

Advanced approaches and practices for rail training and education to innovate Rail study programmes and Improve rail higher education provision

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Abstract

The railway industry is transnational and one of the fastest growing industries in the world, necessitating a skilled workforce able to: master new technologies, ensure and facilitate the effective implementation of innovative practices and handle rail system complexity with ease in the era of digitalisation.

To build and retain such a workforce that responds adequately to new technological developments, innovative practices, and the intricacies of local markets, creation, promotion and application of in-depth knowledge need to be promoted and ensured through multi-national / cultural / sectoral joint ventures to establish a contact, promote innovation, facilitate implementation and ensure the fullest open exchange of good / best practice at all management levels: operational, tactical and strategic. The main objective of this paper is to introduce a rail education focussed strategic partnership established with the purpose of working towards innovation in rail higher education. Specific outputs of this strategic partnership include the development of a portfolio (toolkit) of innovative methods, approaches and professional practices for rail skills development; and an educational standard for rail higher education provision in Europe.

Through the activities of the strategic partnership current gaps and mismatches between industry requirements as well as expectations and the current higher education provision for rail knowledge and skills development will be tackled and addressed.

1 Introduction

1.1 Strategic partnership

Strategic Partnerships are transnational projects designed to develop and share innovative practices and promote cooperation, peer learning, and exchanges of experiences in the fields of education, training, and youth.

The ASTONRail strategic partnership [1] was established with the aim to set up a strategic partnership to work towards innovation in rail higher education. Specifically, the partnership will work collectively to:

- Identify gaps and study mismatches between industry expectation and university education provision;
- Develop a portfolio (toolkit) of innovative methods, approaches and professional practices for rail skills development and as a result improve and modernise the current rail higher education provision in Europe;
- Test and validate this toolkit of innovative methods through an intensive programme;
- Develop strategies (and implement them) for promoting rail careers and attracting more early career young professionals to work in the railway sector;

The specific goals of the ASTONRail strategic partnership include:

- 1) build and retain such a workforce that responds adequately to:
 - new technological developments,
 - innovation,
 - wider economic changes and
 - the intricacies of local markets.
- 2) encourage creation, promotion and application of knowledge:
 - to be secured through multi-national / cultural / sectoral joint ventures,
 - to establish a contact, promote innovation, facilitate implementation,
 - to ensure the fullest open exchange of best practice at all management levels: operational, tactical and strategic.

A graphical presentation of the specific goals of the ASTONRail strategic partnership is shown in Figure 1.



Fig. 1 Graphical presentation of the specific goals of the ASTONRail strategic partnership.

The ASTONRail strategic partnership consists of eight partners specialising in rail higher education and EU focused collaborative projects (Figure 2). Specifically, Aston University (AU) has a proven record of successful EU projects and other professional engagements, represented by ESM, Engineering Systems and Management department at EAS will manage the whole project and be responsible for the seamless communication and dialog between the funding body, ERASMUS+ programme represented by the British Council in partnership with Ecorys UK and the partnership members.

