



STAFFER
EUROPEAN RAIL SKILLS ALLIANCE



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Future vision of the rail sector from the point of view of operators and infrastructure managers

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PREFACE

This report is the first one of two reports that are going to be prepared in the context of the STAFFER WP 2, “*Identification of current and future skills and competence needs from the operational point of view.*” It is also the first deliverable that focuses on the perspective of railway operators and infrastructure managers. Thus, WP 2 is going to prepare the ground for following STAFFER work packages that are dedicated to requirements and needs in the field of qualification, human resources development and transnational exchange and mobility.

WP 2 is building on a close exchange with WP 1 and its results. However, while WP 2 and its results are structured in a similar way, they are to a large extent different.

This is because WP 2 addresses additional topics and issues. Resulting from the strong interest of the railway operators and infrastructure managers involved in STAFFER¹ as well as a larger group of CER affiliates that participate in regular information meetings², three aspects have been addressed in WP 2 that go beyond WP 1 as well as WP 3 (the corresponding WP focussing on the rail supplier industry): Cross-border rail traffic, paying specific attention to European rail freight corridors and language and communication issues in cross-border railway operation and infrastructure management.

As will be shown in the following sections, several specific activities have been carried out as regards both issues.

Further a focus was placed on the survey of railway operators, infrastructure, railway-related education, research institutions and stakeholders. Due to the comprehensive evaluation, the submission of the report was in delay. To avoid an overlapping with the WP1 survey but also because the survey questionnaire was the result of an intensive consultation with the partners involved in WP2 and particularly in WP2.1, the survey was implemented in June 2021.

The WP2 survey that was carried out in close cooperation and with active promotional activities of CER and the involved railway operators and infrastructure managers not only provides an important input for the current WP 2.1 report, but it will also serve as the basis of WP 2.2 as well as railway specific tasks in WP 4, 6, 7.

¹ These are: DB, FS, IŽS, ÖBB, PRORAIL, SNCF and CFL as well as CER.

² Since the launch of STAFFER, CER organises monthly as well as occasional information meetings in parallel to the general monthly WP meetings. The CER meetings are organised in close cooperation with the WP co-leaders and open to all interested CER affiliates.

1 OBJECTIVES OF WP2 AND WP2.1 IN CONTEXT

Like WP 1 from the general perspective and WP 3 from the perspective of the rail supplier industry, WP 2 will provide a closer look from the perspective of the railway operators and infrastructure managers. More precisely, WP 2 covers two broader issues:

WP 2.1 addresses future visions of the rail sector from the perspective of railway operators and infrastructure managers. This task provides an overview of the current state, the general key trends (those referred to in WP1 but also trends specific to railway operation and infrastructure management), current as well as future challenges of railway operation and infrastructure. Beyond the general assessments and evidence, WP 2.1 focuses on skills and qualification requirements as well as further issues:

- Cross-border rail traffic, with special references to EU rail freight corridors,
- Language issues and communication issues in cross-border traffic,
- Skill requirements of railway personnel, including trainers and managers (drivers, traffic controllers, conductors, operation managers, infrastructure/corridor managers, control staff and safety personnel) as well as skills and competences of professional profiles affected by digitalisation/bit data/cybersecurity, energy, and environmental policies.

Task WP 2.1 will set and prepare the background for the activities of Task 2.2 focussing on the identification of skill needs and occupational profiles in railway operation and infrastructure management.

Apart from this, WP 2.1 and the identified current and future skill needs will feed into WP 4 (*“Development of mobility and training programmes”*) and WP 6 (*“Implementation of training and mobility programmes”*), namely task 4.4, the development of mobility and training programmes in the field of cross-border railways, communication and language (co-leader DB) and tasks 6.3, the implementation of cross-European apprentice mobility programmes and work-based internships (co-leader wmp consult), 6.4 implementation of cross-European staff mobility programmes and work-based internships (co-leader DB) and 6.7, implementing of mobility and training programmes in the field of cross-border railways, communication and language (co-leader DB).

And above that, WP 2 is expected to serve as an important basis for further consultation within the CER group of STAFFER partners as regards WP 7 (*“Development of a long-term strategy*

and action plan”), namely task 7.1.1 which is about designing a more specific strategy for rail operators and infrastructure managers (co-leader wmp consult).

2 METHODOLOGY AND ACTIVITIES CARRIED OUT

Against the important role of WP2 for STAFFER activities focussing on railway operators and infrastructure managers throughout the whole STAFFER life cycle, tasks 2.1 was implemented by the co-leader wmp in very close cooperation with its co-leader DB as well as CER and railway operating and railway infrastructure management STAFFER partners. Different formats of exchange and consultation have proved to be important to fine-tune and agree upon the work plan, methodological tools as well as outcomes: regular meetings with a core team consisting of the DB coordinator and DB staff from different departments, close exchange with the railway partners involved tasks 2.1 as well as monthly information meetings for CER affiliates (inside and outside STAFFER) hosted by CER and implemented jointly with the WP 2 co-leaders.

Above that, there has been occasional joint meetings and bilateral exchange with educational and research partners, namely TU Dresden, FH St. Pölten, FH Erfurt, Aristotle University of Thessaloniki – School of Civil Engineering, University of Belgrade, CESI as well as UNIGE.

During the lifetime of task 2.1, six general meetings of all WP2 partners have been implemented to discuss research progress, the methodology and interim as well as pre-final results.

Apart from such meetings and forums, WP 2 co-leaders participated in general STAFFER coordination meetings and several exchange meetings with WP 1.

In the context of elaborating the WP2.1 report and with view on exchanging first ideas about key outcomes and follow-up activities in relation to addressing skills needs and future occupational profiles, there has also been an exchange with the co-leader of WP 3 (MAFEX).

As regards the implementation of the overall and the two specific tasks of WP 2, the co-leaders wmp consult and DB as well as the other railway operation/IM related STAFFER partners have agreed to apply an integrated approach for tasks 2.1 (Vision Report) and 2.2 (Future skills needs analysis).

In this context three main themes will be addressed, of which one will address the focus field of transnational railway operation, language, and communication:

(1) Railway vision – trends, challenges, choices, and related requirements within and outside railway OP/IM companies

(2) Trends and skills requirements and other needs as regards **interoperability, cross-border corridors, language, and communication**

(3) **Skills status-quo analysis and future skills**, competence needs and shifts; modernisation of occupational profiles

Whereas all three issues will be addressed in the current WP 2.1 report, the subsequent work in task 2.2 and the respective report will provide a more in-depth and detailed analysis of skills needs and future occupational profiles in railway operation and infrastructure management.

Against this, WP2 will apply both from the analytical as well as methodological perspective a focused and layered approach that consisted of the elements described in the following subsections.

2.1 Desk research

Desk research and evaluation of existing knowledge and practices: In this context the task 2.1 co-leader has gathered from EU databases (ERASMUS, CORDIS) as well as from STAFFER partners information on transnational cooperation, mobility, and R&D as well as innovation projects.

Furthermore, and in relation to occupational profiles in railways, wmp consult has carried out an in-depth analysis of the **ESCO database** and identified 30 occupations described by ESCO in terms of skills, competences, and knowledge (see Table 1). This database will form the basis of further analysis in the context of the future skills analysis that started already in task 2.1 and will continue during task 2.2 in relation to three focus profiles (train driver, traffic management and control, occupational profiles in maintenance and infrastructure including engineering profiles).

TABLE 1: IDENTIFIED OCCUPATIONAL PROFILES IN THE DOMAIN OF RAILWAY OPERATION AND INFRASTRUCTURE MANAGEMENT

Railway domain	Occupational profile	Staff category
Infrastructure	Railway station manager / director	Manager
	Rail Project Engineer	Professional
	Transport (infrastructure) engineer	Professional
	Rolling stock engineer	Professional
	Railway infrastructure inspector	Technician
	Rail construction supervisor	Professional
	Rail logistics coordinator	Clerical and support
	Rail traffic controller / Train dispatcher	Clerical and support
	Railway electronic technician	Technician



Railway domain	Occupational profile	Staff category
	Rail layer	Elementary
Operations	Rail operations manager	Manager
	Train driver instructor	Professional
	Train attendant	Services and sales
	Chief conductor / Train crew supervisor	Services and sales
	Train conductor	Services and sales
	Train driver	Plant and machine operators and assemblers
	Railway brake, signal and switch operators	Plant and machine operators and assemblers
	Shunter	Plant and machine operators and assemblers
	Platform dispatch assistant / platform assistant	Plant and machine operators and assemblers
	Train preparer	Plant and machine operators and assemblers
	Train cleaner	Elementary
Maintenance	Rail maintenance technician	Technician
	Rolling stock engineering technician	Technician
	Rolling stock inspector	Technician
	Rolling stock engineering drafter/designer	Technician
	Rolling stock electrician	Technician
Customer service	Ticket sales agent	Customer and sales
	Railway sales agent	Customer and sales
	Railway passenger service agent	Customer and sales
	Passenger fare controller	Customer and sales

2.2 Thematic focus group(s)

As regards the themes on transnational/cross-border railway operation, rail freight corridors and issues related to language, communication and skills and competence needs of railway personnel in general and of professional profiles affected by digitalisation, it seems to be very important to bring in the expertise of staff/experts in railway undertakings and infrastructure/network managers.

Therefore, a smaller focus group consisting of experts of DB and ÖBB has been formed, focussing on topics such as key HR and other (technical, regulatory, etc.) challenges and barriers in relation to an efficient functioning of rail freight corridors and meeting the objective related to the objective of achieving a higher modal share of 30% by 2030. The DB and ÖBB focus

group consist of corridor managers (Corridor 1 and Corridor 9) as well as experts and project representatives involved in pilots and other activities of developing foreign language solutions for communication between different actors involved transnational railway operation (both rail and freight), for instance infrastructure managers, operators, train drivers and traffic control centre staff.

At later stage and in the context of task 2.2, additional group members on the other topics will come from further partners (experts from railway operators and infrastructure managers either involved or not involved in STAFFER as well as representatives of educational and research institutions). In the context of task 2.1 the focus group with DB and ÖBB provided important information and contributed to the contents of a survey section dedicated to the issue of cross-border railways, related skills, and mobility/exchange/communication needs. Bilateral exchanges have given input for the survey section dedicated to the other topics.

2.3 Online survey

2.3.1 Contents, target groups and structure of the survey

As mentioned above, it is necessary to carry out an in-depth analysis of trends, requirements as well as skills and HR related requirements from the perspective of railway operators and infrastructure managers. An online survey consisting of several thematic sections addressing the topics listed above, was circulated. Each survey part addressed experts within railway undertakings and infrastructure managers as well as educational and academic institutions.³

Representatives of the following target groups were invited to undertake the survey:

- HR experts
- Experts in relevant business units and functional areas of railway operation and infrastructure management
- Railway related research, education, and training institutions
- Other railway related stakeholders

Information from the survey not only contributed to the current WP 2.1 report but will also feed into future STAFFER activities and tasks such as the elaboration of future occupational profiles, fostering and facilitating transnational mobility and training programmes in the railway sector and will feed into the long-term strategy and action plan from the perspective of railway operators and infrastructure managers.

