SEA countries ["what is"]

Indonesia

The testing bays in USU and UNUD are limited to internal combustion engine test bench. The universities are *seeking to cover conventional and electric vehicle testing through the testing bays in future.*

Malaysia

The testing bays level in UTeM and UPM differ substantially. In general, the universities have engine test cells, gas analysers and different types testing equipment's for testing the material properties. The universities are seeking to cover conventional and electric vehicles, ADAS and vehicle impact tests through the testing bays.

Thailand

The testing bays in MSU and CKU include Engine test cells, where students can learn the engine control systems. The universities are seeking to cover conventional and electric vehicles (including agricultural vehicles for MSU) tests through the testing bays.

5.3 Different approaches regarding the implementation of laboratory concepts / testing bays between European and SEA countries

The range of the equipment in the testing bays in EU and SEA countries differ substantially. The testing bays in EU partner universities is sufficient to cover most of the AE related laboratories. SEA partner universities have testing bays mainly limited to Engine test cells (except UTeM, which has a vast list of the lab equipment in AE related fields).

The universities are seeking to cover Electrified powertrain, Connected Vehicles and Autonomous driving research and education through the testing bays in future. In addition, universities seem to be lacking the competence of managing the test bays.

6. University / business cooperation and employability in Europe and SEA countries

6.1 University / business cooperation and employability in Europe ["what is"]

Politecnico di Torino

PTT has good cooperation with AE industry. The Master level courses offered in PTT are co-led by industrial engineers. Furthermore, the Master thesis works can be co-supervised by the company engineers or done directly in the companies like FCA, CRF, Dayco, Magneti Marelli. The students can have stage/internship in the AE related companies. FCA group and other industrial partners support the Formula Student Team to

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

enhance the cooperation between university and the company. Automotive engineering program was initially established in Partnership between FCA group and the university. Industrial research projects, partnerships (like one with FCA - Polito), University Alumni and Seminar led by AE professionals helps to strengthen cooperation between PTT and Industry in AE research and education. The university is involved in wide range of clusters and associations. PTT has high employability rate of the students, with 88.6% of Master's graduates can find jobs in their field of study. They are occupied in the field of Vehicle and it's component design and testing, Powertrain development and testing, engine control system and Process engineering. The University supports the students to increase the employability by updating the course contents frequently to meet the new industrial challenges based on the results of the projects, by spending stages in companies, by involving the students in industrial projects. Working on Thesis work under co-supervision of specialist from companies, participating in student racing teams and Hands-on trainings, additional knowledge of CAE tools used in AE, studying interdisciplinary degree and having soft skills (language and report writing) are key success factors for graduates to be employed in good companies.

FH Aachen

FHA has practical works organized in companies included in the study plan of the BS and MS students. Project works, BS and MS thesis of the students can be carried out in companies (Ford, Porsche, FEV, etc). Industrial research projects, public funded projects by federal or German ministries, Network and cooperation contracts are used as alternative channels to improve the cooperation between the University and business. FHA is a member of 7 top universities of Applied Sciences in Germany (HAW7). 90 % of graduates of FHA can find jobs within 3 months. Most of the graduates are employed in Automotive Industry (40% directly at OEM, 40% at Engineering Companies, 20% rest like TÜV and non-automotive). Adjust the curriculum in close alignment with industry needs (e.g. Industriebeirat) seems to be key success factor for graduates to be employed.

FH Joanneum

FHJ has good cooperation with the AE industry related companies. Students have to do internships in industry (BS – min 450 hours and MS – min 350 hours). Furthermore, Formula student racing teams are supported by major AE companies. The university has wide cooperation with national and international clusters and bodies. Different projects with industrial partners, involving academic and scientific staff, as well as students are used as additional channels to cooperate with companies. Lecture series in AE by invited guest speakers from companies are organized to enhance the cooperation. More than 98 % of graduates can find jobs within three months, which are mainly occupied in AE related fields, such as Powertrain development, Control Systems, Technical Design, Drivetrains simulation and E-Technique. University supports student's employability by adapting their competences to industrial needs, by merging scientific and industrial teaching, by inviting lecturers working for automotive companies to teach the courses and by promoting internships with partners. Key success factors for graduates of FHJ to be employed are: Working on final thesis in cooperation with companies, having business & linguistic additional skills, participating in formula student projects, invitation of professionals from companies as lecturers, combination of mechatronic degree focusing on automotive engineering and frequent hands-on training during studies.

