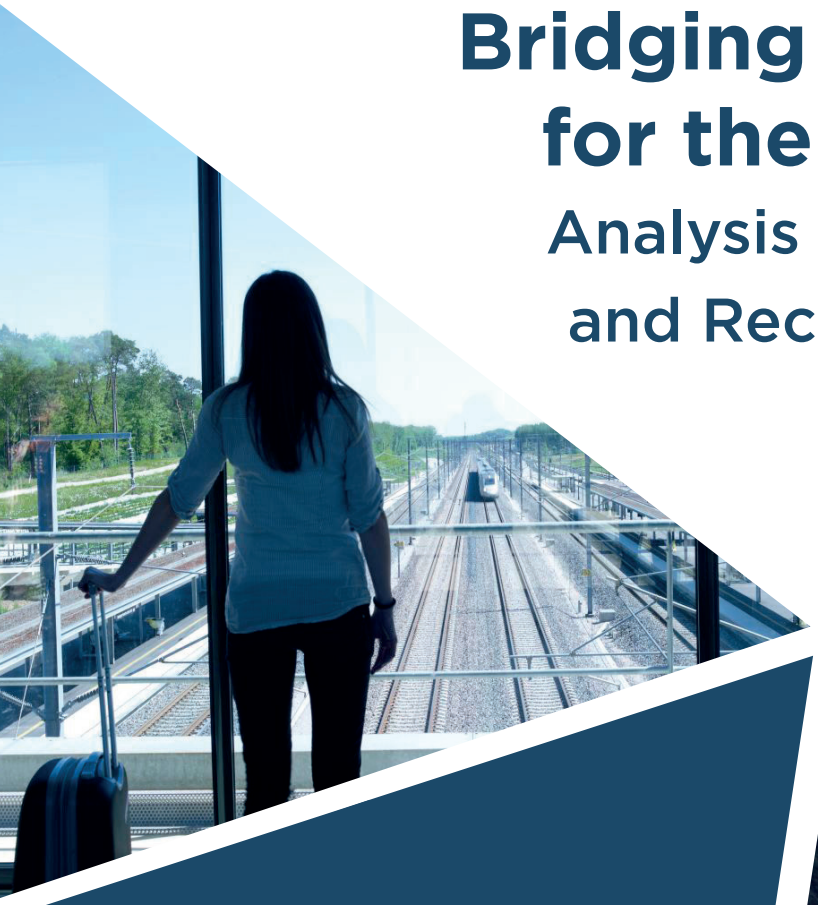
Bridging the Skills Gap for the Rail Sector:

Analysis of Six Measures and Recommendations



Human Capital Report Series

TNO innovation for life

Shift2Rail
Moving European Railway Forward

About this publication

Manuscript completed on 17 April 2019.

Shift2Rail JU, nor any person acting on behalf of Shift2Rail JU is responsible for the use that might be made of the following information.

© Shift2Rail Joint Undertaking 2019.

Reproduction is authorised provided the source in acknowledged.

For any use or reproduction of photos or other material that is not under the copyright of the Shift2Rail Joint Undertaking and Fuel Cells and Hydrogen Joint Undertaking, permission must be sought directly from the copyright holders.

PDF

HI-01-19-635-EN-N

ISBN 978-92-95215-16-0

doi: 10.2881/515850

Project number: 060.32480
Report number: R18068

Authors:
S. Dhondt, F.A. van der Zee, P.R.A. Oeij, T.M. Chen, D. Islam,

Contact:
Steven Dhondt
steven.dhondt@tno.nl
+31 88 866 61 55

Healthy Living
Schipholweg 77-89, 2316 ZL Leiden, P.O. Box 30052301 DA Leiden, The Netherlands
www.tno.nl; T +31 88 866 61 00; infodesk@tno.nl

Photos credits:
Cover © SNCF, Talgo, Shift2Rail JU; Back Cover © Shift2Rail JU

Legal notice:
This document has been prepared by TNO and NewRail for Shift2Rail Joint Undertaking (S2R JU). The information and views set out in this study are those of the authors and do not necessarily reflect the official opinion of the S2R JU. The S2R JU does not guarantee the accuracy of the data included in this study. S2R JU nor any person acting on the S2R JU's behalf may be held responsible for the use which may be made of the information contained therein. More information on the S2R JU is available on the Internet: www.shift2rail.org.

Shift2Rail Joint Undertaking

Avenue de la Toison d'Or 56-60, Brussels

communication@s2r.europa.eu

Summary

Goal of the report D3a

The Shift2Rail Joint Undertaking (hereinafter “the S2R JU”, “the Joint Undertaking” or “the Contracting Authority”), is a public-private partnership in the rail sector, established under Horizon 2020, to provide a platform for coordinating research activities with a view to driving innovation in the rail sector in the years to come. S2R JU has assigned the consortium TNO and NewRail a contract three studies in the “Human capital” working area of the S2R cross-cutting activities (CCA) of its’ research programme:

- *To study the socio-economic context of the rail sector:* this study analyses the socio-economic aspects of human capital, notably the skills that will be needed in the future for the different categories of railway staff - from workers to engineers, railway managers and researchers. This study is included in the report Deliverable 1a (see Dhondt e.a., 2018; D1a);
- *To develop a preliminary prognosis* on the impact of the market introduction of the S2R research and innovation programme and its technologies on human capital. This study is included in the report Deliverable 2 (see Dhondt e.a., 2019; D2);
- *To develop strategies and trainings* based on the above analyses to bridge the skill gaps, with a special attention to ensuring increased flexibility of railway staff. Best practices from other sectors, transfer of knowledge and of workforce (mobility, etc.) are also studied for this goal. This study is included in this report Deliverable 3a (D3a).

This report D3a includes the recommendations for strategies and trainings to bridge the skills gap in the railway sector and ensuring increased flexibility of railway staff. The resulting recommendations are meant for S2R and the railway sector. Best practices from other sectors, transfer of knowledge and transfer of workforce, have been studied for this goal.

Starting point: Interpreting the skills gap in the railway sector

In report D2, a prognosis was made of the impacts of S2R R&I on skills:

- At the level of tasks, there is a shift towards more use of ICT, systems, materials and production processes, but also a tendency towards simplification of tasks and even a phasing out of certain tasks, with redundancy of jobs;
- At the level of competences and skills, most of the changes relate to Science, Technology, Engineering and Mathematics (STEM). The different IP-programmes demand different technical knowledge to be developed. Next to STEM, there are rising social demands, communicative demands and on organisational demands in all jobs in the rail sector, except for train drivers.

It is important to understand what this skills gap means for the operation of the rail companies, meaning manufacturers, system integrators, transport companies and rail infrastructure managers. The skills gap generates new challenges and demands on rail companies:

1. Rail companies will experience a future of growth and decline of tasks within the different occupations. Statistical studies show decline (see report D1a), but discussions with stakeholders (see report D1b) point towards growth in tasks and demand. The precise growth of these tasks will be difficult to estimate. Rail organisations need to organize for flexibility in personnel provision;
2. The combination of new demands and ageing workforce will require the rail organisations to master a fast changing personnel composition;

3. The S2R R&I will be connected to market changes in the major rail markets. Outsourcing and down-sizing, connected to the further liberalisation of the rail market, will demand from rail companies to manage unknown technical capabilities to deal with changes;
4. Lower employment and higher capital intensity of the rail system will demand from rail companies the ability to manage high risk situations and more demanding service and information situations (possibly with less personnel around), also connected to more security and privacy issues connected to the radical increase of the generation and use of data;
5. The rise in need for IT-skills requires the rail companies to rethink how they deal with programming skills and systems knowledge of their personnel;
6. Rail companies will need to rethink their corporate cultures: changing social, communication and organisational skills require different settings to keep a satisfied and more diversified workforce;
7. Rail companies will need to think about ways to achieve faster upscaling of (technical) knowledge (from 1 person to many persons) within their organisations.

The analysis of trainings and strategies is conducted in such a way that they need to help tackle these seven major changes to the skill gaps.

Measures to deal with skills gap

The tender specifications required the project team to look at six specific measures to deal with the identified skills gaps. The focus has been on the following six measures:

- Next Generation Learning (transfer of knowledge);
- Access to virtual learning (transfer of knowledge);
- Access to education (transfer of knowledge);
- Attractiveness of sector to new entrants (transfer of workforce);
- Transfer from reintegration (transfer of workforce);
- Transfer from less represented groups (transfer of workforce).

Research questions and method of the study

To develop recommendations about strategies and training, we have tried to answer the following research questions on the practice of rail companies:

- Which measures do rail companies in four countries (Germany, Netherlands, France, UK) apply that we can see as illustration of the transfer of knowledge and of transfer of workforce mechanisms?
- Why are these measures selected and how effective are they?
- What can be learnt from other sectors?
- How do the transfer of knowledge mechanism relate to the content and requirements for trainings?
- How do the transfer of workforce mechanism relate to the content and requirements for alternative learning systems, the needs of various skill levels and life-long learning?
- What should sectors try to come up as an approach, using the six measures? What further development is then needed?
- What recommendations can be formulated for other rail companies to deal with the future skills gap identified in this report?

To answer the main research questions, we collected information from surveys (European Company Survey (Eurofound) and European Survey of Enterprises on New and Emerging Risks (ESENER: EU-OSHA)), secondary sources and from interviews with the major rail companies in Europe (NS, ProRail, Railcenter, SNCF, DB, Network Rail). In total, the report describes over 45 different measures to deal with the employment change and skills gap. In

this summary, we limit ourselves to the main conclusions that can help rail companies and stakeholders in the sector.

Major conclusions

How does the transfer of knowledge mechanism relate to the content and requirements for trainings?

The S2R R&I will lead to changes in processes and technologies in the different countries. These technological developments inevitably require an adaptation of vocational training programmes, on-the-job training systems and higher education. These *transfer of knowledge mechanisms* help Vocational Education and Training (VET), on-the-job training and academic education to prepare themselves for the future skill gaps that will arise. From the analysis in the report, it is important to take the following points into consideration:

- To understand the role of VET-systems in the different countries, it is important to bear in mind the institutional differences between the countries participating in the research. Companies in all countries have a clear interest to help improve the educational effort, but this effort will be different for each of the countries;
- Companies should better assess the ICT-knowledge that their employees have. It should be a personal interest of every employee to know where they stand, but also to have reliable tooling to assess their knowledge and competence. It would be a good thing to share the German validated test for assessing current ICT-knowledge and to develop this also for the VET and higher education systems;
- A lot of effort is invested in sector to assess new skills profiles. The lesson for the rail sector is that assessing the technological knowledge in a job, should be done with the current jobs and not so much from the drawing board. This also means that it is somewhat hard to give a precise content on the VET, on-the-job and academic programmes. Better than having a precise view on what future skills should be, is to build on a flexible system to assess skills changes when they arise. This requires however a close cooperation of companies with the VET-system, unless of course companies do everything in-house;
- Virtual learning is already well-embedded in the rail sector. Most parties elect blended learning approaches. However, more attention to new simulation approaches may be the future to model technology changes. This will be more necessary for ‘management systems’ (managing a multitude of partner actions, rather than single driving trainer). For the educational system, more access to such systems may only be realisable through the companies. Partnerships should be built on this. eLearning seems only to be used for a limited number of topics. More analysis is needed for eLearning applications, but also more investment is needed to develop eLearning applications.

How does the transfer of workforce mechanism relate to the content and requirements for alternative learning systems, the needs of various skill levels and life-long learning?

In the report, we documented the ‘transfer of workforce’ mechanism needed to deal with alternative learning systems, the needs of various skill levels and lifelong learning aspects of skills segments of the workforce. These transfer of workforce mechanisms are needed to help the rail sector with new personnel in the future. From the analysis, it is important to take the following points into consideration:

- Alternative learning systems and lifelong learning approaches should reflect the culture that companies want to install. They should take into account the issues with former systems and consciously correct for these tendencies (for example gendering). When developing these systems, follow earlier recommendations: equip for the future, try not to guess the future;
- Workforce transfer mechanisms may be biased towards specific skill levels. It is important that all systems are checked for bias toward specific skill levels;

› Lifelong learning needs to be developed in such a way that different trajectories are possible with different groups.

What should the rail sector try to come-up with as approach, using the six measures? What further development is then needed?

The answer to this question is summarized in the following ten recommendations:

1. Continue with closer relationship between VET and company needs. Learn from the different countries about VET. The in-house training system with apprenticeships and graduate programmes in France, UK and Germany is recommendable, but is expensive for the companies. The need remains high for the sector to discuss with governments costs of in-house training and the great need for new recruits.
2. Share validated tests for assessing ICT-competencies.
3. Share information about assessing competences in current jobs to speed-up future roles and technology demands.
4. Keep an openness from companies to the VET- and academic system, even if most of the competence assessment and development of training seems to be an in-house effort. Keep investing into education too, not only in the company trainings. The maritime sector has shown that underinvesting in VET education has stalled development in companies.
5. Learn from practice, less from paper.
6. More support from companies for higher (academic) apprenticeships. A round-table needed for this.
7. Experiment more with skill-swapping schemes.
8. Built partnerships on new management simulation applications.
9. Develop alternative learning systems and lifelong learning approaches from the perspective of new groups or from the perspective and interests of less represented groups. This means that these systems should be flexible to account for the needs of these groups (and to attract these groups).
10. Reintegration needs to be used as a measure at all skill levels. Learning systems should be developed such that reintegrated employees can re-develop their career.

Abbreviations

- ATO = automatic train operation
- COMM = communication competences
- DB = Deutsche Bahn (German Railways)
- ECS = European Company Survey (Eurofound)
- ESENER = European Survey of Enterprises on New and Emerging Risks (EU-OSHA)
- IPs = Innovation Programmes
- ICT = competences and knowledge to use and develop information and communication technologies
- ISCO = International Standard Classification of Occupations
- ISCED = International Standard Classification of Education
- NR = Network Rail
- NS = Nederlandse Spoorwegen (Dutch Railways)
- ORG = organisational competences
- S2R = Shift2Rail
- SOC = social competences
- STEM = science technology engineering and mathematical competences
- T = technical skills (see report for list)
- VET = vocational education and training

Contents

1 Introduction

1.1 Developing recommendations for strategies and trainings for the railway sector

The Shift2Rail Joint Undertaking (hereinafter “the S2R JU”, “the Joint Undertaking” or “the Contracting Authority”), is a public-private partnership in the rail sector, established under Horizon 2020, to provide a platform for coordinating research activities with a view to driving innovation in the rail sector in the years to come. S2R JU has assigned the consortium TNO and NewRail a contract three studies in the “Human capital” working area of the S2R cross-cutting activities (CCA) of its’ research programme:

- *To study the socio-economic context of the rail sector:* this study analyses the socio-economic aspects of human capital, notably the skills that will be needed in the future for the different categories of railway staff - from workers to engineers, railway managers and researchers. This study is included in the report Deliverable 1a (see Dhondt e.a., 2018; D1a);
- *To develop a preliminary prognosis* on the impact of the market introduction of the S2R research and innovation programme and its technologies on human capital. This study is included in the report Deliverable 2 (see Dhondt e.a., 2019; D2);
- *To develop strategies and trainings* based on the above analyses to bridge the skill gaps, with a special attention to ensuring increased flexibility of railway staff. Best practices from other sectors, transfer of knowledge and of workforce (mobility, etc.) are also studied for this goal. This study is included in this report Deliverable 3a (D3a).

This report describes work performed in WP3 which has the objective to deliver recommendations for strategies and trainings to bridge the skills gap in the railway sector and ensuring increased flexibility of railway staff. The resulting recommendations are meant for S2R and her stakeholders. Best practices from other sectors, transfer of knowledge and transfer of workforce, are studied for this goal. This objective has been achieved through two tasks:

- Task 5. Reducing the skills gap for the Railway Sector: this delivers the view of how transfer-mechanisms can help railway transport (report D3a);
- Task 6. Strengthening the skills ecosystem in the Railway Sector: this part integrates all results and formulates the recommendations for S2R (report D3b). Included in these recommendations are the results of a workshop with stakeholders in the rail sector on the recommendations.

1.2 Interpreting the skills gap

In report D2, a prognosis was made of the impacts of S2R R&I on skills. It is important to understand what this skills gap means for the operation of the rail companies, meaning railway undertakings, manufacturing, infrastructure management, integrators. This section gives an interpretation of this impact.

The D2 report indicates that the IPs will lead to conflicting demands for skilling in the future working environment:

- At the level of tasks, there is a shift towards more use of ICT, systems, materials and production processes (ICT, ICT tool usage, system specifics, materials use, production process), but also a tendency towards simplification of tasks and even a phasing out of certain tasks, with redundancy of jobs;

- At the level of Science, Technology, Engineering and Mathematics (STEM), social, communicative and organisational skills, most of the changes relate to STEM-skills needed in the future. The different IP-programmes demand different technical knowledge to be developed. Next to STEM, there are rising social demands, communicative demands and on organisational demands. All demands are rising in all jobs in the rail sector, except for train drivers. For each of the job categories, the required competencies (abilities) needed in the future to deal with these technologies have been assessed separately. 'Common sense logic' among the rail stakeholders dictates that operations and management have limited ICT-knowledge, but a lot of (traditional) operational knowledge. Engineers should be up-to-date, whatever the technology.

In general, the employment levels in the railway sector are expected to change as a result of continuous innovation and re-engineering of processes. A separate investigation is needed to understand what kind of change this will be, considering changes in market demands for services and changes in policy contexts (for example, resistance of employees to change; limitation by national rules). Currently, rail companies are fighting hard for new recruits. Foresight studies also claim that in the future, job growth will be visible in the sector even though statistical research in report D1a shows declining employment levels. This contradiction is only apparent in three situations:

- Firstly, the foresight studies see a change in the conditions for operating in the sector: they predict a rising demand and changing public investment policies. In report D2, these conditions are assumed to not to change;
- Secondly, a major driving force for the great demand for jobs is for demographic reasons: the rail sector is experiencing an extremely ageing workforce and this already leads to the need to find new personnel. The amount of persons needed to replace the 'leavers' is expected to be higher than the amount of job losses caused by the S2R-technology projects. This situation is however very different between countries considered:
  - In France, SNCF has been experiencing the consequences of ageing during the past two decades. The older generations have been replaced and the company sees the current replacement as a 'return-to-normal', this means that age composition is less distorted with overrepresentation of very old age groups;
  - In Germany, DB welcomes the major ageing transition because it allows a strong rejuvenation of the workforce. As a consequence, the current workforce consists already of persons that started their career with DB after 2012. For new persons, the fact that a lot of colleagues are also new-starters, is quite stimulating;
- Thirdly, as a consequence of the economic surge, Europe is currently experiencing major job growth in all countries which in turn leads to a rather more difficult situation to find new recruits on the labour market. And last but not least, the railway sector, moreover, has to compete on the labour market with other sectors, especially where STEM skills are concerned.

These developments provide for a complicated situation in which at the same time employment will be lost and needed to find sufficient replacement of personnel leaving for demographic reasons. The S2R innovation projects will help the sector to become more efficient. The skill changes have different outcomes depending on the type of job.

Given this context, the skills gap can be seen as new challenges and demands on rail companies. These challenges and demands are summarised as the following according to our assessment:

Figure 1.1 The change challenge presented by SNCF to passing-by travellers

1. A broad spectrum of scenarios on growth and decline of tasks within rail companies: this means that the precise growth will be difficult to estimate. Rail organisations need to organize for flexibility in personnel provision;
2. The combination of new demands and ageing workforce will require the rail organisations to master a fast changing personnel composition;
3. The S2R R&I will be connected to market changes in the major rail markets. Outsourcing and down-sizing will demand from rail companies to manage unknown technical capabilities to deal with changes;
4. Lower employment and higher capital intensity of the rail system will demand from rail companies the ability to manage high risk situations and more demanding service and information situations (possibly with less personnel around), also connected to more security and privacy issues connected to the radical increase of the generation and use of data;
5. The rise in need for IT-skills requires the rail companies to rethink how they deal with programming skills and systems knowledge of their personnel;
6. Rail companies will need to rethink their corporate cultures: changing social, communication and organisational skills require different settings to keep a satisfied and more diversified workforce;
7. Rail companies will need to think about ways to achieve faster upscaling of (technical) knowledge (from 1 to many) within their organisations.

This report will focus on connecting these seven major changes to the skill gaps that have been identified in report D2. One extra challenge is added to this list, after assessing all of the measures in this report:

8. The future of work in the rail sector requires more academic level thinking, but current policies are focused on VET- and graduate recruitment and training. This needs to change.

1.3 Measures to deal with the skills gap

The tender specifications require the project team to look at six specific measures to deal with the identified skills gaps. In Figure 1.2, these measures are identified.

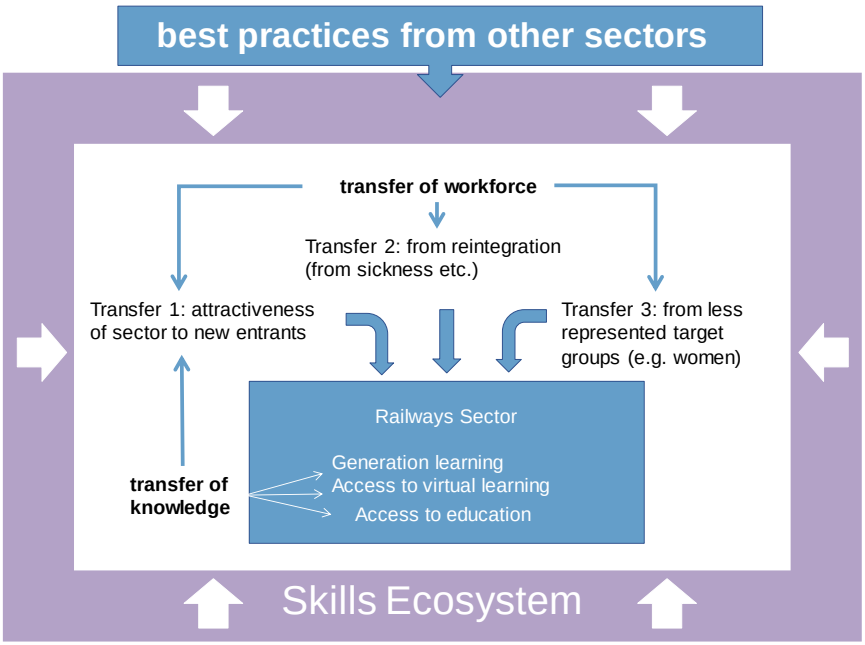


Figure 1.2 Development of Comprehensive Strategies and Trainings in railway sector

The focus should be on the following six measures:

- Next Generation Learning;
- Access to virtual learning;
- Access to education;
- Attractiveness of sector to new entrants;
- Transfer from reintegration;
- Transfer from less represented groups.

Next to this analysis, we also need to interpret the measures in the context of general strategy considerations of rail companies. The strategies and recommendations on education and training for the rail sector will be addressed following two mechanisms: '*transfer of knowledge*' and '*transfer of workforce*'.

To weigh these strategies and recommendations, we have used the following framework to understand which measures have been selected by rail companies and are currently suggested to deal with challenges connected to the skills gap identified in Section 1.2. The following figure shows how the six measures relate to, but also only cover part of the general human resource (HR)-strategies developed by any organisation.

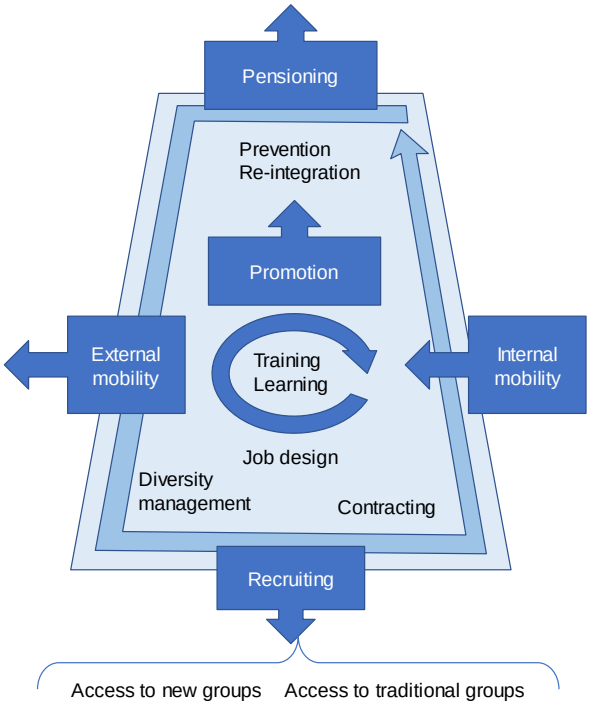


Figure 1.3 Overview possible HR-measures to maintain an organisation

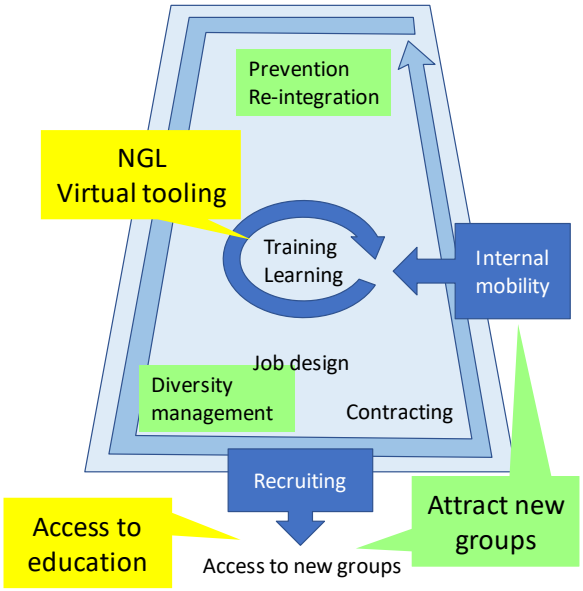


Figure 1.4 Selection of transfer of knowledge (yellow) and transfer of workforce measures (green)

Text box 1.1 Explanation of HR-measures to maintain an organisation

- Recruiting: the recruiting function is focused on guaranteeing the supply of new candidates to match turn-over or growth of employment. It is important that shifts in skills situation are countered with getting access to new 'labour supply', either at the school level or from other companies/sectors.
- Maintenance of personnel: measures such as diversity management, contracting, job design, prevention and reintegration are needed to keep the company aligned with its external environment. Diversity management aligns companies with the diversity in society; contracting takes account of contract possibilities (flexibility); job design helps to build learning components into jobs; prevention is focused on securing healthy working conditions; reintegration deals with bringing absent employees back into the workforce.
- Mobility (external, internal, upwards): this function is connected to the recruiting function of organisations and helps to balance the organisation over time. Promotion helps to offer career perspectives to personnel and works as a measure to reduce turnover.
- Pensioning: legal requirements ensure that workers are not staying indefinitely in an organisation; at the same time legal retirement age is going up throughout Europe.
- Training, learning: a set of measures to ensure that the capabilities of an organisation are matched to the demands.

The figures show a trapezium that represents the personnel distribution according to age in an organisation: there is a large base for the many newcomers in an organisation, and a small top for the remaining personnel in high age-groups. Of course, this trapezium can have many other shapes due to strategic and policy choices or historical situations: for example, an ageing workforce and difficulties in recruiting new talent may change the shape from a trapezium into an hourglass with an overrepresentation of older workers. Above, we have described that SNCF experiences different ageing issue than other rail companies. The illustrations represent possible HR-measures organisations can deploy to manage personnel development.

Figure 1.3 shows the general setting for measures. Figure 1.4 shows in yellow those measures pin-pointed by S2R JU. This figure clarifies that the six measures are only a part of possible approaches to deal with the seven challenges we have identified for rail companies. To develop recommendations about strategies and training, we will try to understand the following issues in the practice of rail companies:

- Which measures do the rail companies apply that we can see as illustration of the six main (S2R) measures?
- Why are these measures selected and how effective are they?
- What is the broader approach of these companies to deal with the seven challenges identified in this report?

A good starting point for dealing with the six measures, is to have an insight into the 'general' practices of European rail companies. This is done in Section 1.4.

The conclusions and recommendations have been validated by stakeholders in a validation workshop in November 2018. In total, some 42 participants participated coming from trade unions, rail companies, EU-agencies, associations, research and consultancies. Results are documented in report D3b. As a starting point for further positioning, an insight from European company surveys and from current practices of rail companies is useful. The information provided in the next chapter gives further background to the strategies developed and which were discussed with the companies concerned.

1.4 Training and hiring policies and OSH in the railway sector: Insights from European company surveys

1.4.1 Two surveys

The European Company Survey (ECS: Kankaraš & Van Houten/Eurofound, 2015) and the European Survey of Enterprises on New and Emerging Risks (ESENER-2: Irastorza, Milczarek & Cockburn/EU-OSHA, 2016) are both employer surveys at the European level. Both surveys provide information on the type of training and hiring policies used by samples of companies in Europe. The ECS is more focused on company HR-policies and the ESENER-2 is more focused on the Occupational Safety and Health (OSH) policies. By selecting companies active working in the rail sector, these surveys give us an indication of current personnel policies used by railway undertakings. For each of the surveys, the information from the rail sector is compared to the general situation in other companies presented by the surveys. This gives an indication to what degree policies of rail companies have particular traits. In the analysis of the surveys, the material has been collected in such a way that they give information about the six core-measures of this study:

- ECS: Table A2.1 in Annex 2 shows a comparison of the main characteristics of personnel policy of the rail sector with all sectors in the ECS 2013. The ECS survey 2013 counts a representative sample of 27,300 establishments, with 10 or more employees, in the EU-28. Among these, 91 establishments have been identified as belonging to the rail sector. These companies belong to the Manufacture of railway locomotives/rolling stock; construction of (underground) railways; Freight & Passenger (interurban) rail transport (3020+4212+4910+4920). A further distinction of results to subsectors is not allowed for statistical reasons. As a total, this group can give a representative image of company practices in the rail sector at the EU-level;
- For the ESENER-2, Table A2.2 in Annex 2 shows a comparison of the main characteristics of personnel policy of the rail sectors with all other sectors, in the ESENER-2 survey. The ESENER-2 survey counts 40,584 establishments, with 5 or more employees, in the

EU-28 in 2014. Among these, there are 41 companies belonging to the rail sector in the EU-28 countries. The rail sectors which can be identified, involve: the manufacture of railway locomotives/rolling stock; construction of (underground) railways; and freight & passenger (interurban) rail transport. A further distinction of results to subsectors is not allowed for statistical reasons. This number is about half of the ECS and can only be seen as a first indication of company practices in the rail sector. The sample is random, but the representativeness seems less than in the ECS.