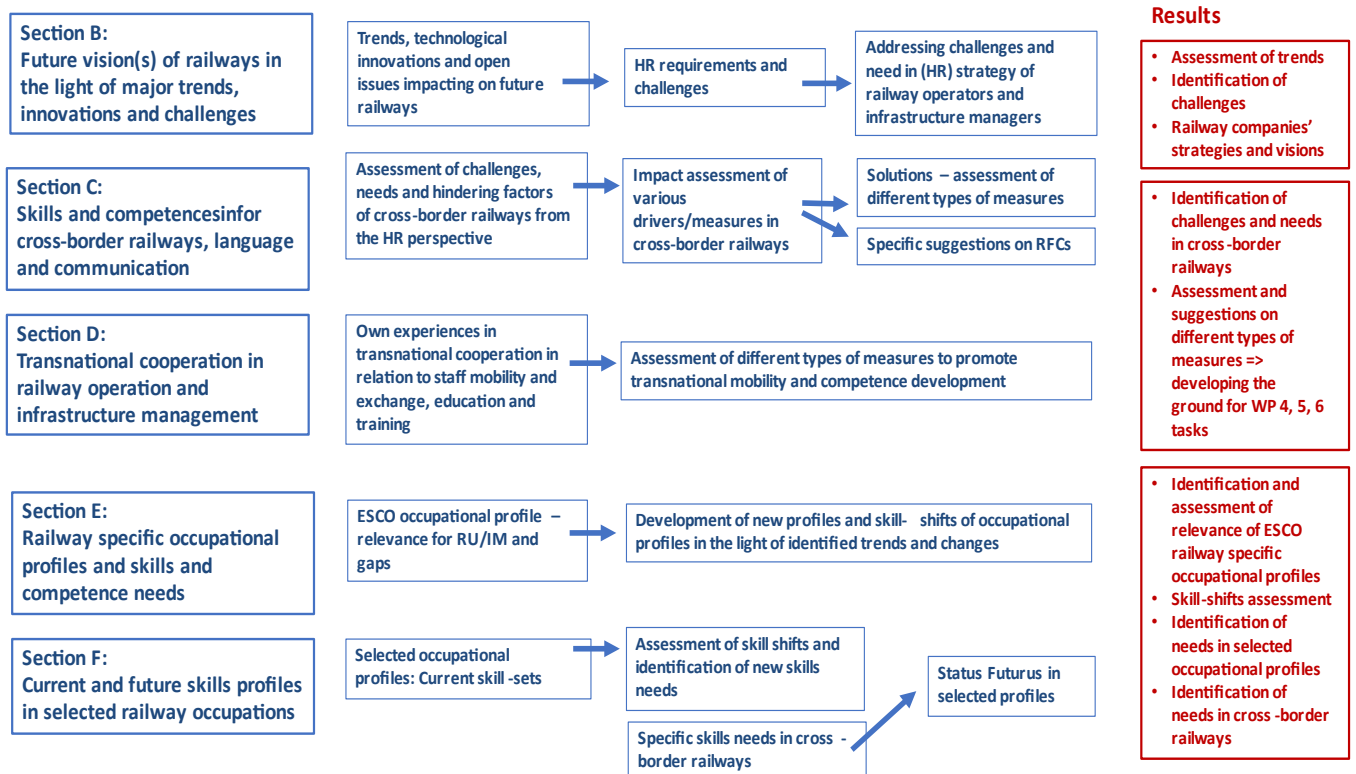
³ As regards dissemination, it should be noted that the survey not only was disseminated to all railway operators and infrastructure managers involved in the STAFFER consortium but that the survey was also disseminated by CER in order to achieve a wider dissemination in terms of countries as well as railway undertakings.

The survey consisted of the following six sections:

- Section A gathering data on the profile of respondents and contact details for follow-up interviews/exchange.
- Section B on future vision(s) of railways in the light of major trends, innovations, and challenges.
- Section C on skills and competence requirements and solutions for cross-border railways, language, and communication.
- Section D on transnational cooperation in railways
- Section E on railway specific occupational profiles, skill-shifts, and future skills needs across different railway occupations.
- Section F aims at a more in-depth analysis of current and future skills requirements in three selected occupational profiles.

The survey logic is illustrated in the following Figure 1.

FIGURE 1: ONLINE SURVEY WP2: SURVEY LOGIC

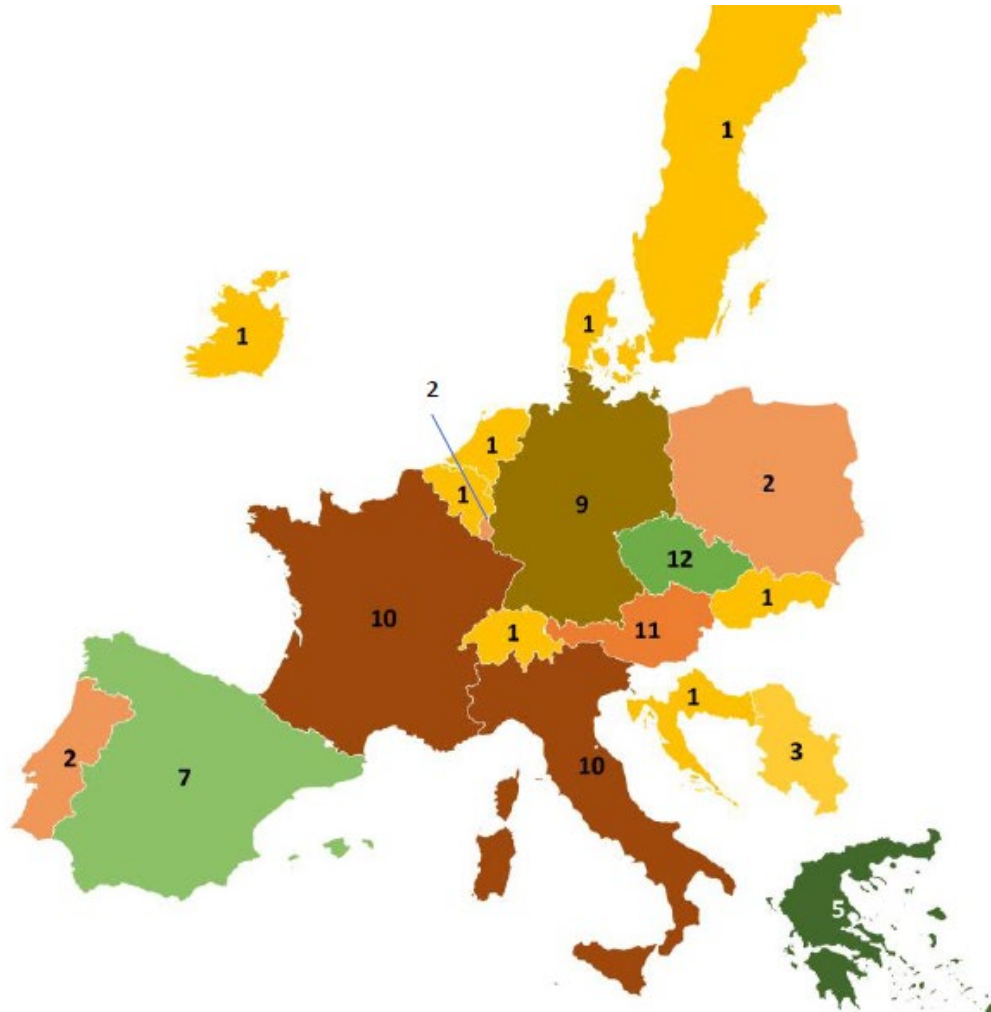


2.3.2 Overview of responses

As of 30th June, 82 complete datasets /responses were gathered by the survey. Responses were received from a total of 19 countries of which 16 are EU Member States (Austria, Belgium,

Croatia, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovakia, Spain, Sweden, one is a candidate country (Serbia), and the remaining two are Switzerland and Russia. The number of responses ranged between 1 (Belgium, Croatia, Denmark, Ireland, Netherlands, Slovakia, Sweden, Switzerland and Russia) and 9-11 (Austria, Czech Republic, France, Germany, Italy). For further details see Figure 2 below.

FIGURE 2: SURVEY RESPONSES BY COUNTRY



N= 82
 Map shows only those countries with responses to the survey, except Russia (1 response)

Source: STAFFER Survey of Railway operator and infrastructure managers 2021

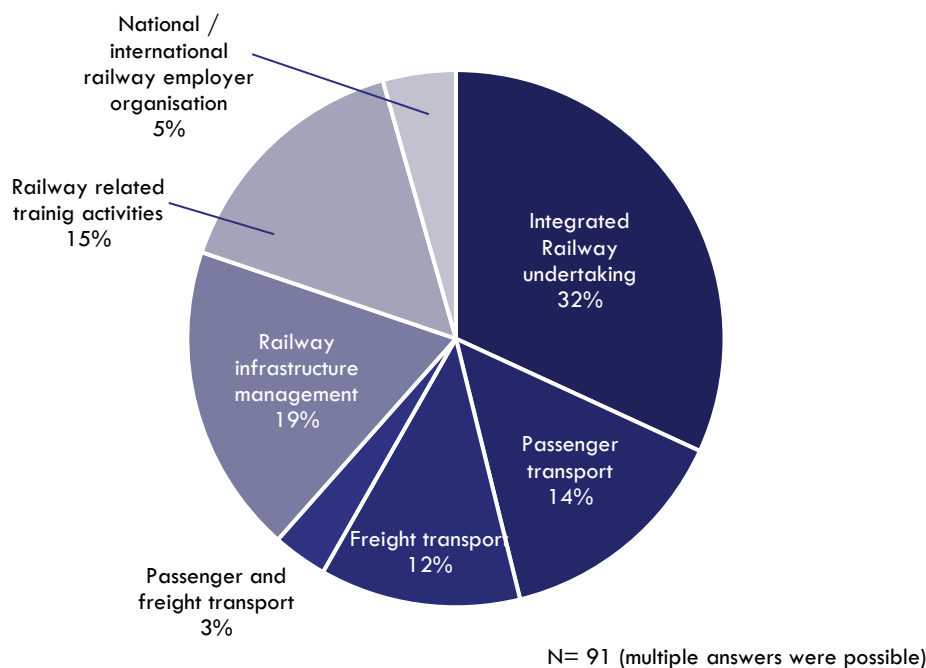
More than three quarters (78%) of responses were made by representatives from different areas of railway operation and infrastructure management. In total, 27 railway operating and infrastructure management companies from 18 countries contributed to the survey. Further responses were from educational institutions and academic research (17%) and from railway employer organisations at national and international level (5%).

As regards railway operators and infrastructure management, the survey responses represent a balanced sample of all main domains, i.e. integrated railway companies (encompassing all main activities including operations and infrastructure management), rail freight and rail passenger transport as well as infrastructure management (see Figure 3).

The responses from participants from integrated railway undertakings are spread quite broadly across different functional areas (see Figure 4). Most responses are from functions within the holding of the company (20%) and infrastructure management (19%). Other functional areas are engineering (14%), freight, passenger, maintenance, stations, traffic management, rail freight corridor management, rolling stock as well as areas such as education, training, innovation and research activities.

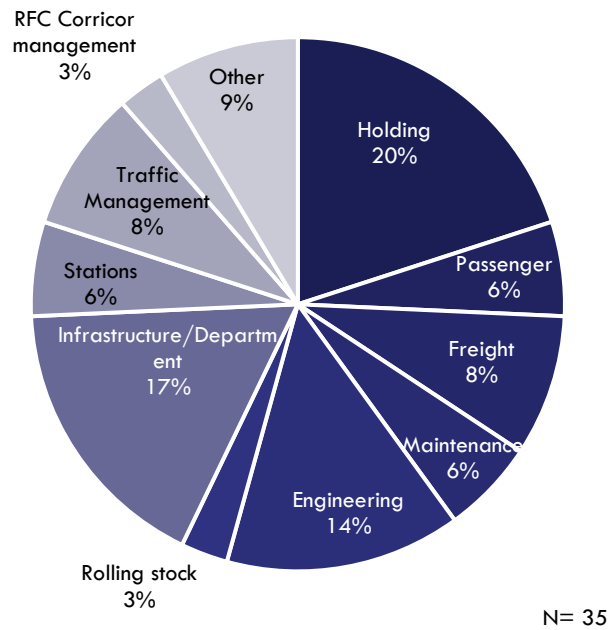
Although the survey is not representative, it reflects different national, corporate, functional, organisational framework conditions as well as characteristics.

FIGURE 3: SURVEY RESPONSES BY TYPE OF ORGANISATION AND ACTIVITY



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

FIGURE 4: RESPONSES FROM DIFFERENT DOMAINS IN INTEGRATED RAILWAY COMPANIES



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

2.4 Action list WP 2 / Task 2.1

The following table provides an overview of main activities carried out in the context of WP 2 until the 14 July 2021.

