



**Discussion of differences and efforts
in automotive engineering
among European and Latin American countries**

1.2 Gap Report

To show differences between EU automotive industry development agendas and efforts and the Latin American automotive industry



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Aims & Objectives

The aim of this report is to outline the main gaps which have been identified in the comparative report. Further implications and suggestions for the training curriculum development are retrieved and discussed in detail. This report serves to detect the main training needs of Latin American partner institutions, which further can also be filled by the ASCENT training developed by the European partners. This report will first outline the methodology used and recap the results from the comparative report before starting a discussion on identified gaps.

Methodology and Approach

The methodology is simply explained: Identified weaknesses and strengths retrieved out of the comparative report let perceive easily the training needs. However, as the needs are not always related to skills, the gaps identified are structured as follows:

- **Educational gaps**
(more practical training related to requirements of the industry, more soft skills training and more theoretical-experimental knowledge and less pure technical knowledge)
- **Infrastructural gaps**
(to initiate supporting services to the industry, installations must follow standards, must be supervised, certified machines fitting to the purpose of the competence centre) * certified machines for the industry cannot be used for educational purposes!
- **University-industry collaboration gaps**
(there are different perceptions in universities and industry concerning their role in a collaboration scheme, standards have to be set in order to facilitate the workflow)

This structure is fully addressed and fulfilled by the project plan. Thereby **educational gaps** can be addressed through the ASCENT training on engineering trends, training of the trainers and soft skills as well as on the subsequent establishment of the competence centers.

Infrastructural gaps are mainly addressed by the selection process and the buying of new equipment, which will be used to support the competence centers. However even before the training, we will also address aspects related to the management of testing bays as well as equipment needed in order to improve the quality of new skills taught (e.g. software, certifications) and will therefore also treat the question of infrastructural gaps at participating institutions. The universities from Latin America have the possibility to benefit from experience European universities do have.

At last **university-industry collaboration gaps** are handled in several module as well as throughout the project, by the competence centers, which will offer services to companies and the project itself, which aims into enhance collaboration among both parties. Starting with some basic knowledge on what parameters need to be fulfilled in order to cooperate successfully with industry, followed by concrete examples for university-industry collaborations which shall be discussed in the module Testing Bays.

Apart from the structure mentioned above the following discussion is based on the results of the comparative report which displayed training needs for:

- Engineering trends (e.g. Safety Management, Quality Management, E-Mobility, Lightweight Design)
- Soft skills
- Testing bays & technical skills
- University-Industry cooperation

Discussion on previous findings and its implications

The previously suggested training topics (see focus group guideline) have been considered as important by different industry experts from all participating countries and have been discussed deeply. Details from experts coming from OEMs, Automotive Associations and other companies dealing with the automotive sector have been taken into account. Out of these discussions the results are shown in the country reports and were considered in this report in order to be implemented in the ASCENT training.

Challenges and training needs faced by partnering institutions are different and the skills required from engineers are different. However, similarities were found and the needs for high expertise of engineers in Quality Management and Soft Skills, apart from Marketing (which is not in the scope of this project) as well as more intensive practical-trainings are highlighted regularly by all participating countries and institutions.

Another issue the experts have mentioned often, was the up to date knowledge on future trends in the automotive industry. This knowledge is important for all graduates and also for already employed engineers to understand the needs and aims of their employers.

Due to the fact that the automotive industry was “born” in Europe, the partners from non-European countries in Latin America desire an upgrade of technical skills of their students. As participating countries are mainly production based countries they think that more emphasis on R&D and software skills is needed in order to be competitive on the global market. This is basically needed in order to give graduates a higher chance of a well-paid employment after university or also to continue being attractive for companies.

Furthermore, it was discussed intensively that the hands-on training and in this context also the cooperation with universities is crucial to prepare future engineers and to create a win-win situation. Thereby both, universities and companies expressed the wish to collaborate more with universities. The challenge faced is that neither companies nor universities do have a “business plan” or a clear idea on how they should start such collaboration – having security that it will be fruitful for both. Thereby they face bureaucratic hurdles but also do often not know where to get advice etc.

