



# MUNER – Italian Motor Valley Excellence for Education and Innovation in Automotive and Sustainable Mobility

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**Abstract.** The MUNER Association is finalized to carry out innovative teaching-by-learning methodologies in a multidisciplinary approach. Based on this framework, it offers three inter-universities Master's Degree programs on the Automotive theme, with the aim of attracting international talent and training them on extremely specialized topics. These programs were pioneers in the adoption of teaching methods characterized by a strong contamination of the academic world with the industry realities, by a strong interdisciplinary approach, especially on the themes that characterized the technological innovation in the automotive sector. The present contribution discusses how innovative educational programs can be designed and implemented in collaboration between universities and industry.

**Keyword:** Education · Motorvehicle Industry · Competence gap

## 1 Introduction

Among the possible, the human capital that is part of a company is certainly one of its main resources, and it is proven to assume a central role in affecting performance and innovation (e.g., Felicio et al., 2014; Wang et al. 2019). In general terms, “human capital is basically a way that is attached to education, training, and other professional initiatives to enhance the levels of knowledge, skill, abilities and social assets of an employee” (Alnachef and Alhajar 2017, p. 1154), and therefore refers in a broad sense to the know-how of a company. The link between the human capital and performance, both financial and non-financial, is proven by the literature, as is its role in boosting the innovative performance. This is not limited to those who are already in the company, the employees, but ultimately extends to new arrivals and hires. More specifically, “by combining complementary knowledge and skills from new and incumbent employees

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(March 1991), an organization can increase its human capital resources, which in turn enable it to achieve competitive advantages” (Wang et al., 2019, p. 102). New hires therefore become fundamental to bring in new knowledge, perspectives and abilities, which are essential to enrich the human capital of the firm, and which become essential to face the innovative changes taking place in an industry. In this vein, scholars agree that newcomers’ fresh ideas and up-to-date competencies enable the organization to adapt more adequately to changing environments (Dalton and Todor 1979). Greater emphasis is then placed on the education and training of the individuals (Nafukho et al. 2007) and of the young about to enter the firms.

Attention must therefore shift to the actors responsible for training and education, and in particular for second-level higher education: the universities. Universities could indeed play an important role in targeting and managing the technologically innovative processes occurring in a specific industry, not only with technology transfer activities, but also by rethinking their teaching and education models. Universities have been called to operate “for the sake of solving specific and compelling problems and challenges confronting society” (Audretsch 2014, p 317), implying for local universities to take on different roles and to collaborate at local and national levels with firms and policy makers (Tagliazucchi et al. 2021). Such collaborations can also materialize in innovative educational models, created to meet the needs of the local industry – such as the automotive as in the case of the Italian motor valley – to face waves of change that evolve globally. To date the automotive industry and the mobility sector are indeed currently experiencing strong and important changes. The acronym ACES - which stands for Automation, Connectivity, Electrification, Sharing - summarizes these changes, which affect both the technological sphere of the vehicle and its use, and the rethinking of transport modes by the user. If, on the one hand, automation, connectivity and the search for alternative powertrains to those of fossil origin are changing the conception and design of the vehicle itself; on the other hand, the issues related to a more sustainable mobility are leading to a rethinking of the ways in which goods and people are moved.

Structured examples of university-industry collaborations that lead to the creation of specific degree paths to target specific innovation and competencies needs are rare, and empirical contributions that analyze them are scarce. The present contribution aims then to discuss how innovative educational programs can be designed and implemented in collaboration between universities and industry, in giving a concrete response to the needs in terms of competencies – soft and hard skills - to a constantly evolving territory and industry.

## 2 The Case: MUNER

In 2017, under the impulse of the Emilia Romagna Region, the main public and private actors of the Motor Valley have put to system their skills and experiences, leading to the foundation of the Motorvehicle University of Emilia-Romagna (MUNER). The Motorvehicle University of Emilia-Romagna was born as an Association in order to create a synergic link between the universities based in Emilia-Romagna (University of Bologna, University of Ferrara, University of Modena and Reggio Emilia, University of Parma) and the local automotive companies that represent the excellence of Made in Italy

in the world by designing and manufacturing high-performance vehicles (Automobili Lamborghini, Dallara, Ducati, Ferrari, HaasF1Team, Maserati, Pagani and Scuderia AlphaTauri), and their most qualified suppliers of technology (Marelli, HPE Group). Later on the group of companies expanded to include: ART, AVL, Bosch, CNH, Danisi, Pirelli, STMicroelectronics.