No	Activity / Meeting	Who	Involved partners	Date	Status
1	Gathering comments from WP 2 railway operators and infrastructure partners on expectations and suggestions regarding concrete outcomes and topics addressed	wmp/DB	Railway operators and CER	Nov-Dec 20	completed
2	Desk research and repository of transnational R&D projects relevant to the WP	wmp	all partners / CER	15. Mar 21	completed
3	Providing input to WP1 survey	CER STAFFER partners	WP1 co-leaders	Jan/Feb 21	completed
4	CER STAFFER Info Meeting	wmp/DB/ CER	CER STAFFER partners and other affiliates	21. Jan 21	completed
5	1st WP2 General Meeting - Presentation of WP2 and first concretisation of work plan and timeline	wmp/DB	all partners	28. Jan 21	completed
6	Concretisation and discussion of methodological approach of WP2	wmp/DB	Railway operators and CER	11. Feb 21	completed
7	2nd WP2 General Meeting: Presentation concretisation of work plan and timeline, including survey concept	wmp/DB	all partners	25. Feb 21	completed



No	Activity / Meeting	Who	Involved partners	Date	Status
8	Presentation and discussion of results and planning with CER STAFFER Info Meeting	wmp/DB/ CER	CER Staffer partners and other affiliates	10 Mar 21	completed
9	Focus Group Rail Freight Corridors /railway language and communication	wmp/DB	German speaking railways and academic STAFFER partners	12 Mar 21	completed
10	3rd WP2 General Meeting	wmp/DB	WP2 partners	30 Mar 21	completed
11	Concretisation of methodology of desk research evaluation, interviews, focus groups and survey	wmp/DB	all partners	25 Mar 21	completed
12	Evaluation project repository, ESCO database analysis, survey / interview contents development	wmp	STAFFER partners and CER Team	March - May 21	completed
13	Focus Group Rail Freight Corridors /railway language and communication	wmp/DB	German speaking railways and academic STAFFER partners	15. Apr 21	completed
14	CER STAFFER Info Meeting: WP2 and WP4 planning, exchange on WP1, RFC focus group results and planning, online survey, expert interviews, adjusted work planning	wmp/DB/ CER	CER Staffer partners and other affiliates	22. Apr 21	completed
15	4th WP2 General Meeting	wmp/DB	WP2 partners	29. Apr 21	completed
16	Focus / expert group language & communication	wmp/DB	German speaking railways and academic partners	5 or 6 May 21	completed
17	CER STAFFER Info Meeting: Finalisation of the survey, interview progress/reports, results of desk research, etc.	wmp/DB	CER Staffer partners and other affiliates	19 May 21	completed
18	5th WP2 General Meeting: Presentation of the survey, reports on other progress	wmp/DB	WP2 partners	27. May 21	completed
19	Launch of WP2 survey	wmp/DB	WP2 partners and external stakeholders	01. Jun 21	completed
20	WP2 Survey: Deadline for provision of responses	wmp/DB	WP2 partners and external stakeholders	15. Jun 21 (extended until 1 July)	completed
21	Evaluation of survey results, elaborating draft WP2.1 report	wmp	WP2 partners	June / July 21	completed / ongoing
22	CER STAFFER Info Meeting: Survey results presentation and draft WP2.1 report	wmp/DB	CER Staffer partners and other affiliates	24. Jun 21	completed
23	6th WP2 General Meeting: Presentation of the survey results and WP2.1 final draft report	wmp/DB	WP2 partners	01. Jul 21	completed
24	Exchange with WP3 co-leader	Wmp	Wmp / Mafex	14 Jul 21	planned
25	Delivery of WP2.1 report to UNIGE	wmp/DB	STAFFER coordination	15. Jul 21	planned





3 KEY TRENDS, INNOVATIONS AND CHALLENGES

3.1 Trends, innovations and challenges from the perspective of railway operators 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 academia⁴ and from railway undertakings) about specific trends that are relevant for railway operation and infrastructure management, a specific and different approach as regards main trends was developed.

This approach is based on a differentiation of trends, innovations, and challenges, whereby the following understand was agreed upon:

3.1.1 Trends and drivers of change

This refers to all the strategic choices and policies that either have been adopted in recent years and are addressed by most railway companies or may be adopted soon.

The following important trends and drivers of change were defined in the context of WP 2 meetings and in bilateral exchange with involved partners:

- **Rail market liberalization**
- **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**

⁴ Here in particular the colleagues from the STAFFER partner Aristotle University of Thessaloniki – School of Civil Engineering contributed significantly to the approach.



3.1.2 Innovations

This includes technologies that either have been adopted or are currently applied in railways and have the potential to be widely implemented because they improve efficiency and performance significantly.

The following important technological and other innovations were defined in the context of WP 2 meetings and in bilateral exchange with involved partners:

- **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**

3.1.3 Open issues

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 undertakings solely but require a joint transnational approach or cooperation.

The following open issues, that might require to a certain extent a joint and transnational approach, were defined in the context of WP 2 meetings and in bilateral exchange with involved partners:

- **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**

The mentioned trends, innovations as well as policy choices, will have a direct impact on the skills and competence needs of the of railway employees in different domains of operations and services, infrastructure management and maintenance.

3.2 Overview of survey results

3.2.1 Trends and open issues

Survey results as regards the assessment of trends and open issues⁵ impacting on future railways 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, the 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. More 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%)
- 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%)
- Door-to-door mobility solutions and Mobility as a Service (MaaS) (31%)

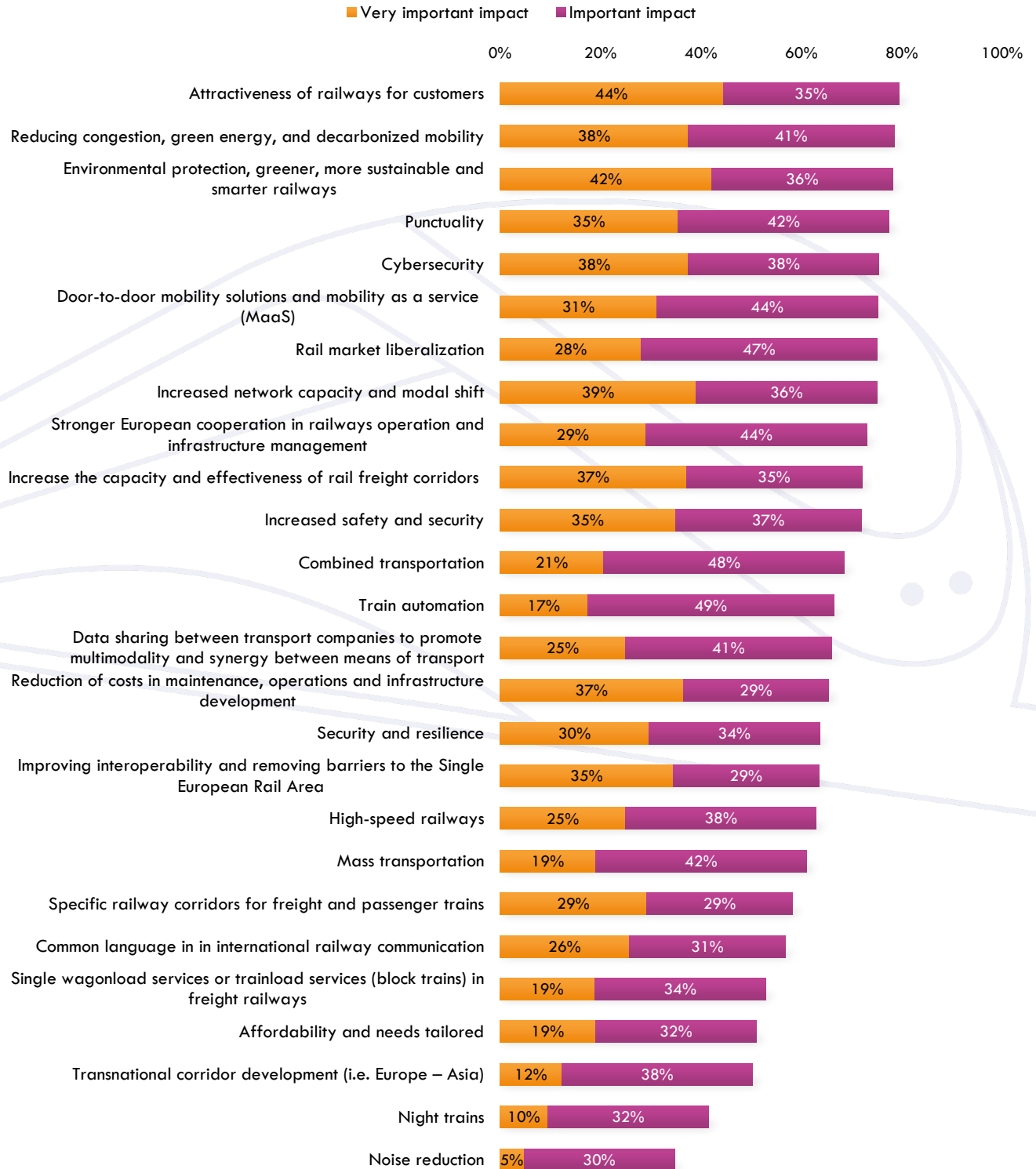
Trends and open issues such as stronger European cooperation in railway operation and infrastructure management, rail market liberalisation, high-speed railways, or the establishment of a common language in international railway communication were rated by around 1/4 of participants as having a very 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.

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]

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 (see Figure 5).

FIGURE 5: 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 Survey of Railway operator and infrastructure managers 2021



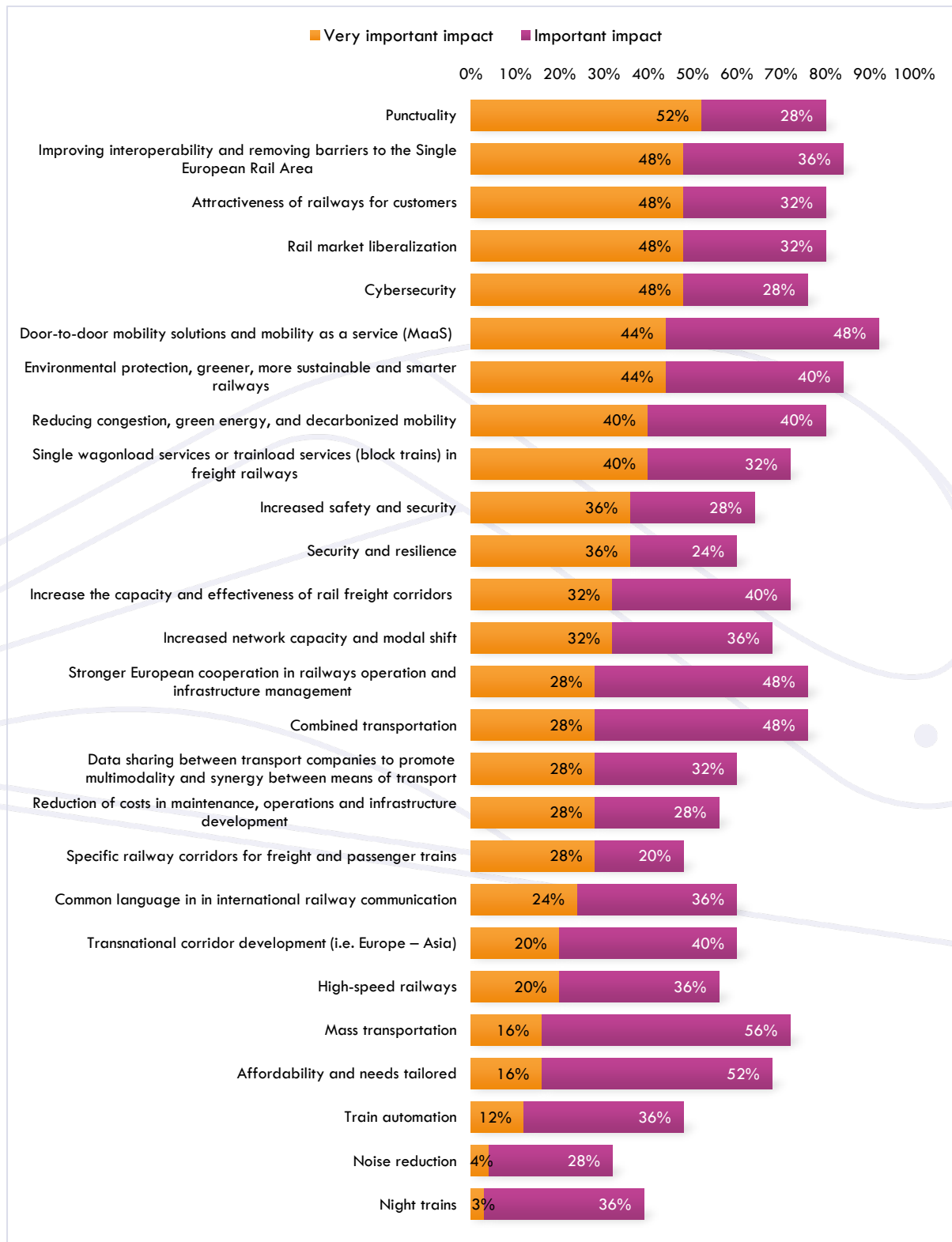
On the opposite, there are trends and open issues that were ranked by comparatively large shares of participants as having only little or no impact at all. One of such issues has been single wagonload services or trainload services (block trains) in freight railways. In this context it should be noted that the results above reflect the general assessments of all participants, thus including all types of railway undertakings, infrastructure managers as well as participants from the domains of railway training and academic research.

