



STAFFER
EUROPEAN RAIL SKILLS ALLIANCE

STAFFER DELIVERABLE 7.1

Developing an integrated sectoral skills strategy for the rail sector - Attracting and upskilling a qualified workforce for a smart and sustainable rail sector in Europe

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PREFACE

This is the revised version of Deliverable 7.1 of the STAFFER project that has been elaborated in year three of the project lifetime. It is based on summarising key results of the STAFFER work packages achieved so far and conclusions in relation to developing a robust and sustainable long-term strategy and action plan for the rail sector.

This consolidated version of the deliverable takes into account comments and input received from STAFFER partners, in particular UNIFE and CER and their national affiliates involved in the project that have been gathered in written form as well as in meetings held in October and November 2023 as well as in January 2024.

While these input reflects the importance of this document it should also be noted that though the current version of the Deliverable 7.1 now includes a consolidated elaboration of the long-term strategy for skills and employability in the rail sector, the concretisation of the strategy in terms of elaborating an action plan and a roadmap for implementing the strategy will continue: Taking into account also the results of the two other deliverables in Work Package 7 on attractiveness of rail as a career path (7.2) and gaining political and financial support, the work will continue in the context of Task 7.4 “*Developing and implementing the action plan of the sectoral skills strategy*” that will be carried out jointly by the four co-leaders of STAFFER Work Package 7 under the lead of UNIROMA1.

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ABBREVIATIONS

LNG	Liquefied Natural Gas
ATO	Automated Train Operation
AS	Automated Systems
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
BIM	Building Information Modeling
MaaS	Mobility as a Service
FMRC	Future Mobile Railway Communication System
AI	Artificial Intelligence
HR	Human Resources
IoT	Internet of Things
ERRAC	European Rail Research Advisory Council
ICT	Information and Communication Technology
RAMS	Reliability, Availability, Maintainability and Safety
CCTV	Closed Circuit Television
ESCO	European Skills/Competences, Qualifications and Occupations
EQF	European Qualification Framework
LCC	Life Cycle Costing
ILS	Integrated Logistics Support
VET	Vocational Education and Training
HEI	Higher Education Institution
CEDEFOP	European Centre for the Development of Vocational Training
EQAVET	European Quality Assurance in Vocational Education and Training
EFQM	European Foundation for Quality Management
WBL	Work Based Learning
FLP	Flexible Learning Programme
NGL	Next-Generation Learning
CDL	Comprehensive Distance Learning
EDO	Employment Development Opportunities
EES	European Employment Strategy
ET2020	Education and Training 2020 Work Programme
SA	Self-Assessment
QA	Quality Assessment
ILO	International Labour Organisation
IT	Information Technology
OT	Operational Technology
NSA	National Safety Authority
Wi-Fi	Wireless Fidelity

1 INTRODUCTION AND GUIDANCE FOR READERS

The STAFFER project consists of four main work efforts. First, it identified current and future skills and competence needs for the entire rail sector. Next, STAFFER developed programmes for effectively training the railway workforce of the future. Third, STAFFER develops cross-European training and mobility programmes and work-based internships for railway students, apprentices, and staff. Finally, STAFFER develops an “integrated” sectoral skills strategy for the rail sector, that also includes an action plan of the sectoral skills strategy, encompassing the time horizon beyond the STAFFER lifetime.

Against this overall setting and structure, this report falls into two major parts:

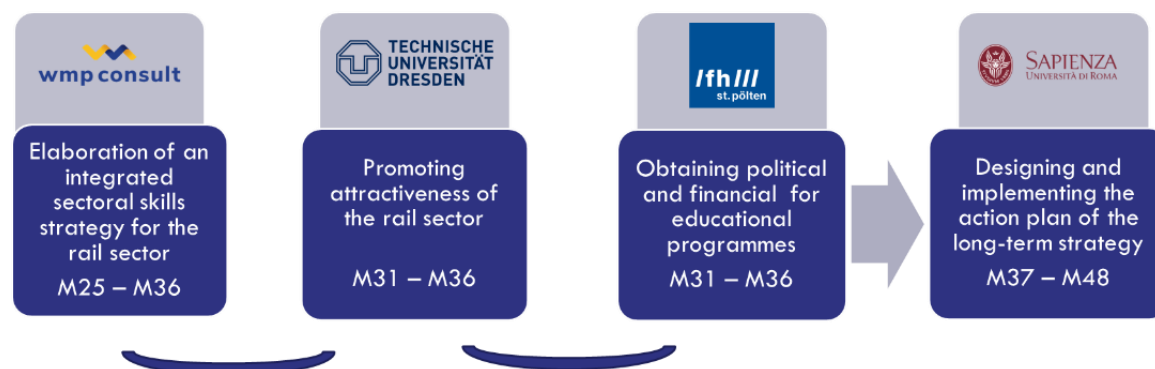
The **first part** comprising of chapters 2 – 6 takes stock of the results achieved in STAFFER: The analysis of key trends and challenges the rail sector is facing (chapter 2), skills needs and occupational profiles from the perspective of railway operation / infrastructure management and the rail supply industry (chapter 3) and the assessment of existing education and training practices in the light of matching needs and offers of skills development and maintaining / improving employability (chapters 4 and 5). Building on current and future requirements, the report also provides an overview of preliminary results in relation to the development and pilot implementation activities developed by STAFFER so far (as of October 2023) on railway related training and mobility programmes (chapter 6).

The **second part** (chapter 7) includes a first draft for an integrated sectoral skills strategy for the rail sector. Considering specific requirements and needs of the two subsectors – rail supply industry and railway operation / infrastructure management, it makes suggestions on key elements and strategic orientations for a strategy on skills development and other measures that support a sustainable workforce development and employability in the rail sector. It also includes first general ideas on defining key activities for the longer-term action plan and possible structures of governance which are addressed by tasks 7.3 as shown in Figure 1 below. Both tasks have been elaborated and documented in parallel. The same relates to task 7.2 which is focussing on attractiveness of the rail sector and making it an attractive career path.¹

The final skills strategy should incorporate key results of these in a synthesis document that will serve as a basis of designing and implementing the action plan of the sectoral skills strategy in task 7.4.

¹ Both deliverables 7.2 and 7.3 are available in the STAFFER repository.

FIGURE 1: WP7 TASKS 7.1 – 7.4.



In this context it seems necessary to clarify of what is meant by the **“integrated sectoral skills strategy for the rail sector”**: With UNIFE and CER involved as key partners, the STAFFER Blueprint project has the ambition to reflect skills needs as emerging from major technological, economic and social trends as well as new needs and requirements from the perspective of both the rail supply industry as well as railway operation and infrastructure management.

This integrated view is supported by the fact that both the supply industry as well as railway operation and infrastructure are impacted by common trends and factors of influence, e.g. technological changes or the harmonisation of technical standards in the European Market. Also, and in relation to skills development (needs) both rail suppliers and railway operation/infrastructure management are characterised by a certain degree of overlapping in relation to professional profiles, when it comes to engineering, IT and technical profiles. Consequently, the rail sector in relation to educational and training providers already shows a high degree of unity, particularly when it comes to academic education and training at higher EQF levels.

However, there are also specificities and differences that need to be reflected also in relation to skills-related needs and requirements that need to be considered and addressed. Railway operation and infrastructure is impacted strongly by national shaped regulation when it comes to operational rules, including signalling and safety while at the same time there are strong trends of harmonising rules and standards because of the European railway packages. And there are other factors of influence as well as challenges related the need to improve the efficiency of cross-border railway operation in freight as well as passenger transport.

These specificities and differences have been considered in the STAFFER workplan and the different work packages and tasks: there have been “domain-specific” work packages and

tasks for example in relation to the identification of trend, innovations and challenges, or occupational profiles along with “integrated” ones.

This is also reflected in work packages 7 and this deliverable: While aiming at developing an “integrated” strategy, it takes into account domain-specific requirements and needs. This is reflected in domain-specific subsections in each chapter as well as the suggestion for key objectives and components/pillars of the long-term skills strategy tries to depict a common orientation but also includes a pillar related to skill needs in relation to cross-border railway operation and infrastructure.



2 TRENDS, INNOVATIONS AND CHALLENGES

2.1 Introduction

The starting point of STAFFER was on the identification of current and future skills and competence needs both from an integrated perspective covering both rail supply industry and railway operation and infrastructure management (WP1) and then, digging deeper, from the perspective of railway operation and infrastructure management (WP2) and the rail supply industry (WP3).

Key results are presented in the sub-sections below, indicating that there are common trends impacting on current and future skills and competences but also specific trends, in particular related to cross-border railway operation.

2.2 General assessment trends impacting rail supply industry and railway operation and infrastructure management

According to the results of STAFFER work package 1² based on literature reviews and surveys amongst STAFFER partners and experts, addressing trends and impacts on railways in the four macro trend areas of 'Technology', 'Society', 'Environment and Politics' and 'Economics and Market', the most important trends came from the environment and politics trends. This can also be seen in the societal and economic and market trends, where micro-trends such as 'sustainability' and 'sustainable management' are ranked as the most important trends impacting on the railway sector.³ The use of digital solutions such as mobility as a service or mobility on demand continues to play an important role for railways as the integration into multimodal transport could be very beneficial for the sector, as seen in the economics and market macro trends.

In addition, the macro trend 'Technology' was rated as less important compared to other trends. Something interesting, as it was rated as a highly important factor for the future of the railway system and contributing to the most necessary skill adaptations for the future workforce. This

² Implemented at the end of 2020 and spring 2021.

³ It should be noted here that sustainability and sustainability go beyond the dimensions of environmental impacts and emissions. As enshrined in the concept of ESG (Environmental, Social and Corporate Governance) it also includes further dimensions in a sense of 'total sustainability'. The impact of ESG and a broader concept of sustainability on railways is and will continue to be immense in the future, also because of new legal obligations of corporate sustainability reporting, introduced by the EU Commission.

could possibly be explained by the fact that experts are still unsure about the impact that these technologies could have on the system as a whole, as their full potential is still being explored.

TABLE 1: TOP 5 TRENDS IMPACTING ON RAIL ACCORDING TO STAFFER WP1 SURVEY

Society	Technology	Environment and Politics	Economy and Market
Sustainability	Data-driven business models	Politics	Sustainability management
New work	Big Data Analytics	Smart and sustainable mobility strategy	New Mobility services
Urbanisation	Future Work	Security	Transnational freight corridors
Talent shortage	Digital provisioning	Climate-political regulation	Renewable energy
Knowledge Management	Artificial intelligence	European Rail Area	Transnational rail passenger corridors

Source: STAFFER WP1 survey 2020/2021

2.3 A more detailed view on trends, innovations, and challenges in railway operation and infrastructure management

Building also on the concept of trends from WP 1 and the related discussion, as well as taking into account several rounds of discussion with WP 2 partners (both from the academia and from railway operation and infrastructure management) about specific trends that are relevant for railway operation and infrastructure management, a more comprehensive approach as regards main trends was developed in the context of work package 2 and implemented in the context of an online survey targeting academic and scientific research and educational institutions in railways as well as railway companies within STAFFER and beyond.⁴

The applied approach is based on a differentiation of trends and drivers of change, innovations, and open issues, whereby the following understand was agreed upon with academic experts within STAFFER:

- **Trends and drivers of change:** this refers to all the strategic choices and policies that have either been adopted in recent years and are addressed by most railway companies or may be adopted soon (within next 5 years).
- **Innovations:** This category includes technologies that have either been adopted or are currently applied in railways and have the potential to be widely implemented because they improve efficiency and performance significantly.

⁴ The WP2 survey that was also promoted by CER was carried out during June 2021 with more than 80 complete datasets /responses gathered from 19 European countries. For further details STAFFER Deliverable 2.1.

- **Open issues and policy choices** refer to aspects and decisions that would have an important impact on future railways. However, such strategic choices cannot be made by individual railway companies solely but require a joint transnational approach or cooperation.

Table 2 below lists the trends, innovations and open issues that were highlighted by STAFFER stakeholders as relevant.

TABLE 2: RAILWAY RELATED TRENDS, INNOVATIONS AND OPEN ISSUES REGARDED AS IMPORTANT BY STAFFER PARTNERS

Trends and drivers of change	Innovations	Open issues and policy choices
<ul style="list-style-type: none"> • Rail market liberalisation • Single European Rail Area • Increased network capacity and modal shift • Transnational corridor development • Rail freight corridors • Greener, more sustainable, and smarter railways • Noise reduction • High-speed railways • Night trains • Attractiveness of railways • Door-to-door mobility • Mobility as a service • Reduced maintenance costs • Mass transportation • Increased safety and security • Interoperability 	<ul style="list-style-type: none"> • ERTMS & ETCS • Automated train operation (ATO) • Digital rail traffic control • AI language solutions • Internet of things and trains • New ticketing systems • Biometrics • Big data • MaaS-platforms • Smart (sensor based, remote) maintenance • New power-supply systems • Building information modelling (BIM) • Digital twins 	<ul style="list-style-type: none"> • Maintain comprehensive railway knowledge • Mixed or dedicated exploitation of railway corridors by freight and passenger trains • Single wagonload services or trainload services (block trains) in freight railways • Universal and/or regional solutions for language and communication in cross-border activities • Development of European systems or transnational cooperation for specific purposes • Digital automated coupling deployment • Routing trains conventional or heavy loads • Routing short or long trains • Decisions as regards the transportation of dangerous goods by rail

Source: STAFFER WP2 survey 2021.

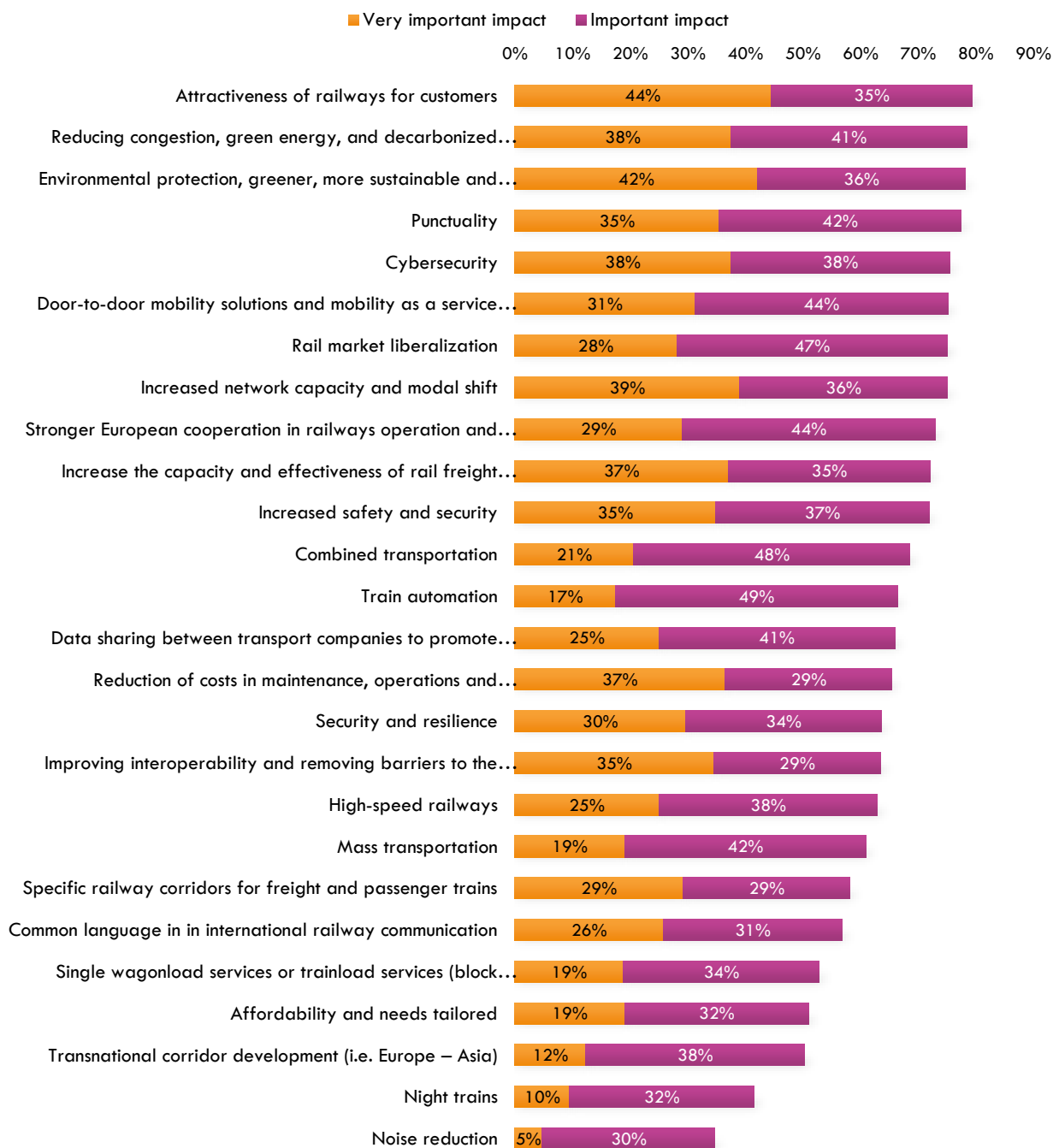
WP2 survey results as regards the assessment of **trends and open issues**⁵ impacting on future railways by 2030 show that major issues that are related to general trends and challenges of our societies and public services are also regarded as very important by railway stakeholders. Amongst the top 5 of very important impacts, attractiveness for customers (rated as having the most important impact by 44% of participants), environmental protection and sustainability (42%) as well as cybersecurity (38%) have been highlighted by respondents.

Further railway-specific issues that were regarded by around 1/3 of respondents as having a very important impact include the following: increased network capacity and modal shift (39%);

⁵ For the survey, trends and open issues as defined in the section above were combined in on single question asking participants to rate a total of 27 trends and open issues according to their impact on future railways (timeline: 2030). [Very important impact; Important impact; Some impact; Little impact; No impact; Don't know]

increasing the capacity and effectiveness of rail freight corridors (37%); reduction of costs in maintenance, operations, and infrastructure management (37%); punctuality (35%), increased safety and security (35%); improving interoperability and removing barriers to the Single European Rail Area (35%) and door-to-door mobility solutions and Mobility as a Service (MaaS) (31%) (see Figure 2 below).

FIGURE 2: RANKING OF FUTURE TRENDS BY IMPORTANCE – TRENDS AND OPEN ISSUES REGARDED AS HAVING A VERY IMPORTANT AND IMPORTANT IMPACT ON FUTURE RAILWAYS BY 2030(N=82)



Source: STAFFER WP2 Survey 2021

Trends and open issues such as stronger European cooperation in railway operation and infrastructure management, rail market liberalisation or high-speed railways were rated by around ¼ of participants as having a very important impact.

Interestingly, only very few respondents regarded noise reduction (5%), night trains (10%) or transnational corridor development, i.e., Europe – Asia (12%) as having a very important impact on future railways within the next decade.

With 17%, less than 1/5 of participants rated train automation as having a very important impact. However, it should be noted that around 50% of all participants indicated that train automation will have an important impact on future railways by 2030.

In addition, there are trends and open issues that were ranked by comparatively large shares of participants as having only little or no impact at all. One such issue was single wagonload services or trainload services (block trains) in freight railways⁶.

When it comes to **technological innovations**, and as shown in figure 3 below, the most important impact on railways within the next five years according to railway operators and infrastructure managers is expected to derive from ERTMS and ETCS deployment.

