Socio-economic aspects of human capital:

Assessment of the state of play in employment in the railway sector

Human Capital Report Series

TNO innovation for life

Shift2Rail
Moving European Railway Forward

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Summary

The goal of the report is to assess the current skills for different categories of railway staff, from workers to engineers, railway managers and researchers (task 1). The study on socio-economic aspects of human capital starts with assessing the state of play regarding present employment situation considering work already done on forecasts for human capital in the railways, differentiating between different European regions. The following questions are central:

- What is the current employment level in the EU-railway sector?
- Can these figures be differentiated at the level of four regions/clusters?
- What is the distribution of employment according to job category and skill level?
- What are drivers for change in skill use? To what degree do working conditions play a role?

Current employment level

According to the Eurostat Labour Force Survey (LFS) 2016, the current level of employment is 817,752 persons working in the following four NACE-sectors:

- 30.20 Manufacture of railway locomotives and rolling stock (7%);
- 42.12 Construction of railways (NACE-3: 421 Construction of roads and railways) (48%);
- 49.10 Passenger rail transport, interurban (ISIC 49.11) (35%);
- 49.20 Freight rail transport (ISIC 49.12) (9%).

Over the period of five years, employment in the sector seems to have declined with more than 60,000 persons, a drop of nearly 7%. The report provides overviews of employment in four major railway companies in Europe: SNCF, DB, NS and Network Rail. A further differentiation of the Eurostat figures to two regions in Europe was done: Germany, Netherlands, France and UK (the so-called core-countries) were compared to all the other countries in Europe. This comparison reveals that the core-countries show stable employment levels, and also a higher level of employment in managerial, engineering and technical jobs in comparison to other countries.

Skills distribution

In the project, the ISCO-distribution for occupations has been used. The classification is quite abstract. To make the distribution somewhat more understandable, the following jobs should be associated with the occupational titles:

- Senior managers: for example, rail operations manager;
- Professional engineers: for example, mechanical engineer;
- Technicians and associate professionals: for example, dispatcher;
- Clerical support workers: for example, railway sales agent;
- Service workers and sales workers: for example, train attendant;
- Craft and related trades workers: for example, rail switch person;
- Plant, machine operators: for example, train drivers;
- Elementary occupations: for example, cleaning personnel.

Table 1 provides an overview of the current skills distribution according to occupational category.

Table 1 Trend 2012-2016: development over time of skill distribution within the professional groups

2012-2016: trend	ISCED 0-2	ISCED 3-4	ISCED 5-6
Senior managers	-10%	+5%	+5%
Professional engineers	0%	-1%	+2%
Technicians and associate professionals	-1%	-3%	+4%
Clerical support workers	-1%	-4%	+5%
Service workers and sales workers	-5%	+5%	-3%
Craft and related trades workers	-4%	+2%	+2%
Plant, machine operators and train drivers	-3%	+1%	+1%
Elementary occupations	-3%	-4%	+6%

The following results are of importance in analysing the skills distribution and development:

- There is a clear upskilling tendency visible in all railway jobs towards ISCED5-6 (academic level), but mainly in higher jobs such as professionals, technicians and clerical support workers. In more basic jobs, job requirements also appear to have shifted upwards, but more to middle educational levels;
- Most of the employees need at least middle level of educational degrees to get recruited and to perform their jobs;
- The CEDEFOP ESJS-survey adds to this picture that educational requirements may be on the rise in these higher jobs, but that employees experience that requirements in work itself may not be rising. Rising recruitment levels seem not connected to changes in job content. The figures do not allow to say if future changes may require higher job levels. The OECD PIAAC-survey confirms this result in the sense that current requirements to work in a job have risen over time. Most employees find that these requirements are needed for the jobs, but an important group of railway employees also find they are overqualified for their jobs;
- Both surveys PIAAC and ESJS allow overviews of different types of skills needed for occupations (technical, communicative, social, organisational skills). The ESJS results do not show major distinctions in skills profiles between occupational groups, which would mean that all jobs require a considerable amount of skills. The PIAAC results show more differences between jobs, with more technical and organisational skill requirements for management and top-professional categories.

Working conditions

A separate analysis was taken up on the drivers of skill changes. The railway sectors have always been a demanding sector to work in. The figures of this research confirm this. The only working condition that is markedly better than other sectors, is the training opportunities/effort.

Foresight and forecasting studies

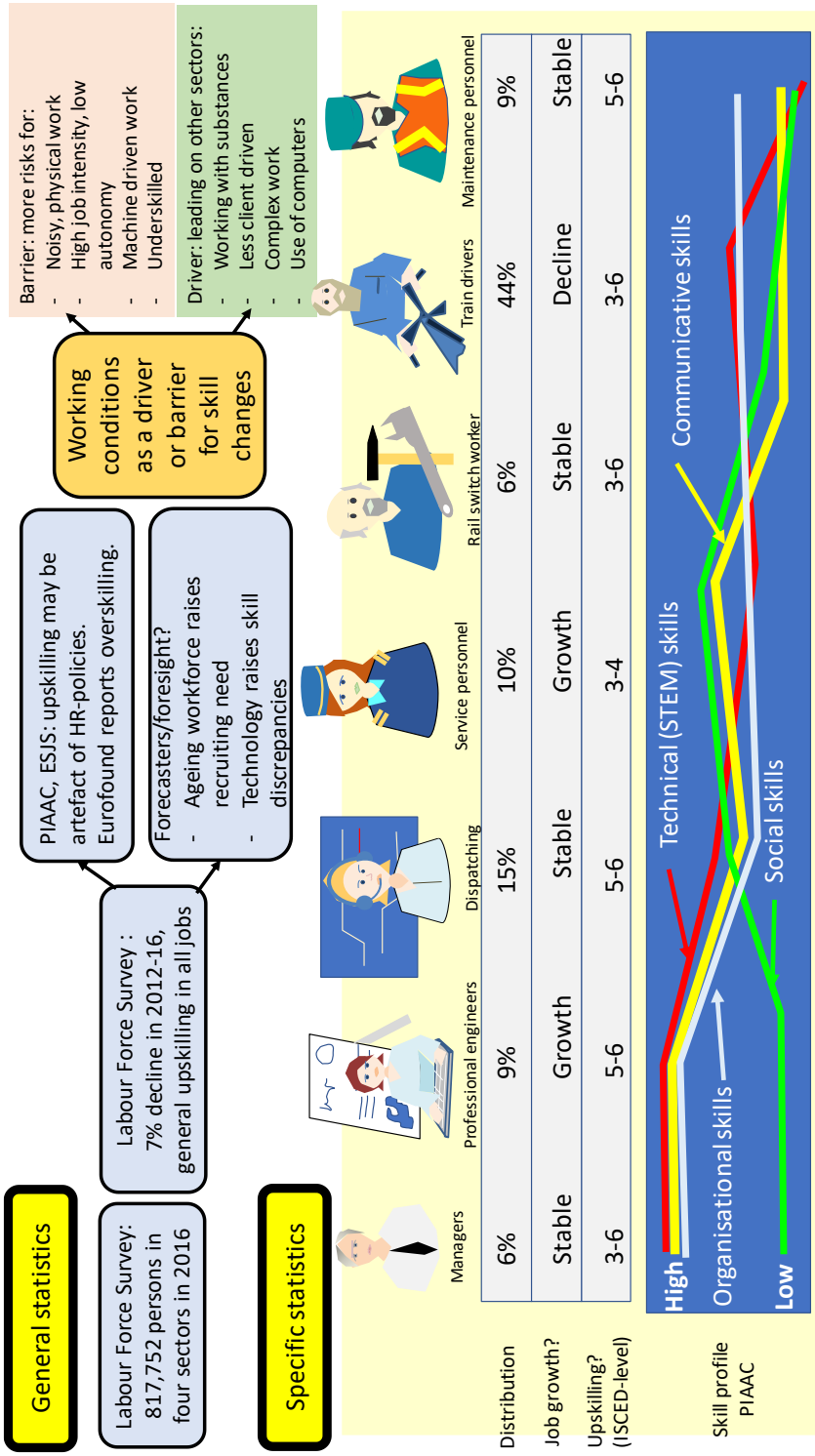
This report analyses a great number of foresight and forecasting studies on employment. The main conclusions from these reports are:

- Employment levels will continue to decline until the end of this decade. After this decade, new growth is foreseen;
- Skill levels should be rising, mainly because of technological demands. The sector will see great skill discrepancies, mainly caused by an ageing workforce;
- Solutions to deal with these skill discrepancies are seen in more training and in shifting employment practices.

In report D1b, the outcomes of these foresight and forecasting studies have been compared to the opinions of experts. The forecast studies show clear discrepancies with the actual

tendencies in employment and skilling. The foresight workshop is needed to explain this difference in outcome.

In the following figure, the main results have been summarized.



Summary of main results

Contents

1 Introduction

1.1 Context

Shift2Rail Joint Undertakings (S2R JU) has asked TNO and NewRail to assess the state of play regarding present employment and skills situation in the railway sector. Currently, there does not exist a clear and fully accepted figure for the actual employment in the railway sector. The complication to generate such a figure stems from the low number of major railway organisations in each country, that leads to the difficulty to collect from and present data by statistical agencies. As Christidis et al. acknowledge: *"Due to confidentiality considerations, Member States providing the micro-data of the LFS do not allow publication of direct estimates if the number of responses is lower than a given threshold to avoid any possibility of reconstructing the database or identifying the respondents in any way."*. Further, the fact that the railway sector overlaps different statistical categories (construction, machine building, passenger and freight transport), makes it hard to precisely calculate the actual employment. All figures about employment remain therefore an estimation of the real employment. To illustrate this point, the Rail Market Monitoring Study (RMMS) conducted by the European Commission (2016) points at the total of 900,000 employees in the European rail. In the figures underlying this estimate, two figures are available: 450,000 and 900,000. The figure of 450,000 seems better underpinned than the 900,000 employees. Christidis et al. (2014) use this second figure in describing the long-term employment trend: *"total employment amounted to 2 million in 1990, dropped to 1.35 million in year 2000, and continued the fall to about 900 thousand in 2010, according to EUROSTAT data"*. For this S2R JU-study, this complication makes it difficult to come up with a precise estimate of employment in the railway sector. Therefore, in this report, we will be pointing out different figures. Each time, we will refer to the precise source for the figure.

1.2 Objective of the report

The objective of the analysis in this report is to assess the current employment and skills situation for different categories of railway staff, from workers to engineers, railway managers and researchers (task 1). The study on socio-economic aspects of human capital starts with assessing the state of play regarding the present employment situation considering work already done on forecasts for human capital in the railways, differentiating between different European regions. This report is the basis for task 2, on assessing new skills required for the long-term rail transport.

1.3 Research question

The main question for this report is what is the current distribution of skills levels for different railway staff categories? The sub-questions are:

- What is the current employment level?
- Can these figures be differentiated at the level of four regions/clusters?
- What is the distribution according to job category and skill level?
- What are barriers for change in skill use? To what degree do working conditions play a role?

1.4 Overview report

This report contains:

- Presentation of the used methodology;
- Overview of sources used for the report;
- Statistics for employment levels in railway sector;
- Statistics of the four regions/clusters;
- Current number of employed staff per selected category and skill level;
- Analysis of forecast/foresight studies on skills.

Estimates of employment in the railway sector will be provided for the whole of Europe, showing the current state of play of staff categories divided according available occupational category (ISCO) and educational level (ISCED-categories).

2 Methodology

2.1 Introduction

The main challenge for this project is to find reliable data on personnel working in the railway sector. In looking at the different studies available (see further Section 6) with data on the railway sector, very different approaches have been used. For this report, we have made some specific choices in how we look at skills and at skills development. We use a multi-source approach and a combination of several methods to select the right personnel categories for estimations. We start with an overview of the procedure to assess the skills.

2.2 How to look at (future) jobs and skills?

2.2.1 How to assess skills?

We analyse human capital requirements in jobs using the current standards in the field. These requirements will be deducted from educational level and job classification. Two standards are important:

1. Classifying jobs and activities according to educational level: we will start with classifying current jobs in the railway sector according to the International Standard Classification of Education (ISCED), the European Qualifications Framework (EQF)[1] and to standards used by CEDEFOP, the European agency for skills research[2]. The EQF is the standard for other qualifications frameworks, such as the (UK) National Qualifications Framework (NQF). Figure 2.1 shows the NQF-levels used in the analysis of skill development in the British railway system by NSARE (NSARE, 2013). We will frame our questions using these standards. In our interviews (and workshops), we will be asking our interviewees to rate jobs/tasks according to these frameworks. In looking at surveys, we will be looking at how the educational levels are used: in practice, we see that ISCED is the most common used standard. This approach of analysing jobs using educational level is used for example in the H2020 SkillFul (EU) project. For our data, we need to understand what the statistical and research agencies allow us to use as information.

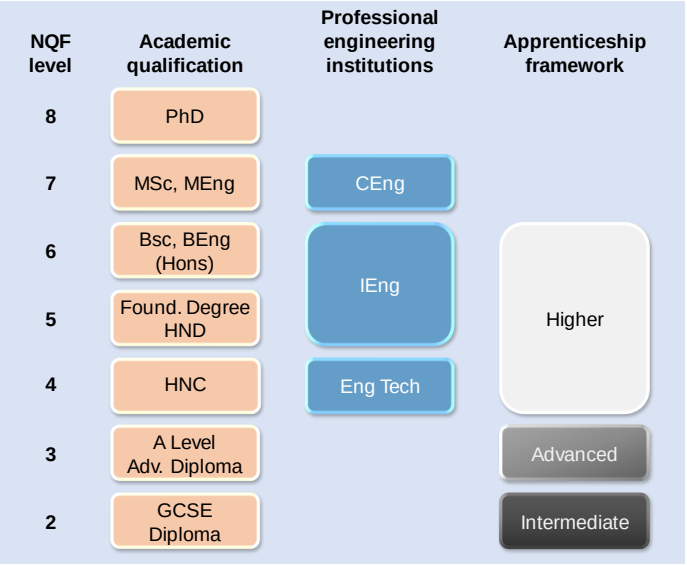


Figure 2.1 NQF levels for academic qualifications, professional engineering institutions and apprenticeship frameworks

[1] https://ec.europa.eu/ploteus/content/descriptors-page.

[2] http://www.CEDEFOP.europa.eu/en.

2. Classifying jobs according to job classification: what we need to understand is the new skill levels of the jobs (including new behaviour and communication requirements), but also the demands for knowledge beyond the railway sector. The ISCO-classification (International Standard Classification of Occupations) already shows, at the 4-digit level, more than 180 job titles in railway transport. The European translation of this ISCO-classification is ESCO.[3]

For the socio-economic context analysis, we will classify jobs according to the two classifications (ISCED/EQF and ISCO/ESCO). Figure 2.2 shows how jobs in an ISCO-approach could be rated according to the ISCED. We will finalise the classification through discussing it with company representatives and other experts. This approach allows us to see that (for example) a management job may cover four levels in the ISCED-classification, as shown in Figure 2.2.

Job classification (~ISCO)	ISCED-level 0 - 2	3 - 4	5 - 6
1 Senior manager		X	X
2 Professionals		X	X
3 Technicians		X	
4 Clerical support workers	X	X	
5 Service and sales workers	X	X	
6 Craft and related trades workers	X	X	
7 Plant, machine operators and train drivers	X	X	
8 Elementary occupations	X		

Figure 2.2 Estimation of ISCED-skill level of certain (railway) jobs, classified according to ISCO (example)

2.2.2 *Net changes in skills levels*

Measuring skills requires a standard approach to calculate net-changes between skills levels. The approach used by NSARE (2013) is a helpful point of reference. The NSARE skills forecasting model looks at the number of people needed each future year for certain jobs or activities (classified according to the methods above), compares the numbers to the previous year's requirements and then estimates the 'gap' or 'surplus'. For Year 1, the required workforce is compared to the current workforce. The model then adds the additional people required to fill gaps left by retirees and other leavers to give an overall resource 'gap' or 'surplus', by

Job classification (~ISCO)	ISCED-level 0 - 2	3 - 4	5 - 6
1 Senior manager			X
2 Professionals			X
3 Technicians		X	X
4 Clerical support workers		X	
5 Service and sales workers		X	
6 Craft and related trades workers		X	
7 Plant, machine operators and train drivers	X	X	
8 Elementary occupations	X		

Figure 2.3 Change in ISCED skill level for several jobs in the ISCO-classification. Technology could be an influencing factor (black = previous situation; red = new situation)

[3] http://prerelease.escoportal.eu/concepts/6b73f82c-2543-4a72-a86d-e988869df5ca/browse.
Using the ESCO-table, we could find 16 job types at manager-level; 46 at the professional level; 25 at the technician-level; 4 at the clerical support level; 3 at the service and sales worker level; 6 at the craft and related trades workers level; 5 at the plant and machine operator level; and 4 at the elementary occupations level. (No titles are available at the skilled agricultural worker level.)

skill level, and by activity type. This approach will be adapted to the S2R-needs. We assess the general state-of-the-art of employment in the rail transport in Europe and evaluate the net changes in each of the cells of the job classification table (ISCED-EQF/ISCO-ESCO). In Figure 2.3, we show how such net-changes could be made visible. Our results will come from studying documents and data sets, and discussions with experts and with company representatives.

2.3 Multi-source approach

As the cited overview studies in the sector show (see Section 6), it is complicated to find one source that can provide a full overview of employment levels and changes in skills within the railway sector. For this reason, a triangulation approach has been used: different sources are analysed to see what the situation is. From the different pictures, a more general estimate is made for the sector. The following sources have been used:

- Eurostat: Eurostat provides the Labour Force Survey (LFS) data from 2016. The LFS gives the most precise overview of employment and occupations in the labour market. Each quarter more than 1.7 million interviews are conducted throughout the participating (33) countries including the EU-28 countries, to obtain statistical information for some 100 variables. The sampling rates in the various countries vary between 0.2% and 2.1% (Eurostat, 2018). For using the data, there are some restrictions. The LFS will be the main reference point for the overviews of employment and skill levels. The other surveys all use the LFS as sampling framework: this means that we shouldn't take the actual distributions of these other surveys as representations of what is happening in the railway sector. These other surveys do offer extra information for certain variables;
- Eurofound: European Working Conditions Survey (EWCS 2015). This survey will mainly be used to document the working conditions. The selections of railway personnel have been made available by Eurofound. The EWCS 2015 covers the employed population in the EU-28 and was also carried out in some other European countries (which we exclude from the analyses, as well as the sampled self-employed in the EU-28EWCS, also excluded here). Per country the sample consists of around 1,000 employed persons on average (Parent-Thirion et al., 2017). Next, these were weighted against the population distribution according to the LFS (Eurostat);
- CEDEFOP European Skills and Jobs Survey (ESJS) (2014): these data are freely available online. The ESJS 2014 covers the employed population in the EU-28 (CEDEFOP, 2015). There is no occupational or (railway) sector identification code for the employees. An *"in visu"*-approach is needed to select employees: some 142 employees from the railways can be identified. This survey offers more documentation of the skills issues in the railway sector (see Appendix 1). The survey allows us to make a more in-depth analysis of several skill related questions;
- OECD Programme for the International Assessment of Adult Competencies (PIAAC-survey): the PIAAC-survey offers, like the CEDEFOP ESJS does, more background information on the skills issue. The survey is not as representative for the EU-situation as the other surveys. The PIAAC survey has been carried out in 20 of the 28 EU-countries in 2012 (2014 for some countries); 14 countries can be used for our purposes since the country datasets of the other 6 countries do not contain the sector information (ISIC) to assess whether the respondent is working in the rail or another sector (in this case Austria, Estonia, Finland, Germany, Sweden, Ireland). The 14 countries represent 64.1% of total employment in the EU-28. The total sample from the 14 countries counts 44,374 employees: Flanders (Belgium), Cyprus, Czech Republic, Denmark, France, Greece (results from 2014), Italy, Lithuania (2014), Netherlands, Poland, Slovak Republic, Slovenia (2014), Spain, United Kingdom. From this total, 451 persons have been selected with a

profession in the railway sector (including the employees in the broad NACE code 421 'construction of roads and railways': however, we have corrected the number of respondents in this category, and its overrepresentation, by a weighting procedure (in accordance with the NWCS-NEA distribution). We have corrected the analyses in this respect, resulting in 248 cases). In the results, we apply weights which consider the employment distribution across the 14 countries, e.g., a respondent from a country with many employed persons in its real population counts heavier than a respondent from a small country in this respect. (This procedure is similar to the approach followed in the Eurofound, EU-OSHA, and CEDEFOP sample results.);

- Netherlands: the Dutch Working Condition Survey (NWCS-NEA). This survey offers more detailed information about Dutch working conditions. The sampling frame is also the LFS;
- UK: the Office of National Statistics (ONS) has provided us access to some data representations. These data are however limited for our purposes. We will not be using them in this report;
- HR-departments of major train corporations: for the overviews of employment at the company level, we rely on data from HR-departments of companies from the four selected countries. These data will be confidential in nature. We will find a procedure to show the results, mainly by aggregating results from all companies.

2.4 Selection of personnel working for the railway sector

The comparability of the current research in employment of railways remains quite limited. Each of the studies (see Section 6 for overview) uses different starting points for selections. In the study made by Christidis et al. (2014), the focus has been on occupations: ISCO 831 "Locomotive engine drivers and related workers". Other occupations were not included. In the RMMS-study (2016), data from the railway undertakings were used. The starting point is sector.

For this S2R-study, first, a selection of sectors was made. The main reason not to start with the occupation for finding our statistics, is that the technological developments in the S2R-projects have a broader impact than the limited occupation-selection strategy would provide us. The following NACE-3-digit levels have been selected:

- 30.20 Manufacture of railway locomotives and rolling stock;
- 42.12 Construction of railways (NACE-3: 421 Construction of roads and railways);
- 49.10 Passenger rail transport, interurban (ISIC 49.11);
- 49.20 Freight rail transport (ISIC 49.12).

Only 3-digit level of NACE was available in some of the selected sources (while the NWCS-NEA contained 5-digit level information).

If the NACE code was not available (ESJS), we proceeded to use ISCO-codes (job title) or job and sector descriptions in the survey to select railway employees. In the Table 2.1, the method for selecting employees in the different sources is indicated.

Table 2.1 Selection method in different surveys

Source	Selection method and level	Survey population	Number of persons selected in railways
Eurostat: LFS 2016	NACE-3	224,106,670 employed persons in the EU-28 (population; estimate)	817,752 after adjustment weighting for NACE 421 (1,728,862 unadjusted)
Eurofound: EWCS 2015	NACE-3	29,285 (employees; sample)	207 after adjustment for NACE 207 (296 unadjusted)
CEDEFOP: ESJS 2014	Occupation, visual selection	48,676 (employees; sample)	141
OECD: PIAAC 2012	NACE-4 (ICIC): 3020, 4210, 4911, 4912	44,374 (employees; sample 14 EU-28 countries)	248 after adjustment for NACE 421 (451 unadjusted)
NL: NCWS - NEA 2014-2015-2016	NACE-5	123,342 (employees; sample)	424

2.5 Presentation at EU and country level

The data will be presented at the EU-28 level, unless otherwise indicated. The original plan was to present data at the level of four regions. The EU statistical data cannot be presented at lower levels than the EU-level. The suppliers of the data warned of not using data at lower levels, for statistical reasons. For as far as possible, we will proceed in delivering other level representations, as long as we don't violate statistical rules. This is done to identify extra information about working conditions and skilling. In discussion with S2R JU, the study will mainly focus on four countries: Germany, France, the Netherlands and the UK.

3 Estimates of current employment in the railway sector

3.1 Introduction

For the assessment of the skills, it is important to have an assessment of the general level of employment and its distribution according to job title in the railway sector. It is difficult to get precise figures on employment in the railway sector. The ERRAC-Rail 2050 report says that the railway sector provides direct employment to 2.3 million persons. Indirectly the sector contributes to some 4 million jobs (ERRAC, 2017). The RMMS-data indicate that only 900,000 people work in the sector (European Commission, 2016). The figures are quite divergent. In this section, such an assessment of the general level of employment is given based on several sources: RMMS-data, Labour Force Survey, and the situation in several major railway organisations. The current situation is described, and where possible, the development of employment over the past years.
For the four countries, we enhance the statistical information with more detailed information coming from national data and data from the major railway transport organisations. We have directed questions to the major railway transport organization to complete the overview. This information will be added in the next months.

3.2 Overview secondary sources (RMMS-data 2016)

On 8 December 2016, the European Commission adopted the fifth report on monitoring development of the rail market. While the Report gives only a high-level overview of the main developments, the full analysis is presented in the accompanying Commission Staff Working Document. On the website of RMMS, the following data collection method is indicated: *"Since 2007, the Commission has collected data on rail market developments in Member States via RMMS Questionnaires. The data have been collected based on a 'gentlemen's agreement' which means that there could be gaps in data availability as well as methodological discrepancies. Nevertheless, relatively good response rates have allowed the Commission to publish the RMMS reports in every two years since then."* Data and figures are available also in an Excel format. The RMMS 2016[4] report gives the following estimate: *"According to the RMMS, at the end of 2014 about 900 000 people were employed by rail operators and infrastructure managers, the number of employees decreased by 4 % between 2009 and 2014. The workforce is predominantly male and the proportion of workers over 40 is in many companies more than 50 %. Ageing is a particular concern in Spain, Greece, Finland and Italy.[5] On the positive side, after long recruitment freezes, rail companies in many Member States have recently begun to recruit again. Secure employment, good salaries and career opportunities under positive corporate climate are today the most common elements referred to in Member States where the sector is considered attractive."* (p. 11). This figure of 900,000 people employed by railways does not include NACE 30.2, manufacture of rolling stock.
In this report 'railway sector' refers to railway undertakings and rail infrastructure managers. The report 2018 is under development.

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[4] European Commission (2016). REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL. Fifth report on monitoring development of the rail market. {SWD(2016) 427 final} Brussels, 8.12.2016, COM(2016) 780 final.

[5] UIC (2012).

Table 3.1 Staff employed in incumbent railway undertakings (2011; 2014)

	2011	2014	Variation (%)
FR	110,000	96,200	-14%
DE	58,000	61,000	5%
NL	24,069	28,348	15%
IT	36,700	31,802	-15%
CZ	33,566	24,163	-39%
AT	26,282	13,181	-99%
PL	25,222	29,555	15%
RO	22,149	20,273	-9%
BE	20,011	20,585	3%
HU	16,085	17,522	8%
ES	13,955	14,429	3%
SK	12,846	12,042	-7%
BG	11,137	10,125	-10%
FI	8,390	7,592	-11%
DK	8,052	8,131	1%
LT	6,733	6,496	-4%
SE	5,265	4,878	-8%
SI	4,562	4,028	-13%
LV	3,944	3,734	-6%
LU	3,753	3,943	5%
PT	3,643	3,484	-5%
IE	1,912	2,280	16%
EL	852	858	1%
HR	0	4,176	
EE	0	1,472	

Sources: RMMS. UK 2011 and 2014, HR and EE 2011 not available. EL data 2012 and IE data 2013 for 2014.

Notes: CZ 2014: whole CD group. DK 2014: includes DSB, Oresund, Private lines and Metro (Freight N/A). DE 2011: not including incumbent's IM and rail related facilities staff. EE 2014: includes Estonian Railways, GoRail, ELRON Edelaraudtee. NL 2014: includes NS staff outside NL. SE 2014: SJ AB and Green Cargo AB.

3.3 Estimates based on statistical sources

3.3.1 Eurostat: Labour Force Survey

For estimating any figures about size of employment in the railway sector, all surveys use the LFS as reference point. Only the LFS can therefore be used as an estimate of the size of employment.

Table 3.2 Estimation[6] of number of employed persons (including self-employed) in the railway sector split by occupation in the EU-28. *Source*: Labour Force Survey 2012-2016 (Eurostat)

	2012	2013	2014	2015	2016
Senior managers	6%	6%	6%	6%	6%
Professional engineers	9%	9%	10%	10%	10%
Technicians and associate professionals	15%	15%	14%	14%	15%
Clerical support workers	10%	11%	11%	11%	11%
Service workers and sales workers	6%	5%	5%	6%	5%
Craft and related trades workers [service personnel]	19%	18%	19%	19%	19%
Plant, machine operators and train drivers [train drivers]	26%	25%	25%	25%	25%
Elementary occupations	10%	10%	10%	10%	10%
Total	100%	100%	100%	100%	100%
N =	876,023	853,240	846,544	837,718	817,752

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

For the four selected railway sectors, the current employment is shown. Employment seems to have declined over the period of five years with more than 60,000 persons, a drop of nearly 7%. Table 3.3 summarises the development in employment over the past years.

Table 3.3 LFS: general trend in employment over period 2012-2016

Major occupations	2012-2016	2016
Senior managers	0%	6%
Professional engineers	+1%	10%
Technicians and associate professionals	0%	15%
Clerical support workers	+1%	11%
Service workers and sales workers	-1%	5%
Craft and related trades workers [service personnel]	0%	19%
Plant, machine operators and train drivers [train drivers]	-1%	25%
Elementary occupations	0%	10%
Total	100%	100%
Overall change in employment level / N =	-7%	817,752

The overall distribution of personnel over the different occupational groups seems to have remained quite stable over time. Train drivers, service personnel on trains and in stations, and more technical professionals are the major job categories. The proportions of the different job categories in the total employment only change marginally. The development over time does not show the tendency predicted by other studies that administrative personnel would decline strongly (see further: Davydenko et al., 2009). Also, the expectation that employment in the railway sector would grow, does not seem to be fulfilled. This discrepancy is discussed in the foresight workshop.
The general-LFS figures show that overall employment in the railway sector is still declining. The railway sector in the EU has not yet reversed the downsizing trend that was visible in the period 2000-2010.

[6] We adjusted the LFS figures by a factor of 0.473 due to inclusion of broad NACE3D category 421 instead of NACE4D (factor based on NWCS 2014-2017 prevalence of NACE4D category 4212 within total of the railway sectors).

3.3.2 *Major European Railway companies*

The picture at the EU-level may be different for the different EU-countries and at the company level. We present the overview of some data for the major operators in six countries.

SNCF

All results have been obtained from the Annual Reports, published on-line. The French major railway organisation is the SNCF. SNCF is composed of four major groups. The following activities can be identified:

- Headquarters (EPIC);
- Network organization (manages 30,000 km of lines, 2,000 km of high speed lines);
- Mobility organization: Passengers; Freight (Geodis, TFMM, Ermewa, STVA); Keolis (of which 40% international);
- Real estate.

Table 3.4 gives an overview of the personnel distribution.

Table 3.4 SNCF: overview of personnel distribution (annual reports): number of natural persons

SNCF	2013	2014	2015	2016	2017
Total group (+international)	257,248	251,092	259,475		270,000
Persons in France			221,351	215,000	
• Network organization			58,116	54,000	
› Of which: engineers (Systra)				5,500	6,100
• Mobility			190,386		
› Of which: Passenger transport				75,000	
› Of which: Freight transport				52,500	50,000
› Of which: Urban transport (KEOLIS)				56,000	
• Real estate (including ICF Habitat)				2,600	

In 2015, the total group consisted of 259,475 persons (31/12) of which 221,351 persons are in France. These persons operate in 150 occupations. Employment seems to be rising at SNCF, which would mainly be caused by hiring in the international operations of SNCF. In France, it seems as if employment is declining over time.
SNCF has its own surveys on employee engagement and satisfaction (Tempo, Allure). About 95,000 persons participated in the 2015 survey.

Deutsche Bahn

Deutsche Bahn (DB) is the major German (and European) railway organisation. Main results are also from the Annual Reports, obtained on-line. Table 3.5 gives an overview of the personnel situation at DB.

Table 3.5 DB: overview of personnel distribution (annual reports): number of natural persons

Deutsche Bahn	2013	2014	2015	2016
Total group (+international)	306,919	306,966	308,010	314,240
(fte)	295,653	295,763	296,972	302,692
Persons in Germany	195,912	195,805	196,469	195,537
(fte)	187,837	187,882	188,671	187,476
• Network organisation (Track, Stations, Energy)	48,794	50,019	48,747	51,957
• Mobility				
› Of which: Passenger transport				
- Long distance	16,564	16,461	17,539	17,538
- Regional	36,878	36,605	38,260	37,672

o Rail (fte)			27,844	27,133
o Bus (fte)			8,785	8,824
› Of which: Freight transport road (DB Schenker)	64,051	64,810	67,952	69,151
			31,273	30,525
› Of which: Freight transport rail: DB Cargo (fte)	30,925	30,842	30,907	30,155
› Of which: Arriva	46,718	45,712	47,390	53,986
- Train UK (fte)			5,588	11,172
- Bus UK (fte)			16,764	16,789
- Europe			22,742	23,412
• Others (engineering, consulting)	51,723	51,314	56,849	53,411

DB shows employment growth, which is mainly caused by growth in international subsidiaries. In most German business units, employment has remained stable over the four years. There does not seem to be a shift in employment between business units.