Against this, it is interesting to take a closer look at the assessments of specific participant groups, here rail freight transport companies. The following figure 6 shows that in that there are quite significant differences in the assessment of future trends between the total groups of participants and participants that represent freight companies (25).

From the perspective of rail freight transport companies' assessments as regards important trends that will impact on future railways by 2030 differ not only in relation to single wagonload, but also in relation to other trends: The following trends have been ranked higher by freight company representatives:

- Door-to door mobility solutions and mobility as a service (92% rail freight companies regard this as a very important or important trend as compared to 'only' 75% of all participants)
- Improving interoperability and removing barriers to the Single European Rail Area (84% as compared to 64%)
- Environmental protection (84% as compared to 78%)
- Single wagonload services or trainload services (72% as compared to 53%)
- Punctuality (80% as compared to 77%)
- Rail market liberalisation (80% as compared to 75%)
- Combined transportation (76% as compared to 69%)

FIGURE 6: RANKING OF FUTURE TRENDS BY IMPORTANCE – TRENDS AND OPEN ISSUES REGARDED AS HAVING A VERY IMPORTANT AND IMPORTANT IMPACT ON FUTURE RAILWAYS BY 2030 FROM THE PERSPECTIVE OF RAIL FREIGHT COMPANIES (N=25)



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

3.2.2 Technological innovations

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.

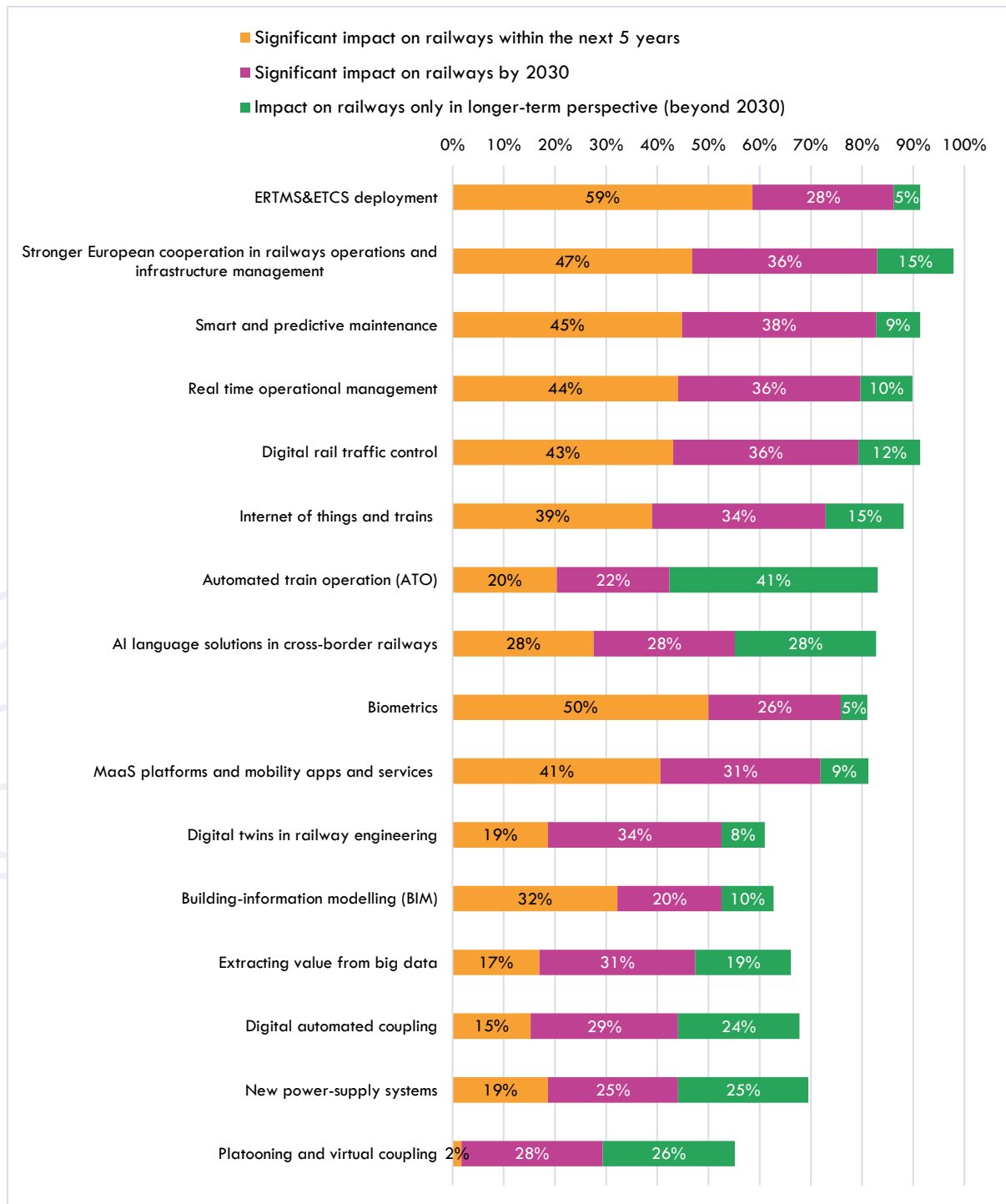
Also, other new technologies and digitalized processes such as biometrics and their deployment in different domains such as biometrics, smart and predictive maintenance tools and processes, Building Information Modelling (BIM) or real-time operational management, MaaS platforms and mobility tools, digital traffic management or connected things and trains (internet of things) are regarded as having a significant impact on railways within the next 5 years.

Remarkably, with the second highest share of 47%, survey respondents also regard “*Stronger European Cooperation in Railway operation and infrastructure management*” having a significant impact on railways within the next 5 years – a direct reference to key STAFFER objectives.

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.

For more details see Figure 7 below.

FIGURE 7: TECHNOLOGICAL INNOVATION AND ITS IMPACT ON RAILWAYS WITHIN THE NEXT 5 YEARS, BY 2030 AND BEYOND (N=82)



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

The following innovations having an important impact were also mentioned by individual participants:

- 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 Railway Mobile Communication System
- System architecture and Conceptual Data Model for railway
- Generally, the capacity of the European railway to take/absorb quicker new technologies, especially digital technology, mainly supported by an evolution towards common and shared technical architectures and data formats
- Improvements in media design and construction of railway infrastructure will lead to faster lines simultaneously operable both passenger trains and freight
- Steering of rail capacity by AI, using algorithms.

However, one survey participant also provided a message of caution, reminding that

“It is important not to forget the experience gained over the past decades. Unfortunately, many things are forgotten, and many innovations cannot be implemented.”

3.2.3 Challenges in the field of HR and workforce planning

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.

To learn more about the most significant challenges, participants in the STAFFER WP 2 survey were asked to choose of 14 challenges those regarded as the most challenging from the perspective of the respective company.

Figure 8 shows the ranking of those challenges that were put on the highest ranks 1, 2 and 3.

The results of responses indicate quite a varied experience of railway companies: While the largest share of respondents indicated that the challenge of increasing the attractiveness of railway jobs is regarded as the most important challenge (31% of respondents placed this item first and a total of 51% placed it in the first three ranks), the ranking of other challenges is less clear.

The following challenges were also regarded as important but much less prominently articulated as the issue of attractiveness:

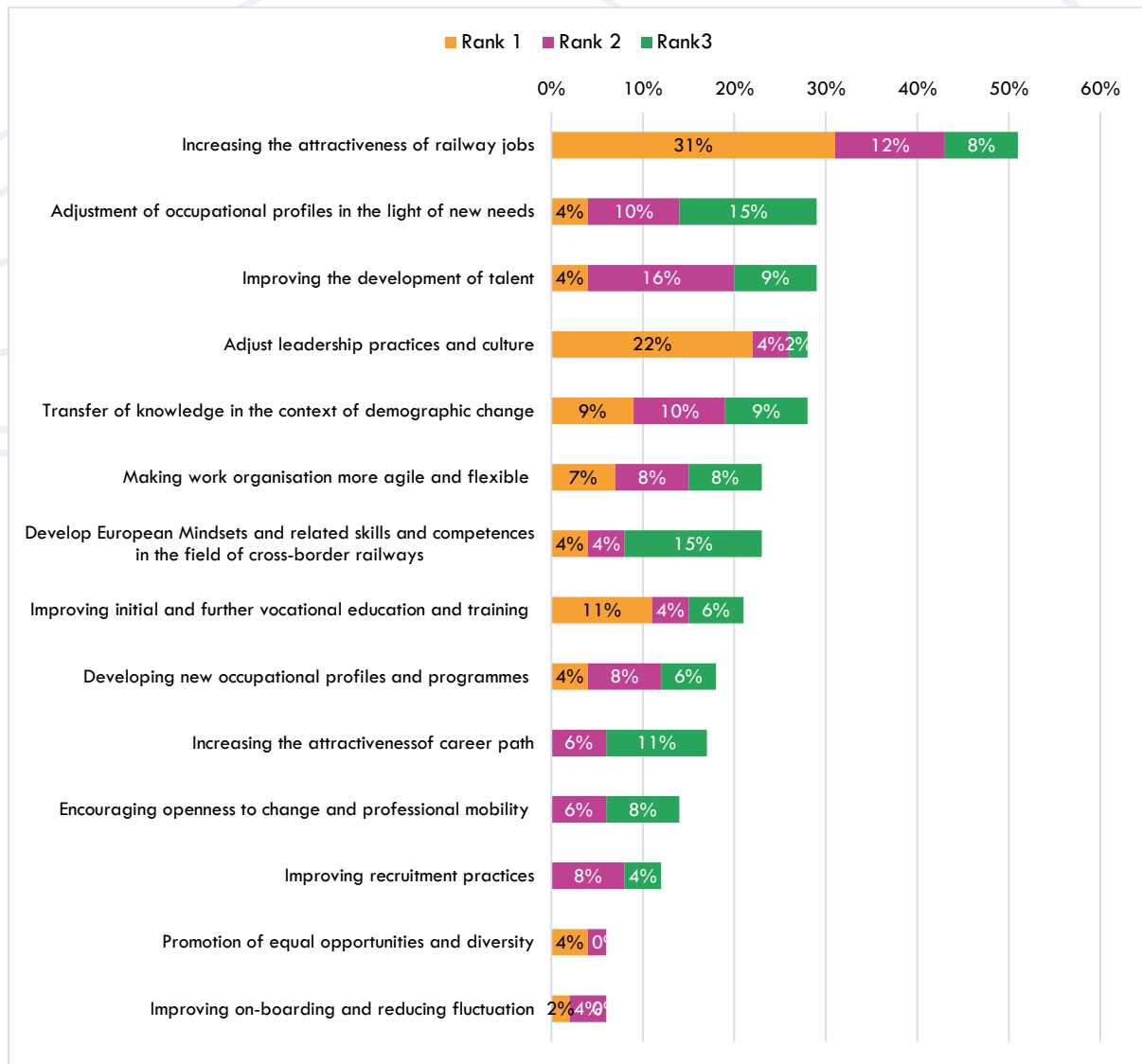
- Adjustment of leadership practices and cultures

- 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

Only 4% of survey respondents indicated that the most important challenges for HR practice would be to develop European Mindsets and related skills and competences in the field of cross-border railways.