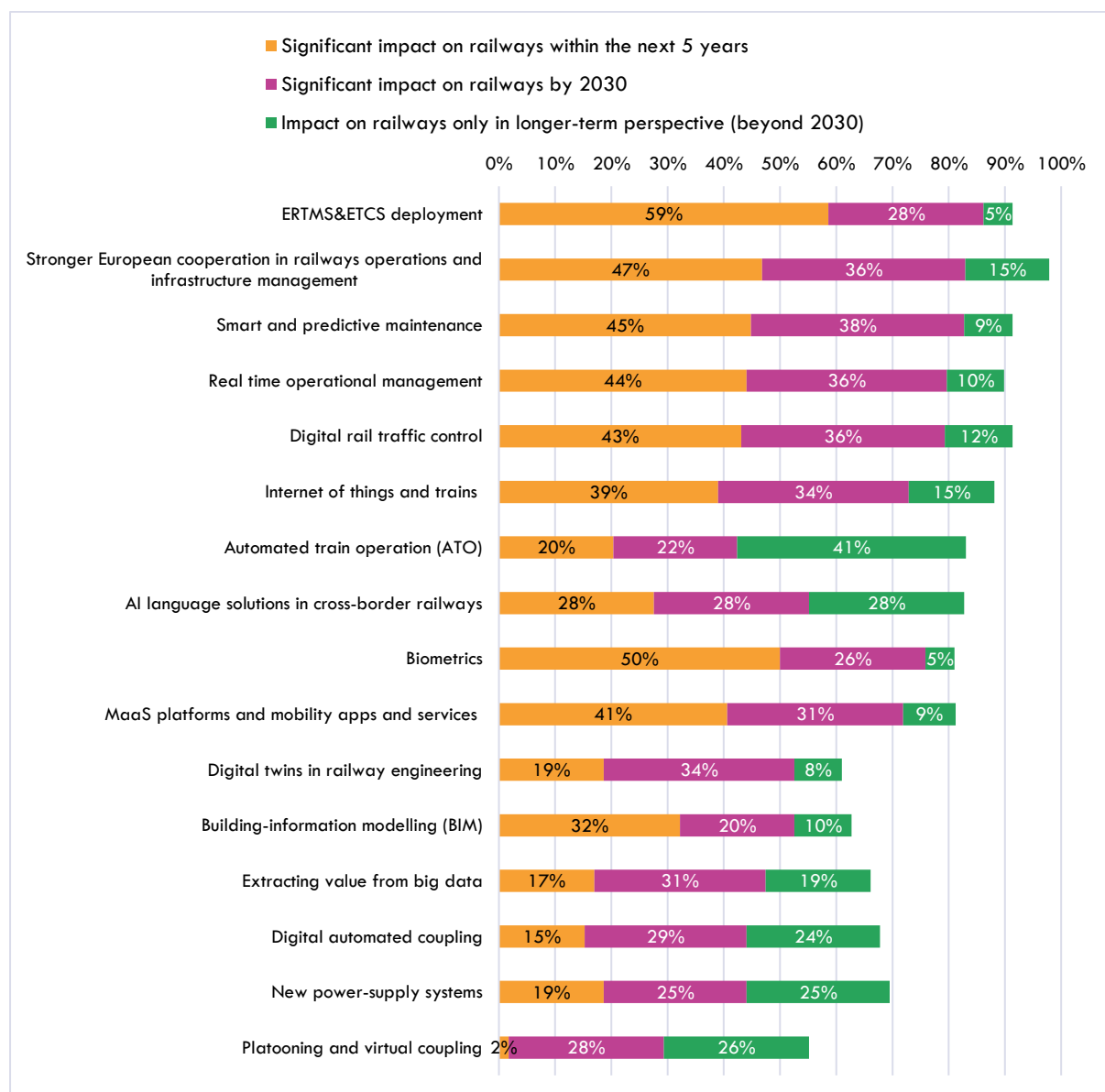
Nearly 60% of participants to the STAFFER WP 2 survey expect a significant impact within the next 5 years. Also, other technologies of digital railways are regarded as having an important impact on railways, namely smart and predictive maintenance, real time operational management, digital traffic control and the internet of things and trains.

However, with the second highest share of 47%, survey respondents regard “*Stronger European Cooperation in Railway operation and infrastructure management*” having a significant impact on railways within the next 5 years (i.e. until 2025/26).

There are also technologies and processes that are expected to have an important impact only in the longer term, i.e., by 2030 or even beyond that. Examples here are automated train operation, extracting value from big data, new power supply systems, platooning or virtual coupling as well as digital automatic coupling.

⁶ It should be noted here that a more detailed analysis per participant type has shown different results on this item. Nearly ¾ of respondents related to the rail freight sector have rated this trend as very important (40%) or important (32%)

FIGURE 3: TECHNOLOGICAL INNOVATION AND ITS IMPACT ON RAILWAYS WITHIN THE NEXT 5 YEARS, BY 2030 AND BEYOND (N=82)



Source: STAFFER WP2 survey 2021

The following innovations were also highlighted by individual survey participants as having an important impact: inspection and control based on drone technology; active suspensions, new car body materials; development of increasingly efficient simulators allowing total immersion for learning and replaying an incident; telecommunication and the introduction of the 5G concepts; 5G and FMRCs Future Mobile Railway Communication System; steering rail capacity by AI, using algorithms.

2.3.1 Challenges from the HR perspective

New technologies and other innovations but also developments in the market environment, railway related policies and other drivers (demographic and general change, increased

diversity, etc.) are expected to result in significant adjustment needs in relation to staff and human resources development in railway operation and infrastructure management.

However, according to the results of the WP2 survey, **by far the most important challenge from the HR perspective is to increase the attractiveness of railway jobs**. 31% of survey respondents placed this challenge first and more than 50% of respondents included it in the top 5 challenges.

Other challenges in relation to workforce development and management were also regarded as important. These include:

- Adjustment of leadership practices and cultures
- Improving initial and further vocational education and training
- Transfer of knowledge in the context of demographic change
- Improving the development of talent
- Adjustment of occupational profiles in the light of new needs

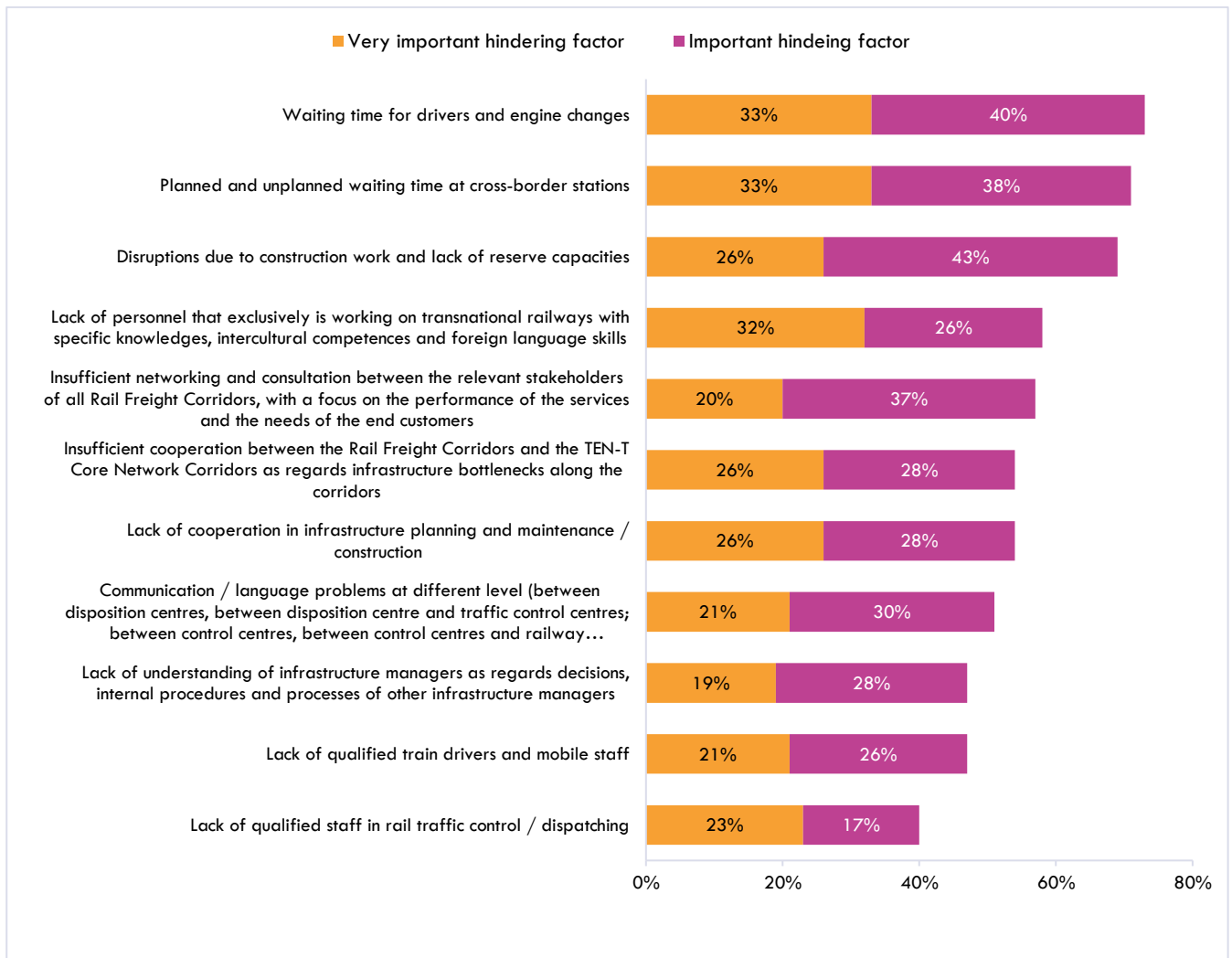
2.3.2 Challenges in the field of cross-border railways and transnational cooperation, language, and communication

Against the ambitious goals of European railway policy in relation to increasing the efficiency and supply of cross-border railways both in passenger as well as freight transport, challenges and barriers for cross-border railways, transnational cooperation, language and communication has been an important topic addressed by various work packages of the STAFFER Blueprint project.

As a starting point, the WP2 survey gathered assessments and visions of stakeholders on the issue, including on challenges and barriers.

As shown in Figure 4 below, the human resources factor according to survey participants is regarded as a significant hindering factor when it comes to efficiency and attractiveness for customers of cross-border railway operation. However, more important challenges in cross-border railways are not related to the human factor but rather to infrastructure and coordination: 73% of survey participants regarded waiting time for driver and engine changes at cross-border stations as the most important hindering factor, followed by planned and unplanned waiting time at cross-border stations (71%), disruptions due to construction works and lack of reserve capacities (69%) and a lack of personnel that is exclusively working on transnational railways with specific knowledges and skills. (58%).

FIGURE 4: ASSESSMENT OF HINDERING FACTORS TO THE EFFICIENCY AND ATTRACTIVENESS OF CROSS-BORDER RAILWAYS IN THE FIELD OF PASSENGER AND FREIGHT TRANSPORT



Source: STAFFER WP2 survey 2021

When asked about measures to address the challenges faced by cross-border railways, the STAFFER survey strongly supports the assessment that the qualifications and skills of the workforce working in cross-border transport are a crucial issue: Measures that were regarded by the largest shares of participants as having an important impact are:

- Development of common European training modules for operational and infrastructure management staff involved in cross-border railways (around half of respondents totally agreed that there is a need for this type of measure).
- HR development and specific skills and knowledge of railway staff involved is regarded as a key factor to promote cross-border railways (also around half of respondents totally agreeing to this statement).
- New digital technologies and automation according to a high share of survey participants have the potential to contribute to the attractiveness of cross-border rail operations.

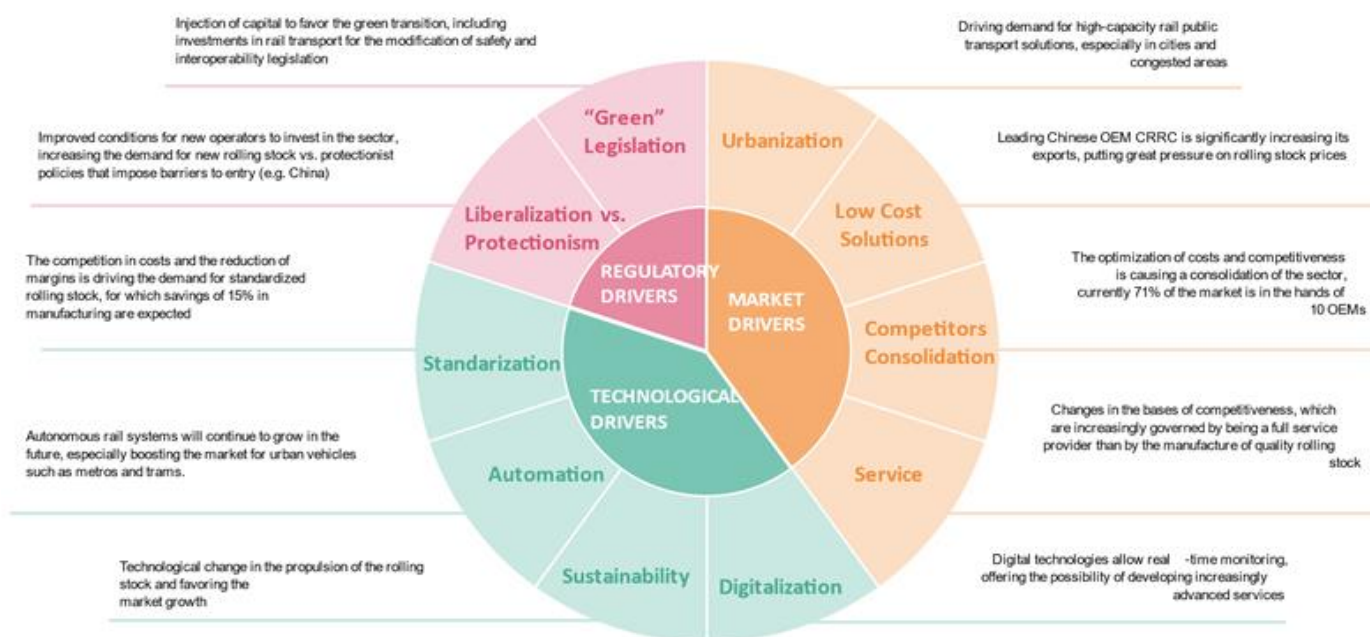
2.4 A more detailed view on trends, innovations, and challenges from the perspective of the rail supply industry

As highlighted in one deliverable in the context of STAFFER work package 3 on the rail supply industry, rail transport is an enabler with a huge potential to link regions and connect society, and by doing so, to facilitate social and economic development.

Therefore, rail must be designed and developed to solve our current problems and demands, and delivering the highest levels of dependability, resilience, and quality. The same relates to the liberalisation of the sector and other more particular drivers such as servitisation, digitisation and automation. In this sense, new communication technologies and IT solutions must be taken into consideration to improve connectivity, real time data, enabling smart prediction, signalling, easier ticketing systems and IoT-based innovations at European scale.

The main drivers of the rail market are presented from the perspective of rail in general are presented in Figure 5 below.

FIGURE 5: MAIN DRIVERS OF THE RAIL MARKET



Source: STAFFER Deliverable 3.1

According to UNIFE World Rail Market study 2020 and Rail Strategic Research and Innovation Agenda developed by ERRAC (2020), by 2050 about 75% of the world population will live in cities. These urban centres face challenges related to urban planning, environmental pollution,

or traffic management. The Rail systems will play a fundamental role and the demand for urban transport solutions such as trams, subways or light rail will increase. Likewise, another challenge the future cities will face is the fast and safe intercity transport, which will mean a rapid growth of high-speed trains.

The bases of competitiveness are changing and are governed more and more by being a full-service provider rather than just a manufacturer of rolling stock. We can see an evolution of the rail sector towards “servitisation”. According to this concept, the rail industry is expected to re-direct their lines of business considering the provision of services on the basis of their products. In the rail supply industry, this entails a transition from the manufacture of rolling stock and signalling towards a value-added proposal based on integrated transport systems that cover all phases of design, development, deployment, and management. This has led to the creation of new business models and the entry of new competitors and customers to the market:

- Design-finance-build-maintain schemes include studies of feasibility, cost-benefit analysis, financing channels, own construction of rolling stock and/or infrastructure (in consortium with third parties), maintenance, spare parts, and staff training.
- New value-added services, such as rehabilitation of both own products as well as those of the competition or updating of rolling stock.
- Auxiliary services, such as workshop design and management of logistics inventory for customers.

Therefore, the actual more valued proposals are based on a set of comprehensive services capable to cover the whole transportation system life cycle, from its conceptualization to its implementation and management. Digital technologies and analytics capabilities offer the possibility of developing increasingly advanced services and new business models.

Technological drivers: ICT is transforming the rail sector. The sector’s main challenge is to move the users at the centre of the process. To achieve this, it is necessary to offer the so-called “door-to-door” services and, at the same time, reduce environmental costs in line with society’s expectations. There are different tools that allow the industry to analyse data and access a larger number of users, such as lifecycle costing reduction and the achievement of RAMS targets in terms of Reliability, Availability, Maintainability and Safety of the rail system as a whole.

Nowadays large volumes of data generated by users, train movements and infrastructure are available. For this very reason, a significant number of players from the Information Technology sectors are emerging by offering intelligent mobility solutions.



Sensor based systems, real-time data transmission and analysis capabilities are increasingly accessible at reasonable low cost, opening the opportunities to new business models and shifting maintenance management from time-and-use-based strategies to on-condition based maintenance.

Monitoring the assets' conditions by resorting to analytics algorithms is essential to perform predictive maintenance and optimize an overall maintenance management.

Further trends driven by new technologies and digitalisation that have been highlighted in the context of work package 3 in Rail STAFFER are:

User-centred digitalisation focussing on monitoring passengers' comfort and safety: Adaptive temperature control based on the number of passengers boarding the train; security monitoring through CCTV cameras and intelligent sensors; Wi-Fi coverage and access; real-time informative systems; mobile apps; ticketing.

Operation-centred digitalisation: Infrastructure monitoring: improvement of infrastructure maintenance based on traffic system and environmental monitoring; removal of obstacles from tracks by visual monitoring; optimization of Human Resources planning based on fleet status; optimization of maintenance cycles based on the critical system status.

Blockchain technology will foster the development of platforms that involve all the players in the value chain and will provide the capacity to record information (manufacturing, tracking, delivery), working together with IoT elements (sensors, QR codes, among others).

Despite all the benefits of digitalisation, these digital solutions are increasingly vulnerable to cyber-attacks since any connected system is likely to be hacked. Therefore, it is also necessary to consider the importance of an early adoption of cybersecurity measures when increasingly digitized environments.

Sustainability: The growing environmental awareness is driving the electrification of rolling stock propulsion, and it is favouring the growth of the market.

The goal of extending the trains' life cycle and then recycling materials and components is crucial in this respect with regard to the efficiency, where the lightening of rolling stock plays a further central role. At European level, the sector is working on legislative support that allows reduce the Time to Market of these materials. Other areas for improvement in the design of trains are the use of anti-graffiti paints, materials that improve sanitation in interior spaces and universal accessibility.

In terms of energy efficiency, access to alternative fuels suitable for each mode of transport is being promoted at a European level, highlighting the use of Liquefied Natural Gas (LNG) and hydrogen (medium/long-term) as the best alternatives to diesel. Another trend that is influencing the rail sector from the sustainability point of view is the modal change to rail system. Rail transport is environmentally more sustainable than other mode of transport. The electrification of rail system has boosted the position itself when it comes to promoting environmental sustainability.

Automation: Autonomous rail systems will continue to grow in the future, especially boosting the market for urban vehicles such as metros and trams.

Autonomous rail systems have increased exponentially in the last 20 years, having today already dozens of fully automated rail systems already in (autonomous) operation across Europe. A further increase towards the so-called AS (Automated Systems) is expected in the coming years, especially in the segment of local means of transport such as subways and light trams, evolving. It should be noted that Europe and Asia are the regions with the largest number of autonomous rail systems, based mostly on subway and light rail systems.

Standardisation: The competition in costs and the consequent reduction of margins is driving the demand for standardized rolling stock, for which the benefits obtained in terms of savings would be around 15% in manufacturing. The financial investors as the Railway Undertaking in the rolling stock market have increased competition but increasing opportunities in after-sale services market are now available for the rail industry. These two changes are promoting the manufacturing of standardized vehicles to be supplied for non-specialized RU's.

The systems with the greatest impact on saving in standardization are interior elements, with a potential cost reduction of 20%.

3 CURRENT AND FUTURE RAILWAY RELATED OCCUPATIONAL PROFILES AND SKILLS NEEDS

3.1 Introduction

The previous chapter on trends, innovations and challenges has illustrated that railway – driven by digitalisation and automation as well as other factors – will change significantly. Therefore, occupational profiles already and in the future experience major changes due to the identified trends, were revealed in the literature research and surveys carried out in the context of STAFFER work packages 1, 2 and 3.

All the above, together with other factors, constitute emerging needs for the development of the European rail system. As a result of the dynamism of the European's Research and Innovation and, consequently, the introduction to the market of new technologies and services, it is then essential to enhance the skill and the competency of the European's rail workforce needs.

This change is likely to affect all occupational profiles (with different intensity) by adding additional layers of new skills, competences and knowledge. Furthermore, new job roles and profiles need to be established, not only in response to digitalisation and automation but also in response to new patterns of mobility, customer expectations and the need to expand and grow cross-border railway operations.

In the following key results of STAFFER project, activities on these aspects are presented from the perspective of the rail supply industry, and from the perspective of railway operation and infrastructure management. Though based on different methodological approaches, quite a number of similar trends in relation to skills needs and -shifts have been identified as will be shown in the sections below.

With view on occupational profiles in rail, the two work packages that have analysed skills shifts and new emerging job profiles from the perspective of rail suppliers (WP3) and from the perspective of railway operators and infrastructures, have applied a similar approach on the basis of using the database of European Skills, Competences, Qualifications and Occupations (ESCO) as reference taxonomy.⁷

⁷ See Deliverables D 2.1 and D 2.2 as well as D3.1 and D3.2. On ESCO: <https://esco.ec.europa.eu/en>.