Netherlands: Nederlandse Spoorwegen and ProRail

Main results are also from the Annual Reports of Nederlandse Spoorwegen (NS) and ProRail, obtained on-line. The Netherlands has been at the forefront of developing an open and competitive railway market. Since 2001, all public transport has been subject to contracting under competitive tendering. Such practices have been integrated into central transport planning. Netherlands is seen as a laboratory for different approaches to contracting integrated public transport networks, a learning place for Europe. In the railway sector, the network is placed under control of ProRail, a company 100% controlled by the Dutch government. The same applies for the NS, a passenger rail company also controlled by the Dutch government. In passenger railway, the NS experiences competition on a minority of lines from Arriva (linked to DB) and Veolia (linked to the French Transdev) (Van de Velde & Eerdmans, 2016). The freight services of the NS merged in 2000 with the DB Schenker group.

Table 3.6 NS / ProRail: overview of personnel distribution (annual reports): number of persons or fte (Annual Reports)

NS + ProRail	2013	2014	2015	2016	2017
• Network organization (ProRail)	4,081	3,916	3,958	4,179	
• (fte)	3,949	3,796	3,847	4,072	
• Mobility (NS)	32,000	28,348	33,895	30,945	31,573
› Of which: Passenger transport (NS Operatie (Reizigers + [NedTrain]))	14,098 [3,057]	14,000 [3,000]	13,900 [2,900]	14,000 [3,000]	13,000
› Of which: Abellio					
- UK	11,161	8,000	12,900	13,000	13,048
- Germany				891	1,392
› Of which: Qbuzz (bus transport) (fte)				1,846	[sold]
• Others (Commerce, Development, Stations)	6,896	6,300	7,150	5,000	6,000

The Dutch figures also show a high level of stability of employment, also between business units. The main growth is in the international units.

UK: Network Rail and other companies

According to the Annual Report of 2017, Network Rail employed 38,529 persons. In 2016, this was 37,481 and in 2015, this was 36,102. The figures of 2016 would also include the Department for Transport (DfT) and the Office of Rail and Road (ORR). There has been a significant growth of personnel. The report by Women in Rail (2015) gives more insight into the compo-

sition of the whole employment in the UK railway sector. Of this total, some 4,157 (13%) are women. The following distribution is indicated in the Women in Rail-report (2015):

- Train operating companies: 35,765 men + 8,737 women;
- Manufacturers: 5,713 men + 754 women;
- Rolling stock: 215 men + 98 women;
- Suppliers: 1,327 men + 73 women;
- Technology Service Companies (TESCOS): 709 men + 205 women;
- Freight companies: 2,357 men +33 women (1.4% of workforce).

The contribution of the industry and its supply chain is the employment of approximately 212,000 people.

Italy: Ferrovie dello Stato Italiane (FS Italiane)

FS Italiane is one of the largest industrial companies in Italy: about 70 thousand people manage more than 8 thousand trains a day, 600 million passengers and 50 million tons - freight per year over a network of over 16,700 km, of which 1,000 are dedicated to high speed. The company is not only active in rail (persons, freight, infrastructure, real estate), but also in the maintenance of the highways in the whole of Italy. These last figures are not included in this analysis. The Italian state is the sole shareholder. In the following table, the distribution of the personnel according to the major activities of the company are shown. Some 15% of personnel is female.

Table 3.7 FS Italiane: overview of personnel distribution (annual reports): number of persons or fte (Annual Reports)

FS Italiane	2011	2012	2013	2014	2015	2016
• Total group (+international)	76510	72341	69115	69115	69002	71581
› Thello, Netinera, …	2404	2344	2357	2419		3721
• Persons in Italy	74106	69997	66758	66696	69002	67860
• Holding + others	6491	5394	4608	5620		2341
• Network organisation (infrastructure)	29368	28307	28258	27532		28170
› Of which: engineers	1248	1206	1150	1152		1236
• Mobility						
› Of which: Passenger transport	36700	34819	32489	32173		27855
› Of which: Freight transport	189	151	74	69		4861
› Of which: Urban transport	939	897	913	885		4292
• Real estate	419	429	416	417		341

According to the Annual Report of 2017, the group employed 74,436 persons. After a strong decline between 2011 and 2015, the group started the grow again from 2016 on. Growth however is mainly internationally. Within Italy, a strong decline is visible for passenger transport.

Portugal: Comboios de Portugal (CP)

CP is a diversified group providing rail transport services and is the largest rail passenger and freight carrier in Portugal. It operates throughout the country, offering essential services to help develop the nation and to ensure its social and territorial cohesion, and it also runs international services (website). The group provides the following activities through its subsidiaries and associated companies:

- CP EMEF: Manufacturing, renovation, major overhauls and maintenance of equipment, railway vehicles, ships and buses; refurbishment engineering, repair and maintenance of transport vehicles; study of workshop facilities for maintenance;

- CP Saros: Insurance mediation;
- CP Fernave: Technical and professional training and development, production of projects and studies and provision of applied psychology services and medical and assessment for the transport and communication area;
- CP Ecosaúde: Provision of health care, creation and management of health care and working conditions units; technical assistance, consulting and auditing, namely in matters of health, hygiene and safety at work, the environment and environmental management; drawing up studies, diagnosis for prevention and control regarding drug, alcohol and tobacco addictions;

Next to these activities, CP also implements ticketing system management for several metro systems. The figures for the train operations are integrated in the following table.

Table 3.8 CP: overview of personnel distribution (annual reports): number of persons or fte (Annual Reports)

CP	2011	2012	2013	2014	2015	2016	2016
Persons in Portugal (total)	3299	2982	2940	3481	3322	3273	2750
• Holding (Fernave, Ecosaúde, Saros)	58		26	55	52	52	42
• ·Mobility							
› Of which: Passenger transport; Network, Real estate	3241	2982	2914	2797	2718	2684	2708
› Of which: Freight transport				629	552	537	0

The figures are far from complete, but they do show the development in Portugal. CP has seen a strong decline in personnel, due to continuous reorganisations, but also by outsourcing the freight group to other partners.

3.4 Comparison of regions

The Labour Force Survey was analysed at the EU-level. The comparison of major rail organisations show different developments between the countries. For this reason, an additional analysis of the LFS-data was conducted to provide an insight into the developments between the four core-countries of this report (Germany, France, Netherlands and UK), compared to the rest of the countries in Europe. The main reason for this is to see to what degree the developments within the four countries are comparable to the rest of Europe. In the following tables (3.9a, 3.9b; 3.10a, 3.10b), the change over time of general employment and occupational levels is identified.

Table 3.9 Estimation of number of employed persons (including self-employed) in the railway sector split by occupation and regional selection. *Source*: Labour Force Survey 2012-2016 (Eurostat)

a:Total GE+FR+NL+UK	2012	2013	2014	2015	2016
Senior managers	8%	10%	8%	7%	7%
Professional engineers	11%	10%	12%	11%	10%
Technicians and associate professionals	21%	19%	18%	18%	19%
Clerical support workers	6%	9%	10%	11%	11%
Service workers and sales workers	6%	5%	4%	7%	5%
Craft and related trades workers [service personnel]	13%	13%	15%	14%	14%
Plant, machine operators and train drivers [train drivers]	24%	23%	23%	22%	21%
Elementary occupations	11%	11%	11%	11%	12%
Total	100%	100%	100%	100%	100%
N =	338,703	335,751	344,760	348,330	339,935

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

b: EU-28 excl. GE, FR, NL, UK	2012	2013	2014	2015	2016
Senior managers	5%	4%	5%	5%	5%
Professional engineers	8%	9%	9%	9%	9%
Technicians and associate professionals	10%	12%	11%	11%	11%
Clerical support workers	12%	12%	12%	11%	10%
Service workers and sales workers	6%	5%	6%	5%	5%
Craft and related trades workers [service personnel]	22%	22%	21%	22%	23%
Plant, machine operators and train drivers [train drivers]	27%	27%	26%	27%	27%
Elementary occupations	9%	10%	10%	10%	9%
Total	100%	100%	100%	100%	100%
N =	537,320	517,489	501,783	489,388	477,817

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

Table 3.9 LFS: general trend in employment over period 2012-2016 and regional selection

a: Major occupations: Total GE+FR+NL+UK	2012-2016	2016
Senior managers	0%	7%
Professional engineers	0%	10%
Technicians and associate professionals	-2%	19%
Clerical support workers	5%	11%
Service workers and sales workers	-1%	5%
Craft and related trades workers [service personnel]	1%	14%
Plant, machine operators and train drivers [train drivers]	-3%	21%
Elementary occupations	1%	12%
Total	100%	100%
Overall change in employment level / N =	0%	339,935

b: Major occupations: EU-28 excl. GE, FR, NL, UK	2012-2016	2016
Senior managers	0%	5%
Professional engineers	1%	9%
Technicians and associate professionals	1%	11%
Clerical support workers	-2%	10%
Service workers and sales workers	-1%	5%
Craft and related trades workers [service personnel]	0%	23%
Plant, machine operators and train drivers [train drivers]	0%	27%
Elementary occupations	0%	9%
Total	100%	100%
Overall change in employment level / N =	-11%	477,817

The previous tables show quite divergent developments between the two regional selections. The four core countries for this study show a remarkable stability of employment over the total period, even though it seems that there are stronger fluctuations within the selected period. For the other countries, the decline in employment with -11% is quite strong.
When looking at the occupational composition within the regional selections, the general composition of employment shows different developments. In GE+FR+NL+UK, the major changes are in clerical support workers (+5%) and train drivers (-3%). Where other studies predicted that administrative personnel would decline in the rail companies (see Davydenko et al., 2009), it is mainly the operational jobs on the trains that decline in importance. In the other regional selection, we see the predicted decline in clerical support workers (-2%) and service and sales workers (-1%). But overall, the occupational distribution here remains quite stable.
The occupational composition is quite different between the regional selections. In the four core-countries, the presence of managers, engineers and technical professionals is 30% higher than in the other selection of countries. In this other selection of countries, the weight of personnel is mainly in service personnel and on-board occupations (train drivers). If these developments are compared to the general population of the different selections, then we see that the overall employment in rail organisations is higher in the other selection of countries than would be expected from looking at population levels. This would mean that the core-countries have relatively less employment in rail organisations. From Eurostat-data, we also know that these four countries have more railways (in length) and more passengers to tend to than the other country selection. These figures show that the companies in the core-countries are probably more efficient in their operations. Possibly, this is achieved by the presence of more managers, engineers and technical experts.

3.5 Summary

Employment in the EU-railway sector has continued to decline in the period up to 2016. The occupational distribution only shows some marginal shifts, not in line with forecast studies. These general figures hide different developments in separate regions of Europe. In this project, more attention will be directed at Germany, Netherlands, France and the UK. These four countries, and their four major railway companies, show a relatively stable situation of employment in the railway sector, but also at the level of the four major rail companies (DB, SNCF, NS/ProRail, Network Rail). Within the other selection of countries, a strong decrease in employment is visible. The composition of employment is different between the regions, with managerial, engineering and technicians more present in the core-countries in this study. The analysis of the four major rail organisations, shows that the core-activities remain quite stable.

This is also the case for FS Italiane. For the four core-countries, we can see that the employment in the major rail companies seems to be declining at the home-country level. If the general employment remains the same, this could mean that either new entrants or foreign entrants to these markets help keep employment stable. The four major rail companies show their growth mainly in foreign operations. The stronger decline of CP in Portugal may be representative for other countries in Europe: CP needs to refocus activities and allows parts to be overtaken by foreign or new entrants. In the whole sector, it would seem that a major concentration tendency is becoming visible. This tendency has not been further analysed.

4 Estimates of current skill distribution in the railway sector

4.1 Introduction

In this section, we give an overview of the skills distribution for the different occupational groups in the railway sector. Again, the LFS will be our main point of reference. We start with what is known from current research and add information from the statistical sources. The EWCS, ESJS, PIAAC and NWCS are used to add some important information to the skills distributions we find in the LFS.

4.2 Estimates from secondary sources

4.2.1 The Skillrail project (2009-2011)

The Skillrail project was a CSA-project under the EU Seventh Framework Programme for research, led by the Portuguese institute IST, from 2009 to 2011. The purpose of the Skillrail project was to develop the appropriate framework for the development of scientific and technological skills for the railway sector of the future considering the needs of individual stakeholders. The focus of the project was on three topics:

1. Higher education for the railway community of tomorrow;
2. Advanced training for European railway stakeholders; and
3. Skill jobs in the railway sector and gender issues.

The main output has been the steps towards the development of an EU railway university, linking initiatives all over Europe into an approach further managed by EURAIL. The needs of the railway organisations were very clear. Olofsson (2011) clearly indicated for which jobs major shortages of personnel would be expected:

- Development and application engineers;
- Drivers;
- Electrical, signal & telecom technicians/engineers;
- Maintenance personnel vehicles;
- Permanent way;
- Planners Transport and Infrastructure economy;
- Rail welders;
- Supervisors and team leaders;
- Traffic management staff;
- Tunnel builders;
- Etc.

As far as can be traced back, a lot of attention has been directed at creating an understanding how to arrange a kind of railway university and how to tackle the gender issue in the railway sector. We are unable to find in the project information any data representation of the foreseen shortages in personnel categories claimed by the project.

4.2.2 The JRC-IPTS study (2014)

The most complete overview of the current (and future) employment in the railway sector is the study done by Christidis et al. (2014).[7] For the period 2000-2010, the number of railway workers shows a decline, certainly in comparison to other transport sectors. These figures are useful for the current analysis because they offer reference points for our analysis of skill development in the sector. The analysis shows that employment levels in the period 2000-2010 have gone down by about 5% in this period, mainly after the 2008 financial crisis.

Christidis et al. provide figures for the educational classification used by the LFS, based on ISCED 1997. This indicator reflects *"the highest level of education or training successfully completed by the respondent. Lower educational level corresponds to pre-primary, primary and lower secondary education, medium educational level is upper secondary and post-secondary non-tertiary education and upper educational level encompasses first and second stage of tertiary education."* Comparing the overall educational classification, 80% of railway workers have a medium educational background (Figure 4.1).

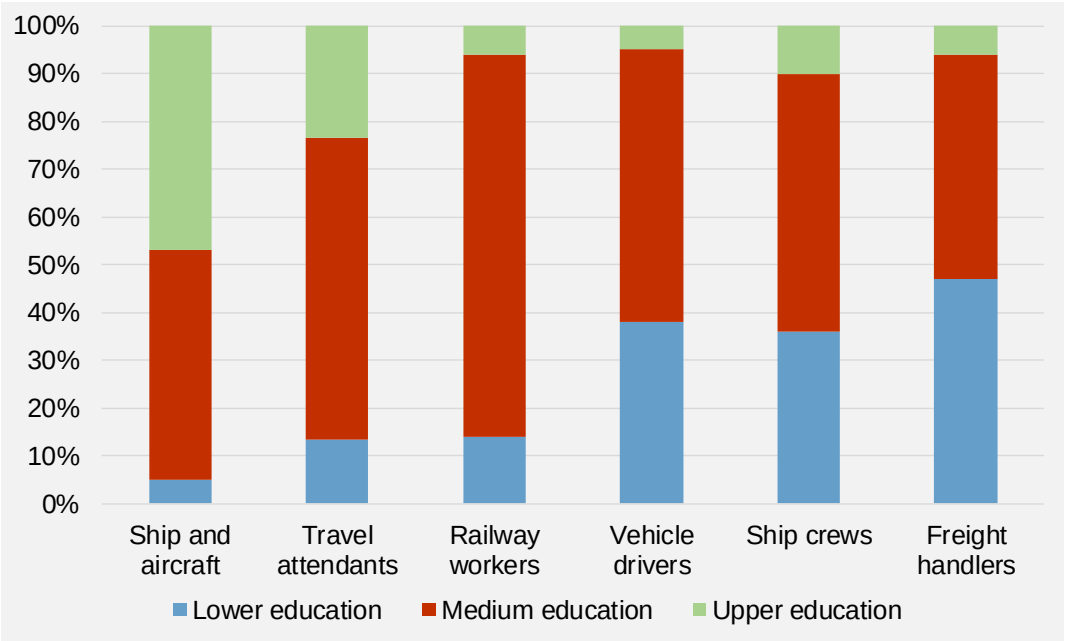

Figure 4.1 Overview of educational background different transport workers (Christidis et al., 2014)

[7] In order to respect the confidentiality guidelines, the so-called small area estimation technique (Rao, 2003) has been adopted, which makes use of aggregate responses so that the prescribed threshold for the number of responses is observed. This methodology minimises variances and potential measurement errors inherent to the detailed breakdowns of the sample tackled in this study. In particular, we have adopted time series modelling in order to estimate the trends presented in this chapter following the approach initially proposed by Pfeffermann (1991), which takes advantage of the sample information observed in contiguous periods and identifies a trend component plus a random term. The latter is modelled as a white noise stochastic process that represents unexplained variations as a result of survey errors. This error term is specified taking the direct estimates for the design variances of the survey errors available from the micro-data (Binder & Dick, 1989). Both terms are estimated for the complete series, with lower standard errors for the identified trend than the estimates based in direct statistical inference from small samples. The chapter presents the results from this analysis, yielding a consistent outlook of the latest developments in the transport sector workforce and setting a context for discussion on how labour supply and demand match and which potential challenges may lie ahead.

4.3 Estimates of skills distribution of staff categories divided according to occupation (ISCO) and educational attainment (ISCED-categories)

4.3.1 Eurostat Labour Force Survey (LFS)

EU-level

Table 4.1 gives an overview of the skills distribution according to occupations for the four railway sectors. Table 4.2 shows the development of skills over time.

Table 4.1 Estimation[8] of number of employed persons (including self-employed) in the railway sector split by occupation and educational attainment in the EU-28 in 2016. *Source*: Labour Force Survey 2016 (Eurostat)

	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
Senior managers	[a]	17,824	32,720	50,544
Professional engineers	[a]	12,495	67,756	80,251
Technicians and associate professionals	10,441	68,224	39,760	118,426
Clerical support workers	8,107	60,186	19,799	88,092
Service and sales workers	4,316[b]	30,255	4,956[b]	39,527
Craft and related trades workers	34,450	111,353	9,625	155,429
Plant and machine operators, assemblers	40,167	150,496	11,253	201,916
Elementary occupations	34,224	44,443	4,899[b]	83,567
Total	131,706	495,277	190,769	817,752

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

Table 4.2 Trend 2012-2016 in estimated number of employed persons (including self-employed) in the railway sector split by occupation and educational attainment in the EU-28 in 2016 (total percentages: percentages sum up to 100% per year). *Source*: Labour Force Survey 2012-2016 (Eurostat). (Colours: green = growth of more than 0.4%; red = decline of more than 0.4%).

	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
2012				
Senior managers	0.6% [b]	1.9%	3.7%	6.2%
Professional engineers	[a]	1.5%	7.8%	9.4%
Technicians and associate professionals	1.4%	8.9%	4.4%	14.7%
Clerical support workers	1.0%	7.2%	1.7%	9.9%
Service and sales workers	0.9%	4.3%	0.9%	6.0%
Craft and related trades workers	4.8%	13.0%	0.9%	18.7%
Plant and machine operators, assemblers	5.8%	18.8%	1.1%	25.7%
Elementary occupations	4.2%	5.4%	[a]	9.5%
Total	18.6%	60.9%	20.5%	100%
N total				876,752
2013				
Senior managers	0.5% [b]	1.8%	4.1%	6.4%
Professional engineers	[a]	1.5%	7.8%	9.3%
Technicians and associate professionals	1.5%	8.9%	4.4%	14.8%

[8] We adjusted the LFS figures by a factor of 0.473 due to inclusion of broad NACE3D category 421 instead of NACE4D (factor based on NWCS 2014-2017 prevalence of NACE4D category 4212 within total of the railway sectors).

	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
Clerical support workers	1.0%	7.6%	1.9%	10.6%
Service and sales workers	0.6% [b]	3.8%	0.7% [b]	5.1%
Craft and related trades workers	4.9%	12.6%	0.9%	18.3%
Plant and machine operators, assemblers	5.5%	18.5%	1.2%	25.3%
Elementary occupations	4.5%	5.3%	0.4% [b]	10.2%
Total	18.5%	60.1%	21.4%	100%
N total				876,752
2014				
Senior managers	0.4% [b]	1.6%	3.9%	5.9%
Professional engineers	[a]	1.4%	8.3%	9.8%
Technicians and associate professionals	1.3%	8.4%	4.5%	14.2%
Clerical support workers	1.3%	7.7%	2.0%	11.0%
Service and sales workers	0.6% [b]	4.0%	0.6% [b]	5.2%
Craft and related trades workers	4.7%	12.9%	1.1%	18.7%
Plant and machine operators, assemblers	5.3%	18.0%	1.5%	24.9%
Elementary occupations	4.3%	5.5%	0.5% [b]	10.3%
Total	17.9%	59.5%	22.6%	100%
N total				846,544
2015				
Senior managers	0.4% [b]	1.6%	3.7%	5.8%
Professional engineers	[a]	1.5%	8.3%	9.8%
Technicians and associate professionals	1.4%	8.0%	4.7%	14.1%
Clerical support workers	1.0%	7.2%	2.5%	10.7%
Service and sales workers	0.5% [b]	4.6%	0.6% [b]	5.7%
Craft and related trades workers	4.2%	13.4%	1.2%	18.7%
Plant and machine operators, assemblers	4.7%	18.3%	1.6%	24.7%
Elementary occupations	4.3%	5.5%	0.6% [b]	10.4%
Total	16.5%	60.2%	23.3%	100%
N total				837,718
2016				
Senior managers	[a]	2.2%	4.0%	6.2%
Professional engineers	[a]	1.5%	8.3%	9.8%
Technicians and associate professionals	1.3%	8.3%	4.9%	14.5%
Clerical support workers	1.0%	7.4%	2.4%	10.8%
Service and sales workers	0.5% [b]	3.7%	0.6% [b]	4.8%
Craft and related trades workers	4.2%	13.6%	1.2%	19.0%
Plant and machine operators, assemblers	4.9%	18.4%	1.4%	24.7%
Elementary occupations	4.2%	5.4%	0.6% [b]	10.2%
Total	16.1%	60.6%	23.3%	100%
N total				817,752

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

Table 4.3 Trend 2012-2016: development over time of skill distribution within the professional groups (based on Table 4.2)

2012-2016: trend	ISCED 0-2	ISCED 3-4	ISCED 5-6
Senior managers	-10%	+5%	+5%
Professional engineers	0%	-1%	+2%
Technicians and associate professionals	-1%	-3%	+4%
Clerical support workers	-1%	-4%	+5%
Service workers and sales workers	-5%	+5%	-3%
Craft and related trades workers	-4%	+2%	+2%
Plant, machine operators and train drivers	-3%	+1%	+1%
Elementary occupations	-3%	-4%	+6%

Sixty percent of the employed persons have an ISCED 3-4 level of education (upper secondary; post-secondary, non-tertiary education). This figure has not changed a lot over this relatively short time period. Even though employment declined rather steep over four years, Table 4.3 shows that in this same period we can see a remarkable upskilling of all occupational groups, except for services/sales workers. Declines in proportions of ISCED 0-2 (low qualifications) are visible in the 'craft and trades workers' and 'plant machine operators/assemblers'. This last group are mainly the drivers of the trains and trams. Even though the job profiles in the railway sectors do not seem to change, the educational level of the occupations shows a shift to higher levels (ISCED 5-6) of skills.

Regional comparison

As was done in the chapter 2, we compare the occupational and educational composition between the two regional selections. The following tables show the results of this comparison.

Table 4.4 Estimation[9] of number of employed persons (including self-employed) in the railway sector split by occupation, educational attainment and region in the EU-28 in 2016. *Source*: Labour Force Survey 2016 (Eurostat)

a: Total GE+FR+NL+UK, 2016	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
Senior managers	[a]	8,953	15,975	24,928
Professional engineers	[a]	6,207	29,399	35,606
Technicians and associate professionals	5,661	37,411	22,194	65,266
Clerical support workers	2,118	24,616	11,891	38,624
Service and sales workers	1,303 [b]	15,086	[a]	16,389
Craft and related trades workers	7,994	35,786	2,929	46,709
Plant and machine operators, assemblers	16,462	53,536	2,088	72,086
Elementary occupations	12,852	23,899	3,576 [b]	40,327
Total	46,390	205,493	88,052	339,935

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

[9] We adjusted the LFS figures by a factor of 0.473 due to inclusion of broad NACE3D category 421 instead of NACE4D (factor based on NWCS 2014-2017 prevalence of NACE4D category 4212 within total of the railway sectors).

b: EU-28 excl. GE, FR, NL, UK, 2016	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
Senior managers	[a]	8,871	16,745	25,616
Professional engineers	[a]	6,288	38,357	44,645
Technicians and associate professionals	4`,781	30,813	17,566	53,159
Clerical support workers	5,990	35,570	7,908	49,468
Service and sales workers	3,013 [b]	15,169	4,956 [b]	23,138
Craft and related trades workers	26,456	75,568	6,696	108,720
Plant and machine operators, assemblers	23,704	96,961	9,165	129,830
Elementary occupations	21,373	20,544	1,323 [b]	43,240
Total	85,315	289,784	102,717	477,817

Note: Due to Eurostat regulations: values of cells with a flag 'a' were not publishable because of low reliability; cell values with a flag 'b' can be published but with a warning concerning their reliability.

Table 4.5 Estimated number of employed persons (including self-employed) in the railway sector split by occupation, educational attainment and region in the EU-28 in 2016 (total percentages: percentages sum up to 100% per year). *Source*: Labour Force Survey 2016 (Eurostat).

a: 2016: Total GE+FR+NL+UK	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
Senior managers	[a]	2,6%	4,7%	7,3%
Professional engineers	[a]	1,8%	8,6%	10,5%
Technicians and associate professionals	1,7%	11,0%	6,5%	19,2%
Clerical support workers	0,6%	7,2%	3,5%	11,4%
Service and sales workers	0,4% [b]	4,4%	[a]	4,8%
Craft and related trades workers	2,4%	10,5%	0,9%	13,7%
Plant and machine operators, assemblers	4,8%	15,7%	0,6%	21,2%
Elementary occupations	3,8%	7,0%	1,1% [b]	11,9%
Total	13,6%	60,5%	25,9%	100,0%
N total				339,935

b: 2016: EU-28 excl. GE, FR, NL, UK	ISCED 0-2	ISCED 3, 4	ISCED 5, 6	Total
Senior managers	[a]	1,9%	3,5%	5,4%
Professional engineers	[a]	1,3%	8,0%	9,3%
Technicians and associate professionals	1,0%	6,4%	3,7%	11,1%
Clerical support workers	1,3%	7,4%	1,7%	10,4%
Service and sales workers	0,6% [b]	3,2%	1,0% [b]	4,8%
Craft and related trades workers	5,5%	15,8%	1,4%	22,8%
Plant and machine operators, assemblers	5,0%	20,3%	1,9%	27,2%
Elementary occupations	4,5%	4,3%	0,3% [b]	9,0%
Total	17,9%	60,6%	21,5%	100,0%
N total				477,817

When comparing the occupational and educational distributions, the last two tables show that the core-countries in our analysis not only have more personnel in management, engineering and technical positions, this personnel is considerably higher educated (+25% higher). The personnel in other selected countries shows higher levels of very low educated personnel (+25%). These figures show that the educational composition possibly shows different degrees of readiness of the countries to deal with the technological changes happening on the rail systems.

4.3.2 Eurofound: EWCS

In Tables 4.6a and b, an overview of the distribution of the survey results for ISCED and ISCO is included for the EWCS 2015 data. We warn that the number of respondents in this table is too small to derive statistical representativeness. The results are presented here for an indication of skills distribution in the railway sector, in comparison to the LFS-data.

Table 4.6a and b EU-28: educational attainment (ISCED 2011) and occupational groups (ISCO) in the railway sector[10]; total percentages. *Source*: Estimation based on EWCS 2015 (Eurofound). (Colours: compared to LFS 2015)

	Educational attainment			
	Low (ISCED 0-2)	Medium (ISCED 3, 4)	High (ISCED 5, 6)	Total
Senior managers	1.5%	2.0%	1.5%	5.0%
Professional engineers		0.5%	7.9%	8.4%
Technicians and associate professionals	1.0%	13.4%	3.0%	17.3%
Clerical support workers		7.9%	4.0%	11.9%
Service and sales workers	3.0%	9.4%		12.4%
Craft and related trades workers	5.4%	9.9%		15.3%
Plant and machine operators, assemblers	2.0%	21.8%	2.0%	25.7%
Elementary occupations	1.5%	2.5%		4.0%
Total	14.4%	64.8%	20.8%	100.0%

[10] In the EWCS: for the broad 421 category (including construction roads), we applied extra weighting (in this case. lower weight) proportional to NWCS prevalence of construction of railroads within the entire railway sector, in order to adjust for over-representation of road construction in this group.

	ISCED 0-1 Primary education	ISCED 2 Lower secondary education	ISCED 3 Upper secondary education	ISCED 4 Post-secondary non-tertiary education	ISCED 5 Short-cycle tertiary education	ISCED 6 Bachelor or higher	Total
Senior managers		1.5%	2.0%		1.0%	0.5%	5.0%
Professional engineers			0.5%		0.5%	7.4%	8.4%
Technicians and associate professionals		1.0%	13.4%		0.5%	2.5%	17.3%
Clerical support workers			6.4%	1.5%	2.0%	2.0%	11.9%
Service workers and sales workers		3.0%	7.9%	1.5%			12.4%
Craft and related trades workers		5.4%	6.9%	0.5%	2.5%		15.3%
Plant, machine operators and train drivers		2.0%	18.3%	3.5%	1.5%	0.5%	25.7%
Elementary occupations		1.5%	2.5%				4.0%
Total	0.0%	14.4%	57.9%	6.9%	7.9%	12.9%	100%

4.3.3 CEDEFOP: ESJS

The ESJS allows to identify the required educational level for getting into the job and - also as perceived by the workers - the required level for executing the job. The following three tables provide an indication of the differences between the educational level currently present, the level required for obtaining a job, and the level actually needed for the job according to the respondent. (However, these figures are indicative since the ESJS sample for the railway sector is rather small for such detailed comparisons).

Table 4.7a CEDEFOP ESJS: occupational category and ISCED-levels (level currently present; 2014; colours = comparison to LFS 2014)

ISCED-level present:	What is the highest level of education or training that you have completed?			
	ISCED 0-2	ISCED 3-4	ISCED 5- 6	Total
Senior managers	0.7%	5.7%	0.7%	7.1%
Professional engineers	1.4%	2.9%	2.1%	6.4%
Technicians and associate professionals	1.4%	13.6%	3.6%	18.6%
Clerical support workers		5.7%	5.0%	10.7%
Service workers and sales workers	4.3%	9.3%	1.4%	15.0%
Craft and related trades workers	2.9%	4.3%		7.1%
Plant, machine operators and train drivers	7.9%	20.7%	2.9%	31.4%
Elementary occupations		3.6%		3.6%
Total	18.6%	65.7%	15.7%	100.0%

Table 4.7b CEDEFOP ESJS: occupational category and ISCED-levels (level needed to get the job)

ISCED-level required to get job:	Qualification needed to get job				Total
	ISCED 0-2	ISCED 3-4	ISCED 5-6	Not applicable - no educational qualifications	
Senior managers	1.6%	4.7%	2.3%		8.6%
Professional engineers			2.3%	3.1%	5.5%
Technicians and associate professionals	3.9%	8.6%	6.3%		18.8%
Clerical support workers	1.6%	3.9%	3.9%		9.4%
Service workers and sales workers	1.6%	12.5%	0.8%	0.8%	15.6%
Craft and related trades workers	0.8%	5.5%			6.3%
Plant, machine operators and train drivers	7.0%	22.7%	0.8%	1.6%	32.0%
Elementary occupations	0.8%	3.1%			3.9%
Total	17.2%	60.9%	16.4%	5.5%	100.0%

Table 4.7c CEDEFOP: ESJS: occupational category and ISCED-levels (level needed to do the job)

ISCED-level required to do job:	Qualification needed to do job				Total
	ISCED 0-2	ISCED 3-4	ISCED 5-6	Not applicable - no educational qualifications	
Senior managers	1.6%	4.7%	2.3%		8.5%
Professional engineers		1.6%	6.2%		7.8%
Technicians and associate professionals	5.4%	8.5%	3.1%		17.1%
Clerical support workers	1.6%	3.1%	4.7%		9.3%
Service workers and sales workers	1.6%	11.6%	0.8%	0.8%	14.7%
Craft and related trades workers	2.3%	4.7%		0.8%	7.8%
Plant, machine operators and train drivers	10.9%	16.3%	0.8%	3.1%	31.0%
Elementary occupations	1.6%	1.6%		0.8%	3.9%
Total	24.8%	51.9%	17.8%	5.4%	100.0%

The figures indicate that for higher level jobs (ISCED3+) the requirements for getting a job are higher than the job content would require.