Technical skills alone are insufficient for engineering professionals and engineers’ career success. Soft skills play a very important role in differentiating engineers during employment and during career development. When analyzing the outcome of the interviewed experts from all participating countries **Soft skills** for engineers seemed to be a very hot topic. When summarizing the content, especially the adaptability of engineers and the ease to handle change, the ability to teamwork, understanding and transferring the industrial demand of the automotive industry into developing a product, which can be sold later on, where named as important skills.

Furthermore, a certain amount of creativity as well as the ability to solve problems, even if they are outside their specialization, should be taught in a good engineering education. Last but not least is the ability to communicate in an understandable way. To sum up, another essential point together with the education of future engineers, namely the ability to adapt to a lifelong learning process.

Experts put emphasis on the following topics, and underlined that those are very crucial for both, companies and students:

- Global trends in engineering, Quality and Innovation Management, Devices and Measurement of pollutant emissions from combustion engines. (see Module 1)
- Test benches and testing procedures (road test) with hands-on training possibilities. Design of testing laboratories (see Module 4)
- To create internships and programs for postgraduate students is a desire among experts from universities and companies in Latin America. Furthermore, a mandatory part should also be integrated into the curriculum for undergraduates. (see Module 2)

Another important aspect that appeared from desk research and focus group interviews was to be trained on “how to increase collaboration” among HEIs and industry. Therefore, the consortium agreed that one module should especially be dedicated to the training of trainers in order to teach them among other related issues “How possibilities of cooperation can be identified (proposals, joint developments, understanding mutual needs and capacities)”. Moreover, this aspect should also be partly integrated into the other module. (Module 2 “Train the Trainer – Identifying Opportunities of Collaboration) Furthermore, in Module 4, examples on how collaborations can be established between universities and industry using the test bays should be analyzed.

The regularly mentioned university-industry gaps have the positive precondition that all partners from Mexico and Argentina have received very positive feedback from industry partners. They have expressed their interest in the project and further collaboration; both parties confirmed that more proximity and a regular communication and exchange basis is needed to create a win-win situation.

The country reports have already listed well discussed suggestions on how to establish such cooperation in order to retrieve benefits for all participating countries. (esp. country report Argentina) Industry-experience before graduating and starting to work is essential in the automotive industry and was identified as a gap among participating non-European universities.

Suggestions and Considerations for the Training Curriculum Development

This part serves as input for the further development of the ASCENT training. The aim is to summarize and structure all relevant areas that have been discovered as needs of non-European partner countries on the one hand, and can be addressed by the availability of experts from European partners on the other hand.

Overview & Structure

Already in the proposal a “draft structure” of the training was developed. Now, after the desk research and the focus group were carried out, most considerations were confirmed and enable us to draw a clear sub-structure of each module. However, the structure can still be adopted according the needs of the Latin American partners and current market trends, if necessary.

The module “University-Industry-Collaboration” was added, because of its high relevance and the clearly related identified gap in Latin America (ref. mechanical engineering/automotive industry). Furthermore, elements fostering this kind of cooperation will be added to the other modules as well.

It is recommended and reasoned by results that the development of a training with the following modules is able to address all identified training needs:

- 1) Engineering Trends
- 2) Training of Trainers & – Identifying Opportunities of Collaboration
- 3) Soft Skills
- 4) Testing Bays / Collaboration between industry and university

CONSIDER!

- Some topics should be addressed whenever possible and adequate to the content treated: e.g. safety management, quality management, innovation management, managing testing bays and its certifications.
- Considering the scope of the training it will not be possible to include all topics which have been named as to be important by experts.
- University-Industry collaboration gaps should be addressed whenever possible as this demand is related to all modules (hands-on training, knowing industry needs, testing bay operation, negotiation tactics etc.)

In the following the collected input from the comparative analysis is listed and linked to the planned modules:

1. ENGINEERING TRENDS

ENGINEERING TRENDS can be found in a variety of areas and are of course relevant especially for graduates or future engineers. It is not easy to limit the scope of this topic and therefore 3 days of training dedicated to engineering trends are planned. The following hot topics have been selected as to be the most relevant by our partner institutions in Latin America.

From expert interviews in Latin America we got to know that respective skills needed for **Quality Management** in the automotive industry are needed. As this topic will definitely become even more important in the future and will support our partners not only in raising its quality but also in intensified cooperation with companies (e.g. through implemented quality management it is possible to get certified and to cooperate with the industry), this was selected to be part of the ASCENT training. Another group of experts added that the use of statistics and **Six Sigma** as well as control tools for quality management would create a high additional value for (potential future) employees and the companies.