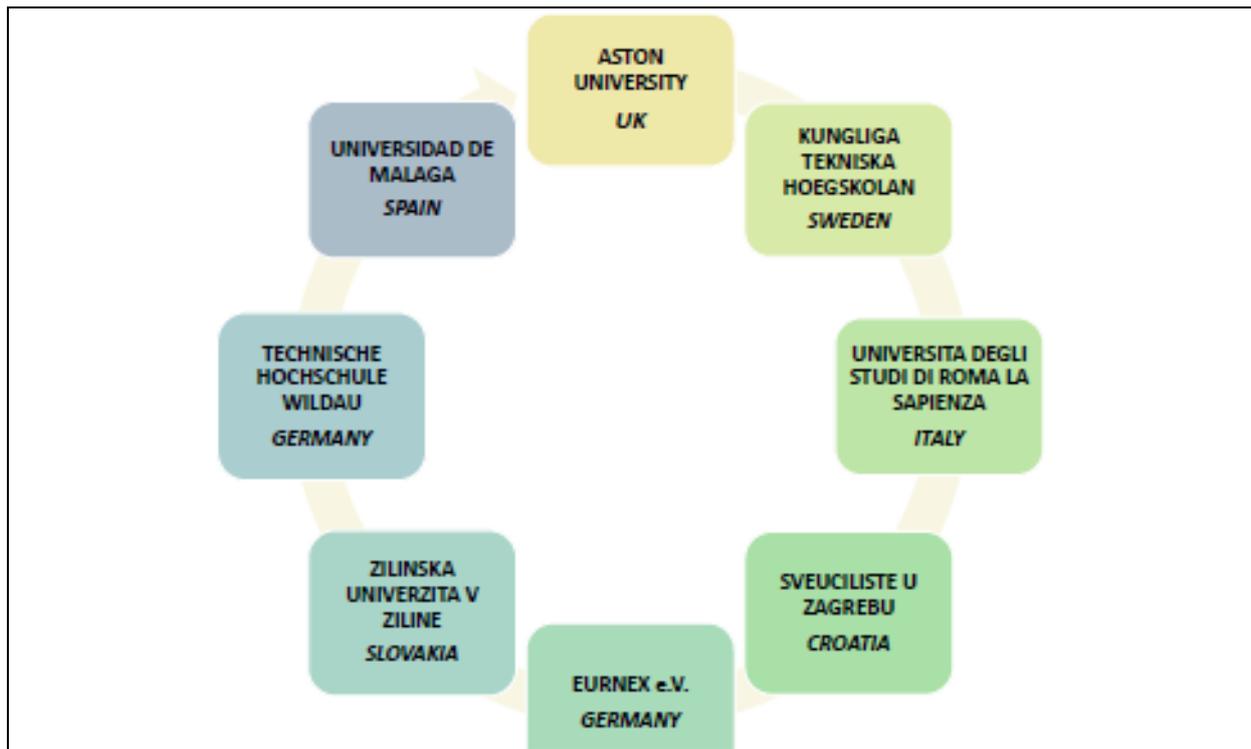


Fig. 2 Partners involved in the ASTONRail strategic partnership.

KTH is the biggest technical university in Sweden, with a strong Rail research and education centre that includes most parts of the railway system. The KTH MSc programme of rail engineering, shared with UIUC in the US and focused on educating rail professionals with a systems perspective, including both specific subsystem knowledge and understanding of the different interactions within the complex railway system. KTH Railway Group currently is in country-wide discussions on Competence Development, amidst a generational shift of rail professionals and the societal pressure of improved and more robust transport system that would enable working towards the UNESCO Sustainable Development Goals.

DICEA is the Civil, Building and Environmental Engineering Department of Sapienza University, Rome. Its rail related teaching and research activities, performed for more than 40 years, are mainly in the field of planning and management of passenger and freight transport systems. DICEA manages a Master Degree in Transport Systems Engineering, a Post- Master Specialist Course in Railway Infrastructures and Systems Engineering and a PhD in Transport and Infrastructure, all include engineering of railway systems. DICEA participated in many EU funded projects within ARTEMIS, ERASMUS, ERASMUS+, FP3, FP4, FP5, FP6, FP7, H2020, IEE and SHIFT2RAIL Programmes.

UNIZG FTTS is a leading teaching and research HEI in Croatia offering all three Bologna levels, bachelor, master, and PhD, in railway engineering. UNIZG maintains two state of the art laboratories: (1) Laboratory for Modelling and Simulation of Railway Systems and (2) Laboratory for Rail Traffic Safety and participated in numerous Erasmus, Erasmus+, Horizon 2020, Interreg, FP7 and other national transport related projects.

EURNEX is an European network of excellence integrating expertise in rail from large number of universities. For the purposes of ASTONRail, EURNEX will ensure the proper dissemination and exploitation of results and further be the link to previous work done in the area of rail skills gap

coverage in relation to the rail sector needs. This work has previously been delivered by the project EURNEX, a couple of decades ago.

UNIZA is one of the most significant HEIs in the Central European with a long rail research and education tradition. Currently university have some Bachelor and Master program specific for railway such as “Railway transport” in the Faculty of Operation and Economics of Transport and Communications, “Rail vehicles” in the Faculty of Mechanical Engineering. UNIZA participate and participated in HORIZONS 2020 programs in the field of rail transport: RIDE2RAI - Travel Companion enhancements and RIDE-sharing services synchronised to RAIL and Public Transport, GoF4R - Governance of the Interoperability Framework for Rail and Intermodal Mobility, Roll2Rail - New dependable rolling stock for a more sustainable, intelligent and comfortable rail transport in Europe.