4.3.4 OECD: PIAAC

The PIAAC also allows to identify the required educational level for getting into the job and the perceived required level for executing the job. The following three tables give an indication of the differences between the educational level currently present, the level required for obtaining a job, and the level actually needed for the job according to the respondent. (However, these figures can only be indicative since the PIAAC sample for the railway sector is small for such detailed comparisons).

Table 4.8a PIAAC: occupational category and ISCED-levels (educational attainment)

	Educational attainment			
	ISCED 0-2	ISCED 3-4	ISCED 5- 6	Total
Senior managers		0.8%	6.0%	6.8%
Professional engineers		0.4%	3.6%	4.0%
Technicians and associate professionals	2.4%	9.2%	4.4%	16.0%
Clerical support workers	1.6%	8.0%	6.0%	15.6%
Service workers and sales workers		8.4%	0.4%	8.8%
Skilled agricultural and fishery workers		0.4%		0.4%
Craft and related trades workers	2.8%	12.0%	0.4%	15.2%
Plant, machine operators and train drivers	7.6%	16.4%	2.4%	26.4%
Elementary occupations	2.4%	4.4%		6.8%
Total	16.8%	60.0%	23.2%	100%

Table 4.8b PIAAC: occupational category and ISCED-levels (qualifications needed to get job)

	If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job?			
	ISCED 0-2	ISCED 3-4	ISCED 5- 6	Total
Managers	0.4%		6.5%	6.9%
Professionals		2.0%	1.6%	3.7%
Technicians and associate professionals	2.9%	4.9%	8.2%	15.9%
Clerical support workers	1.2%	8.6%	6.1%	15.9%
Service workers and sales workers	2.4%	6.1%		8.6%
Skilled agricultural and fishery workers	0.4%			0.4%
Craft and related trades workers	2.4%	11.8%	1.2%	15.5%
Plant, machine operators and train drivers	6.5%	16.3%	3.7%	26.5%
Elementary occupations	2.9%	3.3%	0.4%	6.5%
Total	19.2%	53.1%	27.8%	100%

Table 4.8b PIAAC: comparison rail with other sectors according to ISCED-levels

	Railway	All other sectors
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job?		
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job?		
• Low education (ISCED 1, 2, 3C <2 yrs.)	18.8%▼	33.2%▲
• Medium education (ISCED 3A-B, C>2y, 4A-C)	53.1%▲	31.9%▼
• High education (ISCED 5, 6)	28.1%∇	34.9%∆
N	*246*	*42.871*
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job? (detailed)		
• ISCED 0-1 No formal qualification or below ISCED 1 / ISCED 1 Primary level of education	4.7%▼	16.0%▲
• ISCED 2 Lower secondary level of education (2A, 2B, 2C)	9.0%	10.1%
• ISCED 3 Upper secondary level of education (3A, 3B, 3C)	55.7%▲	38.1%▼
• ISCED 4 Post-secondary, non-tertiary education (4A, 4B, 4C)	2.4%∆	0.9%∇

	Railway	All other sectors
• ISCED 5 First stage of tertiary education (5A, 5B)	27.1%∇	34.4%∆
• ISCED 6 Second stage of tertiary education (leading to an advanced research qualification)	1.0%	0.5%
N	*246*	*42.871*
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job? (2-digit)		
• No formal qualification or below ISCED 1	4.1%▼	12.7%▲
• ISCED 1	0.6%∇	3.4%∆
• ISCED 2	9.0%	10.1%
• ISCED 3C shorter than 2 years	5.1%	7.1%
• ISCED 3C 2 years or more	8.0%	7.9%
• ISCED 3A-B	27.3%▲	16.1%▼
• ISCED 3 (without distinction A-B-C, 2y+)	15.3%▲	7.0%▼
• ISCED 4C	0.3%	0.1%
• ISCED 4A-B	0.2%	0.3%
• ISCED 4 (without distinction A-B-C)	1.9%∆	0.5%∇
• ISCED 5B	14.3%∆	9.5%∇
• ISCED 5A, bachelor degree	4.1%▼	10.5%▲
• ISCED 5A, master degree	8.4%	8.9%
• ISCED 6	1.0%	0.5%
• ISCED 5A bachelor's degree, 5A master's degree, and 6 (without distinction)	0.2%▼	5.4%▲
N	*246*	*42.871*
Thinking about whether this qualification is necessary for doing your job satisfactorily, which of the following statements would be most true?		
1 This level is necessary	72.1%	69.7%
2 A lower level would be sufficient	18.6%	22.4%
3 A higher level would be needed	9.4%	7.9%
N	*232*	*37.131*

From the comparison of Tables 4.6a and 4.6b, we can see that current job requirements for the job someone is working in today, is slightly higher in most of the occupational groups. Tables 4.6c shows that the job requirements are more focused on the middle level of education, more than in this group of all other sectors. The last rows in table 4.6c show whether employees find that the required educational levels today are necessary. Nearly three quarters of employees find that recruiting levels are adequate; some 19% find that recruiting levels are too high.

4.3.5 Netherlands Working Conditions Survey (NWCS-NEA)

Tables 4.7a and b show results from the Dutch NWCS-NEA survey (TNO/CBS). The data for 2014, 2015 and 2016 have been pooled to generate a more reliable picture of work in the railway sector. The following sectors can be identified: Manufacture of railway locomotives/rolling stock & Construction of (underground) railways (3020+4212); Freight & Passenger

(interurban) rail transport (4910+4920), and all other sectors.[11] In total, there are some 123,342 respondents for the whole survey. We can identify 424 persons working in the railway sector. The figures allow us to get some insight into employment and skills distribution in the Dutch railway sector.

Table 4.9a and b The Netherlands: educational attainment and occupational groups (ISCO) in the Railway sector (total percentages). *Source*: NWCS-NEA (TNO/CBS); weighted results, derived from the survey years 2014, 2015 and 2016 ('average result is 2015')

	Educational attainment			
	ISCED 0-2	ISCED 3-4	ISCED 5-6	Total
Senior managers	0.2%	2.2%	2.7%	5.2%
Professional engineers	0.7%	1.2%	6.0%	8.0%
Technicians and associate professionals	1.0%	4.0%	2.7%	7.7%
Clerical support workers	4.0%	10.4%	5.2%	19.7%
Service workers and sales workers	5.5%	14.4%	2.2%	22.1%
Craft and related trades workers	2.2%	4.7%	0.5%	7.5%
Plant, machine operators and train drivers	9.0%	18.2%	1.5%	28.6%
Elementary occupations	1.0%	0.2%		1.2%
Total	23.6%	55.5%	20.9%	100.0%

	ISCED 0-1 Primary level of education	ISCED 2 Lower secondary level of education	ISCED 3-4 Upper/post secondary level of education, non-tertiary education	ISCED 5 First stage of tertiary education (bachelor)	ISCED 6 Second stage of tertiary education (master	Total
Senior managers		0.2%	2.2%	1.7%	1.0%	5.2%
Professional engineers	0.2%	0.5%	1.2%	3.2%	2.7%	7.9%
Technicians and associate professionals		1.0%	4.0%	2.0%	0.7%	7.7%
Clerical support workers	0.5%	3.5%	10.4%	4.2%	1.2%	19.9%
Service workers and sales workers	1.2%	4.2%	14.4%	1.5%	0.7%	22.1%
Craft and related trades workers	0.2%	2.0%	4.7%	0.2%	0.2%	7.4%
Plant, machine operators and train drivers	1.2%	7.4%	18.1%	1.5%		28.3%
Elementary occupations	0.5%	0.7%	0.2%			1.5%
Total	4.0%	19.6%	55.3%	14.4%	6.7%	100%

The NWCS-NEA-data give a reliable picture of the jobs in the railway sector in the Netherlands. Comparing these figures with the EU information (see LFS-2016), we can see that, overall, the required skill levels seem to be quite in line. Lower levels of ISCED are more employed in

[11] *Note*. Percentages are column percentages and are tested with the Pearson χ^2-test (horizontal comparisons). The contrast is subgroup versus 'rest' (weighted deviation contrast). ▲ and ▼: p<0,05, significant high (low) percentages (two-tailed), and Cohen's d is at least 0,20. Open arrows ∆ and ∇: also significant, but Cohen's d is smaller than 0,20 (Cohen, 1988).

the Dutch situation, which is mainly caused by higher levels of such levels in more operational jobs such as service workers and train drivers.

4.4 Estimates of required skills for staff categories

In this section, we are looking at the different skills required from the different staff categories in the railway sector. Currently, there is little information that provides us with insight in what actually is required from the different staff categories. Such insight is important to understand which skills sets will be required in the future. There are only two surveys that can provide some insight into the skills sets: ESJS (2014) and PIAAC (2012). Even though the number of respondents is too low for each of the cells to make reliable estimations, the data do give us some first indication of how the jobs compare to each other. For our comparison, we have clustered the great number of questions into four different skills requirements: STEM skills (technical skills), communication skills, social skills and organisational skills. The CEDEFOP and OECD surveys provide information on all four types of skills. The CEDEFOP data provide comparisons between what the respondents think they have as skills and what the job requires as skills. OECD only provides the latter information. The questions are not the same, so the comparisons should be used with some caution.

4.4.1 STEM skills

The following two graphs summarise the data from ESJS 2014 and PIAAC 2012. Remember that the PIAAC-data only involve a limited number of countries in Europe (14).

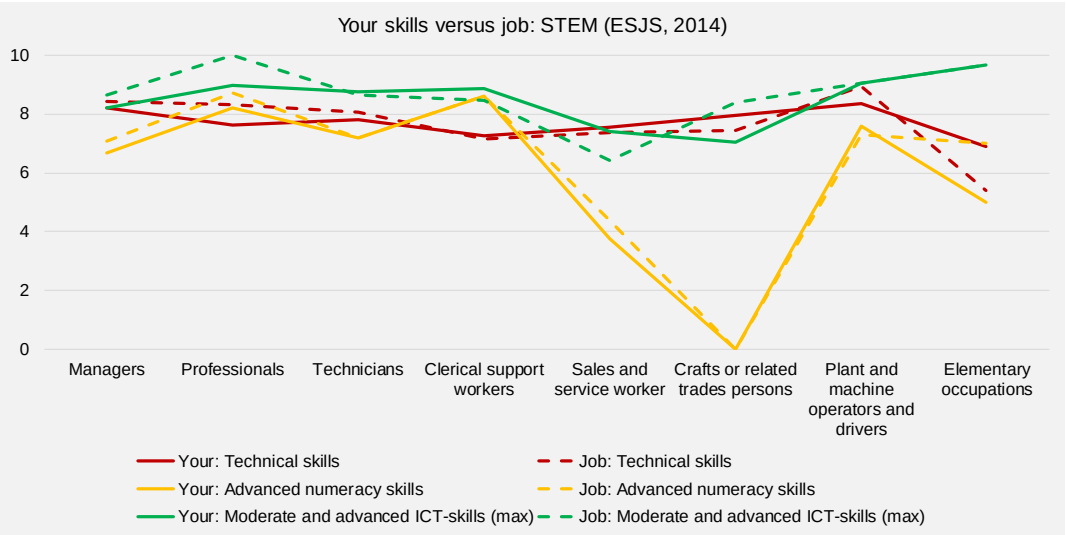

Figure 4.2 ESJS 2014: comparison of STEM-skills for major occupational groups in the railway sectors

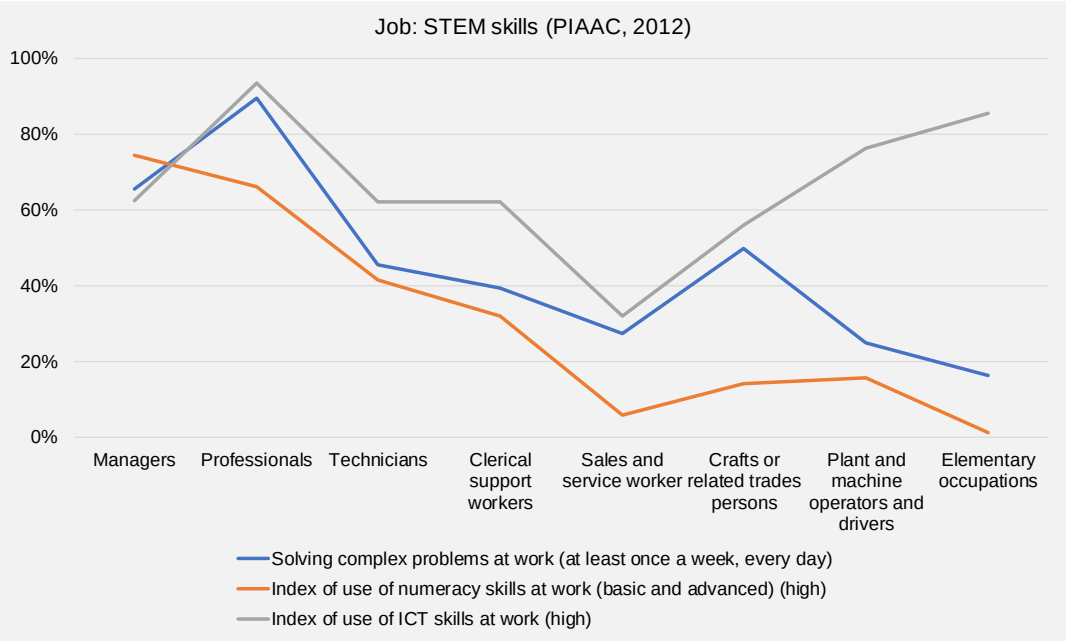

Figure 4.3 PIAAC 2012: comparison of STEM-skills for major occupational groups in the railway sectors

The ESJS (Figure 4.2) has the most elaborated results. The following results are interesting:

- The distinction between what your skills are (full line) and what the job requires (dotted line), does not show any real distinctive results;
- All occupations report high use of technical and moderate/advanced ICT-skills. There are only slight differences visible, even between professionals (engineers) and elementary occupations;
- The main difference between occupations is on advanced numeracy skills. Such skills are less present among sales/service workers, craft or related trades, plant machine operators/drivers and elementary occupations.

In the PIAAC-survey (Figure 4.3), we don't have the same topics as in the ESJS, so we have selected questions that are proxies to the topics of the ESJS. The PIAAC also provides indices for several topics, summarising several questions. The results show clear differences between occupations:

- Professionals show the highest use of the skills for solving complex problems and of ICT skills at work;
- Numeracy skills show less use from management to elementary occupations;
- ICT skills at work are quite high in all occupations except for the sales occupations.

The overall comparison of STEM-skills is not very consistent between the two surveys. The results do not allow the conclusion that lower ranked occupations do not require the identified STEM-skills. All jobs seem to require a proficiency in the different technical skills.

4.4.2 Communication skills

The following two graphs summarise the data from ESJS 2014 and PIAAC 2012.

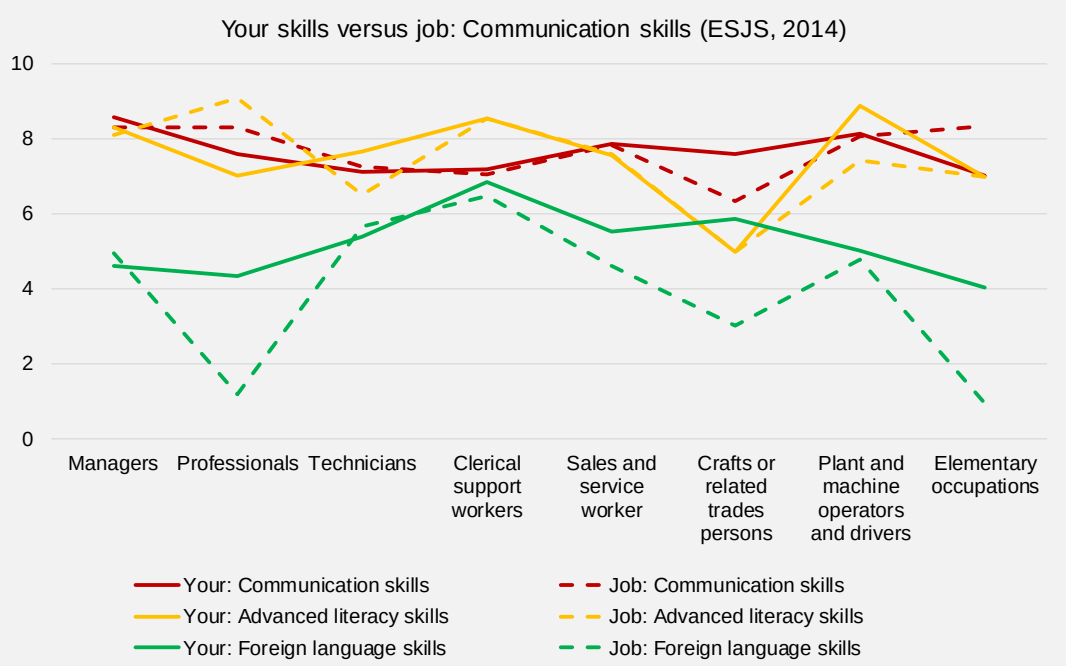

Figure 4.4 ESJS 2014: comparison of communication skills for major occupational groups in the railway sectors

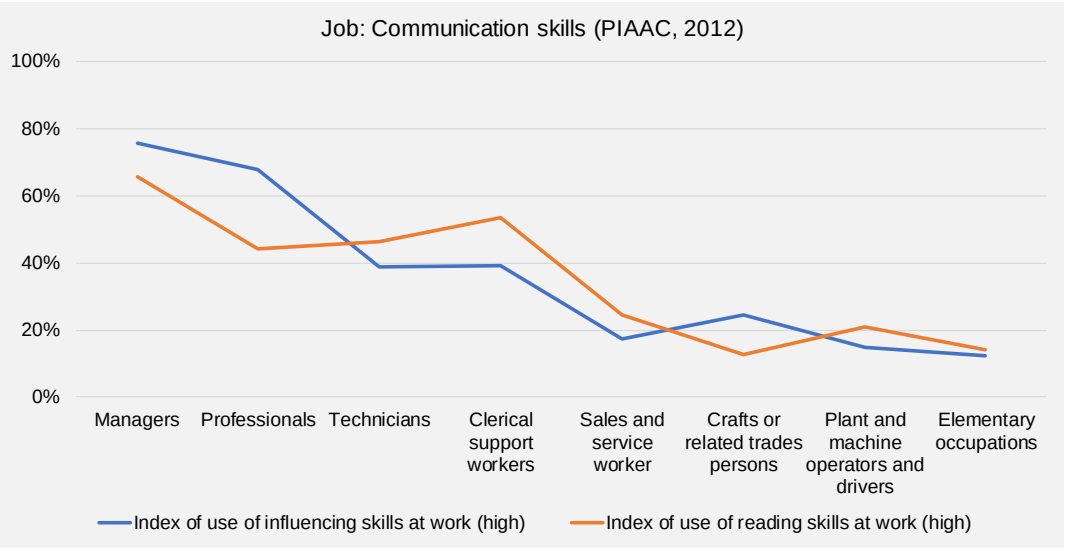

Figure 4.5 PIAAC 2012: comparison of communication skills for major occupational groups in the railway sectors

The ESJS again has the most elaborated results. The following results are interesting:

- The distinction between what your skills are (full line) and what the job requires (dotted line), shows some more variation, but the scores are not very different or do not allow different conclusions between presence of skills and job requirements;
- All occupations report high use of communication and advanced literacy skills. The main difference is for foreign language skills. Managers, professionals and craft workers and elementary occupations report low use of such skills. Clerical and sales workers report higher use of such skills.

In the PIAAC-survey, we don't have the same topics as in the ESJS. There is no information on language skills. As with the STEM-skills, the results show clear differences between occupations:

- Managers and professionals show the highest use of influencing and reading skills. Clerical support work also requires reading skills;
- Other occupations report quite low use of communication skills.

The overall comparison of communication skills is again not very consistent between the two surveys. Management and professionals are in need of stronger communication skills than in other occupations. Language skills are necessary in the jobs with contacts with customers.

4.4.3 Social skills

The following two graphs summarise the data from ESJS 2014 and PIAAC 2012.

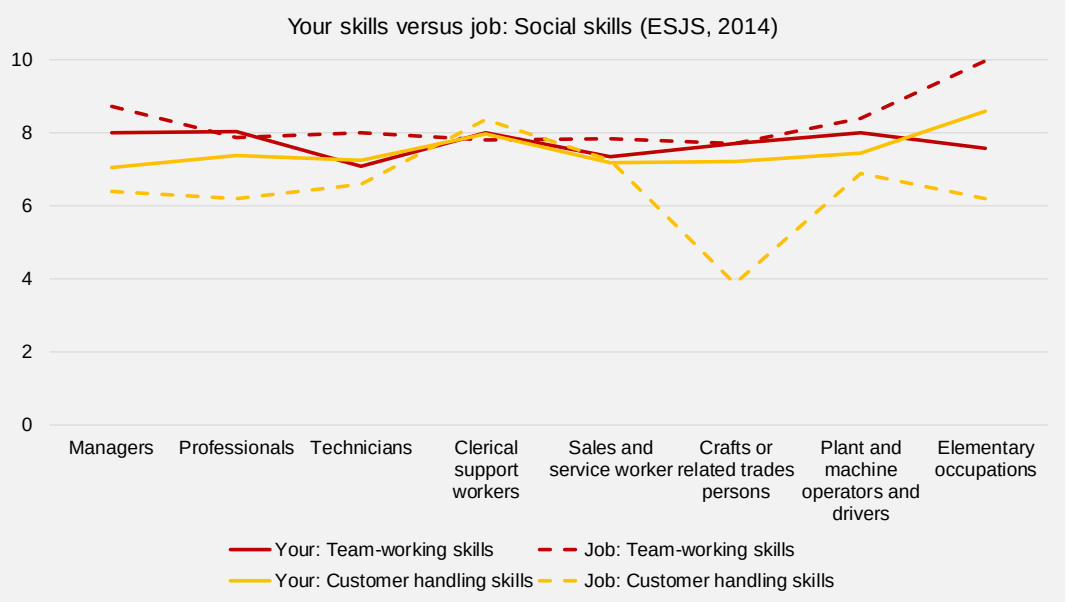

Figure 4.6 ESJS 2014: comparison of social skills for major occupational groups in the railway sectors

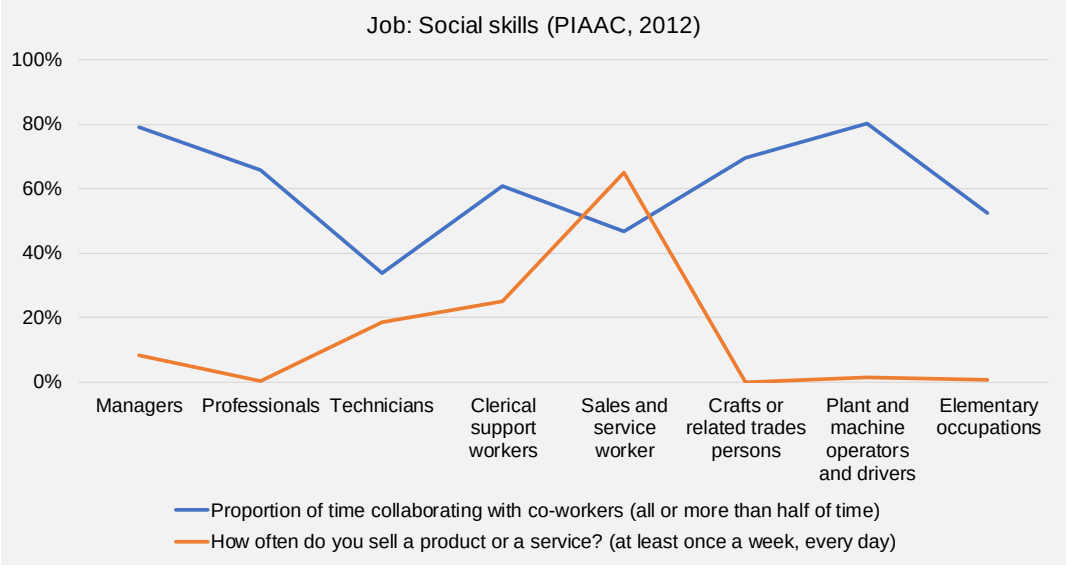

Figure 4.7 PIAAC 2012: comparison of social skills for major occupational groups in the railway sectors

The following results in the ESJS are interesting:

- The distinction between what your skills are (full line) and what the job requires (dotted line), shows some more variation, but the scores are not very different or do not allow different conclusions between presence of skills and job requirements;
- All occupations report high use of team-working skills;
- The difference in customer handling skills is also not extreme, except for the craft workers. These occupations seem to report less demand for such skills.

In the PIAAC-survey, we don't have the same topics as in the ESJS. We selected some proxy questions. As with the previous skill-sets, the results show clear differences between occupations:

- Collaboration is high in all occupations, except for technicians. These jobs seem to be more specialised and probably more solitary;
- Contact with customers is very different between occupations. Only sales and service workers have such contacts.

The overall comparison of social skills is again not very consistent between the two surveys. Social skills are needed for all occupations, but only sales and service workers interact with customers. These are the only occupations requiring such skills sets.

4.4.4 Organisational skills

The following two graphs summarise the data from ESJS 2014 and PIAAC 2012.

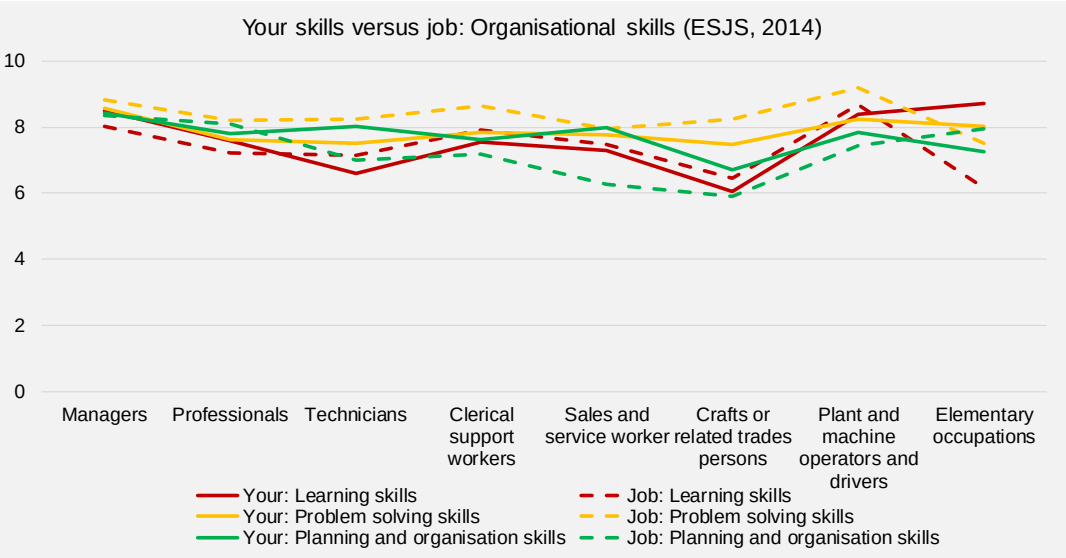

Figure 4.8 ESJS 2014: comparison of organisational skills for major occupational groups in the railway sectors

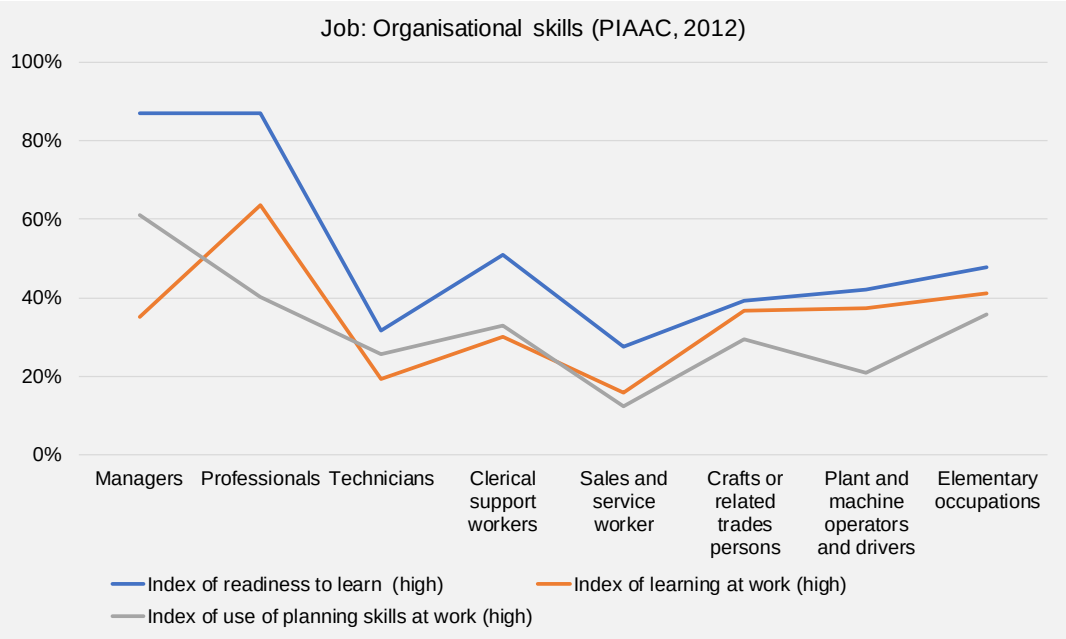

Figure 4.9 PIAAC 2012: comparison of organisational skills for major occupational groups in the railway sectors

The following result in the ESJS is interesting:

- The distinction between what your skills are (full line) and what the job requires (dotted line), shows some limited variation. All occupations report high levels of learning skills, problem solving skills and planning/organisation skills. Managers report highest scores, but the differences are not spectacular.

In the PIAAC-survey, we don't have the same topics as in the ESJS. As with the previous skill-sets, the results show clear differences between occupations:

- The main difference is with 'readiness to learn'. Managers and professionals (engineers) find this requirement important in their jobs.
- The other organisational skills show lower figures, mainly among the clerical and service workers.

4.4.5 *Overall view*

The analysis of ESJS and PIAAC for skill sets does not show a very consistent picture between the two surveys. In the ESJS, it seems that all occupations require all of the skill categories we have identified. In the PIAAC, which is a more limited country dataset, the differences are clearly greater between occupations, with as main tendency that managers and professionals report higher use of all skill sets. For the discussion, it seems that different jobs require different skill sets, but that, with the ESJS in mind, all jobs in the railway sector report high skill requirements.

4.5 Summary

Based on evidence collected in several studies, the following main conclusions can be drawn:

- There is a clear upskilling tendency visible in all railway jobs, but mainly in higher jobs such as professionals, technicians and clerical support workers there is an upskilling re-

quirement towards ISCED5-6 (academic level). In more basic jobs, job requirements seem also to have shifted upwards, but more to middle educational levels;

- Most of the employees need middle level of education to get recruited and to perform their jobs;
- The ESJS adds to this picture that educational requirements may be on the rise in these higher jobs, but that employees experience that requirements in work itself may not be rising. Recruiting is not connected to changes in job content, or it may be that future changes may require higher job levels. The PIAAC confirms this result in this sense that current requirements to work in a job have risen over time. Most employees find that these requirements are needed for the jobs, but an important group also finds they are over-qualified;
- Comparison with national data (only Dutch data available) shows that the general EU-skills distribution seems to be reproduced, but that there are some noticeable differences: the Dutch railway personnel seems to need lower levels of educational requirements for operational jobs such as service workers and railway workers;
- PIAAC and ESJS give overviews of different types of skills needed for occupations. The ESJS does not show major distinctions in skills profiles, which would mean that all jobs require a considerable amount of skills. The PIAAC shows more differences between jobs.

The figures also show that regional differences (core-countries versus rest) do exist.

5 Working conditions driving skills requirements

5.1 Introduction

To understand changes in skill requirements, this report provides a first insight into working conditions developments of the currently employed persons. The EWCS (Eurofound), ESJS (CEDEFOP), PIAAC (OECD) and NWCS-NEA (Dutch data) are the most important sources here. To get an indication of the quality of work, the results of the railway employees are compared to the general working population in these surveys.