The Association is finalized to carry out innovative teaching-by-learning methodologies in a multidisciplinary approach. Based on this framework, it has launched three inter-universities Master's Degree Programs on the Automotive theme, with the aim of attracting international talent and training them on extremely specialized topics. To date, there are eight curricula activated, which refer to three different Master's Degree Programs. More specifically, the curricula activated are the following:

- The curriculum in Electronic and Communication Systems (ECS) is part of the Master's Degree Program in Electronic Engineering for Intelligent Vehicles (EEIV) and it is focused on topics related to advanced automotive electronic engineering.
- The curriculum in Autonomous Driving Engineering (ADE) is part of the Master's Degree Program in Electronic Engineering for Intelligent Vehicles (EEIV). It integrates topics related to advanced automotive electronic engineering with those specific to autonomous driving.
- The curriculum in Advanced Motorcycle Engineering is part of the Master's Degree Program in Advanced Automotive Engineering (AAE). It aims to train real experts in the design and development of high-tech motorcycles, with a focus on electronic engineering, endothermic powertrains and industrial design.
- The curriculum in Advanced Powertrain (AP) is part of the Master's Degree Program in Advanced Automotive Engineering (AAE). This specific Program features two different specializations that provide an in-depth knowledge of powertrain design, production, planning and control of advanced powertrains both electric and endothermic.
- The curriculum in Racing Car Design (RCD) is part of the Master's Degree Program in Advanced Automotive Engineering (AAE) and it provides a high level of training on the dynamics of the vehicle and on the most innovative materials related to the design of racing cars.
- The curriculum in Advanced Sportscar Manufacturing (ASM) is part of the Master's Degree Program in Advanced Automotive Engineering (AAE). The Program aims to train professionals in the development of production systems in the automotive field, from the design of new industrial plants to the new technologies of the industry 4.0.
- The curriculum in High Performance Car Design (HPCD) is part of the Master's Degree Program in Advanced Automotive Engineering (AAE) and it aims to train professionals able to design high performance road vehicles, with strong skills in vehicle design, dynamics and NVH, aerodynamics and electronics.
- The Master's Degree Programs in Electric Vehicle Engineering (EVE) aims to train real experts in the design and development of high-tech electric vehicle, with particular emphasis on the electric subsystems that are embedded in future vehicles.

These Programs were pioneers in the adoption of teaching methods characterized by a strong contamination of the academic world with the industry realities, by a strong

interdisciplinary approach, especially on the themes that characterized the technological innovation in the automotive sector, and by the constant “hands-on” experimentation of the theoretical contents. The Programs hence put in practice a “Learning by doing” methodology of teaching by providing practical experiences within university laboratories and activities within the Motor Valley companies in addition to the fundamental theoretical lectures. The programs also include an alternation of teachers coming both from the university and research world and from the companies themselves, bringing the excellence of both theoretical and basic knowledge as well as practical and hands-on.

By expanding up its role, the Association has also recently engaged in summer and winter schools: dedicated to high school students (advanced engineering summer program Italian Motor Valley Experience), to female bachelor students from the European community (Women in Transport), to master students (International Summer School in Industrial Engineering for Advanced Automotive) and PhD (Future of Automotive for Intelligent Mobility). These programs have the aim of expanding the consolidated educational model on master’s degree programs to specific users, identified as of interest and key importance, at different levels of educational order.

### **3 Results: A Growing Number of Students**

From its inception to date, MUNER has experienced strong growth, attracting the best national and international students within its academic programs. The results in terms of enrolled students are detailed below.

#### **3.1 Master’s Degree Programs**

Over time, the number of students enrolled in MUNER programs has grown, with positive results both in terms of academic results achieved upon graduation and employment immediately after graduation.