3.2 Rail supply industry

3.2.1 Occupational profiles

From the perspective of rail suppliers, WP 3 aims to give an overview of specific macro-trends and their impacts on rail industry suppliers as well as relating to assumed skills needs. Furthermore, a deeper insight into skill shifts, current and future needs of skills and competencies, and the analyzation of occupational profiles are targeted.

The overall methodology developed in WP1 was used to identify the needs of rail suppliers. While WP1 has worked with a questionnaire, the project team decided against a second questionnaire to gain deeper insights into the skill shift and preferred expert interviews to have the specific know how at hands. In order to gain an in-depth insight into the topic, an additional data scrolling approach was used. Figure 6 below represents the report's methodology which had been used for the identification of skills needs and occupational profiles – the mentioned tasks above are embedded in this structure of methodology.

FIGURE 6: METHODOLOGY OF IDENTIFICATION OF SKILLS NEEDS



Source: STAFFER Deliverable 3.1

Best practices: This task covers the stakeholders' requirements. It collects their practices on re-skilling and up-skilling the companies' workforce and is the first try to figure out on which future skills they work on to prepare the workforce for future requirements. The answers are summarized in form of a one pager.

Spreadsheet: Stakeholders had been asked to interview internal company experts regarding to these job profiles with a focus on the following two specific questions: 1) What kind of changes are to be expected in a digitalized world? and 2) What future skills need to be built up?

Compiling the STAFFER list of rail profiles together with the information out of ESCO helped to gain further information about the validity of these job profiles regarding their descriptions,

skills and competences. It also proved that some of the profiles mentioned in the STAFFER list are not existing yet as a job profile in ESCO.⁸

The intention of the conducted expert interviews was not only to expose skills needs and future skills, but also to discover the critical incidents within changes in a digitalized world and beyond. In our understanding critical incidents are defined as actions having a crucial impact on the job profile and, as consequence, on the needed skills and competences.

Data scrolling: To complement the evidence gathered by the spreadsheets from a relatively small group of company experts, a data scrolling was conducted by an external partner.

The aim of the data scrolling was to explore the actual talent demand on the job market for rail suppliers as well as an analysis about skills and their request development over the past four years. These big data analyses are especially interesting as you get smart intelligent insight of big trends in skills that are reflected in job postings and can analysis and even sometimes quantify the skill need in the labor market.

3.2.2 Occupation groups with the strongest need for skill adaptation

On this basis a skill assessment methodology was developed in the context of WP3⁹, that reviews trends and their effects on occupational profiles, to make suggestions on the actions to take for developing the necessary skills in the workforce to handle these effects. The following figures document those occupational groups that, according to an expert survey experience the strongest need for skill adaptation (Figure 7) and the underlying reasons for change (Figure 8).

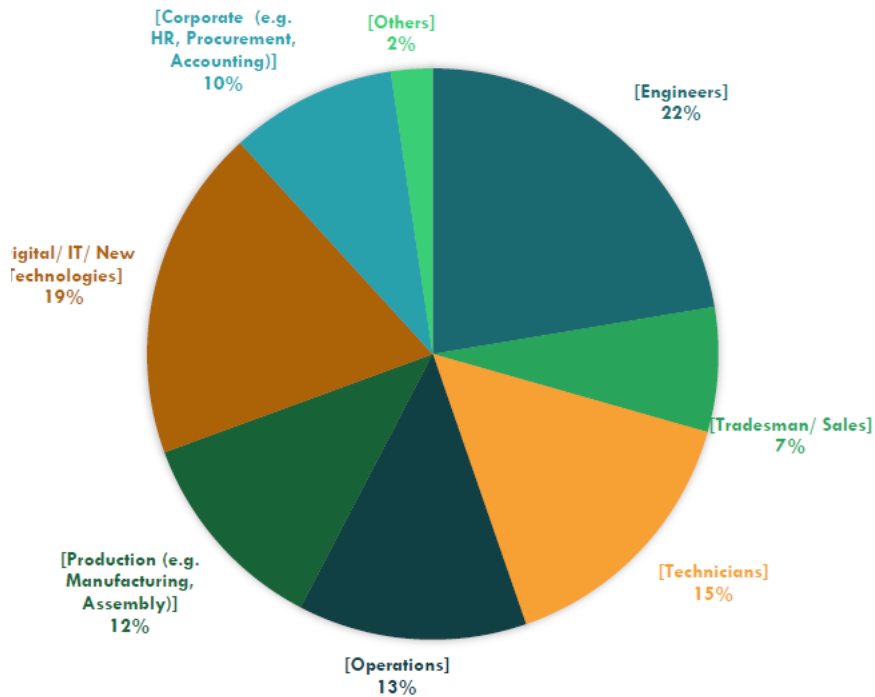
Profiles with the biggest need for adaptation include engineers, digital and IT and technicians as a result of new digital technologies, for example through the increasing complexity of the rail system, the increasing necessity for data security and an increased demand for data analysis.

When asked which skills are missing and are necessary in the future, participants listed applying and handling digital technologies as the most important trend. Skills and overall knowledge about the railway systems but also hard and soft skills, such as language skills or innovative and open to learning attitudes and cultural skills were also deemed important.

⁸ See STAFFER Deliverable 3.2 for the full list of ESCO profiles relevant to the rail supply industry.

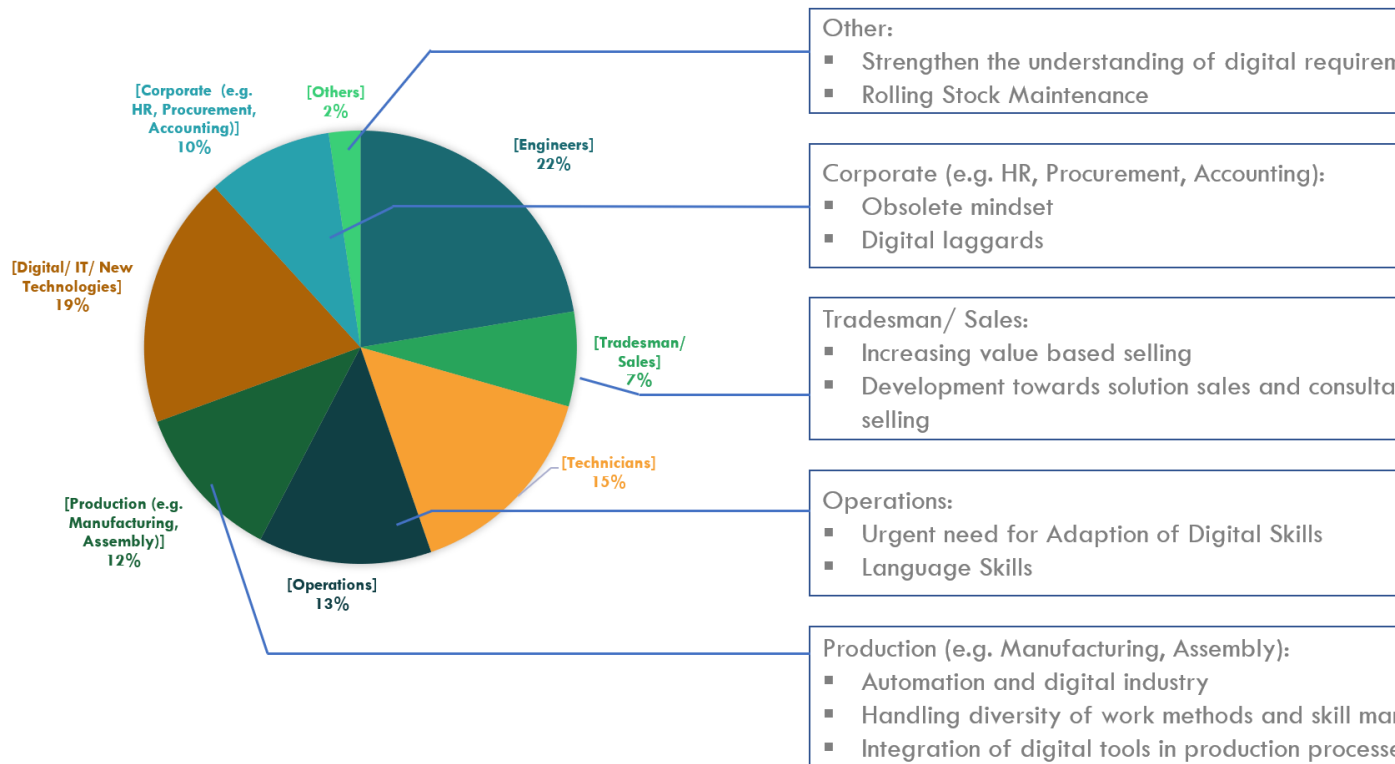
⁹ See Deliverable 3.1.

FIGURE 7: OCCUPATION GROUPS WITH STRONGEST NEED FOR SKILL ADAPTATION



Source: STAFFER Deliverable 3.1

FIGURE 8: REASONS FOR SKILL ADAPTATION NEEDS



Source: STAFFER Deliverable 3.1



As shown in Table 3 below, ESCO did not include every job profile, at least not in the way they are seen by railway suppliers. In case of the STAFFER project’s objectives, ESCO provides a solid base especially in terms of training provisions but is limited regarding future topics and validity of job profiles. Due to the dynamics of the market changes prediction of skill needs as consequence is getting difficult and can only be reflected in a dynamic process that reviews job profiles against current market developments.

TABLE 3: RAIL SUPPLIER OCCUPATIONS AND ESCO

ESCO profile exists	ESCO has no profile or skills/competences / knowledges defined for this occupation group	ESCO has no profile defined, but a description of the occupational profile in form of a single skill/competence/ knowledge
<ul style="list-style-type: none"> • Railway Engineers • Welding Engineers • Civil Engineers • Robot Engineers • Vehicle Architecture • Automation Engineers • Software Engineers • Network Engineers • Information Technology Engineers • Process Engineers • Electrical Engineers • Mechanical Engineers • Welding Technicians • Electrical Technicians 	<ul style="list-style-type: none"> • RAM/ LCC Engineers • ILS Managers • Transportation System Engineers • Programmers 	<ul style="list-style-type: none"> • Computer Engineers • Signal Processing • System Engineers • Artificial Intelligence Engineers • Safety Engineers

Source: STAFFER Deliverable 3.1

3.2.3 Skills and occupational profile adaptation

As highlighted in STAFFER Deliverable 3.1 on the adaptation of occupational profiles on the rail supply industry, skill development and adjustment should not be regarded as only relying on training: Most roles are based on mechanical or electrical knowledge and are undergoing a specification over the career development. Career progression includes a high degree of experience necessary to gain deeper inside into the system rail and to understand the complexity and interconnections. The common 70-20-10 approach from Morgan McCall, Robert Eichinger and Michael Lombardo of Center for Creative Leadership applies. 70% of learning is related to problem solving in being involved in challenging tasks. Employees learn from their own success and failures. 20% is dedicated to learning from others. Especially the exchange with other more experienced experts is considered as a string layer to understand more about the complexity of the rail system. In particular when it comes to interfaces, 10% is formal

learning. Employees participate in a course or in training sessions to learn harder and soft skills and technical understanding of the rail system. This logic makes clear that skill development cannot only rely on training but needs to incorporate on the job learning as well to reflect the specifics of the rail system. New learning methodology might help to create more agile and adaptive forms in combination with rail industry.

From the perspective of the rail supply industry, the analysis conducted in work package 3 gives a broad selection on skill needs and future skills. What has been highlighted in this context is that the quality that makes the difference is more that skills need to be combined or applied for different work groups. The working group discussed how STAFFER can make a difference for us as supplier companies. The experience is that the rail supply industry is used to build up domain specific knowhow for students that come with a broad education – but maybe not rail-specific. What would be an outcome of STAFFER that we all benefit from in a sense that we could not be able to build this up alone. The discussion focused on the five most relevant future or needed soft and hard skills which need to be developed from the point of view of suppliers and which are highly related to each other, and which are summarised in Table 4 below.

TABLE 4: FIVE MOST RELEVANT FUTURE OR NEEDED SKILLS FROM THE POINT OF RAIL SUPPLIERS

Soft Skills	Hard skills
<p>Collaboration: Working together although you do not have a common language, although organizational structure needs to be overcome is essential in our time. Companies build ecosystems with external parties, customers, academia, etc. that needs new ways of collaboration to be defined.</p>	<p>Holistic understanding & system thinking: Especially in times of digitization, systems are continuously changing. Related to both soft skills collaboration and problem solving, a holistic understanding and system thinking are essential key skills to work in cross-functional and interdisciplinary systems. The focus is moving away from the specific knowhow to broader system understanding – also including more work groups from different faculties. Being able to adapt the system by adding or changing part through digital elements or adapting to new sustainable technologies or materials is crucial.</p>
<p>Problem solving: In a time of change there are rather no given solutions anymore as they do not any longer help to solve the problem. To understand a problem, bring interdisciplinary faculties at the table and find new solutions is a capacity that is difficult to train but essential at the same time to make things work.</p>	<p>Bridging of traditional and digital approaches: When a new group of digital experts is entering the company, how could collaboration and understanding with the existing group of traditional engineers be fostered. Especially the understanding of the two technical domains is crucial. This effects also the very early education of students as companies are today only getting people from either the one technical domain or the other. Generating more people who have a deep understanding of traditional rail as well as digitalization will be a success factor in the future.</p>
<p>Life-Cycle Management: Life-Cycle Management is a bit like the holistic understanding of the rail system but with the aspect of evolution over time of operation.</p>	

Source: STAFFER Deliverable 3.1

As an outcome, it is suggested to put these five skills forward for further exploration within more action and strategy-oriented STAFFER work packages and beyond that are going to develop

skill gap solutions. We strongly recommend trying to understand the critical incidents first before developing a solution as all five skills are interconnected and with that rather complex.

3.3 Rail operation and infrastructure management

To carry out the skills needs analysis from the perspective of rail operators and infrastructure managers, a twofold approach was adopted by the co-leaders in WP2, wmp consult and DB, in close cooperation with the STAFFER partners representing railway companies.

In addition to the identification of general trends affecting the whole railway sector, a targeted analysis of technological and other trends, important drivers of change and innovations as well as public policy choices that have strong impact on future railways was carried out.

Building on this, an analysis of future skills and competence requirements as arising from trends and changes as well as from the perspective of cross-border railways and requirements as regards interoperability in a single EU railway market.

This approach was implemented by different methodological tools such as desk research¹⁰, interviews and focus group discussions with experts in different domains of railway operation and infrastructure management¹¹ as well as an online survey, also reflecting the specific focus of STAFFER activities in the context of cross-border railways, communication and language.

With view on skills needs the adopted approach took also included the identification of 30 railway specific occupational profiles as included and described in the ESCO database of European Skills, Competences, Qualifications and Skills.¹²

A key source in the context of the targeted trends analysis and the identification of future skills needs in relation to railway specific occupations was the online survey conducted in June and July 2021. The survey addressed experts within railway operation and infrastructure managers as well as educational and academic institutions and consisted of six thematic sections addressing both major trends and other drivers of change in railways up to 2030 and beyond as well as skills and competence requirements and solutions for cross-border railways, language, and communication; experiences and requirements in transnational cooperation in railways as well as skill shifts and future skills needs in different railway specific occupations.

¹⁰ Apart from already existing research results, desk research also included an in-depth analysis and repository of EU databases (ERASMUS, CORDIS) consisting of more than 190 railway related transnational cooperation, mobility, R&D and innovation projects.

¹¹ Focus group discussions addressed skill and competence requirements in Rail Freight Corridors and foreign language needs in cross-border railway operation.

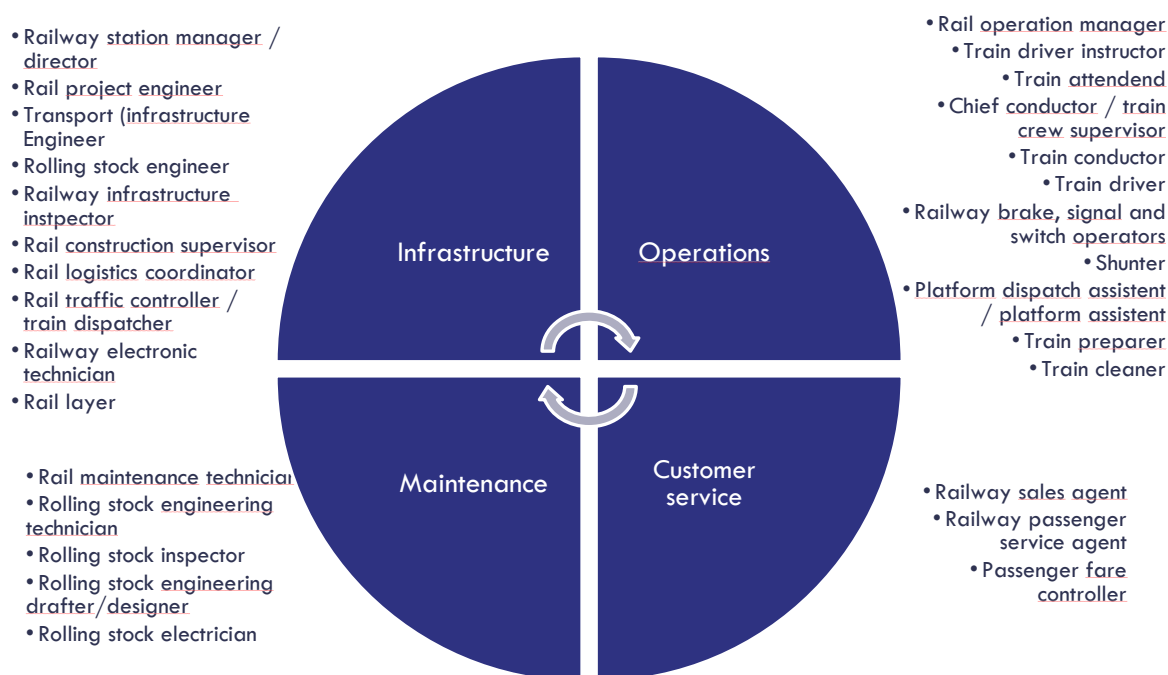
¹² See Deliverables 2.1 and 2.2. On ESCO: <https://esco.ec.europa.eu/en>.



3.3.1 Occupational profiles

For identifying occupational profiles that are relevant for railway operations and infrastructure management, a total of 30 ESCO profiles have been identified in the context of WP 2 in relation to the domains of railway operations (11 profiles), maintenance (5 profiles), infrastructure (10 profiles) and customer services (4 profiles). See Figure 9 below.

FIGURE 9: IN ORDER TO PROMOTE AND FOSTER THE ESTABLISHMENT OF A EUROPEAN RAILWAY AREA AND TRANSNATIONAL MOBILITY IN RAILWAYS, HOW IMPORTANT ARE THE FOLLOWING TYPES?



Source: STAFFER Deliverable 2.1

3.3.2 Skill shifts and adaptation of occupational profiles/groups

Based on the 30 railway specific occupations in the four main domains of railway operation and infrastructure management, respondents of the survey were asked to assess the skill needs and skill shifts in the light of technological trends and innovations.

The following results should be highlighted:

Confirming the results of the generally upskilling trend as described below, only a minority of respondents think that the current skill set will remain the same (below 10% of respondents for most occupations, whereby the highest shares are for occupational profiles such as train cleaner, rail layer or shunter).

Minor needs as regards the development of new skills are expected by survey participants for only occupations such as railway sales agent, train conductors, infrastructure inspector or construction supervisors.

This corresponds to few occupations where respondents expect no major needs in terms of new skills that must be added to the occupational profile. Such occupations are those with a comparatively low educational and training qualification level, e.g., train cleaner, platform assistant, shunters or rail layer as well as passenger fare controllers and railway sales agents.

As regards occupational profiles with a lower level of qualification and skill needs, it should be noted that these results do not mean that digitalisation has no impact on the job and how tasks are carried out. In fact, occupational tasks may already have been strongly affected by new technology (as in the case of ticket sale, controlling or customer services). Furthermore, there are also quantitative impacts, i.e. a reduced demand of jobs in areas that have been digitised already (selling tickets and providing customer information via apps).

By contrast, technical and engineering occupations with higher levels of qualification and corresponding EQF levels were highlighted by survey participants as those with major needs for new skills to be added to the respective occupational profile.

Respondents mentioned the following profiles in particular as occupations that are like to change significantly in the future:

- Rolling stock engineering drafter / designer
- Maintenance technician
- Rolling stock electrician
- Rolling stock technicians

Major skill needs are also indicated by high shares of survey participants for rail operations managers and rail project engineers.

An important result of the survey is also that a high share of survey respondents stated that major new skill requirements and needs are emerging or will emerge in the field of train driving.

An even higher share of respondents thinks that there will be major need in new skills that should be added to the occupational profile of the rail traffic controller / train dispatcher.