Also challenges such as developing new occupational programmes, promotion of equal opportunities and diversity were only indicated by a minority of survey respondents as an important challenge for staff development and HR.

FIGURE 8: MOST IMPORTANT CHALLENGES IN THE FIELD OF HR MANAGEMENT AND STRATEGIC WORKFORCE PLANNING



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

3.2.4 Railway related HR strategies and measures

The survey also included a section dedicated to the current HR strategies and measures in place of railway companies. Respondents were asked to express their level of agreement with several statements that are related to certain challenges and needs.

Results show that some of the challenges seem to be already addressed actively by HR strategies and measures (see Table 2). The highest share of respondents (47%) confirmed that their company has a policy in place that includes measures to increase the attractiveness of railway jobs and careers for women and young people. Also, 45% of respondents indicated that there is a strategy in place that promoted equal opportunities and diversity.

By contrast, there are two areas of HR challenges that according to one third of respondents have not yet been addressed by HR strategies and measures. Both are related to cross-border railways:

- Measures and activities to promote the development of inter-cultural and cross-border competences and mindsets: Only 19% indicated that this is part of the HR strategy but 35% indicated the opposite.
- Initiatives to have first-hand experience for intercultural exchanges, for example geographical mobility or intercompany exchange: Only 12% indicate that this is part of the strategy but 39% indicated the opposite.

TABLE 2: RAILWAY RELATED STRATEGY AND MEASURES – LEVEL OF AGREEMENT WITH DIFFERENT STATEMENTS

	Totally agree	Partly agree	Don't agree
<i>We have defined and already implemented concrete measures addressing new skills needs and competence requirements of the workforce</i>	32%	60%	7%
<i>We have started to develop and establish new occupational profiles in response to new needs related to digitalisation and automation</i>	19%	54%	23%
<i>Our policy includes measures to increase the attractiveness of railway jobs and careers for women and young people</i>	47%	28%	21%
<i>Equal opportunities and diversity are addressed actively by our strategy</i>	45%	46%	4%
<i>Employability, inclusiveness, and an inter-generational approach is a component of our HR strategy</i>	40%	47%	11%

<i>We have taken measures to align corporate culture and leadership with new requirements in railways</i>	25%	55%	13%
<i>Our strategy includes measures and activities to promote the development of inter-cultural and cross-border competences and mindsets</i>	19%	40%	35%
<i>Our strategy includes initiatives to have first-hand experience for intercultural exchanges (for example geographical mobility, intercompany exchange)</i>	12%	46%	39%

Source: STAFFER Survey of Railway operator and infrastructure managers 2021

4 CROSS-BORDER RAILWAYS AND TRANSNATIONAL COOPERATION, LANGUAGE AND COMMUNICATION

4.1 Visions of cross-border railways, language, and communication

Asked about agreement or disagreement with statements regarding cross-border railway, language and communication, between one third and nearly 50% of participants of the survey totally agreed to various measures of promoting cross-border activities (see Figure 9).

Measures that were regarded by the largest shares of participants as having an important impact are

- There is a need to develop common European training modules for operational and infrastructure management staff involved in cross-border railways (49% 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 key to promote cross-border railways (also a 49% share of respondents totally agreeing to this statement).

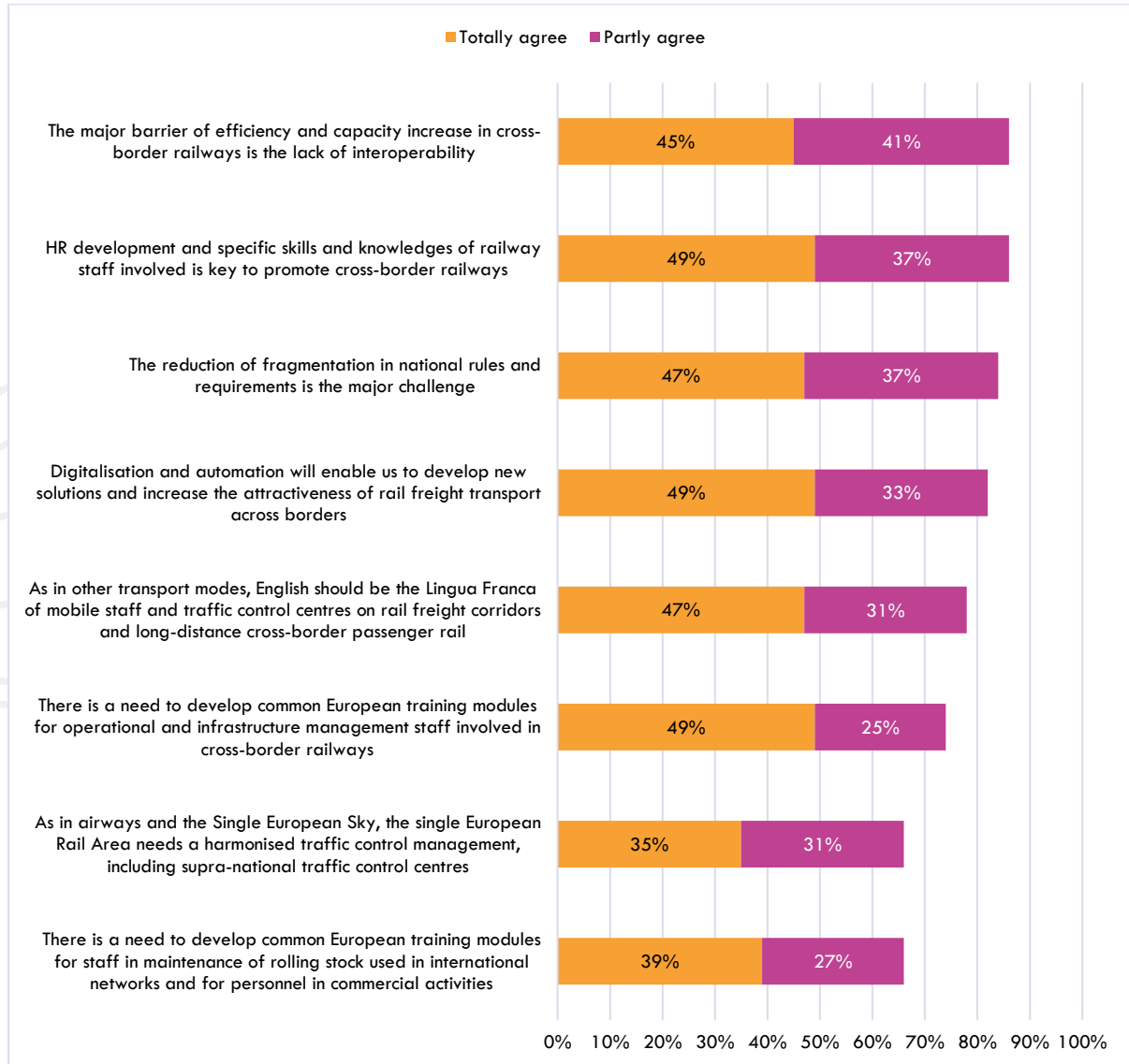
More than 80% of respondents either totally or partly agreed to the opinion that digitalisation and automation will enable the development of new solutions and increase the attractiveness of rail freight transport across borders.

When it comes to language in cross-border railways, also large shares of the survey respondents indicated the need to develop foreign language skills and establish English as the common

language in transnational railways. This vision is shared by 47% of survey respondents and partly shared by 31%. Only 10% disagreed.

Even the vision that as in airways and the Single European Sky, the single European Rail Area needs a harmonised traffic control management, including supra-national traffic control centres was totally shared by 35% of survey respondents and partly shared by 31%.

FIGURE 9: ASSESSMENT AS REGARD TO THE FUTURE OF CROSS-BORDER RAILWAYS, LANGUAGE AND COMMUNICATION

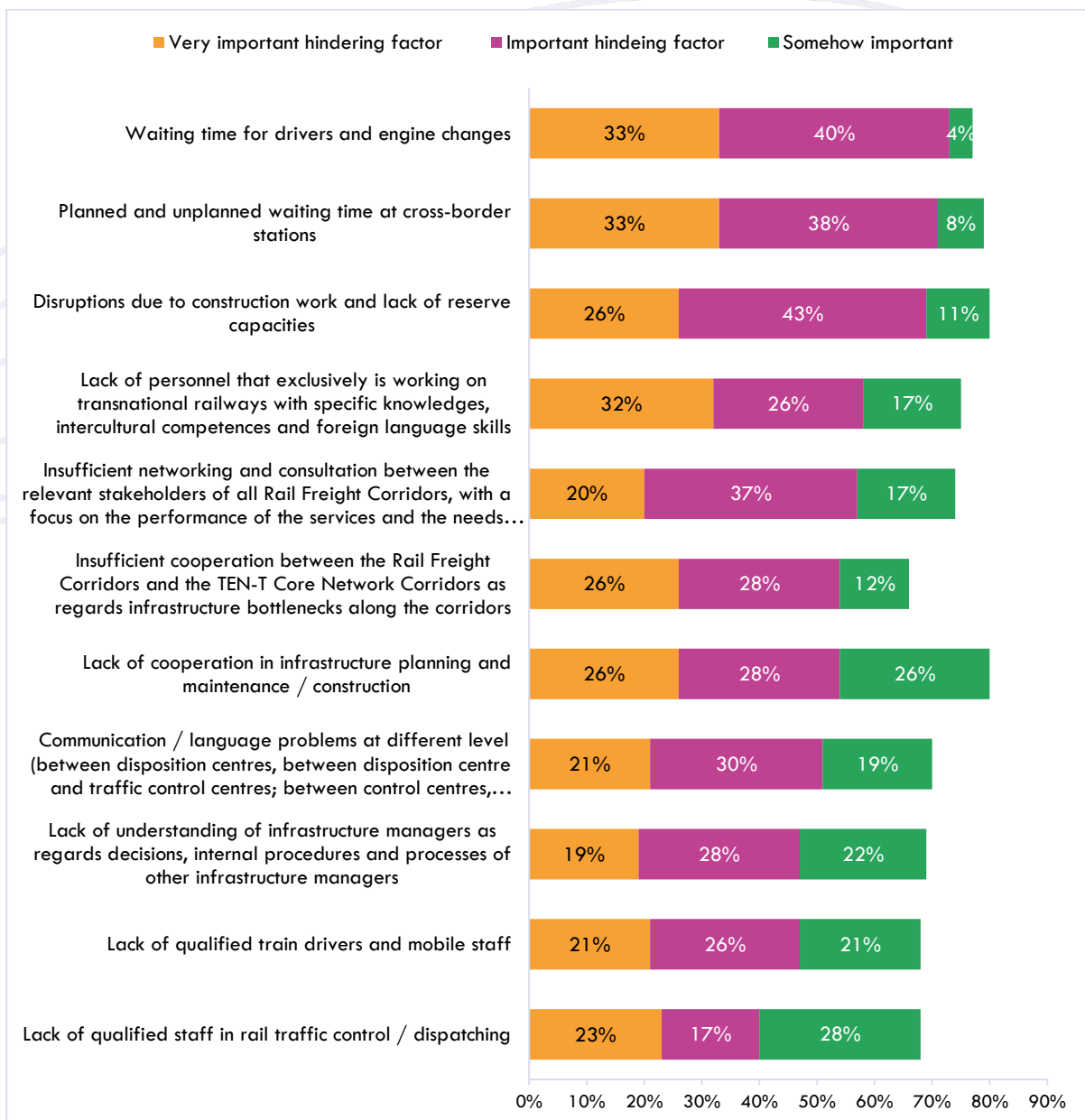


Source: STAFFER Survey of Railway operator and infrastructure managers 2021

4.2 Hindering factors of cross-border railways

As shown in Figure 10, 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. Factors that were regarded as particularly important are waiting time for driver and engine changes at cross-border stations (73% regard this as a very important or important hindering factor) and a lack of personnel that exclusively is working on transnational railways with specific knowledges, intercultural competences and foreign language skills (58%).

