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Skills and Training Requirements for the Future Transportation Sector of Europe

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Abstract. More than 10 million people are directly employed by the transport industry in Europe, accounting for 4.5 % of total employment and representing 4.6 % of Gross Domestic Product (GDP). This fact, combined with the rapid developments and changes of the sector, makes imperative the need to create, attract and retain appropriate staff. As the overall trend is to increase automation, the sector will depend more and more on specialised equipment and products. Future jobs will therefore require new and advanced skills in engineering as well as in back office operations, but at the same time, the growing interdisciplinary elements of transport activities will also require transport professionals with developed skills in safety, security, logistics, IT, behavioural sciences, marketing and economics. The European Research project SKILLFUL has developed a structured foresight into the vocational and academic qualifications in the Transportation sector of the future and has proposed training schemes and their supportive business models that could ideally be adopted European-wide, to enhance employability and sustainable industrial development in the transportation sector in Europe. The identification of future requirements constituted the basis of the project. The impact of new technologies and game changers, as well as emphasis on intermodality and interdisciplinarity on employability and future worker skills, have led to the development of relevant scenarios on future jobs knowledge and skills requirements, regarding the road transport in Europe. This has led to the identification and design of proper and specific curricula for training (with emphasis on middle-skilled professionals and lifelong learning), while also to the introduction of six novel concepts of business actors, expected to facilitate the training process and enhance the transport-education chain. The project goes a step beyond by addressing also critical issues towards a Pan-European master curriculum on transport.

Keywords: European transportation sector, future skill requirements, training, employability, business roles

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Навыки и требования к обучению с целью обеспечения будущего транспортного сектора Европы

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Реферат. В Европе более 10 миллионов человек заняты непосредственно в транспортной отрасли, что составляет 4,5 % от общей занятости (4,6 % валового внутреннего продукта (ВВП)). Эта статистика в сочетании с быстрым развитием и изменениями в данном секторе экономики предполагает необходимость обучения, привлечения и сохранения квалифицированного персонала. Поскольку общая тенденция заключается в увеличении процесса автоматизации, данное направление экономики будет все больше зависеть от специализированного оборудования и приспособлений. Поэтому на новых рабочих местах потребуются новые квалификации и навыки, передовые технологии в осуществлении инженерно-технических работ, а также в ведении технической документации; в то же время усиление роли междисциплинарных элементов транспортной деятельности также потребует привлечения профессионалов в области транспорта, обладающих высоким уровнем знаний и навыков в сфере безопасности, охраны, логистики, информационных технологий, бихевиористики, маркетинга и экономики. В рамках реализации Европейского научно-исследовательского проекта SKILLFUL был выработан структурированный прогноз будущих профессиональных и академических квалификаций

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в секторе транспорта, а также предложены схемы обучения и поддерживающие их бизнес-модели, которые идеально подходят и могут быть приняты в масштабе всей Европы. Это должно повысить возможности трудоустройства и обеспечить устойчивое развитие транспортного сектора в Европе. Определение новых требований и легло в основу данного проекта. Влияние новых технологий и наличие решающих факторов, которые кардинально меняют ситуацию в сфере транспорта, выдвижение в категорию приоритетных интермодальности и междисциплинарности в вопросах трудоустройства и развития в будущем новых навыков привели к разработке соответствующих сценариев с целью формирования новых знаний и навыков для новых рабочих мест в сфере автомобильного транспорта в Европе. В связи с этим определены и разработаны надлежащие специальные учебные программы (особое внимание уделено подготовке специалистов среднего звена, вопросам организации образования через всю жизнь), а также внедрению шести новых концепций бизнес-акторов, что должно способствовать организации учебного процесса и продвижению транспортно-образовательной сети. Рассматриваемый проект выходит за рамки своих специфических задач, решая при этом и важнейшие вопросы, которые связаны с общеевропейской основной учебной программой по транспорту.

Ключевые слова: Европейский транспортный сектор, перспективные требования к навыкам, обучение, трудоустройство, роль бизнеса

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Introduction

Labour markets around the world are experiencing significant changes, within the transport sector having a leading role due to the constant technological development and the new business schemes. Moreover, social and demographic changes affect the field, as in ageing societies workers are retiring later, while labour mobility, immigration, and labour market integration contribute significantly to economic growth in many countries, causing, however, challenges that need to be addressed.