TH WILDAU will bring in a team of experienced scholars who have specialised in rail higher education for some decades now. The research group for transportation and logistics has been active at TH Wildau for decades and has realized a lot of research projects in the transportation and rail field. Further, researchers and lecturers at TH Wildau implement research projects in the field of attracting higher education for young people. In addition, TH Wildau will offer the knowledge for building up a bachelor study programme in transportation engineering that focuses on the connection of rail and other transport modes. TH Wildau is proud to be one among the strongest research universities of applied sciences in Germany with experience in EU-programms like Erasmus, Erasmus+, Horizon 2020, InterReg, FP7.

UMA with an MSc in Rail Mechanical Eng, the department of Mechanical Engineering specialises in vehicle engineering and rail technology, with a strong Vehicle Mechanics lab incl.component test benches & pantograph testing.

Priorities

The priorities of the ASTONRail strategic partnership are centred on developing, testing and implementing new approaches and innovative practices for tackling skills gaps and mismatches between industry expectations and rail higher education provision. To guarantee excellence in teaching and skills development, we work at an international level, aiming for high promotion of internationalisation agendas of the institutions we represent. Rail systems are international, hence we need to make sure that this aspect is reflected in the curriculum and ensure that the international nature of the railways is embedded in university modules, tutorials and teaching practice.

Current study by Cannon et al (2019) [2] on data analysis of current and emerging skills development and training schemes in the rail transport sector revealed that although the rail transport is one of the fastest growing industries in the world at the moment currently there is an imminent need for building and maintaining a skilled rail workforce that will keep the industry growing sustainably. Due to speed developments of new technologies and applications in computer science, the gap and mismatch between knowledge gained (by the teacher), knowledge passed on (from the teacher to the students) and knowledge implemented (by the students) is getting larger and larger. A skilled rail workforce is built and maintained through robust university study programmes, teaching and training schemes, intensive programmes and professional development courses. The ASTONRail strategic partnership was established to work towards identifying and bridging the current rail skills gaps and mismatches and develop exquisite new

approaches, effective teaching practices and methods for rail job categories in the entire rail sector across different countries from Europe.

The current state of the art and practice suggests that there is significant variety in the number of rail orientated university study programmes and training courses across Europe.

Normally those career positions that give rail workers higher levels of responsibility have more university-led courses and professional training schemes. Talking of the three management levels, namely strategic, tactical and operational, universities have this tendency to offer skills for jobs at strategic and tactical levels. Due to a lack of resources at many European universities, rail operations for instance are taught by PowerPoint presentations. As a result, it is difficult to judge whether the students acquired the required skills and competences they need to take on an operations management role in a railway company. This is but an example of a mismatch, which needs to be tackled and addressed.

To address such mismatches and to fill in the current rail skills development gaps, there is no need for more skills development training schemes and programmes to be made available in Europe. We know that there are many universities in Europe offering rail higher education (the interested parties are referred to RailUniNet [3],[4] and EURNEX [5]). Instead, we need to develop a better understanding of the current rail higher education offers, rail skills development schemes and assessment methods to be able to map them out against the industry expectations and requirements. When this is done, it will immediately become apparent where the gaps and mismatches are; this outcome will give us the foundation and understanding we need to develop new methods and practices to tackle and overcome any current rail skills gaps and mismatches.

A multi-method approach

Railway related teaching should follow an interdisciplinary approach and the current gap between industry expectations and the rail higher education provision should be identified and be bridged by innovative methods and approaches. At first instance, the ASTONRail strategic partnership aimed to gain a better understanding on the current training courses and programmes in rail education systems the gaps and mismatches between industry expectation and rail higher education provision.

The ASTONRail strategic partnership employs a multi-method approach (Figure 3) that includes:

- Partnership Coordination and Management to ensure the professorship delivers according to the time-frame agreed and up to the right standard.
- Risk Assessment Management Panel is formed and will be mobilized in case the partnership members need to deal with any potential risk and/or conflict of interest.
- Qualified global panel to study and review rail-related education and training programmes and initiatives in terms of entry requirements and levels (e.g. Bachelor, Master, Post-Master, PhD, other specialist initiatives), teaching contents, placement perspectives, operators and industries involvement.
- Questionnaire development and survey implementation to collect information about the current Industry needs and compare the findings with previous studies of this kind. As a result, gained is a better understanding of what has been, is and will be required by the railway industry in the near future.
- Mapping and literature reviews to analyse how the current higher education provision meets the industry expectations.
- A portfolio of new approaches to include a toolkit of new learning, teaching and training material, methods, approaches and professional practice for rail higher education. The toolkit developed will be presented to associated partners and stakeholders. The word will be spread as widely as possible.