FIGURE 10: ASSESSMENT OF HINDERING FACTORS TO THE EFFICIENCY AND ATTRACTIVENESS OF CROSS-BORDER RAILWAYS IN THE FIELD OF PASSENGER AND FREIGHT TRANSPORT

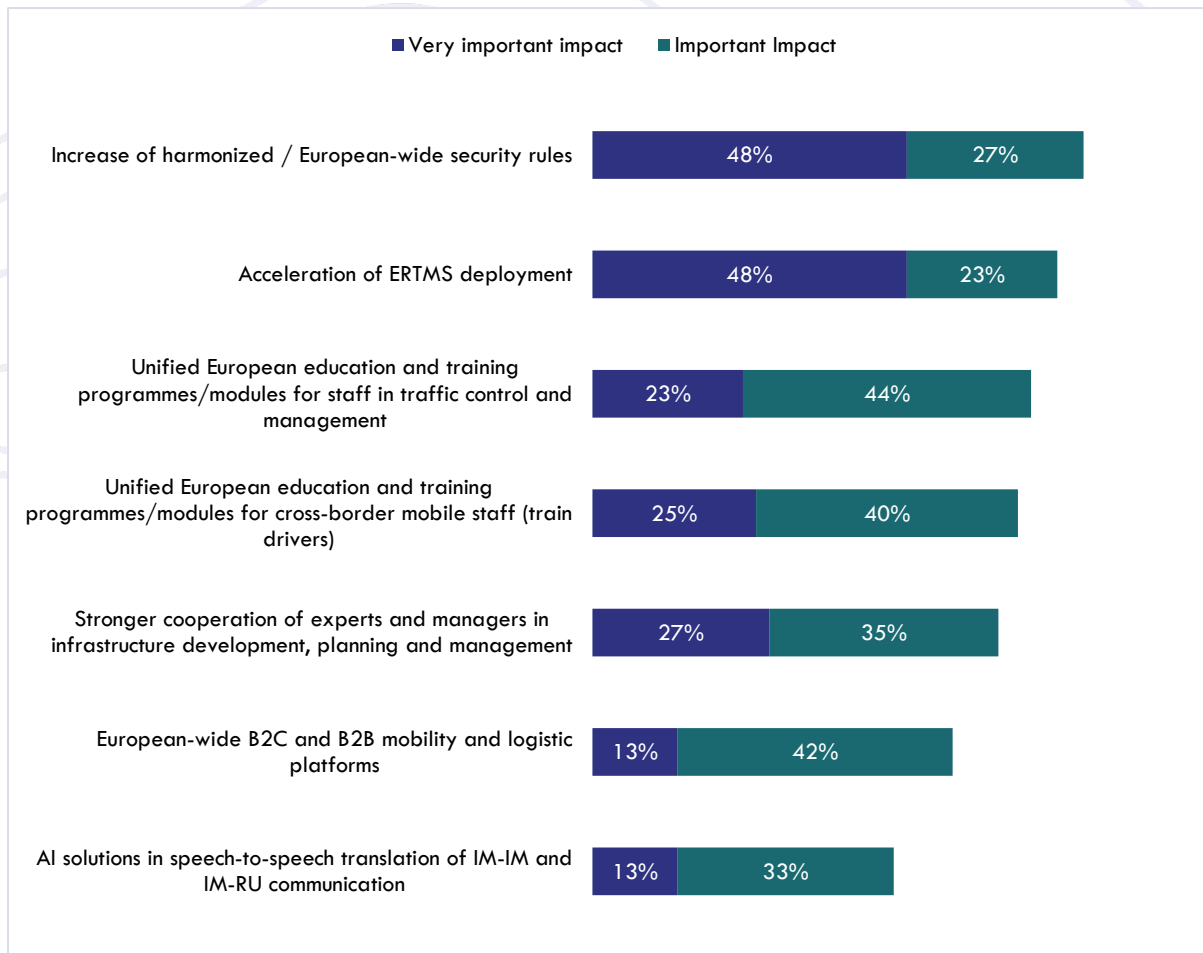


Source: STAFFER Survey of Railway operator and infrastructure managers 2021

4.3 Measures to increase the efficiency of cross-border railway operation

Corresponding to the assessment of hindering factors of cross-border railways, survey participants regarding measures such as stronger cooperation of experts and managers involved in infrastructure development, planning and management as well as unified education and training modules at European level as important (See Figure 11). However, key measures to increase the efficiency of cross-border railways will be to foster European wide, harmonised security rules and the acceleration of ERTMS deployment.

FIGURE 11: ASSESSMENT OF MEASURES TO INCREASE THE EFFICIENCY AND ATTRACTIVENESS OF CROSS-BORDER RAILWAYS IN THE FIELD OF PASSENGER AND FREIGHT TRANSPORT



Source: STAFFER Survey of Railway operator and infrastructure managers 2021



Further measures suggested by respondents (quotes):

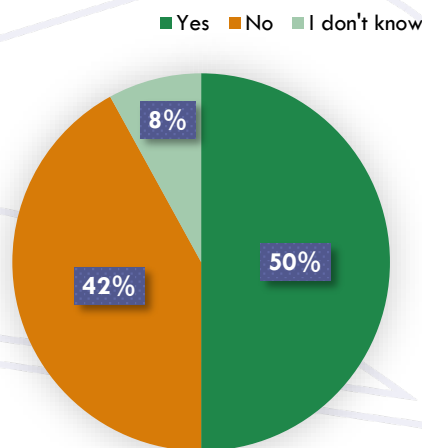
- Concerning the services and sales, promote cross-border travel, offer attractive prices, offer end-to-end routes with other means of transport (multimodal transport)
- In terms of human resources, make future jobs attractive.
- Harmonized technical system for signalling and regulation and operation and control.
- Implementation of cross-management-competences RU - IM. This is a need to know, which processes on RU side and on IM side are essential to work together (i.e. "Wheels-Rails-Complexity").
- The harmonization of rules, technology and signals is an important basis for easy cross-border traffic. Each difference creates an effort in qualification and a potential risk.
- Mobile staff usually only travel between two countries. If a foreign language is required, it should be the language of the country that is being travelled to/visited. This means that one participant always communicates in his or her mother tongue. This offers a higher level of security than communicating in a language that is a foreign language for both parties.
- If automation allows for the efficient concurrent routing of both passenger and freight trains on the same track, then the entire logic behind dedicated corridors would be reshaped.
- Technical solutions addressing gauge differences
- The most important measures are: Increasing of harmonized/ European-wide security rules, stronger cooperation of experts and managers in infrastructure development, planning and management and unified European education and training programmes /modules for staff in traffic control and management.
- Bilingual telephone forms. Instant translation systems in verbal communications by radiotelephony.
- Full implementation of Digital capacity management, TTR
- Digital Platforms

5 EXPERIENCES AND REQUIREMENTS OF TRANSNATIONAL COOPERATION

The WP2 survey has gathered valuable information on current and past experiences of railway undertakings in transnational cooperation (as regards railway education and training but also other HR and technology fields) against the background of around half of respondents indicating that they have some experience of involvement in transnational cooperation projects (see Figure 12).

This information is not presented in detail in this report but will be presented in the context of the WP 2.2 report in relation to recommendations and concrete ideas on needs as regards mobility and exchange of different groups of railway staff as well as education and training in transnational and cross-border railways operation and infrastructure management.

FIGURE 12: HAVE YOU BEEN OR ARE YOU CURRENTLY INVOLVED IN ANY TRANSNATIONAL COOPERATION PROJECTS?

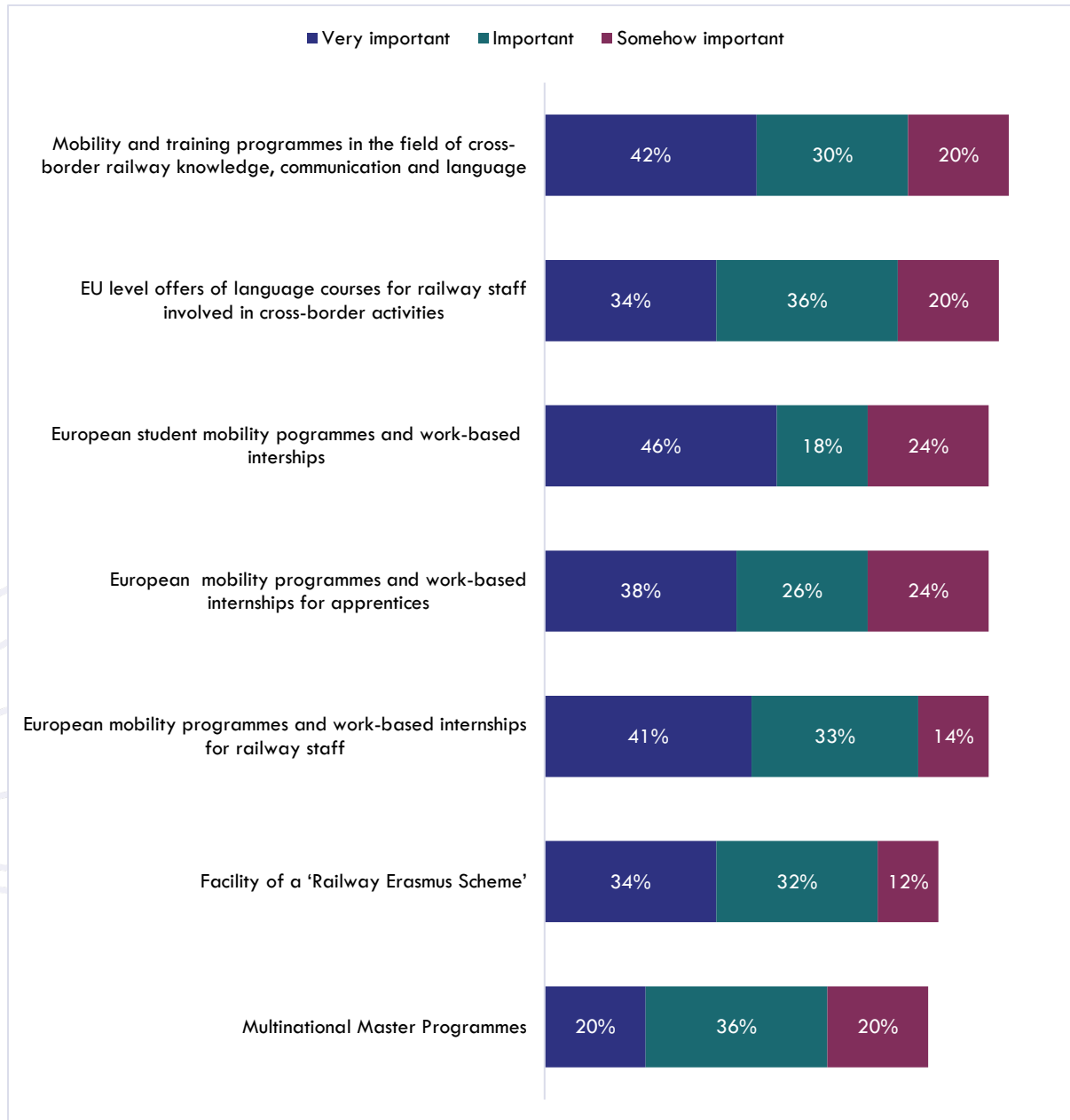


Source: STAFFER Survey of Railway operator and infrastructure managers 2021

However, already at this stage and as shown in the Figure 13 below it can be stated that high shares of survey respondents agree with key ideas and proposed activities of the STAFFER consortium regarding fostering more transnational exchange and mobility such as internships, staff exchange as well as developing EU level offers of foreign language training or multinational master courses.

More qualitative results of the survey (feedback on open questions) and results from follow-up interviews will be included in the WP2.2 report.