Overall and as regards future skills development and measures related to employability in railways the survey results raise several issues that will be important to be addressed by railway operating and infrastructure management companies: Which fundamental, general skills will become more important for workers and employees to stay in a job and build a career in specific occupational profiles? Which technical skills will become more important and which

transversal, soft skills? From the perspective of railway education and training, which responsibility the vocational education and training system outside and inside railway companies need to play in the future?

Furthermore, the survey results confirm that the decision as highly relevant to select the three occupational profiles of the train driver, profiles in traffic management and control and occupational profiles in maintenance and infrastructure, including engineering occupations.

3.3.3 Current and future skills: More in-depth analysis of three occupation groups

Based on an agreement of all railway operation and infrastructure management partners in STAFFER, three occupational profiles /groups were selected for an in-depth analysis as they are particularly relevant in terms of the impact of main trends such as digitalisation and expected changes due to emerging technologies such as automated operation, digital traffic control, disruptive changes in infrastructure and maintenance of rolling stock as well as construction (BIM, digital twins, predictive maintenance, etc.).

- Train drivers (including train driver instructors)
- Staff in traffic control centres (dispatchers, signal box staff, etc.)
- Engineering and technician profiles in maintenance of rolling stock and infrastructure

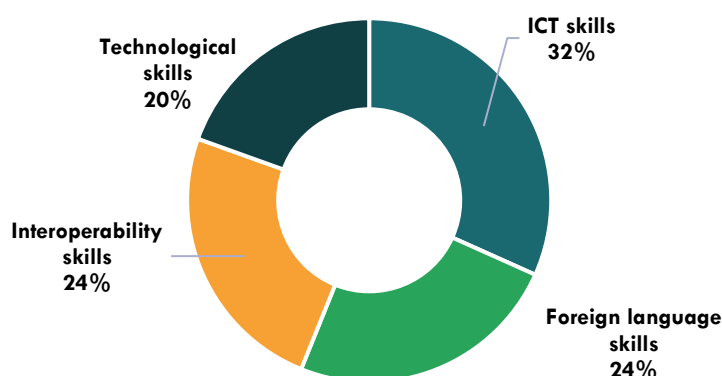
3.3.3.1 Train drivers

The current skill requirements of train drivers according to the STAFFER survey respondents is characterised by basic to moderate fundamental skills and moderate to higher requirements as regards technical skills. Also, transversal skill requirements are rated as essential or very important by most survey participants. In relation to fundamental skills, basic literacy, basic numeracy, and basic ICT skills were highlighted as essential or very important. The share of respondents who regard those skills as less important is zero. Even around one fifth of respondents think that advanced literacy and numeracy skills are required to perform the job of a train driver. When it comes to transversal skills, survey participants confirm the already existing experience that train drivers are working in a very demanding environment: Top transversal skill requirements of train drivers according to survey respondents are problem solving skills (78% regard this as essential or very important), learning skills (64%) and communication skills (58%). Also, teamworking skills are assessed as essential or very important by more than 40% of the survey participants.

According to experts of railway companies, the occupational profile of train drivers in the future will become much more demanding. Against the current rapid technological change, ICT skills as well as technological skills and competences will become more important in the future for the job of a train driver. Such skills are needed to master new technologies and tools such as mobile devices and other technological equipment both on-board as well as mobile tools. Survey participants also highlighted that ICT requirements are becoming more complex and require more system thinking of train drivers (see Figure 10). Besides technology related skills, around one quarter of the survey participants – anticipating the increase in cross-border railways – also highlighted foreign language skill needs as becoming more important in the future for the job of the train driver.¹³

Furthermore, a quarter of the participants also highlighted the need of skills, knowledge and competences related to **interoperability**, i.e., the knowledge about European and national systems of traffic safety and control, the understanding of regulation in neighbouring countries, etc. Survey participants also highlighted the need that train drivers need to obtain more cross-functional knowledge within railway operation, infrastructure processes and networks.

FIGURE 10: TRAIN DRIVER: FUNDAMENTAL FUTURE SKILL NEEDS AS HIGHLIGHTED BY SURVEY PARTICIPANTS



Source: STAFFER Deliverable 2.2.

As regards of transversal future skill requirements, survey participants highlighted communication skills. More than 50% of the participants in this context referred to skills related to the handling of new digital communication tools that is likely to substitute or complement oral communication with traffic control centres. Around a quarter of responses referred to new skills in the fields of team-working (collaboration, cooperation) as becoming more important in the

¹³ This indicates the fact that large parts of rail freight transport in Europe already today and even more in the future are cross-border. Furthermore, survey participants seem to also anticipate a future increase in transnational passenger transport in Europe.

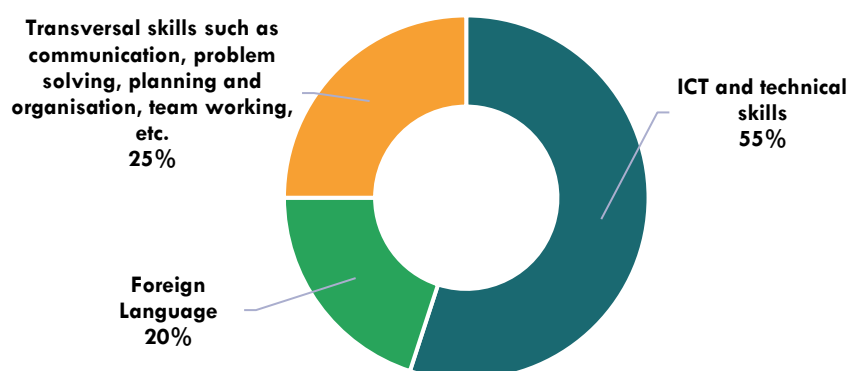
future as well as skills such as problem solving, adaptability, dealing with complexity, autonomy, or resilience.

3.3.3.2 Staff in traffic control, command and signalling

Occupational profiles in traffic control activities are related to different railway-specific occupations in railway infrastructure as well as in operations. Such profiles are also related to different entry qualification levels and/or specialisation. Examples (national language differs here) are rail operation managers, train dispatchers, signal box operators, traffic controllers or logistics coordinators. Fundamental skills requirements of traffic control staff compared to train drivers are higher when it comes to ICT and numeracy. The majority of survey respondents regard advanced literacy skills, advanced numeracy and moderate ICT skills as essential or very important to perform the job. Apart from such fundamental requirements, also technical skill requirements are rated quite high by survey respondents: Nearly 80% think that specialised knowledge is essential or very important. Finally, transversal skill requirements of traffic control centre staff are markedly higher than in the case of train driving: More than 90% of respondents regard problem solving skills as essential or very important. More than 80% think the same in relation to teamworking and communication skills and around 3 / 4 think so as regards planning and organisation skills.

Digitalisation in traffic control will have a significant impact on the occupational profile of staff in traffic control centres. As shown in Figure 11 below, more than 50% of respondents to the STAFFER online survey highlighted a significant skill shift towards more advanced ICT knowledge and skills for staff in traffic control centres. This indicates a significant shift from current moderate to advanced skill requirements. Apart from handling new digital technologies, participants also highlighted the need of understanding and obtaining IT system knowledge.

FIGURE 11: STAFF IN TRAFFIC CONTROL CENTRES: FUNDAMENTAL, TECHNICAL AND TRANSVERSAL FUTURE SKILL NEEDS AS HIGHLIGHTED BY SURVEY PARTICIPANTS



Source: STAFFER Deliverable 2.2



Participants also stressed that the understanding and differentiating of safety systems and related tools and railway system thinking will become more important in the future as well as more advanced literacy, the use of digital communication tools and media as well as working in 'virtual' environments, including in cross-border constellations. The latter will also require more foreign language skills. Survey responses and focus group discussions also indicate that transversal skills will become more important in the future. Skills mentioned also by other participants are problem solving, troubleshooting competences, intercultural competences, using technical tools for supporting and ameliorating cross-border communication, team working, coordination, adaptability, agility, collaboration, and communication.

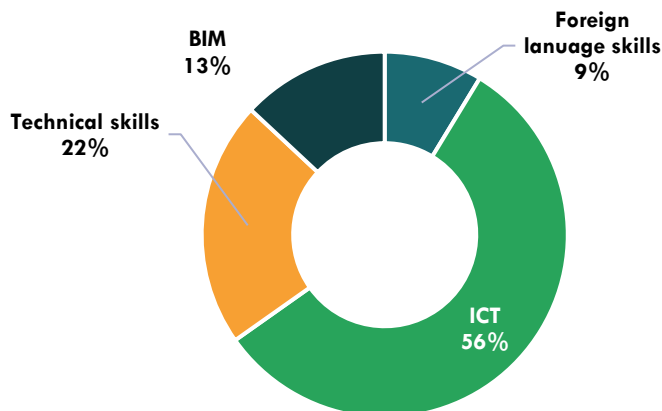
3.3.3.3 Technical and engineering staff in maintenance of rolling stock and infrastructure

This group is even more diverse than different profiles in traffic control activities. In terms of general qualification requirements profiles range from manual blue-collar jobs in basic functions and EQF level to higher qualified blue- and white-collar occupations such as electricians, drafters, mechanics to academic qualifications in engineering and project engineering and management. Thus, the profiles addressed by respondents in the STAFFER survey tend to be related to higher EQF level requiring academic qualifications or at least technical vocational programmes at the level EQF 3,4 or 5. Against this but also of course in the light of technological developments related to digitalisation and automation it is not surprising that the survey respondents rate the current fundamental, technical as well as transversal skill requirements as high in most cases and aspects. In the field of fundamental skills, advanced literacy, advanced numeracy as well as at least moderate ICT were regarded as essential or very important. Furthermore, more than 50% of the respondents think that foreign language skills are essential or very important for carrying out the respective jobs in infrastructure and maintenance. When it comes to technical skills and specialised knowledges these are of course essential according to survey participants as well as the ability to operate specialised technical equipment or product and service knowledge. Key transversal skills according to the WP2 survey are problem solving (94%) were ranked highest by survey respondents. Learning skills are rated as the second most important transversal skill by nearly 90% of survey respondents followed by teamworking skills, planning and organisation skills with more than 70%).

For technicians and engineers in maintenance of rolling stock and infrastructure, experts report a general upskilling need across different occupational profiles, triggered in particular by digitalisation and new technologies. The following Figure 12 shows that survey participants overwhelmingly referred to ICT and other technology related skills that will become more important for the respective occupational profiles in infrastructure and maintenance. Advanced

ICT skill needs are also related to new and disruptive technologies such as BIM, augmented and virtual reality skills, digital twins. Participants also highlighted the need of employees and workers to continuously update their knowledge in the rapidly changing ICT and digital technology environment.

FIGURE 12: ENGINEERING PROFILES IN INFRASTRUCTURE AND MAINTENANCE: FUNDAMENTAL FUTURE SKILL NEEDS AS HIGHLIGHTED BY SURVEY PARTICIPANTS



Source: STAFFER Deliverable 2.2

In addition, foreign language skills were mentioned by a comparatively small share of respondents. This may be related to the fact that English language skills are already quite well developed in occupations such as engineers.

Apart from transversal skills that were already highlighted for the other occupational profiles (teamworking, communication, problem solving) survey participants also highlighted skills and competences such as working in transnational teams, planification and organisation skills, continuous and self-learning capacity and skills, project management as well as creativity, adaptability, assertiveness, flexibility, conflict resolution competences and “emotional intelligence.”

3.3.4 New requirements in cross-border business and processes

The STAFFER survey of railway operators and infrastructure managers so far has been the only larger survey about new requirements and skill need in cross-border business and processes. Table 5 below summarises key results as highlighted by company level experts as well by researchers and other stakeholders.

TABLE 5 NEW OCCUPATIONAL REQUIREMENTS IN CROSS-BORDER RAILWAYS

Train driver	Staff in traffic control	Technicians and engineers in maintenance and infrastructure
<ul style="list-style-type: none"> • Using AI tools, e.g., AI translation tools for supporting and ameliorating communication in a foreign language with traffic control centre staff in cross-border railways. • Basic ICT skills will become a more important entry qualification. • Interoperability knowledge and skills, e.g., on European rules and specificities of other country security and traffic control rules. • System thinking: Understanding of different European rail systems and related structures and processes. • ERTMS knowledge. • Continuing education and training, coaching, regular further training courses and learning to learn capacities will become more important in the future. • Ability to continuous learning and openness 	<ul style="list-style-type: none"> • The need to know more about the regulation, processes, and operational practice in other countries. • Foreign language needs and requirements – generally English language skills but also foreign language skills in relation to the concrete cross-border situation and along the respective corridors. • Intercultural competences and knowledge about other countries and railway cultures. 	<ul style="list-style-type: none"> • Advanced literacy and ICT skills will become more important as well as technological knowledge and foreign language skills (e.g., in the context of increasing international cooperation and globally used technologies and technical solutions). • Knowledge about European rules and regulation. • Significant new requirements as regards ICT knowledges and skills for technicians in maintenance. • Knowledge and skills in system architecture and system engineering • In countries where English language skills is not part of occupational training programme or engineering studies, participants stressed the need to acquire new knowledge and language skills. • Transversal skills such as planning and organisation methodologies that can adapt to increased number of traffic; problem solving and critical thinking skills; working in international teams and cross-border collaboration and projects; capacity to learn and intercultural competences; teamwork, cooperation, and cross-culture vision thinking

Source: STAFFER Deliverable 2.2



4 ANALYSIS OF EXISTING RAILWAY EDUCATION AND TRAINING OFFERS AND ADDRESSING NEW REQUIREMENTS (WP4)

4.1 Mapping of educational providers and programmes

In the context of STAFFER (task 4.1) a mapping of existing VET in secondary and tertiary education institutions providing final certifications and/or diplomas was carried out.¹⁴

Based on responses from a survey in which 30 companies, training institutions or education centers participated, a total of 101 programmes was identified and analysed.

The final result of this mapping exercise is a comprehensive database comprising education and training related to the rail sector.¹⁵ The list includes a differentiation for EQF levels of certification and diploma. The mapping criteria consider different features (EQF level, localization, presence of mandatory/elective internships, and so on) with the aim of providing a complete picture of the present European situation.

This database allows the benchmarking of the existing programmes and will constitute the basis for the development/integration of new ones.

A public version of the database has been linked to the project website. It is planned that the database will be updated with all the initiatives started during and after the project life-time of STAFFER.

4.2 Qualification standards¹⁶

Based on the mapping of the main education and training providers, STAFFER task 4.2 aimed at the identification of common qualification standards and a common set of skills to achieve at any EQF level (from 3 to 8) to work in the rail sector.

In this context, several analytical questions and challenges were arising: At first glance, qualification standard can appear quite difficult to describe. What should be considered as “qualification standards”? Would a simple yes or no answer to “*is person x qualified in this skill*”

¹⁴ Task 4.1 was led by ESTACA and implemented during the first semester (M1-6).

¹⁵ Both Deliverable 4.1 as well as the database (Excel) is available on the STAFFER website.

¹⁶ Task 4.2 was led by CESI and implemented during the second semester (M7-12). The Deliverable 4.2 is available on the STAFFER Website: <https://www.railstaffer.eu/wp-content/uploads/2022/02/Deliverable-Key-findings-WP4.2.pdf>

suffice? After reading the inputs from previous work packages as well as exchanging with task co-leaders as well as with work package co-leaders it appeared obvious a too narrow description of qualification standards would only lead to their inoperability on the field. The agreed upon decision was to establish a few tools.¹⁷

Based on a close collaboration with STAFFER partners from companies and higher education institutions (HEIs) and based on the result of previous work packages and tasks, data gathering and analysis activities on the issue of qualification standards were carried out and discussed in several workshops with industrial partners as well as HEI focusing on occupational profiles that are defined in the ESCO database and/or regarded as highly relevant for railways by rail suppliers and operators/infrastructure managers.

4.3 Analysis and benchmarking of railway sector training programmes¹⁸

In addition to the analyses of educational programmes, in STAFFER Task 4.3 existing railway sector training and education programmes in 13 European countries¹⁹ were analysed and benchmarked. Data was collected by a survey carried in the first semester of 2021. The output of this task was a database with the list of VET and Higher-Education entities providing mobility and training related to the rail sector, differentiating for EQF levels of certification and diploma.

The following Table 6 provides an overview of main results of programmes per country:

TABLE 6: RAILWAY SECTOR TRAINING AND EDUCATION PROGRAMMES IN 13 COUNTRIES

Country	Programmes
Austria	Austria has a different education system than other European countries, but although training in the sector is encouraged from an early age, there is a need for further investment in the development of training programmes for the sector.
Belgium	Belgium is a country with a very active railway sector. However, there are fewer opportunities for students or professionals to specialise in railways than in other countries.
Czech Republic	Although the Czech Republic has training courses related to the sector, it shows a need for further development of railway programmes. There are no Master's Degree options and most of the Bachelor's Degree options are subjects, instead of specific Degrees for the railway sector. Looking at the training at vocational level very few options have been found.

¹⁷ See chapter 3 of Deliverable 4.3.

¹⁸ Task 4.3 was led by MAFEX and implemented during the second semester (M7-12). The Deliverable 4.3 is available on the STAFFER Website.

¹⁹ Italy, Belgium, Greece, Germany, France, Spain, Czech Republic, Austria, Serbia, Netherlands, Luxembourg, Poland and Slovakia

Country	Programmes
France	France, has a wide range of training courses on offer, however, even if it has several options available, training at university level in the railway sector is more limited as not many options are available compared to other European countries.
Germany	Germany is a country with a wide range of training opportunities related to the railway industry, especially in the university sector, where the combination of dual education is particularly noteworthy.
Greece	Greece has a gap at the tactical and operational level. It is therefore necessary to work on the development of training programmes for specialisation in the railway sector
Italy	Italy offers a good selection of railway academic and vocational training programs. However, Italy does not have any Bachelor's Degree directly related to the railway sector. Further, as any emerging opportunities there are gaps in college education related to how apply key emerging technologies in the rail sector.
Luxembourg	No training related to the railway sector has been found in the country
Netherlands	The Netherlands has a training gap in the railway sector. Few options were found at university level, and at VET/CFP level
Poland	Poland most vocational training is controlled by the government-owned company PKP S.A.. Regarding university level training, there are some sector-specific options at master level but at bachelor level only subjects are taught, not specific degrees.
Serbia	Serbia has different options available but in all the categories above these options are very limited. At university level, sector-related training was only found at the University of Belgrade.
Slovakia	Although Slovakia has training courses related to the sector, it shows a need for further development of railway programmes. There is the possibility to attend subjects at different universities, but there is no sector-specific and ad hoc training available.
Spain	Spain is a country with many training opportunities. Both operators and training centres offer courses to train in the railway sector. But in terms of university training there is a deficiency in Bachelor's Degrees, although there are many subjects available there are no specific degrees for the sector, most of the specialisation is at master's level.

Source: STAFFER WP4, Deliverables 4.3:

In the context of task 4.3 new and emerging training tools and methods in academic and vocational education programmes have been identified and described (see Figure 13). These tools and methods will be considered and applied in the proposed railway sector education and training programs developed in STAFFER Task 4.5.

FIGURE 13: NEW AND EMERGING TRAINING TOOLS, METHODS AND SCHEMES



Source: STAFFER WP4, Deliverables 4.3

The following table (see Table 7) provides for a brief characterization and description of the new training and education tools, methods and schemes.

TABLE 7: RAILWAY SECTOR TRAINING AND EDUCATION PROGRAMMES IN 13 COUNTRIES

E-learning	Course or training plan developed through computer networks, offered to geographically dispersed individuals who are able to interact from a different location and at a different time
Virtual/augmented reality	Created around a digital ecosystem, through technology, to simulate reality that allows training in environments or activities that in reality would be difficult to simulate
Gaming environment	Integration of gaming elements into the educational system, with actions or missions in order to achieve goals, overcome obstacles or win (learn)
Instructor-led individualised training	A qualified instructor or teacher interacts with one or several trainees, with the aim of helping them gaining self-awareness, clarifying goals, achieving their development objectives, unlocking their potential and acting as a sounding board
Blended learning	Mixing of multiple learning methods, face-to-face classes, online learning...
Peer led/mentoring learning programme	The process of interaction between an experienced person (the mentor) and a less experienced person in the field (the mentee), who aims to acquire knowledge from the mentor

Networked learning	A learning in which information and communications technology are used to promote the connections between one learner and other learners; learners and tutors; a learning community and its learning resources
Smart learning technologies: personalized learning processes	Learning is based on, smart devices and smart technologies
Scenario/story based learning	A learning model based on the definition of the experiences in a narrative context, which helps people to frame and understand their perception of the world.
Experiential learning	It develops people's ability to learn from their own experience within a concrete and well-developed conceptual and operational framework
Informal learning	Learning gained in an unstructured way, from day-to-day actions such as work, hobbies and contact with other people
Work- Based learning	A training models capable of resolving the traditional dichotomy between formal university learning and informal learning specific to work contexts

Source: STAFFER WP4, Deliverables 4.3

4.4 Selection and development of mobility and training paths, programmes and courses

In the context of Task 4.5, STAFFER partners developed suggestions on new training contents and mobility programmes that reflect the skill and competence needs resulting from the skills analyses conducting in previous work packages and tasks.