5.2 EU-level data

5.2.1 EWCS (Eurofound)

Table A1.1 in Appendix 1 shows the results from the 6th EWCS survey for the EU-28 in 2015. The figures allow us to get insight into working conditions in the EU railway sector. Important results for the employees in this sector, coming from the comparison with all other employees, are:

- A relatively high percentage of employees in the railway sector are exposed at work to breathing in smoke, fumes, powder or dust, etc.: 20.5% face this around half of the time or more (versus 10.5% of the workers in other sectors);
- Exposure at work 'to noise so loud that you would have to raise your voice to talk to people' is the case around half of the time or more for 36.9% of the employees (versus 18.1%);
- Around half of the time or more exposure at work to low temperatures whether indoors or outdoors, is experienced by 29.8% (versus 10.7%) of the employees;
- Also, around half of the time or more exposure at work to vibrations from hand tools, machinery, etc. is highly prevalent (32.5% versus 13.0%);
- Like in other sectors, around three out of five employees in the railway sector work in a group or team that has common tasks and can plan its work, although team autonomy is somewhat low regarding the topic 'deciding by themselves who will be the head of the team' (12.4% of the employees can, versus 26.5%);
- Comparatively many workers in the railway sector have, over the past 12 months, undergone training to improve their skills and which was paid for or provided by the employer (57.3% versus 41.1%);
- Moreover, a high share of employees received a substantial number of days training: one out of five employees (20.4%) followed training for 10 or more days (versus 7.5%);
- Only just a few employees did ask for training to be provided for them by their employer (0.5% versus 10.0%).

In the following graph (Figure 5.1), the main drivers for changes in skill profiles are shown using data on railway employees in the Eurofound Working Conditions Survey (2015). The figure compares the results for railway employees (all occupational categories) with employees in other sectors. Those working conditions were selected that relate to the main skill categories discussed in previous sections of this report:

- Technical skills: substances, physical work, complex tasks, use of computers
- Communication skills: noise;
- Social skills: direct demands: people;

- Organisational skills: jobs demands, autonomy, machine driven, skills to cope with more demands.

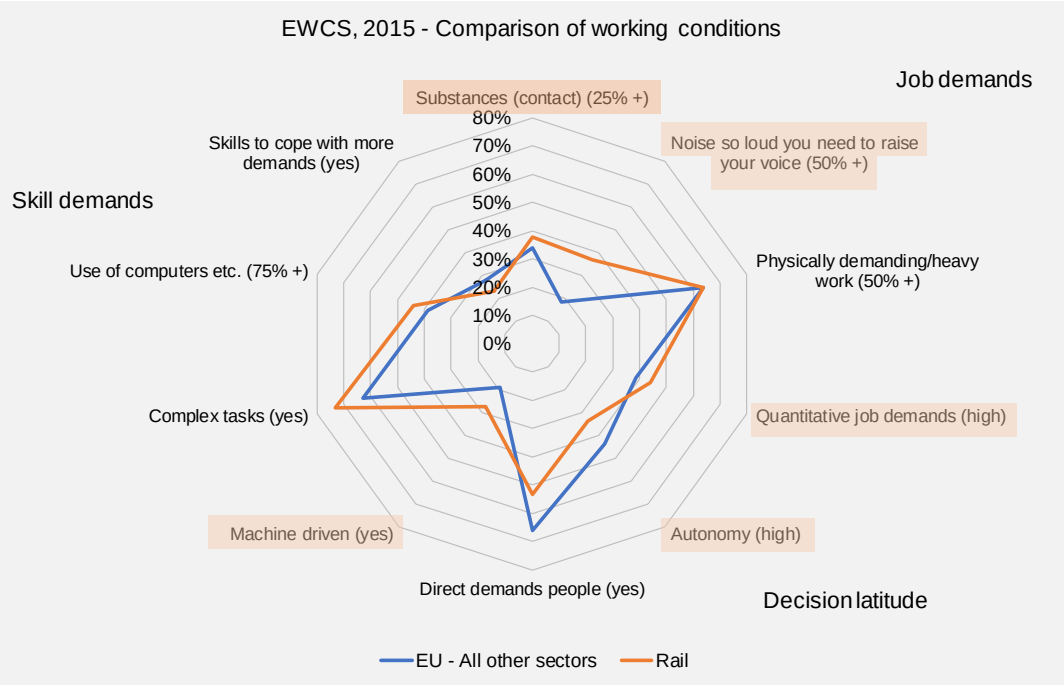

Figure 5.1 Comparison of main working conditions of rail employees

The railway workers compare as following:

- Better than other employees: contact with substances, noise, job demands, machine driven, complex tasks, use of computers;
- Comparable to other employees: physical demands;
- Worse than other employees: autonomy, direct demands from people, skills to cope with more demands.

5.2.2 ESJS (CEDEFOP)

Table A1.2 in Appendix 1 presents the results from the ESJS for the EU-28 in 2014.
The figures refer to employees as selected by an in-visu approach of the job titles as described by the respondents (employees). Important results for the railway sector, coming from the comparison with all other sectors, are:

- The highest level of literacy skills required for doing the job, is best described for most employees (64.8%) as 'basic literacy skills (e.g., reading manuals, procedures, letters or memos)' (versus 45.0% for the employees in the other sectors), while 'advanced literacy skills (e.g., writing long documents such as long reports, handbooks, articles or books)' are required for 35.2% of the employees (55.0%);
- 'Basic numeracy skills (e.g., calculations using decimals, percentages or fractions, understanding tables and graphs)' are required from 86.3% of the employees (versus 67.1%). Additionally, 'advanced numeracy skills (e.g., Calculations using advanced mathematical or statistical procedures)' are needed for 13.7% of the employees (versus 32.9%). However, the importance hereof for doing their job is relatively low compared to other employees: a score of 7.13 on a scale from 0-10 (0=not at all important - 5=moderately important - 10=essential) (versus 8.18 for the other employees);
- The highest level of Information Communication Technology skills required for doing their job, is low for a relatively high share of employees. 'Basic ICT skills (e.g., using a PC,

tablet or mobile device for email, internet browsing) are required for 44.6% of the employees (versus 21.9%). 'Moderate ICT skills (e.g., Word-processing, using or creating documents and/or spreadsheets)' are a requirement for 44.9% of the workforce in the railways sector (versus 61.3%), while 10.5% (versus 16.8%) need 'advanced ICT skills (e.g., developing software, applications or programming; use computer syntax or statistical analysis)';

- Like the results from the EWCS, a high share of employees in the railways sector attended training courses (work-based, classroom based and online): 81.6% (versus 62.7%);
- The main reason for doing this training was relatively often - for 55.5% of the employees - to comply with mandatory policy of employer or legal requirement (e.g., health and safety, induction sessions) (versus 41.5% of the employees in the other sectors);
- To stay up-to-date with changing skill needs of the job was reported less often as a reason 41.8% (versus 57.2%);
- This also holds for the reasons 'to perform better at the job' (36.3% versus 52.3%), and 'to improve career prospects' (16.8% versus 31.7%);
- Changes in the workplace were relatively often supported by training activities paid for by their employer (only 13.8% did not receive training, versus 31.5% in other sectors). These trainings accompanied changes in the last 5 years in their workplace such as changes to the technologies to be used, to working methods and practices, to the products/services they help to produce, or to the amount of contact with clients or customers;
- Rail employees report as relatively important in their decision to accept the job, before starting working for their current employer, the fact 'the company/organisation was well known/respected in its field'. This topic was rated 8.08 on average on a scale from 0=not at all important to 10=essential (versus 7.02 among employees in the other sectors);
- Besides there was a high scale score (7.88) for the topic 'the pay and package of benefits (e.g., health insurance, bonuses, company car, etc.) was good' (versus 6.41).

5.2.3 PIAAC-survey (OECD)

Important findings from the PIAAC survey (Table A1.3 in Appendix 1), for the railway sector in the examined 14 EU-countries, are:

- The share of employees is about equal for the railway and other sectors regarding participation during the last 12 months in courses conducted through open or distance education; attendance of any organised sessions for on-the-job training or training by supervisors or co-workers; participation in seminars or workshops, or other courses or private lessons. More so than in the other sectors, these training activities did take place only/mostly during working hours (90.2% in the railway versus 73.6% in other sectors);
- Also, more often their employer paid (partly or totally) for tuition or registration, exam fees, expenses for books or other costs resulting from participation in this activity (87.4% versus 70.8%);
- Lastly, in line with the ESJS results on numeracy skills, relatively few employees read - every day/at least once a week - diagrams, maps or schematics in their job (29.4% versus 46.9%).

5.3 Netherlands Working Conditions Survey (NWCS-NEA)

Table A1.4 in Appendix 1 shows results from the Dutch NWCS-NEA survey (TNO/CBS). As clarified earlier, the data for 2014, 2015 and 2016 have been pooled to generate a more reliable picture of work in the railway sector. In total, there are 123,342 respondents for the whole

survey. We can identify 424 persons in the railway sector. Important results from Table A1.4 in Appendix 1, are:

- In the last year, in the manufacture of railway locomotives/rolling stock/railways construction sector many employees faced a major restructuring (30.9%) and/or a downsizing with compulsory redundancies (35.2%). This was much less so the case in freight/passenger rail transport (respectively 17.2% and 2.5%) and in the other sectors (18.1% and 11.9%);
- More than half of the employees in the railway sectors report that they have to do dangerous work (versus 22.4% in the other sectors). Relatively big dangers in the manufacture of railway locomotives/rolling stock/railways construction sector are to slip or to trip (76.7%), to get trapped (47.2%), or to crash, or collisions (74.4%). Confrontation with violence (72.1%) and to crash or collisions (68.0%) are relatively big dangers in freight/passenger rail transport;
- The clear majority of the employees in freight/passenger rail transport (58.0%) find their job physically demanding, whereas this is the case among 50.1% of the employees in the manufacture of railway locomotives/rolling stock/railways construction sector and 42.8% of the employees in other sectors. Relatively many in the manufacture of railway locomotives/rolling stock/railways construction sector find the current OSH measures on physically heavy work insufficient (24.1%);
- One out of five employees in the manufacture of railway locomotives/rolling stock/railways construction sector have ‘so much noise at their workplace that they need to talk loudly to be audible’ (9.2% and 7.0% in the other railway sectors, respectively all other sectors);
- Employees in the manufacture of railway locomotives/rolling stock/railways construction sector have a lot of autonomy (72.2%), while autonomy of those in freight/passenger, etc. sectors is low (39.3%), compared to the autonomy of the average employee (50.6%), especially since the first group is regularly able to take time off work when they want to. This is (much) less so the case for the other groups;
- The extent to which employees in freight/passenger rail transport often or always encounter high quantitative job demands is low (requirement to work very fast, to do a lot of work or work extra hard): a score of 18.4% versus 31.7% for those in the other railway sectors and 38.0% for those in other sectors. A relatively large share of the employees in the manufacture of railway locomotives/rolling stock/railways construction sector report that the current OSH-measures on demanding work/work stress are insufficient (46.2%);
- Many employees in freight/passenger rail transport face unwanted behaviour such as intimidation, physical violence and/or bullying by clients (e.g., passengers, etc.): 58.6% of the employees reported so, versus 7.9% in the manufacture of railway locomotives/rolling stock/railways construction sector and 23% in the other sectors. Moreover, 35.1% of the employees in freight/passenger rail transport find the current measures on intimidation, aggression or violence by customers insufficient. The same holds for measures on viruses, bacteria or fungi (5.3%);
- Also, 6.2% of the employees in freight/passenger rail transport were, in the past 12 months, victim of one or more work accidents with one or more days of sick leave - versus respectively 3.2% and 1.5% of the employees in the other (rail) sectors;
- Average individual sickness leave percentage is highest among employees in the manufacture of railway locomotives/rolling stock/railways construction sector: 8.35% days of sick leave on average per year per worker). Also, individual sick leave percentage of workers in freight/passenger rail transport (5,94%) is higher than the average in other sectors (3,83%);
- Regarding other OSH measures, relatively many employees in the manufacture of railway locomotives/rolling stock/railways construction sector experience the current measures on prolonged computer work as insufficient (26.1%), as well as on dangerous substances (9.2%) and safety and work accidents (15.4%);

- Like the results from other (European) surveys, also many employees in the Dutch railway sectors report that they did participate in training or a course for their work, in the last two years. In the manufacture of railway locomotives/rolling stock/railways construction sector 70.7% of the employees did so, in freight/passenger rail transport 65.1% - versus 51.3% of the employees in the other sectors;
- Lastly, only 35.5% of the employees in freight/passenger rail transport report that they could easily get a new job/position with another employer - versus 53.0% and 56.1% of the employees in respectively the manufacture of railway locomotives/rolling stock/railways construction sector, and the other sectors.

5.4 Summary

Main results are:

- The working conditions in the railway sector are perceived as more demanding than in other sectors. The Dutch data confirm the EU results and add to these results that most employees find that measures to tackle these demands are insufficient;
- Training efforts, on the other hand, are substantial and higher than in other sectors.

6 Foresight and forecasting studies

6.1 Introduction

In this section, an inventory is presented of foresight and forecasting studies on skills and relevant factors having an impact on skills. An analysis of 26 forecast studies has been carried out, including studies of skill development and relevant technological developments affecting employment and skills (such as task-based technological change; skill-based technological change). This inventory includes sources of Eurofound and the European Commission (and related institutions). No rail specific sources were found of CEDEFOP, Eurostat and EU-OSHA. The inventory also shows insights from the many reports by EU-projects, consultancies and the sources of the major railway in each of the four countries and at the EU-level. Additional information has been collected through websites and statistics. These foresight and forecasting studies have been analysed to understand the current state of play in employment and skill-development. The results will be used in this first overview on the state of play.

6.2 Foresight and forecasting studies on skills in Europe

6.2.1 Overview of foresight and forecasting studies from the railway sector

To identify the different studies, the following websites have been consulted:

- Eisenbahntechnische Rundschau;
- NSAR news site;
- Railtechnology Magazine;
- Railway Engineer;
- Railway Staff;
- Railway Gazette.

In Table 6.1, an overview is given of recent foresight and forecasting studies with views on skill developments in the future.

Table 6.1 Overview of recent forecast studies in railway sector (* selected for analysis)

Country	Foresight and forecasting studies	Year
UK	RSSB Scoping Study for a Rail Skills Supply & Demand Forecasting Model	2005
UK	RSSB Workforce Competence and its Management: A five to ten year view (2006)	2006
EU*	Investing in the future of jobs and skills	2009
EU*	Skillrail	2012
EU	Eurofound, Employment in railways sector	2012
UK*	NSARE, Skills forecast	2013
AUS	Industriellenvereinigung. Impact Austrian railways	2013
EU	TRIP, Employment in transport	2013
EU*	JRC study on skills	2014
UK	Women in Rail 2015 – Industry survey report	2015
EU	CER Women in Rail	2015
EU*	Panteia, trends and prospects working conditions transport	2015
SLO/CZ	Challenges in Slovak republic	2016
EU	Foster Rail (future of surface transport research rail - CSA)	2016
EU	SCI/Verkehr Threats to future rail	2016
EU	CER. Attractive working conditions	2016

Country	Foresight and forecasting studies	Year
EU	Council of the European Union	2016
EU	Commission staff working document - Report from the commission to the European Parliament and the Council. Fifth report on the monitoring developments of the rail market	2016
EU	UNIFE World Rail Market Study 2016 (Roland Berger)	2016
EU	ERRAC, Rail 2050 vision. Rail – the backbone of Europe's mobility.	2017
EU	C4R Capacity for Rail. Rail freight systems of the future with analysis of market up-take, Madrid	2017
Baltics	EY Rail baltica global project cost-benefit analysis	2017
EU	Skillful (Bekiaris)	2017
EU	Érsek. Locomotives study.	2017
EU	SCORE 2017 Report on current status of framework conditions for the European transport manufacturing industry (Kramer)	2017
EU	European Commission, Coach services	2017
EU	SCORE 2018: comparison EU-projects Futurail, Skillrail (Pagaldy)	2018
EU	S2R Innovation potential (Chen)	2018

In Appendix 2, we have included a summary of the main conclusions on employment and/or skills for each of these studies. Those studies marked with an asterisk are documented below.

6.2.2 Studies by RSSB (2005; 2006)

RSSB conducted several studies to prepare major forecasting studies in the 2000s. In practice, the objectives remained limited to a scoping study and a study on competence management. In 2005, the RSSB conducted a short scoping study (Scoping Study for a Rail Skills Supply & Demand Forecasting Model (RSSB T442)) to determine the boundaries of a labour market model, the information required to develop the model, and the possible sources of such information. A stakeholder workshop was then held to determine how the industry currently carried out resource planning, how the model could assist them in this process, and whether they would support its development. The key research finding was that, generally, the industry would be unsupportive of a macro-economic model for the whole UK rail industry, but believed it may be useful for the Government and training providers. The companies had their own benchmark studies and forecasts based on data that are put into the public domain. The companies were already dealing with existing and potential skills shortages in ways that supported their own interest. They believed this was the correct approach, as it serves to maintain competitiveness within the industry. Suppliers of rail goods and services could also work outside Britain so their interests do not necessarily coincide with those of the British rail industry. For as far as studies should be conducted, companies supported a study to assess the scope and effectiveness of training and a study to identify whether excessively high standards of performance specified for certain trades was a barrier to entry leading to skill shortages. It would take to the 2010s for a next forecasting study to be conducted.
The aim of the competence management project (Research Programme Management Workforce Competence and its Management: A five to ten year view (2006) (RSSB Report T590)) was to research the competence management requirements of the rail industry over the next 5-10 years and make recommendations on how these requirements can be met. In the project, competence management arrangements in the rail industry of 2006 were reviewed. From this study, with comparison to international best practice and with air traffic management, industry requirements over the next 5 to 10 years were identified, leading to recommendations for improvement. Competence management practices in railway companies were quite spread out on dimension of individual and business strategy. The rail industry is not peculiar in having some companies who only achieve minimum compliance of competence management guide-

lines with other companies performing in a similar way to leading edge companies. According to this study, the key question for the rail industry was how to change competence management practices. The main policy advice from the study was that railway group members, their suppliers and contractors should use competence management to make sure that the staff and contractors they employ perform in ways that are safe, reliable and contribute to continuous improvement in overall operational and safety performance. Their approach to competence management should take into account both the need to optimise the competence of individual staff members and the need to optimise the competence of the business as a whole. The recommendations of the study focused on better competence management arrangements and support line managers and supervisors to do this. Competences of semi- and un-skilled workers needed to be developed so that they require less supervision. Future changes should be occupational licensing proposals, effective risk-based approach to assessment across the industry, and increase the pool of suitably qualified applicants for engineering and technician jobs in the rail industry. These plans have been carried over the following years by other actors (Skillrail; NSARE). The next overview study by RSSB was in 2017, on non-technical skills for operators. RSSB has limited itself to safety management practices, what limits their overviews of the general development of skills in the UK railway sector.

6.2.3 Investing in the future of jobs and skills (Davydenko et al., 2009)

This study is limited to NACE-codes 49.1 and 49.2. It describes the employment situation in 888 companies at the EU-level in 2006. Interestingly, in 2006, a survey about future skill needs in rail transport, conducted by the UK Sector Skills Council (SSC) for passenger transport in 2006, stressed “soft skills” like leadership skills, people management and customer service have been named as most important for operating train companies in the future (GoSkills, 2006). The figures date from a period that deregulation was still the main topic on the agenda of rail stakeholders. Technology was focused on building high speed trains, and new systems to conduct such developments throughout Europe.

Separate studies were conducted for rail vehicle drivers (locomotive engine drivers, tram drivers). The analysis took account of different scenarios for future change in the European railway sector of jobs, skills and knowledge (p.91): *no limits* (less barriers and regulation), *off-roading* (limited resources available at all levels), *shifting gears* (regulation dominant, but more growth possibilities), *slow-down* (stagnation because of rising costs). The scenarios are plausible futures and paths to achieve these futures. In the following list, the main futures are described for major job categories:

- *Managerial functions* should maintain their level in all scenarios, even if growth would be quite high. Managers would require more e-skills because planning and managing will become more computer-based. In most cases, more understanding of regulation will be needed. Managers will require broader skill sets to deal with rising complexity. Only in continuing crisis situations, more entrepreneurship will be required;
- For the *business and logistics professionals* an increase in employment is foreseen, because of privatisation, business restructuring, more need for marketing and service concepts, the necessity for improving efficiency and the implementation of new technologies. As with managers, the future professionals will require broader skill sets. Team work will be required and higher analytical capabilities to be able to identify trends in complex situations;
- Railway companies were quite overstaffed with *administrative and back office workers*. These job functions would shrink in any scenario, except if overall demand for rail would increase dramatically. On the other side, skill demands will rise for these functions. Some functions will experience outsourcing of tasks;
- The number of *stewards, mechanics and train drivers* will increase due to the converging factors of growing demand for rail transport and the call for safety improvement. Stew-

ards, for example, will not only add to on-board comfort but will also provide safety. Only in the “off roading” scenario, where regulations are less strict and demand for transport declines, the number of stewards, mechanics and train drivers will decline. Skill requirements will be rising: more e-skills, multi-skilling, more language skills, more creativity. Rail mechanics will experience rising technical knowledge requirements. Interdisciplinary abilities will be important. Train drivers will not all have the same changes in skills: much is dependent on the transport system (tram, train, high speed train, etc.). In any scenario, skill requirements will become higher. Demands will be higher because of changing levels of personnel.

Strategies to deal with changes depend on the type of job:

- Rail transport managers: sector specific training; recruiting from other sectors (post) and other countries; changing vocational education and training; changing work organisation;
- Logistics professionals: mainly more job specific courses to meet skills gaps.

6.2.4 Skillrail (2012)

The SKILLRAIL project (funded under the FP7) focused on improving education and training for railway workers, including a specific framework for creation, dissemination and transfer of knowledge within the European railway sector. SKILLRAIL aimed at fostering a better match between the human resources needs and the offer of skills coming out of the different research-based education and training institutions across Europe. According to studies, there is a huge number of educational programmes offered by hundreds of educational institutions, key industry actors, international associations or educational institution-industry alliances. This raises the need for harmonisation across Member States. The studies recognise that substantial progress in terms of harmonisation has been made by the educational institutions. The next further steps towards harmonisation and standardisation are mainly related to the types of degrees offered, the duration of studies, as well as the course credits, structure and content, while simultaneously leaving some room for diversity of student profiles. Recommendations suggested are mainly focused on strengthening of interactions between enterprises and educational institutions and the creation of further short cycle training courses in order to be faster in responding to labour market needs. To meet future requirements, this project proposes a virtual European University of the Railway (EURAIL) to address the training needs of the sector. The project does not include separate forecast or foresight analyses.

6.2.5 NSARE, Forecasting engineering jobs (2013)

The NSARE conducted one of the most in-depth forecasting of engineering jobs in the past years. The results are limited to the UK situation, but the lessons are useful outside the UK. From the analysis, non-engineering roles were discarded. The analysis links investments from 2013 to 2028 to employment forecasts. The forecasting model provides insight into:

- Activities: track, signalling and telecommunications, electrification and Plant, traction and rolling stock;
- Skill levels: prof engineer/general manager NQF 6-8; technician/manager 4/5; skilled 3; semi-skilled (2);
- Maintenance 0%; Projects and renewals (% 5 categories).

From these data it was possible to extrapolate an existing railway engineering workforce of some 100,000 people, 84,500 of whom are involved in railway engineering specific activities. Nearly 70% work in Track, almost half are semiskilled and 4.4% are female. The highest average age is in T&RS activities where some 20% are over the age of 55. Scenarios were calculated on the basis of shifting pensioning ages. A lesson from the study was that estima-

tions beyond 5 years are nearly impossible. The main reason is that future workloads are not available.

6.2.6 The JRC-IPTS study (2014)

Christidis et al. have used this material to make projections for employment in rail transport covering both passenger and freight activities. They start with the observation that it is difficult to acquire detailed data on employment that distinguishes between passenger and freight transport. Their calculations are at the level of both groups. The following conclusions are important for this study:

- The growth between 2010 and 2030 is expected to be comparable for the two types of rail transport according to the 2013 EU reference scenario, both increasing by about 48% in the period. However, the estimated growth in employment is significantly lower, only 4.9% in the same period, mainly because of an increase in productivity from the continued restructuring of rail operators across the EU and the impact of new technologies in all aspects of rail operations. Productivity is driven by privatisation (with mostly cuts in both administrative and technical jobs) and introduction of new technologies for traffic management, control, ticketing, maintenance and operation of rail services;
- The employment model expects the downward trend to continue until 2020, with the total number of jobs falling to 900 thousand. Employment is projected to grow again in the next 10-year period (2020 to 2030), when growth in passenger demand is expected to accelerate because of a higher penetration of high speed rail. Nevertheless, the overall picture for the sector in terms of employment is that of stagnation.

The employment changes hide major change in the levels of employment by occupation group:

- The number of administrative staff is expected to decrease by a further 23%, from 376 thousand in year 2010 down to 290 thousand in 2030. It is indicative that productivity for administrative jobs is expected to almost double (a 92% increase between 2010 and 2030). The trends for a reduction of administrative staff are a result of staff shifting to other sectors and staff retiring. Importantly, the estimates show recruitment of administrative staff with different profiles and skills than the ones leaving;
- The numbers of mobile and technical staff, on the other hand, are expected to grow more steadily, more in line with the growth in demand. Productivity for mobile and technical jobs is expected to grow at comparable rates to those of activity (27% and 11% respectively). The increase in recruitment of technical staff is noteworthy, being the result of the expected high growth in rail activity in combination with the low growth in productivity.

6.2.7 Panteia (2015)

The study of Panteia is one of the most comprehensive on employment developments in the railway sectors. Employment in 2010 is estimated at 685,100 (passenger, freight, inframanagement, urban rail). This was a decline from 689,800 in 2008. Within this number 510,400 work in passenger transport, 174,700 persons in freight.

Rail employment will further decline in this period with 0,1% between 2010-2020. Different scenarios have been tested to estimate employment development:

1. constant age-specific participation rates;
2. maximum age-specific/constant cohort-specific rates.

From a policy point of view this means that stopping the current steep decline of age-specific participation rates would help to keep up the labour force in transport-related occupations. In scenario 1 the supply of locomotive engine drivers, railway brake, signal and switch operators and transport conductors show the same growth rate as the average for all transport-related occupational categories (in 2010-2020 annually -0.1%). In scenario 2 the percentage for these

categories are lower (-1.0%) than average (-0.8%). Rail operators experience problems attracting new employees, although the extent of these problems differs markedly per staff category. The rail transport sector is especially facing recruitment problems at the level of higher education (engineers). Whereas employment in locomotive engine drivers, railway brake, signal and switch operators and transport conductors in the period 2010-2020 increases, the labour supply in these occupations decreases in scenario 1, while labour supply increases in scenario 2. Overall, the conclusion is that there will be shortages in technical jobs, shortages because of replacement for retirees, and higher demands for safety. The rail transport sector is especially facing recruitment problems at the level of higher education, notably on locomotive engine drivers.

Factors of importance for this decline:

- Continuous restructuring with productivity increases and costs (and thus employment) reduction, in line with other transport sectors;
- Restrictions in access to other Member States' networks (in spite of EU law providing for open access) have a negative impact on employment;
- Promoting single wagon load transport allows a credible environmental alternative to road and generates employment;
- New market entrants in the rail freight business concentrate on full train services with low labour intensity, while investment in the development of new infrastructure and the improvement of existing networks will create jobs in maintenance and support services for this new infrastructure;
- A relatively new phenomenon in the rail transport sector is self-employment (self-employed locomotive drivers - for instance in France - mainly in freight rail traffic);
- In the period 2010-2020, there are increases in employment expected for the most important rail transport occupations: locomotive engine drivers, railway brake, signal and switch operators and transport conductors (annually +0.7%, +0.6% and +0.7% against an average of 0.0%);
- Besides mutual recognition of requirements between ‘railway networks’, successful cross-border operations ask for common language and/or common communication system. Mostly, the solution is recruitment of train drivers and other on-board staff with knowledge of two or more languages. In some cases, a common simplified communication system has been chosen instead of a common language.

To tackle this decline, some specific policy suggestions for rail transport were provided in the report:

- The working image of rail transport is poor. It will require a major, multi-focus effort to make railway work more attractive and therefore, reduce the (expected) shortages with better working conditions and attracting female workers. Comparatively a large amount of information on good practices has already been disseminated throughout the sector;
- Shortages already occur and are expected to become more profound. Railway operators do not seem fully aware of the occurring issues with regard to recruiting young people. Employers must be aware to contribute. There is a lack of public training places. However, there is no clear view on the solutions and who should be involved in the implementation.

6.2.8 *Skillful project (H2020) (Bekiaris, 2017)*

This project is under way. The Inception Report does not yet provide an insight into possible data collection. The SKILLFUL project aims to identify the skills and competences needed by the Transport workforce of the future (2020, 2030 and 2050 respectively) and define the training methods and tools to meet them. The project critically reviews the existing, emerging and future knowledge and skills requirements of workers at all levels in the transportation sector,

with emphasis on competences required by important game changers and paradigm shifters (such as electrification and greening of transport, automation, Mobility as a Service, etc.); structures the key specifications and components of the curricula and training courses that will be needed to meet these competence requirements optimally, with emphasis on multidisciplinary education and training programmes; and identifies and proposes new business roles in the education and training chain, in particular those of “knowledge aggregator”, “training certifier” and “training promoter”, in order to achieve European wide competence development and take-up in a sustainable way.

As in our project, SKILLFUL uses the following categorisation of skill:

- **Low-skilled workers:** Most low-skilled workers require the so-called new basic skills. Workers in low-skilled jobs are expected to act appropriately at work and to perceive instructions from others correctly. Many low-skilled jobs also require physical abilities and mechanical skills, especially in the transportation field (i.e., loaders at ports, ticket collectors, truck drivers, road infrastructure maintenance personnel, etc.). In fact, some low-skilled jobs require physical and mechanical skills at higher levels than other jobs;
- **Middle skilled workers:** The term “middle skills” is being used to describe a wide range of jobs that do not require college degrees but can offer attractive careers to people with high school diplomas and sometimes additional skills training. In the transportation sector, some representative examples of middle-skilled workers are train drivers, aircraft maintenance personnel, traffic management centre operators, etc.;
- **High-skilled workers:** In the group of high-skilled workers are mainly employees who carry out tasks that require at least a University education and training and beyond. It usually refers to positions of managers and scientists or high level technical positions, such as air traffic controllers, engineers, etc. In general, the definition used for a highly-skilled worker is mainly on the basis of level of salary, educational qualifications and/or specific sectors or occupations.

The project uses a much broader scope for sectors. In the railway sector, SKILLFUL looks at train drivers. There is little on data on the railway sector. The project is also focused on training methods and future estimations. We will use the material for those activities in this S2R project.

Bekiaris (2017) foresees the following changes to employability: from paradigm shifters and game changers; critical emerging technologies; emerging novel service concepts and bundles; new business schemes. The interviews of 125+ experts on short term, 2030 and 2050; plus, the analysis of 80 reports provides the following insights on changes or disappearing jobs:

- Short term: freight forwarders, logistic centre staff; transportation scheduler, mobility planner; ticket issuers, controllers; customer service; manufacturing staff; fuel station operators; manual operators; travel agents;
- Medium term: IT security; driving licence instructors; drivers;
- Long term: traffic police.

Emerging jobs are the following:

- Short-term: logistics manager; logistic operator; experts AI; IoT developers; security; charging station operators; maintenance charging stations; automated vehicle operator; designers vehicles; ethics and law specialists; MaaS integrators;
- Medium-term: energy billing supervisor; transport planners; infomobility experts; automation experts;
- Long-term: predicting engineers.