In the ECS, rail companies are mainly bigger sized companies (four times bigger on average: 250 employees) in comparison to the rest of companies of other sectors. More of these rail companies have experienced personnel downsizing in period 2010-2013 than on average (5% more companies have downsized). The number of downsizers outnumbers the growth companies, whereas outside the rail sector, growth companies outnumber the downsizers. Nearly twice as much rail companies in comparison to non-rail companies have experienced organisational change in the period 2010-2013.

1.4.2 Transfer of knowledge: Conditions

In both surveys, there are no specific questions about new learning methods. However, the ECS provides questions about conditions for *Next Gen Learning (see further in this report)*. About 70% of companies make employees document and keep records of their good work practices or lessons learned, with the purpose to share these with other employees. This is 10% higher than outside the rail sector. The learning demands are higher in the rail sector. About 70% of companies require (versus 60% outside rail) at least one year of on-the-job-learning in order for the person to become proficient in their task. The training methodologies need to be focused on specialized work. Nearly 10% less rail companies use task rotation as a job measure. Rail employees are performing more specialized work than employees in other sectors. They are also more appraised and evaluated at a personal level in comparison to employees in other sectors. All of these conditions provide possibilities for companies to develop Next Gen Learning. A possible barrier for implementing new learning methodologies is the lower schooling levels of personnel in rail companies. The number of companies with 40% or more employees with a university degree is at 8,5%, whereas in the rest of the survey this is at 24% of companies.

Both surveys do not provide insights into use of virtual training tools, neither in access to education. The ECS does however, show what training approaches are used by the rail companies. The ESENER-2 only looks at training for OSH-risks. Nearly 60% of rail companies in the ECS has given employees paid time-off from their normal duties to undertake training, either off or on their premises. On-the-job-training is also more prominent among rail companies. More rail companies also provide training to employees to take on different job positions or improve/extend skills within current jobs.

1.4.3 Transfer of personnel

For the topic of transfer of personnel, both surveys show what company practices are more common among rail companies. In terms of HR-strategy, most rail companies are focused on retaining employees with temporary contracts and hiring employees for a long time. However, these percentages (and practices) are not very different from other sectors. The recruiting problem is at the same level as the non-rail companies: about 40% experience finding difficulties in finding employees with the required skills. This was in the period of economic downturn in Europe. The figures will surely be higher at the current date.

For reintegration, the ESENER-2 is a good source on strategies. The ECS only shows that rail companies apply more preventive OSH-training strategies than all other companies. The ESENER-2 shows that work in rail companies is still more risky than work outside the rail sector. More rail companies find that work is more tiring and painful (77% of companies versus 56% of companies outside rail), loud noise is a risk (55% versus 30%), high and low temperatures are an issue (65% versus 36%), machine or vehicle accidents (80% versus 46%), risks of slips, trips and falls (61% versus 36%) and time pressure (76% versus 42%). It is no surprise that absenteeism is reported as substantial higher in rail companies than in other companies (10% of rail companies rate absenteeism as high versus 5% in other companies). Rail companies are, however, more attentive to these situations and apply to a higher degree all kinds of risk assessments, safety measures, investments, preventive measures and training. Management and staff are also reasonably aware of these situations.

In terms of diversity, the ECS shows that women workers are clearly underrepresented in the workforce of rail companies. More than half of rail companies have less than 20% women in their personnel, where in general this would be less than 30% of companies. The number of companies with employees older than 50 years shows however the reverse image: the percentage of companies with 20% and more 50 year' old employees is nearly double the number than in the rest of sectors. The figures show the need for rail companies to work on their diversity policies.

1.5 Research questions for D3

The main research questions are:

- Which measures do rail companies in four countries (Germany, Netherlands, France, UK) apply that we can see as illustration of the transfer of knowledge and of transfer of workforce mechanisms?
- Why are these measures selected and how effective are they?
- What can be learnt from other sectors?
- How do the transfer of knowledge mechanism relate to the content and requirements for trainings?
- How do the transfer of workforce mechanism relate to the content and requirements for alternative learning systems, the needs of various skill levels and life-long learning?
- What should sectors try to come up as an approach, using the six measures? What further development is then needed?
- What recommendations can be formulated for other rail companies to deal with the future skills gap identified in this report?

1.6 Method of the study

1.6.1 Collecting and analysis of information about measures

To answer the main research questions, we collect information from different sources and enhance the quality of this material by discussing this material with the major rail companies in four European countries. The information has been tabulated, analysed and checked on several quality dimensions. The main quality criteria are the clearness of information, the reliability of information and the availability of performance data. Our results have been checked by the rail organisations.

Sources

The following sources have been consulted:

- Two EU-wide surveys about current HR-strategies in rail organisations. Two surveys are relevant for this purpose: the European Company Survey (ECS 2013; Eurofound (Dublin, Ireland)) and the ESENER survey (EU-OSHA (Bilbao, Spain)). These surveys give an overview of measures and possible impact;
- Major journals documenting developments in the sector. The following sources have been researched: Rail News; Global/European Railway Review; Railway Gazette; Railway Staff; Railtechnology Magazine; Eisenbahntechnische Rundschau; NSAR Newssite;
- These publications have been consulted through their websites. Articles have been collected from 2012 to the current date. 428 articles dealing with the six measures have been selected and analysed. A separate report has been written for this purpose. Main conclusions have been integrated into this report;
- Documents and data from rail organisations have been requested and studied: in-depth study and (intra-rail) comparison of documents and data on training strategies in different categories (=operators, infrastructure, machine) of the rail sector (inventory from web-search, direct requests to the four country main operators) and material from interviews with these organisations. The materials have been analysed, reported and discussed with the leading train operators/infrastructure companies in France, UK, Germany and The Netherlands;
- Next to rail information, an overview of best practices was made from other sectors (from logistics: air, road, maritime).

Interviews

The following table shows the organisations visited and the interviews conducted.

Table 1.1 Overview of contacts for interviews and surveys

Organisation	Contacts
NS (NL)	Mr Maarten Willems, Projectleider Arbeid van de Toekomst Mr Herman Bakker, HR
ProRail (NL)	Ms Sandra Visser, Beleidsadviseur | HR Expert Center Ms Marjolein Knegt, Adviseur & Projectleider HRM
Railcenter (NL)	Mr Willem Brummel, Directeur
SNCF (FR)	Mr Vincent Louart, SNCF- DIRECTION DES RESSOURCES HUMAINES DU GPF, Pôle Recrutement, Emploi et Compétences Ms Barbara Grau, SNCF – Direction Cohésion & Ressources Humaines Direction Stratégie Sociale, Chargée des Affaires européennes
DB (GE)	Ms Caroline Schwarte, Strategische Personalentwicklung und Grundsätze Nachwuchskräfte (HDN) Mr Mario Ma Perilli, DB Training, Learning & Consulting, Leiter New Learning Solutions (HS.L 5(2)) Ms Inga Masina, Expertin Globale Personalgewinnung Projekte und Programme/, Expert Global Talent Acquisition Projects and Principles
Network Rail (UK)	Mr Mark Allen, Development Manager Ms Karen Venn, Diversity & Inclusion Project Manager Mr Simon Goodland
Slovenian Railways	Mr Peter Verlic

The main interview questions have been on the six measures dealing with skill gaps. Questions have been put forward on the availability of the measures, the aim and target groups of the measures, and on any results on the effectivity of the measures to solve or mitigate the skills gaps.

Analysis

The analysis of all of the material has been done by developing a table for each organisation with on the one side measures aimed at transfer of workforce and of knowledge, and on the other side different kind of skills gaps. These tables have been compared.

1.6.2 Identifying recommendations for strategies and trainings

The strategies and recommendations for education and training have been assessed in light of the new requirements for skills and competences of the workforce brought forward by the implementation of S2R innovative solutions. This means that a table was produced with on the one side measures aimed at the transfer of workforce and of knowledge, and on the other side the different kind of skills gaps. The table helped to identify:

- Good practices from the leading rail companies;
- Good practices from other sectors (from logistics: air, road, maritime; also other sectors discussed with S2R JU In task 1 - workshop 1), transfer of knowledge and transfer of workforce. The significance of these practices for the rail transport sector has been identified. The overview is included in a separate annex aimed at S2R-members, showing how the identified skills gaps can be tackled by measures from other sectors.

1.7 Workshop

A third and last workshop was organised on November 30th with over 40 representatives of the participating countries and other stakeholders. This workshop had as agenda:

- To discuss results from the data analysis.
- To discuss the overviews of skills gap.
- To discuss possible overviews of good practices and possible scenarios for reducing the skills gaps for major workforce categories in these countries.

The workshop consists of representatives of the participating countries and other stakeholders. A summary of results is included in this D3b report.

1.8 Set-up of report

The report is set-up around the six mechanisms: Chapters 2 to 7 deals respectively with Next Generation Learning, Access to Virtual Learning, Access to Education, Attractiveness of the Sector to New Entrants, Transfer from Reintegration and Transfer from Less Represented Groups. Each of these chapters starts with clarifying main definitions and main challenges, describing main measures applied by rail organisations, and an assessment of the measures. In Chapter 9, main recommendations are formulated on the basis of main observations. The annexes contain the more detailed information for some of the chapters.

2 Next Generation Learning

2.1 Definition

Next-Generation Learning (NGL) is the first knowledge transfer mechanism that S2R has suggested for research. NGL is positioned in the literature as a learning approach different from standardized class based training, as an approach in which students and teachers - both secondary and post-secondary - will have access to high-quality, relevant, and engaging educational content in a variety of forms. Class time and structure will be more flexible, adaptable to the learning needs of the students. Students will have access to multiple sources of instruction and use assessment and diagnostic tools to help direct the pace and format of their personal learning. Teachers will tailor their instruction and guidance to ensure progress and mastery for all students, with a focus on those who have historically been underserved. The scientific discussion on NGL focuses mainly on academic students and the difficulty of 'teacher-centric training systems' to adapt to blended learning and more learner-centric approaches (Wilson et al., 2010; Lytras et al., 2016; Scott-Webber, 2016). Important in this respect is the availability of new teaching technologies, but for the rail sector, also the fact that the technological changes seem best to be countered with the NGL knowledge transfer mechanism.

Next Generation Learning Challenges seeks to answer these questions:

- How do we better engage young people in learning and demonstrate its relevance to - real life - and their aspirations?
- How do we personalize learning to accelerate and deepen understanding and knowledge retention?
- How do we encourage persistence and completion in spite of the competing demands of students' lives?
- How can institutions and educational systems afford improvements in student success in light of flat or declining budgets?

The Next Generation Learning is a 'collaborative community-connected' approach to achieve the following outcomes:

1. Increased community, in our case, rail sector, prosperity shared by all;
2. A strengthened talent pipeline;
3. Young people prepared for college, careers, lifelong learning, and leadership;
4. Educational equity and justice for all; and
5. The capacity to contribute and go further.

Next Generation Learning, for example at Ford NGL[1], is a unique and comprehensive community initiative that brings together educators, employers, and community leaders to implement a proven model for transforming secondary schools, which ultimately improves the regional workforce development system. Ford NGL supports a growing number of communities that are committed to expanding and strengthening their networks of transformed secondary schools.

[1] Ford Next Generation Learning at www.fordngl.com.

2.2 Next Generation Learning: Overview

This chapter mainly focuses on the possibilities of NGL as a new learning methodology to better transfer ever newer knowledge contents to students and trainees. NGL has been used as an approach in the training centres and pedagogical approaches used by the rail training centres. Maybe the training centres and companies have not used the NGL-terminology as such in their training, but the elements of personalisation, technology as teaching tool and learner-communities learning in practice seem to have become quite common. To understand to what degree NGL is been used, what components are identified by the different rail organisations, and to what degree NGL is seen as a means to deal with future skill gaps, the following table gives an overview of examples of NGL-measures taken by national rail organisations and organisations from other sectors. The detailed overview of each of the measures is provided in Annex 1. The table provides an answer to the following questions:

- What is the example and which organisation is responsible?
- What skill gaps are tackled with the training?

Table 2.1 Overview measures Next Generation Learning in the rail (training) sector and other sectors[2]

Example	Organisation	Lessons for technological skill gap
NGL as a general approach	SNCF	Digital passport helps personnel to discuss any gaps in skills and competences with management.
RailNewcaslte	Newcastle University	No lessons yet, mainly because of lack of students.
Roles Based Capability (RBC)	Network Rail	Strong methodology to deal with changes within roles within NR.
Techniekfabriek	Nedrail	Collaboration and programmes attuned to the technological requirements of the Dutch railways.
Skills Fitness Test and individualisation of training	DB Training	Skills Fitness Test allows better alignment between needs of a person and the training components. The self-tests are connected to newly developed training systems, much in line with what the RBC of NR does.
Other sectors		
Process industry	Honeywell Process Solutions (Canada)	New technology connected to operator training simulator need new competency development methodologies to help operators.

As reported, all rail companies have integrated parts of the NGL-philosophy in their training approaches to ensure a better transfer of knowledge to current employees and to new recruits. Other sectors such as maritime, airlines and bus operators have been checked, but they didn't really add new information to the rail initiatives. The example of the process industry has been added for the reason that the development in the work of process operators up to a certain degree is comparable to the main operator functions in the rail sector.

The examples in the annex have been selected from the interviews because they illustrate seven advantages of the NGL-components in comparison to traditional learning and training methodologies:

1. The methodologies help to target competency gaps that arise with (e.g.) technological change and innovation;
2. The training methodologies avoid (irritating) redundancy in training materials;

[2] For detailed overview of each of these measures, please consult Annex 1.

3. The methodologies reduce the overall training time;
4. The methodologies ensure that the trained knowledge is always practice related;
5. The trainings employ the technologies that operators will be confronted with later;
6. The trainings use core elements that new recruits are used too; and
7. The new methodologies ensure that training components are going to be redeployed in the future.

The total return-on-investment of training should improve with the methods. All rail companies can learn from the parts presented:

- Target competency gaps: The training institutes (NR Training, DB Training, Railcenter etc.) all have a better understanding of how to pin-point the knowledge areas students and employees need to further develop. Over the years, there have been several approaches to bring more insight into what an employee knows and does not yet know.
  In the UK, the SkillsID database was developed by NSARE in 2013 to provide employees with the possibility to follow more closely their own skill development and to show to new employers what progress they have made over time. At its core is a full list of all relevant qualifications, skills and competences, accessible by the individual and their sponsor/employer, but hidden to others. Another approach has been adopted in Germany in which previous diploma or certificates are not anymore the criterion to be selected for job interviews. With such a measure, everyone is allowed to apply for a job. From 2014 on, students can fill out an online test if they want to start a vocational training or a dual study with DB ('Neues Bewerberverfahren bei der Deutschen Bahn'). Thus, the DB eliminates the preselection of school grades. Strengths and abilities of the individual take centre stage, according to the group. All applicants will be invited without pre-selection.
  These approaches help to open up the labour market supply. The examples of measures in Annex 1 allow to improve on the identification of skills with recruits and employees. The Role Based Competency (RBC) methodology is a new method developed by Network Rail Training (NRT) to identify required skills in roles by reverse engineering use of skills and competences in practice. RBC helps to break up tasks into components and identifies trainings needed for these components. DB Training and SNCF have developed methods to identify the skill level of employees. SNCF has a test to identify digital skills. DB Training has develop several sets of questions that can be used which skills need updating and helps to connect the employee to training components;
- No wasted time during training: DB Training has tested and analysed their trainings in great detail to identify what elements could be redundant. They see that trainees can get irritated by such redundancy and shy away from further training;
- Reduce training time: The RBC methodology breaks up learning components into modules that are then integrated into Moodle-programmes. The modules help reducing training time;
- Practice related (RBC, TF, DB): All of the trainings discussed during the interviews are always focused on real-life practice:
  - ProRail insists that 70% of training needs to be on-the-job, 20% from working with colleagues and 10% from courses;
  - Practice related training can be even brought to the extreme when looking at Skills Swap schemes. Apprentices from the UK Great Western Railway (GWR) and Amey company have been swapping places in 2016 (Rail Technology Journal) as part of a "rare" cross-organisational skills exchange between the operator and the engineering consultancy company. The skills swap helps operators from both companies to better understand what the other companies do and this helps collaboration between the companies. GWR and Amey have invested in this scheme together with training programmes to develop their skills in engineering;

- The Dutch TechniekFabriek (Technology Factory) was developed as a collaboration between rail operators and several VET-schools to improve the quality of the (mechatronic) students that are delivered on the labour market. The previous class-based trainings were not adequate for the companies;

› Technology supported: All of the reviewed training methodologies use virtual learning, learning management systems, simulators (see next section). In this sense, the methods used in the trainings are in line with what operators will be using in practice. The example of the operator training simulator shows in more detail how the technology is in line with the operational system operators will experience in the future;

› New training approach (learning nuggets, gamification, team based, learning on demand): Blended learning is the future. Not everything can be offered through technology as learning content. The point is to understand what adaptive learning is: where are the gaps in the knowledge of a pupil and how can that be filled up and how does technology play a role in this. The Dutch Railcenter, not mentioned in the table, has experience with the various multimedia methods to do that;

› Redeploy training components (RBC): RBC has been specifically designed to have components that can be redeployed in other trainings. Modules should be copied into other roles, if possible.

2.3 Assessment

NGL focuses on the transfer of knowledge to new recruits or to current employees. The idea is that old training methodologies are too slow and too expensive to help the rail sector confront the skill gap that has been identified. Table 2.2 summarizes in what way NGL helps to deal with the skills gap issues identified in Section 1.2

Table 2.2 Linking transfer mechanisms to the skill gap

Skill gaps and challenges S2R innovation programmes	Next Gen Learning helps:
Programmes feed into unpredictable growth and decline of tasks: this requires 'flexible personnel provision for the future'	Faster learning, more specific learning
Programmes require mastering fast changing personnel composition	Faster learning, more specific learning
Programmes require managing unknown technical capabilities (suppliers, ageing groups)	Integration of quality expectations of network
Programmes lead to rising risk situations that need managing	Learning in the future (perspective to deal with future risks)
Rise in need for IT-skills: programming skills, systems knowledge	Directed at IT-skills
Programmes support a new corporate culture: changing social, communication and organisational skills	Approach to represent ideal method to deal with culture
Programmes require faster upscaling of (technical) knowledge (from 1 to ∞)	Individual customisation of knowledge content + digital tool helps upscaling

From this table, NGL has a function for all the challenges the skill gaps present to rail companies. Personalised training and training connected to real-life working situations help speed up the training efforts of companies. NGL will be needed to deal with the disbalances that will arise in future provision of the right knowledge in rail companies.

NGL as a new training philosophy is delivering the training institutes and departments in the rail sector a new terminology and language to redirect the training effort. There is a better understanding of the core components in skill and training to deal with the future skill gaps. The philosophy helps the organisations to adapt faster to the future situations. All organisations are working within their own national environments and it certainly would be helpful if the organisations share their experiences. The different topics discussed in this section can be useful for such a discussion.

3 Access to Virtual Learning

3.1 Definition

The second type of Transfer of Knowledge mentioned in Figure 1.2, is 'Virtual learning'. A Virtual Learning Environment (VLE) in educational technology is a Web-based platform for the digital aspects of courses of study, usually within educational or training institutions. VLEs typically allow participants to be organised into cohorts, groups and roles present resources, activities and interactions within a course structure provide for the different stages of assessment report on participation; and have some level of integration with other institutional systems. The VLE learning platform allows:

- Content management - creation, storage, access to and use of learning resources,
- Curriculum mapping and planning - lesson planning, assessment and personalisation of the learning experience,
- Learner engagement and administration - managed access to learner information and resources and tracking of progress and achievement,
- Communication and collaboration - emails, notices, chat, wikis, blogs,
- Real time communication - live video conferencing or audio conferencing.
- Important is that the tools are embedded in a pedagogical approach.

Figure 3.1

Next Generation Learning needs to be developed with the use of virtual learning..

3.2 Virtual learning: Overview

In Table 3.1, an overview is given of several measures, examples of virtual learning at different rail companies and the maritime sector. The table provides the core idea of each of these measures that helps to deal with the skill gap created by the S2R-Innovation projects.

Table 3.1 Overview measures virtual learning[3]

Example	Organisation	Lessons for technological skill gap
Moodle e-Learning	Network Rail	Portal does not show training for technological topics. Elearning is not yet the context for this.
Digital tools	SNCF	Broad set of tools (elearning, virtual and augmented reality, simulation, employee support systems.
App Mijn Vakmanschap	NS	Employee support system needed to follow-up skill development.

[3] For detailed overview of each of these measures, please consult Annex 1.

Example	Organi-sation	Lessons for technological skill gap
Digital training system	DB Training	Understanding how digital training is different from face-to-face training. More attention needed in developing these tools.
e-Learning, MyLearningPortal and simulation	NS	Close monitoring of use, no data available. Used for high tech training, connected to simulator.
Other sectors		
Simulation of Sea Traffic Management	STM	Simulation allows reduction of learning time. Jobs change from reporting on situations to more decision making. Situational awareness and more oversight are required.
Virtual learning tools in Maritime	Different sources	Virtual tools are effective for technical skills; maritime sector tends to underinvest.

It is noteworthy to see that in the rail sector over the past years, a lot of organisations have rebuilt their training facilities taking into account the digital possibilities available (Network Rail, NCHSR, DB, Infrabel (3D simulator for the training of on-track safety staff), Scot-Train (Petershill Road facility), Crossrail. The rail sector has a strong belief in the power of these tools.

The overview in Table 3.2 shows that all rail organisations are well equipped with virtual learning tools. All of them possess the range from simulators, e-learning, MOOCs, employee support systems, social media platforms and portals. The tools are only effective if they are fitted into a pedagogical and learning strategy. All rail companies have a lot of experience (since the 1980s) with these tools and clear views for what they can be used. Our interviewees all stressed the importance of using blended learning, and not only rely on virtual tools for transfer of knowledge. A comment that was made, was that the most powerful form of training still remains the combination of practical learning with good supervisorship. Technology remains subordinate.

The DB Training experience is instructive here. The shaping of a digital training is very different in comparison to face-to-face (ftf) learning. In a ftf-context, the trainer can personalize the training to the needs of the pupil. In digital learning, you can't see feedback from the pupil. The digital training needs to allow for extra information to allow personalisation: e.g., selection of own speed of training, a good mix of pictures, movies, sound, etc. Everything needs to be directed at direct attention of the pupil. In the railway sector, this is however a main problem: people working within the rail business are very traditional. They are not used to learn, not used to learn to self-organise their training. The training approach of DB Training takes account of these difficulties. DB Training invented a method for supplying each training, next to the content part, also with an awareness part: where does the topic come from?, why is it important for your business?, why is it important for you (motivational)? Only then the content follows.
Is content offered at the individual level? This is not the case. Each training component can be reduced to 3-4 learning types and relevant content. Users are offered a training according to the fitting learning type. This is offered in these ways in the training instruments. In essence, this means that training is very specific to the personal situation, but it is not personalized. That would be impossible (too expensive) to arrange.

It is important to understand that DB Training always analyses the full content of learning. DB Training always asks the task owner what is needed in the training. A user will always maximise his or her needs, but DB Training knows how to focus on what is relevant: for each learning component, an analysis is done at three levels: must know (65% of the training content), good

to know, nice to know. DB Training focuses on the 65%: this is the added-value. The content is always independent of learning technology. Training is not better or worse because of the technology used, but it is the content that matters.
The experiences from the maritime sector confirm that the tools need to be embedded in a broad approach to have the targeted learning outcomes.
In the future, rail organisations will need to deal with stronger privacy rules. Over the past years, personal data has been collected to monitor the effectiveness of trainings. This kind of data has been collected in connection to the e-learning system. Possibly, separate surveys will be needed to develop insights from the offered trainings.

Figure 3.2 App 'Mijn Vakmanschap' offered by NS to its personnel

3.3 Assessment

Virtual learning needs to be seen in connection to other approaches of learning. For NGL, virtual tools are the main carrier for the 'transfer of knowledge'. The following table summarizes in what way virtual tooling can help to deal with the skill gap issues identified in Section 1.2.

Table 3.2 Linking transfer mechanisms to the skill gap

Skill gaps and challenges S2R innovation programmes	Virtual tooling
Programmes feed into unpredictable growth and decline of tasks: this requires 'flexible personnel provision for the future'	More access to knowledge areas (e.g., direct translations?)
Programmes require mastering fast changing personnel composition	Larger upscaling: one to many
Programmes require managing unknown technical capabilities (suppliers, ageing groups)	Faster access to external knowledge
Programmes lead to rising risk situations that need managing	Tool can be used for purpose

Skill gaps and challenges S2R innovation programmes	Virtual tooling
Rise in need for IT-skills: programming skills, systems knowledge	Tool can be used for purpose
Programmes support a new corporate culture: changing social, communication and organisational skills	Tool can be used for purpose
Programmes require faster upscaling of (technical) knowledge (from 1 to ∞)	Larger upscaling: one to many

Virtual learning and tooling needs to be connected to NGL. Virtual learning will help the individualisation of training, but also to support life-long learning through personal monitoring of learning development. Virtual learning will also help employees to make use of 'lost time' during the day. An important element is that virtual tools allow for upscaling of training to large numbers of employees.
Virtual tooling has become an important carrier for the Next Generation Learning that is now advocated in learning. The rail organisations use a broad range of tools to support their employees. However, having developed a long time experience with these tools, rail organisations insist on using blended learning approaches.

4 Access to Education

4.1 Definition

The third approach of 'transfer of knowledge' is access to education. The main idea is that rail companies develop new methods to get access to new knowledge from students, academics and other labour market groups. These methods consist of new agreements with VET/CVET, professional and academic educational institutions. Such methods can be apprenticeships, but also collaboration agreements with these institutions for direct learning or for life-long learning support. The methods can direct themselves to technical, but also non-technical knowledge. To understand why companies need to develop such new access, the next section shows the current education gap in the rail sector as identified in the H2020 Skillful project.

4.2 The current education gap in the rail sector: Learning from the Skillful project

1. The skills gap in the sector can only exist if there is insufficient supply and/or training provided by the rail sector (with internal or external training). To understand this 'education gap', results of the EU H2020 Skillful l project are summarized in the table in Annex 3 and Table A2.1. This study provides an insight into the educational approaches in a set of EU-countries. Some extra information has been added for the situations in France and The Netherlands, not included in the H2020 Skillful-project. This table gives an overview of the availability of training courses aimed at the rail sector in a selection of countries at the professional (professional, VET, CVET) and at the academic level. The two tables show the availability in the different European countries of different level of training and education facilities. In some countries, all training is provided within the companies and not in the educational system.
2. The rail sector provides a large number of jobs at various levels and in very specific technical (and other) competences. The table shows that for the bigger countries, the education system provides supply of trainees and educated students at a broad set of competences. In the other countries, it appears that educational institutions need to specialize in their offerings. This leads to a broad set of possible trainings, but there is not a full coverage of trainings available for the broad set of skills required in the sector. Most major rail organisations have reverted to in-house training systems to ensure sufficient supply of the right skills. In some countries, the railways are still a state-owned operation with very closed approaches to education and employment situation (Ireland, Italy, Poland). These countries do not rely on the educational system to provide them with talent. These different approaches reflect the possibilities these countries have to respond to new demands in the rail systems. The approach used in the H2020 Skillful-project (2017, pp. 34-35) has been split for academic and non-academic trainings schemes. The table shows the responsiveness of the systems.

Table 4.1 Ranking of countries responding to the needs and existing training and education at the academic level in railway sector

Categories	Countries	Reasons
Average to high response to demand	UK, France, Spain, Italy, Germany, Bulgaria	High supply of rail oriented university degree programmes.
Long response to demand	Belgium, Ireland, Netherlands, Romania, Poland, Portugal, Slovakia, Greece, Sweden	A small amount of rail oriented university degree programmes.

Table 4.2 Ranking of countries responding to the needs and existing training and education at the not-academic level in railway sector

Categories	Countries	Reasons
High response to demand	UK, France	Comprehensive training system for rail sector in place. Apprenticeship scheme in place. Many certified companies provide courses to meet the needs for daily operation. Easy access to Virtual learning system with easy access to information. Information available in a living world language.
Average response to demand	Netherlands, , Romania, Spain, Italy, Germany, Belgium	A comprehensive training system for rail in place. Apprenticeship scheme not in place. There are a reasonable number of certified companies providing courses to meet the needs for daily operation. Challenging to access information. Information unavailable in a living world language.
Long response to demand	Bulgaria, Ireland, Poland, Portugal, Slovakia, Greece, Sweden	Apprenticeship scheme not in place. Monopoly by a single rail company providing training for jobs in rail. In-company training – information not disclosed to external parties. None or a small number of certified companies providing courses to meet the needs for daily operation. Uneasy access to information. Information unavailable in a living world language.

The overall situation still remains a situation of insufficient supply of new talent from the schooling system. Only the UK and France have sufficient supply of talent through the educational system. The UK has a well-developed market of providers. France possesses a large network of suppliers functioning under the guidance of SNCF. But even in the UK, an organisation such as Network Rail organises most of its training needs in-house. In Germany, at the university level, there seems to be a situation as in France. At the non-academic level, the companies build on a well-developed apprenticeship system. In the Netherlands, the rail sector has its own training providers (NS Rail Training; Railcenter). Each of the rail companies are looking to the new training methods and approaches to educate their professionals, or new methods to attract more employees.