The specific challenge occurring from this, concerns the identification and assessment of future requirements for skills and training tools/methods across transport modes and systems, in order to improve the potential of the workforce but also improve the gender balance in the field of transport (as only a rate of 22 % represent women working in the transport sector) [1]. This creates particular challenges for those working in the transport sector, now and in the future, in terms of upskilling, training and qualifications.

Attracting and retaining skilled professionals in the transportation sector will require significant investment in training to address existing skill shortages and further adapt to the evolution of the sector and its developments. Training investments can be provided by different sides of the transport sector. Companies may decide to invest in training to address the specific needs of their activity. However, they would do so only if they are able to seize the return of this investment, by retaining their workers and offering them opportunities to be promoted. Where this is not possible, the skill shortage requires government intervention.

Across the different transport modes, the labour issue plays out in different ways. For example, a shortage of pilots exists in most regions of the world, while in the rail sector, skill requirements were traditionally of a technical nature, but are becoming more and more service-oriented, implying a shift in focus towards commercial and business competencies. Another important challenge for all sectors is also to acquire the necessary skills demanded by the integration of information technologies.

Within this context, and with regard to the transport sector, SKILLFUL identifies the needs and requirements for the user groups, which range from low to high skilled workers, across transportation modes and for multimodal chains and for all levels/types of works (blue collar, white collar, managers, operators, researchers, etc.).

The SKILLFUL project

The SKILLFUL project (<http://skillfulproject.eu/>) is a European funded Research project that aims to identify and present the necessary skills and competences for the transportation workforce of the future, in three different horizons (short-term in 2020, medium term in 2030 and long term in 2050), and to suggest the appropriate training schemes that will be required to address these needs. More specifically, the aim of the project is threefold:

- to critically review the existing, emerging and future skills requirements of the transportation sector professionals;
- to structure the key specifications and components of the curricula and training courses, in order to meet these challenges;

- to identify and propose new business roles in the transport and education chain, in order to achieve European wide competence development and take-up in a sustainable way.

The project analyses the emerging and foreseen trends in future transport, considering the whole transportation chain in Europe (including all transportation modes) and all different levels and types of transport professions (blue collar, white collar, managers, operators, researchers, etc.). The project also assesses existing training and education programmes of transport across Europe and suggests a number of University and Vocational training schemes the future transport needs, defining also the competences of their trainers and trainees.

Furthermore, six novel business roles are introduced and suggested for the education and training chain related to the transportation sector that are considered necessary for the effective future training provision throughout the European transportation sector.

Overview of SKILLFUL methodology

The whole project process can be divided into three major categories/steps:

- **Step 1.** Identification of Future Trends/ Needs & Best Practices;
- **Step 2.** Development of Training Schemes & Definition of Profiles and Competences;
- **Step 3.** Verification and Optimization of training schemes.

In a nutshell, the first step lays the necessary foundations for the implementation of the appropriate educational/training programs and relevant curricula, methodologies and tools and for configuring also their wider context, while also includes the identification of future trends and the impact on jobs that are likely to affect the European Transportation system (WP1). Following on from this, training methodologies and approaches have been identified and developed to meet the emerging and future needs of transportation professionals (WP2). This first part of the project is the one that has identified the needs existing in the whole chain system of Transport and education, with the identification of: a) the factors that will affect the transport system over the next years and in different time frames (short-term until 2020, mid-term until 2030 and long-term until 2050), whereas game changes, new and evolving technologies,

new services and business schemes etc.; b) how this is going to be done (i. e. what factors will bring what changes); c) which professions jobs is foreseen to be mostly affected and what new ones are expected to emerge, resulting to lists with 28 specific professions and/or positions.

This prioritisation has acted as a “feeder” for the next SKILLFUL activities and main outcomes of the project; indicatively the following ones:

- connection of emerging training needs to the existing educational systems, noting and tackling further educational needs and gaps;
- suggestion and development of new training schemes in order to address the aforementioned training needs and gaps;
- identification of requirements and competences both for trainers and trainees and for each training module/scheme developed within SKILLFUL;
- identification and description of the six new business roles, proposed for the education and training chain related to the Transportation sector, expected to change the future training provision of the transportation sector and become the catalyst for its sustainability.