The first academic year of MUNER, 2017–2018, started with enrolling around 60 students in two programs. The number of enrolled students grew over the last six year to reach over 160 students enrolled in the three programs, in 2023–2024, marking the growth rate of 166%.

Up to date, over 900 students have studied at MUNER Master’s Degree Program. About 400 of these are now alumni. Upon graduation, around 90% of graduates gets immediately hired or involved in professional or academic activities. This latter included University research and PhD programs. A significant portion of hired graduates work MUNER’s prestigious companies.

#### **3.2 Summer and Winter Programs**

Orientation and integrative courses in the form of summer and winter schools have also seen strong development and interest.

The advanced engineering summer program Italian Motor Valley Experience is designed to offer international high-school students the possibility of a residential and

immersive experience within the Italian motor valley. It is held at the Enzo Ferrari engineering department of the University of Modena and Reggio Emilia, open to a limited number of students with a strong STEM background and interest in the world of two and four wheels, it integrates cultural and educational activities. The pilot edition, held in 2019, saw the participation of a group of seven students from California (US). In the following years it saw significant growth: in 2021 there were 25 enrolled students in the on-line edition – due to COVID-19 ban of travelling, coming from Europe and the United States; in 2022 there were 22 enrolled students in the on-site edition, coming from Europe, the United States and Canada; in 2023 there were 21 enrolled students in the on-site edition, coming from Europe, the United States, Canada, Latin America. The 2021 and 2022 editions are also part of the activities of the “MUNER International School of Higher Education in Automotive for Intelligent Mobility”, a project financed by the Emilia Romagna Region and approved with Resolution no. 1251 of 07/22/2019.

The summer program Women In Transport offers motivated and passionate female students an immersive experience in the automotive world, with the ultimate aim of overcoming gender stereotypes. It is promoted and accredited within the “Women in Transport - EU platform for change” platform. In its first edition, in 2022, 18 students were enrolled from 9 different European countries, hosted at the Enzo Ferrari engineering department of the University of Modena. The following edition, in 2023, saw the participation of 17 students, hosted at the University of Bologna. Both editions are part of the activities of the “MUNER International School of Higher Education in Automotive for Intelligent Mobility”, a project financed by the Emilia Romagna Region and approved with Resolution no. 1251 of 07/22/2019.

The International Summer School in Industrial Engineering for Advanced Automotive aims to improve the training of future engineers, providing specialized knowledge in the mechanical, automotive and production fields, tailored to the needs of the thriving automotive industry, which is particularly present in the Emilia-Romagna region. Since 2021, the summer program host yearly between 30 and 40 students. The winter program Future of Automotive for Intelligent Mobility aims at introducing young professionals to some of the most advanced trends in the automotive sector and focuses on fostering the skills and attitudes needed for young engineers to contribute to an unprecedented paradigm shift in the industry. In its 2022 edition the program hosted 23 participants.

#### **4 Discussion and Conclusion**

Among the ways of integrating fresh technological competencies within the firm, the role of human capital is prominent (March 1991), and in particular the newly hired (Wang et al., 2019). To face concurring waves of technological innovation changes, automotive companies need to focus on the newly and fresh competences to maintain their competitive position (Teece 2018). The education background of newly-graduates employed into the firms is then a key issue, and it becomes prominent not only to involve companies in current educational paths, but to implement new educational models based on hands-on experience, learning-by-doing approaches, and a mix of theoretical knowledge from university professors and researchers and practical knowledge from industry professionals. The main objective of MUNER concerns precisely the implementation

of a new educational model that hinges on these pillars. By postulating that the individual education background of newly-graduates can be transformed into competencies in support of innovative processes in firms, specific actions can be designed to rethink the second-level educational in collaboration between universities and the local industry. Ultimately, these actions in support of new model of second-level educational offer may have a positive effect in addressing technologically innovative challenges for the benefit of the local innovative system, and in promoting new skills and knowledge development and diffusion in key areas, such as carbon reduction and sustainable transportation.

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