The adopted methodology for programme selection and definition consists of four main phases:

- Phase 1. Skills and EQF levels matching
- Phase 2. Occupational profiles clustering and programme selection
- Phase 3. Skills and programme matching
- Phase 4. Programme finalisation

The approach consisted in the following activities:

- Selection of innovative field/trend/skillset relevant for the sector.
- Identification of the subskills for each innovative field/trend/skillset
- Subdivision of the subskills according to the different EQF levels.

14 topics and issues were identified according to the results of previous WP1, WP2, WP3 as new or important fields relevant for the railway sector as reported in Table 8 below.

TABLE 8: SELECTED TOPICS AND THEMATIC AREAS REGARDED AS HIGHLY RELEVANT FOR RAILWAY EDUCATION AND TRAINING PROGRAMMES

Topics and thematic areas
1. Big Data & Artificial Intelligence <u>(AI)</u>
2. Cybersecurity & Internet of Things (IoT)
3. Global new energies & technologies
4. Formal methods for system design & verification
5. Living language
6. Networking and ICT technologies
7. Norms, standards and certification
8. Reliability, maintenance and life cycle management
9. Safety, dependability, security
10. Smart cities and smart station design
11. Transportation systems
12. Transversal skills in railways
a. Learning skills
b. Communication
c. Soft skills
13. Virtual reality
14. Web development

Source: STAFFER WP 4, Deliverable 4.5

In the second phase, the occupational profiles identified by WP2 and WP3 were analysed. Based on the profiles selected in the fields of the rail supply industry and railway operation and infrastructure management, the occupational profiles were analysed and clustered from the point of view of training needs and educational paths.

Six main programmes were identified covering the main identified occupational profiles in the domains of rail supply industry and railway operation / infrastructure management. In this third phase, the skills identified in Phase 1 for each field were assigned to the selected six Programmes. The contents of the programmes were identified also considering T4.4 results. The last phase consisted of programme finalisation including the identification of the relevant EQF level for each programme and programme refinement according to EQF level requirements. Therefore, the programmes were developed for selected EQF levels which are considered the most relevant for that profile. The lists of topics subdivided for each trend or field were merged and refined considering the specific EQF level and the specific programme requirements according to the EQAVET framework. The list of the final nine programmes is reported in Table 9 below.

TABLE 9: DEVELOPED PROGRAMMES

Programme title	EQF Level
Train driver	EQF 3-4
Rail traffic controller / operations technician	EQF 3-4 Post-master and mid-career training EQF 7
Railway systems technician	EQF 3-4
Railway systems engineering	EQF 7-8
Railway traffic / operations engineering	EQF 6 EQF 7
Rail transport engineering	EQF 7 EQF 8

Source: STAFFER Deliverable 4.5

The programmes at low EQF levels correspond to specific occupational profiles, such as the train driver programme, in which the link to the occupational profile is evident. In other cases, such as the “Rail traffic/operations technicians programme” and the “Railway systems technicians programme”, the programmes are related to a group of occupational profiles. The “Rail traffic/operations technicians programme” covers all the occupational profiles related to traffic management and control, while the “Railway systems technicians programme” covers the occupational profiles related to design and maintenance of infrastructure but also rolling stocks.

The programmes at higher EQF levels are related to specific railway engineer profiles are introduced, overcoming the traditional subdivision in engineering disciplines. In detail, three different engineers are identified, the Railway systems engineer responsible for designing and planning the physical rail systems; the Rail traffic/operations engineer responsible for designing and planning train control and operations; the Rail transport engineer responsible for the organization of all the aspects of the rail transport system (infrastructure, rolling stock, and operations) into an efficient and effective transport system, also considering business aspects.

4.5 Development of training contents reflecting new needs in the field of cross-border railways, communication and language

As already mentioned throughout this report, the issue of cross-border railway operation and infrastructure management has been on focus of STAFFER because the lack of skills, competences and knowledges in the current railway workforce has a negative effect on the efficiency and functioning of railway operation across border. Therefore, task 4.4 was dedicated to this issue and the aim to develop courses, training programmes as well as competence and knowledge building activities in railway operation and infrastructure management.

Task 4.4 built on suggestions and concrete proposals that were gathered in surveys in previous work packages, namely the survey carried out in task 2.1. Based on this an through additional inquiries amongst STAFFER partners, around 140 proposals for required skills , competence and knowledge acquisition were identified that were clustered into 15 thematic areas (see table 10 below):

TABLE 10: THEMATIC AREAS IDENTIFIED AS HIGHLY RELEVANT FOR TRAINING AND EDUCATION IN THE FIELD OF CROSS-BORDER RAILWAYS, COMMUNICATION AND LANGUAGE

Thematic areas, issues and skills	
Train operation technology	Technical innovations
General railway conditions	Vocational education
Collaboration skills	Customer requirements
AI languages solutions	Cross-border quality network
Environmental aspects of railway	Foreign language skills
Problem solving skills	ICT skills
Building-information modelling	Safety and security
Communication skills	

Source: STAFFER WP4, Deliverables 4.4

Building on this stock-taking process, results were summarised in four categories and documented as a result.²⁰ For each individual programme, result documents were created which contain a brief programme description, learning aims and an organisational framework as shown in the following Figure 14 below.

FIGURE 14: OVERVIEW OF THE STRUCTURE OF THE RESULTS IN TASK 4.4



Source: STAFFER WP4, Deliverables 4.4

²⁰ An excel database of all suggested programmes as well as worksheets per type of measure have been prepared as annexes to the Deliverable 4.4 report.

Regarding the **Training Programmes** four documents with four different topics were created. The four main topics are: Language and Communication, European Mindset and Skills, Technologies and Digitalisation and European Railway Operation. Special importance is attached to the European mindset. It was found out that all STAFFER target groups lack a European self-perception. The European dimension of the railways must be addressed in the recruiting, onboarding and qualification of rail employees. The specific training programmes or learning Apps are getting created in WP 6, Task 6.7. It should be noted that the training programmes are aimed at rail companies and manufacturers as well, depending on the content of the module.

The main topics for future **European CBR Conferences** are: Human Resources, Operational Functionality and Digitalisation. A materiality of the work is that there is not enough professional exchange and substantive cooperation among European rail management. A large number of proposals for meetings, workshops and conferences were summarised in the three (above mentioned) conference formats. The idea is to create CBR conferences on a European level. The aim must be to organise a joint and, above all, continuous exchange. Further planning is going to take place in WP 6, Task 6.7. The Conferences are aimed at rail companies and manufacturers as well, depending on the subjects of matter.

Regarding to the **Mobility Programmes** another four templates got created which are assigned to the different target groups of the participants: Exchange Programmes for Apprentices, Operational Staff exchange, Internships for Students and Student exchange Programmes (Railway ERASMUS). All Programmes contain a general description which contains the aims of the programme, Learning aims and preconditions (participants point of view), obligations of sending and receiving companies and organisational frame and conditions. The templates are going to be filled in with further detailed content for different target groups in WP 6 (Task 6.2, 6.3 and 6.4). The Programmes are aimed at rail companies and manufacturers. Manufacturers will find themselves more in the student mobility programmes.

Academic Modules were found in Task 4.4 and a document was created to bundle the information. They are sorted by the easiness of implementation. The document represents an input for Task 4.5 to include into the programmes innovative contents about the topic of Cross Border Railways, Communication and Language. In addition, it can serve as an idea pool for implementations during the project's lifetime (Task 6.6) but also beyond STAFFER.

For further information on the development of exemplary measures and pilot project activities see sections 6.4 , 6.5 and 6.6 below.

5 VALIDATION OF MOBILITY AND TRAINING PROGRAMMES FOR INCREASING EMPLOYABILITY AND CAREER OPPORTUNITIES

In the context of STAFFER work package 5 and related tasks 5.1, 5.2, 5.3 and 5.4 a transfer and validation of new and/or updated mobility and training paths based on the programmes and curricula as developed in Tasks 4.4 and 4.5 (see sections 4.4 and 4.5 above) have been carried out (task 5.4 still ongoing in 2024) with the specific goal to increase employability and career opportunities of young professionals according the covered EQF levels.

5.1 Identification of criteria and measurable indicators to evaluate employability and career opportunities²¹

The approach for development of methodological umbrella for assessment of employability and carrier opportunities had two phases: conceptualization and operationalization. The first one is about what is being measured and the second is about how it is going to be measured. Both phases entail several steps with similar underlying idea: assemble state of the art - body of knowledge different views on employability concept and indicators, enrich it with insights from rail sector perspective and finally nest it the STAFFER's objectives. The rationale behind is that employability is a complex concept that strongly depends to the context in which it is immersed. The aim is not to embrace every aspect of employability but those that are in line with STAFFER.

Based on insightful findings from the literature and series of consultations with rail operators/infrastructure managers and suppliers, a conceptual framework for devising employability criteria and indicators is set as in Figure 15 below.

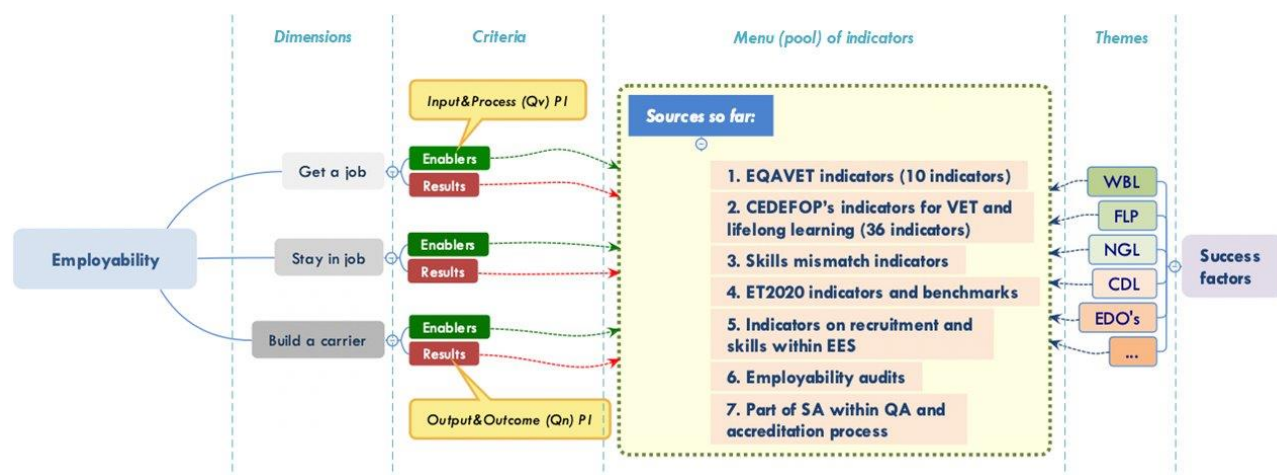
As employability is a complex social construct but also widely studied both in terms of definition and measuring the idea was to put existing employability metrics under evaluation end extract those relevant for STAFFER. Simply put the existing metric are put under 'double lenses': of employability dimensions and criteria on one side and success factors on other side.

Three key dimensions are included in the framework: (1) Get a job - refers to two main aspects preparation for employment in terms of education and training and transition from education to work; (2) Keep a job (stay in employment) and (3) Build a career (progress in employment).

²¹ Task 5.1 was led by the University of Belgrade and implemented during the second semester (M6-12). Deliverable 5.1 is available on the STAFFER Website.

They refer to three main stages in employment and add a dynamic dimension to it. Based on CEDEFOP's elaboration on associating EQAVET indicators and two groups of criteria from EFQM excellence model two types of criteria are considered: enablers and results. The reason behind is to cover both the enablers or in employability terms effectuation conditions and results reflected on the labour market. Focus on success factors and building indicators as success indicators was addressed by the intention to cover employability enhancing activities with proposed indicators.

FIGURE 15 POSITIONING OF INDICATORS AND USED SOURCES OF INDICATORS IN THE CONCEPTUAL FRAMEWORK



Source: STAFFER WP5, Deliverable 5.1

(Abbreviations: Qv – Qualitative, Qn-Quantitative, PI-Performance Indicator, WBL-Work Based Learning, FLP-Flexible Learning Pathways, NGL – Next Generation Learning, CDL – Carrier Development Learning, EDO's – Employment Development Opportunities, EES-Employer Establishment Surveys, SA-Self Assessment, QA-Quality Assurance)

The operationalisation phase is divided in three main sub-phases (steps):

In the **first step** the initial set of indicators was prepared regarding measuring all relevant processes that influence employability and skills in rail sector. After an evaluation by STAFFER partners a consolidated set of indicators, also including employability toolkit (audit and mapping tool), is obtained. The initial set of indicators is formed considering sources such as EQAVET, CEDEFOP, Skills mismatch indicators (ILO), ET2020 indicators and indicators on recruitment and skills within EES. On the other hand, the initial set of items is constructed regarding the examples of employability audits and self-assessment (SA) within quality assessment (QA) and accreditation processes. Both initial sets were formed considering not only different dimensions, their process and outcome sides, but also success factors. Initial set contains 34 indicators. It should be noted that some indicators cover more than one dimension of the employability concept. Within the enabler group of employability criteria, a useful source of measurable indicators is so called employability toolkits is developed as well. They are mostly

based on tailored audit or self-assessment schemes structured to reveal the uptake of employability within programmes. These are in fact specific questionnaires that search and uptake of employability elements within programme content and provision.

The **second round of evaluation** of set of indicators, items and attribute showed that from 34 proposed indicators, 13 had got a positive opinion by most of the participants. Only one indicator is fully accepted by all participants and the 12 were conditionally accepted with requests for revision in terms of clarification, doubts of their relevance for training providers or challenges to monitor the indicators on the individual basis.

As the **final result** and the consolidated set of employability indicators, all participants agree that the most important indicator is value of training for current workers (indicator marked with green) (see Figure 16). This can be explained as rising needs for workers adaptability in terms of changing demand for their skills and knowledge in forthcoming digitalisation of the railway sector. In this indicator, operators and suppliers have found the common ground, following the education and training providers. Of course, except first indicator in the set, all indicators will be tailored according to the participant needs and specific jobs in rail sector (indicators marked with orange). Majority of chosen indicators falls in the 'results' (9 are in 'results' indicators and 4 'enablers indicators).

FIGURE 16 CONSOLIDATED SET OF EMPLOYABILITY INDICATORS

No.	Name of indicator	Source	Type	Criteria
30	Workers helped to improve their work by training	CEDEFOP	Quantitative	Results
5	Number of successfully completed/abandoned VET programmes, according to the type of programme and any individual criteria	EQAVET	Quantitative	Results
8	Share of employed learners at designated point in time after completion of training, according to the type of programme and any individual criteria	EQAVET	Quantitative	Results
20	Indicator of incidence of hard-to-fill vacancies (due to shortage of qualification, skills or experience)	ESS 2019	Quantitative	Results
21	Indicator of density of hard-to-fill vacancies (due to shortage of qualification, skills or experience)	ESS 2019	Quantitative	Results
7	Destination of VET learners at designated point in time after completion of training, according to the type of programme and any individual criteria	EQAVET	Quantitative	Results
9	Information on occupation obtained by individuals after completion of training, according to type of training and any individual criteria	EQAVET	Quantitative	Results
12	Information on mechanisms set up to identify changing demands at different levels	EQAVET	Qualitative	Enablers
6	Success rate of disadvantaged groups according to age and gender	EQAVET	Quantitative	Results
32	Attractiveness of the framework conditions of the training (serving the most modern job profiles, training part-time, in stages, ...)	DB added	Qualitative	Enablers
2	Share of teachers and trainers participating in further training	EQAVET	Quantitative	Enablers
10	Satisfaction rate of individuals and employers with acquired skills/competences	EQAVET	Quantitative	Results
13	Schemes used to promote better access to VET	EQAVET	Qualitative	Enablers
Legend: ■ Fully accepted ■ Need adjustment (rephrasing)				

Source: STAFFER WP5, Deliverable 5.1

5.2 Assessment of employability and career opportunities from the point of view of rail operators and infrastructure managers as well as rail suppliers

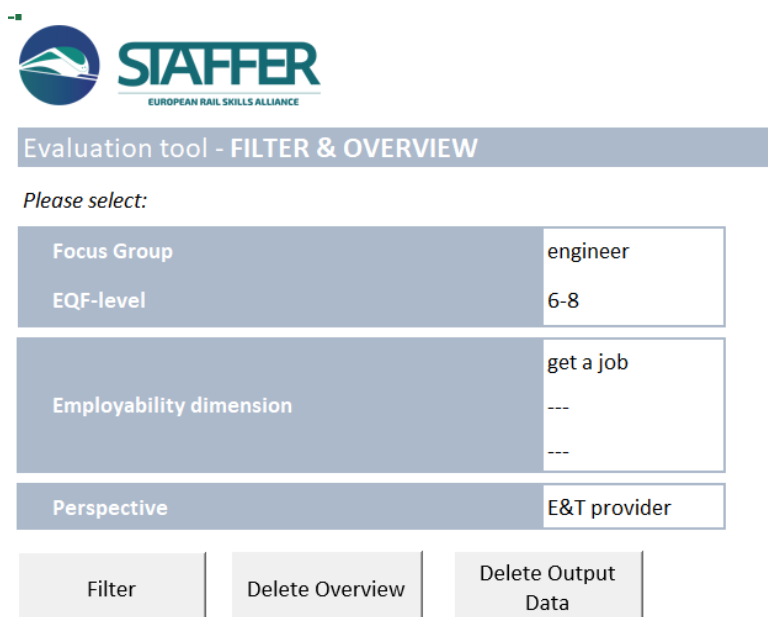
The consolidated set of criteria and indicators railway operators and infrastructure managers as well as suppliers will be used for the assessment of employability and career opportunities mobility and training programmes. For this purpose, an evaluation tool was created that is illustrated in Figure 17 below.

The consolidated set of indicators was fine-tuned during tasks 5.2 and 5.3 from the perspective of rail operators/infrastructure managers and rail suppliers.²²

In a test phase, 4 different qualification programmes were evaluated in the assessment perspectives of employees, employers and suppliers:

- Number of considered programmes: 4 evaluated programmes (in trial assessments).
- Number of considered indicators: 71 indicators in 3 assessment dimensions of employability.

FIGURE 17 EVALUATION TOOL: CHOICES ON QUALIFICATION LEVELS, DIMENSIONS OF EMPLOYABILITY AND AUDITOR PERSPECTIVE



The screenshot shows the STAFFER logo (European Rail Skills Alliance) and a web interface titled "Evaluation tool - FILTER & OVERVIEW". Below the title, it says "Please select:" followed by four dropdown menus:

- Focus Group: engineer
- EQF-level: 6-8
- Employability dimension: get a job (with two empty options below it)
- Perspective: E&T provider

At the bottom, there are three buttons: "Filter", "Delete Overview", and "Delete Output Data".

Source: STAFFER WP 5, Task 5.2

The most important requirement for the further use of the evaluation method with the evaluation tool in the continuation of Task 5.4 is that the qualification objectives for securing employability

²² Task 5.2 focussed on the perspective of railway operators and infrastructure managers, was led by DB and Task 5.3, focussing on the rail supplier perspective was led by Alstom. Both tasks were implemented during the second year of STAFFER (M13-24). Both deliverables are available on the STAFFER website.

are already defined in the development phase of the training, programs, and study modules in WP6. This is the only way that an initial audit of the training, programmes and study modules can be carried out in the development phase and an accompanying evaluation can be pursued in the implementation phase (see Table 11).

TABLE 11 SELECTED TRAINING COURSES, PROGRAMMES AND COURSES OF STUDY FROM CURRENT OFFERS FOR THE TRIAL ASSESSMENTS

Focus group	Training / Program	Task 5.2 - Partners	Type of program	Employability dimension	perspective	Status
Railway engineer	Different programs	Udl (SNCF)	in company training	stay in job build a career	provider (E&T)	✓
Railway manager	Master European Railway Systems	FH Erfurt	University program	stay in job build a career	provider (E&T) student (employee) employer	✓
Train driver	Functional training for train drivers	DB	in company training	get a job	provider (E&T) employee employer	✓
Engineer/train operator		IŽS	in company training	build a career	employer	✓

In the context of task 5.3 the extended list of employability indicators and questions that were developed by 5.1 was used as a basis for building its employability assessment tool, from the perspective of railway suppliers. Each indicator and question were assessed from perspective of relevancy, acceptance, credibility, easy to understand and robustness. Following suppliers' review of employability indicators, 67 indicators have been selected under the following 6 dimensions:

- Employability within curriculum
- Employment development opportunities
- Career development and learning support
- Partnership with employers
- Options for work experience
- Development and support in personal skills

As part of the methodology selection, it has been raised by the task partners that the selected assessment methodology should ensure all of the perspectives are covered: Education & Training provider, employer and employee.