Expected changes in the human capital of the transportation system in Europe and suggested training schemes

The analysis made within the SKILLFUL project, as described above, provided some interesting outcomes about the technological and business trends that are already affecting or are expected to affect the European transportation system in the near and long future. The main trends that are expected to influence transport in Europe and its employability, as identified by the project are listed below:

- globalisation;
- digitalisation and connectivity;
- greening of transport (electrification, alternative fuels, propulsion systems);
- automation (robotics, autonomous and unmanned transport systems);
- smart transport (tracking, predictions, big data, efficient logistic and transport chains);
- mobility as a service, sharing/combined transport systems, multimodality;
- new transport vehicle systems adopting future needs of the customers regarding on demographic and climate change and needs;

- safe and secure transport;
- employability and sustainable employment.

During the interviews that have been conducted within the first phase of SKILLFUL, participants have been asked to highlight the professions, jobs and occupations that they foresee to be most affected or may disappear by also defining the timeframe of these changes, while also suggest the new occupations that are expected to arise in the same timeframes, in order to cover the emerging and future needs of the transport system in Europe and worldwide. For the justification of all these estimations, direct correspondence between each one of the future changes in the occupational sector with specific driving forces has been made, while also a description of the responsibilities and competences for the altered and emerging jobs has been provided. Thus, according to the outcomes of SKILLFUL, 28 occupational fields of the transportation sector have been defined, concerning the professions that are expected to be mostly affected by the present and future changes and developments of the European transportation system (13 professional fields for jobs/positions to be changed or eliminated and 12 groups for jobs/positions to be emerged) [2].

Development of the training courses and schemes

One of the project objectives was to propose and develop future training curricula and schemes both for the university education and the vocational training of the transport sector's workforce, as well as to identify critical issues to be addressed in order to meet the future needs of the field. Proposed future training curricula and courses included information on course content, objectives and learning outcomes. At the same time, the trainees' minimum requirements together with trainer's competences for each course have been defined and described by their developers. The trainer's competence was understood as a capability including knowledge, skills, attitudes and experiences to perform or carry out defined tasks in a particular context of training. It was set in the wider context of the EU's work in transport field to be able for future development and flexible to the needs of practice. A full list of requirements for trainer's competences for each training scheme was based upon a conceptual framework and on

relevant outputs of previous project work, including literature review and a wide consultation of stakeholders (internal and external to the Consortium of the project), who have been identified as experts either in the field of transport or education/training or both.

In addition, a detailed analysis was performed for each course, in order to identify the correlations between the emerging and future trends in the transport sector to be covered on the one side and with the most promising training methodologies of the future. These correlations were retrieved in for each course in order to ease readability and interpretation of the identified expected changes and additional needs for the future. The most relevant training methodologies and tools that have been identified are listed below:

➤ **Training methodologies**

- E-learning.
- Virtual/augmented reality.
- Gaming environment.
- Human led individualized training.
- Blended learning.
- Peer led/ mentoring learning programme.
- Traditional lecture.
- Networked learning (e.g. social media networking).
- Smart learning technologies: personalised learning processes and schemes based, for example on big data, machine learning and AI.
- Scenario/story based learning.
- Training on the job/experiential learning.
- Informal learning.

➤ **Training tools and technologies**

- Portfolio.
- Smart learning technologies.
- Virtual Learning Environment.
- Educational robotics.
- Podcasting.
- Game-based learning.
- Virtual/augmented reality.

➤ **Settings**

- Distance (D-)/Mobile (M-)/Ubiquitous (U-) – Learning.
- Flipped/inverted Classroom.
- Work-based learning.

- Collaborative/team-based learning.
- Informal learning.
- Networked learning (social network technologies).
- Pedagogical model.
- Heutagogy/E-heutagogy.
- Active/Authentic learning.
- Observation/Discovery-based learning.

Within SKILLFUL 34 training courses have been suggested and described and 17 of them have been also fully developed and evaluated through the realisation of pilots, including real users. SKILLFUL courses have been clustered in the following categories.

- Courses for **transport infrastructure operators** addressing the requirements for new skills and competences to catch up with emerging technologies.