6.2 University / business cooperation and employability in SEA countries ["what is"]

Indonesia

In USU and UNUD send the students to companies for having some internships in companies or to work on minor projects (usually related to final project). The faculties of the universities cooperate with the national clusters and associations related to AE, like BP2TD and Land Transportation Education and Training Agency. In average, more than 50 % of graduates can find jobs within three months. The main field of occupation of

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

the graduates is related to the maintenance and sales of the vehicles. Job fairs are organized to support the employability of the students. Key success factors which help graduates to be employed are having soft skills, language proficiency and additional certificates.

Malaysia

In UPM and UTeM industrial training/internship (10 weeks) is compulsory for the students. Industrial experts are invited to train/teach students and also examine the engineering programs. Technical talks and consultations projects are organized to allow students to work on industrial projects and research. The faculties of the universities cooperate with the international and national clusters and associations related to AE, Society of Automotive Engineers (SAE), Malaysia Automotive Institute (MAI) and Malaysia Institute of Road Safety Research (MIROS) are being some of them. In average, more than 80 % of graduates can find jobs within three months. The main field of occupation of the graduates is related to the AE and to manufacturing sector in general. Job fairs are organized to support the employability of the students. Key success factors for graduates to be employed are: having practical skills, soft skills and having curricula aligned with AE industry needs. Furthermore, involvement of stakeholders in the university life is an additional factor.

Thailand

In CKU and MSU have different levels of cooperation with the companies. In CKU 7 weeks of industrial training is mandatory for the students. Industrial experts are invited to train/teach students. Feedbacks from the industry are also taken into account in the development or update of the curriculum. The faculties of the universities cooperate with the clusters and associations related to AE. More than 80 % of graduates can find jobs within three months. The main field of occupation of the graduates is related to the AE, however includes field of sales and warranty services of vehicles as well. Job fairs are organized to support the employability of the students. Key success factors for graduates to be employed are: having practical skills, hardworking, soft skills including English proficiency and ability to work under high pressure.

6.3 **Differences between university / business cooperation in European and SEA countries**

The European universities have high-level cooperation with the AE industries. Universities in SEA countries have limited cooperation with companies. In the EU universities the organization of racing teams, spending stage/internships in the companies and having industrial project related research topics for the students are main reasons to have good cooperation between universities. In SEA universities, spending stage/internships in the company is the main way of cooperation between universities and industries. The high majority of graduates of the European universities can find jobs within short time in AE related fields of occupation. Even though the employability rate of the graduates of SEA universities is high, the graduates are not mainly occupied in the field of their study. The key factors for graduates of European universities is having practical oriented curriculum aligned with the needs of the industry, whereas for the universities from SEA countries having soft skills (language proficiency, communication) is the main factor to find job in short time.

7. Summary and Conclusions

7.1 **Gaps that exist and need to be filled**

- AE degree programs are not run separately from ME. Limited teaching offer on AE related topics.

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP

- All SEA universities have lack of competences in Vehicle dynamics, electrified powertrains (HEV and EV) Crashworthiness, electrified powertrains (HEV and EV), ADAS and connected vehicles, and Industrial process education.
- The universities lack Testing bays in the field of Electrified powertrain, Connected Vehicles and Autonomous driving labs. Lack of competence of managing the test bays also can be highlighted.
- Limited number of topics are supported by hands on trainings in all the universities.
- The universities have limited to good level of cooperation with the companies. This is probably due to low level of cooperation of students with the companies.
- High employability rate of graduates, however some of graduates do not find a job in automotive industry.
- The universities have limited development of new trends of Sustainable Automotive industry like electrification, autonomous and connected vehicles.

7.2 Factors needed to achieve future objectives [„what should be“, what is needed for that]

- To handle specific needs coming from AE industry activation of dedicated AE program, organization of trainings to setup new courses are needed. Specifically, universities need training on vehicle dynamics (longitudinal, lateral) and Electrified powertrains, Autonomous and Connected vehicles, and Industry 4.0 and production plants.
- The list of test equipment to accomplish hands-on lessons needs to be generated and purchased. Training in using the test equipment and managing the test bays should be organized.
- Setting up multidisciplinary projects to link different AE courses in one study case (Numerical or Experimental + Numerical) can help to link the university and industries by addressing the needs of latter. These projects could be inspired by industrial partners.
- For further improvement of the University-Company cooperation organizing seminars, stages involving local industrial partners can be beneficial. To foster a research cooperation example of cooperation projects between University and companies can be demonstrated by European universities. Furthermore Stages, cooperation projects, study cases proposed by the industry, Organizing Career days and Company days helps to improve the employability of the graduates.
- Need to organize the training courses, as well as cooperation projects in vehicle electrification and autonomous vehicles.

Annex: Excel table Gap analysis

Feedbacks

The Gap report was modified according to feedbacks from SEA partners.

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein. Project number: 598710-EPP-1-2018-1-AT-EPPKA2-CBHE-JP