MIND4 CHANGE

Possible impact in railway sector

Source: Mind4change
Date: 16/12/2025
Reference: <RefXXXX>
Version: Final
No of pages: 17

INTERNATIONAL UNION OF RAILWAYS

KEY CONTRIBUTORS

Name	Company
Ignacio Hernandez (safety expert)	RENFE
Allan Armougum (Direction scientifique et de la recherche)	SNCF

CONTENTS

1. INTRODUCTION

1.1. SCOPE

As outlined in Deliverable 1, “Digital Revolution: How technology is redefining work and organisations”, under the section “Possible Impact on the railway sector”, the Mind4change Working Group examines how emerging technologies could reshape current job profiles.

The analysis focuses on frontline roles and management positions that contribute to safety performance, using the PDCA cycle as a framework for assessing railway safety-related professions.

This exercise is not intended to be exhaustive; rather, it provides an illustrative perspective on how technology might influence existing roles. It highlights technology as a potential driver of transformation within the sector. The following table offers examples of what this evolution could look like.

It is important to note that the analysis does not cover aspects that were beyond our ability to anticipate.

2. EXAMPLES OF POSSIBLE CHANGES IN EXISTING RAILWAY PROFESSIONS

2.1. FRONTLINE WORKERS/OPERATIONAL STAFF

		Operational Staff impacted	Possible change in future in existing professions	Impact on human role / organization
		General impact	1. Possible attention distraction due to new technologies environment (supplied by the company or personal devices). 2. Untrained staff in degraded situations of technology 3. Cybersecurity	1. Increased need for digital literacy and cybersecurity awareness; potential for decreased focus due to multitasking. 2. Increased risk of errors and decreased efficiency; need for improved training programs and emergency response protocols. 3. Greater emphasis on IT security roles; need for ongoing training to handle evolving threats.
OPERATION	**RU**	**Train Preparation** Shunter, Brake test, Loader, Wagon master, Dispatcher, Manoeuvres staff fleet manager, Shift planners, Depot controllers, Cleaners/train presentation,	4. Automatic coupling of vehicles instead of manual coupling (DAC project) 5. Automatic identification of vehicles in yards (augmented reality) to form a train. 6. Automatic set of brake changeovers (P/G, Load/empty, etc.) (e.g. robotics or devices on wagons according to data) 7. Predeparture checks assisted by technology (drones, artificial vision, …) 8. Optimization of manoeuvres sequence to form a train. 9. Driverless driving of locomotives / telematic driving from office 10. Previous knowledge of vehicles with brake problems by the shunter () 11. Automatic brake test 12. Automatization of switches movement 13. Automatic loading, automatization of cranes uses. 14. …	5. Reduced physical labour for staff; potential shift towards roles focused on monitoring and maintenance of automated systems. 6. Enhanced efficiency in train formation; staff will need training in AR systems and interpreting augmented data. 7. Decreased manual handling; shift towards system monitoring and troubleshooting roles. 8. Increase efficiency and accuracy in checks; staff will need to manage and interpret data from these technologies. 9. Streamlined operations; staff roles may shift towards oversight and optimization rather than manual coordination. 10. Significant reduction in manual driving; increased focus on system supervision and remote operations management. 11. Improved safety and efficiency; roles may shift towards data analysis and preventive maintenance. 12. Reduction of manual testing 13. Reduction in manual switching tasks; increased focus on system monitoring and troubleshooting.