4.3 Access to education: Overview

In Table 4.3 an overview is given of several measures, examples of Access to Education in different countries and sectors. The table provides the core idea of each of these measures that helps to deal with the skill gap created by the S2R-Innovation projects.

Table 4.3 Overview measures 'Access to education' [4]

Example	Organisation	Lessons for technological skill gap
Newcastle College Rail Academy	University of Newcastle	Specialist knowledge supplied.
University of Birmingham Rail Academy	Birmingham University	Newest course is specifically focused on ATO-developments.
Apprenticeship Training Schemes	Network Rail	Growing supply of technically schooled students, aligned with company interests.
Graduate studies	Network Rail	Strong rise in past years in programmes. Much directed at helping adapt all technical studies to company needs.
Collaboration agreements with Secondary (VET) Schools	NS	NS shifts own trainings to VET-institutions, with great savings.
Collaboration agreements with Secondary (VET) Schools	Railcenter	Supply of technical trained personnel, train drivers, aligned with company interests.
Minor Rail Technology (NL)	UAS Utrecht	New technical (bachelor-level) for the rail sector.
Apprenticeship Training Schemes	Arriva	In line with UK policy. Not specifically technical.
General policy	SNCF	In-house model dominant: flexible towards new domains
Apprenticeship and other measures	DB	Broad well developed model with a lot of tradition. Professorships to keep link to technical universities.
Other sectors		
Access to education in Maritime sector	Maritime sector, Dutch experiences	Discussions about splitting up tasks within marine officer occupation. Collaboration schools and companies to achieve better alignment.
Recruiting bonuses Aviation Business & Piloting	European Flight Academy	Competition requires more measures to attract talent to the training.

When focusing on the different measure listed in Table 4.3, the following major initiatives show how access to education has been improved to help the skill gap in the sector. The first initiative is the development of the apprenticeship system in the UK and the second is the development of the intermediate schooling supply in the Netherlands. The example from the aviation, but more specifically from the maritime sector does however gives some guidance on possible choices to be made in developing more relationships between education and rail sector.

4.3.1 The UK-example: Network Rail taking the lead in the new apprenticeships

Apprenticeships are a central system in the UK, but also in Germany, to help connect students during their training more closely to the needs of companies. In the UK, the apprenticeship system has been thoroughly reviewed over the past couple of years. The system is now focused on carrying a levy on employers for apprentices and using this levy, to finance specific

[4] For detailed overview of each of these measures, please consult Annex 1.

approved apprenticeships programmes.[5] These programmes can be coordinated by the Institute of Apprenticeships. Such funding is available for each of the jobs defined in the occupational map of a sector. Rail occupations are included in the Transport and Logistics occupational map. The HR-director of Network Rail has been president of the working group to develop this occupational map and the profiles behind each of the occupations listed. The following occupations are listed as approved for apprenticeships:

- Passenger transport driver rail (level 2);
- Passenger transport onboard/station team member (level 2);
- Network operations (network performance operator, scheduler) (level 2);
- Transport planning technician (level 3).

Objectives of this change are to limit the number of subsidized routes to those occupations with the most future (greatest need in the sector), to ensure better quality in the training by proposing a standard and by securing a process in which employers can integrate their views on the required competences and skills for these occupations. An apprenticeship must be at least 12 months including 20% of the job training.

This new system means that other kind of in-roads into these occupations are not foreseen in the UK and will not be funded by the government. Level 2 means starting levels in the occupations and apprentices take up to 12 months and receiving some 3,000-6,000 pounds funding. Level 4 takes 18 months of training and receive funding for 12,000 pounds. Costs exceeding these funding rates must be paid by employers. The system has also led to a rearrangement of the educational market.

Next to the new apprenticeships training, the UK government is changing the approach to follow-up technical training (T levels). Both T levels and apprenticeships will provide in depth technical training via two different routes. Apprenticeships are employment with training, and apprentices specialise in one occupation as they learn on the job. T levels will be primarily studied at an education or training provider. Students will study a broad occupational area before specialising, and will have the opportunity to apply their knowledge and skills on a substantial work placement. The intention is for T levels to replace most current technical qualifications available to 16 to 19 year olds in the UK.

Companies such as Network Rail have engaged themselves deeply into the development of the system and adapting their own procedures for new students. In this example, the rail sector has been thoroughly engaged in the new development of the access to education for rail occupations.

4.3.2 The Dutch example of Railcenter

In order to understand the issue of "access to training" in a country such as the Netherlands, it is important to see that training systems differ greatly between the larger countries such as France, Germany and the UK, and a medium-sized country such as the Netherlands (17 million inhabitants). The Netherlands can be an example for other medium sized countries in Europe. In the Netherlands, infrastructure and transport have been separated and this split is reflected in the training system. The training sector for both parts (internal operation, access to education) also looks different. Railcenter is the training centre for all occupations in the network and construction sector of rail. It was outsourced some 17 years ago from NS (Dutch Railways) and is now managed as a Foundation by representatives of railway contractors, engineering firms, ProRail (infrastructure) and a board member from mainstream education. NS does not take part in Railcenter. Railcenter is more than just training: Railcenter has all the training equipment (old and new) so that, in addition to training, it can also be used for experimenting, testing and simulating on location in Amersfoort. In addition to training, Railcenter

[5] https://www.gov.uk/government/publications/apprenticeship-levy-how-it-will-work/apprenticeship-levy-how-it-will-work.

devotes a lot of attention to promoting the rail profession and it functions as a meeting point between players from the field.
In the Dutch rail market, there are separate training providers next to Railcenter. There is no legal obligation to follow training at Railcenter. However, ProRail, as main manager of the rail infrastructure, has drawn up a list of over 50 critical tasks for which companies are obliged to engage certified employees. These certificates are only issued if a candidate has passed an exam successfully. This independent exam is a responsibility of the RailAlert foundation. Railcenter is the main supplier of these certified trainings.
Railcenter has been the main carrier for developing new relationships between the rail supplier companies and the educational system. In the regular Dutch educational system, rail-related training is very weakly represented. The vocational education training institutes (ROC) and university of applied sciences (Hogeschool) face too limited demand of rail students to set up a track-oriented vocational training. The only rail training provided at the VET level is for train drivers. This training runs at three ROCs. In order to increase visibility of rail among students, a minor track technology has been set up between Railcenter and the Utrecht University of Applied Sciences. The minor now runs for the sixth year, in which teaching is mainly done by specialists from the sector. In 2018, more than 20 pupils will follow the minor. The success of the minor for the railway sector is demonstrated by the fact that over 70% of the previous participants work in the railway sector. Another example is the training for Rail Engineering as an optional training at ROC Midden Nederland. This optional component (counterpart of the minor but at secondary vocational level) was also set up by Railcenter in collaboration with the main rail contractors. There are 25 places offered and 30 young people have applied. The training takes place at Railcenter and at the companies. The pupils even go on a training during a night shift with a mechanic. This allows them to get a good picture of the work and hopefully it will leads to future job applications at the companies. The development of more sector-specific training would obviously be great for the rail sector, but limited volume of students for specific technical training remains a challenge. Apprenticeships do not really exist in the Netherlands. Internship systems do not last more than 3 months. Work-training systems exist in the Netherlands as a the long-term BBL system.
For the rail sector in the Netherlands, increasing access to education is primarily a strategy to get more control on the educational programmes without managing the programmes themselves. This is mainly the consequence of the particular government policy in the Netherlands. One reason for this is that Dutch policy makers want students from 16 to 18 years to leave any education with at least a basic qualification. The idea is that a basic qualification helps chances of getting a (future) job. A basic qualification is a general secondary education (havo/vwo), or VET (mbo)-level 2 or higher diploma. Qualification obligation extends the compulsory education.
The government wants the (VET) educational institutions to cooperate more with companies on the content of the programmes offered to these students. For companies this offers the advantage that pupils come into contact with the sector as a potential employer at an early stage. There are upsides and downsides to this situation. An upside is that training costs for students are borne by the education system. The downside is that the motivation of (some) students to remain until their 18th birthday in a traditional school is sometimes limited. Companies see a growing mismatch between what students deliver as competences and what they need. The Dutch government has the plan to extend the qualification obligation until 21 years of age to prevent too many young access the labour market without any qualification whatsoever. Railcenter sees its activities as important in networking between the VET-schools and the companies.

4.3.3 Learning from other sectors

Both examples show different approaches to developing access to education in the rail sector. These approaches are different mainly because of institutional differences. The Railcenter-example does show the benefit of developing a network partner in a context of strong differentiation between market partners in the rail sector. The challenges of the rail sector with access to education can be also be seen in other sectors. In Annex 1, the examples of the airline pilots and the marine officers are described. For airline pilots, the markets of private trainers is seen to come under pressure because of the rising market demands for pilots. This type of occupation has already long time been confronted with highly automated machines. But given the fact that most large airplanes can be flown full automatically, there are no real examples of airline companies investing in autonomous airplanes. Pilots need to keep developing their piloting skill. The development in the airline sector seems to be that airline companies are more and more integrating the full training of pilots into their companies. Airlines are offering higher and higher bonuses to attract new candidates to their trainings.

The maritime sector has seen a separate development as the rail sector. The demand for marine officers is much larger than for rail personnel. There are more specialized educational systems for the maritime sector. The technological developments have been treated differently from what is currently under investigation in the rail sector. In the rail sector, a lot of thought is given to what train drivers may be needing to do in the future. In the maritime sector, the idea in the past years was that marine officers in more and more automated vessels might be able to combine desk tasks with engineering tasks. This idea has been experimented by companies but currently is being abandoned quite quickly. The demand from the maritime companies is to add more specialized tasks to the separate marine officer functions. In practice, integration has been reversed for more specialized functions. Companies are also more and more engaged by educational institutions to co-develop the trainings for marine officers. In some cases, companies are developing collaborations to offer their officers to learn tasks within the network of companies.

4.4 Assessment

Transfer of knowledge to the rail sector can also be accomplished by linking the educational institutions more closely to the needs of the rail sector. The following table summarizes in what way this helps to deal with the skill gap issues identified in Section 1.2.

Table 4.4 Linking transfer mechanisms to the skill gap

Skill gaps and challenges S2R innovation programmes	Access to education
Programmes require mastering fast changing personnel composition	Channelling new talent to rail companies
Rise in need for IT-skills: programming skills, systems knowledge	Attracting talent from other sectors Dealing with competition from other sectors

Access to education needs to be improved if companies experience insufficient supply of talent or if talent is not channelled to the right educational needs the rail companies have. Rail companies do not always have sufficiently adequate schooling systems themselves that deliver the right knowledge. Two main issues have restricted the better access of companies to the educational system. First, educational systems in the past have been quite reticent to discuss with rail companies their needs and the rail companies have not always been able to offer sufficient jobs to students. Second, companies have only recently experimented with new learning systems for new recruits. The companies have only started to share these experiences.

Having more access to education, in terms of better collaboration with the educational system and co-developing apprenticeship systems, is currently a main approach by rail companies. Most of the major rail companies however, do rely on their own training departments to secure sufficient specific rail knowledge for their operations. The analysis has shown that institutional differences between countries explain different approaches to the issue, even though in all countries employers want to develop better relations with educational institutions (VET, bachelor level) to provide more specific knowledge to the sector. Better relations with the educational systems provides more flexibility in programming of the trainings, which is certainly needed for the future. The experience of the maritime sector is helpful in this sense that it shows that finding solutions for the future technological changes may require several options that need to be developed.

5 Attractiveness of Sector to New Entrants

5.1 Definition

Transferring workforce is the most direct way to deal with transfer of knowledge and finding new personnel. To find new personnel, rail companies need to set-up a clear recruiting strategy and have a clear idea how to attract even more labour market groups. In the past, recruiting may have been skewed towards 'traditional' labour market groups: male, white, technical background. Also, the companies may have also counted on sufficient self-applications of candidates. In the new labour markets, rail companies need to deal with shortages of personnel, even if they need to let go parts of their personnel. The ageing workforce forces the companies to find new ways to replace personnel groups, in labour markets in which competition with other companies is growing. For attracting new entrants, the following measures are in focus:

- General campaigns to develop specific and new branding of the sector and of the companies to improve image of sector;
- New recruiting procedures, shifting from broadcasting to multicasting;
- Redeployment and intersectoral mobility;
- Networked approaches in which collaboration with a broad set of partners is sought to improve the sector image.

Important in this respect is the monitoring and measurement of net-effectiveness of such measures.

5.2 The challenge

The challenge in transferring workforce is a complicated one for rail organisations. Companies are trying to balance very conflicting demands: they need to recruit sufficient new talent to deal with an ageing workforce and they need to take account of the unpredictability of the technological challenges.

The ageing workforce is an issue in all four countries. As indicated in the introduction to this report, the issue is somewhat different between the countries. At SNCF, the major generation shift has already passed. The major recruiting boost was in the 1970s (50 years ago) and this generation has now left the company. SNCF has been able to develop more balanced recruiting level of about 10,000 persons (5% of total personnel) per year.

The most fluctuating recruiting effort can be seen at DB. DB is one of the biggest employers in Germany. The recruiting demand has risen quite importantly, mainly because of the rising average age of personnel in DB (now: 47 years). Some six years ago, the company needed to find 6,000 new recruits per year. This year, the recruiting need exceeded 22,000 persons. In the coming years, it will be around 15,000 vacancies per year. This rise is affected by recruiting in the past. DB had known a major growth of the company after the re-unification of Germany. After re-unification, DB needed to slim down the organisation because of the major overlaps in personnel in the new unified company. This slimming down has finished years ago, at this moment recruiting is very important for DB to deal with the new demand, the technological challenges and the ageing employment at DB.

In the UK, Network Rail also foresees large volumes of retirees in the next 5-15 years. For Network Rail this means that they need a mixture of new entrants and upskilling/reskilling in large volumes to create a natural pipeline of talent for the future. Also, many projects do not operate in parallel, and therefore Network Rail seeks to 'incubate' the talent they have from one programme to the next so that lessons learnt as well as the transferable skills are not lost from one project to another.

Figure 5.1 Recruitment advertisement of Belgium rail organisation

For the technological challenge, as is clarified in report D2, the personnel shift is more complicated than simply calculating the number of staff that is being cancelled out by introducing new technology. For the Dutch situation, for example, some 70% of the Dutch rail security system is based on relay technology that dates back to the beginning of the 1950s (built with help from the Marshall Plan). It is therefore very outdated and must be replaced in the future. In practice, rail organisations will need to keep staff who can work with the old technology, next to new staff who can work with new relay technology. Rail companies need to decide if specialists in the old technologies will move over to the new technologies, but also if new recruits should acquaint themselves with old technology. New technologies are always better than older technologies. The technologies are however more complex than previous vintages. A risk is that the technology is also so complex that if it really breaks down there is insufficient knowledge to recover quickly. Recent examples from neighbouring sectors are the computer problems at the traffic control at the major Dutch airport operator Schiphol: the breakdowns meant that many flights had to be cancelled with serious economic consequences. In the past 18 months, this has happened four times.

5.3 Overview

5.3.1 Introduction

In Table 5.1, an overview is given of several measures for the four topics listed above. The full information is included in Annex 1. For comparison purposes, the impact of the Dutch Technology Pact is used as reference point. This example shows that a lot of campaign measures may be insufficient to change labour market behaviour of individuals in general. This example is more instructive than overviews from campaigns in other sectors, because these tend to work in general much in line with what the rail sector is trying to achieve. The table provides the core idea of each of these measures that helps to deal with the skill gap created by the S2R-Innovation projects.

Table 5.1 Overview measures Attracting new talent[6]

Example	Organisation	Lessons for technological skill gap
Labour Market Communication "Touch Campaign" NS	NS	Rebranding the image of NS as an innovative employer helps to change the mindset of young academics and high-tech minded youth. For lasting impact, more campaigns are needed.
Attractiveness for new candidates at SNCF	SNCF	Modernization of image is a tool for attracting new labour market groups.
Rising demand for recruiting at DB	DB	The recruiting strategy is multi-dimensional and complex to fit the requirements of the labour markets and the needs of DB.
Employer and sector branding	DB	Carefully developing the brand helps to get access to target groups on the labour market.
Redeployment of personnel and 'quereinstieg'	DB	Measures allow to keep technical talent deployed in the sector.
Labour market campaigns	NR	The recruiting strategy is multi-dimensional and complex to fit the requirements of the labour markets and the needs of NR.
Redeployment of personnel and intersectoral mobility	NR	Measures allow to keep technical talent deployed in the sector.
Other sectors		
Dutch Technology Pact (sector of manufacturing industry)	Network of partners	Measures are focused on improving attraction of technology among young, to train technical professionals for the future, and to retain professionals within the sector. Net-effectiveness of measures are unclear.

In Table 5.1 an overview is given of measures that should improve the attractiveness of working in rail. In this section, there are promotional measures such as events and prizes to attract new groups to the rail sector. More developed measures have to do with company practices: lowering and changing recruitment demands to get access to greater number of recruits, offering better working conditions to work with digitization, supporting mobility to other jobs.

5.3.2 *General campaigns to develop specific and new branding of the sector and of the companies*

An analysis of rail related labour market campaigns in UK rail journals over the past years has resulted in a list with a multitude of actions: Kids' week in Wales (2013); Next Generation Rail Conference organized by RSSB and YRP (2015); Recruiter and HR Person or Team of the Year Award (Stobart Rail, 2015); YRP Rail Week (2016); 2016 Young Rail Professionals' Annual Dinner; Entrepreneurs in Action (EiA) in setting the 2016 Classroom to Boardroom business challenge; Future Engineers (2017); Enterprise for Education (2016); Enjoyment to Employment (2016); National Apprenticeship Week (2017); national Big Bang careers (2017); 2018 Year of Engineering (UK; DfT). The campaigns are focused on different target groups and are meant to broaden the supply base for future and current recruiting efforts of rail companies. Such campaigns can be found in all countries under investigation. Next to campaigns, companies engage in prizes to attract more attention to themselves: e.g., the Queen's Anniversary Prize for Higher and Further Education (2018) in the UK. Companies also engage in

[6] For detailed overview of each of these measures, please consult Annex 1.

specific company events targeted at very specific groups. DB reports that they organise some 600 events per year to talk to all kind of target groups.
This continuous communication with the labour markets is hard. The Dutch Railcenter acknowledges that in the many campaigns they conduct, it is difficult to remain well connected to what young people want. The 'times' change quickly and the messages need to be redeveloped each time.
A lot of effort is done by the rail companies to ‘re-brand’ their profile in the labour market. The following table shows the current brand recognition the major rail companies have in the Universum employer branding surveys.

Table 5.2 Ranking of main rail companies in the Universum Employer Branding 2018 among students in different educational programme (number in ranking)

	Business	Engineering, IT, Natural sciences	Humanities, Liberal arts, Education
NL - NS	55	56	31
NL - ProRail	75	50	52
GER - DB	40	15/34/37	61
UK - Network Rail	90	29	63/59
FR - SNCF	25	13	

Universum’s research draws on the opinions of more than tens of thousands of professionals in the different countries. This talent survey give a clear indication of where the organisations ranks when it comes to its potential to attract new recruits. The reports give crucial elements for developing employer branding strategies of companies (see website Universum). More and more campaigns of rail companies are less focused on general branding of the sector as rail, but much more on showing that the companies are also tech companies. The above table shows the positioning of the companies as engineering and IT specialists. They need to do this to attract new talent to high tech jobs. The previous table shows the performance of the rail companies in the engineering and IT communities. Figure 5.2 contains the advice of Universum in developing an employer branding strategy.

Figure 5.2 Components of an employer branding strategy according to Universum

The conclusion for this part is that the companies all have developed a lot of experience with different kind of campaigns (overhaul campaigns, employer branding, nurturing campaigns). They are all very professional, but need to campaign against other very strong approaches from other sectors. As was reported in the analysis of the Dutch NS campaign: the campaigns have the ability to change the perception of their audiences as targeted, but having only one campaign in ten years will not result in lasting impacts.

5.3.3 New recruiting procedures, shifting from broadcasting to multicasting

The European rail organisations have strongly professionalized their recruiting departments to deal with the great number of recruits, trainees and messages they need to convey on the labour markets. Not only do they need to conduct more actions, they are all positioned to convey new messages to their labour market groups.

For example, DB has been experiencing growing recruiting demands that require a strong professionalization of the recruitment process. DB Recruiting, created some six years ago, is now several thousands of persons. The Talent acquisition department now comprises 400 persons. DB Recruiting is, next to the recruiting process, also responsible for employee referral projects; diversity; international projects (to become more attractive on an international scale); recruiting for the international parts of the company (Arriva, Schenker). DB is more and more an international operating company.

The previous section already documented the need for new company profiles in the campaigns, but these profiles need to be backed-up by a new culture in the companies. For example in DB, the fact that the recruiting effort has risen enormously has had as important side-effect that since 2013, already a third of the total employment at DB is completely new to the sector. For new recruits, this helps to give them a feeling that they truly are operating in a renewed company. For DB, the recruiting effort also has to be backed by new agreements with trade unions. One example is the new collective agreement on digitization at DB (2016).

The objective of the agreement is to create better working conditions to deal with digitization. Homeworking and flexible working arrangements are part of this deal.
That rail organisations switch from general 'broadcasting' in their labour market communication to communication at different levels and with different messages is illustrated in the following overview, documented in Annex 1. "DB plays the entire personnel marketing keyboard, addresses the target group individually via regional newspapers and digital media and tries to get in personal contact quickly. For example, the ICE is used for job interviews; potential train attendants can thus conduct their job interview in the future work environment. This makes the interview an exciting experience and a spark for the job, and the company can more easily skip during the application phase. In order to address new groups of applicants, Deutsche Bahn also uses its own employees as testimonials. Trainees as well as newcomers report on their job in various locations as part of recruiting action days. Social media and events can be addressed for cross-promotion suitable groups of applicants on topic-specific content. In this way you get access to technology-affine people who can be invited to special events in the company" (Neumann, 2018). The aim in the recruiting process is to make the process as smooth as possible for the applicant. The recruiting process should reflect the technological demands people will be operating in in the future in these companies.

5.3.4 Redeployment and intersectoral mobility

Getting access to new entrants also means to look at recruiting demands and at international and other sectoral labour markets. DB has lowered its *recruiting demands* in this sense that it does not select on the basis of diploma (see above), but on more general criteria. *International recruiting* is important for all companies, but has become a contentious topic in most EU-countries. In England, to receive Levy funded apprenticeship training, an apprentice needs to spend at least 50% of their working hours in England. With the upcoming Brexit, UK-employers are looking carefully at what strategy to follow, to which degree it will harm their recruiting possibilities. In Germany, producers have developed recruiting actions in Spain, but also trained engineers from India and from the UK. For train drivers, DB is looking at Romanian recruits. To work in Germany, however, anyone still needs high level knowledge of the German language. The international recruiting is a specialised field in itself and is not further developed as an access to workforce measure.

In the *case of redeployment of personnel*, companies in the rail sector are more and more confronted with the unpredictability of contracts they are performing and need to reapply for. Redeployment means that contractors are allowed or may even be obliged to take-over personnel from another contractor if old contractor loses continuation of a previous contract. In the UK, one of the main contractors of Network Rail recently went into bankruptcy, even after having just won several new contracts. For Network Rail, this brought as a challenge that several important tasks on the network would risk to be discontinued. After months of dealing with different partners, the contracts and personnel were taken over by other contractors. The UK law regulates how personnel needs to be redeployed (the TUPE-regulation, see annex). The rules are in line with what is allowed in the Netherlands: new employers can take over personnel from a previous employer, but need to respect previous contractual obligations in the future. Redeployment is, however, fraught with several difficulties:

- A main issue is what happens when a major part of this personnel has received important training investment over the past years. For train security mechanics, for example, a long learning time is required and a lot of investment is required to obtain and keep the certificates. Whether training costs are taken over by the new concession holder (or at least reimbursed) depends on whether this is included in the collective labour agreements. The maintenance contractors in the Netherlands have agreed such compensation in their collective agreement.

- Next to the fact that in contracting, companies need to take account of the training investment, they also need to consider the labour market, future contracts and the will of the personnel:
  - When winning new concessions from other parties, the new concessionaires are very much focused on taking over staff. In the Dutch rail industry, maintenance contracts are given for 5 years. In the recent re-tendering of the ten major maintenance contracts on the Dutch rail, nine concessions did not go to the same party. For the new concessionaires, there is a large incentive to take over the staff of the old concessionaire. In the past decade, the old concessionaire would have wanted to contribute to the transition of personnel. In the current situation, the old concession holders are not inclined to cooperate because there is such a shortage of (qualified) personnel. The old concessionaires are more inclined to transfer their current staff to new locations. In practice, also this is a difficult option because the success of such an intention depends on the degree the staff is prepared to move to other parts in the country. In most cases, the staff tends to leave to other sectors outside the railways.
  - For the staff, the situation is also not that clear-cut. Personnel is not obliged to switch to the new concessionaire, but staying with a new concessionaire may bring new risks (for example: they are not always at an advantage to other personnel from the new concessionaire). Currently, any railway staff is very attractive for other sectors such as construction and electrical infrastructure (Tennet etc). The rule for any employer is that it is increasingly cheaper to hire qualified personnel than to train yourself.
- This discontinuity in contract ownership has serious consequences for the contractors. There is a lot of insecurity among contract holders what the future will bring for them. Some parties in the Dutch market are considering completely dropping out of the competition, finding the market is too unpredictable. This would lead to a further concentration of the market.
- A major complication in redeploying personnel is at the international level. Companies in the UK and the Netherlands are used to work in competitive and deregulated markets. For such companies, it is difficult to enter the more regulated markets such as Germany and France, mainly because of agreements within these markets between the major rail organisation and local players. A company like the Dutch Strukton is active in Europe and works in Belgium, Sweden, Denmark and Italy. They can transfer knowledge and personnel between their companies in these countries, but not easily in France or Germany. Markets are still not completely deregulated.

For *intersectoral mobility*, all depends on the relative position of the rail sector in comparison to other sectors such as ICT, construction and engineering. Currently, the rail companies need to offer more opportunities (comparable payment, perks) to their personnel in order not to lose them to other sectors.

5.3.5 *Networking supports in which collaboration with a broad network of partners is sought to improve the sector image*

Most of the previous measures are company-based. In most of the countries, major players in the whole rail sector have collaborated to develop a better positioning of the companies in recruiting new talent. Next to national approaches (for example UK National Training Partnership and the Dutch Technology Pact), there are examples of regional and international initiatives (for example: UITP) to achieve the same goal.

Rail Forum East Midlands (RFEM) is an example of a region that is taking innovative action to tackle the national skills shortage. “RFEM represents over 150 rail organisations - from infrastructure to rolling stock and from manufacturing to technology services. The strategy sets out four key priority areas. One of these is to Facilitate Local Delivery of National (and Regional) Strategy. Working closely with RSG and NSAR, RFEM is implementing specific actions locally for the benefit of members. Second, encouraging more people to take up a career in rail. This work includes taking a co-ordinated approach to education outreach in the East Midlands and working with the Career Transition Partnership (CTP) to offer a co-ordinated approach to working with armed forces leavers. Thirdly, driving up the number of apprenticeships in rail, including supporting companies to either make the best use of their apprenticeship levy payments or, for non-levy payers, to navigate the new funding arrangements. An example is the establishment of a Rail Employment and Skills Academy with Derby College. The academy allows employers to work with the college to advise on the content of the curriculum, develop facilities, offer work placements and workplace visits and set projects. The academy will focus on both apprentices and full-time students who may progress onto an apprenticeship or higher education, and the intention is that all the full-time students will be ‘sponsored’ in some way by an employer. The academy provides opportunities for students from across a range of disciplines, not just engineering or construction. Students will be studying a wide variety of subjects, such as business and management, commercial, marketing, digital technology and even catering.” (Rail Technology Magazine, 17/1/2017).

The most extensive approach in the rail sector is the *UK National Training Partnership* that develops an ecosystem to support training of newcomers. The National Training Partnership was launched in 2017 by NSAR to support world-class career opportunities in rail. The National Training Partnership is meant to bring together NSAR’s newly formed National Network of Colleges and Training Providers, the Training Alliance and Quality Assurance provision and will support the UK rail industry in achieving an integrated approach to education, professional development and training. The National Training Partnership helps in optimising training provision and improving rail employment opportunities. NSAR recently established its National Network of Colleges and Training Providers and will comprise of selected Further Education (FE) Colleges, partner universities, Development Centres, specialist training academies and NSAR Quality Assured training providers. Through the Colleges and Training Providers which NSAR has forecast will be required to meet predicted workforce demands, the Training’s Partnership’s aim is to secure a steady long-term flow of talented people entering the rail industry through an apprenticeship (NSAR Newswebsite).

The *Dutch Technology Pact* does much the same as the UK National Training Partnership, but then for the whole of the tech sectors. As of 2013, the education community, business sector and government have been jointly developing the Technology Pact in an effort to structurally improve alignment between education and the technology job market, and reduce the shortage of technically trained staff. This Technology Pact is now updated in order to adequately respond to new technological developments. Annex 1 contains more details of the Pact. Important for the other described network approaches is to understand how effective these initiatives may be. The Dutch Technology Pact keeps monitor data on the development of the number of technicians and this helps to understand to what degree the Pact has had an impact. The number of people working in technical professions has increased over the years and the number of unemployed technicians has become minimal. However, it is unclear whether these developments would have occurred without campaigns too because the developments are much in parallel to the general developments on the Dutch labour market. In addition, it appears that in the figures the number of young people in technical jobs has not really increased, but older workers have started to work longer. Despite the absolute increase

in the number of young technicians, there is a stronger aging of technically skilled workers (and remaining in the workforce). This phenomenon also occurs among IT professionals. Here the group consists of almost three quarters of higher educated people. The growth of the group of higher educated people was also 25 percentage points over the period studied; the growth among younger IT professionals is much lower. The example shows that it is difficult for even a well-funded and very broad programme to show its net-effectiveness. The number of technicians has risen, but maybe not the elite the programme was intended for.