- Dissemination focused activities and exploitation of results undertaken throughout the ASTONRail strategic partnership lifetime.
- Course curriculum followed by a training scheme implemented and tested in the shape of an intensive study programme in rail systems. The ASTONRail Intensive study programme was delivered in University of Zagreb and incorporated good experiences of key partners, which made the programme highly transnational and international.
- Service structures for public awareness and outreach to promote careers in rail.
- A handbook to be a dynamic, live open platform on building a skilled workforce through next generation methods, policies and practice of effective rail training and education techniques and mechanisms. The focus is on the new learning, teaching and training material, methods, approaches and practices that are well documented to guideline an implementation in interested universities and higher education institutions.
- An educational standard for rail higher education provision is envisaged to be drafted and presented in the ASTONRail strategic partnership conference (to take place in Stockholm, July 2023) to a wide audience of stakeholders for discussion, improvement and validation.

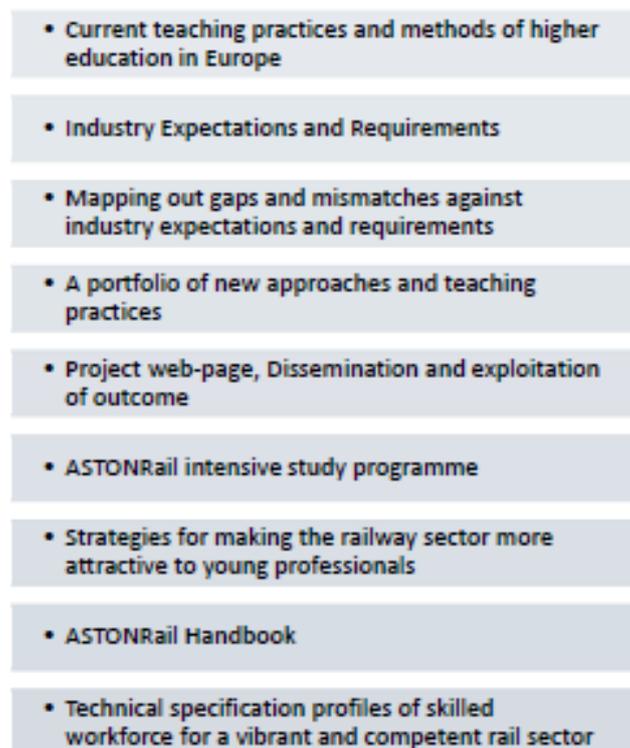


Fig. 3 The activities of the ASTONRail Strategic Partnership: a multi-method approach

Conclusions

Current university-based rail education and training methods are strongly subject-specific. These are professor-led/senior trainer-led offering a few opportunities for young/early career professionals to take part in the building of a new rail-related programme/course and/or curriculum. This situation has a negative impact on the creativity of the young rail trainee as it is rather limited in nature and does not give too many options and potential avenues for self-learning activities and knowledge development. Therefore, there is a need for a more integrated competence-based, young rail trainee-led method to make sure that many options and avenues to knowledge gain and development are offered for building the skills needed. This will aid in the development of an

understanding of multi-disciplinary concepts, innovative solutions, new policies and practices at all management levels: strategic, tactical and operational. Post event analysis to identify lessons learned and proactive training methods developed for future use will also figure in this.

For young rail enthusiasts and new rail employees to become highly skilled rail professionals, they have to acquire self-study skills and self-motivation and hence become self-lifelong learners. To secure this, these young rail talents and new rail professionals should be capable of defining, planning and organising their own ideas and also identifying their own training needs with positive available guidance and support. Such an ability will give them a systematic understanding and necessary awareness of knowledge as well as help them with their own career planning.

Ideally new rail skills gained in universities through rail university research based projects, curricula, programmes / courses should not be developed in isolation. Instead they should be developed in partnerships with both the industry and other education and training organizations delivering similar programmes and courses. Every university-based education and training method should be designed with respect to sectoral, structural, organisational and technical constraints where key trends in industry have to be taken into account, incorporated in the method and kept updated.

Within the scope of this paper, we presented the ASTONRail strategic partnership established to attend to these needs, close current gaps between the industry requirements and current university provision and work towards innovation in rail higher education.

Acknowledgement

The ERASMUS+ programme of the European Commission for providing the funding.

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