				14. Reduced manual labor; roles may shift towards supervising automated systems and ensuring proper operation.
		Train Driving Train driver	15. Driverless driving 16. Predeparture checks assisted by technology. 17. Automatization of documentation (route book) 18. Increment of advice systems the driver (energy consumption efficient driving, “Google glasses”) 19. Automatic language translation in trans frontier traffics 20. Automatic issue of written orders	16. Major reduction in need for manual drivers; increased demand for remote operation and system management roles. 17. Enhanced efficiency: roles will require new skills in managing and interpreting technological data. 18. Reduced manual documentation; staff will focus on managing and verifying automated records. 19. Enhanced driving support: roles may shift towards managing and integrating these advisory systems into daily operations. 20. Facilitates communication; roles may involve managing translation systems and ensuring accurate communication. 21. Reduced manual order processing; focus shifts to overseeing system-generated orders and handling exceptions.
		Train Operation Train attendant, Onboard service (catering), Cleaning, Security staff, On-board instructors/ trainees, Customer service operatives, Revenue protection officers, Station/platform staff, Train guards.	22. Telematic assistance in crewless trains. 23. …	23. Improved operational support; roles may focus on remote monitoring and intervention as needed. 24. …
		RU Control Centre Train controller	25. Automatization of documentation (route book) 26. Automatization of processes in Control Centers 27. Remote driving from Control Centre 28. …	25. Enhanced efficiency in record-keeping; staff will need to adapt to managing automated documentation systems. 26. Streamlined operations; roles will shift towards overseeing and optimizing automated processes.

				27. Reduced on-site driving, increased focus on remote control and system supervision.
	IM	**Local Train Operation** Signaller, Level crossing operators/attendants	28. Optimization of manoeuvres sequence to form a train. 29. Automatization of tasks like confirmation of train completeness passing stations, control of train conditions when passing stations 30. Automation	29. Increased operational efficiency; staff will need to adapt to new procedures and oversight roles. 30. Enhanced accuracy and efficiency; roles will involve managing and responding to automated system outputs. 31. Increased efficiency; staff roles may shift towards managing and troubleshooting automated systems.
		IM Control Centre Regulator, train controller, Node logistics	32. Optimization of manoeuvres sequence to form a train. 33. Optimization of trains sequences. 34. …	33. Enhanced efficiency in train formation 34. Improved scheduling and efficiency; roles will involve overseeing and fine-tuning automated scheduling systems.
ASSESS	VEHICLES	**Inspection & Maintenance Staff:** Mechanics (mechanical fitters), Every-day / heavy maintenance, Engineers, Supply chain, Depot management, Electricians,	35. Optimize the inspection tasks according to information coming from sensors. 36. Use of drones for inspection purposes 37. Virtual reality / digital twins supporting maintenance 38. …	36. Enhanced precision in inspections; roles will shift towards data interpretation and system management. 37. Increased efficiency in inspections and monitoring; staff will need training in drone operation and data analysis. 38. Improved maintenance training and simulation; roles will involve managing and utilizing VR/digital twin systems. 39. …

	INFRASTRUCTURE	**Inspection & Maintenance staff** Track/signal box builders, Station/building managers, Corridor planners, Plant/ Tunnel/Bridge construction, Asset management, Train control systems, Bridges and structures, Buildings and facilities, CCS systems (interlockings, signals, control systems) GSM-R and analogue telephones, Electrical supply, etc.	40. Optimize the inspection tasks according to information coming from sensors. 41. Use of drones 42. Virtual reality / digital twins supporting maintenance 43. …	40. Reduces manual inspections; staff will focus on interpreting data and responding to issues flagged by sensors. 41. Reduces the need for physical inspections by humans, improving safety and efficiency; requires drone operation skills. 42. Shifts roles towards data analysis and simulation-driven planning, reducing manual, on-site inspections. 43. …

Note: In order to assess the feasibility of each of the possible changes in future in the existing professions, it is recommended to analyse according to the Gartner Hype Cycle for the specific technology involved. The implementation of each of the changes can be done using several combinations of technologies, referring to Gartner cycle to each technology and the state of maturity of this technology in the affected company.

2.2. MANAGEMENT STAFF

	Management Staff impacted	Possible change in future in existing professions	Impact on human role
	General impact	1. Need of information managements due to increase in information sources 2. Cybersecurity 3. Data Governance 4. …	1. Shifts human roles toward data analysis and interpretation, requiring advanced digital skills 2. Requires upskilling of staff in cybersecurity practices 3. New roles focused on compliance, data protection, and data quality and governance management 4. …
LEADERSHIP	**Leadership and commitment / Safety policy** Managers, Safety executives, Corporate comms, Strategy	5. Improve participation and reporting by use of IT social tools, etc. 6. …	5. Enhance collaboration, transparency, and real-time decision-making 6. …
PLANNING	**Actions to address risks** Safety experts	7. Digitalization of SMS, 8. Automatic control of safety barriers 9. …	7. Reduce manual safety tasks; requires oversight of automated systems 8. Switch from human involvement to managing and auditing safety processes in an automated way.
	Safety objectives and planning Safety experts	10. Improvement in setting safety objectives due to more information to work with. 11. …	10. Data-driven safety planning and more precise risk management 11. ...
OPERATION	**Operational planning and control**	12. See Annex A Frontline workers/ operational staff	12. ...
	Asset management	13. See Annex A Frontline workers / operational staff	13. ...