5.4 Assessment

Attracting new entrants is important for the 'transfer of personnel'. The following table summarizes in what way these measures can help to deal with the skill gap issues identified in Section 1.2.

Table 5.3 Linking transfer mechanisms to the skill gap

Skill gaps and challenges S2R innovation programmes	New entrants
Programmes feed into unpredictable growth and decline of tasks: this requires 'flexible personnel provision for the future'	If connected to new contract systems: then more flexible?
Programmes require mastering fast changing personnel composition	Broadening supply base with new talent
Programmes require managing unknown technical capabilities (suppliers, ageing groups)	Broadening supply base with new talent
Rise in need for IT-skills: programming skills, systems knowledge	Attracting talent from other sectors Competition
Programmes support a new corporate culture: changing social, communication and organisational skills	New entrants need new culture (requirement) Bring new culture
Programmes require faster upscaling of (technical) knowledge (from 1 to ∞)	New entrants may be more receptive

Access to new groups is essential for rail companies to find new talent to deal with the technological challenges that (for example) S2R-innovations will offer. The table and the analysis show that access to new groups requires an integration of different set of strategies within companies, but also among different companies. Redeployment efforts will for example become more important in the future, but this requires that within the rail sector some general agreement arises between rail companies. The regional and national network approaches can help to create such understanding. The risk for the rail sector is that much of new workforces and training investment may get lost to mobility to other sectors.

6 Transfer from Reintegration

6.1 Definition

Reintegration is defined as those measures applied to help employees for whatever reason not at work, to return to work. Reintegration is one of more unlikely measures to deal with the technological developments since most of the absenteeism and sickness-at-work have little to do with technology itself. Technology can, however, be a solution to many of the demanding work situations in the rail sector. For example, it can help reduce the amount of work in the nights. The major measure to deal with high demands at work (physical, mental) is to work in a preventive way in designing good jobs and working conditions.

Figure 6.1 Example of publicity about safety policies at a major Dutch construction company

6.2 Overview

Table 6.1 includes several interventions deployed by the rail companies in this study. The overview is far from complete, but is meant to indicate a sample of such measures and their effectiveness.

Table 6.1 Overview measures Reintegration[7]

Example	Organisation	Lessons for technological skill gap
Reintegration	NS	Support of a specialised agency is offered to help employees in return-to-work situation find jobs in- and outside NS. No clear result.

[7] For detailed overview of each of these measures, please consult Annex 1.

Example	Organisation	Lessons for technological skill gap
MOVE-project	NS	Short-term career assessment to help re-focus employee to new tasks and roles.
Reintegration	ProRail	Training courses to develop sustainable employability. Craftmanship can help ability to work with technology.
Alpha Cells as reintegration means	SNCF	Job carving applied to create new jobs and supported with coaching helps integration. No relation with technology.
Other sectors		
Dirigo project	Sweden, Försäkringskassan	Vocational rehabilitation interventions also need a societal approach to be able to offer clients opportunities for job training and real jobs

The table shows that the rail companies do spend attention to return-to-work programmes. In most cases, the companies try to find new jobs for their employees, inside or outside of the company. The most developed approach are the Alpha Cells at SNCF that use a job carving approach to create new jobs for work incapacitated employees. Such measure does not immediately deal with technological change. The example of the Dirigo-project is added to this list as a point of reference. It shows the example of return-to-work effort in the Swedish context. Even if the project is not very helpful for the rail sector per se, it does show what most of the return-to-work interventions have in common: that is the combination of different on-the-person measures (motivational interviews), supportive supervisor support and work redesign. As in many other of these return-to-work research, the interventions need to have a broad cooperation of stakeholders to hold any (if any) success (Vogel et al., 2017.

6.3 Assessment

Table 6.2 connects the measures to the skill gaps under research.

Table 6.2 Linking transfer mechanisms to the skill gap

Skill gaps and challenges S2R innovation programmes	Reintegration
Programmes lead to rising risk situations that need managing	Prevention? Lifelong learning perspective

It is clear from this table, that prevention should be the main focus in dealing with rising risk situations at work. For as far as interventions between countries can be understood, it is important to understand the strong differences between social security regulations and what the costs are for companies. In the Netherlands, companies are fully responsible for all sickness and remedial costs in the first two year of absenteeism of an employee. This is much longer than in other countries. The goal of the Dutch legislation is to shift the (societal) burden of absenteeism to employers. Employers should be incentivized to do more in terms of prevention and support to sick employees. One also needs to understand the multitude of interventions possible, depending on the physical factors, mental factors and social factors that need to be taken into account. Interventions can be directed at management behaviour, co-worker behaviour, task-redesign etc. There are a multitude of commercial approaches and it is not always clear what works. The Alpha Cells seem to be an effective approach, but more systematic research would be needed to see what works. Current research is not that optimistic about return-to-work interventions (Vogel et al., 2017).

Reintegration is not a first measure that can help companies deal with technological change. At best, it is focused a helping employees find employment in newly developed jobs, but these jobs will rather be at the fringes of operation and not so much in core technology areas.

7 Transfer from Less Represented Target Groups

7.1 Definition

A last measure to improve the transfer of workforce for rail organisations is to make sure that the number of persons from all labour market segments are at least represented in personnel at the level of their presence in the labour market. A first reason for organisations to do this, is to avoid being blamed and shamed for possibly discriminating specific groups in society.
Drivers for such policies can be legislation, but also more mundane reasons such as: putting the organisation at a disadvantage of other organisations that profit from such extra supply of talent; profiting from the extra possibilities that more diversity gives to an organisation. The extra benefits seen in a more diverse population is currently integrated into the concept of more inclusive management. Inclusive management means that companies are explicitly targeting a more diverse population because of these extra benefits. These benefits can be other skills and talents, the ability to better deal with the outside world itself, the possibility of better understanding of technology and processes that companies now miss if their personnel is homogeneous. One example of this last advantage is that companies can create better value systems to deal with the changing society.
Diversity is seen in many different ways: gender equality, inclusion of individuals coming from priority neighbourhoods, focusing on LBGTQI-communities, integrating colleagues with a multi-cultural background.

7.2 Overview

Table 7.1 includes several interventions to improve access to less represented groups by the rail companies in this study. The overview is far from complete, but is meant to indicate a sample of such measures and their effectiveness. The reference point is current research on the benefits of inclusive management.

Table 7.1 Overview measures attracting from less represented groups[8]

Example	Organisation	Lessons for technological skill gap
90 sustainable jobs in operational organisation.	NS	These jobs are meant to satisfy the general policy of the company. It also helps to satisfy the legal obligations of the company for support to less able persons. The measure aims at a broad set of jobs. There is no link to technological change.
Diversity and Inclusion at NS.	NS	The recruitment of multicultural talent is focused on technical talent. This helps with the expected rise in technical jobs.
Access to less represented groups	SNCF	More diversity could be helpful for technical jobs.
Diversity and inclusive management	ProRail	This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
Recruiting groups less represented groups	DB	This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.

[8] For detailed overview of each of these measures, please consult Annex 1.

Example	Organi-sation	Lessons for technological skill gap
Diversity & Inclusion initiatives	NR	This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
Armed Forces into Rail	NR	A lot of military have the technical expertise that NR needs.
Increasing the number of persons with a disability working in Network Rail	NR	This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
Other sectors		
Inclusive policies in scientific literature (see Annex 1 for full list)	-	Women and other groups at a distance in technical jobs need better contexts.

NR defines on its website in the strongest terms what the components of an inclusive management approach should be. NR sees 'diversity' as the commitment to recognise and respect differences between people while valuing the contribution everyone can make to our business. 'Inclusion' means creating safe and welcoming workplaces with fair cultures that encourage innovative and fresh ways of thinking, and allow people to speak up, especially to suggest where things could be done better. Diversity is about getting a mix and inclusion is about making sure that mix works well. In this policy at NR, the components are:

- Access and inclusion - this covers activities that create a more open and safer working environment, from the way NR designs stations and facilities to the support for potential applicants and new members of staff. Components are: the Inclusive Leadership Programme, Flexible working, Employee networks, Diversity Champions and Equality Reps, Anti-bullying and harassment campaign, Everyone Week;
- Behaviours and benchmarking - this includes those activities that support an inclusive and fair culture, and enhance interactions so that our safety and performance improve. A first objective is to positively influence the career choices of the next generation and those who don't traditionally apply so that NR attracts applications from a wider range of potential employees. Examples of programme activities are: Early engagement, Work experience, The Apprenticeship programme, The Graduate programme, Work placements.
  A second objective is to use open, transparent and merit-based processes to appoint, promote and retain the best people who bring a diverse range of opinions, ideas and experiences. Examples of programme activities are: The Disability Confident Scheme, Diversity in Leadership, Inclusive training and development, Positive action.
  A third objective is to manage individuals and teams fairly in a way that is customer-driven, collaborative, accountable and challenging. Examples of programme activities are: Reasonable adjustments, Transparent pay Inclusive premises and facilities, Line manager guides, Living wage;
- Collaboration - this encompasses those activities that promote working with others across our business and the rail industry.

The actions are therefore the use of a different language in communication (for example the way DB tests its labour market communication for any bias), offering other support to different groups (for example DB offers housing to underprivileged groups), 'mixité' (for example, SNCF ensures that not only more women are in male jobs, but also the reverse: more men in women jobs). All of these elements are reflected in personnel composition, in campaigns and other measures. The major point that all companies stress is that the targeted equality in management is still far away.

For an underpinning of the importance of inclusive policies, also to help bridge the skills gaps rail companies will experience, some insights from research are helpful. Research suggest that inclusive management is a key strategy for effectively managing diversity (Moon, 2018). Workforce diversity needs cultures and structures that are in support. It is important to understand that, for example, gender issues are not only an individual decision. It is insufficient to simply motivate women to choose a career in engineering. To establish inclusive management concepts in technology-oriented organizations, it is needed to see that gender issues and related responsibilities should be seen as part of a professional leadership competence. Organizations aren't gender neutral but are producing and reproducing gender codes within all areas of organizational practices (Hanappi-Egger & Warmuth, 2010). A second set of studies identifies the possibilities to make value driven organisations. It is possible for organisations to make work values central to the employment relationship of any worker. For younger worker, this is done by asking them to explain what "success" or "efficiency" means to them in their work. This provides a window into the values-based reasoning underpinning younger workers' work-related attitudes and behaviour (Winter & Jackson, 2014).

7.3 Assessment

Table 7.2 connects the measures to the skill gaps under research.

Table 7.2 Linking transfer mechanisms to the skill gap

Skill gaps and challenges S2R innovation programmes	Access to less represented groups
Programmes require mastering fast changing personnel composition	Diversity as an asset
Programmes support a new corporate culture: changing social, communication and organisational skills	Diversity is pre-condition for new culture

Access to less represented groups is not only a ‘numbers’ opportunity, but a real opportunity to improve the technology base of an organisation. The different measures used by the rail organisations show that they have been capable of getting access to new talent and to balance their capabilities to what societies want from these organisations. The precise benefit of inclusive management will probably not be measurable, but the positive impacts are clear in terms of less turnover of groups with valuable knowledge for rail organisations.

8 Conclusions and Recommendations

8.1 Introduction

The previous six chapters have looked more deeply at each of the transfer of knowledge and workforce measures. Examples from rail and other companies have been investigated to see to what degree these measures can deal with the skill gaps identified in report D2. To come to recommendations for the rail sector, the following steps are still needed:

- How does the transfer of knowledge mechanism relate to the content and requirements for trainings?
- How does the transfer of workforce mechanism relate to the content and requirements for alternative learning systems, the needs of various skill levels and life-long learning?
- What should sectors try to come-up with as approach, using the six measures? What further development is then needed?

8.2 How does the transfer of knowledge mechanism relate to the content and requirements for trainings?

The S2R IPs will lead to changes in processes and technologies in the different countries. These technological developments inevitably require an adaptation of vocational training programmes, on-the-job training systems and higher education. The following tables give a summary of what the measures would mean for these three types of education and training used in the rail and other sectors. The results from previous chapters are used to deduct requirements for each of these types of training, taking into account the skills gaps that needs to be solved.

Table 8.1 Vocational training and requirements from the analysis

Knowledge transfer	Vocational training
NGL	• TechniekFabriek (TF): stronger collaboration needed between education and companies is a prerequisite for using new learning approaches. The approach is very much practice driven approach and much more an alignment between education and companies, in content and exchange of teaching personnel. TF helps for major technological challenge as new train systems etc. The collaboration is also needed to ensure sufficient supply of students. The methodology helps to secure that students learn skills required by industry. NGL offers competence-based learning (CBL), but the TF shows that CBL should be developed together with the companies (and their training departments). • Digital passport/skills fitness test as starting point (DB): assessing current knowledge and required development. Can be applied in apprenticeships systems too. • RBC: starting from the current practice to redefine skill requirements, also basis building stone for new apprenticeships training.
Access to virtual learning	• Most digital instruments looked at are developed for company practice. It is important to acquaint students early on with their future work environments. Possibly integrate special modules for all these tools in training on Moodle, apps etc. • The TechniekFabriek as a model seems to allow for good connection between virtual learning and new requirements in the rail industry.

Knowledge transfer	Vocational training
Access to education	Participation of rail in development of apprenticeships should be continued (Network Rail). Difficulty in most countries remains the issue of developing courses in educational institutions (NL) and in-house training schemes (UK, Fr, GER).

Table 8.2 On-the-job training and requirements from the analysis

Knowledge transfer	On-the-job training
NGL	• Digital passport/skills fitness test as starting point (SNCF, DB): assessing current knowledge and required development is helpful. Link up with approaches such as the UK SkillsID-approach. • RBC: starting from the current practice to redefine skill requirements, but also leading to requirements for new trainings (focus on building blocks rather on full solutions). RBC can help to better align elearning-modules. • Skill-swapping: only experimental method, but probably promising venue for on-the-job training, certainly in a world in which collaboration between network partners will only rise and cross-organisational skills are crucial. • New simulator based training allow for integration of components of blended learning (learning nuggets, gamification, team based, learning on demand).
Access to virtual learning	• eLearning and Learning management systems are prerequisite for NGL to have any effect. Monitoring of development in knowledge and competences is needed. App-systems are requirement to learn in workplaces. • Most eLearning systems are still limited in their reach. Rail organisations seem to limit development to safety related and general shareable knowledge. Unclear is why more technical topics could not be integrated. • Simulation systems have developed quite fast: companies will need to find collaborations with schools to offer access to these systems.
Access to education	• Apprenticeships allow for link with on-the-job training. This is however limited to those countries that have a tradition in this (UK, GER). • Learning from other sectors can help pose right questions: main question is how train drivers will fare with ATO. Maritime experience shows that integrated job profiles do not seem to work. Possibly more research into this topic. Maritime invests in more specialization of captains, much along lines of airline pilots.

Table 8.3 Formal training and requirements from the analysis

Knowledge transfer	Formal training
NGL	Collaboration between different education institutions has been possible for 'higher apprenticeship' freight logistics. However, unclear why companies do not buy in such more practical approach to academic excellence. Are companies are interested in this kind of 'higher apprenticeship'?
Access to virtual learning	• Simulation systems are now more developed and allow rail systems management. Focus should be on reducing learning time and possibly more experimentation to reduce introduction time for new technologies. • Academic institutions, for as far they have rail technology as a degree, are well equipped with virtual learning tools. The issue is to get more rail technology in the curricula.

Knowledge transfer	Formal training
Access to education	• Adopting courses to newest technology (ATO) is something that could be shared. Investments in training are substantial (Birmingham). • Cooperation of Network Rail in the National Technical Colleges helps to co-direct the content of the programmes. Rail academies provide more training grounds for academics too. • Major railways stay connected to Technical Universities via professorships. Maybe this should be expanded to Human Capital research too.

These transfer of knowledge mechanisms help VET, on-the-job training and academic education to prepare themselves for the future skill gaps that will arise. From the above analysis, it is important to take the following points into consideration:

- To understand the role of VET-systems in the different countries, it is important to bear in mind the institutional differences between the countries participating in the research. One of the differences lie in the availability of apprenticeship systems. Apprenticeships combine alternating periods at the workplace and in training institutions and they are well suited to provide young people with an entry point into the labour market and supply enterprises with skilled workers. In the Netherlands, the traditional apprenticeship system has been replaced by a school based education and a dual-track (work-learning). This is something quite different in comparison with the other three countries. Only the dual learning track (work-learning, BBL) is comparable to the other countries. Another difference between the Netherlands and the other countries is the obligation of the VET-system to make sure that candidates finish with a qualification. In most countries, 50% of candidates never obtain such a qualification (Eurofound, 2018). The fact that 100% of Dutch students will end up with a qualification is certainly helpful for the students, but the fear is that educational institutions may be under pressure to give away these certificates. The changes discussed in the Dutch system (i.c. TechniekFabriek) have to do with the distance that had grown between the education system and the companies. Companies have a clear interest to help improve the educational effort. This is certainly the case in the UK with the introduction of the new apprenticeship system and the changes at the academic level. Network Rail (and other rail partners) are heavily engaged in defining the profiles and the terms for funding, etc.;
- Another important new element, according to the investigation, is the attention of the companies to assess the ICT-knowledge that colleagues have. It should be a personal interest of everyone to know where they stand, but also to have reliable tooling to assess this knowledge and competence. It would be a good thing to share the German validated test and to develop this also for the VET and higher education systems;
- A major novelty is also the fact that assessing the technological knowledge in a job, should be done with the current jobs and not so much from the drawing board. This approach however will not tell what knowledge and competences are needed in the future but can be used to assess what is needed once the changes are taking place. This approach also means that it is somewhat hard to give a precise content on the VET, on-the-job and academic programmes.
  The flip-side of this observation is that the identification of the precise content of training programmes may be a futile exercise: having a flexible system to assess changes when they are there may be more important than trying to guess what will happen in the future. This requires however a close cooperation with the VET-system, unless of course companies do everything in-house. The risk of only working in-house is the continued institutional separation of VET and companies;
- At the academic level, it seems as if the technological change is insufficiently tackled. Educational institutions (for example NewCastle University) has developed in cooperation

a more practical programme based on NGL-rules, but the need does not seem to be there among rail companies;

- The future will bring skill gaps as identified in the report D2. The question is how far in the future this will be, and according to some accounts, they may be further than calculated. The impact on training is that it may be more adequate to have methods (assessments, tests, procedures to develop trainings) in place to deal with the change once it is there, rather than to plan in great detail training contents;
- The maritime sector shows that it is better to let practice to lead the content (example: integrating or splitting up jobs on ships). There are great many ideas of what will happen to different occupations, but it is important that companies experiment and inform education what their needs are;
- Virtual learning is already well-embedded in the rail sector. Most parties elect blended learning approaches. However, more attention to new simulation approaches may be the future to model technology changes. This will be more necessary for 'management systems' (managing a multitude of partner actions, rather than single driving trainer). For the educational system, more access to such systems may only be realisable through the companies. Partnerships should be built on this;
- eLearning seems only to be used for a limited number of topics. More analysis needed for this, but otherwise: more investment needed.

8.3 How does the transfer of workforce mechanism relate to the content and requirements for alternative learning systems, the needs of various skill levels and life-long learning?

Tables 8.4-8.6 focus on 'transfer of workforce' mechanism and how they take into account alternative learning systems, needs of various skill levels and lifelong learning aspects of skills segments of the workforce.

Table 8.4 Alternative learning systems and requirements from the analysis

Workforce transfer	Alternative learning systems
Attractiveness to new entrants	Rebranding of a sector (NS, SNCF, DB) may have unintended impacts at the vocational level. If a sector is seen as something else as 'rail', it may influence youth going to VET-schools. But it may also have positive effects on parents to think their kinds have better opportunities. It is important that campaigns and 'rebranding' is supported by alternative learning systems, i.e. aligned with the new culture and content that the sector wants to portray.
Reintegration	Alternative learning systems may be helpful to achieve reintegration or return-to-work: traditional systems are linked to traditional relations. Systems should build on 'support and confidence-building'.
Less represented target groups	Probably, approaches to change the culture in companies needs to start in the educational system. A new brand of a sector needs to start in educational programmes. Alternative learning should not reproduce 'old' gendering and non-inclusive culture.

Table 8.5 Needs of various skill levels and requirements from the analysis

Workforce transfer	Needs of various skill levels
Attractiveness to new entrants	Campaigns and rebranding may be biased toward people with higher education. It is important that all target groups of skill level are included in the messages.

Workforce transfer	Needs of various skill levels
Reintegration	Interventions for return-to-work need to be directed at all skill levels. Effectiveness of Alpha Cells proves it is suitable for this purpose.
Less represented target groups	These less represented target groups need to have opportunities in jobs at all skill levels. Currently, mainly management levels are too homogeneous.

Table 8.6 Lifelong learning aspects of skills segments of the workforce and requirements from the analysis

Workforce transfer	Lifelong learning aspects of skills segments of the workforce
Attractiveness to new entrants	Rebranding and campaigning among new entrants may profit from showing the possibilities of lifelong learning in the rail jobs. It is needed to adopt policies to make that a reality.
Reintegration	Lifelong learning programmes are a main prevention measure to make sure that persons do not get stuck into jobs with no future. These programmes help people coming back to develop a new perspective and limit the possibility of relapsing.
Less represented target groups	Groups less represented may need different learning trajectories to remain in jobs. These lifelong learning approaches need to take different trajectories into account.

These transfer of workforce mechanisms are needed to help the rail sector with new personnel in the future. From the above analysis, it is important to take the following points into consideration:

- Alternative learning systems and lifelong learning approaches should reflect the culture that companies want to install. They should take into account the issues with former systems and consciously correct for these tendencies (for example gendering). When developing these systems, follow earlier recommendations: equip for the future, try not to guess the future;
- Workforce transfer mechanisms may be biased towards specific skill levels. It is important that all systems are checked for bias toward specific skill levels;
- Lifelong learning needs to be developed in such a way that different trajectories are possible with different groups.

8.4 What should the rail sector try to come-up with as approach, using the six measures? What further development is then needed?

1. Continue with closer relationship between VET and company needs. Learn from the different countries about VET. The in-house training system with apprenticeships and graduate programmes in France, UK and Germany is recommendable, but is expensive for the companies. The need remains high for the sector to discuss with governments costs of in-house training and the great need for new recruits.
2. Share validated tests for assessing ICT-competencies.
3. Share information about assessing competences in current jobs to speed-up future roles and technology demands.
4. Keep an openness from companies to the VET- and academic system, even if most of the competence assessment and development of training seems to be an in-house effort. Keep investing into education too, not only in the company trainings. The maritime sector has shown that underinvesting in VET education has stalled development in companies.
5. Learn from practice, less from paper.

6. More support from companies for higher (academic) apprenticeships. A round-table needed for this.
7. Experiment more with skill-swapping schemes.
8. Built partnerships on new management simulation applications.
9. Develop alternative learning systems and lifelong learning approaches from the perspective of new groups or from the perspective and interests of less represented groups. This means that these systems should be flexible to account for the needs of these groups (and to attract these groups).
10. Reintegration needs to be used as a measure at all skill levels. Learning systems should be developed such that reintegrated employees can re-develop their career.

References

Andersén, Å., Ståhl, C., Anderzén, I., Kristiansson, P., & Larsson, K. (2017) Positive experiences of a vocational rehabilitation intervention for individuals on long-term sick leave, the Dirigo project: A qualitative study. *BMC Public Health, 17*(1), art. no. 790.

Argote, L., & Fahrenkopf, E. (2016). Knowledge transfer in organizations: The roles of members, tasks, tools, and networks. *Organizational Behavior and Human Decision Processes, 136*, 146-159

Argote, L., & Ingram, P. (2000). Knowledge Transfer: a Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes, 82*(1), 150-169.

Beckett, A., Douglas, M., Gabites, I., & Mackrill, P. (2014). Could introducing simulation into mandatory STCW short course programs be an innovative approach to assessing competence? (Conference Paper). In *15th Annual General Assembly International Association of Maritime Universities, IAMU AGA 2014 - Looking Ahead: Innovation in Maritime Education, Training and Research* (pp. 186-197).

Belev, B., Dimitrova, M., & Meczkowska-Christiansen, A. (2018). Refresher Training in Maritime Qualification (Conference Paper) (Open Access). *IOP Conference Series: Earth and Environmental Science, 172*(1), Article number 012022.

Chen, C.-J., Hsiao, Y.-C., & Chu, M.-A. (2014). Transfer mechanisms and knowledge transfer: The cooperative competency perspective. *Journal of Business Research, 67*, 2531-2541.

Dhondt, S., Kraan, K.O., Chen, T.M., van der Meulen, F.A., Islam, D., van der Zee, F.A. (2018). Socio-economic aspects of human capital: assessment of the state of play in employment in the railway sector. Deliverable 1a. Leiden: TNO

Dhondt, S., Chen, T.M., van der Zee, F.A., Islam, D. & Robinson, M. (2019). Analysis of Impact of S2R-innovation Programmes on Employment and Skills in the Rail Sector. Shift2Rail: CCA - Human Capital Deliverable D2. Leiden: TNO.

Emad, G.R. (2017). The need for improving assessment system in maritime education and training (Conference Paper). *18th Annual General Assembly of the International Association of Maritime Universities - Global Perspectives in MET: Towards Sustainable, Green and Integrated Maritime Transport, IAMU 2017, 1,* 136-143.

Eurofound (2018). *Adaptation of national apprenticeship systems to advanced manufacturing*. Luxembourg: Publications Office of the European Union.

Fernandez, V., Simo, P., & Sallan, J. (2009). Podcasting: A new technological tool to facilitate good practice in higher education. *Computers & Education*. Retrieved January 18, 2017, from http://www.sciencedirect.com/science/article/pii/S0360131509000645.

Fraszczyk, A., Marinov, M., & Woroniuk, C. (2012). Innovative Forms of Education in Rail Freight and Logistics. *4th International Scientific Conference on Transport Problems*. Katowice-Slemien, Poland. Retrieved January 18, 2017, from http://eprints.ncl.ac.uk/pub_details2.aspx?pub_id=185114.

Hanappi-Egger, E. (2012). Shall I stay or shall I go? On the role of diversity management for women's retention in SET professions. *Equality, Diversity and Inclusion, 31*(2), 144-157. (DOI: 10.1108/02610151211202790).

Hanappi-Egger, E., & Warmuth, G.-S. (2010). Gender-neutral or gender-blind? on the meaning of structural barriers in computer science and engineering. Joint International IGIP-SEFI Annual Conference 2010.

Harman, C., & Brelade, S. (2003). Doing the Right Thing in a Knowledge Transfer. *Knowledge Management Review, 6*(1): 28-31.

Kassar, A. (2106). Towards dynamic maritime education and training systems (Conference Paper). *2016 International Association of Maritime Universities - 17th Annual General Assembly,* pp. 19-25.

Lytras, M.D., Mathkour, H.I., Abdalla, H., Al-Halabi, W., Yanez-Marquez, C., & Siqueira, S.W.M. (2015) An emerging - Social and emerging computing enabled philosophical paradigm for collaborative learning systems: Toward high effective next generation learning systems for the knowledge society (Editorial). *Computers in Human Behavior, 51*, 557-561.

Marinov, M., & Fraszczyk, A. (2014). Curriculum Development and Design for University Programmes in Rail Freight and Logistics. *Procedia-Social and Behavioral Sciences*. Retrieved January 18, 2017, from http://www.sciencedirect.com/science/article/pii/S1877042814036222.

Moon, K.-K. (2018). Examining the Relationships Between Diversity and Work Behaviors in U.S. Federal Agencies: Does Inclusive Management Make a Difference? *Review of Public Personnel Administration, 38*(2), 218-247. (DOI: 10.1177/0734371X16660157)

Muhammad, I.F., & Yutuc, W.E. (2014). Use of virtual learning environments and cloud computing systems in maritime education and training: Issues and challenges (Conference Paper). *RINA, Royal Institution of Naval Architects - Education and Professional Development of Engineers in the Maritime Industry*, pp. 109-116.

Muhammad, I.F., & Yutuc, W.E. (2016). A study on the development and implementation of massive open online courses in maritime education and training (Conference Paper). *RINA, Royal Institution of Naval Architects - International Conference on Education and Professional Development of Engineers in the Maritime Industry*, EPD Volume September.

Nonaka, I., & Takeuchi, H. (1995) *The Knowledge–Creating Company - How Japanese Companies Create the Dynamics of Innovation.* New York: Oxford university Press.

OECD (1996). *The Knowledge-based Economy*. Paris: OECD. OCDE/GD(96)102

Pachl, J., & White, T. (2003). Efficiency through integrated planning and operation. In *Implementation of Heavy Haul Technology for Network Efficiency* (pp. 6–69). Virginia Beach: International Heavy Haul Association.

Roffel, J., & Ross, M. (2016). Levelling up: Progress from operator training to competency management (Conference Paper). American Fuel and Petrochemical Manufacturers, AFPM - AFPM Annual Meeting 2016, Pages 436-452.

Roffel, J., & Ross, M. (2017). New technology addresses operator training challenges(Conference Paper). *American Fuel and Petrochemical Manufacturers, AFPM - AFPM Annual Meeting 2017*, pp. 728-742.

Scott-Webber, L. (2016). Challenge: 4000 years of behavioral conditioning define the designs of face-to-face classrooms-next generation learning environments. In N.A. Alias, & J.E. Luaran (Eds.), *Student-Driven Learning Strategies for the 21st Century Classroom* (pp. 10-25). Hershey, PA: IGI Global.

Sellberg, C., Lindmark, O., & Rystedt, H. (2017). Training skills and assessing performance in simulator-based learning environments (Conference Paper). 18th Annual General Assembly of the International Association of Maritime Universities - Global Perspectives in MET: Towards Sustainable, Green and Integrated Maritime Transport. *IAMU*, 1, pp. 8-18

Senčila, V. (2015). Harmonization of professional and educational requirements for seafarers (Conference Paper). *Transport Means - Proceedings of the International Conference, Volume 2015-January*, pp. 302-305.

Skillful (2017). Best practice on current and emerging training schemes, methodologies and tools in the transport sector and mapping to future training requirements and scenarios' Deliverable 2.1.