FIGURE 13: 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 Survey of Railway operator and infrastructure managers 2021

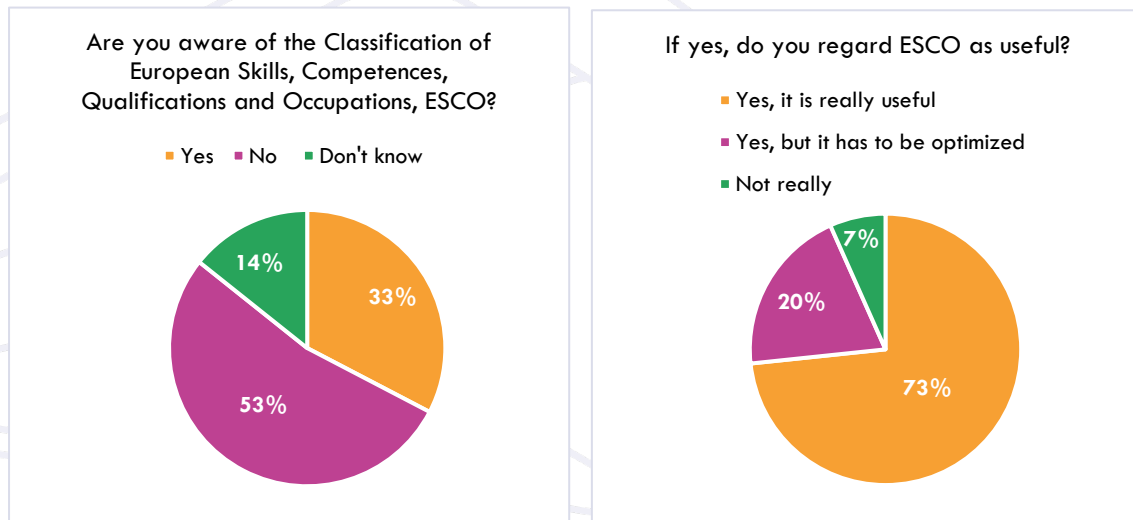
6 RAILWAY SPECIFIC OCCUPATIONAL PROFILES, SKILLS AND COMPETENCE NEEDS

6.1 Knowledge of and assessment of the ESCO Classification of Skills, Competences and Qualifications

When reflecting on the relevance of the ESCO classification for railway operators and infrastructure managers it is important to note that only a minority of one third of survey respondents indicated to know about the European Classification (Figure 14).

Three quarter of those who are aware of ESCO designate it as useful. A further 20% think that it is useful but requires certain improvement (Figure 14).

FIGURE 14: AWARENESS OF ESCO AND ASSESSMENT OF USEFULNESS



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

The following qualitative assessments as regards ESCO should be mentioned here:

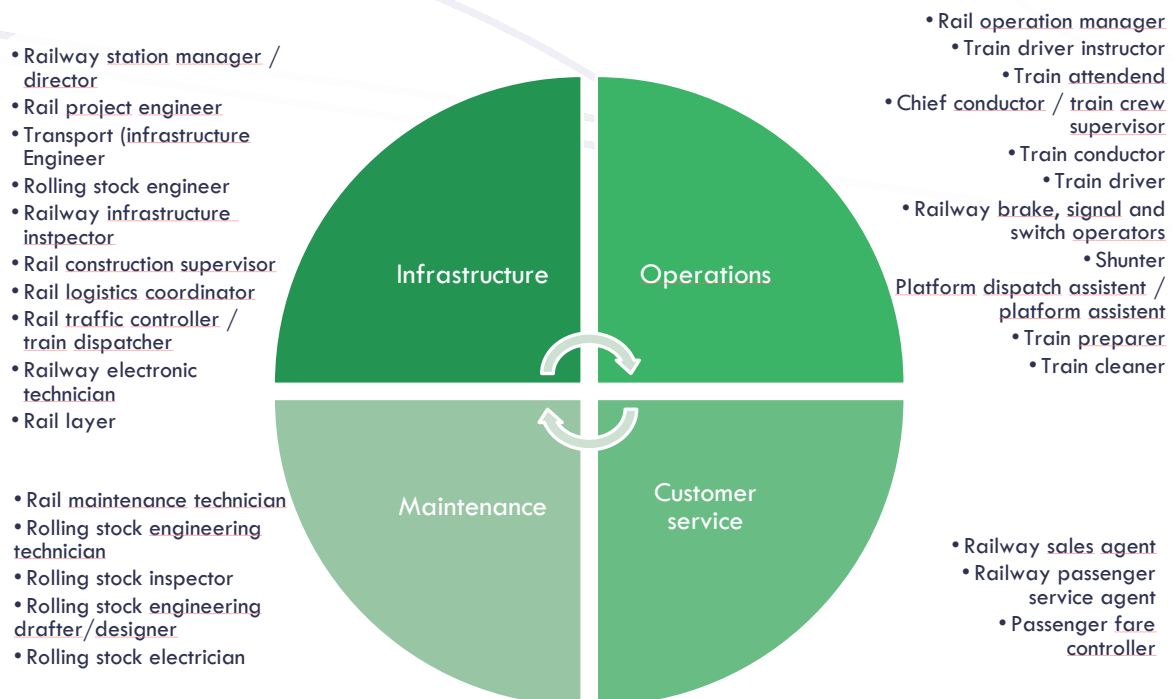
- ESCO can be useful if it is well applied and can contribute to more harmonised occupational profiles.
- ESCO offers the possibility to compare a position from one company to another, thus avoiding that the titles prevent one from understanding that it is in fact the same function.
- We think it contributes to harmonise rail culture in Europe.
- ESCO is indeed useful although the level of detail of profile description might require more depth.
- Useful for skills and competences but maybe not enough for education requirements.

- Sometimes, the occupation is much too generic, on the other side, there are some “micro”-occupations which are not very relevant as a railway occupation.
- ESCO is useful but a higher level of detail should be adopted.
- It is useful but it requires additional training to be used.
- The list of ESCO professions follows a different logic as compared to the definition of professions in the railway sector.
- ESCO does not adequately address variety of jobs in or related to railways. Hard to unify, as specifics differ widely due to national traditional career paths.
- There is a lack of many railway jobs that correspond to the reality that is experienced on the field.
- The definitions of the trades are very old and need to be updated.
- Mistakes (sometime significant) in the translation in different languages.

6.2 30 ESCO occupational profiles related to railway operation and infrastructure management

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).

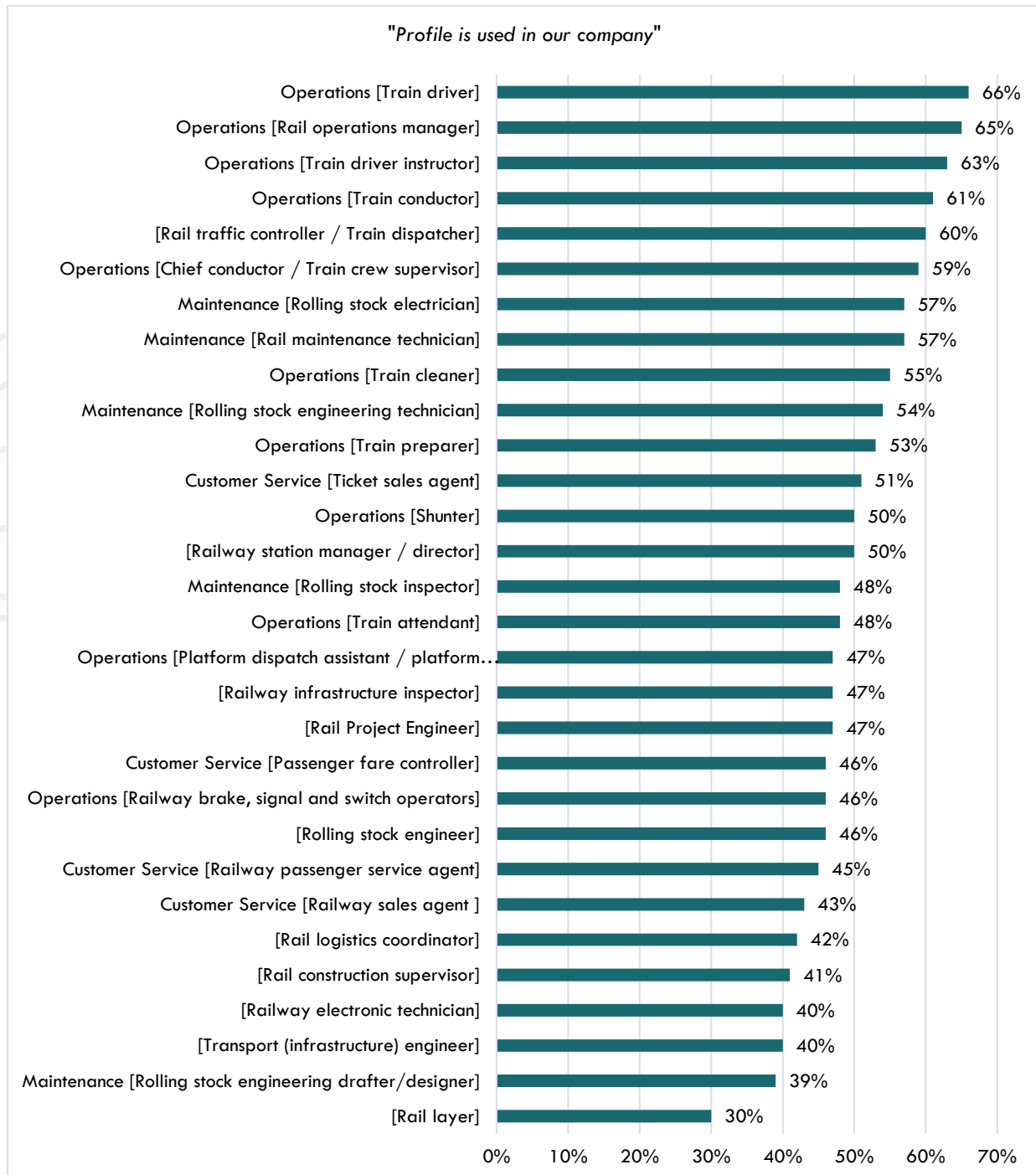
FIGURE 15: IN ORDER TO PROMOTE AND FOSTER THE ESTABLISHMENT OF A EUROPEAN RAILWAY AREA AND TRANSNATIONAL MOBILITY IN RAILWAYS, HOW IMPORTANT ARE THE FOLLOWING TYPES?



6.3 Relevance of ESCO occupational profiles

Based on these occupational profiles that are described in the ESCO database of the EU Commission in terms of skills, knowledge, and qualification requirements the WP 2 survey provided an opportunity to ask railway practitioners and experts about the relevance of such profiles for their own practice in the own company and whether such profiles match the company's own classification of occupational profiles, positions and/or functional groups.

FIGURE 16: RELEVANCE OF ESCO PROFILES FOR RAILWAY UNDERTAKINGS



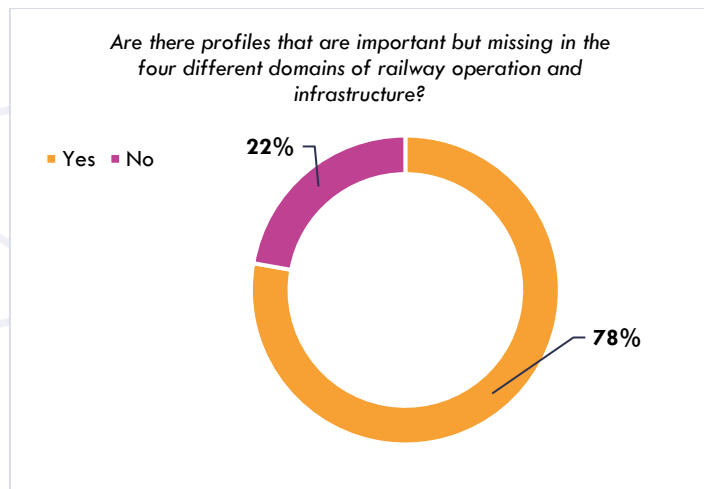
Source: STAFFER Survey of Railway operator and infrastructure managers 2021

As regards the relevance of the 30 occupational profiles and as shown in Figure 16, the share of respondents who indicated that a respective profile would also be used in the own company varied between only 30% (rail layer) and 66% (train driver). By contrast, between 9% of respondents (regarding occupations such as rail project engineers, rail traffic controller/train dispatcher, railway electronic technician, train driver, shunter, rail maintenance technician) and 22% (passenger fare controller)

stated that the profile is not used in the own company. These profiles are possibly not used because they do not match the profile of the specific activity of the company.

Furthermore, nearly 80% of survey participants stated that there are occupational profiles that are not included in the ESCO list yet but are relevant for the railway undertaking in different domains (see Figure 17).

FIGURE 17: MISSING PROFILES THAT ARE RELEVANT FOR RAILWAY UNDERTAKINGS' PRACTICE



Such occupations are often ones that also exist in other sectors but may also be railway specific.