Therefore, it has been agreed to proceed with a hybrid methodology approach: survey and in depth/expert interviews. This approach has allowed, on one side, to verify and test the identified employability indicators and, on the other side, to gain additional insights into employability factors via in-depth interviews.

5.3 Validation and continuous evaluation of employability and career opportunities²³

Task 5.4 will collect the individual assessments from operators and infrastructure managers and suppliers to give an integrated overview and validation of the employability and career opportunities putting special emphasis on “customer validation”, that the revised curricula and their implementations actually meet the identified skill gaps and competence needs due to the macro-trends considered in WPs 1-3.

This task will run in parallel to WP 6 to provide continuous monitoring and assessment of the implemented mobility and training programmes.

The output of this task will constitute a tile of the sustainability plan, as it will provide a tool for the continuous comparison of the implemented programmes and the skill needs during and after the project lifetime.

The key elements of task 5.4 are the following:

- The creation of one single tool for the evaluation/assessment of employability and career opportunities (within programmes) based on the audit tool elaborated in task 5.1.
- For this purpose the employability attributes were integrated in the audit tool as a 6th dimension („Development and support in personal skills“)
- The tool should be applicable and filterable for all stakeholder perspectives (Individual, E&T, employer), EQF-Levels (3-5, 6-8), dimensions (get a job, stay in job, build a career) and occupational profiles.

²³ Task 5.4 is led by the University of Applied Science Erfurt and is implemented during the last year of STAFFER (M25-48), i.e. still ongoing.

6 PILOT ACTIVITIES IN THE CONTEXT OF MOBILITY, EXCHANGE, AND TRAINING PROGRAMMES

In the context of STAFFER work package 6, pilot activities and programmes in railway education and training as well as mobility and exchange have been designed and implemented. It needs to be noted that some of the measures will start in 2024 and will continue after the end of the funding period of STAFFER while others still are under development and have already a longer term perspective.

In particular the following activities have been or are going to be performed in the last two years of the STAFFER project:

- Development of a methodology, including a set of KPIs for the continuous monitoring the implemented programmes and achievements (task 6.1., completed).
- Development of a framework/scheme for facilitating transnational mobility students, apprentices, trainees, or other staff groups in rail industry (tasks 6.2, 6.3, 6.4 and 6.7., ongoing).
- Implementation of VET at lower and higher EQF levels (pilot cases) designing new courses or adapting the existing ones to introduce the necessary knowledge and work-based activities to enhance the sectoral skills of students, trainers, or other staff groups in rail industry (tasks 6.5 and 6.6.).

Preliminary results are presented in the sections below, reflecting the current state of task implementation in the seven sub-tasks of work package 6.

6.1 Continuous programme monitoring²⁴

STAFFER Task 6.1 has developed measures and tools for continuous monitoring and evaluation of the results achievements, detecting bottlenecks in implementation and identifying both negative and positive effects of the investment programme and the activities involved.

In line with the EQAVET guidelines and framework for quality management, Deliverable 6.1²⁵ provides a methodology based on the results-based management strategy, ensuring that all actors involved in development of the programmes contribute both directly and indirectly to results achievement (see Figure 18).

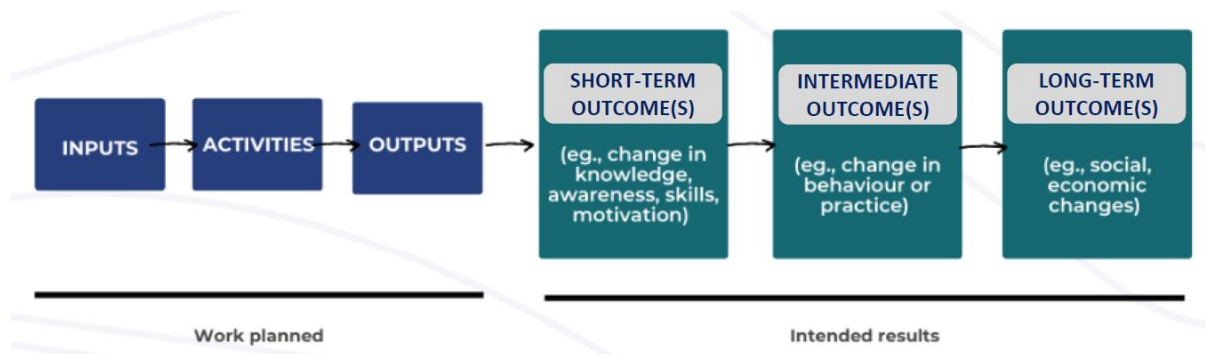
²⁴ Task 6.1 was led by MAFEX and was implemented during the second year of STAFFER (M13-24)

²⁵ Available at STAFFER website.



Considering key elements and principles of the Theory of Change (ToC), the methodology and the deliverable support the monitoring and evaluation of programmes developed in the STAFFER project by providing a set of guidelines and templates for programme evaluators to monitor during the course of the programme, the degree of objectives achievement and whether they are going in the right direction.

FIGURE 18: DEFINING EXPECTED RESULTS OF PROGRAMMES AND PROJECTS (“RESULTS CHAIN”)



Source: STAFFER Deliverable 6.1

Deliverable 6.1 provides a number of supporting documents, guidance sheets and suggestions for monitoring as well as evaluation indicators that are helpful for project leaders and coordinators to monitor and evaluate the programmes with the aim to see their impact and positive and negative aspects in order to replicate them, adapt them or generate new programmes.

6.2 International student mobility programmes and work-based internships²⁶

In the context of task 6.2 a standardised process for rail sector students to identify, apply for, and be accepted at, institutions offering rail-related courses will be developed. A first version of the standardised process has been elaborated by October 2023 and is summarised in Figure 21 below.

The process will be supported by a tool on the STAFFER project website, which will provide information on the courses offered by all participating educational institutions, application information and a short common application form. A skeleton of the tool has been elaborated by October 2023²⁷ which will be completed by information from more than 50 educational

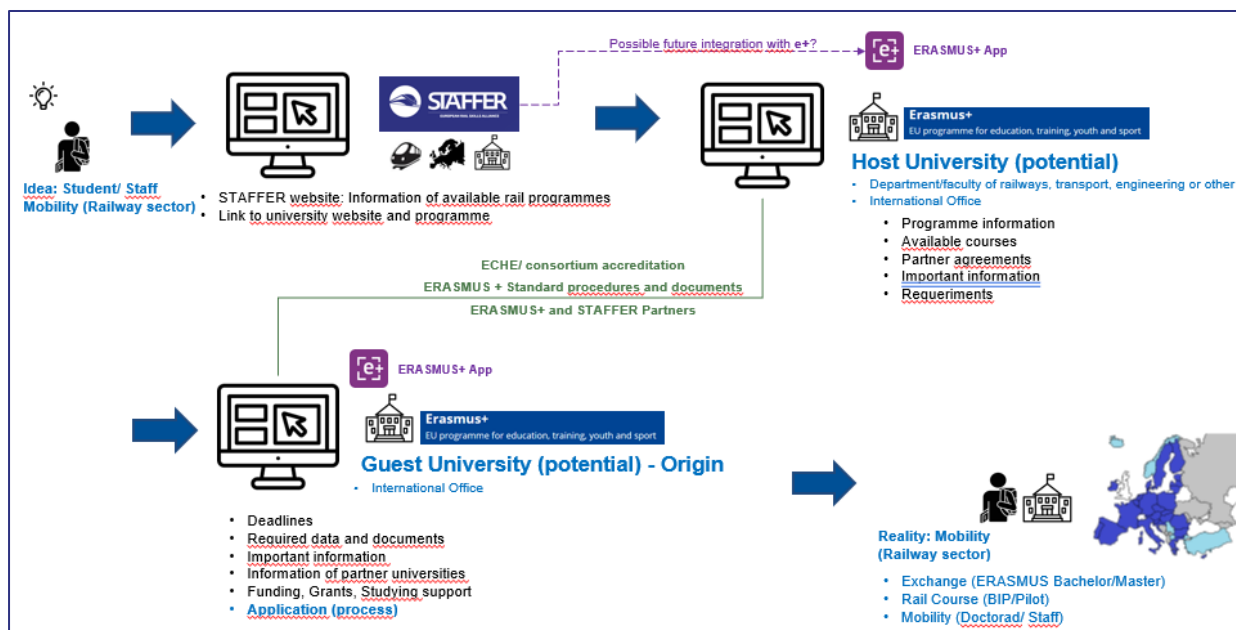
²⁶ Task 6.2 is led by the University of Applied Science St. Pölten and is implemented during the last two years of STAFFER (M25-48)

²⁷ <https://www.railstaffer.eu/student-mobility-programmes/>

institutions that have been identified by the task leader as a first step. An overview of the website and its functionalities is presented in Figures 19 and 20 below.

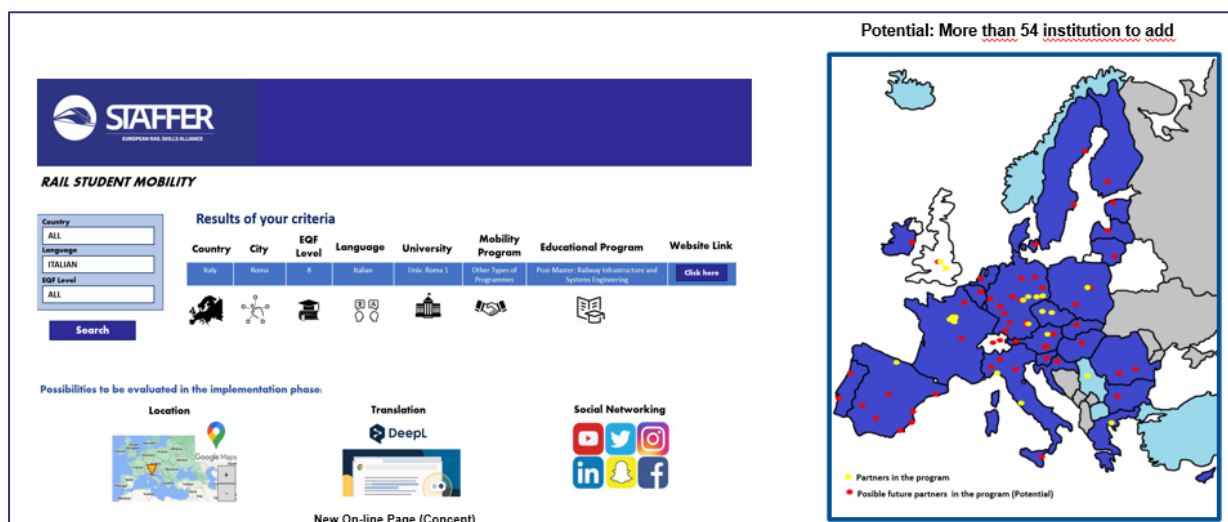
Finally, in the context of task 6.1 at least a pilot of the STAFFER student mobility programme will be developed, involving industrial partners for work-based internships.

FIGURE 19: STANDARDISED PROCESS FOR RAIL SECTOR STUDENTS TO IDENTIFY AND ENROLL FOR LEARNING AND TRAINING MOBILITY



Source: University of Applied Science St. Pölten, task 6.2 status report at STAFFER Annual Meeting 2023

FIGURE 20: SCREENSHOT OF THE STAFFER WEBSITE PAGE WITH THE TOOL MADE AVAILABLE TO RAIL SECTOR STUDENTS TO IDENTIFY AND ENROLL FOR LEARNING AND TRAINING MOBILITY



Source: University of Applied Science St. Pölten, task 6.2 status report at STAFFER Annual Meeting 2023

6.3 International apprenticeship mobility programmes and work-based internships²⁸

Task 6.3 will aim at preparing the STAFFER Apprentice Mobility programme. While the aim is similar to the one addressed by Task 6.2 but the ambition is to provide railway companies involved in STAFFER and those who are interested in the apprenticeship programme with concrete guidance and tools for planning, organising and managing apprenticeship mobility and exchange programmes as well as gaining access to financial funding from the Erasmus programme.

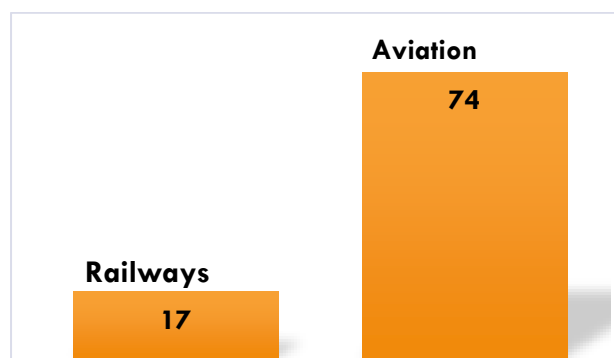
Activities carried out so far include the following:

In depth-analysis of Erasmus+ mobility projects for initial learners and apprentices as documented in the Erasmus project database, covering projects carried out between 2014 and 2022. This analysis has shown that railways has not been very active in international mobility in training and learning so far. Compared to other sectors (see Figure 21 below on railway compared to the aviation sector), there is very few experiences of railway operators and infrastructure managers making use of Erasmus funding for learning mobility projects.

The following reasons have been by company level stakeholders in the context of interviews carried out in 2023:

- Initial VET programmes are still very much shaped by national requirements and traditions
- There is reluctance at learners and apprentices to become engaged in learning mobility
- There are financial, administrative and organisational burden and hurdles from the perspective of railway companies and companies are not actively promoting mobility

FIGURE 21: EVALUATION OF ERASMUS PROJECTS IN THE FIELD OF “VET LEARNER AND STAFF MOBILITY”, 2014 – 2022 (NUMBER OF PROJECTS)



Search carried out by wmp consult on the basis of search terms such as ‘railway’; ‘train driver’, ‘rail traffic controller’, ‘signalling’; ‘rail technician’, ‘railway engineer’ for railways and ‘aviation’; ‘aircraft’, ‘airline personnel’ for civil aviation.

Source: wmp consult task 6.3 status report at STAFFER Annual Meeting 2023

²⁸ Task 6.3 is led by wmp consult and is implemented during the last two years of STAFFER (M25-48)

In task 6.3 there has been an intensive exchange with railway operators and infrastructure managers involved in STAFFER but also additional ones (e.g. from Poland, Switzerland and other countries) about already existing experience in mutual exchange and mobility programmes as well as expectations and needs for apprenticeship mobility and work-based internships of apprentices at initial (EQF level 3-4) and higher (EQF level 5-8) as well as internships (e.g. in the context of talent programmes).

As a result of this exchange it became clear that railway companies have a strong interest in becoming more active in the field of learning mobility across borders targeting apprentices and trainees or “young talents”. However, a further result of stakeholder exchange and meetings with companies that already have experience in organising apprenticeship exchanges (e.g. between France and Germany or Luxembourg and Germany) there is a lack of expertise and knowledge about making use of Erasmus funds and programmes.

Based on this, the following general considerations have developed as regards the STAFFER apprenticeship programme:

The **STAFFER apprenticeship scheme** should be open to all occupational groups and EQF levels.

- **For different target groups different formats of mobility activities may be necessary:** Apprentices in technical and industrial/commercial occupations, mobility projects for learners at EQF level 3-5 may need the help of interpreters. As apprenticeship training plans are dense and do not foresee longer visits or stays in another company or even country – mobility projects can only have limited duration. For learners in higher apprenticeships or traineeship (EQF level 6-8, i.e. at Bachelor or Master or higher level) these restrictions do not exist and English is already quite a “lingua franca”. Mobility projects therefore could be longer visits and learning/working experience on concrete tasks and issues.

There is also a need to design **different types of mobility and internships:**

- **Short-term learning mobilities:** Focus is on experience of visiting a foreign country and learning about another national railway system; networking; inter-cultural and language knowledge; raising interest and awareness.
- **Learning Mobility Plus:** Longer-term visits of co-learning and co-working experience.

On this basis and in close collaboration with VET/apprenticeship experts of STAFFER railway partners, concrete needs for organisational, legal and other guidance materials and supporting tools should be made available at a sub-section on the STAFFER website.²⁹

Furthermore, the task leader of 6.3 in collaboration with railway companies involved in STAFFER as well as railway operators and infrastructure managers outside STAFFER, have the ambition to develop 1-2 concrete project proposals for an application for Erasmus+ funding in the field of VET Mobility in 2024.

In this context, there has been already an intensive and very productive exchange between the 6.3 task leader and the national Erasmus+ Agency in Germany in order to take into account Erasmus+ funding criteria and guidelines.

6.4 Cross-border staff mobility programmes and work-based internships³⁰

Task 6.4 aims at preparing and designing the STAFFER Staff Mobility programme. This programme will be very similar to the Apprentice Mobility programme, but it will be designed for the different categories of workers in the rail sector. Therefore, it will focus on “upskilling”, that is it has the end of complementing, improving, and updating the pre-existent skills of workers.

After an initial exchange with other STAFFER railway partners as well as railway companies (operators and infrastructure managers), DB, SNCF and ÖBB in cooperation with partners in neighbouring countries (Serbia, Czech Republic) have developed a number of ideas for staff mobility and job shadowing activities and projects that target specific occupational groups in railway operation (train drivers/instructors; traffic control staff; dispatchers; corridor managers) in order to enhance existing skills in particular in cross-border railway services (e.g. related to rail freight corridors). However, though such activities were regarded as providing an added value to the companies involved, concretisation proved to be quite complicated and difficult for several reasons, including a lack of motivation and support by higher management levels, lack of personnel and staff shortages as well as a lack of expertise in obtaining project funding and co-financing.

²⁹ With the financial support of UNIFE, a section on Student Mobility Programme was already established and integrated as part of Task 6.3 in the STAFFER website which is available at: <https://www.railstaffer.eu/student-mobility-programmes/>

³⁰ Task 6.4 is led by Deutsche Bahn and is implemented during the last two years of STAFFER (M25-48)

In fact, a key facilitating factor to develop concrete measures of cross-border staff mobility and learning programmes seems to be that at the working level there are already contacts and cooperation between railway operators and infrastructure managers in different countries. And here, STAFFER was able to attract the interest of two railway infrastructure companies that already have established exchange and cooperation on the topic of ERTMS deployment: DB Netz and ProRail in the Netherlands indicated a strong interest to develop a pilot activity in the context of STAFFER based on already existing cooperation on the issue of ERTMS deployment in Europe and a Summer School that both organisations organised and funded in September 2023 targeting trainees and “railway newcomers” with an academic degree in railway engineering and technology. Based on the strong need for exchange on good practices and technological developments and salutations, both companies as well as further interested railway companies had a strong interest to develop a pilot project of an international ERTMS educational programme targeting young professional.

Based on an evaluation of the 2023 Summer School event and with the help of STAFFER task 6.3 and 6.4 task leaders, an application for a transnational cooperation project was elaborated and delivered to the Erasmus+ Agency in Germany. Basis features of this pilot project are summarised in the Table 12 below.

TABLE 12: STAFFER PILOT PROJECT APPLICATION “RAILWAY CCS EDUCATIONAL PROGRAMME”

General information		Main activities
<u>Project period</u>	01/01/2024 until 31/12/2024	Providing a 2-weeks education and training event on railway CCS/ERTMS and different formats of networking of peers: 30 participants from DB Netz, Pro Rail and additional European companies
<u>Project partner</u>	DB Netz AG, ProRail B.V., wmp consult	
<u>Target group</u>	Rail newcomers, professionals, experts from european countries	
<u>Erasmus+ funding</u>	Small-scale partnerships programme	
Objective		Outcome
Establishing a European network of expertise and harmonization of <u>education</u> and collaboration within ERTMS - a single European railway area.		A group of (young) professionals with joint knowledge and international network in their field, that enhances collaboration between the European rail infrastructure managers

Source: DB Netz, Task 6.4 presentation of preliminary results at STAFFER Annual Meeting 2023

6.5 Mobility programmes in the field of cross-border railways, communication and language³¹

STAFFER Task 6.7, based on the findings of Task 4.4, the participant education institutions in cooperation with the involved railway companies have been aiming at developing and implementing new courses or qualification modules to introduce the necessary knowledge and work-based activities to enhance the sectoral skills of students, trainers and workers in the fields of cross-border railways, communication and language. In order to develop and implement measures that provide a concrete added-value for the involved STAFFER partners (and further CER affiliates), the tasks leader DB has established five working groups focussing on different topics related to the issue of cross-border railways. In these working groups several key themes and/or measures have been identified for pilot activity implementation that are summarised in Table 22.