Snow, K. C. (2012). How Service Learning is Integrated with Transportation Curriculum to Support Career and Education Development. 94th Annual Meeting of TRB (paper Submitted for consideration for presentation), Washington DC.

Sudhindra, S., Ganesh, L.S., & Arshinder, K. (2017). Knowledge transfer: An information theory perspective. *Knowledge Management Research and Practice, 15*(3), 400-412. doi:10.1057/s41275-017-0060-z.

Vogel, N., Schandelmaier, S., Zumbrunn, T., Ebrahim, S., de Boer, W.E., Busse, J.W., & Kunz, R.(2017). Return-to-work coordination programmes for improving return to work in workers on sick leave. *Cochrane Database of Systematic Reviews, 3*, art. no. CD011618. DOI: 10.1002/14651858.CD011618.pub2.

Watkins, K., La Mondia, J., & Brakewood, C. (2015). Developing a New Course for Public Transportation Education. Final Report. Project #2012-029S. Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE).

Wilson, G., Randall, M. (2010). Implementing and evaluating a "Next generation learning space": A pilot study (Conference Paper). *ASCILITE 2010 - The Australasian Society for Computers in Learning in Tertiary Education, Sydney: Ascilite*, pp. 1096-1100.

Winter, R.P., & Jackson, B.A. (2014). Expanding the Younger Worker Employment Relationship: Insights From Values-Based Organizations. *Human Resource Management, 53*(2), 311-328. (DOI: 10.1002/hrm.21600).

Annex 1 Overview of measures implemented by companies

1. Next Generation Learning: Examples from practice

Measure: SNCF Policy NGL

- *Organisation:* SNCF.
- *Goal:* SNCF is one of the major rail companies in Europe. This also entails that SNCF makes major investments in training and education. The company has a long tradition in training and educating its workers. For example, a lot of the training investment is conducted within the 15 internal rail training centres. As with most rail organisations in Europe, these centres have been used to deploy very standard class room based training approaches. Over the past years, this approach has been strongly adapted to more and more individualizing training and education. The goal is to use blended learning methods, modularised teachings, regularly (compartmentalized) assessments of competences, e-learning as elements of the NGL. Pre-assessments of competences of employees are important to direct the courses and the coaching. Learning from real practice is core to the whole approach: students need to pick up their questions from practice. This NGL is also present in the training and education of non-academic positions in SNCF. For example, train drivers are trained to be able to use a broader skills-set than in the past. Next to the traditional approach to focus on learning to follow the rules, all in a framework of more safety, a lot of attention is directed at helping train drivers to be aware of their customers and to communicate about what is going during the voyage.
  The whole development of NGL leads in SNCF to a new competences model. Not one method is best, but there is an insistence on blended learning. All the components of this NGL are now building blocks for a learning management system (LMS) that should help trainers and trainees develop better integration into SNCF-processes and into more adapted careers. The LMS helps to re-engineer the whole training methodology within SNCF.
- *Target jobs:* All jobs.
- *Timing:* Current practice.
- *Impact:* The new approach is very much at the core of the 15 training centres.
- *Lessons for technological skills gap:* SNCF is much focused at better identifying the development of the professions and the required skills. For example, the profession of the train driver will see a total new working context when ATO will be deployed. The train driver will be less a driver of the train, but more a surveyor of all what is happening on a train. This requires more focus on development of cognitive and awareness skills of the train driver. Train drivers need to constantly ask themselves if they have all the information for making correct decisions and to understand what to do to solve any doubt they have.
  SNCF encourages its personnel to broaden their skills sets and promotes adequate training. In particular SNCF invests in the development of digital culture and skills. It is necessary to have the resources prepared for the constant evolution in this area. All employees of SNCF are encouraged to acquire a digital passport that shows if their digital skills are up-to-date. This passport helps each individual worker to discuss with the employer new training or even new jobs.
- *Source:* interview SNCF.

Measure: RailNewcastle

- *Organisation:* Newcastle University.
- *Goal:* RailNewcastle at Newcastle University, UK, has implemented an innovative intensive programme in rail logistics co-funded by Lifelong Learning Program of the European Commission. This is an example of Next Generation Learning approach. The purpose of the intensive programme is to help nine higher education institutions to work together in developing an innovative course that promotes a multidisciplinary approach (students from different backgrounds) in rail freight logistics and combines various teaching and learning techniques (lectures, discussions, research projects, technical visits, workshops, seminars, etc.) (Fraszczyk et al., 2012). Also RailNewcastle offered an innovative curricula for an MSc in Rail Freight and Logistics which employed a flexible mobility-based hybrid model integrating subjects, teaching and learning methods from European Universities (UNEW, DICEA, VTU and HAW-Ingolstadt) (Marinov & Fraszczyk, 2014).
- *Target jobs:* Academic level logistics.
- *Timing:* Current practice
- *Impact:* Due to lack of a bare-minimum number of students enrolling for the one-year long MSc courses, it was suspended. The experience of running the course suggests that the railway companies are less keen to send their employees for such higher education.
- *Lessons for technological skills gap:* No lessons yet.
- *Source:* NewRail.

Measure: Role Based Capability training - Network Rail

- *Organisation:* Network Rail.
- *Goal:* As part of the NGL, the Role Based Capability (RBC) approach at NR (Network Rail) is one of the best examples how the learning and training has become individualized and personalized. The approach is mainly linked to the engineering roles needed to maintain the railway network in the UK. Technological change is an important driver for developing new approaches to maintaining and developing competence of engineers.
  The technical strategy of NR, much in line with what S2R sees as the technological future, depends on what the current engineering capability of NR is. It is important to keep track of and maintain the workforce to develop stronger capabilities. NR Training has developed the RBC programme to do just that. RBC has been tested in a proof of concept with the role of Section Planners in Wales. The objective of 'Role Based Capability' (RBC) is to provide an innovative competence and development system which develops a person's whole capability so that they:
  - Discharge their accountabilities within any relevant Means of Control (MoC),
  - Are developed for their next role, prior to promotion,
  - Practice required corporate behaviours: Challenging; Customer Driven; Collaborative; and Accountable.

  Ultimately the aim is to develop the confidence to challenge unsafe activity and can work more collaboratively in order to improve overall performance. Its components include Annual Capability Conversation, Action Learning and the Skills Assessment Scheme (SAS). The SAS uses a risk based assessment scheme to assess how much training is needed and under which regime such training should be conducted.
- *Methodology:* The RBC should lead to new training approaches and therefore starts with a new analysis of roles key functions within NR to understand the training needs. NR

needed to reassess existing capabilities within NR and to show what needs to be redeveloped as cognitive and behavioural competence, and engineering skills. Several steps are taken in the RBC-approach following the principles of ADDIE[9]:

- Analysis: there is a lot of emphasis on analysis. The start is a **reverse engineering** of how NR currently trains people in roles and then identifying what the core elements in role are. The role competence/skills requirement are reverse engineered and this delivers the learning needs. NR builds task scalars of what a sectional planner does and then defines the requirements for training. Learning material is identified using a systems perspective learning on what a planner does when thinking of the job from 'design to destruction'. A lot of work is put into that framework. A Professional Competence Matrix is used: competences of a person are mapped to roles. This helps to identify gaps and link training need to these personal gaps.
- Design phase: a learner journey is used to understand how a generation Y-person would learn. The learning is very much individualized and modularised: a lot of effort is invested into instruments for this individual learning (e.g., with a Moodle). This starts then with an initiation assessment on the Moodle. An outcome is the kind of mentoring and coaching support needed. The modular training makes elements of the training transferable to other roles if the skill/competence need is identified.

› *Target jobs:* Currently, 18 roles have been prioritized for the RBC.

› *Timing:* Current practice

› *Impact:* To develop these new profiles, NR has used the experts in each of their respective fields: this means that engineers have been made available to co-develop the profiles. The proof of concept of RBC was piloted in Wales. The RBC has been developed by using visits, questionnaires and assessments. The process started with what the all the good practices were in the job of the Section Planners in the Wales route. Questionnaires were answered by about 70% of participants to identify what they needed to be doing in their job. All of the skills sets were mapped, all of the training material, methods, modules and how to deliver the training. For assessing if a worker is able to perform the roles of a section planner, a manager can assess current capabilities up to a level-3. Above this, experts need to be engaged to evaluate if someone can perform the roles. The RBC program is currently not funded to deliver the training either internally or externally. The programme results (the course/training material) could be made available to training providers when an internal NR customer (Route) funds the training. Network Rail Training (NRT) will aim to offer the training to internal NR customers in the first instance. There is currently a disconnect in NRT's ability to deliver training versus the potential customer need - i.e. not enough training resource to deliver "face2face" training hence alternative training solutions are also being developed by NRT.
The major NR-**routes** (sub-organisations of NR) are going to be the customer for NR Training. The routes will have the funding and NR Training needs to sell itself to the routes.

› *Lessons for technological skills gap:* The technology change is one of the drivers to start redeveloping the training needs at NR. As far as the methodology is applied to more jobs, NR will have a strong methodology to better attune competences and skills to the new technological requirements.

› *Source:* Interview Network Rail.

[9] ADDIE is an instructional systems design (ISD) framework that many instructional designers and training developers use to develop courses. The name is an acronym for the five phases it defines for building training and performance support tools: Analysis, Design, Development, Implementation, Evaluation.

Measure: TechniekFabriek at Nedtrain

- *Organisation:* NedTrain (now: NS Operation, a subsidiary of NS).
- *Goal:* The TechniekFabriek (TechnologyFactory) consists of a partnership between 4 Regional Education Centres (ROCs (VET); secondary schools) spread across the country, focusing on seven training directions (mbo levels 2-3-4; secondary professional level degrees) and linked to nine NS learning locations. In 2017, some 500 participants were involved in the learning activities. First action to develop the TechniekFabriek started in 2011. The reasons for setting up TechniekFabriek 2011 were a large outflow non-academic professional (mbo) staff in a tight labour market, the economic situation at that time and the fact that students from the ROCs did not meet requirements. In previous years there was little attention to basic knowledge and skills, which led to delays in getting new personnel to work. An employee engagement study in 2010 showed that employee satisfaction with respect to training was low. Other factors were also driving the development of a new training approach: the intake of new material (train) types (Flirt, SNG, ICNG) required broader and different (basic) knowledge and skills from employees; changes in legal requirements requested at least mbo-2 diploma required on the labour market; the outflow of personnel at NS was greater than the inflow, which meant that shortages were expected. More importantly, pupils who came in from the ROCs as (apprentice) mechanic at NedTrain were not directly employable, they did not meet the requirements. There was a need for quality improvement and central control.
  In the period 2012-2015, in addition to TechniekFabriek for inflow of non-academic technically trained students, three other training programs were also set up: Web on Rail, Starway, Qualified Working R & D for current employees. The mbo-programs were conceived as a broad programme, consisting of train technology and other technology requirements. The tasks conducted by professionals in the train environment are the building blocks and formed the common thread in the training:
  - Trainings are focused on technical content (Mechatronics), business context and on attitude & behaviour. Each learning trajectory in a ROC provided job guarantee for each student as a junior mechanic;
  - Web on the Track (WOS): another Mechatronics training;
  - Qualified working R & O: aimed at mechanics, electro-technicians, painters and machining experts;
  - Starway for service technician electrical engineering and fitters;
  - Learning trajectories are only mbo training, without NS courses.

  In all models the step to ***Next Gen Learning*** was taken, making sure that professional practice should be the start of learning according to the 70-20-10 format. All training should be done in a hybrid learning environment: "Learning to work, working to learn", you learn mainly by doing. A hybrid learning environment is a training in which a school is connected to the professional practice, with the real job of a mechanic as the starting point for learning. The approach is seen as an integral, collective approach to learning: learning = working = learning, and this is the basis for a (workplace) learning organization. Next Gen is not the standard yet: the courses for mechanics such as 'Web on the Track' and 'Qualified working R & D current employees' follow an education method that is still mainly focused on the class room. In projects, there is increasing attention for adjustments towards the hybrid learning environment.
- The advantages of this new approach are:
  - Practice and theory are brought together as close as possible; learning trajectories are carried out in the context of Operation;
  - The TechniekFabriek manages the ROCs partnership, the Learning Center, Operation, QHSE. The intention is to unburden the NS Operations by reducing roles for

operation and reducing costs through structural programs with ROCs. The following figure shows the vision of the NS;

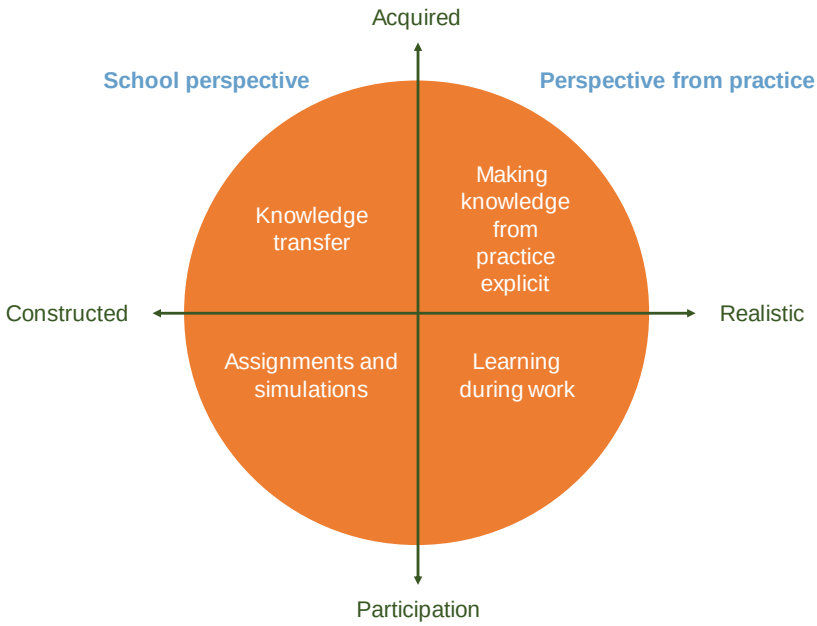


Figure A1.1 NS-Next Generation Learning philosophy: basic principles

- The whole approach also leads to a different professionalisation of teachers and practice. It is necessary to continue this mind shift in training. Teachers, learning guides, practical training, the TechniekFabriek, and practical instructors in Operation, each have their own expertise, and together they form a logical whole for students. The coaching takes place from a coaching role, conveying company perspective and expectations. The practical didactics provide other competences and skills than just instruction.
- Inflow, throughflow and tailor-made secondary education is created by putting together arrangements based on professional tasks.

› *Target jobs:* Mechanic jobs, maintenance, electrotechnicians, painters, but mainly for youth at a distance of the labour market.
› *Timing:* 2011 and on-going.
› *Impact:* In the past years, some 1,000 employees qualified following this new approach. Success and promotion rates are very large. There are now 35 trainers and about 35 employees from the operation involved in the training. The whole is supported by a subsidy from the government (+600,000 Euros in 2016). With this flexibility, the withdrawal of personnel to the operation, and thus the costs, is minimized.
› *Lessons for technological skills gap:* The approach has helped Nedtrain to improve its schooling system for specialists to deal with the new materials and ICT-revolution it is confronted with.
› *Source:* NS-interview; internal documents.

Measure: Next Gen Learning (NGL): the degree of individualization of training and the skills fitness-test

› *Organisation:* DB.
› *Goal:* In NGL, DB Training has concentrated on better understanding how learning in the work situation takes place, how digital tooling needs to be connected to other approaches.

Training contents have been modularized to fit this understanding. This has led to some innovative strategies. The training situation at DB is that DB is a huge company with many divisions and occupations. At the same time, in the German rail world, one must be aware that a lot of people do not have access to email, tablets, etc. These people will not be ready for totally digital content. This context is important to understand the specific approach of NGL at DB Training. DB Training has refocused its training services drastically over the past years towards more individualized trainings, using the combination of different kinds of digital and non-digital methods. The approach to NGL at DB Training consists of several parts:

- Designing to needs: the development of new trainings always starts with identifying the characteristics of a target group for which a training is needed. What is their access to education, how can they learn, how does the hardware look alike? The second important thing is that in training DB Training tries to avoid to have users learn the things they do not need. Learning not necessary things is a show-stopper: users are easily irritated by over-supply of content. NGL needs to be real learning, and needs to be applied. This means that the training needs to touch the 80% of daily business: the training content needs to improve the daily performance, the rest is of the training content needs to come in on the job work. For this, the starting point is identifying small tasks that are trained, and these are put in the flow of the training. *For example: yearly re-certification for Train Drivers (Rangiere) is a requirement and this needs to be done with a training. This new training solely focuses on new content since the last training the drivers have had. Then they follow electronic testing (easy process). The rest of the (required) knowledge about safety, etc. is assumed to be there. This allows a limited time of 3-4 hours training package for train drivers. If you pass the training, the certificate (yearly license) is added to your personnel file*;
- Demand-driven training: DB Training offers a catalogue of possible trainings. People interested can choose. Such trainings are always max. 50 min, and offered on a learning platform. Within Central DB (excluding DB Schenker), there are some 220,000 employees. Some 120,000 of them have an account on this catalogue. The plan is that the whole of DB will have access to the catalogue in 2019. The trainings in the catalogue are planned and modularized. Everyone can apply for any training, as long as their manager agrees with the costs.

To find the right training, DB Training has invented a specific 'fitness test' that helps identify skill gaps. The procedures is that an employee can conduct the test and receive a personal feedback, with no other feedback to anyone (also not to the manager). An employee needs to complete 40-50 questions (randomized). The test indicates which gap exists and indicates which courses help to close the gap. The training can be long, short, connected to certification, etc. In 80% of the training, a blended training (face-to-face, digital) approach is used. This whole approach allows that the training selection is not affected by topics that are not needed.

- *Target jobs:* All jobs within DB.
- *Timing:* Current approach.
- *Impact:* DB Training focuses on having the trainings as much aligned with the required competences.
- *Lessons for technological skills gap:* The skills fitness test allows persons to better identify which training they need. The fitness test has made that training content is broken up into different content parts. In the past, bigger content parts were offered: but this is an expensive approach. Now, knowledge parts are broken up to a modular level. To understand what the need is of an employee, he or she needs to complete all relevant questions. The newness of this approach is that skills are connected to training content.

The training methodology is currently applied to 3 domains: digitalization, operational excellence, and enabling people. These domains cover 150 different contents. Behind the content, there is an extensive skills matrix. Employees can complete three fitness checks with each 50 questions. The novelty of the DB Training approach is to identify the skill matrix and to put it into the system, connected to training contents. This connection changes every second.

The challenge in NGL is not so much the content, but the set-up between the skill, the training content, and the training method. The method depends on the learning target, you need to use the best approach. DB Training wants to grow this system in the next years.

The importance of this system is that it allows to be connected to the major changes in jobs, connected to technological change. Employees, for example train drivers, are currently recruited, knowing that these jobs will disappear in the future. These employees can be made aware of these changes and helped to prepare for the transition in the future.

- *Source:* Interview at DB Training.

2. Next Generation Learning: Learning from other sectors

Measure: NGL in the process industries: operator training simulators

- *Organisation:* Honeywell Process Solutions, ON, Canada.
- *Goal:* the goal of the methodology is to use operator training simulation to develop operator competency. For the process industries, the main goal is to have people trained fast and right. This has become difficult because of faster technology changes (new control rooms look different with those of ten years ago), but also by changes in personnel composition and with changing expectations of younger worker. An extra complication for the process industries is the fact that many unsafe situations cannot be replicated in a training situation. For the process industries, simulation is an important methodology to use. The maturing of technologies such as augmented reality, virtual reality and photographic techniques provide new opportunities to replicate real life situation. The main issue with operator training simulator systems is that of the 3 functional components in such a system (the process simulation, the operator's control environment, the tools and content used by instructors to deliver training), the training model is in need of improvement. Honeywell has developed a new technology to better describe the pre-training needs for basic process and control knowledge.

  Through a combination of new technologies (virtual, augmented, distance) and a competency management approach, organizations can enhance students' learning experience in the contexts of new recruiting and of continuous professional development. The use of KPI-based feedback is essential to help identify performance gaps and provide opportunities for active interventions. Gamification techniques and traditional challenge and response scenarios provide a richer experience for teacher and student alike.
- *Target jobs:* Process operators.
- *Timing:* Current.
- *Impact:* The operator training simulator allow to train dangerous situations without have to be in the situation. The technology has been fitted to the new learning and training methodologies.
- *Lessons for technological skills gap:* The new required skills can be broken down in the right components and can be trained in shorter time and in a more adequate training approach.

- *Source:* Roffel et al. 2016, 2017; Honeywell Process Solutions website[10].

3. Virtual Learning: Examples from practice

Measure: Moodle e-learning system at Network Rail

- *Organisation:* Network Rail.
- *Goal:* Network Rail had replaced its Oracle based Virtual learning system by a Moodle eLearning Platform. Non-NR users still have access to the Oracle based elearning system to complete NR eLearning and online assessments. Next to these virtual environments, most of the training of NR remains class room based or on 'made-up systems' (mock-ups).
  The Virtual learning system[11] collects a series of personal data to evaluate the progress of training: eLearning training courses (including enrolment, completion status, test scores); User activity (details of first access and most recent access); Role in Training Centre (e.g., trainee or Training Manager); Training events and types of events which the user has permission to access.
  Individual users have the ability to update the personal data in their own profile. Personal data can also be updated by the individual organisations which manage their employee's details. Network Rail ensures that Personal data will not be transferred outside the European Economic Area and will not be shared with any third parties except Atlassian.
- *Target jobs:* All jobs.
- *Timing:* Available on the internet.
- *Impact:* There are some 55+ courses available on the system. This is only a small part of the total amount of trainings available at NR (>800).
- *Lessons for technological skills gap:* From the Network Rail Training catalogue, it seems that no courses are available to support technological competences. These competences are mainly trained in the classical class room setting.
- *Source:* Interview Network Rail.

Measure: Digital tools - SNCF

- *Organisation:* SNCF.
- *Goal:* Employees are supported by several digital tools. Operators can use their smartphone to diagnose operational situation. The smartphones help employees with right course of action since 2014. SNCF is insistent on its suppliers to deliver all products and services with digital tooling. Interesting sources can be found at: https://www.digital.sncf.com/ressources.
  SNCF has been using digital tools over a long period of time to train employees. One of the first examples are the 'train driving simulators'. SNCF continues developing other digital tools to support training.
  The company uses 3D- and augmented reality to help personnel to appropriate the environment, the gestures and actions. In maintenance and traffic management jobs, for example, such training modules are readily available. Such tools are aimed to reconstruct real-life working situations and help operators acquire the right skills and behaviours. Operators not only learn the content of the task, but also to understand impact of actions.
  Another example is that employees are supported by several digital tools. Operators can use their smartphone to diagnose operational situations, have access to the documentation and safe the result of their action.

[10] https://www.honeywellprocess.com/en-US/Pages/search-results.aspx?k=roffel&start1=1.

[11] https://elearning.networkrail.co.uk/login/index.php.

SNCF is currently experimenting with digital matching tools to evaluate the competences of its employees. Employees are motivated to use these matching tools. They need to report their motivations for tasks, benefit from personality tests, etc., all information required to build a personal profile. This profile is used to help compare the abilities of employees with their current job requirements, but also with other job profiles. The profiles help the employee to start thinking about their career path and the development of their competences . The matching tool uses algorithms developed by suppliers. Trade unions have been engaged in the development of these tools. The whole tooling is supportive of the employability of SNCF's workers.

- *Target jobs:* All jobs.
- *Timing:* Current.
- *Impact:* Not available, but the digital-website acknowledge an enormous user base of the digital tools (SharePoint, social media, Yammer).
- *Lessons for technological skills gap:* The tooling has however not yet been used to prepare employees for future technological changes. Prospective tools are difficult to build.
- *Source:* interview SNCF.

Measure: App Mijn Vakmanschap

- *Organisation:* NS.
- *Goal:* An App available to all technical personnel of NS. The App 'My profession' offers all the information needed for each operator, extracting relevant information from the relevant technical area. The App is installed on all mobile phones delivered to NS-personnel. It offers news messages, the possibility to check major manuals, offers videos to describe materials used. The app allows for push-messages to employees to help them keep their knowledge up-to-date.
- *Target jobs:* Train drivers and main train attendant.
- *Timing:* Current.
- *Impact:* All (relevant) personnel uses the app. The app is now available to 4,000 employees. Evaluations are only available in a couple of months.
- *Lessons for technological skills gap:* App allows to collect manuals, guides, regulations. Supportive information is readily accessible for any operator.
- *Source:* NS interview.

Measure: eLearning, MyLearningPortal and simulation at NS

- *Organisation:* NS.
- *Goal:* The use of eLearning as an instrument to support training needs within the organisation. The tool is used for a great number of jobs, so just only the major principles of the current approach are described. NS uses a Learning Portal (MyLearningPortal) to offer e-learning modules. Examples are management training, other professions. Candidates need to register through the MyLearningPortal to follow an e-learning training. On the basis of various pillars offered in the learning portal, a learning process is developed. Training courses are structured in such a way that they allow to achieve different levels of the intended learning outcome. Within each module, tasks are then developed that are important in the development. In practice, the following steps can be taken:
  - The participant registers for an intake, after approval by the manager;
  - The participant is linked to his/her learning path in 'My Learning Portal' (including the specific parts of his/her work area);
  - During the intake, agreements are made about which modules of the learning trajectory are being followed and at what time. On the basis of:
    - Existing experience and expertise;
    - Priorities in the work;

  - Compulsory parts (for example in the context of License to Operate/competent);
- Each module starts with a digital self-scan;
- Each module contains a range of learning interventions with the emphasis on 'learning in the workplace';
- Supporting information is offered on local webpages.

This means that learning trajectories consist of a combination of (1) business-guided assignments, (2) learning centre/business-supervised trajectories and (3) self-study. The first component consists of practical situations, workplace assignments, practical days, discussions; the second consists of training/teaching days and simulation days; and the third consists of e-learning. E-learning consists of following all offered modules and video instructions. Such modules for self-learning consist of ‘learningsnacks’ (short videos), manuals, assignments, PowerPoints and self-tests. Self-tests help to monitor progress. Depending on the qualification trained, students can apply for Acquired Learning Qualification (Dutch: EVC) or certification by external certification centres.

Depending on the needs of the organization, a strict procedure is used to develop new modules and training courses.

The simulation-part in some trainings, is inserted depending on the topic that needs to be trained. For example, for the ERTMS-qualifications, train drivers are trained on simulators at the training centre in Amersfoort.

E-learning is also used in blended courses. For example, using TrainTool to develop specific safety communication skills and to secure sufficient retraining. Certification and testing is part of such blended learning.

› *Target jobs:* Any job.
› *Timing:* Current practice.
› *Impact:* The procedure to develop such trainings and tools is strictly monitored. The payback time is clear, so no over-supply exists. The impact of each learning intervention is measured with the Phillips Evaluation Model (5 levels) and NPS (Net Promotor Score). Scores are confidential.
› *Lessons for technological skills gap:* Depending on the issue, new modules can be offered.
› *Source:* NS interview.

4. Virtual education in other sectors

Measure: Simulation of Sea Traffic Management

› *Organisation:* STM.
› *Goal:* Sea Traffic Management connects and updates the maritime world in real time, with efficient information exchange. Through data exchange among selected parties such as ships, service providers and shipping companies, STM is creating a new paradigm for maritime information sharing offering tomorrow´s digital infrastructure for shipping. STM-services allow personnel on-board and on shore to make decisions based on real-time information. These services enable more just-in-time arrivals, right steaming, reduced administrative burden and decreased risk related to human factors. Example of services are: Route optimisation services; Ship to ship route exchange; Enhanced Monitoring; Port Call Synchronisation; Winter Navigation. STM´s aim is to create a safer, more efficient and environmentally friendly maritime sector. Sea Traffic Management will overcome many of the challenges of communication and information sharing between stakeholders in the maritime transport industry. It will create significant added value for the maritime transport chain, in particular for ship owners and cargo owners.

The project also has a collaboration between 11 schools and 30 ship bridges, to make

the simulation a multi-person event. The simulated environment allows for shipping 'against' a multitude of partners with data-exchange between shores and ships. The training situation allows for comparison between real-life practice with the simulations. Trainees get to have better training on the simulators.

- *Target jobs:* Sea farers, port management.
- *Timing:* Project runs up to 2030.
- *Impact:* The three-week training within the STCW-rules allows to reduce parts of the 365 required training, from 60 days to 3 weeks. The training also allow to compensate for the shortage in apprenticeships that the educational system requires.
- *Lessons for technological skills gap:* The project learnt from the Air Traffic Management System-project. The project is mainly about the changes in operational performance within the ports and shipping lanes, based on better communication technologies. The project has calculated the benefits for the network, the practice will only be visible in 2030. For the operators, the change will mainly be from reporting jobs to actually dealing with information and enlarged decision making. Situational awareness is crucial.
- *Source:* Website http://stmvalidation.eu/about-stm/.

Measure: Virtual tools in Maritime Education Training

- *Organisation:* Several.
- *Goal:* Virtual tools in Maritime Education Training have been evaluated in a great number of articles. The main results of these studies are:
  - The maritime sector has a strong tradition in developing virtual tools for learning. Given the fact that seafarers need to update their knowledge in at-distance-settings, a lot of experience has been accumulated over time of learning experiences;
  - The set-up of trainings and simulations need careful attention. Not only pedagogical principles are important (source), also the instructions and debriefing need to be well-developed to enhance students' professional competences. Technical and non-technical skills can and need to be evaluated at the same time (Sellberg et al., 2017);
  - With the maritime industry's mindset focused on competency development of shipboard personnel through practical training, the value of virtual systems may not be fully realized. VLEs and CCS brings the advantage of exposing the students to a higher level of computing skills that can be transferred relatively directly to new technologies used in the maritime and shipping industry plus having the benefit of providing instruction in a flexible manner with varying time and location autonomies (Muhammed & Yutuc, 2014).