6.2.9 IMPACT-2

This IMPACT-2 project is still under way. The conclusions reached at this stage are that the requirements and needs of the humans in the system (the report looks at: staff and customers) need to be considered in order to fully benefit from the advances in technology (Metzger,

2018). Some first analyses are presented about the impact of the considerable changes induced by the technical innovations of the Shift2Rail project on the railway workforce. The report focuses on changes for several jobs in the railway sector, for which they will be affected in ways that are currently unknown. The Shift2Rail research projects are addressing the impact of several of these technology changes on typical jobs:

- Train drivers: The introduction of automatic train operations (ATO), developed in IP2 and IP5 which means changing the role of the train driver, requiring "additional qualifications of the train driver in the technical systems, (emergency) operations on the train and customer service. One of the most prominent job changes will require the train driver to be more (service-)oriented towards the customer rather than oriented towards the technical systems only." The report suggests that qualified customer service staff may be asked for emergency operation of the train and to handle technical problems;
- Traffic controller: If "train traffic control will be mostly automated (e.g., with conflict detection and resolution tools) in the future, the controller´s job profile will shift from that of actively controlling traffic to monitoring the automation and more general train disposition tasks". More strategic decision-making by such controllers will require a different set of qualifications;
- Shunting jobs: The introduction of automated shunting will shift the job "from a heavily manual and physical one on the coupling hook towards a job that requires the operation and monitoring of the automated control of the hook and, if necessary, trouble-shooting". In addition, the real time marshalling yards require more IT support with corresponding qualifications in the jobs;
- Crossing supervision: Digital interlocking with IP-based connection of remote devices reduces personnel demands, but at the same time personnel must be dispatched to remote locations in case of emergencies or disturbances. Technology knowledge and trouble-shooting requirements will rise.

The report does point out some difficulties for the railway operators: too little information about distribution of personnel across the different railway-specific human capital across job categories; and more forecast and an understanding of the impact of new (S2R-)technologies on these staff categories are needed. The report also lists the most important S2R technical demonstrators (TDs) that are expected to have an impact on job profiles in the future. These changes will also be discussed in further steps of our own project.

6.3 Analysis of forecasting and foresight studies

The different foresight and forecast studies use different approaches to paint the picture of the future and different technology scenarios. Scenarios for employment and skills are developed with different purposes. The main differences are those using policy changes (Davydenko et al., 2009) and those using differences in employment changes (ageing of workers: pensioning scenarios) (Harper, 2007; NSARE, 2013). To understand the employment and skills situation of the future, the studies stress some particularities of the EU-railway sector driving the changes in employment and skills demand:

- The context remains one of deregulation, harmonisation, but also fragmentation of the railway sector. At EU-level, the railways are managed under different models, with different competition regimes. The market liberalisation has not been completed, but is in development since 2007 for freight. There is still a lot to do for passengers' transport. Outsourcing is the main strategy, but a lot of legislative rules are blocking change. Employers and trade unions are working on reduction of risks and insecurity in passenger transport;

- The need for EU-investments is framed in improving, maintaining and using the European innovation advantage. Investments, however, have been on and off: the economic crisis has affected public budgets;
- The railways are also experiencing growing competition from bus companies and road transport. Even though the sector can win on the ecological side, the inefficiencies of the sector and unreliability of services do not help its position in comparison to other transport sectors;
- Technology has changed from investing into high speed train technology, into digital technologies for managing all elements of the railway undertaking: new technologies for traffic management, control, ticketing, maintenance and operation of rail services. Investments are in less labour intensive complete trains in freight, in automatic shunting (ERTMS), in less skill requirements.

The main lessons from these studies are the following:

- Employment will continue to decline, but there will be a big replacement need. The Christidis-study expects employment growth after 2020 when growth in passenger demand is expected to accelerate as a result of a higher penetration of high speed rail;
- The skills issue has changed over time. In the 2000s, the stress was on “soft skills” like leadership skills, people management and customer service which have been named as most important for operating train companies in the future. In the current decade, the skills issue has been framed in the context of engineering and digital skills.

The changes are different for different jobs. In Table 6.2, some predictions are listed for different occupational jobs.

Table 6.2 Overview of predictions for occupational jobs

	Davydenko et al., 2009	Crhistidis et al., 2014	Panteia, 2015
Managerial	Stability. Managers would require more e-skills because planning and managing will become more computer-based. More understanding of regulation will be needed. Managers will require broader skill sets to deal with rising complexity. Entrepreneurship will be required.		Supply, distribution and related managers remains stable.
Business and logistics professionals	An increase in employment is foreseen, because of privatisation, business restructuring, more need for marketing and service concepts, the necessity for improving efficiency and the implementation of new technologies. Broader skill sets required: team work, higher analytical capabilities.		Transport conductors: number changes from 174000 to 186000

	Davydenko et al., 2009	Crhistidis et al., 2014	Panteia, 2015
Administrative and back-office workers	Railway companies were quite overstaffed. These job functions will shrink in any scenario. Skill demands will rise for these functions. Some functions will experience outsourcing of tasks.	The number of administrative staff is expected to decrease by a further 23%. Productivity for administrative jobs is expected to almost double (a 92% increase between 2010 and 2030). Recruitment of administrative staff with different profiles and skills than the ones leaving.	
Stewards, mechanics and train drivers	The number of will increase due to the converging factors of growing demand for rail transport and the call for safety improvement. Skill requirements will be rising: more e-skills, multi-skilling, more language skills, more creativity. Rail mechanics will experience rising technical knowledge requirements. Interdisciplinary abilities will be important. Train drivers will not all have the same changes in skills: much is dependent on the transport system. Demands will be higher because of changing levels of personnel.	The numbers of mobile and technical staff, on the other hand, are expected to grow more steadily, more in line with the growth in demand. Productivity for mobile and technical jobs is expected to grow at comparable rates to those of activity (27% and 11% respectively).	Demand for travel attendants and travel stewards will rise from 168.000 to 196.000. Locomotive engine drivers: 2010 = 272000; 2015 = 280; 2020 = 292 Railway brake, signal and switch operators: 66; 68; 70

The studies all foresee rising demands for engineers and more technical personnel on the trains. Administrative personnel should decline quite sharply.

The solutions for tackling the skills issues have remained roughly the same over the past ten years: more diversity (more women); more transfer of skills (to deal with the pensioning issue); better working conditions for better image; more training of the current workforce. More investment into harmonisation of training, more agreement into better working conditions.

6.4 Summary

Table 6.3 contains an overview of the main foresight and forecasting results and predictions for employment and skills for the rail sector in the future.

Table 6.3 Overview of five forecasts for shifts in employment (E:) and skills (S:) for four major occupational groups

Occupational groups	Davydenko et al., 2008	Christidis et al., 2014	Panteia, 2015	Skillful, 2018	IMPACT-2 2018
Horizon	2020	2030	2020	2020, 2030, 2050	
Managerial	E: Stability S: eSkills; broad skills sets		E: Stability S: [?]	E: Emerging S: [?]	
Professionals				E: Emerging S: eSkills; data skills	E: [?] S: Shifting skills
Administrative	E: Strong decline S: [?]	E: Strong decline S: Other skills		E: Decline S: [?]	
Train drivers	E: Increase S: eSkills, broad skills sets, interdisciplinary abilities	E: Steady growth S: [?]	E: Steady growth S: [?]	E: Decline S: [?]	E: [?] S: Service skills

7 Conclusions

The goal of the report is to assess the current employment and skills for different categories of railway staff, from workers to engineers, railway managers and researchers. The following questions were central to the research:

- What is the current employment level in the EU-railway sector?
- Can these figures be differentiated at the level of four regions/clusters?
- What is the distribution of employment according to job category and skill level?
- What are drivers for change in skill use? To what degree do working conditions play a role?

What is the current employment level?

According to the Eurostat Labour Force Survey (LFS) 2016, the current level of employment is 817,752 persons working in the four sectors “Manufacture of railway locomotives and rolling stock” (7%), “Construction of railways” (48%), “Passenger rail transport, interurban” (35%), “Freight rail transport” (9%). In the past five years, employment in the sector has declined with nearly 7%. A further differentiation of this employment development according to regions was done, comparing Germany, Netherlands, France and UK (‘core-countries’) versus all other countries. This comparison reveals that employment levels remain quite stable in the core-countries, and that the grunt of employment decline happened in the non-core-countries.

What is the distribution of employment according to job category and skill level?

Figure 7.1 shows the current distribution of employment in the rail sector according to the major occupational categories (ISCO-classification).

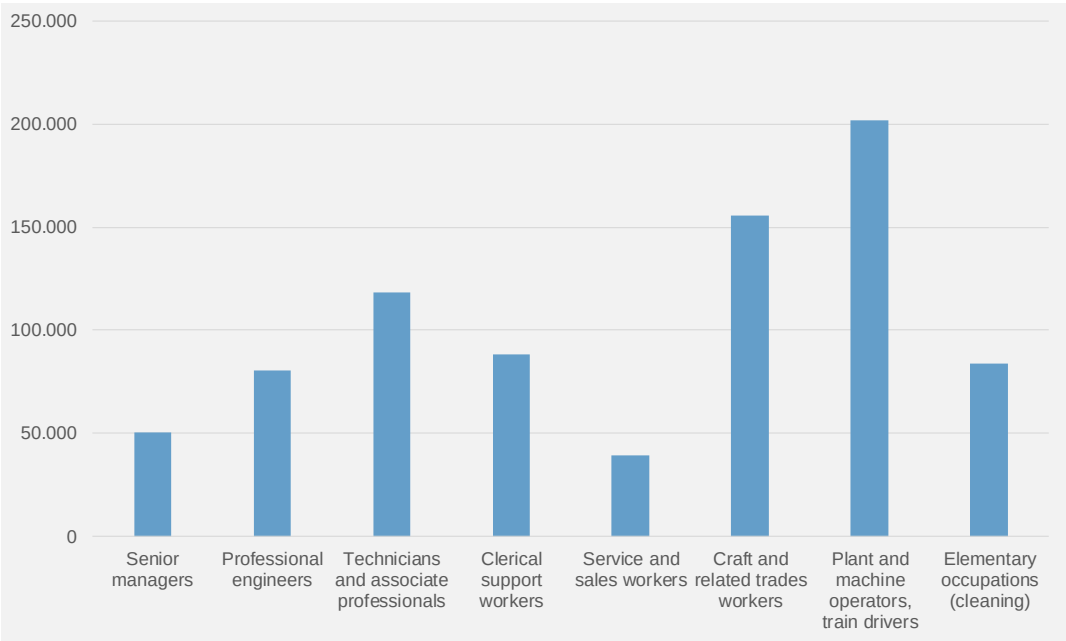

Figure 7.1 Distribution of employment in the railway sector according to occupation (LFS, 2016)

For the skill distribution and development, we found the following results:

- There is a clear upskilling tendency visible in all railway jobs towards academic level (ISCED5-6), but mainly in higher jobs such as professional engineers, technicians (for example dispatchers) and support workers such as railway sales agents. In more basic

jobs such as train drivers, job requirements also appear to have shifted upwards, but more to middle educational levels (professional training);

- Most of the employees need at least middle level of educational degrees to get recruited and to perform their jobs;
- A further result is that the apparent rise in skills may also be attributed to rising educational requirements used by companies, and not so much in change in work itself. An important number of employees find they are overqualified for the work they are doing;
- There are differences in skills profiles between railway occupations. Not all occupations have the same technical, communicative, social, organisational skills. Technical and organisational skills are very important for management and engineering occupations, less so for other categories.
- Occupational distributions differ between the regions compared in the report: the core-countries show more employment in managerial, engineering and technical occupations. The educational level also seems considerably higher of these occupations.

Working conditions as a driver for skill changes?

The railway sectors have always been a demanding sector to work in. The figures of this research confirm this. The only working condition that is markedly better than other sectors, is the training opportunities/effort. This means that work is demanding in the sector, but the sector provides more training to deal with skill changes than other sectors. The over-skilling of a lot of employees allows the sector to more manoeuvring space for implementing task and technical changes.

What do foresight and forecasting studies say?

A lot of studies have been conducted over the years to estimate what skills and employment will do in the future. Comparing the predictions from the past about our current employment, helps to understand what is changing in practices. This helps us to understand what we may expect in the next decade. These studies generally predict a further decline in employment until the end of this decade. The expectation is that in the 2020s, new growth in employment is inevitable because of the ageing workforce (many will leave the sector). Technological change will require a great effort from the rail sector to deal with rising skill discrepancies. Solutions to deal with these skill discrepancies are seen in more training and in shifting employment practices. An important observation in this respect is that these foresight and forecasting studies show clear discrepancies with the actual tendencies in employment and skilling. The forecasters see other things than current statistics show us. This discrepancy is the main starting point for the discussion in workshops with the sector.

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Appendix 1 Tables

Eurofound EWCS 2015

Table A1.1 Results from the 6th EWCS survey: EU-28 (2015; Eurofound); Comparison of Manufacture of railway locomotives/rolling stock; construction of roads and railways[12]; Freight & Passenger (interurban) rail transport (302+421+491+492), and all other sectors

	All other sectors	Rail
NACE Revision 2, 2 digit		
• Manufacture of other transport equipment		5.7%
• Civil engineering		9.1%
• Land transport and transport via pipelines		85.1%
N		*207*
Highest level of education or training successfully completed (2011 ISCED classification)		
• Low (ISCED 1-3)	15.8%	15.0%
• Medium (ISCED 4 and 5)	52.3%▼	64.6%▲
• High (ISCED 6-9)	31.9%▲	20.4%▼
N	*28,788*	*203*
Highest level of education or training successfully completed (2-digit 2011 ISCED classification)		
• ISCED 0-1 Early childhood education / Primary education	2.5%	0.4%
• ISCED 2 Lower secondary education	13.3%	14.7%
• ISCED 3 Upper secondary education	45.5%▼	57.7%▲
• ISCED 4 Post-secondary non-tertiary education	6.8%	6.9%
• ISCED 5 Short-cycle tertiary education	7.9%	7.4%
• ISCED 6 Bachelor or equivalent	12.6%	11.1%
• ISCED 7 Master or equivalent	10.6%▲	1.9%▼
• ISCED 8 Doctorate or equivalent	0.8%	0.0%
N	*28,788*	*203*
ISCO 08 1-digit		
• Armed forces occupations	0.4%	0%
• Managers	4.2%	5.1%
• Professionals	19.1%▲	8.5%▼
• Technicians and associate professionals	15.0%	16.8%
• Clerical support workers	11.7%	12.1%
• Service and sales workers	19.4%∆	11.7%∇
• Skilled agricultural, forestry and fishery workers	1.1%	0%
• Craft and related trades workers	11.4%	14.6%
• Plant and machine operators, and assemblers	7.9%▼	26.9%▲
• Elementary occupations	9.8%∆	4.3%∇
N	*28,872*	*207*

[12] In the EWCS: for the broad 421 category (including construction roads), we applied extra weighting (in this case lower weight) proportional to NWCS prevalence of construction of railroads within the entire rail sector, in order to adjust for over-representation of road construction in this group.

	All other sectors	Rail
Age groups		
• 15-24 years	8.7%∆	4.7%∇
• 25-54 years	74.6%	75.5%
• 55-64 years	15.0%	19.7%
• 65 years or older	1.7%	0.1%
N	*28,785*	*207*
Q18c. During the last 12 months has your work changed in any of the following ways - The amount of influence you have over your work?		
• decreased	22.5%	28.2%
• no change	74.2%∆	68.0%∇
• increased	3.3%	3.7%
N	*28,742*	*206*
Q18d. During the last 12 months has your work changed in any of the following ways - Your tasks and duties?		
• decreased	35.0%∇	42.7%∆
• no change	62.5%∆	54.0%∇
• increased	2.5%	3.2%
N	*28,859*	*207*
Substances [5 items: inhaling (tobacco) smoke/dust etc; contact chemical products/substances/infectious materials)		
• Only '(Almost) never'	66.0%	62.1%
• At least one answer 'Around 1/4 of the time or more'	34.0%	37.9%
N	*28,776*	*207*
Exposed at work to breathing in smoke, fumes, powder or dust etc.		
• (almost) never - around 1/4 of the time	90.5%▲	79.5%▼
• around half of the time or more	9.5%▼	20.5%▲
N	*28,838*	*207*
Exposed at work to handling or being in skin contact with chemical products or substances		
• (almost) never - around 1/4 of the time	93.9%▲	86.9%▼
• around half of the time or more	6.1%▼	13.1%▲
N	*28,857*	*207*
Exposed at work to handling or being in skin contact with chemical products or substances		
• (almost) never - around 1/4 of the time	90.0%∆	84.7%∇
• around half of the time or more	10.0%∇	15.3%∆
N	*28,866*	*207*
Exposed at work to tobacco smoke from other people		
• (almost) never - around 1/4 of the time	95.2%▲	90.4%▼
• around half of the time or more	4.8%▼	9.6%▲
N	*28,843*	*207*
Exposed at work to handling or being in direct contact with materials which can be infectious		
• (almost) never - around 1/4 of the time	90.7%	94.5%
• around half of the time or more	9.3%	5.5%
N	*28,819*	*206*

	All other sectors	Rail
Exposed at work to noise so loud that you would have to raise your voice to talk to people		
• (almost) never - around 1/4 of the time	81.9%▲	63.1%▼
• around half of the time or more	18.1%▼	36.9%▲
N	*28,873*	*207*
Exposed at work to high temperatures which make you perspire even when not working		
• (almost) never - around 1/4 of the time	86.6%▲	78.0%▼
• around half of the time or more	13.4%▼	22.0%▲
N	*28,862*	*205*
Exposed at work to low temperatures whether indoors or outdoors		
• (almost) never - around 1/4 of the time	89.3%▲	70.2%▼
• around half of the time or more	10.7%▼	29.8%▲
N	*28,851*	*207*
Physically demanding/heavy work ['vibrations'; 'tiring/painful positions'; 'lifting/moving people'; 'carrying/moving heavy loads'; 'repetitive hand/arm movements', 'vibrations']		
• Only '(almost) never/around 1/4 of the time'	36.3%	36.1%
• At least one answer 'around half of the time or more'	63.7%	63.9%
N	*28,835*	*207*
Exposed at work to vibrations from hand tools, machinery, etc.		
• (almost) never - around 1/4 of the time	87.0%▲	67.5%▼
• around half of the time or more	13.0%▼	32.5%▲
N	*28,861*	*205*
Job involves tiring or painful positions		
• (almost) never/around 1/4 of the time	71.6%	75.2%
• around half of the time or more	28.4%	24.8%
N	*28,846*	*207*
Job involves lifting or moving people		
• (almost) never/around 1/4 of the time	92.8%∇	97.9%∆
• around half of the time or more	7.2%∆	2.1%∇
N	*28,906*	*207*
Job involves carrying or moving heavy loads		
• (almost) never/around 1/4 of the time	82.1%	82.2%
• around half of the time or more	17.9%	17.8%
N	*28,894*	*206*
Job involves repetitive hand or arm movements		
• (almost) never/around 1/4 of the time	49.7%	52.8%
• around half of the time or more	50.3%	47.2%
N	*28,848*	*206*
Job involves working with computers, laptops, smartphones etc.		
• (almost) never/around half of the time	61.3%	55.9%
• around 3/4 of the time or more	38.7%	44.1%
N	*28,886*	*206*

	All other sectors	Rail
Quantitative job demands [>= 3 on scale 0=never - 6=all of the time; 2 items: working at very high speed/to tight deadlines]		
• low	54.4%	53.1%
• high	45.6%	46.9%
N	*28,690*	*206*
Job involves working at very high speed?		
• (almost) never/around 1/4 of the time	52.4%∇	60.0%∆
• around 1/2 of the time or more	47.6%∆	40.0%∇
N	*28,772*	*206*
Job involves working to tight deadlines?		
• (almost) never/around 1/4 of the time	50.2%	51.5%
• around 1/2 of the time or more	49.8%	48.5%
N	*28,777*	*207*
Autonomy [high = score 1 on scale 0=no - 1=yes; 4 items: choose order/methods/speed/problem solving on own]		
• low	56.1%▼	66.1%▲
• high	43.9%▲	33.9%▼
N	*28,852*	*207*
Are you able to choose or change… - Your order of tasks		
• Yes	64.1%∆	54.7%∇
• No	35.9%∇	45.3%∆
N	*28,796*	*206*
Are you able to choose or change… - Your methods of work		
• Yes	65.9%▲	52.0%▼
• No	34.1%▼	48.0%▲
N	*28,793*	*207*
Are you able to choose or change… - Your speed or rate of work		
• Yes	68.1%	62.5%
• No	31.9%	37.5%
N	*28,717*	*207*
Generally, does your main paid job involve… - Solving unforeseen problems on your own?		
• Yes	82.4%	84.7%
• No	17.6%	15.3%
N	*28,802*	*207*
Select the response which best describes your work situation - You can take a break when you wish?		
• sometimes/rarely/never	57.1%	58.9%
• always/most of the time	42.9%	41.1%
N	*28,759*	*206*
Select the response which best describes your work situation - You have enough time to get the job done?		
• sometimes/rarely/never	28.5%	24.1%
• always/most of the time	71.5%	75.9%
N	*28,733*	*206*

	All other sectors	Rail
On the whole, is your pace of work dependent on… - The work done by colleagues?		
• no	57.6%∆	49.5%∇
• yes	42.4%∇	50.5%∆
N	*28,395*	*203*
On the whole, is your pace of work dependent on… - Direct demands from people such as customers, passengers, pupils, patients, etc?		
• no	33.7%▼	46.5%▲
• yes	66.3%▲	53.5%▼
N	*28,533*	*204*
On the whole, is your pace of work dependent on… - Numerical production targets or performance targets?		
• no	56.6%∆	49.4%∇
• yes	43.4%∇	50.6%∆
N	*28,081*	*205*
On the whole, is your pace of work dependent on… - Automatic speed of a machine or movement of a product?		
• no	80.9%▲	72.3%▼
• yes	19.1%▼	27.7%▲
N	*27,856*	*203*
On the whole, is your pace of work dependent on… - The direct control of your boss?		
• no	60.7%	62.1%
• yes	39.3%	37.9%
N	*28,280*	*205*
Generally, does your main paid job involve… - Meeting precise quality standards?		
• no	25.8%∆	18.7%∇
• yes	74.2%∇	81.3%∆
N	*28,607*	*207*
Generally, does your main paid job involve… - Assessing yourself the quality of your own work?		
• no	26.4%∇	33.1%∆
• yes	73.6%∆	66.9%∇
N	*28,573*	*207*
Generally, does your main paid job involve… - Monotonous tasks?		
• no	53.9%	57.9%
• yes	46.1%	42.1%
N	*28,725*	*206*
Generally, does your main paid job involve… - Complex tasks?		
• no	37.1%▲	26.8%▼
• yes	62.9%▼	73.2%▲
N	*28,727*	*206*
Generally, does your main paid job involve… - Learning new things		
• no	28.0%	24.5%
• yes	72.0%	75.5%
N	*28,709*	*203*

	All other sectors	Rail
Does your job involve short repetitive tasks of less than… 1 minute		
• no	77.3%	81.6%
• yes	22.7%	18.4%
N	*28,463*	*205*
Does your job involve short repetitive tasks of less than… 10 minutes		
• no	59.2%▼	71.9%▲
• yes	40.8%▲	28.1%▼
N	*28,403*	*205*
Does your job involve rotating tasks between yourself and colleagues?		
• no	50.8%∇	59.0%∆
• yes	49.2%∆	41.0%∇
N	*28,786*	*205*
Do those tasks require different skills?		
• no	22.4%	26.7%
• yes	77.6%	73.3%
N	*14,112*	*84*
Who decides the division of those tasks - Your boss / manager?		
• no	30.9%	27.3%
• yes	69.1%	72.7%
N	*14,098*	*84*
Who decides the division of those tasks - They are decided by people who are rotating tasks?		
• no	44.1%	38.2%
• yes	55.9%	61.8%
N	*14,062*	*84*
Do you work in a group or team that has common tasks and can plan its work?		
• no	40.0%	39.6%
• yes	60.0%	60.4%
N	*28,683*	*206*
Is that always in the same team or group, or in several teams or groups?		
• Always in the same team or group	74.0%	75.1%
• In several teams or groups	26.0%	24.9%
N	*17,166*	*124*
For the team in which you work mostly, do the members decide by themselves…? - On the division of tasks		
• no	43.8%▼	54.3%▲
• yes	56.2%▲	45.7%▼
N	*17,130*	*124*
For the team in which you work mostly, do the members decide by themselves…? - Who will be the head of the team		
• no	73.5%▼	87.6%▲
• yes	26.5%▲	12.4%▼
N	*16,951*	*124*

	All other sectors	Rail
For the team in which you work mostly, do the members decide by themselves…? - The timetable of the work		
• no	59.0%▼	72.8%▲
• yes	41.0%▲	27.2%▼
N	*17,076*	*124*
Your colleagues help and support you		
• sometimes/rarely/never	27.8%∇	34.1%∆
• always/most of the time	72.2%∆	65.9%∇
N	*27,477*	*205*
Your manager helps and supports you		
• sometimes/rarely/never	41.3%▼	51.6%▲
• always/most of the time	58.7%▲	48.4%▼
N	*27,948*	*203*
Select the response which best describes your work situation - You are consulted before objectives are set for your work?		
• sometimes/rarely/never	55.9%∇	63.8%∆
• always/most of the time	44.1%∆	36.2%∇
N	*27,992*	*204*
Select the response which best describes your work situation - You are involved in improving the work organisation or work processes of your department or organisation?		
• sometimes/rarely/never	55.7%∇	65.0%∆
• always/most of the time	44.3%∆	35.0%∇
N	*28,160*	*205*
Which of the following statements would best describe your skills in your own work?		
• I need further training to cope well with my duties	15.0%	19.1%
• My present skills correspond well with my duties	57.2%	58.1%
• I have the skills to cope with more demanding duties	27.8%	22.9%
N	*28,650*	*205*
Over the past 12 months, have you undergone any of the following types of training to improve your skills - Training paid for or provided by your employer?		
• no	58.9%▲	42.7%▼
• yes	41.1%▼	57.3%▲
N	*28,851*	*206*
Over the past 12 months, have you undergone any of the following types of training to improve your skills - Training paid by yourself?		
• no	94.0%	96.6%
• yes	6.0%	3.4%
N	*28,845*	*206*
Over the past 12 months, have you undergone any of the following types of training to improve your skills - On-the-job training (co-workers, supervisors)?		
• no	61.6%	57.1%
• yes	38.4%	42.9%
N	*28,846*	*206*

	All other sectors	Rail
Over the past 12 months, have you undergone any of the following types of training to improve your skills - Other training?		
• no	85.8%	81.5%
• yes	14.2%	18.5%
N	*28,790*	*205*
Over the past 12 months, how many days in total did you spend in training paid for or provided by your employer		
• no training/0 days	59.3%▲	42.8%▼
• 1 day	5.6%	6.1%
• 2-3 days	12.3%	12.4%
• 4-5 days	9.7%	12.8%
• 6-9 days	5.6%	5.5%
• 10-19 days	4.3%▼	10.0%▲
• 20 days or more	3.2%▼	10.4%▲
N	*28,655*	*206*
Do you agree or disagree with the following statements on the training received over the last 12 months, paid for and provided by your employer - The training has helped me improve the way I work?		
• disagree or neither agree/disagree	16.9%	20.5%
• (strongly) agree	83.1%	79.5%
N	*12,538*	*124*
Do you agree or disagree with the following statements on the training received over the last 12 months, paid for and provided by your employer - I feel that my job is more secure because of my training?		
• disagree or neither agree/disagree	40.4%	33.1%
• (strongly) agree	59.6%	66.9%
N	*12,462*	*124*
Do you agree or disagree with the following statements on the training received over the last 12 months, paid for and provided by your employer - I feel my prospects for future employment are better?		
• disagree or neither agree/disagree	39.8%	36.5%
• (strongly) agree	60.2%	63.5%
N	*12,365*	*124*
Did you ask for training to be provided for you by your employer?		
• no	90.0%▼	99.5%▲
• yes	10.0%▲	0.5%▼
N	*16,898*	*79*

Cedefop ESJS

Table A1.2 CEDEFOP ESJS: distribution of quality of work variables

	Rail	All other sectors
Occupation (ISCO 1 digit)		
• Managers	7.4%	7.3%
• Professionals	7.0%▼	18.1%▲
• Technicians or associate professionals	18.0%	17.4%
• Clerical support workers	10.8%▼	24.0%▲
• Sales, customer or personal service workers	15.1%	14.1%
• Skilled agricultural, forestry and fishery workers	0%	0.8%
• Building, crafts or related trades persons	7.3%	6.8%
• Plant, machine operators and train drivers	30.7%▲	6.7%▼
• Elementary occupations	3.7%	4.7%
N	*142*	*48,469*
What is the highest level of education or training that you have completed?		
• ISCED 0-2	18.9%	14.2%
• ISCED 3-4	64.7%▲	50.3%▼
• ISCED 5-6	16.5%▼	35.5%▲
N	*142*	*48,534*
What is the highest level of education or training that you have completed? (detailed)		
• No completed education	0.9%	0.3%
• Primary education (ISCED 1)	1.0%	1.4%
• Lower secondary education (ISCED 2)	17.0%	12.4%
• Upper secondary education	59.7%▲	39.9%▼
• Post-secondary including pre-vocational or vocation education but not tertiary (ISCED 4)	5.0%∇	10.4%∆
• Tertiary education - first level (ISCED 5)	16.5%▼	29.7%▲
• Tertiary education - advanced level (ISCED 6)	0%▼	5.8%▲
N	*142*	*48,534*
ISCED qualification needed to get job		
• ISCED 0-2	17.2%	15.8%
• ISCED 3-4	59.9%▲	41.9%▼
• ISCED 5-6	16.9%▼	37.4%▲
• Not applicable – no educational qualifications are needed	6.0%	4.9%
N	*129*	*45,641*
ISCED qualification needed to get job (detailed)		
• No completed education	1.1%	1.8%
• Primary education (ISCED 1)	0.4%	1.6%
• Lower secondary education (ISCED 2)	15.8%	12.5%
• Upper secondary education (ISCED 3)	51.6%▲	33.4%▼
• Post-secondary including pre-vocational or vocational education but not tertiary (ISCED 4)	8.2%	8.5%
• Tertiary education – first level (ISCED 5)	16.9%▼	35.5%▲
• Tertiary education – advanced level (ISCED 6)	0%	1.9%
• Not applicable – no educational qualifications are needed	6.0%	4.9%
N	*129*	*45,641*

	Rail	All other sectors
ISCED Qualification needed to do job		
• ISCED 0-2	23.8%∆	16.8%∇
• ISCED 3-4	52.3%∆	42.8%∇
• ISCED 5-6	17.9%▼	35.0%▲
• Not applicable – no educational qualifications are needed	6.0%	5.4%
N	*130*	*45,396*
ISCED qualification needed to do the job (detailed)		
• No completed education	1.1%	2.2%
• Primary education (ISCED 1)	0.4%	2.0%
• Lower secondary education (ISCED 2)	22.4%▲	12.7%▼
• Upper secondary education (ISCED 3)	46.6%▲	33.8%▼
• Post-secondary including pre-vocational or vocational education but not tertiary (ISCED 4)	5.7%	9.0%
• Tertiary education – first level (ISCED 5)	17.9%▼	33.4%▲
• Tertiary education – advanced level (ISCED 6)	0%	1.6%
• Not applicable – no educational qualifications are needed	6.0%	5.4%
N	*130*	*45,396*
Age group (24 up to 65 ESJS population)		
• 24-34 years	22.3%	23.7%
• 35-54 years	63.9%	61.2%
• 55 up to 65 years	13.8%	15.1%
N	*142*	*48,534*
What is your gender?		
• Male	82.0%▲	51.8%▼
• Female	18.0%▼	48.2%▲
N	*142*	*48,534*
Have any of the following changes in your role taken place?		
I have been promoted to a higher-level position		
• No	58.1%▼	70.8%▲
• Yes	41.9%▲	29.2%▼
N	*142*	*48,534*
I moved to a different unit/department		
• No	82.8%	79.8%
• Yes	17.2%	20.2%
N	*142*	*48,534*
I have not been promoted or moved department but the nature of my tasks and responsibilities have changed		
• No	86.4%∆	78.6%∇
• Yes	13.6%∇	21.4%∆
N	*142*	*48,534*
I now have a lower level position than when I started		
• No	96.9%	98.2%
• Yes	3.1%	1.8%
N	*142*	*48,534*
No changes, my role has remained the same		
• No	65.4%	62.9%
• Yes	34.6%	37.1%
N	*142*	*48,534*