FIGURE 22: WORKING GROUPS, INVOLVED PARTNERS AND TOPICS SELECTED FOR IMPLEMENTING PILOT ACTIVITIES IN FIELD OF CROSS-BORDER RAILWAYS, COMMUNICATION AND LANGUAGE

Digitalisation technologies	European Mindset and Diversity	Language	Communication+ Networking	Railway operation
Lead: DB Co-lead: SNCF	Lead: ÖBB Co-Lead: DB	Lead: DB Co-lead: ÖBB	Lead: DB	Lead: DB Co-Lead: CTU
Core Group: CESI, ÖBB, ESTACA	Core Group: IŽS, UASFHE, FS, SNCF	Core Group: IŽS, SNCF, CESI	Core Group: IŽS, UniRoma, CTU, FS, SNCF, CESI	Core Group: SNCF, ÖBB, ESTACA
Measures: • Joint ETCS / BIM training	Measures: • Mentoring programme for female engineers	Measures: • Define railway specific vocabulary	Measures: • Introduction of an EU-wide networking and communication platform	Measures: • Multilingual brake simulation • Energy-saving training

Source: Leader and working group members of task 6.7 at the STAFFER annual meeting 2023.

For example, in relation to technology and digitalisation, core group members are going to develop an e-learning module on the application of Building Information Modelling, BIM that is going to make already existing experience and knowledge in some VET institutions and companies available for a larger audience. The following Figure 23 provides an overview.

³¹ Task 6.5 is led by Deutsche Bahn and is implemented during the last two years of STAFFER (M25-48)

FIGURE 23: WORKING GROUP TECHNOLOGIES AND DIGITALISATION FOCUSING ON BIM (BUILDING INFORMATION MODELLING)

Technologies Digitalisation Co-Lead: SNCF, DB Core Group: CESI, ÖBB, ESTACA Focus: <ul style="list-style-type: none"> • ETCS • BIM 	Achieved Benefits	Elearning : Introduction to BIM – Its benefits
	Target Groups	STAFF : introduce to employees to the concept of BIM and its importance
	Expected Outcomes	Presentation with set of slides, videos, quizz...
	Detailed Content	Basic concepts- Benefits – Tools and techniques – Applications - Roles – Examples based on real cases
	Planned Dissemination	Hosted in the STAFFER and/or partners websites
	Necessary Steps	<ul style="list-style-type: none"> • Setting up a working team (training and technical experts) • Definition of the Elearning structure (goals, content, timeline..) • Write script • PILOT

Source: Leader and working group members of task 6.7 at the STAFFER annual meeting 2023.

Other activities initiated in WP7 relate to the training on digital technologies in rail operation, signalling and command, i.e. ERTMS/ETCS as the European standard. This has been identified as a potential area, where further training activities currently are carried out by companies on their own so far. Due to the still existing national differences in the implementation of ERTMS/ETCS systems, the development of harmonised curricula or training programmes is neither possible nor useful for the moment, there has been a strong interest amongst railway operators and infrastructure managers to exchange information on how ERTMS/ETCS is trained in relation to different staff groups and occupational profiles and exchange on experiences and good practice examples.

Besides activities addressing important skills needs in the context of technologies and digitalisation. Pilot measures fostering the development of new skills, knowledges as well as activities of cross-border exchange and cooperation have been developed and are going to be implemented the following areas:

- Developing European Mindsets and Diversity
- Railway language and foreign language skills and tools in cross-border railways
- Communication, exchange and networking
- Fostering more coordination and harmonisation in the context of education and training in railway operation

6.6 Preliminary ideas for cross border mobility, exchange and cooperation for different staff groups in railway operation and infrastructure management

The following Table 13 summarises ideas for pilot activities developed for apprentices but also other staff groups in railway operation and infrastructure management that have been concretised with view on Erasmus+ mobility and transnational cooperation projects. The compilation has been developed in tasks 6.3, 6.4 and 6.7.

TABLE 13: POSSIBLE AND PLANNED PILOT ACTIVITIES AND MEASURES IN THE FIELD OF MOBILITY, EXCHANGE AND COOPERATION FOR DIFFERENT TARGET GROUPS AT COMPANY LEVEL

Activities / Projects	Apprentices and Learners	Trainees/ Young professionals	Higher apprentices / Internships	Experts	Trainers	Staff involved in further training
Cross-border Mobility and Exchange	2-weeks of mobility/foreign country training visit of apprentices ³²	Traineeship in a foreign country	Internships or longer-term study/learning abroad	Job shadowing of experts in a neighbouring country	Job Shadowing of train drivers/trainers in a neighbouring country	Work and learning mobilities in the context of rail corridor related activities
	Internships / Job-Shadowing, etc. learning abroad for a duration of 3-12 months after the completion of the apprenticeship or VET programme (ErasmusPro)					
	Mobility projects for specific occupational groups, e.g. female engineering students/talents				Mobility / job shadowing for teachers to improve foreign language skills	Exchange Programme Women in Engineering
Transnational cooperation projects	Projects for learners' projects, e.g. railway-specific foreign language app for apprentices	Summer School CCS (ERTMS) for trainees and railway newcomers from DB Netz and further countries ³³	Transnational conference of specific topics / projects for higher apprentices	Rail Experts Conference Platform	Projects to develop common European training modules/courses, e.g. BIM in Rail, ETCS training, green / energy saving training	Development of a "Language Buddies" concept
	Foreign language qualification for apprentices engaged in mobility projects	Mentoring project of young women in engineering occupations			Curricula development for trainers	

Source: wmp consult and DB in the context of tasks 6.3, 6.4 and 6.7

³² 1-2 pilot mobility projects likely to be prepared in the context of Task 6.3. In 2024.

³³ Erasmus+ application for was prepared in the context of Task 6.4 in October 2023 and will be proposed for Erasmus+ funding in 2024.

6.7 Implementation of VET programmes at EQF levels 3 to 5³⁴

Based on the output of WP4, the participant education institutions in task 6.5 will implement new courses, or adapt the existing ones, to introduce the necessary knowledge and work-based activities to enhance the sectoral skills of students, trainers and workers at lower EQF in secondary schools, and/or in centres which provide specific, non-academic, certified formation. New and adapted courses will be based on a set of common study materials to be prepared and introduced in selected ongoing and new education and training initiatives. A particular attention will be devoted to the work-based learning.

The topics will be in the field of the priorities identified in WP1, WP2 and WP3 and will be modular, to be flexible enough and introduced into various teaching levels.

At least a pilot VET at EQF level 5 will be implemented. The realization of pilot VET at EQF 3 and 4 will be considered. In any case, pilots will be monitored, and their quality assessed by means of the procedure defined in Task 6.1.

At the STAFFER annual meeting 2023, the task leader presented an update on task implementation, objectives, goals and targets. By the end of the STAFFER project period:

- At least a pilot VET at EQF level 5 will be implemented.
- The realisation of pilot VET at EQF 3 and 4 will be considered.
- Pilots will be monitored, and their quality assessed by means of the procedure defined in Task 6.1.
- Defined targets in STAFFER proposal are to reach 200 students at the level of Bachelor of Science (EQF 6) and for higher education at EQF 5 and 50-60 students : EQF 3 and 4 levels.

As an output of task 6.5, the deliverable will describe the implemented programmes, relevant activation procedures, study materials and a guide for the implemented programmes to be disseminated. Also, the outcomes of the implemented pilots will be reported.

In cooperation with railway related VET institutions involved in STAFFER (For.Fer; HTL Mödling; HTL Rennweg), CNAM has selected vocational training programmes for pilot activities covering the following occupations:

- Rail Traffic / Operation Technician: 1 programme at EQF level 4 (For.Fer)
- Rail System Technician: 10 programmes at EQF level 3, 4 and 5 (all VET institutions involved)
- Train drivers: 1 programme at EQF level 4 (For.Fer)

³⁴ Task 6.5 is led by CNAM and is implemented during the last two years of STAFFER (M25-48)

6.8 Implementation of VET at EQF levels 6 to 8³⁵

Based on the outputs of WP4, and under the task lead of UNREOMA1, the participant education institutions will implement new courses, or adapt the existing ones, to introduce the necessary knowledge and work-based activities to enhance the sectoral skills of students, trainers and workers. New and adapted courses will be based on a set of common study materials to be prepared and introduced in selected ongoing and new education and training initiatives.

The topics will be in the field of the priorities identified in WP1, WP2 and WP3 and will be modular, to be flexible enough and be introduced into various teaching levels and specializations of academic courses, such as bachelor and master programmes at the national level, international and/or joint bachelor and/or master programmes, post-aster, international joint doctorate, etc. Pilot VETs at EQF levels from 6 to 8 will be implemented by integrating existing programmes and/or by realizing new ones. Pilots will be monitored, and their quality assessed by means of the procedure defined in Task 6.1.

At the STAFFER annual meeting 2023, the task leader presented an update on task implementation, objectives, goals and targets. By the end of the STAFFER project period, and according to the STAFFER project plan, it is planned to implement as pilot projects:

- 7 training programmes identified among the 24 programmes (see Figure 26 below) that the educational partners will implement individually in the academic year of 2023/24 (with its own resources or even by inviting visiting professors from other educational partners and/or representatives of companies).
- A summer school of the duration of 1-2 weeks to be organised in summer 2024 (face-to-face/remotely/blended) with the participation of teachers and students of different partners.

It is important to note that the involvement of companies in the implementation phase is crucial (companies can host students for technical visits and internships, send their representatives to give seminars, to attend lectures and to assess the quality of the programme). As of November 2023, FS Group and Université de l'Ingénierie SNCF have expressed their interest to collaborate with the HEIs that will implement the pilot VETs, but the hope is that other partner companies will also participate.

As regards, outputs, the deliverable 6.6 on the implementation of VET at EQF levels 6-8 will describe the implemented programmes, the outcomes of the implemented pilots, the relevant

³⁵ Task 6.6 is led by the University of Rome – UNIROMA1 and is implemented during the last two years of STAFFER (M25-48).

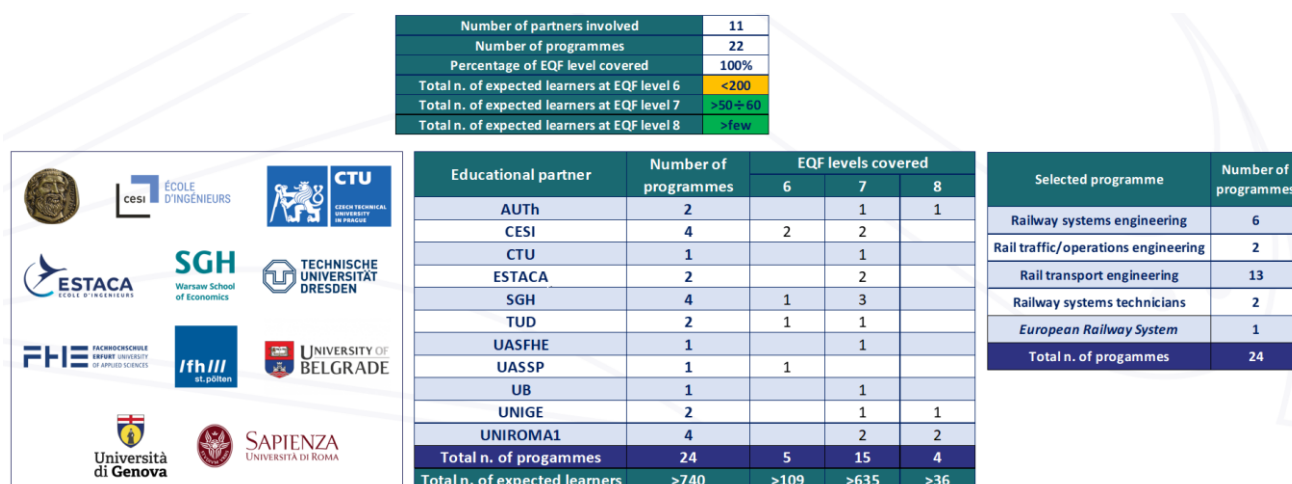
activation procedures, document the study material and will include a guide for the implemented programmes to be disseminated.

At the annual STAFFER meeting in October 2023, the 6.6 task leader also presented a comprehensive overview of programmes at EQF level 6-8 as offered by the involved partners, including those that have been selected for pilot activities.

The following Figure 24 provides an overview of the higher educational institutions involved in the development and implementation of programmes as well as the programmes that have been selected for implementation. It should be noted that the implementation of programmes will happen in some cases after the end of the STAFFER project period.

It should be noted that the expected numbers of participants is likely to be significantly higher than the indicative planning in the STAFFER work plan.

FIGURE 24: IMPLEMENTATION OF TRAINING PROGRAMMES AT EQF LEVEL 6 TO 8



Source: UNIROMA1 update on work in task 6.7 at the STAFFER Annual Meeting 2023.

In close cooperation between UNIROMA1 “Sapienza” with CNAM, a **first training programme** in Signalling Systems was implemented, at EQF level 7, in Rome from 26 June to 5 July 2023. It was offered by UNIROMA1 to a group of 17 French students from Le Cnam and included lectures held by Sapienza professors, seminars by representatives of FS Group and technical visits organised in collaboration with various companies. The following Figure 25 illustrates the set-up of the pilot activity.

FIGURE 25: IMPLEMENTATION OF TRAINING PROGRAMMES AT EQF LEVEL 6 TO 8



MOBILITY PROGRAMME IN SIGNALLING SYSTEMS FOR LE CNAM STUDENTS AT SAPIENZA UNIVERSITY OF ROME

Schedule

Day	Activities
1. Monday 26/06	AM: arrival and accommodation. 16:00: welcome event with reciprocal presentations and drink (Room 15).
2. Tuesday 27/06	9:00-13:00: seminar on historical evolution of railway signalling system in Italy – prof. Riccardo Licardelle (Room 15). 15:30-18:00: guided visit of RFI traffic control centre at Roma Termini station.
3. Wednesday 28/06	9:00-13:00: seminar on historical evolution of the Italian railway network and comparison with France – prof. Marco Antognoli (Room 15). 14:30-17:30: guided visit of Trenitalia operations room.
4. Thursday 29/06	AM: free time. 18:00-20:00: guided visit of ATAC transport history museum at Piramide metro station.
5. Friday 30/06	12:40-13:53: Roma-Napoli transfer by high-speed train with technical visit in the driver's cabin. 15:00-18:00: seminar on historical, cultural and touristic activities of Fondazione FS with a focus on the adaptation of historic rolling stock to modern control command and signalling systems + guided visit of the historical-technical national railway museum in Pietrarsa.
6. Saturday 01/07	Free time.
7. Sunday 02/07	AM: free time. 16:35-17:45: transfer Napoli-Roma transfer by high-speed train with technical visit in the driver's cabin.
8. Monday 03/07	9:00-12:30: seminars on railway engineering ongoing research activities at DICEA and DITS – prof. Stefano Ricci (Room 8). 15:00-18:00: guided technical visit of control centre and depot of the fully automated metro line C.
9. Tuesday 04/07	10:00-13:00: guided visit of Trenitalia maintenance facility at Roma Smistamento. 14:00-16:00: regional train dynamic driving simulator at Roma Smistamento.
10. Wednesday 05/07	9:00-12:30: presentation of the metro line C project and guided visit of metro line C construction site at Fori Imperiali station. 14:00-15:00: presentation of the activities of the Ferrovie dello Stato Italiane Group and interest of the Group in the STAFFER project - Vito Pagliarisi (Room 30). 15:00-17:00: interactive session with individual impressions of students.



Source: UNIROMA1 “Sapienza” update on work in task 6.7 at the STAFFER Annual Meeting 2023.

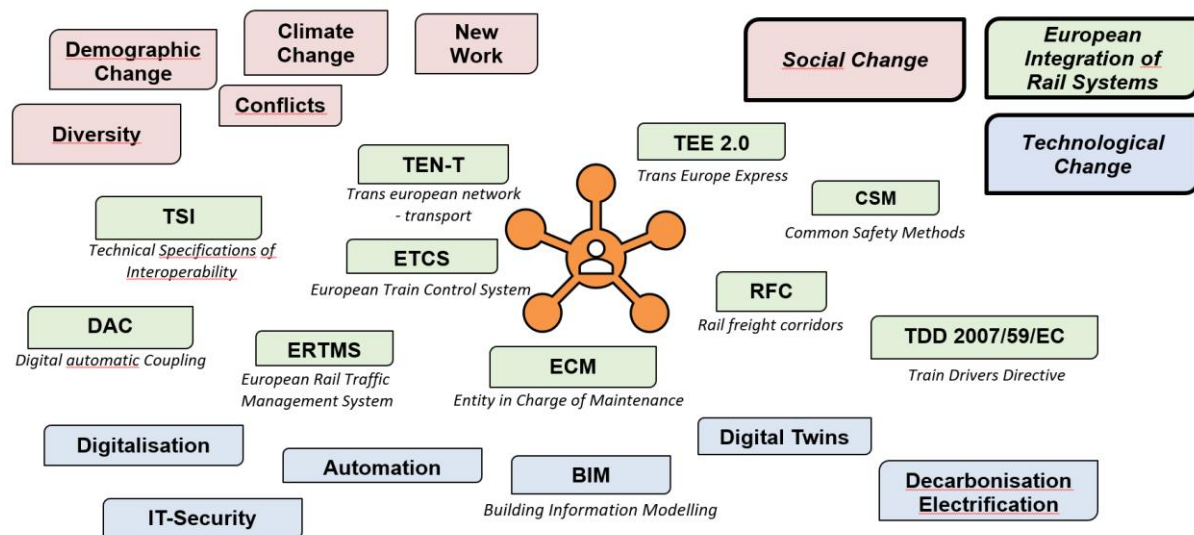


7 A LONG-TERM STRATEGY FOR SKILLS AND EMPLOYABILITY IN THE RAIL SECTOR

7.1 Why a long-term strategy for skills and employability in the rail sector is needed

The rail sector and rail specific occupations and activities in the rail supply industry as well as in railway operation/infrastructure management are currently experiencing an enormous change which is driven by new and often disruptive digital technologies, accelerated automation as well as social and demographic challenges (see Figure 26) below. The sector is also expected to play a key role in achieving the goals of the European Green Deal and the Fit for 55 initiatives of the European Union by increasing its share in passenger and freight transport, becoming more efficient and developing attractive services in the field of mobility of the future.

FIGURE 26: SOCIAL AND TECHNOLOGICAL CHANGE AND EUROPEANISATION OF THE RAIL SECTOR



Source: Lehman, M. et al. 2023

In addition to the development and designing of concrete measures on these topics, an important objective must also be to develop a medium and longer-term strategy or framework of action for a sector-specific strategy in the area of vocational and employment-specific skills and competences. Such strategy should consider and focus on the requirements of both rail transport companies and manufacturers.

The unique complexity of the railway system must be considered, not only in planning and production, but above all in the safe interaction of operation, vehicles and infrastructures. This

interaction of the subsystems and engineering disciplines should also be reflected even more strongly in integrated profiles with specific system competences (Systems Engineering).

From the point of view of rail suppliers, railway operators and infrastructure managers, such a strategy is overdue. Accompanying and forward-looking human resources development has neither been provided for nor systematically pursued at the sector level as part of the four railway packages adopted since the beginning of the millennium, nor within the framework of Europe-wide research and process support in the rail sector, e.g. the European Rail Research Advisory Council (ERRAC), the Horizon research programme or Shift2Rail and its successor Europe's Rail Joint Undertaking.

At the same time, the pressure to act is increasing in view of the aspects listed in Figure 26 above of the forced technological and organisational integration of the European railway system on the basis of harmonised regulations and uniform standards³⁶. All this is overlaid by ambitious objectives of European railway policy in both freight and passenger transport, as formulated in the 2020 strategy for sustainable and smart mobility.³⁷

7.2 Overall objective and approach of the integrated sectoral skills strategy for the rail sector

This chapter includes a consolidated version for an integrated sectoral skills strategy for the rail sector that takes into account the input received from STAFFER partners and here in particular the railway social partners UNIFE and CER and their affiliates involved in STAFFER.

It builds on the STAFFER achievements gained so far as described in the previous chapters, considering the specific requirements and needs of the two subsectors – rail supply industry and railway operation / infrastructure management, it makes suggestions on key elements and strategic orientations for a strategy on skills development and other measures that support a sustainable workforce development and employability in the rail sector.

The integrated strategy is motivated by the ambition to address the following factors of influence, requirements of skills and workforce requirements:

- A multiple set of challenges and tasks that are arising from EU regulation and market liberalisation, technological change, demographic and societal factors, as well as environmental requirements and needs.

³⁶ https://transport.ec.europa.eu/transport-modes/rail/ertms/preparing-future-evolution_en

³⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789>

- The fact that the railway workforce will change significantly in coming years, becoming more diverse in terms of age, gender as well as professional and cultural backgrounds, working culture and work expectations.
- Human resources planning and management must adapt to new needs as regards recruitment, onboarding, continuous education and training as well as other requirements in a more complex European rail system and against the expectation that the railway workforce will need to expand significantly in the coming year in order to match the increased demand in the field of passenger as well as freight transport.
- The need for a closer cooperation for railway operating companies and infrastructure managers across borders.
- The need to match the Single European Rail Area, technical standardisation and harmonisation of rules and regulation by intensified transnational cooperation and joint activities in the field of HR planning, competences and skills development as well as training.