  The maritime industry tends to underinvest in the new learning tools, relying on improving performance of the sector in the current period, that may be temporary effect, and possible short-term negative effect of investment costs for instruments such as MOOCs. The advice is to count of the probable future benefits of such tools (Muhammed & Yutuc, 2016; Beckett et al., 2014).
- *Target jobs:* Sea farers, port management.
- *Timing:* Current research.
- *Lessons for technological skills gap:* Tools are usable for technical skills.
- *Source:* See authors.

5. Access to education: Examples from practices

Measure: Newcastle College Rail Academy

- *Organisation:* University of Newcastle.
- *Goal:* The Newcastle College Rail Academy offers a unique training environment to help the rail sector meet its skill shortages by providing a range of specialist training dedicated to rail infrastructure. The purpose-built facility contains a number of real working environments with industry standard equipment and resources to train technicians and engineers for signalling, telecommunications, electrification and plant, P-way and safety critical operations all under one roof. The courses are specifically focused on employers to deal with skill shortages and specific training needs.
- *Target jobs:* Technicians and engineers for signalling, telecommunications, electrification and plant, P-way and safety critical operations, at professional and academic levels.
- *Timing:* 2018.
- *Impact:* The courses are focused on new and current personnel of rail companies. It allows companies to get access to new talent.
- *Lessons for technological skills gap:* Specialist knowledge supplied to counter major changes.
- *Source:* Website.

Measure: University of Birmingham Rail Academy

- *Organisation:* Birmingham University.
- *Goal:* At the University level education, Birmingham University offers the following undergraduate degree courses (Civil and Railway Engineering BEng; Civil and Railway Engineering Meng; Electrical and Railway Engineering BEng; Electrical and Railway Engineering Meng) and Postgraduate degree courses (Railway Systems Engineering and Integration Masters/MSc/Diploma/Certificate; Railway Safety and Control Systems Masters/MSc/Diploma/Certificate; Railway Systems Integration MRes; Scholarships in Master of Research in Railway Systems Integration; PhD opportunities in the department of Civil Engineering; PhD opportunities in the department of Electronic, Electrical and Systems Engineering). The university offers continuous professional development, for example new in 2018: a course on principles of railway control systems (basis for professional signalling engineer status).
- *Target jobs:* Broad range of engineering jobs.
- *Timing:* Continuous programme.
- *Impact:* Courses are adapted to needs. New course is focused on EU-developments, but also ATO-operations, etc. Unclear how many students are following courses.
- *Lessons for technological skills gap:* Programmes are adapted to needs of industry. ATO is in focus.
- *Source:* Website.

Measure: Graduate studies at Network Rail

- *Organisation:* Network Rail.
- *Goal:* As part of the Apprentice levy more training will be undertaken at UK Government Levels 4,5,6 and 7 in Network Rail. Network Rail operates a number of Graduate Training Schemes, recruiting graduates from university post award. Network Rail offers a range of programmes that meet national standards and are accredited by a university, college or professional body. Network Rail provide job-related training at all levels, including: Masters degrees; Bachelor degrees; Professional Diplomas; Higher National Diplomas (HND); Higher National Certificates (HNC); National Vocational Qualifications (NVQ).

Network Rail (NR) offers two overarching routes for **graduates** and, after joining, graduates are able to follow any number of different career paths. The first is an engineering study at Network Rail. Within engineering, NR has three specific schemes: Civil Engineering, Electrical and Electronic Engineering, and Mechanical Engineering. The emphasis on the Engineering graduate training scheme is to support graduates professional development to work towards achieving Eur Eng., I.Eng or C.Eng with their PEI as soon as possible. The second is Business management at Network Rail. In business management, NR has a number of different schemes available: Finance, General Management, Health, Safety and Environment, Human Resources, IT and Business Services, Project Management, Property and Supply Chain management. The Engineering graduate training scheme has prerequisite requirements of a graduate obtaining a Professional Engineering Institution (PEI) accredited Engineering degree at 2:2 or above. Network Rail manages more engineering projects and employs more specialists than any other British organisation. NR do not necessarily fund these graduates during their Degree education but the Engineering graduate training scheme (2 years) follows a program that allows graduates to obtain relevant experience from around the business with supporting courses & training. Interestingly, the graduate programmes also include welcome bonuses to new candidates.

- *Target jobs:* All jobs in the network technology, channelled through 11 graduate schemes.
- *Timing:* Continuous programme.
- *Impact:* The programme is an in-house programme and tries to attract new talent. The number of graduates has risen over time from 89 in 2014/15 to 160 in 2017/18 and to 153 to 2018/19. Aligned to this programme is the action to develop a skills agenda and to plan the workforce in a strategic way. NR is engaging the technical universities and is working with the Government' actions for technical education. Effort has been made by NR to offer training material (specialist campaigns for Level crossings for example) but not to undertake formal training in schools. NR are influential in curriculum development for University Technical Colleges that they engage with, including the setting and assessing of projects, as well as leading on a number of apprenticeship standards in terms of content and delivery. NR is the Panel Chair for the Institute of Apprenticeships (part of the Department for Education), leading across the Transport & Logistics sector involved with the future technical-levels for colleges as well as apprenticeship standards to give them parity of esteem.
- *Lessons for technological skills gap:* The graduate programmes are aligned with the technical needs of NR. Employers influence the content of the programmes.
- *Source:* Website, yearly reports.

Measure: Collaboration agreements with Secondary (VET) Schools in the Netherlands

- *Organisation:* NS.
- *Goal:* NS develops agreements with secondary education facilities to attract new students and perform specific trainings. In such an agreement, NS tries to align the interest of the educational facility with their own interests and to shift trainings to the vocational educational institutions. This is not always easy to accomplish. Achieving such an alignment brings substantial savings for NS. The educational institutions do however have its own policies. This may affect the outcome of the education. Students may finish their education without sufficient qualifications. Important in this respect that these collaborations arise in the context of new Dutch legislation that obliges VET-institutions to ensure students finish with a diploma. For companies such as NS, it is important that the quality of the training given by these institutions responds to the needs of NS.
- *Target jobs:* E.g., train drivers, service machinist.
- *Timing:* 2017-18.

- *Impact:* Costs for training a student is very high for NS. Having the schools take care of the training is a great benefit for NS. NS sees the collaboration as quite effective.
- *Lessons for technological skills gap:* Trainings are directed at specific occupations. Quality of the training is important to achieve the skills needed.
- *Source:* NS interview.

Measure: Collaboration in Dutch rail sector for secondary education

- *Organisation:* Railcenter and VET-schools.
- *Goal:* In regular education, rail-related training is very weakly represented. Due to the relatively small size of the need for personnel, it is not worthwhile for a VET-school (ROC) to set up a track-oriented vocational training. The volume of students is just too low. The only exceptions are the secondary school training (mbo) for train drivers that now runs at three VET-schools and the TechniekFabriek. The visibility of the rail sector in mainstream education and therefore as a potential employer is low. The objective is to create a better cooperation between educational institutions (VET) and rail companies for schooling that is more aligned with the interests of the companies. Different secondary professional schools provide training for a set of railway related jobs. The most important training is that for train drivers. Other actions are:
  - *Minor Introduction Rail Technology:* ROC Midden Nederland and Railcenter; TechniekFabriek: NS and the ROCs of Twente and Amsterdam work together to train students to be mechanics (mbo level 2). The students follow a total of 2 years in-house training at NS, during which they engage in practical learning. They receive professional training, a bursary in the first year, a salary in the second year and a 100% employment guarantee upon receiving their diploma;
  - *Choice for Rail Technology part:* Collaboration between different companies and several schools;
  - *Experience days:* An important action is to provide sufficient contact between companies with possible interested youth. These actions are also oriented at non-technical higher secondary schools (Artcadia, Imagine your future: 135 schools).
- *Target jobs:* Professional technology jobs and train driving.
- *Timing:* Continuous action.
- *Impact:* The initiatives have been quite successful in attracting sufficient new students and reaching a great number of students with the campaigns. The trainings are different from the past, ensuring more in-company experience for students. A discussion point is the alignment of the trainings with the requirements from the educational system (CREBO; SBB-certification). In October 2018, the Introduction Rail Technology optional part starts at ROC Midden Nederland. This optional component (counterpart of the minor but at secondary vocational level) was set up by Railcenter together with the contractors. There are 25 places offered and 30 young people have applied. The training takes place at Railcenter and at the companies. The pupils even go on a night shift with a mechanic. This allows a good picture of the work and hopefully leads in the future to an application at one of the companies in the railway sector. Sector-specific training would obviously be great, but there is insufficient volume for specific technical training. Only for train drivers, given the size of the target group, is it worthwhile to set up a regular vocational training program. In addition to this vocational training, NS also trains drivers themselves.
- *Lessons for technological skills gap:* Mainly focused on enlarging the supply of newly trained students. The better connection with companies during the schooling helps to make the students more aware of the technological challenges ahead, as an incentive and as a benchmark to test their knowledge. The trainings provide new technical talent to the sector.
- *Source:* Interview Railcenter; https://www.s-bb.nl/node/61404/spoorbouw.

Measure: Minor Rail technology at UAS Utrecht

- *Organisation:* University of Applied Sciences Utrecht (HU Utrecht).
- *Goal:* In regular education, rail-related training is very weakly represented. As with VET-schools, it is not worthwhile for a Bachelor-education (Hogeschool) to set up a track-oriented vocational training. The volume of students is just too low. The visibility of the rail sector in mainstream education and therefore as a potential employer is low. In order to increase visibility, a Rail minor track technology has been set up together with Utrecht University of Applied Sciences. The minor now runs for the sixth year, in which teaching is mainly done by specialists from the sector. The companies supporting the training, sponsor a visit of students to major international train fairs such as Innotrans. Companies such as Strukton provide students with a clothing package (helmet, safety shoes, jacket, etc.).
- *Target jobs:* All jobs, at least bachelor-level.
- *Timing:* Start September 2018.
- *Impact:* This year, more than 20 pupils will follow the minor. The success of the minor for the railway sector is demonstrated by the fact that over 60% of the previous participants work in the railway sector.
- *Lessons for technological skills gap:* The trainings provide new technical talent to the sector.
- Source: "ProRail (2018). ProRail aangesloten bij Trainbow. (www.prorail.nl/inhoud/prorail-aangesloten-bij-trainbow)."

Measure: Apprenticeship and training schemes at Network Rail

- *Organisation:* Network Rail.
- *Goal:* Include on-the-job training in companies and apprenticeship programme. Network Rail's (UK)[12] operates 26 modern training centres across the UK. Network Rail strongly believe that it's vital to get each individual's training programme just right. That's why they have set up own state-of-the art training and development centres, with almost all training and developments delivered by own people (i.e. in-house).
- *Target jobs:*
  Example - Railway maintenance training
  Network Rail maintenance workers inspect the condition of track, fences, structures, electrification plant and signal equipment on the railway, then make any necessary repairs. Network Rail runs 11 maintenance training centres across the UK, with currently 110 trainers who are all former maintenance workers themselves. All of those attending training learn how to work safely, and then take specialist courses for their specific roles.
  Example - Training of signallers
  Before starting work, each of the signallers completes a 12 week training course. It's mostly classroom-based training and education but with some real signal box experience. For this, Network Rail have two training centres in Watford and Leeds, where signallers get the most up-to-date training, including computer-based materials and signal panel simulators.
- *Timing:* 2018.
- *Impact:* The number of trainees is now at 814 apprentices in 2018/19, including 145 female apprentice starts. Since 2005, there have been more than 3,000 apprentices of which 75% haver remained at NR. The idea is expand the range of trainings to higher degree level programmes.
- *Lessons for technological skills gap:* Growing supply of technically schooled students, aligned with company interests.

[12] https://www.networkrail.co.uk/careers/training-and-development/.

- *Source:* Interview Network Rail, yearly reports.

Measure: Apprenticeship at Arriva[13]

- *Organisation:* Arriva.
- *Goal:* At Arriva over 60,000 colleagues working in many cities, towns and regions. They do all kinds of jobs, in a variety of settings. Every Arriva employee is part of a global team of people. Together, they provide a range of high quality, good value transport solutions based on finding new ways to improve our customers' journeys, while reducing the impact of transport on the environment. Arriva has roles for drivers, engineers and conductors as well as finance, commercial and human resources positions within our local businesses or at our headquarters. Arriva offers development programmes from the very start of the employees' career. The Arriva apprentices work across its business while receiving specialised training. The apprentices are guided and mentored by senior specialists (i.e. in-house training) and get to know the company from the ground up. At the end of the apprenticeship, they will gain a recognised qualification and have the opportunity to continue your career at Arriva. Typically, apprenticeships at Arriva last between 1 and 4 years and focus on technical and operational areas such as: Stations, Fleet, Engineering, Planning, Finance, Ticketing, Office administration, Bus driving. The Arriva Graduate Programme is a 18 month scheme developed to attract and develop future leaders.
  During the Programme, Arriva's graduates will have to attend international graduate events and training modules, work on assignments with fellow graduates, and have the opportunity to meet Arriva's senior managers. They will receive coaching, career support and have a personal mentor who will track their development. They will also become part of the Graduate Club, which is an international network of Arriva Graduates.
- *Target jobs:* All jobs within Arriva.
- *Timing:* 2018.
- *Impact:* Arriva claims that if someone is an ambitious and a good performer, the graduate growth opportunities are limitless at Arriva. Arriva is as good as the people who work here. Arriva is proud of having committed team and believe that together they are always focused on the future. Numbers are unclear.
- *Lessons for technological skills gap:* In line with new apprenticeship in development in UK.
- *Source:* Website Arriva.

Measure: General policy at SNCF

- *Organisation:* SNCF.
- *Goal:* For SNCF, there is not really a great attention to this kind of measure in this sense that SNCF already possesses a broad scale of trainings and educations, fully operated from SNCF side. Any student can find SNCF-backed training needed to work at the organisation. Further, SNCF follows the French legislation for certification and job profiles. The company foresees that certification of acquired skills may become an important instrument in the future. Employees are offered new approaches to get their skills and competences valued and recognized. This procedure has been developed and is under implementation.
- *Target jobs:* All jobs.
- *Timing:* Current policy.
- *Impact:* Not clear, no figures available.
- *Lessons for technological skills gap:* No information available.
- *Source:* Interview.

[13] www.arriva.co.uk.

Measure: Apprenticeships and other access to education measures at DB

- *Organisation:* DB.
- *Goal:* On a yearly base, some 3,800 new colleagues start in an apprenticeship. These apprenticeships are in all domains: business, sales, in railway related jobs. New candidates, school leavers follow a 2-3 years programme. The programme is different for different jobs: it can be 8 weeks work, then to school for 6 weeks, and at the end tests in schools; in other systems there a 3 days' work and 2 days' schools. The schooling costs in these systems are for DB. An apprentice receives about a monthly income of 1,000 Euros per month at the age of 16 years.
  DB has links with most universities. In the technical areas, DB has several "Stiftung Professors" to create cooperation with the universities. Such cooperation also exist with schools. DB does not have a corporate university. There is mainly cooperation at the course level.
- *Target jobs:* All jobs.
- *Timing:* Current policy.
- *Impact:* Not clear, no figures available.
- *Lessons for technological skills gap:* No information available.
- *Source:* Interview.

6. Access to education: Examples from other sectors

Measure: Access to education in Maritime sector

- *Organisation:* Maritime sector.
- *Goal:* The Maritime sector is an interesting comparison sector for the rail sector. The sector provides the opportunity to become a captain or marine officer in different types of situation (freight, passenger). The sector is confronted with many of the same questions the rail sector is confronted with. For the seafaring companies, the question is which kind of trainings are needed for the future and how to develop new models of cooperation with the educational sector to develop more access to education.
  This sector is international and uses international agreements (STCW convention) to align maritime education and training (MET) requirements. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)[14], 1978, as amended, sets the standards of competence for seafarers internationally. For maritime training institutes worldwide, International Maritime Organisation (IMO) has developed a series of model courses which provide suggested syllabi, course timetables and learning objectives to assist instructors develop training programmes to meet the STCW Convention standards for seafarers. The STCW Convention requires that training leading to the issue of a certificate is 'approved'. The IMO does not approve any training courses or institutes. This is a privilege and responsibility of Member Governments who are Parties to the STCW Convention. These international norms are seen as a way to streamline educational requirements. However, each country defines their own norms, even if the standard is international. MET systems still rely on the minimum standards laid down by STCW convention to achieve the required standards for competency and qualification of seafarers. Furthermore, the STCW convention does not designate the suitable teaching methodology for different subjects to achieve the required competencies and skills. National maritime education and training (MET) systems differ in academic level, content, duration of study programmes and consequence of school and sea time during these programmes. Otherwise, EU countries' national MET systems should be in compliance

[14] http://www.imo.org/en/OurWork/HumanElement/TrainingCertification/Pages/Default.aspx.

not only with STCW convention requirements, but and with legislation of European educational area (Senčila, 2015). The evaluation of competencies of seafarers still heavily relies on written and oral examinations. New technologies such as simulators, but also distant examinations are small part of their assessment systems. Training components in the STCW are partly mandatory (part A) and partly recommended (part B).
Even with this framework, the content of the trainings has been adapted over time in discussion between the educational institutions and the companies. One option in the past years has been the integration of the 'bridge tasks' and the 'engineering room tasks'. The idea was that the bridge task would be that limited, that it would be better to integrate the two above tasks. The major shipping lines have dropped the demand for these integrated training. Rather, the two tasks require further specialization. Next to the deck (navigation) officer and marine engineering officer, the role of marine electro-technical officer has been separated in the engineering department. Each of these functions is becoming more complex in this sense that past knowledge still remains quite important (for example: astro-navigation for desk officers) and that new knowledge is added to this existing knowledge. Officers require understanding of data management, but also of human resources and social-communicative skills to be able to cope with international crews.

The maritime sector is confronted with a set of new issues. A first issue is who has to pay for the trainings (Belev et al., 2018). Shipowners are still required to pay, but they limit their effort to the mandatory part. The quality of training is also seen as questionable. The local Port State Control and administrations are the main actors to inspect and provide assistance in ensuring that the crew`s qualification complies with IMO`s requirements. The sector is also confronted with technological change and new requirements to seafaring crews. Autonomous Seafaring is seen as a future possibility. In the meantime, the growing demand for skilled and competent seafarers requires relevant delivery of qualitative training and education. The sector is however experiencing serious recruiting issues and problems with the quality of training of seafarers, sometimes leading to accidents and disasters (Kassar, 2016). Traditional seafarer training has always focused on the acquisition and use of practical skills. The global trend in maritime education and training is increasingly to link an essentially vocational education that provides specific and restricted competence outcomes with more general or deeper academic components leading to an academic qualification (Emad, 2017). Improving the current paradigms under which seafarers are trained will provide a more sustainable career path for seafarers as well as compensate for the poorer human resource practices among some shipping industry employers, identified as one of the key reasons for the difficulty in retaining ship officers onboard ships.
All of these issues have increased the necessity for shipowners to collaborate more closely with the educational system. In the Netherlands for example, this has led to several initiatives. A first is that the educational bachelor institutions (four institutions) have started collaboration in 2014 with the employers association and trade union on a new occupational profile and new educational content for the marine officer. A second initiative is the development of the Maritime Academy, a collaborative training initiative between major maritime companies (mainly machine builders), offering internal training for employees. Tailored trainings are offered when the market is not able to supply the required training. This academy offers opportunities to employees of companies active within the Maritime Academy to follow training in other companies. A third initiative is the co-development of the new marine officer training within the Dutch education institutions as described above.

- *Target jobs:* Marine officers, desk officers, engineering officers.
- *Timing:* Current.

- *Impact:* Actions have led to maintenance of labour market position in different countries, but around new occupational profiles.
- *Lessons for technological skills gap:* The maritime sector has discussed the integration of different tasks within the marine officer job, but has decided to stop the integration. The sector is investing in more specialization of the separate tasks to deal with the rising complexity within the separate tasks.
- *Source:* See references. SWZ Maritime, Vol 138, May 2017 (special on the future of maritime education).

Measure Access to education: Sign-on-bonuses in Aviation Business & Piloting diploma's

- *Organisation:* European Flight Academy (EFA).
- *Goal:* EFA takes care of the flight training to become a pilot. Each major airline in the world has its own training centre, EFA is the training centre for Lufthansa Group. The training for a pilot is a bachelor level training and consists of a combination technical, economics and management aspects. A large part is practical training. The recruitment demands are considerable. The demand for such training is high, but the costs to follow the training are also expensive (approx.. 125,000 Euros for a full training, and other costs). The market for air pilots has been fluctuating considerably over the past years.[15] To attract new candidates, Lufthansa uses sign-on-bonuses (in 2018: 20,000 Euros[16]) to attract new candidates. More and more, airlines are offering new procedures to get a diploma. Next to bonuses, other airlines are offering 'ab initio' programmes in which they pay for the training and offer the pilot a job at the end. Pilots need to repay afterwards in lower salaries. The training market for pilots is also privatized: there are a lot of providers, but over the past years it has been clear that the market is concentrating, mainly along the lines of the great carriers. Smaller providers have difficulty to cope with high costs and strong regulations.
- *Target jobs:* Bachelor of Science in Aviation Business and Piloting.
- *Timing:* Yearly training.
- *Impact:* The different measures have different impacts. The market demands for pilots seems to be rising considerably (for example because of rise of flights and impact of China on demand). The measures allow airlines to keep up to 80% of students.
- *Lessons for technological skills gap:* The requirements for pilots have not considerably changed over the years, having to already deal with highly automated situations. Still, the requirements of flying show that autonomous flying is still far away.
- *Source:* Website http://www.htwsaar.de/wiwi/studium/studienangebot/ab.

7. Attracting new entrants: Example from practice

Measure: Labour Market Communication "Touch Campaign" NS

- *Organisation:* NS.
- *Goal:* A new campaign is conducted to create consideration and interest in people who do not immediately think of NS as an employer. The target group is highly educated (bachelor, academic level), 25-45 years of age. Showing that any younger person may in the future work for the NS, having an innovative job with societal relevance. An example

[15] https://www.reuters.com/article/us-singapore-airshow-pilots/airlines-flight-schools-try-to-lure-pilots-with-cheaper-or-free-training-idUSKBN1FT0JJ.

[16] https://www.luchtvaartnieuws.nl/nieuws/categorie/2/airlines/lufthansa-aviation-training-bonus-voor-nederlandse-piloten.

of a message is that 100% of trains are working on electricity from wind energy. Trains are futuristic objects with more than 20,000 sensors that can be monitored at a distance.
- *Target jobs:* All jobs.
- *Timing:* March-April 2018.
- *Impact:* The market analysis shows that the perspective of future employees has changed. NS is now seen as an employer for highly educated technical and ICT-employer. Important is that the campaign is repeated in the future to achieve more impact on the profile of NS as an employer. More repetition of the campaign is needed, since this was a first campaign in ten years.
- *Lessons for technological skills gap:* Not specific for technology jobs. But profiling NS as a technological advanced company helps target technicians and ICT-specialist.
- *Source:* NS-interview.

Measure: attractiveness for new candidates at SNCF

- *Organisation:* SNCF.
- *Goal:* SNCF is very well aware to have a positive image in French society. It is working very hard to further develop this image so it can attract new generations of employees. SNCF has been using the benefits of digitalization in these actions. Social media and tv-spots are a main instrument to communicate job offers and vacancies. Everything is done to make it easier to find jobs at SNCF. These instruments are also used for employer branding of SNCF as a 'top employer'. The image of working in the sector has been thoroughly modernized. A digital tool is also developed to make applying for a job a positive experience for the candidate. The website of SNCF even also engages candidates to develop apps for SNCF. See earlier comments.
- *Target jobs:* All.
- *Timing:* Current policy.
- *Impact:* No information available.
- *Lessons for technological skills gap:* Modernization is needed to attract technology-focused candidates.
- *Source:* Interview SNCF; website.

Measure: Rising demands for recruiting at DB

- *Organisation:* DB.
- *Goal:* DB Recruiting aims at all labour market groups: a core focus is on pupils for new talent, but the perspective is broader: 40% of recruits are needed as apprentices, 40% as blue collar workers, 10% as new talent, 10% from universities. In all jobs (also dispatching and train drivers; all qualification levels; all train technologies), the need is important. The need may be different according to regions. *For example: the Southern provinces of Germany require a lot of effort in any job, mainly because the competition with the automotive sector is important.* An important focus is on IT-groups (programming, cyber, etc.).
  The goal of the recruiting is to secure the manning of all posts, with the highest possible quality of persons, who also adhere to the DB philosophy. The recruiting process has changed considerably over the past years. The following points characterize the recruiting process:
  - Next to professionalizing the recruiting process at DB, the second action is make the sector more attractive for future workers. This is not only an effort by DB, but also a railway broad effort. *For example, for Women in Rail, DB works with competitors on small initiatives such as producing videos, portraying all company in the rail sector*;
  - A third element of the strategy is to educate new recruits. Apprenticeships are an important channel. In the recruiting, all tools are used. For blue collar workers, even

Virtual Reality is used to give pupils a more embedded experience of what jobs may be in the company. Pupils only rarely know what jobs are at DB;
- The main aim in recruiting strategy is not so much more technical jobs, because all jobs are experiencing shortages. The demand for IT-personnel clearly is the top-demand for the DB Recruitment. DB experiences a lot of competition for such persons;
- DB needs to remain very close to the markets for blue collar workers. Academics are ready to move for their job, school leavers do not want to move. The recruiting effort is clearly different;
- DB looks quite a lot abroad for new talent. For example, Romanian train drivers (20) were recruited for the Munich area. The main issue with international recruiting is the requirement to have at least C1-level command of the German language. The high demands and safety requirements of work in the rail sector require a good understanding of the language. All communication in DB is in German.

In recruiting, DB test new recruits on seven DB-values and skills. Every DB-worker needs to have these skills: customer focus, thinking and acting economically; preparedness to change; communication and cooperation ability; feeling of responsibility; intercultural competences; feeling for leadership; strategic sensitivity. Also being open to new technology is important here. This is a general request from all parts of DB.

› *Target jobs:* All.
› *Timing:* current policy.
› *Impact:* The environment for new employees is positive. Some 7 to 10,000 are recruited per year. This means that in the period 2012-2018, a third of the total personnel at DB has been renewed. This makes the organisational environment very attractive to new recruits. Career moves are more readily available.
› *Lessons for technological skills gap:* The recruiting strategy is multi-dimensional and complex to fit the requirements of the labour markets and the needs of DB.
› *Source:* Interview.

Measure: Employer and Sector Branding at DB

› *Organisation:* DB.
› *Goal:* The image of DB on the labour market has changed, intentionally. Since 2012, DB has worked on a new employer branding campaign. Everyone in Germany knows DB, but not everyone has DB as an employer in mind. The campaign ('Kein Job wie jeder andere') showed all the possibilities for employment at DB. There are more than 500 job types. DB follows the improvement in image in the media rankings (e.g., Universum rankings). In all market segments, DB has improved its profile. The goal is to get just under the top-10 of employers. Currently, for pupils, DB is on place 13. In other target groups, a same improvement is visible. DB profiles itself also in the IT sector as an alternative for other IT-employers. IT experts are for example invited at events in Frankfurt (visit at the Silver Tower). The DB-CEO addresses these specialists directly. On a yearly basis, there are some 600 DB-events directed at different target groups.
› *Target jobs:* All jobs.
› *Timing:* Current policy.
› *Impact:* Visible in the Universum rankings. DB has improved its image over time, also as an IT-employer.
› *Lessons for technological skills gap:* Carefully developing the brand helps to get access to target groups on the labour market.
› *Source:* Interview, Universum-website.

Measure: Redeployment and intersectoral mobility of personnel at DB

- *Organisation:* DB.
- *Goal:* DB has experience with transfer of personnel when services are won from or are lost to competition. DB has a collective agreement that guarantees that nobody of DB will lose a job. This employment guarantee in the DB Group, does not guarantee work at the same place. The employees are even free to switch to the competitors of DB. This is the case DB loses a service contract to competitors. Employees are allowed to switch to the competitor (Eisenbahntechnische Rundschau, 2013). However, the company is currently more focused on trying to attract more personnel. On a yearly base, more than 22,000 persons need to be recruited: this is as much as most of the operators in the different EU-countries. DB even tries to take over personnel from other sectors: e.g., 2,000 people from Deutsche Telekom were planned to be made redundant. DB has worked hard to recruit these persons for their own operations. These specialists are important for in the rail market.

  DB also focuses on candidates from other sectors for recruitment *"Quereinstieger"*. The main requirement is that some vocational training has been acquired and that the workers are healthy. Such new workers need to follow a 2-3 years path in which a 9 month technical training on the job. At the end of this period, an exam is required. This channel is used for train attendants and drivers. On a yearly base, a couple of hundreds of persons are recruited for all fields of DB. This approach gives opportunities to aged workers from other sectors, even above 50 years. DB needs train drivers in all age groups. DB plays the entire personnel marketing keyboard, addresses the target group individually via regional newspapers and digital media and tries to get in personal contact quickly. For example, the ICE is used for job interviews; potential train attendants can thus conduct their job interview in the future work environment. This makes the interview an exciting experience and a spark for the job, and the company can more easily skip during the application phase. In order to address new groups of applicants, Deutsche Bahn also uses its own employees as testimonials. Trainees as well as newcomers report on their job in various locations as part of recruiting action days. Social media and events can be addressed for cross-promotion suitable groups of applicants on topic-specific content. In this way you get access to technology-affine people who can be invited to special events in the company (Neumann, 2018[17]).
- *Target jobs:* All jobs.
- *Timing:* Current policy.
- *Impact:* See recruiting strategy.
- *Lessons for technological skills gap:* Measures allow to keep technical talent deployed in the sector.
- *Source:* Interview DB, articles, websites.