	Rail	All other sectors
How often, if at all does your job involve responding to non-routine situations during the course of your daily work		
• Never/sometimes	35.3%	40.4%
• Usually/always	64.7%	59.6%
N	*141*	*48,028*
How often, if at all does your job involve learning new things		
• Never/sometimes	51.5%	48.2%
• Usually/always	48.5%	51.8%
N	*142*	*48,352*
How often, if at all does your job involve choosing yourself the way in which you do your work		
• Never/sometimes	38.9%∆	29.9%∇
• Usually/always	61.1%∇	70.1%∆
N	*141*	*48,323*
How often, if at all does your job involve working as part of a team		
• Never/sometimes	28.1%	28.0%
• Usually/always	71.9%	72.0%
N	*142*	*48,370*
Think about the level of skills needed to do your job as well as possible. How would you rate your own level of skills? [scale 0 - 100; 0 means: you need to develop all of your skills, and 100: you have all the skills] [Mean] [Range: 0−100]	81,7	82,3
N	*142*	*48,534*
Which of the following best describes the highest level of literacy skills required for doing your job?		
• Basic literacy skills (e.g. Reading manuals, procedures, letters or memos)	64.8%▲	45.0%▼
• Advanced literacy skills (e.g. Writing long documents such as long reports, handbooks, articles or books)	35.2%▼	55.0%▲
N	*130*	*43,601*
Which of the following best describes the highest level of numeracy skills required for doing your job?		
• Basic numeracy skills (e.g. Calculations using decimals, percentages or fractions, understanding tables and graphs)	86.3%▲	67.1%▼
• Advanced numeracy skills (e.g. Calculations using advanced mathematical or statistical procedures)	13.7%▼	32.9%▲
N	*118*	*41,971*
Which of the following best describes the highest level of Information Communication Technology skills required for doing your job?		
• Basic ICT skills (e.g. Using a PC, tablet or mobile device for email, internet browsing)	44.6%▲	21.9%▼
• Moderate ICT skills (e.g. Word-processing, using or creating documents and/or spreadsheets)	44.9%▼	61.3%▲
• Advanced ICT skills (e.g. Developing software, applications or programming; use computer syntax or statistical analysis	10.5%	16.8%
N	*117*	*41,361*
For doing your job, how important are - Basic literacy skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	8,09	7,91
N	*84*	*19,569*

	Rail	All other sectors
For doing your job, how important are - Advanced literacy skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,63	8,11
N	*46*	*23,875*
For doing your job, how important are - Basic numeracy skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,64	7,40
N	*102*	*28,003*
For doing your job, how important are - Advanced numeracy skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,13▼	8,18▲
N	*16*	*13,738*
For doing your job, how important are - Basic ICT skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,50	7,08
N	*52*	*9,009*
For doing your job, how important are - Moderate ICT skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	8,38	8,23
N	*52*	*25,109*
For doing your job, how important are - Advanced ICT skills: [scale 0 - 10: 0=not at all important - 5=moderately important - 10=essential] [Mean]	8,24	8,69
N	*12*	*6,832*
How would you best describe your - Basic literacy skills: [scale 0 -10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	8,24	7,93
N	*84*	*19,496*
How would you best describe your - Advanced literacy skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,97	7,71
N	*46*	*23,810*
How would you best describe your - Basic numeracy skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	8,01▲	7,58▼
N	*102*	*27,884*
How would you best describe your - Advanced numeracy skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	6,96	7,66
N	*16*	*13,699*
How would you best describe your - Basic ICT skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,23	7,43
N	*52*	*8,955*
How would you best describe your - Moderate ICT skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,77	7,64
N	*52*	*24,993*
How would you best describe your - Advanced ICT skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	8,26	7,83
N	*12*	*6,806*

	Rail	All other sectors
For doing your job, how important are - Technical skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	8,02▲	7,38▼
N	*135*	*46,234*
For doing your job, how important are - Communication skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,71	8,01
N	*137*	*46,781*
For doing your job, how important are - Team-working skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	8,19	8,05
N	*134*	*46,902*
For doing your job, how important are - Foreign language skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	4,78	5,12
N	*107*	*39,291*
For doing your job, how important are - Customer handling skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	6,76	7,27
N	*120*	*43,289*
For doing your job, how important are - Problem solving skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	8,55▲	8,13▼
N	*140*	*46,948*
For doing your job, how important are - Learning skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,74	7,73
N	*138*	*47,068*
For doing your job, how important are - Planning and organisation skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,21∇	7,66∆
N	*133*	*46,233*
How would you best describe your - Technical skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,88▲	7,42▼
N	*133*	*45,836*
How would you best describe your - Communication skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,75	7,67
N	*137*	*46,385*
How would you best describe your - Team-working skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,71	7,75
N	*133*	*46,492*
How would you best describe your - Foreign language skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	5,40▼	6,04▲
N	*105*	*38,924*
How would you best describe your - Customer handling skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,44	7,37
N	*117*	*42,815*

	Rail	All other sectors
How would you best describe your - Problem solving skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,91	7,78
N	*140*	*46,537*
How would you best describe your - Learning skills: [scale 0 - 10; 0=My level is a lot lower than required - 5=level is matched to what is required - 10=level is a lot higher than required] [Mean]	7,60	7,70
N	*136*	*46,709*
How would you best describe your - Planning and organisation skills: [scale 0- 100: 0=not at all important - 5=moderately important - 10=essential] [Mean]	7,81	7,60
N	*131*	*45,804*
Overall, how would you best describe your skills in relation to what is required to do your job?		
• My skills are higher than required by my job	34.6%	39.8%
• My skills are matched to what is required by my job	62.4%	54.8%
• Some of my skills are lower than what is required by my job and need to be further developed	3.0%	5.4%
N	*139*	*48,065*
Compared to when you started your job with your current employer, would you say your skills have now improved, worsened or stayed the same? [scale 0 - 10: 0=My skills have worsened a lot - 5 = stayed the same - 10=improved a lot] [Mean]	8,08▲	7,71▼
N	*133*	*47,340*
You attended training courses (work-based, classroom based and online)		
• No	18.4%▼	37.3%▲
• Yes	81.6%▲	62.7%▼
N	*121*	*41,381*
Your supervisor taught you on-the-job		
• No	57.5%	60.5%
• Yes	42.5%	39.5%
N	*121*	*41,381*
You learned by interacting with colleagues at work		
• No	36.6%	31.4%
• Yes	63.4%	68.6%
N	*121*	*41,381*
You learned at work through trial and error		
• No	48.3%	40.8%
• Yes	51.7%	59.2%
N	*121*	*41,381*
You learned by yourself (e.g. with the aid of manuals, books, videos or online materials)		
• No	58.9%▲	48.5%▼
• Yes	41.1%▼	51.5%▲
N	*121*	*41,381*
Increased, decreased or remained the same: The variety of tasks? [scale 0 - 10; 0=Decreased a lot - 5=Stayed the same - 10=Increased a lot] [Mean]	7,39	7,35
N	*137*	*48,303*

	Rail	All other sectors
Increased, decreased or remained the same: The difficulty of the tasks? [scale 0 - 10; 0=Decreased a lot - 5=Stayed the same - 10=Increased a lot] [Mean]	7,28	7,12
N	*140*	*48,272*
Increased, decreased or remained the same: The need to learn new things? [scale 0 - 10; 0=Decreased a lot - 5=Stayed the same - 10=Increased a lot] [Mean]	7,38	7,36
N	*141*	*48,236*
When you started your job with your current employer, overall, how would you best describe your skills in relation to what was required to do your job at that time?		
• My skills were higher than required by my job	16.2%▼	27.1%▲
• My skills were matched to what was required by my job	64.8%▲	50.7%▼
• Some of my skills were lower than what was required by my job and needed to be further developed	19.0%	22.2%
N	*137*	*47,855*
Training in last 12 months: Training courses attended mostly or only during work hours		
• No	45.8%▼	58.2%▲
• Yes	54.2%▲	41.8%▼
N	*142*	*48,534*
Training in last 12 months: Training courses attended mostly or only outside of work hours		
• No	86.2%	80.8%
• Yes	13.8%	19.2%
N	*142*	*48,534*
Training in last 12 months: Training whilst performing your regular job (e.g. instruction by a supervisor/coworker using your normal tools of work; job rotation; peer support, participation in learning or quality circles)		
• No	65.2%	66.0%
• Yes	34.8%	34.0%
N	*142*	*48,534*
Training in last 12 months: I have not undergone any training		
• No	74.9%	67.6%
• Yes	25.1%	32.4%
N	*142*	*48,534*
You paid (with or without help from family/friends)		
• No	95.1%∆	89.1%∇
• Yes	4.9%∇	10.9%∆
N	*106*	*32,423*
Your employer paid (or you paid and you were fully reimbursed by your employer)		
• No	19.5%▼	31.2%▲
• Yes	80.5%▲	68.8%▼
N	*106*	*32,423*
Your employer paid part of the cost		
• No	93.6%	91.6%
• Yes	6.4%	8.4%
N	*106*	*32,423*

	Rail	All other sectors
The government or other public sector organisation paid		
• No	89.7%	89.2%
• Yes	10.3%	10.8%
N	*106*	*32,423*
Someone else/another organisation paid		
• No	96.8%	97.1%
• Yes	3.2%	2.9%
N	106	32,423
[What were your main reasons for doing this training?] **To stay up-to-date with changing skill needs of the job**		
• No	58.2%▲	42.8%▼
• Yes	41.8%▼	57.2%▲
N	*106*	*32,423*
To comply with mandatory policy of employer or legal requirement (e.g. health and safety, induction sessions)		
• No	44.5%▼	58.5%▲
• Yes	55.5%▲	41.5%▼
N	*106*	*32,423*
To perform better at the job		
• No	63.7%▲	47.7%▼
• Yes	36.3%▼	52.3%▲
N	*106*	*32,423*
To improve career prospects		
• No	83.2%▲	68.3%▼
• Yes	16.8%▼	31.7%▲
N	*106*	*32,423*
For personal/non-job-related reasons		
• No	89.3%	85.8%
• Yes	10.7%	14.2%
N	*106*	*32,423*
[In last 5 years/Since you started your main job have any of these changes taken place in your workplace] **Changes to the technologies you use (e.g. machinery, ICT systems)**		
• No	49.1%	56.7%
• Yes	50.9%	43.3%
N	*142*	*48,534*
Changes to your working methods and practices (e.g. how you are managed or how you work)		
• No	43.9%∇	52.9%∆
• Yes	56.1%∆	47.1%∇
N	*142*	*48,534*
Changes to the products/services you help to produce		
• No	77.2%	71.3%
• Yes	22.8%	28.7%
N	*142*	*48,534*

	Rail	All other sectors
Changes to the amount of contact you have with clients or customers (e.g. dealing with customer/client queries or complaints)		
• No	76.1%	74.0%
• Yes	23.9%	26.0%
N	*142*	*48,534*
Were any of these changes supported by training activities paid for by your employer? Please select one option only		
• I received training for all of the changes	38.8%▲	22.3%▼
• I received training for some of the changes	47.4%	46.2%
• I did not receive any training	13.8%▼	31.5%▲
N	*76*	*31,877*
I enjoy learning for its own sake [scale 0=Strongly disagree - 10=Strongly agree] [Mean]	6,94▼	7,41▲
N	*134*	*48,197*
I try to relate learning to practical issues [scale 0=Strongly disagree - 10=Strongly agree] [Mean]	8,06	8,05
N	*98*	*43,674*
I prefer to have others plan my learning [scale 0=Strongly disagree - 10=Strongly agree] [Mean]	4,74▲	3,99▼
N	*97*	*43,369*
I prefer problems to which there is only one solution [scale 0=Strongly disagree - 10=Strongly agree] [Mean]	5,09	5,01
N	*99*	*43,092*
The job suited your qualifications and skills [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	6,96	7,24
N	*131*	*47,066*
You wanted to gain some work experience [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	6,96	6,77
N	*123*	*46,094*
The job provided security [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	8,33▲	7,65▼
N	*140*	*47,054*
The job offered good career progression/career development [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	7,26▲	6,53▼
N	*140*	*46,356*
The company/organisation was well known/respected in its field [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	8,08▲	7,02▼
N	*138*	*46,116*
The pay and package of benefits (e.g. health insurance, bonuses, company car etc.) was good [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	7,88▲	6,41▼
N	*132*	*45,690*

	Rail	All other sectors
The job was close to home [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	6,44	6,68
N	*134*	*46,428*
You were interested in the nature of the work itself [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	7,69	7,77
N	*134*	*46,668*
The job had a good work-life balance [Before starting working for current employer, how important in decision to accept the job [scale 0- 100: 0=not at all important - 10=essential] [Mean]	7,37	7,45
N	*133*	*46,269*
I will lose my job in the next year [scale 0 - 10; 0=very unlikely - 10=very likely] [Mean]	1,55▼	2,62▲
N	*136*	*45,586*
Several of my skills will become outdated in the next five years [scale 0 - 10; 0=very unlikely - 10=very likely] [Mean]	3,31	3,76
N	*131*	*45,850*

OECD PIAAC

Table A1.3 OECD-PIAAC

	Rail	All other sectors
Four rail sectors NACE rev.2 activity code (4 digit)		
• 3020 Manufacture of railway locomotives/rolling stock	7.5%	
• 4210 Construction of roads and railways	17.9%	
• 4911 Passenger railtransport, interurban	63.1%	
• 4912 Freight rail transport	11.5%	
N	*248*	
Educational attainment level		
• Low (ISCED 0-2)	17.1%	21.9%
• Medium (ISCED 3-4)	60.1%▲	42.6%▼
• High (ISCED 5-6)	22.8%▼	35.4%▲
N	*248*	*43,605*
Educational attainment level		
• ISCED 0-1 Pre-primary level of education / Primary level of education	3.4%	5.2%
• ISCED 2 Lower secondary level of education (2A, 2B, 2C)	11.3%	13.6%
• ISCED 3 Upper secondary level of education (3A, 3B, 3C)	61.1%▲	44.5%▼
• ISCED 4 Post-secondary, non-tertiary education (4A, 4B, 4C)	1.3%	1.3%
• ISCED 5 First stage of tertiary education (5A, 5B)	22.8%▼	34.7%▲
• ISCED 6 Second stage of tertiary education (leading to an advanced research qualification)	0.0%	0.7%
N	*248*	*43,605*
Educational attainment level (2 digit)		
• No formal qualification or below ISCED 1	2.1%	1.7%
• ISCED 1	1.3%	3.4%
• ISCED 2	11.3%	13.6%
• ISCED 3C shorter than 2 years	2.4%	3.2%
• ISCED 3C 2 years or more	23.7%∆	17.8%∇
• ISCED 3A-B	26.3%∆	19.2%∇
• ISCED 3 (without distinction A-B-C, 2y+)	8.7%▲	4.3%▼
• ISCED 4C	0.1%	0.1%
• ISCED 4A-B	0.4%	0.4%
• ISCED 4 (without distinction A-B-C)	0.8%	0.7%
• ISCED 5B	6.3%	9.4%
• ISCED 5A, bachelor degree	6.8%	9.2%
• ISCED 5A, master degree	8.5%	9.9%
• ISCED 6	0.0%	0.7%
• Foreign qualification	0%	0.1%
• ISCED 5A bachelor's degree, 5A master's degree, and 6 (without distinction)	1.2%▼	6.1%▲
N	*248*	*43,605*

	Rail	All other sectors
Occupational classification of respondent's current job at (ISCO 2008, 1-digit level)		
• Legislators, senior officials and managers	6.8%	7.3%
• Professionals	3.7%▼	16.7%▲
• Technicians and associate professionals	16.0%	16.6%
• Clerical support workers	15.6%	11.7%
• Service workers and sales workers	8.6%▼	17.7%▲
• Skilled agricultural and fishery workers	0.3%	1.0%
• Craft and related trades workers	15.4%∆	9.9%∇
• Plant, machine operators and train drivers	26.8%▲	8.3%▼
• Elementary occupations	6.9%	10.7%
N	*248*	*43,199*
Age groups		
• 15-24 years	4.4%∇	10.4%∆
• 25-54 years	85.2%▲	76.6%▼
• 55-64 years	10.4%	12.7%
• 65 years or older	0.1%	0.2%
N	*248*	*43,607*
Gender		
• Male	84.1%▲	51.8%▼
• Female	15.9%▼	48.2%▲
N	*248*	*43,606*
During the last 12 months, have you participated in courses conducted through open or distance education?		
• Yes	5.6%∇	10.0%∆
• No	94.4%∆	90.0%∇
N	*247*	*42,921*
During the last 12 months, have you attended any organized sessions for on-the-job training or training by supervisors or co-workers?		
• Yes	36.6%	38.1%
• No	63.4%	61.9%
N	*247*	*42,915*
During the last 12 months, have you participated in seminars or work-shops?		
• Yes	13.0%∇	20.0%∆
• No	87.0%∆	80.0%∇
N	*247*	*42,917*
During the last 12 months, have you participated in courses or private les-sons, not already reported?		
• Yes	7.7%	9.6%
• No	92.3%	90.4%
N	*247*	*42,924*
How many of these activities did you participate in?		
• No learning activities	52.3%	48.4%
• One or more learning activities	47.7%	51.6%
N	*247*	*42,918*

	Rail	All other sectors
Could you please specify more precisely the main reason for participating in this activity?		
• To do my job better and/or improve career prospects	51.7%	51.2%
• To be less likely to lose my job	2.4%∆	0.7%∇
• To increase my possibilities of getting a job, or changing a job or profession	0.4%	2.9%
• To start my own business	0%	0.4%
• I was obliged to participate	27.2%▲	17.0%▼
• To increase my knowledge or skills on a subject that interests me	16.7%	22.2%
• To obtain a certificate	0.8%	2.9%
• Other	0.8%	2.8%
N	*115*	*20,176*
Did this activity take place ...		
• Only/mostly outside working hours	9.8%▼	26.4%▲
• Only/mostly during working hours	90.2%▲	73.6%▼
N	*116*	*21,437*
How useful was this training for the job or business you had at that time or still have? Would you say it was ...		
• Moderately/very useful	19.0%	18.5%
• Somewhat useful/not useful at all	81.0%	81.5%
N	*116*	*21,414*
Did an employer or prospective employer pay for tuition or registration, exam fees, expenses for books or other costs resulting from your participation in this activity? Would that be ...		
• No employer or prospective employer at that time	0.5%	2.4%
• No, not at all / no such costs	12.2%▼	26.8%▲
• Yes, partly/totally	87.4%▲	70.8%▼
N	*118*	*22,074*
About how much was job-related of the time in the past 12 months spent on these activities (all types of courses, training, private lessons, seminars or workshops)?		
• None of the time - up to half of the time	13.5%	19.2%
• All/more than half of the time	86.5%	80.8%
N	*88*	*15,276*
In the last 12 months, were there learning activities you wanted to participate in but did not? (both learning activities that lead to formal qualifications and other organised learning activities included).		
• Yes	14.9%▼	23.4%▲
• No	85.1%▲	76.6%▼
N	*247*	*42,915*
Over the last 12 months, has the number of people working at the place where you work ...		
• Increased	18.9%	18.1%
• Decreased	32.3%∆	24.7%∇
• Stayed more or less the same	48.8%∇	57.2%∆
N	*238*	*42,281*

	Rail	All other sectors
Index of use of task discretion at work, categorised WLE (derived) [4 items]		
• low (zero to 60%)	80.1%▲	69.5%▼
• high (more than 60%)	19.9%▼	30.5%▲
N	*248*	*43,482*
To what extent can you choose or change the sequence of your tasks?		
• Not at all/very little/to some extent	66.5%∆	57.2%∇
• To a (very) high extent	33.5%∇	42.8%∆
N	*248*	*43,553*
To what extent can you choose or change how you do your work?		
• Not at all/very little/to some extent	61.3%	55.5%
• To a (very) high extent	38.7%	44.5%
N	*248*	*43,498*
To what extent can you choose or change the speed or rate at which you work?		
• Not at all/very little/to some extent	70.4%▲	60.0%▼
• To a (very) high extent	29.6%▼	40.0%▲
N	*248*	*43,513*
To what extent can you choose or change your working hours?		
• Not at all/very little/to some extent	82.5%	81.7%
• To a (very) high extent	17.5%	18.3%
N	*248*	*43,569*
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job?		
• Low education (ISCED 1, 2, 3C <2 yrs)	18.8%▼	33.2%▲
• Medium education (ISCED 3A-B, C>2y, 4A-C)	53.1%▲	31.9%▼
• High education (ISCED 5, 6)	28.1%∇	34.9%∆
N	*246*	*42,871*
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job?		
• ISCED 0-1 No formal qualification or below ISCED 1 / ISCED 1 Primary level of education	4.7%▼	16.0%▲
• ISCED 2 Lower secondary level of education (2A, 2B, 2C)	9.0%	10.1%
• ISCED 3 Upper secondary level of education (3A, 3B, 3C)	55.7%▲	38.1%▼
• ISCED 4 Post-secondary, non-tertiary education (4A, 4B, 4C)	2.4%∆	0.9%∇
• ISCED 5 First stage of tertiary education (5A, 5B)	27.1%∇	34.4%∆
• ISCED 6 Second stage of tertiary education (leading to an advanced research qualification)	1.0%	0.5%
N	*246*	*42,871*

	Rail	All other sectors
If applying today, what would be the usual qualifications, if any, that someone would need to GET this type of job? (2-digit)		
• No formal qualification or below ISCED 1	4.1%▼	12.7%▲
• ISCED 1	0.6%∇	3.4%∆
• ISCED 2	9.0%	10.1%
• ISCED 3C shorter than 2 years	5.1%	7.1%
• ISCED 3C 2 years or more	8.0%	7.9%
• ISCED 3A-B	27.3%▲	16.1%▼
• ISCED 3 (without distinction A-B-C, 2y+)	15.3%▲	7.0%▼
• ISCED 4C	0.3%	0.1%
• ISCED 4A-B	0.2%	0.3%
• ISCED 4 (without distinction A-B-C)	1.9%∆	0.5%∇
• ISCED 5B	14.3%∆	9.5%∇
• ISCED 5A, bachelor degree	4.1%▼	10.5%▲
• ISCED 5A, master degree	8.4%	8.9%
• ISCED 6	1.0%	0.5%
• ISCED 5A bachelor's degree, 5A master's degree, and 6 (without distinction)	0.2%▼	5.4%▲
N	*246*	*42,871*
Thinking about whether this qualification is necessary for doing your job satisfactorily, which of the following statements would be most true?		
• This level is necessary	72.1%	69.7%
• A lower level would be sufficient	18.6%	22.4%
• A higher level would be needed	9.4%	7.9%
N	*232*	*37,131*
Supposing that someone with this level of qualification were applying today, how much related work experience would they need to GET this job? Would that be ...		
• None	16.1%▼	26.8%▲
• Less than 1 month	4.7%	5.8%
• 1 to 6 months	18.7%	16.6%
• 7 to 11 months	6.6%	7.5%
• 1 or 2 years	25.0%	22.2%
• 3 years or more	28.9%∆	21.1%∇
N	*244*	*42,530*
In your own job, how often do you learn new work-related things from co-workers or supervisors?		
• Never / less than once a month / less than once a week but at least once a month	56.5%	55.3%
• At least once a week / every day	43.5%	44.7%
N	*248*	*43,490*
How often does your job involve learning-by-doing from the tasks you perform?		
• Never / less than once a month / less than once a week but at least once a month	53.7%▲	42.5%▼
• At least once a week / every day	46.3%▼	57.5%▲
N	*248*	*43,437*

	Rail	All other sectors
How often does your job involve keeping up to date with new products or services?		
• Never / less than once a month / less than once a week but at least once a month	62.4%	58.6%
• At least once a week / every day	37.6%	41.4%
N	*246*	*43,410*
Index of learning at work, categorised WLE (derived) [3 items]		
• low (zero to 60%)	67.6%∆	59.8%∇
• high (more than 60%)	32.4%∇	40.2%∆
N	*248*	*43,482*
What proportion of your time do you usually spend cooperating or collaborating with co-workers?		
• None of the time - up to half of the time	37.2%∇	46.0%∆
• All/more than half of the time	62.8%∆	54.0%∇
N	*248*	*43,518*
How often does your job usually involve sharing work-related information with co-workers?		
• Never / less than once a week	9.9%▼	17.8%▲
• At least once a week / every day	90.1%▲	82.2%▼
N	*248*	*43,542*
How often does your job usually involve instructing, training or teaching people, individually or in groups?		
• Never / less than once a week	80.5%▲	70.6%▼
• At least once a week / every day	19.5%▼	29.4%▲
N	*248*	*43,558*
How often does your job usually involve making speeches or giving presentations in front of five or more people?		
• Never / less than once a week	90.8%	87.5%
• At least once a week / every day	9.2%	12.5%
N	*248*	*43,582*
How often does your job usually involve selling a product or selling a service?		
• Never / less than once a week	86.6%▲	78.3%▼
• At least once a week / every day	13.4%▼	21.7%▲
N	*248*	*43,572*
How often does your job usually involve advising people?		
• Never / less than once a week	51.9%∆	43.2%∇
• At least once a week / every day	48.1%∇	56.8%∆
N	*248*	*43,556*
Index of use of planning skills at work, categorised WLE (derived) [3 items]		
• low (zero to 60%)	71.4%	66.9%
• high (more than 60%)	28.6%	33.1%
N	*248*	*43,482*
How often does your job usually involve planning your own activities?		
• Never / less than once a week	39.6%▲	29.5%▼
• At least once a week / every day	60.4%▼	70.5%▲
N	*248*	*43,507*

	Rail	All other sectors
How often does your job usually involve planning the activities of others?		
• Never / less than once a week	70.9%	68.1%
• At least once a week / every day	29.1%	31.9%
N	*248*	*43,579*
How often does your job usually involve organising your own time?		
• Never / less than once a week	33.6%▲	24.9%▼
• At least once a week / every day	66.4%▼	75.1%▲
N	*248*	*43,511*
Index of use of influencing skills at work, categorised WLE (derived) [7 items]		
• low (zero to 60%)	69.9%	65.4%
• high (more than 60%)	30.1%	34.6%
N	*248*	*43,482*
How often does your job usually involve persuading or influencing people?		
• Never / less than once a week	64.1%Δ	54.5%∇
• At least once a week / every day	35.9%∇	45.5%Δ
N	*247*	*43,480*
How often does your job usually involve negotiating with people either inside or outside your firm or organisation?		
• Never / less than once a week	70.1%	65.6%
• At least once a week / every day	29.9%	34.4%
N	248	43,521
How often are you usually faced by relatively simple problems that take no more than 5 minutes to find a good solution?		
• Never / less than once a week	31.9%	31.4%
• At least once a week / every day	68.1%	68.6%
N	*247*	*43,475*
How often are you usually confronted with more complex problems that take at least 30 minutes to find a good solution? (The 30 minutes only refers to the time needed to THINK of a solution, not the time needed to carry it out).		
• Never / less than once a week	60.9%	63.8%
• At least once a week / every day	39.1%	36.2%
N	*246*	*43,433*
How often does your job usually involve working physically for a long period?		
• Never / less than once a week	58.8%Δ	51.3%∇
• At least once a week / every day	41.2%∇	48.7%Δ
N	248	43,558
How often does your job usually involve using skill or accuracy with your hands or fingers?		
• Never / less than once a week	42.1%Δ	33.9%∇
• At least once a week / every day	57.9%∇	66.1%Δ
N	*248*	*43,543*
Do you feel that you have the skills to cope with more demanding duties than those you are required to perform in your current job?		
• Yes	91.3%Δ	85.8%∇
• No	8.7%∇	14.2%Δ

	Rail	All other sectors
N	*245*	*42,926*
Do you feel that you need further training in order to cope well with your present duties?		
• Yes	26.8%	29.8%
• No	73.2%	70.2%
N	*248*	*43,535*
Index of use of reading skills at work (prose and document texts), categorised WLE (derived) [8 items]		
• low (zero to 60%)	67.5%	66.4%
• high (more than 60%)	32.5%	33.6%
N	*248*	*43,482*
In your job how often do you usually read directions or instructions?		
• Never / less than once a week	41.0%∇	50.3%∆
• At least once a week / every day	59.0%∆	49.7%∇
N	*248*	*43,577*
In your job how often do you usually read letters, memos or e-mails?		
• Never / less than once a week	34.8%	36.4%
• At least once a week / every day	65.2%	63.6%
N	*248*	*43,583*
In your job how often do you usually read articles in newspapers, magazines or newsletters?		
• Never / less than once a week	64.8%	61.6%
• At least once a week / every day	35.2%	38.4%
N	*248*	*43,586*
In your job how often do you usually read articles in professional journals or scholarly publications?		
• Never / less than once a week	74.4%	75.2%
• At least once a week / every day	25.6%	24.8%
N	*248*	*43,578*
In your job how often do you usually read books?		
• Never / less than once a week	91.8%	88.5%
• At least once a week / every day	8.2%	11.5%
N	*248*	*43,592*
In your job how often do you usually read manuals or reference materials?		
• Never / less than once a week	70.9%	72.6%
• At least once a week / every day	29.1%	27.4%
N	*248*	*43,576*
In your job how often do you usually read bills, invoices, bank statements or other financial statements?		
• Never / less than once a week	81.3%∆	73.7%∇
• At least once a week / every day	18.7%∇	26.3%∆
N	*248*	*43,586*
In your job how often do you usually read diagrams, maps or schematics?		
• Never / less than once a week	53.1%▼	70.6%▲
• At least once a week / every day	46.9%▲	29.4%▼
N	*248*	*43,592*

	Rail	All other sectors
Index of use of writing skills at work, categorised WLE (derived) [4 items]		
• low (zero to 60%)	63.6%	66.3%
• high (more than 60%)	36.4%	33.7%
N	*248*	*43,482*
In your job how often do you usually write letters, memos or e-mails?		
• Never / less than once a week	48.6%∆	41.4%∇
• At least once a week / every day	51.4%∇	58.6%∆
N	*248*	*43,591*
In your job how often do you usually write articles for newspapers, magazines or newsletters?		
• Never / less than once a week	98.8%	97.6%
• At least once a week / every day	1.2%	2.4%
N	*248*	*43,594*
In your job how often do you usually write reports?		
• Never / less than once a week	65.2%∇	72.2%∆
• At least once a week / every day	34.8%∆	27.8%∇
N	*248*	*43,587*
In your job how often do you usually fill in forms?		
• Never / less than once a week	45.5%▼	56.6%▲
• At least once a week / every day	54.5%▲	43.4%▼
N	*248*	*43,580*
Index of use of numeracy skills at work (basic and advanced), categorised WLE (derived) [6 items]		
• low (zero to 60%)	73.9%	71.3%
• high (more than 60%)	26.1%	28.7%
N	*248*	*43,482*
In your job how often do you usually calculate prices, costs or budgets?		
• Never / less than once a week	• 77.2%	• 71.9%
• At least once a week / every day	• 22.8%	• 28.1%
N	*248*	*43,587*
In your job how often do you usually use or calculate fractions, decimals or percentages?		
• Never / less than once a week	73.1%∆	66.5%∇
• At least once a week / every day	26.9%∇	33.5%∆
N	*248*	*43,591*
In your job how often do you usually use a calculator - either hand-held or computer based?		
• Never / less than once a week	57.4%∆	50.8%∇
• At least once a week / every day	42.6%∇	49.2%∆
N	*248*	*43,585*
In your job how often do you usually prepare charts, graphs or tables?		
• Never / less than once a week	80.5%	82.9%
• At least once a week / every day	19.5%	17.1%
N	*248*	*43,590*
In your job how often do you usually use simple algebra or formulas?		
• Never / less than once a week	74.8%	75.3%
• At least once a week / every day	25.2%	24.7%
N	*248*	*43,574*

	Rail	All other sectors
In your job how often do you usually use more advanced math or statistics such as calculus, complex algebra, trigonometry or use of regression techniques?		
• Never / less than once a week	96.8%	95.2%
• At least once a week / every day	3.2%	4.8%
N	*248*	*43,581*
Index of use of ICT skills at work, categorised WLE (derived) [7 items]		
• low (zero to 60%)	34.6%∇	41.6%∆
• high (more than 60%)	65.4%∆	58.4%∇
N	*248*	*43,482*
Do you use a computer in your job? [incl. cell-phones and other hand-held electronic devices that are used to connect to the internet, check e-mails etc.]		
• Yes	55.5%▼	67.1%▲
• No	44.5%▲	32.9%▼
N	*248*	*43,596*
In your job how often do you usually use email?		
• Never / less than once a week	20.7%	20.4%
• At least once a week / every day	79.3%	79.6%
N	*138*	*29,267*
In your job how often do you usually use the internet in order to better understand issues related to your work?		
• Never / less than once a week	34.8%	33.7%
• At least once a week / every day	65.2%	66.3%
N	*138*	*29,260*
In your job how often do you usually conduct transactions on the internet, for example buying or selling products or services, or banking?		
• Never / less than once a week	90.6%▲	81.8%▼
• At least once a week / every day	9.4%▼	18.2%▲
N	*138*	*29,261*
In your job how often do you usually use spreadsheet software, for example Excel?		
• Never / less than once a week	39.8%∇	48.3%∆
• At least once a week / every day	60.2%∆	51.7%∇
N	*138*	*29,253*
In your job how often do you usually use a word processor, for example Word?		
• Never / less than once a week	40.7%	34.4%
• At least once a week / every day	59.3%	65.6%
N	*138*	*29,260*
In your job how often do you usually use a programming language to program or write computer code?		
• Never / less than once a week	92.5%	91.6%
• At least once a week / every day	7.5%	8.4%
N	138	29,219