Building on this and taking into account the results of the first three years of research and analysis, stakeholder consultation and joint collaborative work in the development and implementation of measures and activities to develop skills, foster cooperation and exchange and improve employability, the integrated strategy of the rail sector should foster and promote the **core aim** of “*Attracting and upskilling a qualified workforce for a smart and sustainable rail sector in Europe*”.

7.3 Three pillars of a long-term strategy on skills and sustainable workforce development

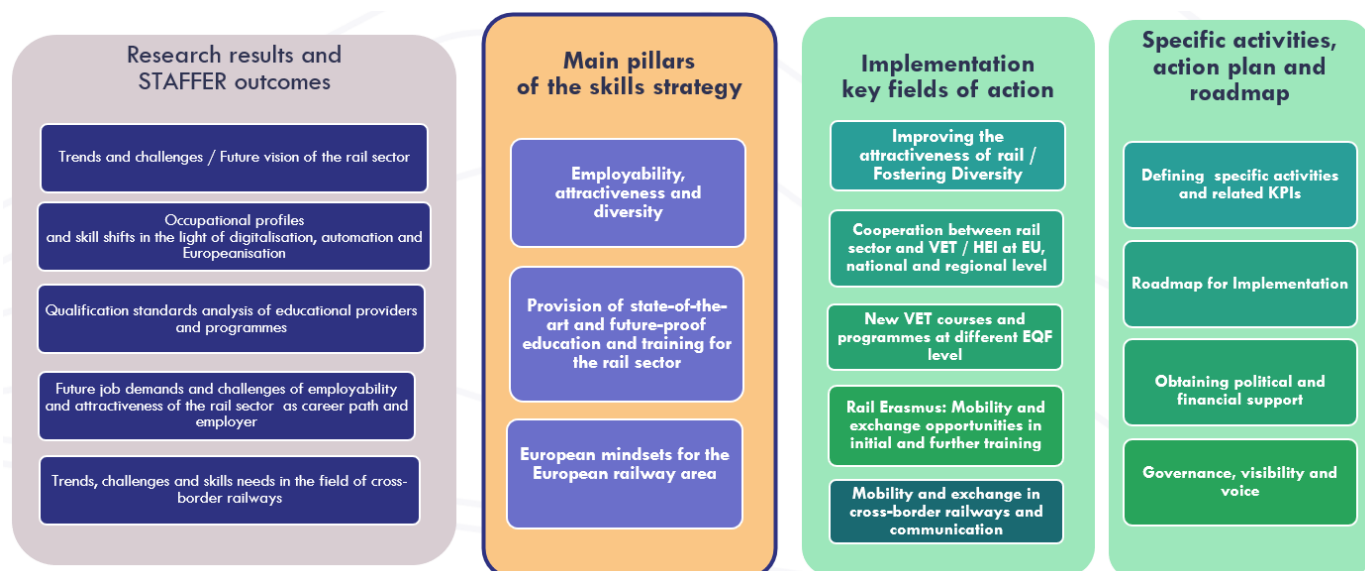
In order reach this goal, the skills strategy for the rail sector is based on STAFFER analyses on main trends, challenges and needs and should rest on **three main pillars**:

- The first pillar consists of measures and activities improving employability, attractiveness of rail as an employer and for young talents and for a more diverse workforce.
- The second pillar describes a set of measures, actions and activities related to the provision of State of the Art and future proof occupational education and training in the rail sector.
- The third pillar consists of skill related as well as other measures and activities that should facilitate the implementation of the European Rail Area and the transition from national to European mindsets.

Based on these three pillars and key fields of action that are also described in Figure 27 below, the rail sector skills strategy needs also a clearly described and detailed action plan and roadmap for implementation. This will not only include the drafting of specific measures and

activities but also ideas on how to gain political and financial support from European, national and regional institutions and political actors. These latter aspects related to implementing the strategy on the basis of an action plan and roadmap need to be addressed by the STAFFER task 7.4 in close collaboration with STAFFER partners, including the active involvement of the two peak-level associations of the sector, CER and UNIFE.

FIGURE 27: “ATTRACTING AND UPSKILLING A QUALIFIED WORKFORCE FOR A SMART AND SUSTAINABLE RAIL SECTOR IN EUROPE” - KEY ELEMENTS OF THE INTEGRATED SKILLS STRATEGY FOR THE RAIL SECTOR



Source: wmp consult, task 7.1

7.3.1 Fostering employability, attractiveness and diversity

Increasing the attractiveness of the rail sector as a future-proof and innovative industry is an important lever here and forms the first pillar of the long-term strategy. Whereas in the case of employability - as explained before - at least a narrow or broader definition framework could be set out, attractiveness is an even more individual concept. This is both a weakness and a strength, as there is no definition specific to the rail sector, but it opens a variety of starting points.

Based on numerous internal project discussions but also industry-wide events, at least ten aspects or dimensions of the attractiveness of the rail sector for future and current employees can be crystallised, without claiming to be exhaustive. The following Table 14 provides an overview of these ten dimensions.

TABLE 14: DIMENSIONS OF ATTRACTIVENESS FROM THE PERSPECTIVE OF EMPLOYEES

Dimension		Explanation and related aspects
1	Motivation, purpose and commitment	Shaping change, i.e. play an active role in the transport and energy transition.
2	Cooperation between theory and practice	Gain a wide range of insights into various railway-specific positions and career profiles through internships, trainee programmes or dual study programs.
3	Diversity and equal treatment	Networks, success stories and mentoring programs for women in the rail sector.
4	Openness and permeability for different occupational backgrounds	Facilitating lateral entry into different qualification levels through further training opportunities.
5	Interdisciplinarity	Develop and test new ways of working through close collaboration between engineering disciplines and digitalization experts.
6	Internationality (1)	Gain experience and change perspectives through foreign collaborations and international projects.
7	Internationality (2)	International recruiting and international educational cooperation as additional possibility to enter the labour market.
8	Career paths	Offer different careers by focusing on interests and strengthening skills in project management, leadership roles or specialist knowledge, thereby avoiding high fluctuation between sectors.
9	Good working condition and social standards	Strong social dialogue with binding outcomes in terms of reliable working conditions and social standards.
10	Work-Life-Balance	Task specific work environments that offer flexibility in relation to working time, workplace, taking into account individual needs and changes during the life course.

Source: Based on Lehman, M. et al. 2023.

There is a need to go beyond upskilling and reskilling of the current working force and also focus on attractiveness given the growing gap of resources and the competitive market setting in Europe (competition for instance with industries like aerospace and automotive). Attractiveness should be the focal point of the sector skills strategy and target it from the beginning.

The focus should be on profiles that from the perspective of rail suppliers and railway operators and infrastructure managers will be needed in the future and where already today the labour market is very tight and where there will be an increased demand in the future, e.g. engineering profiles, IT and technical profiles but also train drivers and staff with interoperability skills needs in traffic control, command and signalling.

Given the overall low share of female workers in the rail sector - the average share of women in railway operation and infrastructure in Europe is about 20 % whereby this level is largely stagnant, with only slight increase since 2013 – there is a strong need to attract more women into rail-related occupations and to foster a generally more diversified workforce.

Given the fact that labour shortage already today in many European countries already has a negative effect on the reliability and quality of railway operation, there is also the need to think about additional ways of recruitment, for example international recruitment, including recruitment of third country nationals for the sector.

Besides these general needs, STAFFER partners representing the rail supply industry as well as the railway operators and infrastructure managers have made the following concrete recommendations to foster attractiveness of the rail sector:

- It is important to communicate on a story-telling basis what rail brings to our societies, such as cutting-edge technologies and new green mobility innovative solutions that are part of the green and digital transition. Important to bring the rail sector and its technologies closer to the aspirations of the young generations and promote rail towards students and young professionals.
- Making rail more attractive to young people should start already before initial VET and university levels. Need to target children and young teenagers at the primary, elementary and high school levels.
- Work on advertisements and communication campaigns to bring newcomers to the sector, including on social media channels. Increase the presence for instance in Tik Tok to engage with young people and bring provocative ideas and share inspirational and personal experiences from the current workforce (go beyond corporate-driven messages).
- Organise specific activities and events to catch young people's attention and build an interest around rail, for instance through events in schools (Parent Days), universities and site visits (operation centres and rail facilities, visits of metro lines, etc.).
- Evaluate and modernize curricula in primary and secondary school education of transport related subjects, e. g. geography, social sciences, physics, informatics to nest railway topics in the interest of teachers and pupils as relevant matters to discuss and study technical and societal progress.
- From the perspective of the rail supplier industry, the sector should engage with other industry sectors that are aligned with the green and digital transition, as well as the net-zero industry targets and build a common approach. This should encompass the industrial / manufacturing processes as well as the products themselves (green mobility). Focus on efforts at EU and national levels, for instance in the context of the Green Deal Industrial Plan for the Net-Zero Age and its policy frameworks to financially support skills development.
- This is also highly relevant from the perspective of railway operation and infrastructure management, however from a different perspective: Against the severe labour shortage, particularly in manual and technical occupations such as train drivers, train attendants as well as in maintenance of rolling stock and infrastructure, there is an urgent need to consider new ways of becoming more attractive to people of all age groups, gender and ethnic background. The railway workforce already today has



become much more diverse and this process will (need) to accelerate in the future, e.g. by cross-border recruitment.

- Against the severe pressure of labour shortage, there is a need to think about new and innovative ways of (up)skilling of refugees and other groups by a more pro-active approach of recruiting, onboarding and integration.
- In this context, but also against the background of similar challenges in other transport sectors (e.g. automotive, freight and logistics, maritime shipping) as well as the huge impact of digitalisation and decarbonisation on the future of transport it is also suggested that the rail sector should engage more in exchange with other transport sectors on experiences and good practices.

It should be noted that the issue of attractiveness and in particular of making the rail sector to an attractive career path has been the topic of a separate task in Work Package 7³⁸, elaborated under the lead of the Technical University of Dresden. Key results of this task are described in Deliverable 7.2 and will be taken into account in Task 7.4, i.e. designing and implementing the action plan of the long-term skills strategy.

7.3.2 Skills for smart and sustainable railways in Europe

Identification of skill needs and requirements: STAFFER has shown that there is a significant gap between skill intelligence measures and practices within the rail sector (e.g. occupation related future labs; ongoing development of skills and competence profiles relevant at company and sector level, recruitment strategies, etc.) and national or even European levels of skill intelligence (e.g. ESCO or CEDEFOP³⁹). Given the challenges related to digitalisation, automation in an increasingly tight labour market (engineers, train drivers, etc.) this gap needs to be closed or at least addressed by EU coordinated action.

In this context, the relation between rail industry and railway companies on the one hand and educational providers, in particular universities at the level of student education programmes on EU rail specific education curricula are essential. A fundamental objective of STAFFER and any follow-up activities shall be to integrate the identified skills needs and occupation profiles into the curricula and programmes of the educational providers to match the needs and offers.

In this context, the following needs should be highlighted:

³⁸ Task 7.2 was dedicated to “Making the rail sector a great place to work“ – promoting attractiveness of the rail sector as a career path”.

³⁹ See the database on skill development as elaborated by CEDEFOP and the example of drivers: <https://www.cedefop.europa.eu/en/tools/skills-intelligence/occupations?occupation=8.83>

- From the perspective of both the rail supply industry and railway operation and infrastructure there is the requirement to gain a better understanding of what needs to be done to enhance and reskill / upskill the current workforce, such as: invest in learning and make learning a habit for all the staff, adapting to new requirements on a continuous basis (new technologies), introduce small bit-size learning content to allow people to learn from everywhere and 70-20-10 learning principle (70% learning on the job, 20% learning from others, 10% by trainings), and challenging the routine tasks by fostering exchange and interdisciplinary learning processes. This could also lead to promote new types of relationships between industry and educational partners enabling to create training paths for employees.
- When it comes to engineering profiles, the primary focus should be on levels EQF 5-8 engineering profiles with technical skills, for example system engineers or engineers dealing with ERTMS deployment. Need also to work at MBAs offers for educated staff to promote more innovative thinking, IT/OT integration and system engineering understanding.
- Cooperation should be accompanied and strengthened by exchange programmes between the industry and universities: In this context, the rail supply industry has suggested a sort of an ERASMUS+ Rail Engineering Programme to foster the relation between the two sides and build a critical mass and interest towards rail international careers. This cooperation should be enhanced and supported by the relevant regional authorities through their Smart Specialisation Strategies.
- The same need has been articulated by railway undertakings and in particular railway infrastructure managers in relation to skill and knowledge requirements of railway engineers in the field of ERTMS. This has been addressed in STAFFER Work Package 6 already by pilot activities, including cross-border cooperation activities targeting young railway professionals at EQF levels 5-8.
- Address the challenges related to the processes to change curricula and programmes at universities across the EU as apparently it takes too long (about 3 years), ensuring a broader education & training offer built on a continuous collaboration between industry & education providers.
- Rail supply companies are mostly running global businesses. As such, and given the focus on EQF 5-8 profiles, intercultural experience are not so much a problem per se. However, it remains necessary to continue our efforts with the complete sector workforce in mind. Finally, from a compliance perspective it is impossible to consider exchange programmes between competing companies.
- This contrasts to the perspective of railway operation and infrastructure managing undertakings: Intercultural experiences and learning certainly has become more relevant in relation to several aspects, including the increase of cross-border railway operation, the introduction of European, transnational digital traffic control systems and the expectation that volumes of rail transport need to increase significantly in the future in order to meeting the targets of the Green Deal. This will also require new interoperable skills, knowledges and perhaps even new occupational profiles related to cross-border railways.



7.3.3 European mindsets for the European rail area

The transition from national to European mindsets should be regarded as a huge generational requirement in railways: Despite 25 years of EU level initiatives to foster the development of a single European Railway Area (by opening the rail transport market to competition, cross-border rules for interoperability and safety and developing rail infrastructure), railways still is deeply influenced by national technical adaptation, traditions, rules and practices.

This is also very visible in the field of skills and occupational development and therefore there is a strong need to promote the development of strengthening European mindsets, competences and skills by more cooperation of VET and academic institutions and programmes that so far hardly exist for example at Bachelor or Master level.

Therefore, from the perspective of all educational qualification levels (including EQF 3-4) as well as railway staff, skill development in all countries and railway companies as well as the rail supply industry increasingly should be oriented towards the acceleration of standardisation of technical, operational and infrastructure related rules and standards. Quoting cross-border initiatives developed in the context of STAFFER on ERTMS: *“There is the need to develop harmonised training modules and contents at European scale to avoid a situation where 27 EU Member States need to do this individually”*.

Increase the number of and further refine (e.g. digital skills) interoperable occupational profiles: i.e. reflecting the increased number of railway personnel which are involved in cross-border rail transport (freight, long-distance passenger, regional/local rail in border sections, etc.).

In railway operation, drivers who have to communicate with the infrastructure manager on critical safety issues must have language skills in the language indicated by the infrastructure manager concerned. Their language skills must be such that they can communicate actively and effectively in routine, adverse and emergency situations. A sound target system on railway communication and a migration strategy shall be laid down in the legal framework. Instead of the train drivers learning new languages to the full necessary extent for the areas of operation the railway undertaking intends to operate in, which is expensive and burdensome, it is recommended to make best use of tools (digital tools as well as multilingual forms or other suitable means (e.g. relevant railway vocabulary) and future technological developments, where appropriate and if the existing level of safety is fully maintained.

Railway stakeholders, in particular railway operators and infrastructure managers lag in comparison to other transport sectors when it comes to making use Erasmus mobility funds for learners and Erasmus funds to develop cross-border approaches to learning and skills development.

However, in particular for future generations of railway undertakings leaders at company or sector level such experience is important to develop more open and European mindsets and thinking about the own job. Therefore, there is a need for railway specific mobility projects (or even a sector-wide framework) that provides opportunities for apprentices, students as well as trainers to learn abroad and develop own competences.

As pilot experiences developed in the STAFFER project shows, internationalisation strategies in initial and further learning require a clear political will and support from higher level management. Therefore, also the development of management and HR capacities and resources for internationalisation in the field of initial and further training is important.

7.4 Outlook: Designing the long-term action plan and roadmap of the rail sector's skills strategy

As mentioned already above, the task of designing a long-term action plan for implementing the skills strategy will be carried out in STAFFER task 7.4. It will be supported not only by the deliverable 7.1 but also the consideration and results of 7.2 on promoting attractiveness of the rail sector as a career path and 7.3 and its consideration in relation to develop an action plan for obtaining political and financial support for the STAFFER educational programme.

To provide support for the design of the action plan it is also suggested that as a next step the three pillars and related fields of key action as described above are concretised by information and suggestions of specific activities that have been already developed and designed in various STAFFER tasks in the context of Work Package 6 by pilot activities or ideas for concrete measures of skills development and formation in Work Package 4.

In order to facilitate this process, in the context of Task 7.1 a grid for gathering information on specific activities related to the three pillars and key fields of action of the strategy has been developed (see Table 15 below) for gathering and describing specific activities and measures that are suggested as important and needed for skill development and other objectives of the rail related skills strategy.

To facilitate this, a simple database excel sheet for gathering information on already designed or planned pilot measures and other specific activities that are regarded as important has been prepared. The database should provide an overview and brief description of specific measures and activities supporting and underpinning the overall objective of the long-term strategy and the action plan, including indicators such as target groups, partners/stakeholders involved and key performance indicators as well as initial ideas on possible funding sources and timelines.

TABLE 15: MAIN TOPICS, KEY ACTIONS AND GOOD PRACTICES

Pillar	Key Actions	Specific Activities	Link to STAFFER WP	KPIs	Partners involved	Possible funding	Timeline
1 Employability, attractiveness Diversity	Working in rail as an attractive and sustainable career path						
	Securing employability ...						
	Promoting female employment and a more diverse workforce						
	Improving the attractiveness of rail						
2 Skills for smart and sustainable railways	Cooperation between rail sector and VET/HEIs						
	New courses and programmes at different EQF level						
	Developing new occupational profiles						
3 European mindsets for the European Era	Railway Erasmus for students, learners and staff						
	Language and communication						
	Expert platforms of exchange, learning and networking						
	Skills and competences for cross-border rail operation						

Source: wmp consult, STAFFER Task 7.1

7.4.1 Governance and Coordination: Thinking ahead beyond STAFFER

We regard it as essential that the effort of elaborating the final version of the skills strategy and action plan is based on a process of synthesising these elements as much as possible to secure a strong outcome and message to the whole rail sector and sectoral stakeholders. There is a clear need that the strategy and related actions and implementation plan/roadmap are developed in a synchronised and coordinated way.



A key activity in the context of Work Package 7 in the remaining project during will consist of condensing the results into an industry-wide long-term strategy that should be prepared and last beyond the end of the project in October 2024.

This also includes the agreement of policy recommendations⁴⁰ and the development of implementation proposals in the form of key actions on a bi-, multi- and transnational level as well as securing their political and financial support and promotion.

Given the complexity of the rail sector and the challenges its workforce is facing in terms of skills adjustments, demographic change and other needs (internationalisation, interoperability, etc.) it is regarded as important that the implementation of the long-term strategy is coordinated at EU level and across all levels of formal and informal education and training.

The STAFFER Blueprint is a unique experience of transnational collaboration between the rail supplier sector, railway operators and infrastructure managers as well as quite a large number of educational providers, coordinated by the University of Genoa in consultation with a steering group of all partner organisations and monitored by an Advisory Board consisting of highly relevant stakeholders from European and national level, including the European Railway Agency, the European Rail Research Advisory Council, EU Commission DGs and representatives of two European Trade Union Federations.

When thinking beyond STAFFER and considering the concrete activities that started already now as well as in the light of forthcoming requirements and needs of the rail sector in Europe, there will be the need of EU level coordination, governance and supervisory structures for the years to come after the end of STAFFER, representing the whole rail sector:

- Currently, there is no existing organisation responsible for taking a Europe-wide approach to railway sector workforce development.
- The sector will face significant adjustment requirements in the context of speeding up the development of the Single European Railway Area and this requires a strong approach on skills and workforce development.
- The sector already today is facing significant labour shortage that is hampering railway services in passenger and freight and against the vision of railway growth measures to address labour shortage currently and even more in the future will need to become more international.

⁴⁰ Task 8.3 is about “Policy recommendations and exploitation activities” and is led by CER and UNIFE.

From the perspective of WP7 co-leaders this would also strengthen the aspect of “ownership” and practical relevance of the action plan and roadmap for the implementation of the long-term skills strategy and the related action plan.