Measure: Labour market campaigns at NR

- *Organisation:* NR.
- *Goal:* NR invests in different campaigns to improve the attractiveness of the rail sector and work at NR: overhaul campaigns; employer branding is used to improve the competitive position versus other sectors, as for example the consulting sector. The aim is to enhance the image of engineering with university students etc.; nurturing campaigns are used to make persons more interested to work in the sector in several steps. Such campaigns are next to campaigns or actions conducted by Department of Transport, NSARE or other actors in the sector.

[17] https://www.personalwirtschaft.de/recruiting/artikel/deutsche-bahn-denkmuster-beim-recruiting-aufbrechen-durch-quereinsteiger.html.

- *Target jobs:* All jobs.
- *Timing:* On-going.
- *Impact:* Not reported.
- *Lessons for technological skills gap:* No information available.
- *Source:* interview NR.

Measure: Redeployment of personnel and intersectoral mobility at NR

- *Organisation:* NR.
- *Goal:* Redeployment of personnel is regulated by legislation, in the TUPE-regulation. TUPE refers to the "Transfer of Undertakings (Protection of Employment) Regulations 2006" as amended by the "Collective Redundancies and Transfer of Undertakings (Protection of Employment) (Amendment) Regulations 2014". The TUPE rules apply to organisations of all sizes and protect employees' rights when the organisation or service they work for transfers to a new employer. TUPE has impacts for the employer who is making the transfer and the employer who is taking on the transfer. When TUPE applies, the employees of the outgoing employer automatically become employees of the incoming employer at the point of transfer. They carry with them their continuous service from the outgoing employer, and should continue to enjoy the same terms and conditions of employment with the incoming employer. Following a transfer, employers often find they have employees with different terms and conditions working alongside each other and wish to change/harmonise terms and conditions. However, TUPE protects against change/harmonisation for an indefinite period if the sole or principal reason for the change is the transfer. Any such changes will be void (website ACAS). NR complies with the TUPE-regulation. The regulation was in effect when one of the main construction companies (Carillion) went out of business. People have been transferred to Amey and UK Powerlines Group, other suppliers of NR, on the basis of a business case.
  The RBC platform (see NGL) allows to train external persons to the requirements of NR. The system is now focused to get an initial assessment for the current workforce. External recruiting will be needed to deal with the demand. A strategic planning of personnel is not yet possible with the RBC, but it does make the personnel supply more flexible. Internal and external competences can be better balanced, persons can be better informed. It helps to better align with external training providers and develop strategic relationships.
- *Target jobs:* No specific group.
- *Timing:* Current legislation.
- *Impact:* Only when redeployment and intersectoral mobility are required.
- *Lessons for technological skills gap:* Smooth transition of personnel is a prerequisite to keep technical talent within the sector.
- *Source:* Interview NR, Railway Gazette.

8. Attracting new entrants: Learning from other sectors

Measure: Technology Pact in The Netherlands

- *Organisation:* Network of partners in NL.
- *Goal:* As of 2013, the education community, business sector and government have been jointly developing the Technology Pact in an effort to structurally improve alignment between education and the technology job market, and reduce the shortage of technically trained staff.
  This Technology Pact is now updated in order to adequately respond to new technological developments. Its ambitions, however, remain the same: developing a structural approach to ensure a well-trained workforce with enough smart and capable technicians for

the jobs of today and tomorrow. There is still considerable scope for improvement in terms of the number of preparatory secondary vocational education and secondary vocational education pupils opting for a technical degree programme and the number of girls enrolling in technical programmes. The number of technical jobs in the Netherlands is expected to grow by a total of approximately 400,000 in the period until 2020. Companies will experience labour market shortages for professions such as: electricians, CNC operators, technical calculators, maintenance engineers, specialist language programmers and process operators. The updated Pact will focus more on actions at the regional level.
The goals of the campaigns are to discover technical and technological talent at an early stage, attracting expert lecturers in order to provide inspirational basic education. This is included in six actions: 1. Ensure that all primary schools offer their pupils Science & Technology education on a structural basis by 2020, with a prominent emphasis on digital skills. 2. Help primary education teachers improve their skills in the area of Science & Technology education. 3. Strengthen public-private partnerships in support of primary and secondary education. 4. Ensure greater intake and retention of secondary education pupils opting for an exact sciences profile, and effectively apply career orientation and counselling programmes. 5. Improve the alignment between secondary education, vocational education and higher education. 6. Stimulate the professionalisation of current lecturers and increase the number of lecturers with educational Master's degrees in the secondary education system.
Secondly, the goal is to train technical professionals for the future with four more actions: 7. Active collaboration between the education community and business sector in terms of the training and education of lecturers at vocational education institutions. 8. Ensure more sustainable public-private partnerships within the vocational education sector. 9. Ensure effective alignment between the available range of education programmes, the regional business community and secondary and vocational education institutions, as well as sufficient suitable work placement positions/apprenticeships (for both boys and girls). 10. Ensure effective alignment between higher education institutions and the business community and within the higher education community itself, with a greater focus on international and technical talent.
The last goal is to retain technical professionals and talent for the technology sector with two more actions: 11. Promote collaboration between regional and industry sector networks, and offer better access to labour market information. 12. Make optimal use of technically-skilled staff and their talents and retain them for individual companies, the overall industry sector and technology itself by investing in sustainable employability.

- *Target jobs:* Attracting new talent to tech sector; maintaining tech-educated to remain in technology jobs, but also ICT-jobs.
- *Timing:* Programme started in 2013, and will continue to 2020.
- *Impact:* The Technology Pact keeps monitor data on the development of the number of technicians. The number of people working in technical professions has increased over the years and the number of unemployed technicians has become minimal. However, it is unclear whether these developments would have occurred without campaigns because the developments are parallel to the general developments on the Dutch labour market. In addition, it appears that in the figures the number of young people in technical jobs has not really increased, but that the older workers continue to work longer. Despite the absolute increase in the number of young technicians, there is a stronger aging of technically skilled workers. This phenomenon also occurs among IT professionals. Here the group consists of almost three quarters of higher educated people. The growth of the group of higher educated people was also 25 percentage points over the period studied; the growth among younger IT professionals is much lower.

- *Lessons for technological skills gap:* The example shows that it is difficult for even a well-funded and very broad programme to show its net-effectiveness. The number of technicians has risen, but maybe not the elite the programme was intended for.
- *Source:* https://www.techniekpact.nl/nationaal-techniekpact-2020.

9. Reintegration

Measure: Reintegration at NS

- *Organisation:* NS.
- *Goal:* For reintegration policy, NS adheres to the requirements of the Dutch Gatekeeper Act (Wet Poortwachter) in the Netherlands, that specifies in detail how reintegration of previously absent personnel should be conducted. In addition to this, NS focuses on providing facilities to employees, during their sickness period, to find new jobs in- or outside of the NS organisation. A specialized agency Fourstar helps with this. Even if the provisions are far-reaching, the use of these provisions seems to be lower than expected. For the reintegration itself, some seven types of measures or interventions are offered: life style (4 programmes), psychic complaints (2 programmes), physical complaints (1 programme), long-term or chronic complaints (1 measure), future of job (2 programmes), daily issues in life (4 programmes), other issues/health complaints (3 programmes).
- *Target jobs:* All jobs.
- *Timing:* Standard policy.
- *Impact:* Not available.
- *Lessons for technological skills gap:* One measure is specifically focused on job content and job change: “Career advice - Move NS”.
- *Source:* “NS. (2018) Fitwijzer. Overzicht aanbod hulp bij gezondheid, vitaliteit & werkplezier.”

Measure: Move NS

- *Organisation:* NS.
- *Goal:* Move NS is a part of the reintegration policy of NS. Employees can always request a career path consultation. The start is a conversation with a Move NS-expert in a ‘short term career assessment’. The direct manager does not have to have a role in this first consultation. If a career development plan has been requested, the direct line manager needs to give an approval. It is possible to receive a voucher for such a development process.
- *Target jobs:* All jobs.
- *Timing:* Standard policy.
- *Impact:* Not available.
- *Lessons for technological skills gap:* The measure is focused on job content and job change, but does not necessarily only have to do with technology.
- *Source:* “NS. (2018) Fitwijzer. Overzicht aanbod hulp bij gezondheid, vitaliteit & werkplezier.”

Measure: Reintegration at ProRail

- *Organisation:* ProRail.
- *Goal:* Absenteeism is low at ProRail. Furthermore, the company follows the rules of the Dutch Gatekeeper Act. Insofar as there is action in the area of absenteeism, this concerns case managers who support line managers in the implementation of the Act. New functions can be offered both inside and outside ProRail.
  A more important policy in this respect is sustainable employability. The company offers

a palette of interventions with which everyone can strengthen themselves. The menu is focused on four areas: physical, mental, mobility, craftsmanship:

- Mobility: career counselling, mediation (in the event of redundancy), career tests, personal coaching, earlier retirement, experience places;
- Craftsmanship: EVC (handful), external training, individual training advice, internal training;

Most courses are done externally (see above). There is a practice lab where you are trained on conversation techniques, individual resistance, etc. There are team development programs.

- *Target jobs:* All jobs.
- *Timing:* Standard policy.
- *Impact:* Not available.
- *Lessons for technological skills gap:* The measures are focused on job content and job change, but does not necessarily only have to do with technology.
- *Source:* Interview.

Measure: Alpha Cells as reintegration means at SNCF

- *Organisation:* SNCF.
- *Goal:* The reintegration of employees after sickness is regulated by labour law. SNCF abides by the law. Because SNCF is such a big company, it is always possible to offer new employment to reintegrating personnel. SNCF has dedicated systems to follow-up the conditions of absentee employees. Multi-disciplined teams follow an employee and offer solutions and help to re-integrate into work.
  The same broad approach is used to help employees who risk to come into obsolete jobs. A first step is to make sure that a prospective view on the employment situation is used. The digital passport, discussed in another section, helps as an instrument to show what an employee is capable of doing.
  For those employees who have a major difficulty in reinserting into their former occupations, SNCF created internal entities so-called “Alpha Cells”. These multi-disciplined teams create a safe environment for employees to rethink their career and work. These teams started as an experiment in 2015, and seem to be very successful in helping employees reintegrate into new job positions. The cells were created in a collaboration with an external consultancy. Several factors are responsible for an upsurge in the number of employees in difficulty, also at SNCF: lengthening the professional life, hardship, pressure in the organisation on the background of increased productivity search, difficulty of adaptation of some employees to technological developments, and personal problems. At the same time, even as the number of vulnerable employees increases, the number of jobs likely to be offered as an alternative (gardening, security guard, IT, etc.) is decreasing. SNCF sees approximately 200 employees per year in this situation of work incapacity. The company wanted to have a sustainable solution for these colleagues. The intervention developed with the Alpha Cells is to tackle the loss of confidence and to offer these employees worthy and useful activities, which often exist in companies but are carried out at the margin by other employees for whom these activities are not core business.
- *Target jobs:* All.
- *Timing:* Current policy since 2015.
- *Impact:* Since the beginning of 2017, 320 weak employees have joined one of the 19 "Alpha" cells set up by the group. By September, 70 had already left the system to re-enter a new profession.
- *Lessons for technological skills gap:* Technology developments is one of the causes for people not being able to reintegrate. The new intervention mainly helps people in other jobs.

- *Source:* Interview and https://www.focusrh.com/strategie-rh/mobilite-interne-fidelisation-des-salaries/avec-alpha-la-sncf-remet-sur-les-rails-les-salaries-les-plus-fragiles-30238.html.

10. Reintegration: Learning from other sectors

Measure: The Dirigo-project

- *Organisation:* -
- *Goal:* The process of returning to work after long-term sick leave can sometimes be complex. Many factors, (e.g., cooperation between different authorities and the individual as well as individual factors such as health, emotional well-being and self-efficacy) may have an impact on an individual's ability to work. The aim of this study was to investigate clients' experiences with an individually tailored vocational rehabilitation, the Swedish Dirigo project (funded by ESF), and encounters with professionals working on it. The Dirigo project was based on collaboration between rehabilitation authorities, individually tailored interventions and a motivational interviewing approach.
- *Target jobs:* All jobs.
- *Timing:* -
- *Impact:* The analysis showed overall positive experience of methods and encounters with professionals in a vocational rehabilitation project. The positive experiences were based on four key factors: 1. Opportunities for receiving various dimensions of support. 2. Good overall treatment by the professionals. 3. Satisfaction with the working methods of the project, and 4. Opportunities for personal development. The main result showed that the clients had an overall positive experience of a vocational rehabilitation project and encounters with professionals who used motivational interviewing as a communication method. The overall positive experience indicated that their interactions with the different professionals may have affected their self-efficacy in general and in relation to transition to work
- *Lessons for technological skills gap*: The knowledge is essential for the professionals working in the area of vocational rehabilitation. However, vocational rehabilitation interventions also need a societal approach to be able to offer clients opportunities for job training and real jobs.
- *Source:* Andersén, Å., Ståhl, C., Anderzén, I., Kristiansson, P., Larsson, K. (2017) Positive experiences of a vocational rehabilitation intervention for individuals on long-term sick leave, the Dirigo project: A qualitative study. *BMC Public Health, 17*(1), art. no. 790.

11. Attracting from less represented groups: Examples from practice

Measure: 90 sustainable jobs in operational organisation (disability)

- *Organisation:* NS.
- *Goal:* To recruit persons with a disability to work in the NS-operation. The main reasons is that these workers are highly motivated to work for the organisation. Job carving is the method to adapt jobs to the ability of persons. Use will be made of tax exemptions, subsidies and wage measures. The NS is attentive that these jobs should not ‘repress’ the existing recruiting policy. For this reason, the new jobs are only temporary, unless the candidate appears to fit a certain job quite well. These jobs are also counted as part of the legal obligation to provide for sustainable jobs. If needed, new candidates can be supported by a job coach.

- *Target jobs:* Planner, project manager, warehousing, customer contacts, repair, train drivers, SAM, waste disposal.
- *Timing:* Decision in 2017.
- *Impact:* A growth plan is foreseen: 2018 = 90; 2019 = 180; 2020 = 200 jobs (140 FTE in year 2020). Of this total, some 90 are in operation (41, 41, 9). This represents a wage cost (loonwaarde) of 1,7 M€ per year.
- *Lessons for technological skills gap:* These jobs are meant to satisfy the general policy of the company. It also helps to satisfy the legal obligations of the company for support to less able persons. The measure aims at a broad set of jobs. There is no link to technological change.
- *Source:* "NS (2017). Stappenplan Duurzame Baan Operatie 13 juli 2018 herziene versie 2018."

Measure: Diversity and Inclusion at NS

- *Organisation:* NS.
- *Goal:* NS wants its personnel to be a reflection of society. This is partly because of company objectives, collective agreement 2015-2017, but also a legal requirement (Participation and Quotum Law; National Collective Agreement; legal obligation for 3% quotum). These measures are a new direction for the diversity policy within NS, in this sense that in the period 2007-2012 the focus was on reducing the gender gap, in the period 2012-2016 the aim was to let the company be a reflection (Fair share) of society. The new policy runs under the heading of 'inclusive working culture'.
- *Target jobs:* Only for multicultural talent, the focus is on technical jobs.
- *Timing:* Decision in 2017.
- *Impact:* Diversity targets for women, young (<36), LBGTQI and multicultural background in lower task groups, have all been reached, accept for the management levels. The only target that has not been reached is for persons with a labour market issue (Social Return on Investment) (1. Persons with a disability; 2. Highly educated multicultural talents including refugees):
  - *For gender:* 33% of personnel is female, sufficient women in pipeline senior management, 34% senior managers are women, ICT is 23%, company awards for policy, LGBTQI in labour market communication. Policy consisted of 'charter 'Talent to the top'', targets and learning interventions;
  - *For persons with a disability:* Target is 200 persons. In the past, on average, some 60 persons currently working at NS fall under the legal definitions. Some 50 sustainable jobs have been created. For some 35 NS-persons, such sustainable jobs have been created after a reintegration period. Procedures have been developed to support managers. For the future, some 200 sustainable jobs will be created (see above: sustainable jobs). SROI-agreements with suppliers;
  - *For multicultural talent:* In 2016, some 10% of new candidates fit into this category. 90% of refugees working at NS have found permanent employment at NS (60%) or with other companies (30%). Company measures have been adapted to better suit this group. New measures are explicitly focused on ten jobs with secondary/professional/academic training in technology. Managers are evaluated on their performance in this respect.
- *Lessons for technological skills gap:* The recruitment of multicultural talent is focused on technical talent. This helps with the expected rise in technical jobs.
- *Source:* "NS (2017). Presentatie Diversiteit en Inclusie tbv RvB 13 juni 2017."

Measure: Strengthening the presence of multicultural talent at NS

- *Organisation:* NS.
- *Goal:* The policy is aimed at four goals: (1) creating inclusive working environments; (2) strengthening the multicultural presence; (3) visibility of the NS as employer; (4) to measure the impact of interventions. The actions are focused on more growth, changing management behaviours, strengthening self-action by this talent, and positioning the NS as an attractive employer.
- *Target jobs:* The targets are mainly in distribution in management and lower level positions. New recruitment should be at 5% multicultural talent, internal growth also at 5% at managerial levels; 10% in positions for non-management jobs. The emphasis is on (senior) operational management. NS wants to have a larger share of employees with a different cultural background everywhere, including Technology and ICT. But the specific focus comes from two things:
  1. NS already has a lot of nationalities on the shop floor: NS does pretty well there. However, NS sees no or limited flow to middle and senior management positions. NS would like to change that so that NS has representation of multicultural talent in all layers;
  2. The other reason is that visibility (inside and outside) of multicultural talent is also determined by our senior management. That is why NS also focus on attracting multicultural talent in (visible) senior management positions.
- *Timing:* Start implementation plan June 2018.
- *Impact:* Currently, there is sufficient employment for multicultural talent at NS (nearly 3% of personnel), but there seems to be too little recognition and opportunities for these persons.
- Lessons for technological skills gap: this measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
- *Source:* “NS. (2018). Gewoon doen! Plan van aanpak groei van aandeel hogeropgeleid multicultureel talent.”

Measure: Access to less represented groups at SNCF

- *Organisation:* SNCF.
- *Goal:* SNCF has a long tradition in finding access to less represented groups for its positions. Specific actions have been developed to feminize the workforce, give access to disabled persons, allowing military and professional sportsmen/women find a place in the organisation, and to suppress any discrimination. Concerning women, the objective is not only to feminize the organisation, but also to work on a ‘healthy mix’ (‘mixité’). In jobs that are viewed as women jobs, the strategy is to ensure that men also occupy such tasks. A lot of attention is directed at attracting girls (Girls’ day; company visits) and young women to work at SNCF. A part of this effort is also to attract female engineers.
  Another important action for SNCF is the policy to attract younger workers from ‘priority neighbourhoods’. This is done through the recruiting forums aimed at ‘equality and competence’. Some twenty percent of new recruits are coming from these neighbourhoods.
- *Target jobs:* All.
- *Timing:* Current policy.
- *Impact:* 21% of current recruits are women (+1% in comparison to 2016); 21% of recruits come from ‘quartiers prioritaires’. 3,000 employees have been engaged in a serious game about diversity.
- *Lessons for technological skills gap:* More diversity could be helpful for technical jobs.
- Source: Interview, yearly report 2018.

Measure: Diversity and inclusive management at ProRail

- *Organisation:* ProRail.
- *Goal:* ProRail mainly wants to have a workforce that is a realistic reflection of society, such as culture, gender and age. A programme manager diversity has been appointed. The manager is currently working on a vision determination at the moment (new theme for ProRail). More structurally, the focus is on inclusive employership: employees with different backgrounds must be able to find their place at ProRail. Now the male/female distribution is about 60/40. There are no specific ambitions in this area yet. However, there are steps to take for more women at the top.
  There are separate initiatives (but due to the appointment of the program manager diversity there will be a structured program):
  - Attracting people at a distance from the labour market (disability or limitation): They are put to work above formative;
  - Asylum seekers: Here are some separate initiatives;
  - ProRail has become member of Trainbow to support more diversity among the employees. This action has already got support from Trainbow NS since 2009.
- *Target jobs:* All jobs.
- *Timing:* Start September 2018.
- *Impact:* There seemed to be too little recognition and opportunities for these colleagues.
- *Lessons for technological skills gap:* This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
- *Source:* "ProRail (2018). ProRail aangesloten bij Trainbow. (www.prorail.nl/inhoud/prorail-aangesloten-bij-trainbow)."

Measure: Recruiting groups less represented groups at DB

- *Organisation:* DB.
- *Goal:* Diversity is an important strategy for DB. DB strives that women workers and other less represented groups get a more important place in the company. For women, the strategy is to make them more involved in the company. It is clear that such involvement depends on role models in the company: in any campaign, all profiles that are shown need to show roles for women. DB has an internal network of women workers. Currently there is a network of 850 women cooperating to create more impact in DB. They have meetings on a lot of topics (for example: soft skills). The network is supported by visits from the highest management levels.
  DB also looks at recruiting labour market minorities. DB analyses the presence of immigrant workers in certain regions and adapts its communication to suit the needs of these groups. For example, to recruit Turkish candidates in the Frankfurt area, the marketing is focused on the parents to attract new pupils. For the S-Bahn in Stuttgart, Croatian train drivers have been targeted for employment. These workers are sought for "Quereinstieg" (cross-border mobility) into jobs. If needed, DB supports recruitment with housing projects. In Munich, housing prices are extremely high and this prohibits finding new employees. In this case, Romanian train drivers (20 persons) were supported with a housing project.
  DB also looks at groups at a distance of the labour market. The Chance Plus-programme has been directed at pupils who have left school without a diploma. DB gives these candidates a second chance. This is a sort of apprenticeship. Such candidates develop work experience (on a yearly base: some hundreds). The jobs are cleaning of buildings, etc. These persons work in job with high turnover rates.
- *Target jobs:* All jobs.
- *Timing:* Current policy.

- *Impact:* Company targets are reached. Currently, some 23% of the workforce is female. In 2020 this should be 25% . At the management level, this is 19,2% . In 2020, this also has to reach 20%.
- *Lessons for technological skills gap:* This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
- *Source:* Interview.

Measure: Diversity & Inclusion initiatives at NR

- *Organisation:* Network Rail.
- *Objective:* The objective of NR is to make NR-personnel reflect the society NR is working in. NR aims by becoming a more open, diverse and inclusive organisation to deliver a safe, accessible railway for everyone. NR expects the number of people using the railway to double over the next 25 years. To meet this challenge, remain cost-competitive and deliver for our customers, NR needs a diverse workforce with innovative ideas and creative solutions, as well as a culture where everyone feels able to perform. The diversity and inclusion strategy sets out how NR will deliver a safer, more accessible and improved service for our customers and passengers, and how Network Rail becomes a better place to work for everyone. Diversity and inclusion are seen as powerful tools to help improve performance. NR has several themes in which progress is followed and measured. Within each theme NR has out specific objectives based on the latest research, good practice and the benefits NR wants to deliver. NR has an award-winning, industry-acclaimed diversity and inclusion team. The main parts of the strategy are *Everyone strategy* and *Spaces and Places for Everyone strategy*.
  The objective of NR is to have women in 20% of all roles and functions of NR by 2020. To achieve this objective a whole set of measures has been developed: system of champions, business is training, positive discrimination, guarantee that all women candidates will be invited for job interview. The progress is followed with a specially developed dashboard, monitoring recruitment, trainings, progress, leavers, maternity, flexible working requests. NR has worked with Deloitte to design a set of Key Performance Indicators (KPIs) that tell NR if the work it is doing is progressing against our objectives. The KPIs are listed on the website. The KPIs are measured using an online dashboard and national and local scorecards; they will be privately and then publicly assured. The following actions are important:
  - Job Descriptions are rendered more gender neutral. Gender interview panels are used for new recruits;
  - Early engagement of young women with stress on STEM-competences. A separate action is on girls with STEM;
  - NR has analysed where it loses talent over time. That is why NR is profiling itself as a “returner place”: women that have gone out, but are coming back into the workforce. For NR, this means to have a forecast of jobs that are going to be available when these persons are returning. This requires more forward planning;
  - NR takes care to campaign about the possibilities for women at NR. The women’s initiative is focused on delivering roles model for women. NR is not working with “Women in Tech”. For NR, the focus is on women and rail/women and transport, not specifically women in technology;
  - There are several positive action plans directed at women: NR wants to understand how to you keep women within the organisation. A buddy system (paternity) has been developed specifically for this goal.

  Another one of the measures is monitoring the ethnicity of that all persons working at NR. The programme NR conducts for this has been evaluated as Best Employer for Race in 2017. In the 2017 McGregor-Smith Review of race in the workplace it is showcased to be

best practice on race equality in UK workplaces. Successful organisations had to evidence that they are putting leadership on race into place within their organisations, creating inclusive workplace cultures and taking action in at least one of three areas - leadership, progression and recruitment. They also had to be able to demonstrate the impact of these policies on BAME employees. A first reward was in 2014. NR runs six other employee networks in connection to diversity: LGTB, multi-flavour network, ethnic networks, etc. In total, some 2,800 persons are connected to these network. Actions are organized to develop soft skills for these networks (for example how to challenge wrong behaviour), to use Yammer networks, etc.

For inclusive policies, NR develops discussion networks, but also inclusive leadership networks. A lot of action is done on employees who act as carers. These persons experience a myriad set of problems. They (the 'sandwich group') require enormous flexibility: they need to support their parents and at the same time they need to take care of their children. This forces these persons to make career breaks. NR wants to support these groups.

NR needs to comply to national legislation (Equality Act 2010) when changing anything in its services or organisation. NR needs to conduct diversity impact assessments to show that for any change that affects the distribution of changes, is mitigated with adequate measures. Like a risk assessment process, a DIA is a tool that helps any programmes, policies, and projects - and the way that services are designed, built and operated - to work well for employees and passengers. It anticipates the likely effects of the work on the characteristics protected by the Equality Act: age; disability; gender; gender reassignment; pregnancy and maternity; race; religion or belief; sexual orientation; and marriage and civil partnerships - in short, everyone. Once any potential negative impacts have been identified, the DIA can be used to plan ways to remove or mitigate these, where possible. DIAs can also be used to promote best practice (website NR).

- *Target jobs:* All jobs.
- *Timing:* Current policy.
- *Impact:* Some 17% of the workforce is female. In 2020 this should be 20%. Women now represent nearly 25 per cent of both the Board and Executive Committee. The apprenticeships are now 50/50 men/women. NR collaborates with a number of charities who offer benchmarking to help us measure our performance against other organisations and sectors so that NR can become a leader in diversity and inclusion for the rail industry. NR were ranked 237 (out of 325) in Stonewall's 2014 Workplace Equality Index which looks at how inclusive organisations are for lesbian, gay, bisexual and trans (LBGT) employees and potential employees.
- *Lessons for technological skills gap:* This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
- *Sources:* NR-website.

Measure: Armed Forces into Rail (NR)

- *Objective:* Network Rail has a long history of supporting the Armed Forces. In particular, NR is committed to helping Ex-Forces personnel reintegrate into successful civilian careers whilst supporting the already established Reservist community. In 2015, the British Armed Forces Military Covenant was signed. For this, NR was honoured by the Ministry of Defence with the Employers Recognition Scheme Silver award back in 2016 and the Employers Recognition Scheme Gold award in October 2017. NR works closely with the Career Transition Partnership and the Officers Association to ensure everyone making the move is fully supported.
- *Target jobs:* All jobs.
- *Timing:* Current policy.

- *Impact:* -
- *Lessons for technological skills gap:* A lot of military have the technical expertise that NR needs.
- *Sources:* NR-website.

Measure: Increasing the number of persons with a disability working in Network Rail.

- *Objectives:* The objective of NR is to improve less represented groups as for example disabled persons to get a job at NR. A lot of attention is directed at persons with a disability, but a lot of persons have not declared their disability. One of the measures is that all persons with a disability not only will have a job interview when applying for a job, but they will also have a training at NR.
- *Application:* In 2016 NR scored 55 per cent against the Business Disability Forum's Disability Standard and have been given a clear set of recommendations for how to improve our performance in this area.
- *Lessons for technological skills gap:* This measure is part of a plan to deal with the demographic shift in the organisation and to deal with labour market shortages.
- *Sources:* NR-website.

12. Attracting from less represented groups: Learning from other sectors

Measure: Inclusive policies in scientific literature

- *Organisation:* -
- *Goal:* Workforce diversity has been depicted as a double-edged sword that leads to both positive and negative work-related outcomes. Inclusive management not only strengthens the positive relationship between racial diversity and innovative behaviour but also attenuates the positive relationship between gender diversity and turnover behaviour. These findings suggest that inclusive management is a key strategy for effectively managing diversity (Moon, 2018). The question then is what makes workforce diversity the work.

  A first set of studies focuses on gender diversity. The analysis of the low retention rates of highly-educated female engineers in their chosen professions in science, engineering and technology is helpful to understand that workforce diversity, gender issues is not only an individual decision. It is insufficient to simply motivate women to choose a career in engineering. To retain women in such sectors, the current gender-biased organizational cultures and structures have first to be changed (Hanappi-Egger, 2012).

  Most approaches tend to focus on the deficits of women rather than on the structural exclusion. It seems to be a topic of very personal engagement and consequently it is seen as an issue women have to deal with. To establish inclusive management concepts in technology-oriented organizations, it is needed also work on the structural side of organisations and policies. This means that gender issues and related responsibilities should be seen as part of a professional leadership competence. Organizations aren't despite the long lasting presumption gender neutral but are producing and reproducing gender codes within all areas of organizational practices. Consequently, indirect inclusion and exclusion mechanisms are created leading to the fact that some selective groups are attracted and others not (Hanappi-Egger & Warmuth, 2010).

  A second set identifies the possibilities to make value driven organisations. It is possible for organisations to make work values central to the employment relationship of any worker. For younger worker, this is done by asking them to explain what "success" or "efficiency" means to them in their work. This provides a window into the values-based

reasoning underpinning younger workers' work-related attitudes and behaviour (Winter & Jackson, 2014).