	Rail	All other sectors
In your job how often do you usually participate in real-time discussions on the internet, for example online conferences, or chat groups?		
• Never / less than once a week	95.6%	91.9%
• At least once a week / every day	4.4%	8.1%
N	*138*	*29,261*
What level of computer use is needed to perform your job?		
• STRAIGHTFORWARD (e.g. computer use for straightforward routine tasks, e.g. data entry or sending and receiving e-mails)	32.4%	33.0%
• MODERATE (e.g. word-processing/spreadsheets/database management)	63.9%	58.5%
• COMPLEX (e.g. developing software/modifying games/programming/maintaining network)	3.7%∇	8.4%∆
N	*138*	*29,223*
Do you think you have the computer skills you need to do your job well?		
• Yes	90.8%	91.1%
• No	9.2%	8.9%
N	*138*	*29,243*
Has a lack of computer skills affected your chances of being hired for a job or getting a promotion or pay raise?		
• Yes	9.2%	6.7%
• No	90.8%	93.3%
N	*135*	*29,163*
Index of readiness to learn categorised WLE (derived) [6 items]		
• low (zero to 60%)	54.9%	55.9%
• high (more than 60%)	45.1%	44.1%
N	*248*	*43,482*
When I hear or read about new ideas, I try to relate them to real life situations to which they might apply		
• Not at all/very little/to some extent	56.4%	57.1%
• To a (very) high extent	43.6%	42.9%
N	*247*	*43,095*
I like learning new things		
• Not at all/very little/to some extent	27.7%	23.8%
• To a (very) high extent	72.3%	76.2%
N	*248*	*43,545*
When I come across something new, I try to relate it to what I already know		
• Not at all/very little/to some extent	39.5%	39.3%
• To a (very) high extent	60.5%	60.7%
N	248	43,280
I like to get to the bottom of difficult things		
• Not at all/very little/to some extent	39.2%	37.6%
• To a (very) high extent	60.8%	62.4%
N	*248*	*43,521*
I like to figure out how different ideas fit together		
• Not at all/very little/to some extent	43.1%	44.8%
• To a (very) high extent	56.9%	55.2%
N	247	43,252

	Rail	All other sectors
If I don't understand something, I look for additional information to make it clearer		
• Not at all/very little/to some extent	22.7%	21.2%
• To a (very) high extent	77.3%	78.8%
N	*247*	*43,538*

Dutch NWCS (NEA)

Table A1.4 Results from the NWCS - NEA survey (2014+2015+2016 samples pooled; TNO/CBS); Comparison of Manufacture of railway locomotives/rolling stock & Construction of (underground) railways (3020+4212); Freight & Passenger (interurban) rail transport (4910+4920), and all other sectors

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
Four rail sectors NACE rev.2 activity code (5 digit) vs. all other sectors			
• 30200 Manufacture of railway locomotives and rolling stock	5.8%▲	0%	0%▼
• 42120 Construction of railways and underground railways	94.2%▲	0%	0%▼
• 49100 Passenger rail transport, interurban	0%	97.9%▲	0%▼
• 49200 Freight rail transport	0%	2.1%▲	0%▼
• all other sectors	0%▼	0%▼	100%
N	*123*	*301*	*123,342*
Occupation (ISCO-08 major group)			
• Armed forces	0%	0%	0.4%
• Legislators senior officials and managers	7.6%	4.4%	6.2%
• Professionals	14.9%▼	5.2%▼	25.5%▲
• Technicians and associate professionals	19.6%	3.0%▼	17.5%▲
• Clerks	20.2%▲	19.7%▲	11.3%▼
• Service and sales workers	3.1%▼	29.2%▲	18.1%
• Skilled agricultural and fishery workers	0%	0%	1.1%∆
• Craft and related trades workers	25.9%▲	0.4%▼	7.2%
• Plant and machine operators, and assemblers	5.0%	37.8%▲	4.2%▼
• Elementary occupations	3.9%	0.3%▼	8.4%▲
N	*120*	*292*	*121,712*
Sex			
• Man	92.9%▲	78.3%▲	52.5%▼
• Woman	7.1%▼	21.7%▼	47.5%▲
N	*123*	*301*	*123,342*
Age			
• 15-24	1.3%▼	1.8%▼	15.1%▲
• 25-34	19.1%	14.7%∇	21.0%∆
• 35-44	23.4%	16.3%∇	21.0%
• 45-54	28.0%	37.6%▲	24.2%▼
• 55-64	28.2%▲	28.5%▲	16.9%▼
• 65-74	0%	1.1%	1.8%
N	*123*	*301*	*123,342*
Educational attainment			
• Low (ISCED 0-2)	20.2%	24.7%	22.6%

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
• Medium (ISCED 3-4)	49.3%	56.9%▲	43.1%▼
• High (ISCED 5-6)	30.4%	18.4%▼	34.3%▲
N	*123*	*298*	*122,001*
Educational attainment			
• ISCED 0-1 Primary level of education	5.5%	3.7%	5.7%
• ISCED 2 Lower secondary level of education	14.7%	21.0%	16.9%
• ISCED 3-4 Upper/post-secondary level of education, non-tertiary education	49.3%	56.9%▲	43.1%▼
• ISCED 5 First stage of tertiary education (bachelor)	23.8%	11.6%▼	21.6%∆
• ISCED 6 Second stage of tertiary education (master)	6.6%∇	6.7%∇	12.8%∆
N	*123*	*298*	*122,001*
In the last year, were there any of the following changes in your workplace (establishment/location)? [multiple answers possible]			
a. A major restructuring	30.9%▲	17.2%	18.1%
b. A takeover by another organisation	4.4%	4.3%	3.9%
c. A takeover of another organisation	0.9%	0.6%∇	4.1%∆
d. A downsizing without compulsory redundancies	15.4%	9.9%	11.6%
e. A downsizing with compulsory redundancies	35.2%▲	2.5%▼	11.9%
f. A merger with another company	5.1%	2.0%∇	4.4%
g. Outsourcing of supportive services	11.8%	11.2%	8.1%∇
h. Relocation of activities to another country	2.8%	2.0%	2.7%
i. Automation of activities	11.4%	17.0%▲	9.9%∇
j. None of the above	33.9%▼	63.5%∆	56.1%
N	*123*	*299*	*122,202*
Do you have to do dangerous work?			
• No	45.9%▼	47.7%▼	77.6%▲
• Yes (sometimes or regularly)	54.1%▲	52.3%▲	22.4%▼
N	*121*	*297*	*121,817*
What is the biggest danger that you are in during your work? [multiple answers possible]			
• To fall from a great height.	29.1%	18.7%∇	27.3%
• To trip, to slip.	76.7%▲	51.2%∆	42.5%▼
• To get trapped.	47.2%▲	22.6%	18.2%▼
• To get cut, to get stabbed.	18.1%▼	3.8%▼	32.7%▲
• To crash, collisions	74.4%▲	68.0%▲	20.1%▼
• An accident with hazardous materials	6.4%▼	19.2%	21.1%∆
• Confrontation with violence	2.1%▼	72.1%▲	30.1%▼
• To get burned	5.8%▼	0.8%▼	16.5%▲
• To choke	0%	0.8%▼	5.5%▲

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
• Other danger during work	23.2%	5.9%▼	18.6%∆
N	*65*	*155*	*27,137*
Physically demanding/heavy work [‘force’, ‘vibrations’, ‘position’ and/or ‘repetition’]			
• Only ‘no’ or ‘yes, sometimes’	49.9%	42.0%▼	57.2%▲
• At least one answer ‘yes, regularly’	50.1%	58.0%▲	42.8%▼
N	*119*	*293*	*122,232*
Does your job require you to apply a lot of force?			
• No or sometimes	72.7%	94.6%▲	79.6%▼
• Yes regularly	27.3%	5.4%▼	20.4%▲
N	*118*	*285*	*119,894*
Does your job require you to use a tool, apparatus or a vehicle that shakes or trembles?			
• No or sometimes	77.6%▼	65.4%▼	91.2%▲
• Yes regularly	22.4%▲	34.6%▲	8.8%▼
N	*119*	*292*	*121,032*
Do you have to work in awkward work postures			
• No or sometimes	82.0%▼	88.9%	89.9%∆
• Yes regularly	18.0%▲	11.1%	10.1%∇
N	*119*	*291*	*120,702*
Does your job require you to make repetitive movements?			
• No or sometimes	67.3%	50.7%▼	65.8%▲
• Yes regularly	32.7%	49.3%▲	34.2%▼
N	*119*	*293*	*120,890*
Is there so much noise at your workplace that you need to talk loudly to be audible?			
• No or sometimes	79.7%▼	90.8%	93.0%▲
• Yes regularly	20.3%▲	9.2%	7.0%▼
N	*119*	*292*	*120,890*
Do you work with water or watery solutions?			
• Never or sometimes	98.9%▲	99.7%▲	84.0%▼
• Often or always	1.1%▼	0.3%▼	16.0%▲
N	*118*	*295*	*120,825*
Substances ['substances on skin', 'inhaling substances' and / or 'contact infectious substances']			
• Only ‘Never’ or ‘sometimes’	85.0%	90.6%∆	84.7%∇
• At least one answer ‘often’ or ‘always’	15.0%	9.4%∇	15.3%∆
N	*120*	*301*	*122,932*

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
During your work does your skin make contact with substances? (such as glue, paint, solvents etc.)			
• Never or sometimes	96.7%∆	99.7%▲	91.2%▼
• Often or always	3.3%∇	0.3%▼	8.8%▲
N	*120*	*299*	*122,323*
Do you inhale substances during work?			
• Never or sometimes	86.0%▼	96.9%∆	92.6%
• Often or always	14.0%▲	3.1%∇	7.4%
N	*120*	*299*	*122,197*
Do you come in contact with possibly infected persons, animals or materials?			
• Never or sometimes	97.6%	92.8%	94.7%
• Often or always	2.4%	7.2%	5.3%
N	*120*	*298*	*122,378*
Autonomy [>=2.5 on scale 1=no - 3=regularly; 5 items]			
• No or sometimes	27.8%▼	60.7%▲	44.0%∇
• Regularly	72.2%▲	39.3%▼	56.0%∆
N	*123*	*300*	*123,119*
Are you able to decide for yourself how to do your work?			
• No or sometimes	25.7%▼	48.9%∆	39.9%
• Yes regularly	74.3%▲	51.1%∇	60.1%
N	*123*	*299*	*122,901*
Are you able to decide for yourself in which order to do your work?			
• No or sometimes	27.4%▼	51.7%▲	38.0%∇
• Yes regularly	72.6%▲	48.3%▼	62.0%∆
N	*123*	*299*	*122,943*
Are you able to influence the pace in which you work?			
• No or sometimes	36.0%	53.0%∆	43.9%
• Yes regularly	64.0%	47.0%∇	56.1%
N	*123*	*300*	*122,719*
Do you need to come up with solutions yourself?			
• No or sometimes	22.7%▼	39.7%∆	32.2%
• Yes regularly	77.3%▲	60.3%∇	67.8%
N	*122*	*300*	*122,639*
Are you able to take time off work when you want to?			
• No or sometimes	32.1%▼	76.1%▲	51.7%▼
• Yes regularly	67.9%▲	23.9%▼	48.3%▲
N	*123*	*299*	*122,657*

	Manufacture of railway locomotives/rolling stock; constrution (underground) railways	Freight/passenger rail transport, interurban	All other sectors
Are you able to decide for yourself at what times you work?			
• No or sometimes	67.8%▼	85.3%▲	76.6%
• Yes regularly	32.2%▲	14.7%▼	23.4%
N	123	300	122,973
Quantitative job demands [>=2.5 on scale 1=Never - 4=always; 3 items]			
• Never or sometimes	68.3%	81.6%▲	62.0%▼
• Often or always	31.7%	18.4%▼	38.0%▲
N	*123*	*299*	*122,735*
Do you have to work very fast?			
• Never or sometimes	64.5%	83.0%▲	63.7%▼
• Often or always	35.5%	17.0%▼	36.3%▲
N	*123*	*300*	*122,698*
Do you have to do a lot of work?			
• Never or sometimes	59.4%	76.8%▲	54.7%▼
• Often or always	40.6%	23.2%▼	45.3%▲
N	*123*	*299*	*122,539*
Do you need to work extra hard?			
• Never or sometimes	79.2%▲	86.6%▲	69.3%▼
• Often or always	20.8%▼	13.4%▼	30.7%▲
N	*123*	*298*	*121,772*
Skill discretion [>=2.5 on scale 1=Never - 4=always; 3 items]			
• Never or sometimes	28.3%▼	44.7%	39.3%
• Often or always	71.7%▲	55.3%	60.7%
N	*76*	*205*	*80,671*
Is your work varied?			
• Never or sometimes	25.5%	36.9%	33.1%
• Often or always	74.5%	63.1%	66.9%
N	*76*	*205*	*80,542*
Does your job require learning new skills?			
• Never or sometimes	55.9%	56.3%	52.2%
• Often or always	44.1%	43.7%	47.8%
N	*76*	*205*	*80,574*
Does your job require creativity?			
• Never or sometimes	28.0%▼	51.5%∆	42.8%
• Often or always	72.0%▲	48.5%∇	57.2%
N	76	206	80,547
Emotionally demanding work [>=2.5 on scale 1=Never - 4=always; 3 items]			

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
• Never or sometimes	92.8%	91.0%	90.6%
• Often or always	7.2%	9.0%	9.4%
N	*123*	*299*	*122,919*
Does your work get you into emotionally difficult situations?			
• Never or sometimes	94.9%	91.1%	92.3%
• Often or always	5.1%	8.9%	7.7%
N	*123*	*300*	*122,870*
Is your work emotionally demanding?			
• Never or sometimes	91.7%	88.1%	88.0%
• Often or always	8.3%	11.9%	12.0%
N	*123*	*299*	*122,766*
Do you get emotionally involved with your work?			
• Never or sometimes	85.4%	90.8%∆	86.9%
• Often or always	14.6%	9.2%∇	13.1%
N	*123*	*299*	*122,768*
Mentally demanding work [>=2.5 on scale 1=Never - 4=always; 3 items]			
• Never or sometimes	11.1%▼	15.2%∇	22.9%▲
• Often or always	88.9%▲	84.8%∆	77.1%▼
N	*123*	*298*	*122,850*
Does your work require you to think very intensively?			
• Never or sometimes	30.8%▼	53.0%∆	44.2%
• Often or always	69.2%▲	47.0%∇	55.8%
N	*123*	*297*	*122,786*
Does your work require that you keep your mind on your job?			
• Never or sometimes	9.2%∇	7.6%▼	15.9%▲
• Often or always	90.8%∆	92.4%▲	84.1%▼
N	*123*	*299*	*122,660*
Does your work require a lot of your attention from you?			
• Never or sometimes	14.2%▼	21.5%	25.2%∆
• Often or always	85.8%▲	78.5%	74.8%∇
N	*123*	*296*	*122,122*
How many hours a day do you use a computer screen for your work? [Mean] [Range: 0−13 hours]	4,44∆	3,51∇	3,91
N	*121*	*293*	*119,639*
Working with a computer			
• 0 up to 5 hours per day	52.8%∇	69.7%∆	62.4%
• 6 or more hours per day	47.2%∆	30.3%∇	37.6%
N	*121*	*293*	*119,639*

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
Social support supervisor [>=2.5 on scale 1=little - 4=a lot; 2 items]			
• (Very) little	8.1%∇	17.3%	14.9%
• (Quite) a lot	91.9%∆	82.7%	85.1%
N	*123*	*291*	*117,539*
My supervisor looks out for the well-being of the employees			
• (Totally) disagree	12.9%∇	22.1%	20.5%
• (Totally) agree	87.1%∆	77.9%	79.5%
N	*123*	*293*	*118,491*
My supervisor pays attention to what I say			
• (Totally) disagree	15.3%	23.7%∆	18.8%
• (Totally) agree	84.7%	76.3%∇	81.2%
N	*123*	*294*	*118,553*
Social support colleagues [>=2.5 on scale 1=little - 4=a lot; 2 items]			
• (Very) little	1.2%	1.6%	3.6%∆
• (Quite) a lot	98.8%	98.4%	96.4%∇
N	*120*	*290*	*118,625*
My colleagues show a personal interest in me			
• (Totally) disagree	5.5%	10.9%	9.1%
• (Totally) agree	94.5%	89.1%	90.9%
N	*120*	*292*	*119,034*
My colleagues are friendly			
• (Totally) disagree	1.2%	2.8%	3.6%
• (Totally) agree	98.8%	97.2%	96.4%
N	*123*	*296*	*120,592*
External unwanted behaviour [4 items]			
• Only 'no, never'	92.1%▲	41.4%▼	77.0%▲
• At least one answer 'yes, once' or more often	7.9%▼	58.6%▲	23.0%▼
N	*123*	*301*	*123,160*
Unwanted sexual attention from clients (or patients, students, passengers etc.)?			
• Never	100%▲	92.5%	94.7%
• Once to very often	0%▼	7.5%	5.3%
N	*121*	*301*	*123,014*
Intimidation by clients (or patients, students, passengers etc.)?			
• Never	95.0%▲	45.2%▼	81.2%▲
• Once to very often	5.0%▼	54.8%▲	18.8%▼

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
N	*123*	*299*	*122,981*
Physical violence by clients (or patients, students, passengers etc.)?			
• Never	100%▲	77.6%▼	94.3%▲
• Once to very often	0%▼	22.4%▲	5.7%▼
N	*122*	*301*	*122,936*
Bullying by clients (or patients, students, passengers etc.)?			
• Never	97.1%	67.9%▼	94.7%▲
• Once to very often	2.9%	32.1%▲	5.3%▼
N	*122*	*300*	*122,798*
In past 12 months victim of one or more work accidents with one or more days of sick leave?			
• Victim of one or more work accidents with one or more days of sick leave	3.2%	6.2%▲	1.5%▼
• No work accident with one or more days of sick leave	96.8%	93.8%▼	98.5%▲
N	*122*	*299*	*122,250*
Demanding work, work stress [OSH-measures needed?]			
• Not needed, because not an issue here	5.5%▼	9.4%▼	20.7%▲
• Not needed, current measures are sufficient	37.9%	43.8%∆	36.6%∇
• Needed, current measures are insufficient	46.2%▲	35.7%	31.0%∇
• Needed, no measures have been taken yet	10.4%	11.1%	11.7%
N	*120*	*300*	*122,318*
Emotionally demanding work [OSH-measures needed?]			
• Not needed, because not an issue here	36.5%▼	23.5%▼	48.8%▲
• Not needed, current measures are sufficient	46.9%▲	54.5%▲	35.2%▼
• Needed, current measures are insufficient	13.1%	19.0%∆	12.5%∇
• Needed, no measures have been taken yet	3.4%	2.9%	3.5%
N	*121*	*297*	*121,831*
Prolonged computer work [OSH-measures needed?]			
• Not needed, because not an issue here	25.7%▼	49.1%∆	43.2%
• Not needed, current measures are sufficient	39.9%	32.2%	35.7%
• Needed, current measures are insufficient	26.1%▲	12.1%	14.3%
• Needed, no measures have been taken yet	8.3%	6.6%	6.7%
N	*122*	*298*	*121,764*
Physically heavy work [OSH-measures needed?]			
• Not needed, because not an issue here	32.0%▼	52.7%	53.6%∆
• Not needed, current measures are sufficient	40.4%∆	32.9%	31.9%
• Needed, current measures are insufficient	24.1%▲	12.3%	11.5%∇
• Needed, no measures have been taken yet	3.6%	2.1%	3.0%

	Manufacture of railway locomotives/rolling stock; construtcion (underground) railways	Freight/passenger rail transport, interurban	All other sectors
N	*121*	*300*	*122,176*
Noise [OSH-measures needed?]			
• Not needed, because not an issue here	28.2%▼	32.3%▼	63.4%▲
• Not needed, current measures are sufficient	61.4%▲	40.0%▲	27.7%▼
• Needed, current measures are insufficient	9.4%	22.8%▲	7.0%▼
• Needed, no measures have been taken yet	1.1%	5.0%▲	1.9%∇
N	*122*	*299*	*121,820*
Intimidation, aggression or violence by customers (or patients, students, passengers etc.) [OSH-measures needed?]			
• Not needed, because not an issue here	75.6%▲	26.7%▼	64.2%▲
• Not needed, current measures are sufficient	24.4%	35.1%∆	28.8%
• Needed, current measures are insufficient	0%▼	35.1%▲	5.8%▼
• Needed, no measures have been taken yet	0%	3.1%∆	1.2%
N	*120*	*296*	*121,895*
Intimidation, aggression or violence by supervisors or colleagues [OSH-measures needed?]			
• Not needed, because not an issue here	68.0%	52.2%▼	72.9%▲
• Not needed, current measures are sufficient	26.5%	36.4%▲	21.6%▼
• Needed, current measures are insufficient	3.5%	10.9%▲	3.9%▼
• Needed, no measures have been taken yet	1.9%	0.5%	1.6%
N	*121*	*297*	*121,728*
Dangerous substances [OSH-measures needed?]			
• Not needed, because not an issue here	38.0%▼	61.9%▼	71.9%▲
• Not needed, current measures are sufficient	51.6%▲	36.7%▲	24.1%▼
• Needed, current measures are insufficient	9.2%▲	1.4%	3.3%
• Needed, no measures have been taken yet	1.1%	0%	0.7%
N	*121*	*300*	*121,853*
Safety, work accidents [OSH-measures needed?]			
• Not needed, because not an issue here	19.2%▼	27.3%▼	53.7%▲
• Not needed, current measures are sufficient	65.4%▲	57.4%▲	39.0%▼
• Needed, current measures are insufficient	15.4%▲	14.6%▲	6.2%▼
• Needed, no measures have been taken yet	0%	0.6%	1.1%
N	*122*	*297*	*121,540*
Viruses, bacteria, fungi [OSH-measures needed?]			
• Not needed, because not an issue here	62.7%	51.5%▼	64.5%▲
• Not needed, current measures are sufficient	25.2%	30.7%	28.5%
• Needed, current measures are insufficient	11.6%▲	12.5%▲	5.7%▼
• Needed, no measures have been taken yet	0.6%	5.3%▲	1.4%▼
N	*120*	*298*	*121,422*

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
General health			
• Reasonable, bad or very bad	20.8%	18.7%	17.6%
• Good or very good	79.2%	81.3%	82.4%
N	*121*	*301*	*122,914*
Burn-out complaints [>3.20 on scale 1=never - 7=every day; 5 items]			
• No	85.4%	88.5%	85.9%
• Yes	14.6%	11.5%	14.1%
N	*123*	*301*	*123,038*
I feel emotionally drained by my work			
• Never to monthly	84.4%	87.1%	86.8%
• Once per month to every day	15.6%	12.9%	13.2%
N	*123*	*301*	*122,796*
After a day's work I feel empty			
• Never to monthly	68.2%	75.6%	70.6%
• Once per month to every day	31.8%	24.4%	29.4%
N	*123*	*300*	*122,749*
When I get up in the morning and I am confronted with work I feel tired			
• Never to monthly	81.8%	85.2%	81.8%
• Once per month to every day	18.2%	14.8%	18.2%
N	*123*	*300*	*122,724*
Working with people all day is really demanding			
• Never to monthly	92.2%	88.1%	89.8%
• Once per month to every day	7.8%	11.9%	10.2%
N	*122*	*301*	*122,488*
I feel completely exhausted by my work			
• Never to monthly	86.6%	88.6%	87.0%
• Once per month to every day	13.4%	11.4%	13.0%
N	*122*	*299*	*122,481*
Individual sickness leave percentage (adjusted for part-time work) [Mean] [Range: 0−100]	8,35▲	5,94∆	3,83▼
N	*121*	*297*	*121,642*
Employability [>=2.5 on scale 1=low - 4=high; 4 items]			
• (Very) low [<2.5]	20.1%	19.6%∆	15.4%∇
• (Very) high [>=2.5]	79.9%	80.4%∇	84.6%∆
N	*123*	*296*	*121,985*
I can easily meet the physical demands that my work places on me			

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
• (Totally) disagree	15.7%▲	7.1%	9.6%
• (Totally) agree	84.3%▼	92.9%	90.4%
N	*123*	*301*	*122,806*
I can easily meet the psychological demands that my work places on me			
• (Totally) disagree	12.2%	8.2%	9.2%
• (Totally) agree	87.8%	91.8%	90.8%
N	*123*	*301*	*122,389*
I could easily get a new job/position with my current employer			
• (Totally) disagree	50.4%	53.2%	51.7%
• (Totally) agree	49.6%	46.8%	48.3%
N	*123*	*295*	*121,329*
I could easily get a new job/position with another employer			
• (Totally) disagree	47.0%	64.5%▲	43.9%▼
• (Totally) agree	53.0%	35.5%▼	56.1%▲
N	*120*	*296*	*121,118*
Interesting work [importance]			
• Not important	0.8%	3.6%	2.9%
• (Very) important	99.2%	96.4%	97.1%
N	*123*	*299*	*122,576*
Learning opportunities [importance]			
• Not important	2.7%▼	18.4%▲	10.0%∇
• (Very) important	97.3%▲	81.6%▼	90.0%∆
N	*121*	*299*	*122,177*
Interesting work [satisfaction]			
• Not satisfied	6.8%	7.8%	8.8%
• (Very) satisfied	93.2%	92.2%	91.2%
N	*123*	*291*	*118,379*
Learning opportunities [satisfaction]			
• Not satisfied	16.3%	15.6%	18.2%
• (Very) satisfied	83.7%	84.4%	81.8%
N	*123*	*288*	*117,649*
Did you change job in your company in the last two years?			
• Yes	14.9%	14.1%	18.3%∆
• No	85.1%	85.9%	81.7%∇
N	*123*	*300*	*122,781*
Has your job been extended in the last two years?			
• Yes	51.4%▲	38.2%	41.0%
• No	48.6%▼	61.8%	59.0%

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
N	*122*	*299*	*122,415*
Have you made a job advancement within your company in the last two years?			
• Yes	10.5%	10.8%	14.0%
• No	89.5%	89.2%	86.0%
N	*122*	*298*	*122,222*
Have you gone from a higher to a lower job position in the last two years?			
• Yes	6.5%	2.7%	4.0%
• No	93.5%	97.3%	96.0%
N	*122*	*297*	*122,214*
How do your knowledge and skills fit with your current job?			
• I have less knowledge and skills than I need for my current job	3.9%	1.4%∇	5.5%∆
• It fits well	68.1%	58.6%	61.8%
• I have more knowledge and skills than I need for my current job	28.0%	40.0%∆	32.7%
N	*122*	*298*	*121,878*
Does your supervisor stimulate the development of your knowledge and skills?			
• No	24.4%	25.2%	25.9%
• Yes, to some extent	52.9%	55.8%	51.6%
• Yes, to a large extent	22.7%	19.0%	22.5%
N	*123*	*300*	*121,791*
In the last two years, did you participate in training or a course for your work?			
• No	29.3%▼	34.9%▼	48.7%▲
• Yes	70.7%▲	65.1%▲	51.3%▼
N	*120*	*300*	*122,516*
Do you currently need a training or course? [multiple answers possible]			
a. No, no need for a training or course	45.3%	62.8%∆	53.7%
b. Yes, to be able to do my current work better	18.3%	9.9%∇	17.3%∆
c. Yes, to handle future changes in my current job	21.8%	10.8%∇	17.5%
d. Yes, to increase my employment prospects in the future	31.6%	21.9%	24.6%
N	*123*	*301*	*122,452*
Skills obsolescence [>=3.5 on scale 1=low - 5=high; 3 items]			
• Low [<3.5]	79.5%	81.7%	79.2%
• High [>=3.5]	20.5%	18.3%	20.8%
N	*123*	*298*	*121,852*

	Manufacture of railway locomotives/rolling stock; construction (underground) railways	Freight/passenger rail transport, interurban	All other sectors
I do not use certain knowledge or skills often enough so that I forget or lose them			
• Totally disagree up to neutral	62.3%	66.0%	65.8%
• (Totally) agree	37.7%	34.0%	34.2%
N	*123*	*298*	*121,839*
I miss 'new' knowledge or skills that have become important due to changes in my work			
• Totally disagree up to neutral	73.5%	80.7%	76.6%
• (Totally) agree	26.5%	19.3%	23.4%
N	*123*	*296*	*121,539*
I have knowledge or skills that I no longer need due to change of employer/company			
• Totally disagree up to neutral	70.5%	66.6%	70.3%
• (Totally) agree	29.5%	33.4%	29.7%
N	*122*	*295*	*121,229*
At my workplace, employees are encouraged to think about ways to do the job better			
• Never or sometimes	35.4%▼	57.5%∆	49.6%
• Often or always	64.6%▲	42.5%∇	50.4%
N	*75*	*208*	*80,420*

Table A1.5 Results from the NWCS - NEA survey (2014+2015+2016 samples pooled; TNO/CBS); Comparison of Manufacture of railway locomotives/rolling stock & Construction of (underground) railways (4211+4213 versus 42.12)

	4211&4213 Construction of roads and civil engineering	4212 Construction of (underground) railways
Occupation (ISCO-08 major group)		
• Armed forces	0%	0%
• Legislators senior officials and managers	7.5%	7.7%
• Professionals	13.3%	12.5%
• Technicians and associate professionals	23.4%	19.8%
• Clerical support workers	14.9%	21.4%
• Service and sales workers	1.7%	2.9%
• Skilled agricultural and fishery workers	1.2%	0%
• Craft and related trades workers	16.5%▼	26.2%▲
• Plant and machine operators, and assemblers	13.0%▲	5.3%▼
• Elementary occupations	8.5%	4.1%
N	*476*	*111*
Sex		
• Man	90.1%	92.9%
• Woman	9.9%	7.1%
N	*483*	*114*
Age		
• 15-24	6.9%▲	1.3%▼
• 25-34	24.8%	18.1%
• 35-44	22.3%	23.6%
• 45-54	28.4%	27.2%
• 55-64	16.3%▼	29.8%▲
• 65-74	1.4%	0%
N	*483*	*114*
Educational attainment		
• Low (ISCED 0-2)	26.9%	21.1%
• Medium (ISCED 3-4)	45.2%	52.0%
• High (ISCED 5-6)	27.8%	26.9%
N	*479*	*114*
Educational attainment		
• ISCED 0-1 Primary level of education	7.5%	5.9%
• ISCED 2 Lower secondary level of education	19.5%	15.3%
• ISCED 3-4 Upper/post-secondary level of education, non-tertiary education	45.2%	52.0%
• ISCED 5 First stage of tertiary education (bachelor)	22.2%	22.9%
• ISCED 6 Second stage of tertiary education (master)	5.6%	4.0%
N	*479*	*114*

	4211&4213 Construction of roads and civil engineering	4212 Construction of (underground) railways
In the last year, were there any of the following changes in your workplace (establishment/location)? [multiple answers possible]		
a. A major restructuring	16.7%▼	32.8%▲
b. A takeover by another organisation	5.5%	3.6%
c. A takeover of another organisation	2.5%	1.0%
d. A downsizing without compulsory redundancies	5.1%▼	15.5%▲
e. A downsizing with compulsory redundancies	18.4%▼	36.7%▲
f. A merger with another company	3.1%	5.4%
g. Outsourcing of supportive services	7.4%	12.2%
h. Relocation of activities to another country	0.6%▼	2.9%▲
i. Automation of activities	5.2%▼	12.1%▲
j. None of the above	61.8%▲	32.3%▼
N	*477*	*114*
Do you have to do dangerous work?		
• No	58.7%▲	44.2%▼
• Yes (sometimes or regularly)	41.3%▼	55.8%▲
N	*480*	*113*
What is the biggest danger that you are in during your work? [multiple answers possible]		
• To fall from a great height.	34.0%	29.9%
• To trip, to slip.	57.6%▼	78.9%▲
• To get trapped.	34.6%▼	48.5%▲
• To get cut, to get stabbed.	21.6%	18.6%
• To crash, collisions	51.7%▼	76.6%▲
• An accident with hazardous materials	17.0%▲	6.6%▼
• Confrontation with violence	11.0%▲	2.2%▼
• To get burned	13.6%	5.9%
• To choke	12.0%▲	0%▼
• Other danger during work	17.3%	21.0%
N	*197*	*62*
Physically demanding/heavy work ['force', 'vibrations', 'position' and/or 'repetition']		
• Only 'no' or 'yes, sometimes'	48.4%	47.1%
• At least one answer 'yes, regularly'	51.6%	52.9%
N	*481*	*111*
Does your job require you to apply a lot of force?		
• No or sometimes	70.3%	71.0%
• Yes regularly	29.7%	29.0%
N	*473*	*109*