- **Lifelong training schemes for low – to middle-skilled** segments of transport professionals.

- **Interdisciplinary thematic courses** on key technologies, services, and trends that focus on issues proven to have a transferable character among modes.

- The **Young Researchers Seminar**, which is a joint initiative of ECTRI, FERSI and FEHRL organised every 2 years in a different European city. Within SKILLFUL two seminars have been organised focusing on the issues and trades identified by the project and with the participation all researchers from all modes.

SKILLFUL has also suggested and designed a first core syllabus towards a Pan-European Transport Engineering master, together with the development of several modules, in accordance again to the requirements that have emerged by the outcomes of the SKILLFUL project.

New business roles in Transport Education and Training chain

During the second phase of the SKILLFUL project new business roles have been identified and proposed for the education and training chain related to the Transportation sector. The promotion and adoption of these business roles could dramatically change the future training provision of the transportation sector and ensure in a great extent its sustainability. For example, as energy aggregators have paved the way for new and more efficient schemes for the reduction of energy consumption Europe-wide; “knowledge aggregators” may equally become the catalyst for a sustainable and advanced VET/CVET quality in the transportation area. Furthermore, some of the suggested roles, such as the ones of “training certifiers” and “training promoters” could also help the expansion of training schemes from local/national level to European and, thus, strongly facilitate the mobility of the European workforce

Based upon the outcomes of the SKILLFUL project, as indicatively described above, six new roles of business actors have been identified and suggested (Tab. 1).

Table 1

Suggested business roles by SKILLFUL project [3]

Transport Knowledge Aggregators	Transport Knowledge Aggregators are entities that collect and analyse information on emerging technologies and services in the transport domain from different sources. Their mission is to aggregate them, connect them and produce training courses to offer to the greater Transport Education and Training Ecosystem
Transport Lifelong Training Promoters	Lifelong learning promoters in Transport are actors that support financially, institutionally or by other means the continuous re-skilling (usually upskilling) of Transport workforce, in order to keep on pace with emerging job needs and enhance employability of the existing workforce
Transport Training Certifiers	Transport training certifiers are entities that have the authority of de jure or de facto certifying key knowledge and skills in the Transportation sector that are then acknowledged across the sector Europe-wide
Transport Training Infrastructure Providers	Transport Training infrastructure providers are entities that open to third parties (with various business models) big infrastructures for the purpose of training and skills creation of transport professionals
Collaborative passion arenas in Transport	Collaborative passion arenas in Transport refer to the equivalent of open source development communities for skills’ creation. It concerns signified communities that create and share knowledge in Transport, collaboratively developing alternative knowledge and self-organising/recognising it between them; through Hacathlon or equivalent competitions. They are based on social communities and co-creation spaces
In vivo Altschool social networks in Transport	In vivo Altschool social networks in Transport can be defined as training/skills development environments on Transportation issues within the living society, with emphasis on mutual training and real life skills creation

Business roles and professional titles like “aggregators”, “promoters”, “certifiers”, “infrastructure providers” and “collaborative arenas”, have been already met in different business domains. The Information and Communication Technology (ICT) sector has largely contributed to new ways of conducting business through the forms that services have taken, i. e. products or services are not sold as used before, but are rather “rented” or paid for during their use by the customer. Within SKILLFUL, such roles are transformed and instantiated for promoting future skills in the Transport sector.

CONCLUSIONS

1. The transport sector is going through major changes, as global challenges and megatrends like automation and digitalization, together also with safety and security concerns, are affecting the future of the whole transport system and its human capital. These constant technological and business developments and the growth of the transport sector also make the need for continuous education, training and qualification of transport professionals imperative. In this context, one of the main challenges for the European transport sector is also whether it would be able to attract but also maintain that are properly skilled and able to cope with the new needs of the sector.

2. Considering the importance of such employability and education/ training issues for the whole Europe, the EU funded research project SKILLFUL has been working on the identification of the leading relevant scenarios on employability enhancement in the future, as well as towards the identification of key educational and training schemes for all levels and types of transport occupations, training approaches, and transport modes, in order to meet the future needs of the sector. The SKILLFUL project aims to generate a structured foresight into the vocational and academic qualifications in the transportation sector of the future that could be adopted European-wide, and to enhance the future employability of the European transport sector.

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