- *Target jobs:* All (technical) jobs.
- *Timing:* -
- *Impact:* Not taking inclusiveness into account leads to more women leaving organisations.
- *Lessons for technological skills gap:* Women and other groups at a distance in technical jobs need better contexts.
- *Sources:*
  - Moon, K.-K. (2018). Examining the Relationships Between Diversity and Work Behaviors in U.S. Federal Agencies: Does Inclusive Management Make a Difference? *Review of Public Personnel Administration, 38*(2), 218-247. (DOI: 10.1177/0734371X16660157).
  - Hanappi-Egger, E., & Warmuth, G.-S. (2010). Gender-neutral or gender-blind? on the meaning of structural barriers in computer science and engineering. *Joint International IGIP-SEFI Annual Conference 2010*.
  - Hanappi-Egger, E. (2012). Shall I stay or shall I go? On the role of diversity management for women's retention in SET professions. *Equality, Diversity and Inclusion, 31*(2), 144-157. (DOI: 10.1108/02610151211202790).
  - Winter, R.P., & Jackson, B.A. (2014). Expanding the Younger Worker Employment Relationship: Insights From Values-Based Organizations. *Human Resource Management, 53*(2), 311-328. (DOI: 10.1002/hrm.21600).

Annex 2 Surveys

1. Eurofound ECS 2013

Table A2.1 Results from the Eurofound ECS survey 2013. Comparison of the Rail sectors Manufacture of railway locomotives/rolling stock; construction of (underground) railways; Freight & Passenger (interurban) rail transport (3,020+4,212+4,910+4,920) - as a whole - versus all other sectors

	Rail sectors	All other sectors
A public sector organisation is either wholly owned by the public authorities or they have own more than 50%. Is your establishment part of ...		
· The private sector	72.4%▼	93.2%▲
· The public sector	27.6%▲	6.8%▼
·N	91	26,898
Is the establishment at this address a single independent company/organization with no further branch-offices, production units or sales units elsewhere in [country]**?**		
· A single independent company/organization	71.0%	77.2%
· One of a number of different establishments	29.0%	22.8%
·N	91	26,990
Establishmenty size		
· 10 to 19 employees	21.7%▼	42.5%▲
· 20 to 49 employees	36.2%	41.7%
· 50 to 249 employees	28.4%▲	13.4%▼
· 250 to 499 employees	4.6%▲	1.2%▼
· 500 or more employees	9.2%▲	1.2%▼
·N	91	26,990
Since the beginning of 2010 has this establishment introduced any new or significantly changed products or services (either internally or externally)? [% yes]	47.3%	40.7%
·N	87	26,727
Since the beginning of 2010, has this establishment introduced any new or significantly changed processes, either for producing goods or supplying services? [% yes]	41.1%	35.6%
·N	87	26,654
Since the beginning of 2010, has this establishment introduced any organizational change? [% yes]	52.4%▲	32.4%▼
·N	91	26,720
How many employees work in this establishment? [Mean] [Range: 10−59800]	239▲	48,0▼
·N	90	26,880
Since the beginning of 2010, has the total number of employees in this establishment increased, decreased or stayed about the same?		
· Increased	24.1%	28.4%
· Decreased	29.7%	24.5%
· Stayed about the same	46.2%	47.1%
·N	91	26,883

	Rail sectors	All other sectors
Percentage of employees are female?		
· None at all	0.1%	3.8%
· Less than 20%	51.2%▲	25.8%▼
· 20% to 39%	24.6%	20.3%
· 40% to 59%	22.0%	23.9%
· 60% to 79%	1.8%▼	15.2%▲
· 80% to 99%	0%▼	9.7%▲
· All	0.4%	1.5%
·N	60	18,390
Percentage of employees are older than 50 years of age?		
· None at all	2.3%▼	14.6%▲
· Less than 20%	28.3%▼	41.2%▲
· 20% to 39%	43.5%▲	26.3%▼
· 40% to 59%	22.7%▲	12.5%▼
· 60% to 79%	3.3%	4.1%
· 80% to 99%	0%	1.1%
· All	0%	0.2%
·N	69	18,463
Percentage of employees have a university degree?		
· None at all	22.2%	26.3%
· Less than 20%	31.6%	36.4%
· 20% to 39%	37.6%▲	13.5%▼
· 40% to 59%	1.5%▼	8.5%▲
· 60% to 79%	4.7%	6.2%
· 80% to 99%	0%▼	6.6%▲
· All	2.4%	2.6%
·N	65	19,067
Approximately what percentage of employees work in jobs which require at least one year of on the job learning in order for the person to become proficient in his/her task?		
· None at all	28.4%▼	40.7%▲
· Less than 20%	17.0%	10.5%
· 20% to 39%	10.1%	9.7%
· 40% to 59%	17.2%▲	8.2%▼
· 60% to 79%	7.2%	5.4%
· 80% to 99%	2.6%	7.0%
· All	17.3%	18.4%
·N	84	24,223
Departments based on function : sales, production, administration, research etc. - Does this establishment have any of the following types of departments? [% yes]	78.6%	72.5%
·N	91	26,939
Departments dealing with different types of products or service - Does this establishment have any of the following types of departments? [% yes]	43.0%	46.1%
·N	90	26,797
Departments dealing with specific geographical areas, regions etc. - Does this establishment have any of the following types of departments? [% yes]	15.0%	19.6%
·N	91	26,887

	Rail sectors	All other sectors
Who normally decides on the planning and execution of the daily work tasks of the employees at this establishment?		
· The employee undertaking the tasks	0.3%▼	6.4%▲
· Managers or supervisors	46.9%	53.9%
· Both employees and managers or supervisors	52.8%▲	39.6%▼
·N	91	26,919
Do employees in this establishment document and keep records of their good work practices or lessons learned, with the purpose to share these with other employees? [% yes]	70.2%	61.7%
·N	83	26,386
A team is a group of people working together with a shared responsibility for the execution of allocated tasks, within or across units of the establishment. Do you have any teams fitting this definition in your establishment? [% yes]	88.2%▲	73.2%▼
·N	90	26,891
With regard to the employees doing teamwork, do most of them work in a single team or do most of them work in more than one team at the same time?		
· Most of them work in a single team	61.9%	56.7%
· Most of them work in more than one team	38.1%	43.3%
·N	79	19,550
Do the team members decide among themselves by whom the tasks are to be performed, or is there usually a superior distributing the tasks within the team?		
· Team members decide among themselves	10.2%▼	26.9%▲
· Tasks are distributed by a superior	89.8%▲	73.1%▼
·N	77	19,388
Do any of the employees at this establishment rotate tasks with other employees?		
· Yes, most do	24.0%	22.8%
· Yes, some do	32.4%▼	43.8%▲
· No, none do	40.9%▲	28.5%▼
· No, the high level of required skills or expertise prevents employees from rotating tasks	2.7%	4.9%
·N	91	26,843
In the past 12 months, what percentage of employees received paid time-off from their normal duties to undertake training, either off or on your premises?		
· None at all	25.5%	32.7%
· Less than 20%	13.5%	18.9%
· 20% to 39%	9.4%	15.4%
· 40% to 59%	18.6%▲	8.4%▼
· 60% to 79%	3.2%	4.1%
· 80% to 99%	3.5%	4.5%
· All	26.4%▲	16.1%▼
·N	80	23,687

	Rail sectors	All other sectors
In the past 12 months, what percentage of employees have received on the job training?		
· None at all	20.3%	29.9%
· Less than 20%	16.4%	14.0%
· 20% to 39%	7.0%▼	14.9%▲
· 40% to 59%	11.2%	9.9%
· 60% to 79%	5.6%	4.4%
· 80% to 99%	6.8%	4.7%
· All	32.6%▲	22.2%▼
·N	85	23,958
Increase awareness on health and safety issues and hazard prevention measures - Did the training for your staff have any of the following objectives...? [% yes]	87.1%	78.4%
·N	77	23,031
Improve and extend the skills used in their current jobs - Did the training for your staff have any of the following objectives...? [% yes]	86.6%	89.4%
·N	74	23,015
Provide the skills needed for employees to take on a different job position - Did the training for your staff have any of the following objectives...? [% yes]	61.1%	51.2%
·N	77	22,961
To enable employees to rotate tasks with colleagues - Did the training for your staff have any of the following objectives...? [% yes]	41.4%	51.7%
·N	76	22,937
Approximately what percentage of employees have a performance appraisal or evaluation interview at least once a year?		
· None at all	21.5%	31.0%
· Less than 20%	2.4%	4.4%
· 20% to 39%	10.3%	6.2%
· 40% to 59%	6.6%	6.0%
· 60% to 79%	0.1%	2.8%
· 80% to 99%	5.6%	4.4%
· All	53.5%	45.2%
·N	89	26,160
The majority of employees who had a temporary contract got a further contract afterwards - Do you agree or disagree with the following statements about the human resource management strategy in this establishment? [% (strongly) agree]	89.1%	87.5%
·N	75	22,171
Employees are hired with the intention to employ them for a long time - Do you agree or disagree with the following statements about the human resource management strategy in this establishment? [% (strongly) agree]	91.1%▼	96.8%▲
·N	91	26,664
When recruiting the management usually look first whether there are any suitable internal candidates - Do you agree or disagree with the following statements about the human resource management strategy in this establishment? [% (strongly) agree]	86.4%	85.5%
·N	89	25,341

	Rail sectors	All other sectors
Difficulties in finding employees with the required skills - Does the management encounter any of the following problems at this establishment currently? [% yes]	41.3%	39.3%
·N	88	26,803

2. EU-OSHA ESENER-2 2014

Table A2.2 Results from the EU-OSHA ESENER-2 survey 2014. Comparison of the Rail sectors Manufacture of railway locomotives/rolling stock; construction of (underground) railways; Freight & Passenger (interurban) rail transport (3,020+4,212+4,910+4,920) - as a whole - versus all other sectors

	Rail sectors	All other sectors
What proportion of the employees is aged 55 years or older?		
· None at all	0.7%▼	25.8%▲
· Less than a quarter	38.2%	52.7%
· A quarter to half or	50.3%▲	17.5%▼
· More than half of your workforce	10.7%▲	4.1%▼
·N	40	40,161
Does this establishment belong to the public sector? [% yes]	37.8%▲	15.0%▼
·N	40	40,315
Is the following risk factor present or not in your establishment (regardless of whether it is currently under control and regardless of the number of employees it affects.)		
types of risks: tiring or painful positions [% yes]	77.2%▲	55.8%▼
·N	40	40,415
types of risks: lifting or moving people or heavy loads [% yes]	51.9%	47.3%
·N	40	40,461
types of risks: loud noise [% yes]	55.8%▲	29.7%▼
·N	40	40,461
types of risks: repetitive hand or arm movements [% yes]	55.0%	51.9%
·N	40	40,381
types of risks: heat, cold or draught [% yes]	65.4%▲	35.9%▼
·N	40	40,414
types of risks: risk of accidents with machines [% yes]	69.3%▲	48.3%▼
·N	40	40,496
types of risks: risk of accidents with vehicles in the course of work [% yes]	88.0%▲	45.5%▼
·N	40	40,453
types of risks: chemical or biological substances [% yes]	39.7%	38.0%
·N	40	40,489
types of risks: increased risk of slips, trips and falls [% yes]	61.5%▲	36.2%▼
·N	40	40,448
There may also be health risks resulting from the way work is organised, from social relations at work or from the economic situation. Is each of the following risks present in this establishment?		
psycho-social risks: time pressure [% yes]	75.8%▲	42.5%▼
·N	38	40,363
psycho-social risks: poor communication or cooperation [% yes]	18.3%	16.7%

	Rail sectors	All other sectors
·N	40	40,377
psycho-social risks: employees' lack of influence [% yes]	6.2%	13.4%
·N	38	40,044
psycho-social risks: job insecurity [% yes]	23.9%	15.6%
·N	40	40,213
psycho-social risks: difficult customers [% yes]	48.1%	57.5%
·N	40	40,369
psycho-social risks: long or irregular working hours [% yes]	27.5%	22.7%
·N	40	40,476
psycho-social risks: discrimination [% yes]	2.7%	2.2%
·N	40	40,496
Do you regularly carry out workplace risk assessments? [% yes]	91.8%▲	77.2%▼
·N	40	40,130
IF YES:		
routinely evaluated: safety of machines *[% yes]*	*89.7%*	*85.1%*
·N	*37*	*30,520*
[in group of establishments where risk factor is present] routinely evaluated: dangerous chemical or biological substances [% yes]	*99.2%*	*90.1%*
·N	*14*	*13,026*
routinely evaluated: work postures, physical working demands *[% yes]*	*74.3%*	*75.7%*
·N	*37*	*30,594*
routinely evaluated: exposure to noise, vibration, heat or cold *[% yes]*	*75.7%*	*62.9%*
·N	*37*	*30,585*
routinely evaluated: supervisor-employee relationships *[% yes]*	*61.1%*	*54.8%*
·N	*37*	*30,260*
routinely evaluated: organisational aspects such as work schedules *[% yes]*	*77.0%*	*66.3%*
·N	*29*	*30,535*
Reasons for addressing health and safety: fulfilling legal obligation		
· Major reason	88.6%	86.2%
· Minor reason	2.0%	9.2%
· Not a reason	9.4%	4.6%
·N	40	40,169
Reasons for addressing health and safety: meeting expectations from employees		
· Major reason	75.6%	79.6%
· Minor reason	22.4%	15.2%
· Not a reason	2.0%	5.2%
·N	40	40,097
Reasons for addressing health and safety: increasing productivity		
· Major reason	44.0%▼	64.9%▲
· Minor reason	44.9%▲	22.0%▼
· Not a reason	11.1%	13.1%
·N	40	39,898
Reasons for addressing health and safety: organisation's reputation		
· Major reason	70.7%	77.3%
· Minor reason	21.8%	15.2%
· Not a reason	7.4%	7.6%
·N	40	40,295

	Rail sectors	All other sectors
Reasons for addressing health and safety: avoiding fines from the labour inspectorate		
· Major reason	63.9%▼	78.8%▲
· Minor reason	18.9%	13.7%
· Not a reason	17.2%▲	7.5%▼
·N	40	40,122
Difficulties in addressing health and safety: lack of time or staff		
· Major difficulty	39.4%▲	25.7%▼
· Minor difficulty	12.6%▼	32.3%▲
· Not a difficulty	48.0%	42.0%
·N	40	40,266
Difficulties in addressing health and safety: lack of money		
· Major difficulty	8.0%▼	22.9%▲
· Minor difficulty	25.5%	29.4%
· Not a difficulty	66.5%▲	47.7%▼
·N	40	40,093
Difficulties in addressing health and safety: lack of awareness among staff		
· Major difficulty	15.0%	17.8%
· Minor difficulty	49.9%	35.5%
· Not a difficulty	35.1%	46.7%
·N	40	40,326
Difficulties in addressing health and safety: lack of awareness among management		
· Major difficulty	13.0%	12.3%
· Minor difficulty	46.1%▲	25.6%▼
· Not a difficulty	40.9%▼	62.1%▲
·N	40	40,284
Difficulties in addressing health and safety: lack of expertise or specialist support		
· Major difficulty	13.1%	13.5%
· Minor difficulty	34.0%	28.2%
· Not a difficulty	52.9%	58.3%
·N	40	40,255
Difficulties in addressing health and safety: paperwork		
· Major difficulty	37.6%	29.0%
· Minor difficulty	27.5%	31.5%
· Not a difficulty	34.9%	39.5%
·N	40	40,234
Difficulties in addressing health and safety: complexity of legal obligations		
· Major difficulty	46.9%	40.3%
· Minor difficulty	17.4%	29.6%
· Not a difficulty	35.6%	30.2%
·N	40	39,849
In group of establishment with 20 or more employees: Do you have an action plan to prevent work-related stress? *[% yes]*	*40.2%*	*33.8%*
·N	*29*	*13,667*
Used measures for psychosocial risks: reorganisation of work [% yes]	48.5%	38.5%
·N	38	39,740

	Rail sectors	All other sectors
Used measures for psychosocial risks: confidential counselling for employees [% yes]	23.0%	36.7%
·N	32	39,715
Used measures for psychosocial risks: set-up of a conflict resolution procedure [% yes]	27.7%	29.7%
·N	32	39,793
Used measures for psychosocial risks: intervention if excessively long or irregular hours are worked [% yes]	42.9%▲	26.1%▼
·N	40	39,758
[In the group of establishments that used any of these prevention measures for psychosocial risks:] Did the employees have a role in the design and set-up of measures? *[% yes]*	*89.1%▲*	*64.6%▼*
·N	*26*	*24,109*
In group of establishments with health risks resulting from the way work is organised, social relations at work or the economic situation:		
Reasons making addressing PSR difficult: lack of awareness among staff *[% yes]*	*25.1%*	*26.2%*
·N	*36*	*30,300*
Reasons making addressing PSR difficult: lack of awareness among management *[% yes]*	*23.2%*	*17.4%*
·N	*36*	*30,519*
Reasons making addressing PSR difficult: lack of expertise or specialist support *[% yes]*	*25.7%*	*22.5%*
·N	*33*	*30,494*
Reasons making addressing PSR difficult: reluctance to talk openly about the issue *[% yes]*	*29.1%*	*30.3%*
·N	*36*	*30,423*
Do you have sufficient information on how to include psychosocial risks in risk assessments? [% yes]	82.2%▲	56.4%▼
·N	29	38,431
[If risk of 'Lifting or moving people or heavy loads' present:] Preventive measures for Muskuloskeletal Disorders (MSD): equipment to help with the lifting or moving [% yes]	90.9%	85.0%
·N	21	19,067
[If risk of 'Repetitive hand or arm movements' present:] preventive measures for MSD: rotation of tasks to reduce repetitive movements [% yes]	61.2%	56.7%
·N	19	20,731
Preventive measures for MSD: encouraging regular breaks for people in uncomfortable working position [% yes]	79.0%	70.3%
·N	40	39,886
Preventive measures for MSD: provision of ergonomic equipment [% yes]	92.0%▲	73.2%▼
·N	40	40,207
Are the health and safety representatives provided with any training during work time?		
· Yes	91.0%	82.2%
· No	1.7%▼	16.9%▲
· Yes, but only some of them	7.3%▲	1.0%▼
·N	29	22,976

	Rail sectors	All other sectors
And what about the employees themselves: On which topics does your establishment provide them with training:		
training topics: proper use and adjustment of their working equipment [% yes]	67.5%	67.2%
·N	40	40,053
[if risk of 'Chemical or biological substances in the form of liquids, fumes or dust' present:] training topics: use of dangerous substances [% yes]	86.5%	84.2%
·N	16	15,298
training topics: how to prevent psychosocial risks [% yes]	34.6%	36.9%
·N	38	39,851
[if risk of 'Lifting or moving people or heavy loads' present:] training topics: how to lift and move heavy loads [% yes]	97.3%▲	79.5%▼
·N	21	19,068
training topics: emergency procedures [% yes]	71.4%	81.3%
·N	40	40,268
Are health and safety issues regularly discussed in staff or team meetings?		
· Yes	69.8%	64.5%
· No	30.2%	34.2%
· In some departments only	0%	1.3%
·N	40	40,013
Rate the level of absenteeism in your establishment compared with other establishments in the sector		
· Very high	0.7%	1.2%
· Quite high	8.4%	3.4%
· About average	59.3%▲	21.7%▼
· Quite low	14.0%	27.0%
· Very low	17.6%▼	46.6%▲
·N	37	39,124

Annex 3 Results from the H2020 Skillful project

Table A3.1 Review of railway training schemes and programmes in different European countries identified by Skillful (2017) project

Country	Professional and apprenticeships[18]	Academic
Belgium	Current training in the rail industry has shown adequate opportunities for all job categories. Training opportunities oscillate around professional training for most of the job positions. • Professional training available: track inspector; timetable planner; train crew; and signalling planner & signalling inspector. • VET/CVET: vehicle design engineer, maintenance of rail vehicles; job categories of economics and administration • Gap: apprenticeships, as none of the courses classified as apprenticeships were present in Belgium.	SKILLFUL (2017, p.15) study identified that only one source of training (for research/teaching assistant - at the operational level) is available (professional training is provided by the University of Hasselt) in academia. College education is not widespread in the Belgian railway industry, only two job positions have college education available (i.e. maintenance of rail vehicles and administrative assistant). Training opportunities oscillate around university level training for most of the job positions.
Bulgaria	The railway sector in Bulgaria shows significant gaps. • Professional training and apprenticeship available: track inspector, rail vehicle maintainer, train crew member, signalling inspector, sales assistant, and admin assistant • GAP: VET and CVET courses not accessible in any work category. • GAP: lack of professional training courses and apprenticeships for other jobs. The good news is that all of the job positions have degree courses.	The University of Transport, Sofia/Bulgaria is the most dominant university when it comes to railway education in Bulgaria. The bachelor degree in railway from this university also offers the development of transferrable skills that can be used in various job positions.
France	• Professional training: well developed system • CET/CVET-level: well developed system.	SNCF has links with 15 universities to supply sufficient candidates for all technical areas.
Germany	• Professional training: only courses for the job categories of track inspector, maintenance of rail vehicles, locomotive engineer and train crew. • CET/CVET-level: track inspectors, timetable planners, train crew members, signalling inspectors, sales assistants and administration managers • Gaps: in apprenticeship levels, not present for all work categories. There is also a deficiency in professional training and VET & CVET.	Significant gaps are identified in college levels. There is a sufficient amount of university degree courses in Germany (e.g., BSc in railway engineering (Technische Universität Darmstadt), MSc in railway engineering (TU Darmstadt), BSc in rail and public urban transport (Technische Universität Dresden, Technische Universität Berlin) and MSc in rail and public urban transport (Technische Universität Dresden, Technische Universität Berlin)). There are also courses for the maintenance of rail vehicles, locomotive engineers, signalling inspectors, sale assistants and administrative assistants.

[18] CVET = continuing vocational education and training

Country	Professional and apprenticeships[18]	Academic
Greece	System does not provide comprehensive courses. There are not enough courses specializing in the rail industry. The courses are either very general or specialized in non-rail areas, for example, the civil engineering course. • Professional level: training track inspectors and research/teaching assistants. • No courses provided for the infrastructure planner, vehicle design engineer and timetable planner.	SKILLFUL (2017, p. 19) study found that Greece only provides one university's degree course. At the strategic level, degree courses are available for all the listed job categories in the study.
Ireland	Inhouse training: Irish Rail, who has a monopoly in terms of rail service provision, train their drivers and crew members. This training is provided in-house. No targeted courses in railway engineering or operations in Ireland. Generally the people working in these areas will have degrees in civil engineering or mechanical engineering and will then be trained by Irish Rail in the specifics of the job. This is similar for the jobs in rail signalling.	There are no rail-oriented university degree programmes in Ireland. There are only a few courses available in some of the job categories. Instead, students take bachelor degrees in civil engineering, with a focus on transportation. There are a number of engineering masters' courses in Irish universities (University College Dublin (UCD), Trinity College Dublin (TCD), National University of Ireland Galway (NUIG) and University College Cork, (UCC). These courses may not have a focus on rail but there are modules on transportation and rail within those programmes, including geotechnical modules with relevance to rail.
Italy	Italy has a number of courses available to meet the needs of the Italian rail industry. The rail industry in Italy has very well developed skills development opportunities. • Professional training: infrastructure planner, vehicle design engineer, timetable planner, signalling planner, sales director, administration manager, group manager; track inspector, maintenance of rail vehicles, train crew, signalling inspector, sales assistant, admin assistant, research/teaching assistant; managing director infrastructure, managing director vehicle's, managing director operations, managing director signalling, managing director commercial, managing director administration, dean/director. • VET/CVET courses: administration manager, group manager, managing director administration, dean/director. • Gaps: in apprenticeships.	Italy has a number of university courses available to meet the needs of the Italian rail industry: infrastructure planner, vehicle design engineer, timetable planner signalling planner, sales director, administration manager, group manager, managing director vehicle's, managing director operations, managing director signalling, managing director commercial, managing director administration, dean/director. Provided that these jobs do have existing courses or education opportunities, the rail industry in Italy has very well developed skills development opportunities, with gaps in college education.

Country	Professional and apprenticeships[18]	Academic
Netherlands	• Professional training: training courses are being developed for train drivers. • VET/CVET courses: trainings have been developed to train mechanics. • GAPS: most trainings do not supply sufficient candidates for need of rail organisations. These companies need to develop own internal training (for example: with Railcenter). Same applies for apprenticeships.	Most university courses are general in nature, not specific oriented at needs of rail organisations. A professorship is funded at Technical University of Delft. Some courses have been started at University of Applies Sciences Utrecht. At other universities courses started but stopped because of insufficient supply of candidates.
Poland	In Poland, the main employer of the railway industry is Polskie Koleje Państwowe Spółka Akcyjna – the Polish National Railway Company. Without much competition, the PKP S.A. dictate the terms and conditions of employment and provide their employees with both ongoing and entry-level training. Details of the training methods are a company secret. All training and courses on the strategic level are provided by the PKP S.A. (only at the operational level). At the tactical management the situation from the strategic level changes slightly. Anyone with a relevant degree can become an infrastructure planner, but further more precise training is provided by the company when hiring a prospective planner. There are a few companies that do their own vehicle design, one of which are Pesa Bydgoszcz S.A. They offer both professional training and apprenticeships. In order to enrol on these courses, candidates must hold a relevant education certificate and/or have experience. Admittance is awarded on the discretion of the company. For operational level, the situation is again dominated by the government-owned company PKP S.A. Most of the education available at the operational level is provided when accepted into the company. In recent years, Public Railway Technical Secondary Schools have regained their popularity. These schools expand the educational offerings relevant to rail every year. Currently, they provide courses to become a general railway technician and traffic controller. As well as vehicle maintenance courses. However, all of the courses are fairly flexible, allowing graduates to look for work in other industries as well.	For academia, no courses or trainings can be found on any level.

Country	Professional and apprenticeships[18]	Academic
Portugal	• It appears that Fernave are providing training courses for signalling planners. operational level, IST Lisbon and Fernave are providing courses. • Inhouse training: The rail company organises internal training for its employees. This process is undisclosed and not available in the public domain.	The Instituto Superior Técnico (IST) in Lisbon provides at the tactical and strategic level rail orientated courses. However, it is difficult to find any information on the courses available at the IP academy online. Railway engineering course are suitable for infrastructure managing directors.
Romania	There are no courses available at operational management level. Romania has a satisfactory quantity of courses available for tactical and operational management levels in the infrastructure job category. There are some gaps in the training available for managing director infrastructure (only university courses and VET/CVET are available).	In Romanian railway transport, the biggest education and training gaps can be found in academia. No college level education is present for any job positions in the railway industry in Romania. The only university course available is for a research/teaching assistant. Furthermore, in administration the only university courses available are at strategic and tactical management level. There are no administration assistant courses or economics courses. The only courses available are university courses at the strategic and tactical management level.
Slovakia	• In-house training Slovak Railways: track inspectors, signalling inspectors; with vocational training offered in Trinova, Kosice, Zoelen, Bratislava and Martin. For train crews, there is internal training of private railway operators and state-owned railway operators. There is also VET offered in many cities across Slovakia. • VET/CVET: all positions are provided (except for infrastructure planner and group manager- where the only courses are offered by UNIZA); sales and administration assistants in transport operation and economics, logistics and transport. • Gap: no professional training or apprenticeships at the tactical level in Slovakia. There is no regularity for training and education available at the operational level in Slovakia.	Courses for rail related jobs at the strategic level in Slovakia are offered by The University of Zilina. Gaps: managing administration director and dean/director at the strategic level. At the tactical level the only types of education and training that are offered in Slovakia are at university level (University of Zilina) and VET/CVET. All positions are provided for (except for infrastructure planner and group manager- where the only courses are offered by UNIZA). For maintenance of rail vehicles there is a course offered by The University of Zilina and there are apprenticeships offered by Stredná odborná škola železničná(SOSZ) Kosice. For the position of research/teaching assistant the only course is offered by The University of Zilina – PhD Or MSc in transport technics and technologies; and transport services.

Country	Professional and apprenticeships[18]	Academic
Spain	• EADIC have a track maintenance and infrastructure course online. Most of the course information can be found online easily. • Centro Formacion Profesionall (XABEC) and ADIF: a course for the maintenance of rail vehicles.	There are quite a few universities providing degree and masters courses for the rail industry in Spain. Courses are still missing in the operations, economics, administration and academia sector, which have room for improvement. • UPM: a master's degree in railway infrastructure provided by Universidad Politecnica de Madrid (UPM). • UPV: Universitat Politecnica de Valencia (UPV) is another university that provide degrees in civil and territorial engineering; rail vehicles design; degree in civil and territorial engineering; maintenance of technical facilities and infrastructures. • ADIF/UNED: Administrador de Infraestructuras Ferroviarias (ADIF) and Universidad Nacional de Educacion a Distancia (UNED): degree in engineering and railway maintenance services. ICADE-VPF (Universidad Pontificia Business School): a masters course in port management & intermodal transport.
Sweden	Sweden seems to have significant training and education gaps within the railway industry. • VET and CVET courses: present. • Inhouse training: entry-level and on-going training courses.	Almost no courses are available at management level. Alongside some unclassified other types of courses and university education for track inspector.
United Kingdom	In the United Kingdom there are many available educational courses and training for people interested in a career in the rail industry. • VET/CVET: managing director Infrastructure at Network Rail. • Professional and VET and CVET trainings: for tactical jobs by NewRail CPD. • Professional, apprenticeship and VET and CVET courses: at operational level college courses offered i.e. from Newcastle College; The Railway Consultancy LTD and Newcastle University Short Courses (CPD). Gaps; in professional training. • Gaps: no apprenticeships and VET & CVET available: vehicle designer profession; rail vehicle design; at tactical level.	There is a gap at college and university level, with just a few organisations offering courses at that level, i.e. Newcastle College, University of Birmingham and Sheffield Hallam University. Courses offered at higher education for railway careers are very limited in terms of professions offered to graduate. Gaps: no apprenticeships available; no training or courses available for deans/directors at all. There are not many courses at the tactical level available as well, with Newcastle University being an exception.

www.shift2rail.org