	4211&4213 Construction of roads and civil engineering	4212 Construction of (underground) railways
Does your job require you to use a tool, apparatus or a vehicle that shakes or trembles?		
• No or sometimes	68.2%	76.2%
• Yes regularly	31.8%	23.8%
N	*478*	*111*
Do you have to work in awkward work postures		
• No or sometimes	83.9%	80.9%
• Yes regularly	16.1%	19.1%
N	*477*	*111*
Does your job require you to make repetitive movements?		
• No or sometimes	57.6%	65.6%
• Yes regularly	42.4%	34.4%
N	*476*	*110*
Is there so much noise at your workplace that you need to talk loudly to be audible?		
• No or sometimes	87.0%▲	78.4%▼
• Yes regularly	13.0%▼	21.6%▲
N	*478*	*110*
Do you work with water or watery solutions?		
• Never or sometimes	85.9%▼	98.8%▲
• Often or always	14.1%▲	1.2%▼
N	*473*	*110*
Substances ['substances on skin', 'inhaling substances' and / or 'contact infectious substances']		
• Only ‘Never’ or ‘sometimes’	80.7%	84.1%
• At least one answer ‘often’ or ‘always’	19.3%	15.9%
N	*483*	*112*
During your work does your skin make contact with substances? (such as glue, paint, solvents etc.)		
• Never or sometimes	93.8%	96.5%
• Often or always	6.2%	3.5%
N	*477*	*112*
Do you inhale substances during work?		
• Never or sometimes	83.2%	85.1%
• Often or always	16.8%	14.9%
N	*482*	*112*
Do you come in contact with possibly infected persons, animals or materials?		
• Never or sometimes	98.0%	97.5%
• Often or always	2.0%	2.5%
N	*481*	*112*

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Autonomy [>=2.5 on scale 1=no - 3=regularly; 5 items]		
• No or sometimes	27.6%	28.4%
• Regularly	72.4%	71.6%
N	*481*	*114*
Are you able to decide for yourself how to do your work?		
• No or sometimes	26.5%	26.9%
• Yes regularly	73.5%	73.1%
N	*481*	*114*
Are you able to decide for yourself in which order to do your work?		
• No or sometimes	29.8%	28.0%
• Yes regularly	70.2%	72.0%
N	*481*	*114*
Are you able to influence the pace in which you work?		
• No or sometimes	34.6%	37.2%
• Yes regularly	65.4%	62.8%
N	*479*	*114*
Do you need to come up with solutions yourself?		
• No or sometimes	22.5%	22.6%
• Yes regularly	77.5%	77.4%
N	*478*	*113*
Are you able to take time off work when you want to?		
• No or sometimes	40.5%	33.7%
• Yes regularly	59.5%	66.3%
N	*480*	*114*
Are you able to decide for yourself at what times you work?		
• No or sometimes	81.2%▲	70.6%▼
• Yes regularly	18.8%▼	29.4%▲
N	*481*	*114*
Quantitative job demands [>=2.5 on scale 1=Never - 4=always; 3 items]		
• Never or sometimes	61.9%	69.6%
• Often or always	38.1%	30.4%
N	*477*	*114*
Do you have to work very fast?		
• Never or sometimes	65.1%	64.8%
• Often or always	34.9%	35.2%
N	*477*	*114*
Do you have to do a lot of work?		
• Never or sometimes	54.9%	60.1%
• Often or always	45.1%	39.9%
N	*475*	*114*

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Do you need to work extra hard?		
• Never or sometimes	70.1%▼	80.1%▲
• Often or always	29.9%▲	19.9%▼
N	*476*	*114*
Skill discretion [>=2.5 on scale 1=Never - 4=always; 3 items]		
• Never or sometimes	34.6%	28.3%
• Often or always	65.4%	71.7%
N	*320*	*73*
Is your work varied?		
• Never or sometimes	22.1%	25.4%
• Often or always	77.9%	74.6%
N	*319*	*73*
Does your job require learning new skills?		
• Never or sometimes	55.9%	54.5%
• Often or always	44.1%	45.5%
N	*320*	*73*
Does your job require creativity?		
• Never or sometimes	36.8%	28.0%
• Often or always	63.2%	72.0%
N	*320*	*73*
Emotionally demanding work [>=2.5 on scale 1=Never - 4=always; 3 items]		
• Never or sometimes	95.2%	92.3%
• Often or always	4.8%	7.7%
N	*483*	*114*
Does your work get you into emotionally difficult situations?		
• Never or sometimes	96.9%	94.6%
• Often or always	3.1%	5.4%
N	*482*	*114*
Is your work emotionally demanding?		
• Never or sometimes	94.5%	91.2%
• Often or always	5.5%	8.8%
N	*483*	*114*
Do you get emotionally involved with your work?		
• Never or sometimes	87.0%	84.5%
• Often or always	13.0%	15.5%
N	*482*	*114*
Mentally demanding work [>=2.5 on scale 1=Never - 4=always; 3 items]		
• Never or sometimes	17.0%	10.6%
• Often or always	83.0%	89.4%
N	*479*	*114*

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Does your work require you to think very intensively?		
• Never or sometimes	36.0%	30.8%
• Often or always	64.0%	69.2%
N	*477*	*114*
Does your work require that you keep your mind on your job?		
• Never or sometimes	10.4%	8.7%
• Often or always	89.6%	91.3%
N	*478*	*114*
Does your work require a lot of your attention from you?		
• Never or sometimes	20.0%	13.8%
• Often or always	80.0%	86.2%
N	*475*	*114*
How many hours a day do you use a computer screen for your work? [Mean] [Range: 0−13 hours]	3,69	4,29
N	*463*	*112*
Working with a computer		
• 0 up to 5 hours per day	61.3%	54.5%
• 6 or more hours per day	38.7%	45.5%
N	*463*	*112*
Social support supervisor [>=2.5 on scale 1=little - 4=a lot; 2 items]		
• (Very) little	13.8%	7.5%
• (Quite) a lot	86.2%	92.5%
N	*463*	*114*
My supervisor looks out for the well-being of the employees		
• (Totally) disagree	21.8%▲	12.3%▼
• (Totally) agree	78.2%▼	87.7%▲
N	*470*	*114*
My supervisor pays attention to what I say		
• (Totally) disagree	17.3%	14.1%
• (Totally) agree	82.7%	85.9%
N	*466*	*114*
Social support colleagues [>=2.5 on scale 1=little - 4=a lot; 2 items]		
• (Very) little	4.6%	1.3%
• (Quite) a lot	95.4%	98.7%
N	*464*	*112*
My colleagues show a personal interest in me		
• (Totally) disagree	9.7%	5.8%
• (Totally) agree	90.3%	94.2%
N	*468*	*112*
My colleagues are friendly		
• (Totally) disagree	4.2%	1.3%
• (Totally) agree	95.8%	98.7%
N	*473*	*114*

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External unwanted behaviour [4 items]		
• Only 'no, never'	90.1%	91.6%
• At least one answer 'yes, once' or more often	9.9%	8.4%
N	*479*	*114*
Unwanted sexual attention from clients (or patients, students, passengers etc.)?		
• Never	99.0%	100%
• Once to very often	1.0%	0%
N	*479*	*113*
Intimidation by clients (or patients, students, passengers etc.)?		
• Never	91.3%	94.7%
• Once to very often	8.7%	5.3%
N	*477*	*114*
Physical violence by clients (or patients, students, passengers etc.)?		
• Never	98.7%	100%
• Once to very often	1.3%	0%
N	*479*	*113*
Bullying by clients (or patients, students, passengers etc.)?		
• Never	97.1%	96.9%
• Once to very often	2.9%	3.1%
N	*476*	*113*
In past 12 months victim of one or more work accidents with one or more days of sick leave?		
• Victim of one or more work accidents with one or more days of sick leave	1.8%	3.4%
• No work accident with one or more days of sick leave	98.2%	96.6%
N	*478*	*113*
Demanding work, work stress [OSH-measures needed?]		
• Not needed, because not an issue here	20.8%▲	5.5%▼
• Not needed, current measures are sufficient	44.6%	38.4%
• Needed, current measures are insufficient	26.1%▼	45.1%▲
• Needed, no measures have been taken yet	8.5%	11.1%
N	*478*	*111*
Emotionally demanding work [OSH-measures needed?]		
• Not needed, because not an issue here	49.9%▲	34.4%▼
• Not needed, current measures are sufficient	37.7%▼	49.1%▲
• Needed, current measures are insufficient	10.2%	12.9%
• Needed, no measures have been taken yet	2.2%	3.6%
N	*477*	*112*

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Prolonged computer work [OSH-measures needed?]		
• Not needed, because not an issue here	44.7%▲	27.3%▼
• Not needed, current measures are sufficient	38.1%	39.6%
• Needed, current measures are insufficient	13.4%▼	25.6%▲
• Needed, no measures have been taken yet	3.8%	7.4%
N	*470*	*113*
Physically heavy work [OSH-measures needed?]		
• Not needed, because not an issue here	31.3%	28.8%
• Not needed, current measures are sufficient	52.6%▲	41.8%▼
• Needed, current measures are insufficient	14.1%▼	25.6%▲
• Needed, no measures have been taken yet	2.1%	3.8%
N	*479*	*112*
Noise [OSH-measures needed?]		
• Not needed, because not an issue here	28.9%	24.8%
• Not needed, current measures are sufficient	61.2%	64.1%
• Needed, current measures are insufficient	8.9%	9.9%
• Needed, no measures have been taken yet	1.0%	1.1%
N	*477*	*113*
Intimidation, aggression or violence by customers (or patients, students, passengers etc.) [OSH-measures needed?]		
• Not needed, because not an issue here	73.0%	74.1%
• Not needed, current measures are sufficient	24.2%	25.9%
• Needed, current measures are insufficient	2.8%	0%
• Needed, no measures have been taken yet	0%	0%
N	*476*	*112*
Intimidation, aggression or violence by supervisors or colleagues [OSH-measures needed?]		
• Not needed, because not an issue here	71.1%	66.8%
• Not needed, current measures are sufficient	24.6%	27.4%
• Needed, current measures are insufficient	3.7%	3.7%
• Needed, no measures have been taken yet	0.6%	2.1%
N	*476*	*112*
Dangerous substances [OSH-measures needed?]		
• Not needed, because not an issue here	50.5%▲	36.4%▼
• Not needed, current measures are sufficient	42.0%▼	52.5%▲
• Needed, current measures are insufficient	6.1%	9.8%
• Needed, no measures have been taken yet	1.4%	1.2%
N	*471*	*112*

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Safety, work accidents [OSH-measures needed?]		
• Not needed, because not an issue here	25.3%▲	16.5%▼
• Not needed, current measures are sufficient	63.9%	67.1%
• Needed, current measures are insufficient	10.0%	16.3%
• Needed, no measures have been taken yet	0.8%	0%
N	*470*	*113*
Viruses, bacteria, fungi [OSH-measures needed?]		
• Not needed, because not an issue here	69.1%	61.1%
• Not needed, current measures are sufficient	25.6%	26.0%
• Needed, current measures are insufficient	3.6%▼	12.3%▲
• Needed, no measures have been taken yet	1.6%	0.6%
N	*472*	*112*
General health		
• Reasonable, bad or very bad	16.5%	21.1%
• Good or very good	83.5%	78.9%
N	*481*	*112*
Burn-out complaints [>3.20 on scale 1=never - 7=every day; 5 items]		
• No	90.2%	84.5%
• Yes	9.8%	15.5%
N	*481*	*114*
I feel emotionally drained by my work		
• Never to monthly	90.0%▲	83.4%▼
• Once per month to every day	10.0%▼	16.6%▲
N	*480*	*114*
After a day's work I feel empty		
• Never to monthly	74.0%	67.3%
• Once per month to every day	26.0%	32.7%
N	*477*	*114*
When I get up in the morning and I am confronted with work I feel tired		
• Never to monthly	86.6%	80.7%
• Once per month to every day	13.4%	19.3%
N	*478*	*114*
Working with people all day is really demanding		
• Never to monthly	94.8%	91.7%
• Once per month to every day	5.2%	8.3%
N	*482*	*113*
I feel completely exhausted by my work		
• Never to monthly	90.2%	85.8%
• Once per month to every day	9.8%	14.2%
N	*476*	*113*
Individual sickness leave percentage (adjusted for part-time work) [Mean] [Range: 0−100]	3,12▼	8,81▲
N	*480*	*113*

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Employability [>=2.5 on scale 1=low - 4=high; 4 items]		
• (Very) low [<2.5]	11.4%▼	21.3%▲
• (Very) high [>=2.5]	88.6%▲	78.7%▼
N	*478*	*114*
I can easily meet the physical demands that my work places on me		
• (Totally) disagree	9.9%▼	16.7%▲
• (Totally) agree	90.1%▲	83.3%▼
N	*482*	*114*
I can easily meet the psychological demands that my work places on me		
• (Totally) disagree	5.8%▼	13.0%▲
• (Totally) agree	94.2%▲	87.0%▼
N	*479*	*114*
I could easily get a new job/position with my current employer		
• (Totally) disagree	45.3%	50.4%
• (Totally) agree	54.7%	49.6%
N	*474*	*114*
I could easily get a new job/position with another employer		
• (Totally) disagree	35.5%▼	49.2%▲
• (Totally) agree	64.5%▲	50.8%▼
N	*474*	*111*
Interesting work [importance]		
• Not important	2.4%	0.8%
• (Very) important	97.6%	99.2%
N	*478*	*114*
Learning opportunities [importance]		
• Not important	10.3%▲	2.3%▼
• (Very) important	89.7%▼	97.7%▲
N	*481*	*113*
Interesting work [satisfaction]		
• Not satisfied	3.9%	5.8%
• (Very) satisfied	96.1%	94.2%
N	*468*	*114*
Learning opportunities [satisfaction]		
• Not satisfied	12.2%	14.6%
• (Very) satisfied	87.8%	85.4%
N	*469*	*114*
Did you change job in your company in the last two years?		
• Yes	16.7%	15.0%
• No	83.3%	85.0%
N	*477*	*114*

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Has your job been extended in the last two years?		
• Yes	38.7%▼	53.7%▲
• No	61.3%▲	46.3%▼
N	*475*	*113*
Have you made a job advancement within your company in the last two years?		
• Yes	16.2%	11.2%
• No	83.8%	88.8%
N	*477*	*113*
Have you gone from a higher to a lower job position in the last two years?		
• Yes	3.8%	6.1%
• No	96.2%	93.9%
N	*474*	*113*
How do your knowledge and skills fit with your current job?		
• I have less knowledge and skills than I need for my current job	5.4%	3.1%
• It fits well	71.4%	70.3%
• I have more knowledge and skills than I need for my current job	23.2%	26.6%
N	*475*	*113*
Does your supervisor stimulate the development of your knowledge and skills?		
• No	20.5%	22.0%
• Yes, to some extent	61.5%	53.9%
• Yes, to a large extent	18.0%	24.1%
N	*478*	*114*
In the last two years, did you participate in training or a course for your work?		
• No	42.8%▲	28.1%▼
• Yes	57.2%▼	71.9%▲
N	*481*	*111*
Do you currently need a training or course? [multiple answers possible]		
a. No, no need for a training or course	58.9%▲	44.7%▼
b. Yes, to be able to do my current work better	16.2%	19.4%
c. Yes, to handle future changes in my current job	20.4%	21.8%
d. Yes, to increase my employment prospects in the future	17.2%▼	32.1%▲
N	*478*	*114*
Skills obsolescence [>=3.5 on scale 1=low - 5=high; 3 items]		
• Low [<3.5]	77.8%	79.3%
• High [>=3.5]	22.2%	20.7%
N	*474*	*114*

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I do not use certain knowledge or skills often enough so that I forget or lose them		
• Totally disagree up to neutral	66.0%	61.2%
• (Totally) agree	34.0%	38.8%
N	*474*	*114*
I miss 'new' knowledge or skills that have become important due to changes in my work		
• Totally disagree up to neutral	75.5%	73.6%
• (Totally) agree	24.5%	26.4%
N	*474*	*114*
I have knowledge or skills that I no longer need due to change of employer/company		
• Totally disagree up to neutral	69.9%	69.8%
• (Totally) agree	30.1%	30.2%
N	*471*	*113*
At my workplace, employees are encouraged to think about ways to do the job better		
• Never or sometimes	44.3%	33.9%
• Often or always	55.7%	66.1%
N	*319*	*72*

Appendix 2 Overview of foresight and forecast studies

Source	Forecast
Interview NSARE, 2013	Forecasts for next 5 years (2013-2018) in **UK**: figures apply to Network Rail, Transport for London, Crossrail, HS2, the light rail sector, the train and freight operating companies and all their railway engineering supply chains. Estimates for technician/engineers and artisans for Track, Signalling & Telecommunications, Electrification &Plant, and Traction & Rolling Stock. Main problem is departure of workforce with huge amount of knowledge. Programmes require mentoring, a new national training academy, new projects. Models was developed in 2009.
NSARE, Forecast, 2013	51 sets of data, representing 44.000 people. Non-engineering roles discarded. Investments from 2013 to 2028. Forecasting model: Activities: track, signalling and telecommunications, electrification and Plant, traction and rolling stock Skill levels: prof engineer/general manager NQF 6-8; technician/manager 4/5; skilled 3; semi-skilled (2) Maintenance 0%; Projects and renewals (% 5 categories) Current workforce: From this data it was possible to extrapolate an existing railway engineering workforce of some 100,000 people, 84,500 of whom are involved in railway engineering specific activities. Nearly 70% work in Track, almost half are semiskilled and 4.4% are female. The highest average age is in T&RS activities where some 20% are over the age of 55. Figure 3: skill levels. Planning for retirements, with different end years. Future work load. Estimations beyond 5 years are nearly impossible.
Industriellen-vereinigung, 2013.	Description current employment and employment impact in the Austria railway and other sectors. 54.000 persons are employed in the sector (2012). Between 2013 and 2020, some 192.000 extra jobs will be created over the whole period. This is 24.000 extra jobs per year in the same period. The Austrian railway system is also the major trainer and educator in Austria. The efforts are also focused on women: half of women in training at ÖBB finishes a technical degree, in comparison to the general education in which this percentage is 12%. The railway systems are the major ICT-trainer of Austria. The labour effect of investments in the sector is calculated at 1,56 which means that any investment in the sector allows for growth in the sector and other sectors.
TRIP, 2013	10 million people are employed in transport sector. 6,7% of them in the railways, about 670.000 persons in 2009. Main issues are low employment of women; the ageing workforce; requirements for higher skills; need to improve quality of work.
CER, Women in Rail - 3rd Annual report, 2015	The average share of women in the participating railway companies / 19,7%/ in 2015 is almost similar to the share of /19,8%/ in 2014 and the share of /19,5%/ in 2013
Women in Rail, 2015	The contribution of the industry and its supply chain, namely is the employment of approximately 212,000 people. Despite 51 per cent of the population being female, right now across the UK just 7 per cent of engineers are women. When we look at the railway industry this drops down to just 4.4 per cent. 39 businesses comprising train operating companies (including their owning groups), manufacturers, rolling stock companies, technical support companies (TESCOs), suppliers, Network Rail, the Department for Transport (DfT) and the Office of Rail and

Source	Forecast
	Road (ORR): 2015 research shows that amongst a total workforce of 85,723 covered by the survey, 14,024 or 16.4 per cent are female. • Network Rail, the Department for Transport (DfT) and the Office of Rail and Road (ORR): 31,945 staff, 4,157 (13 per cent) of which are women. • Train operating companies: 35.765 men + 8.737 women • Manufacturers: 5.713 men + 754 women • Rolling stock: 215 men + 98 women • Suppliers: 1327 men + 73 women • Technology Service Companies (TESCOS): 709 men + 205 women • Freight companies: 33 women (1.4% of workforce) • What can be done? • Tackling perceptions of rail • Changes to education policy • Roles which respect flexible working • Positive action
Ministerstvo financií Slovenskej republiky, 2016.	The challenge with Eastern European operators is the less possibilities to invest in new rail. The impact has been a continuous decline of employment. Between 2003 and 2013, a drop in 33% (14000 persons).
FOSTERRAIL 2015 (Heitor, 2016)	During the past 15 years a number of initiatives and policies have been taken at European level to promote education and training activities in general (unfortunately not specifically for the field of Transport). The most notable of these are the following [5]: • 2000 - Initiation of the concept of the European Research Area (ERA); • 2007 - EU's Green paper aiming to deepen and widen the ERA, by i)removing the institutional and national barriers hampering free movement of researchers and ii) improving their working conditions and widening their career prospects; • 2012 - EU Communication: "A Reinforced European Research Area Partnership for Excellence and Growth", aiming at deepening and re-ensuring the removal of barriers to researcher mobility, training and attractive careers for an open labour market for researchers [7]; • 2000 - 2013: Several other initiatives and actions by a number of relevant organisations such as the COST programme, initiatives by Networks of Excellence (NoEs) (e.g. HUMANIST, EURNEX, NEARCTIS), initiatives by research associations such as ECTRI, Erasmus, Erasmus Mundus, etc.[3] and [4]. All training funded by Marie-Curie. More needed in Societal Challenges of H2020. Initiatives: DETRA, MORE/MORE2, Rail Uni Net; TALENT (UIC) New skills needs: Together with ERRAC associations, members of EURNEX, and other relevant European universities and research institutions, the future topics on training and education in the rail sector will be identified as: • State-of-art and current trends in the development of technically and operationally inter-dependent systems, production methods and industry structure, value added and changes in volume trends, employment trends; • Internal competition between modes (and even within mode sectors), which give a new dimension to skills development and changing trends in staff requirements while the legal and regulatory environment is becoming also more relevant requiring specific skills and knowledge in specific issues e.g. those in the safety domain; • Trade globalization giving also new dimensions to skills development and new challenges in staff requirements • Technical competences associated with: professional intervention across different railway assets; appraisal of the level of intervention in technical careers; new emerg-

Source	Forecast
	ing technology products and services such as Galileo, GSM, IT, environmental efficiency; systems engineering, man-machine interfaces and human factors, signalling systems, innovative and modular RS, modern infrastructure maintenance, sensor technologies and asset management methods; • Competences in the legal domain: interoperability directives, safety rules, certification of rail staff, environmental policies, working conditions, etc.; • Competences in procedures and operational cooperation in different market areas: competition, social objectives, customer demands, cross border operations, liberalisation, low fare airlines, globalization, freight logistics and related passenger and freight services. On higher education: Based on the results of the SKILLRAIL, RIFLE, TURNRAIL and NEAR2 projects, there is still a need to: • Update and develop a comprehensive inventory of current railway higher education programs and activities in the E.U. and the rest of the world, • To determine the demand for railway higher education by the operators, infrastructure managers, transport authorities and the industry, both quantitatively and qualitatively. Establish a web-based railway education forum as a tool for stakeholders to provide input and suggestions. • Appraise current educational offers and define major guidelines at BSc and MSc levels bridging the gaps between knowledge production in Higher Education institutions and required know-how in the different industrial environments. • Establishment of training and education for top management in the sector. The main features of such programs include: › Running efficient and safe rail system while respecting the rules of competition; › Focus on strategic directions, critical technologies, needs and aspirations of customers; › Forward strategies ensuring rail as the backbone of a sustainable European transport system; › Legal and institutional contexts; › Features of the future The creation and development of a portfolio of short training courses for high skilled jobs constitutes a benchmark for the rail training system which mainly answers to the following needs: • To create professional profiles able to operate in the technological changes provided recently by the signalling, communication, IT systems introduced in the railway sector; • To create professional profiles in the international legislation and market liberalisation under implementation in the railway sector; • EU universities and research centres must continue to develop a Knowledge Management System (KMS) in order to analyse and to compare the existing competences, tools and facilities for railway education and research. The EURNEX pole of excellence “Education & Training” created the EURAIL Virtual University which is providing a centralized Learning Management System; • Explore advanced training courses in different settings according to the industry needs and taking into consideration the target audiences: in-house tailored courses for specific companies; summer courses for university students, open advanced courses targeted to larger groups of industry specialists and PhD students;

Source	Forecast
	• Lifelong learning actions aimed to address emerging technologies and recover current staff to new organisational and emerging skill needs; • Learning programmes fully exploiting current virtual learning environments, and e-learning technologies to explore networking of specialists and expose novices and specialists to real operational situations. E-learning classes can be provided to suit needs and timescale in the current climate travel and tight training budgets. To help still meet training needs the e-learning courses can be developed to complement the live class. The e-learning courses may run over different class periods or may allow students to be exposed to recorded classes in after work periods and weekends. E-learning classes are ideal for companies with a group of engineers requiring training. • EURAIL - The European Railway University • Meeting expectations of end users • Exploitation of standardisation potentials • Harmonised European Transport/Rail PhD
SCI/Verkehr, (Leenen), 2016	Despite large investments and overall growth, rail does not seem to be able to increase its modal share in freight transport. Reasons for the growth difficulties are: • Oil prices are at a historically low level giving road transport an advantage. • Private transport and (mega) trucks are taking advantages. • German long-distance busses are winning important market shares from railways. • The rail system is trapped in their structures. • Infrastructure bottlenecks lead to delays • Existing regulatory framework limits innovation • Margins drop due to volatility of transport demand and old-fashioned processes • Digitisation in rail takes decades The way out is the following: • Management of productivity and quality must become core elements of railway companies. • Digital innovation boosts demand for procedural and structural change. • Operators need to strengthen profitability by efficient processes and organization. • Effective change management needs both: railway- and process experience. The authors see large productivity reserves that should help to bring the rail industry back on track.
CER, Attractive working conditions, 2016	Based on RMMS: ± 1 Million workers in 2012. Eurostat showed 600.000 in 2011. Other definitions, no infrastructure in Eurostat. On average 35% in infrastructure staff. Recruitment levels will be quite high in coming years just to replace workforce. Comparison between cases. Strategies to improve attractiveness of sector: • Public perception • Media, social media • Generation management. Evidence of new skill needs: • The fundamental skills required in the sector remain the same, but some new professions are emerging and there is an increasing need for technical, management and transferable skills • The level of labour and skill shortages depends strongly on the country, region and occupation • Key occupations with skills shortages are drivers, engineers and other technical professions Factors driving needs:

Source	Forecast
	• The fundamental functions of rail sector occupations will remain in future • Technological change is likely to have a significant impact on employer requirements of existing occupations • The economic crisis has had an impact on skills needs
Council of the European Union, 2016	The Fourth Railway Package will conclude the opening and structural reforms of the railway market. Trends in employment indicators: 2007 = 100 (index); 2008=96; 2009 = 97; 2010 = 93; 2011 = 91; 2012 = 97 900.000 people in employment: in railway undertaking 549.000 and 357.000 infrastructure management. Decrease of 4% among infrastructure management between 2011 and 2014. There is a gradual move, especially by new entrants, towards creating multifunctional positions (except in the case of drivers) leading to new types of jobs, requiring relatively higher qualifications and continuous in-job training.
European Parliament, 2016.	The Parliament stresses that the European **rail supply industry** (RSI), which encompasses the manufacture of locomotives and rolling stock, and track, electrification, signalling and telecommunication equipment, as well as maintenance and parts services, and which includes numerous SMEs, as well as major industrial leaders, employs 400 000 employees. It also stresses that the railway sector overall, including operators and infrastructure, is responsible for more than 1 million direct and 1,2 million indirect jobs in the EU. A feasibility study should be launched towards a potential European Sectoral Skills Council on Rail in this context. The report points out that, owing to an ageing workforce, the RSI lacks skilled labour; welcomes, therefore, every effort to promote lifelong learning and technical skills; calls for a campaign to increase the visibility and attractiveness of the RSI with young engineers (e.g. through ESF funding); highlights the fact that the sector has a particularly low rate of female employment, and stresses, therefore, that such a campaign should pay special attention to redressing this imbalance; calls on the Commission to encourage social dialogue in order to facilitate social innovation and foster quality long-term employment in order to contribute to the attractiveness of the sector for skilled personnel. Finally, it considers that the teaching of appropriately selected skills is an indispensable investment for the purpose of maintaining the global leadership in technology, and capacity for innovation, of the European rail supply industry in the long term.
Roland Berger, 2016. Forecast 2016 to 2021	Compound annual growth rate 2019-2021 versus 2013-2015 is: 3.1%. Turnkey management (5,5%); rail control (2,7%), infrastructure (3,7%), rolling stock (5,4%), services (1,4%). Large growth in Very High-Speed segment. Fourth Railway Package: harmonisation and liberalisation of European rail market: • Technical pillar: ERA and ERMTS • Political pillar: a structure that delivers; opening domestic markets; maintaining a skilled rail workforce (mandatory take-over of public services workforce) Goal: create a fully open domestic passenger transport market by 2019 by creation of single European railway area. As per our forecasts, the total market for rail supply is set to continue its growth of recent years at 2.6 %.
ERRAC-Rail 2050, 2017	2.3 million people employed in railway sector (operations, infrastructure, manufacture/supply locomotives, services). Supporting up to 4 million jobs. Skilled workforce sustains EU rail mobility. But 30% of workforce is planned to retire in next 10 years.

Source	Forecast
Islam, 2017 (C4R)	Top innovations for rail-rail terminal operations: • Automatic coupling & decoupling • Automated vehicle identification • Longer operative track length • 24 hour working time Driverless is only 7th on list. Skills availability for 24-hour terminal operations: 48.8 moderately confident. Skills shortage should not be blocking factor.
Érsek, 2017	Biggest obstacles to successful crisis management: • Lack of drivers: we know little about them (number; average age, language skills, age pyramid). • Language problems • IM-specific rules for driving train: number per locomotive, language, line knowledge, safety rules.
European Commission (2017). Comparison coach services	The evidence indicates that most coach services are cheaper, on a fare per kilometre basis, than the equivalent rail service. This may be because rail often offers faster journeys and can therefore act as a market 'price-maker'. However, this is not always the case and coach fares have been found between two and three times greater than the equivalent rail fare, despite average speeds being similar between modes. In this case it is likely that there are additional factors such as service frequency and quality which permit coach operators to charge a much higher fare. Our analysis, based on the experience of Member States that have liberalised their coach markets, indicates that the liberalisation of national markets can only be expected to have a limited impact in terms of passenger shift from rail. This could be explained somewhat by the targeting of coach operators of services at different groups of passengers.
SCORE, 2017 (Kramer, 2017)	The workforce in the EU-27 railway equipment production sector numbered **164.8 thousand persons in 2006**, equivalent to 5.2 % of the transport equipment manufacturing workforce (Eurostat, 2009). The manufacturing process for locomotives is labour intensive, demanding highly skilled and experienced workers to assemble and integrate numerous subsystems (USITC, 2011). The ECORYS (2012) study found that two factors drive demand for railway engineers: the trend to more sophisticated technologies (e.g. ERTMS, signalling, etc.) and the growing need to replace the retiring engineers (with knowledge of the old signalling and navigation systems). Identified policy instruments in this area include Directive 2002/14/EC and Directive 2009/38/EC which define information and consultation rights for employees in companies based in the EU and bodies representing employees (Works Councils) of companies operating across borders in different MSs. These policies might affect manufacturers' long-term measures to anticipate and manage restructurings. Directive 2002/14/EC consolidates EU social law by giving employees the right to be informed and consulted systematically in matters affecting their jobs (including company's economic situation and employment structure) and their future employment prospects. On the other hand, the purpose of Directive 2009/38/EC is to improve the right to information and consultation of employees in Community-scale undertakings and groups of undertakings and to facilitate the dialogue between representatives of the workforce and the management of the company.
SCORE, 2018	In Europe, the skill shortage in the railway industry has been identified. They reflect, to some extent, supply-side inadequacies within educational institutions, as these institutions fail to deliver a sufficient quantity and quality of trained persons (Toner, 2011). The FUTURAIL project (funded under the FP7), for instance, emphasises the need for

Source	Forecast
	investing in R&D and in innovative technological upgrading to enhance the competencies in the rail sector. These initiatives combined with talented and skilled staff would help in facing future challenges and lead to a more competitive and innovative rail sector. For “Skilled workforce” Focus Area, the assessment reflects a score of 3, which means that Europe has a competitive advantage. “Employment” KPI combines employment stability, working population ageing and skill shortage analysis in railway manufacturing industries to get a final assessment decision.
Chen et al., 2018	Innovation potential and barriers for uptake: • Networked environment. • A transition towards shared rail data. • Relative speed of innovation. • New business models (X-Rail, Cargo SI, Cooperation)

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