Examples mentioned by survey participants include:

- Railway doctors
- Managers, technicians, designers concerning the design of infrastructure
- Design engineer in infrastructure and systems
- Infrastructure project manager
- Railway design engineer
- Research and development engineer
- Asset manager
- Real estate and facility manger
- Rail instructors
- Movement inspector⁶

⁶ The following clarification was presented in the response: “who regulates train traffic; supervises and controls the work of personnel in charge for shunting and the correct composition of the train; plans and monitors the execution of the train traffic plan and gross routing; performs transport, commercial and wagon services; coordinates work with all services in the station and with the operations department; performs tasks and duties within its professional and health capabilities arising from the contracts that the infrastructure manager has with railway undertakings and third parties; performs other tasks.”

- Occupations and profiles in the planning and administration of transport (e. g. at federal or regional authorities planning and contracting passenger services, railway service planners at RU, railway engineers at authorities alike EBA, ERA etc. issuing permits for technologies, projects, qualifications ...). These profiles resonate with counterparts at IM and RU and suppliers and require similar expertise. For a "healthy" relationship flexibility of staff should be supported.

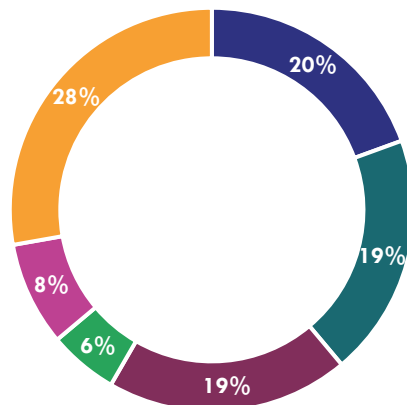
6.4 Railway companies' own experience of occupational profiles

Railway undertakings in practice work with quite different approaches in relation to the description, definition, and demarcation of occupational profiles. This reflects not only company specific requirements but also the differences in national systems of vocational education and training at all EQF levels.

Figure 18 shows that more than 40% of participants in railway undertakings reported in the context of the survey that in their companies more than 100 occupational profiles exist. Of these, nearly 30% stated that there are even more than 200 occupational profiles. By contrast, only 19% of respondents reported that there are less than 20 occupational profiles in place.

FIGURE 18: NUMBER OF OCCUPATIONAL PROFILES RAILWAY UNDERTAKINGS HAVE DEFINED AND DESCRIBED IN THEIR COMPANY

■ unter 20 ■ 20-50 ■ 51-100 ■ 101-150 ■ 151-200 ■ über 200



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

This variety of developing and working with occupational profiles illustrates the challenges when developing a more unified or even more harmonized approach of a European classification system.

6.5 New occupational profiles developed in the past five years

In the light of digitalisation and automation, the development of new services, or driven by other factors, new occupational profiles may have been developed in railway operation and infrastructure management.

As the overview in Table 3 shows, most of the new occupational profiles were developed in the field of IT and digitalisation across the different domains of railway undertakings, including infrastructure. Please note that the overview also includes new educational programmes and modules in the field of apprenticeship and higher education.

TABLE 3: NEW OCCUPATIONAL PROFILES DEVELOPED DURING THE LAST 5 YEARS

Railway domain	Occupational profile
Information technology and digitalisation	<ul style="list-style-type: none"> • IT and physical security • Software application development / coding • Big data analyst • Digital project manager • Digital transformation manager • Digital learning manager • Digital learning specialist/consultants (AI, AR, VR, etc.) • Virtual learning developer • Cybersecurity specialist • Marketing automation
Customer relations and operations	<ul style="list-style-type: none"> • Customer relations manager • Sales specialists
Maintenance and infrastructure	<ul style="list-style-type: none"> • Infrastructure maintainer • Vehicle maintainer • Maintenance technician • Production technician • BIM Specialist • BIM Manager • BIM Coordinator
Others	<ul style="list-style-type: none"> • Change manager • Innovation program manager • Revenue and yield management • Competition law experts
Education and training programmes	<ul style="list-style-type: none"> • Apprenticeship programme coding • New education module “Digitization in Railways” (Bachelor / Master Program, post-graduate training course, post-graduate training course)

Source: STAFFER Survey of Railway operator and infrastructure managers 2021



7 SKILL SHIFTS IN THE LIGHT OF TECHNOLOGICAL TRENDS AND INNOVATIONS

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 skills needs and skills shifts in the light of technological trends and innovations.

The following results should be highlighted at this stage (see Figure 19):

A large share of respondents indicated that they are not able to answer this question (with shares per occupation ranging from 25% for train drivers to 50% for passenger fare controllers). Of those who provided an assessment, only a very low share of respondents thought that the current skillset will remain the same (0-2% in most occupations to 9% as for the train crew supervisor). Only minor needs as regards new skills development are expected also for only quite a few occupations, e.g., train conductors, sales agents, infrastructure supervisors, construction supervisors.

This corresponds to some occupations where respondents expect no major needs in terms of new skills that must be added to the occupational profile. Such occupations are those in various domains with a comparatively low educational and training qualification level, e.g., train cleaner (only 7% of respondents expect major new skills needs), platform assistant (7%), shunters (7%) or rail layer (7%). Similar low shares of major new skills needs are expected for passenger fare controllers (only 8% expect major new skills needs) and railway sales agents (9%).

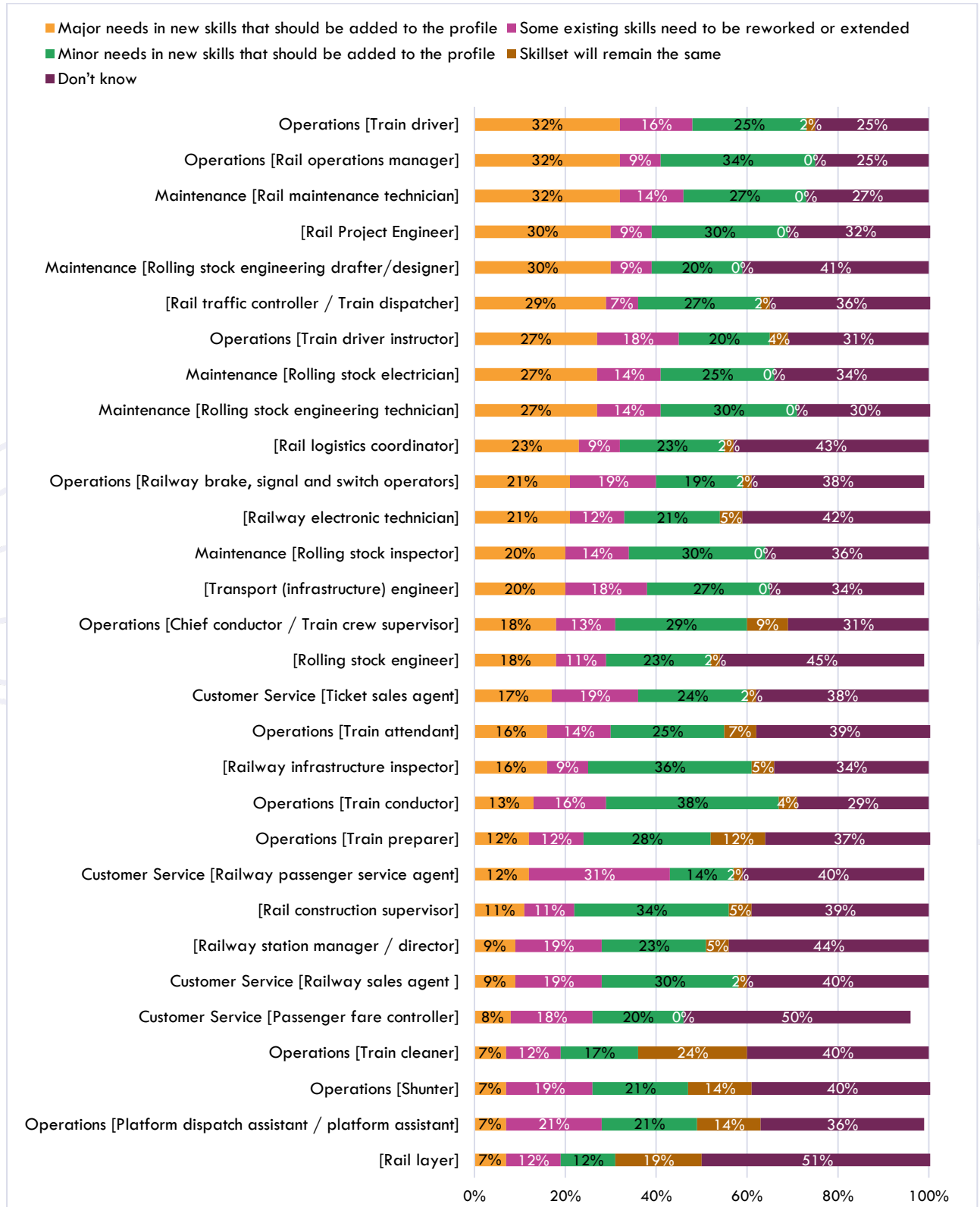
By contrast, technical and engineering occupations with a comparatively high level of qualification and corresponding EQF levels were highlighted by survey participants as those with major needs for new skills to be added to the respective occupational profile. Such profiles are:

- Rolling stock engineering drafter designer (30% expect major new skills needs)
- Rolling stock technicians (27%)
- Maintenance technician (32%)

Major skills needs are also indicated by around one third of survey participants for rail operations managers and rail project engineers. However, an important result of the survey is also that a high share of survey respondents (32%) also stated that there is the need to add major new skills requirements to the occupational profile of the train driver (as well for the train driver instructors).

A comparable high share of respondents (29%) has the same feeling when it comes to the occupational profile of the rail traffic controller / train dispatcher.

FIGURE 19: CONSIDERING THE TECHNOLOGICAL TRENDS AND INNOVATIONS, PLEASE INDICATE PER OCCUPATIONAL PROFILE YOUR ASSESSMENT AS REGARDS SKILL-SHIFTS



Source: STAFFER Survey of Railway operator and infrastructure managers 2021

This illustrates quite nicely that the 3 occupational profiles that were selected for the WP 2.2 task works (train driver; traffic management and control; occupational profiles in maintenance and infrastructure, including engineering occupations) seem to be highly relevant not only in view on transnational railways but also in relation to skills needs and future occupational profiles.

8 CONCLUSIONS AND OUTLOOK

This report should be regarded as a first important output of the STAFFER WP2 which is looking into major trends, challenges, and innovations as well as related needs and requirements in transnational railway operation and infrastructure management.

Such needs and requirements are closely linked to technological innovations, digitalisation as well as trends and challenges related to policy demands (decarbonisation, Green Deal targets, modal shift in freight, etc.) in railways that will impact significantly on all relevant domains and future skills requirements.

Here, the 2.1 report confirms findings that can also be found in the WP 3.1 report (i.e., from the perspective of the rail supply industry) as regards the impact of new technologies and digitalisation on occupational profiles (both existing as well as new emerging profiles) as well as the need to invest more in transversal skills such as problem solving or communication skills.

However, the report has shed also a first light on nuances and differences of areas that are affected or will be affected more than others from the perspective of railway operators and infrastructure managers.

While this report presents only initial findings of skills shifts and new skill requirements as regards a larger sample of occupational profiles (based on the ESCO classification), the continuing work in WP 2 will provide a more in-depth analysis of the WP 2 survey results as regards skills shifts and future occupational profiles, focussing on the three selected profiles of the train driver, profiles in traffic management and occupational profiles in infrastructure and maintenance, including engineering profiles. This analysis certainly will be complemented by follow-up interviews to the survey (which also is a unique source for direct contacts to experts at company level in around 30 different railway operators and infrastructure managers in 19 European countries) as well as own input from the WP 2.2 co-leader DB.

However, this report has also shown that from the perspective of railway operators and infrastructure managers as well as further stakeholder such as railway related academic research and employer organisations, the foreseen activities in the context of the STAFFER project concerning transnational railway operations and cross-border corridors, measures



focussing on language, communication exchange of mobility and staff and stronger cooperation in transnational railways and other measures are highly relevant from the perspective of company level leaders, managers and experts.