Through a H2020 Project called “DRIVES” of the coordinating institution of ASCENT a training in order to certify students for **Quality Management** specifically in automotive engineering is currently updated and further developed and can be introduced to the ASCENT trainees. This need can be fulfilled even by using the output of other EU funded project which we think is a great value –added for both projects and all involved parties.

Safety Management is identified as a gap – already in the comparative report. However, one must differentiate between the usual safety management in plants or at work and functional safety management that relates to the safety of cars for example.

Functional Safety Management is planned to be introduced in Module 1 under the aspect of “future engineering trends in the automotive development”. The safety management of production plants, as well as the Quality Management will be covered when production trends such as Industry 4.0, Digital Factory, Agile Production and fundamental productions strategies are discussed. Several methods for production planning and control (predictive maintenance), production optimization and operations management are included.

All desk research and focus group reports have shown the significant importance of **Alternative Power Systems**, which is responsible for a re-thinking in all related areas. The importance to equip students with related challenges, solution-finding and the state of art in research today has been highlighted various times. Furthermore, the topics powertrain, trends in electric powertrains and in fuel cell powertrains in order to increase efficiency and protect the environment, will be presented as well.

Lightweight materials, a topic which was of further interest of the Latin American universities, will be presented when talking about advanced vehicle aspects and trends. Explicitly the trends in body design and hybrid architecture are covered there.

Furthermore, further trends in automotive engineering, such as **autonomous driving, assistance systems, car-sharing concepts, Big Data and Car Connectivity** are taken into account during the trainings.

2. TRAIN THE TRAINER & – IDENTIFYING OPPORTUNITIES OF COLLABORATION

In order to equip ASCENT trainers, working in the competence centres, with the necessary “toolbox”, this module will explain how training needs can be identified, how activities can be designed with a didactical perspective and how competences can be evaluated.

Furthermore, the **promotion of University – Industry collaboration** turned out to be an issue that needs to be improved in our non-European partner countries. The universities in Latin America can profit from the long lasting experience the European universities do have in this area.

The following should be considered and if possible included / enhanced and will be dealt with during a 3-days training:

- Improved communication & the right contacts – to involve especially the relevant departments of companies as well as of universities into the communication processes (management, human resources, legal department etc.) to develop clear channels and procedures in order to develop joint projects and programs. Therefore, it is also necessary to gain knowledge on how companies work, which departments are needed as well as the suitable management techniques in order to facilitate the process.
- The possibility of exchanging contacts should be used during the implementation of ASCENT and continued after the project end. Thereby it is important to bring also the responsible persons and influencers to common meetings as for example to the cross-border conference. The European university will give best practice examples on how the industrial partners can be addressed on a continuous level by organizing events etc.
- Clarify the scope of flexibility, adaptability and availability of resources of both parties. Name experts at each competence center, who are willing and able to handle the cooperation on a professional level.
- Establish clear rules and objectives to develop a better understandable structure of cooperation. This includes a common framework with forms, legal framework and a proper calculation for (contract-) research.
- Educational institutions should learn how to “sell” their capabilities better (labs, faculty members,...) in order to foster the interest of the industry. Therefore, it is necessary to have a representative website, informative flyers and brochures in order to sell your research abilities in an effective way. Furthermore, the institution should be able to sell their ideas anytime in an understandable way (Elevator Talk).

3. SALES MANAGEMENT - SOFT SKILLS

The Status Quo analysis of the universities in Latin America showed that technical skills alone are insufficient for engineering professional engineers' career success. Soft skills play a very important role in differentiating engineers during employment and during career development. However, this thesis is also supported by the research of European studies in that area. As foreseen in the proposal sales management strategies in order to be able to successfully establish a competence centre and to sell the services are addressed hereby.

The Spanish partner institution (UAB) is specialized on Soft Skills, Module 3 is going to be led by this partner and dedicated to communication, negotiation, and presentation techniques. The remaining European partners will contribute to this module specially to align input with the needs of engineers and the automotive industry and to deliver practical examples in the context.

Communication will be one of the major topics during this training. Develop engineers who can work together in multidisciplinary teams, overcome interpersonal challenges working in interdisciplinary teams, and become persuasive communicators is a critical need for any engineering profession. Therefore, different techniques of Feedback talk, conflict management and moderation techniques etc. are dealt with. Active interpersonal communication skills using reflection, restatement, questioning, and clarification are applied as well. An important interpersonal skill is to show sincere interest in others and their concerns.

Being able to present your ideas and your work in an effective way are covered when talking about the **Presentation Techniques**. The unique requirements each country has when presenting, are kept in mind as well. During the training different exercises on how to present and which tools can be used in conveying your ideas could be included. Being able to do **Networking** is a difficult topic to teach, as some people find it easier as others due to their personality to communicate and network. However, during this training some general rules on how and where networking is helpful and needed is covered. Directly linked to that is the ability to **Sell your ideas and yourself**. During the training, some exercises on how ideas and in the long run the engineer as well can sell themselves by using different techniques (Elevator Pitch) and paying attention to the body language are dealt with. Furthermore, if of interest, the topics technical sales as well as services management can be covered. Apart from the importance of soft skills for engineers, country-based research had in common, that also an update on **Technical Skills** is desired by the automotive industry in Latin America.

Skills related to design and innovation (e.g. cad-cam simulation technology or applied mechanics) have been mentioned specifically. These topics relate directly to functional safety management, as already mentioned and can be considered as to be taught in the same module. Consequently, respective contents could be integrated into Module 1 ("Engineering Trends – Design and Innovation). Additionally, skills on industrial maintenance and hybrid vehicle technology are desired topics to be taught as well during. (Module 1 – "Mechanical and Combustion" and "Alternative Power Trends")

4. TESTING BAYS

This module dedicates mainly the technical skills, as well as infrastructural gaps related to the set up and operation of testing bays.

The following technical skills have been mentioned regularly by all participating countries and should be discussed when establishing the training curriculum:

- Production & manufacturing technology, systems and processes (e.g. lean manufacturing & management, assembly processes and its management)
- Production techniques (e.g. 5S)
- Up to date knowledge of the automotive market, trends and players
- Ability to couple and connect physical/mathematical knowledge with software technology (e.g. to reach efficiency through automatization)
- Specific knowledge (e.g. Matlab, Witness) to predict responses to certain input parameters (e.g. quality management, statistics for decision making, production simulation and optimization)

Experts and research have shown that more training on applying technical knowledge – why and how is needed. A more practical activity is essential and was outlined in all delivered reports. This can probably be best addressed by **intensifying collaboration among companies and HEIs**, because they have also agreed on the fact that this would be the best way to gain real-life and hands-on experience. Both parties are interested – they need to be equipped with some kind of a **“business plan” to know how to start working on such collaboration**.

The HSD works with practical “students teach students” lessons. The output is a practical teaching of methods for production optimization and lean management. The benefits are:

- no infrastructure needed (only office materials)
- students are integrated (the trainings are part of their exams)
- the industry gives positive feedback on such teaching methods
- for the industry, it could be interesting to use such practical workshops as well

Such workshops e.g. Six Sigma Yellow Belt will be implemented in teaching how to use testing bays efficiently.

In order to serve the industry best, basic capacities for testing bays must be considered and taught. Thereby especially international **standards and certifications** have been mentioned in the research reports (this is considered in Module 1 and 4 through QM and Testing Bays).

The groups of experts and research teams agreed that the conduction of a seminar on the **testing of vehicles considering standards** should be included as well. In the automobile sector high standards are needed (e.g. DIN EN ISO, IATF or FMEA), even the automotive suppliers have to deliver these high standards. For this project it is important that the testing bays meet these standards.

Concerning the establishment of testing bays, experts added that especially the design of the basic infrastructure should be discussed within the ASCENT training. This is practically the starting point to the work package 3: The selection process of equipment as well as the supporting of the purchase process.

Conclusion

In this report some gaps could be analyzed and identified. With the designed trainings, the European partners are able to close the biggest identified gaps from the universities in Brazil, Mexico and Argentina. As a result, more practical training including the set-up of specialized test-bays are established. Moreover, soft skills, especially designed for automotive engineers are developed. Furthermore, an update on the needed technical skills, such as Industry 4.0, E-Mobility etc. is given from expert trainers including certifiable teaching

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methods like Six Sigma Yellow Belt. Last but not least, a high standard as well as ideas for a working infrastructure in order to facilitate the collaboration between University and Industry is established.