	Contractors, partners, & suppliers Procurement	14. Connection of QMS of the supplier to SMS. 15. …	14. More oversight and integration between suppliers, reducing manual quality checks 15. …
	Management of change Safety experts	16. Automatic control of safety impacts, efficiency of safety barriers 17. Digital simulation of changes 18. …	16. Relies more on simulations and automated systems to manage risks 17. Facilitates proactive planning and decision-making through simulation 18. …
	Emergency management	19. Use of technologies (drones, artificial intelligence, etc.) to manage emergencies 20. Use of technology (digital twins, etc.) to simulate possible emergencies 21. …	19. Enhances speed and accuracy of emergency response; humans focus on decision-making rather than execution 20. Enhances speed and accuracy of emergency response; humans focus on decision-making rather than execution 21. …
PERFORMANCE EVALUATION	**Monitoring / Internal auditing/ Management review** Auditors, Safety peers, Inspectors, Supervisors/ checkers,	22. Improvement in monitoring due to access to more data 23. Improvement in juridical register / TMCS data to monitor drivers and other personnel activity 24. …	22. Real-time, data-driven audits and evaluations replace manual checkups 23. Enhances real-time monitoring of operational staff and adherence to safety standards 24. …
IMPRO-VEMENT	**Accident investigation /Continuous Improvement** Investigators	25. Improvement of data acquisition to investigate accidents 26. …	25. Shifts role toward data analysis and reconstruction of accidents using advanced technologies 26. …

SUPPORT	**Competences / Training / Medical** Competence assessors, Trainers, Recruitment & selection, HR, Education/ training, instructors, Mentors, Coaches,	27. Improve monitoring and existing competences in the company. 28. Telediagnosis, automatic medical checks 29. Training at distance 30. Expansion of Digital training, AI training, … 31. Improvement of Driving and other professions simulation devices 32. …	27. Training and development shift toward digital and AI-enhanced platforms 28. Automation of health monitoring frees up medical staff for more complex cases 29. Increases access to personalized, remote learning options 30. Reduces risks associated with real-world training; staff focus on virtual and AI-based simulations 31. Reduces risks associated with real-world training; staff focus on virtual and AI-based simulations 32. …
	Documentation, communication and information Rule book and procedures management, Office IT, Corporate comms	33. Need information management due to the increase in information sources. 34. Possible new ways of releasing documentation and communication (more visual) 35. …	33. Greater focus on managing and distributing information effectively and visually 34. Greater focus on managing and distributing information effectively and visually 35. …
	Integration of human and organisational factors safety/ HOF experts	36. Analysis of the impacts of new technologies in exiting jobs. 37. …	36. Experts will need to assess how technologies alter the workforce, requiring more human-machine interaction analysis 37. …

Note: In order to assess the feasibility of each of the possible changes in future in the existing professions, it is recommended to analyze according to the Gartner Hype Cycle for the specific technology involved. The implementation of each of the changes can be done using several combinations of technologies. referring to Gartner cycle to each technology and the state of maturity of this technology in the affected company.

3. CURRENT AND FUTURE SCENARIO OF JOB PROFILES

Considering the current and the future scenario, Mind4change group have drafted some examples on how this evolution would be for some of the jobs listed in the “Operational staff impacted” and “Management staff” column of the two previous tables can be shown. There, an analysis of some jobs from different points of view can be found:

- Human,
- Activity/tasks & processes,
- Organisation and culture,
- IT Systems and tools and
- Competence and training

The job profiles analysed were:

- Rail quality & safety investigator
- Train driver
- Inspector
- Maintenance and repair engineer
- Signaller
- Trainer
- …

Below is shown how the format of the leaflets of the analyzed job profiles:

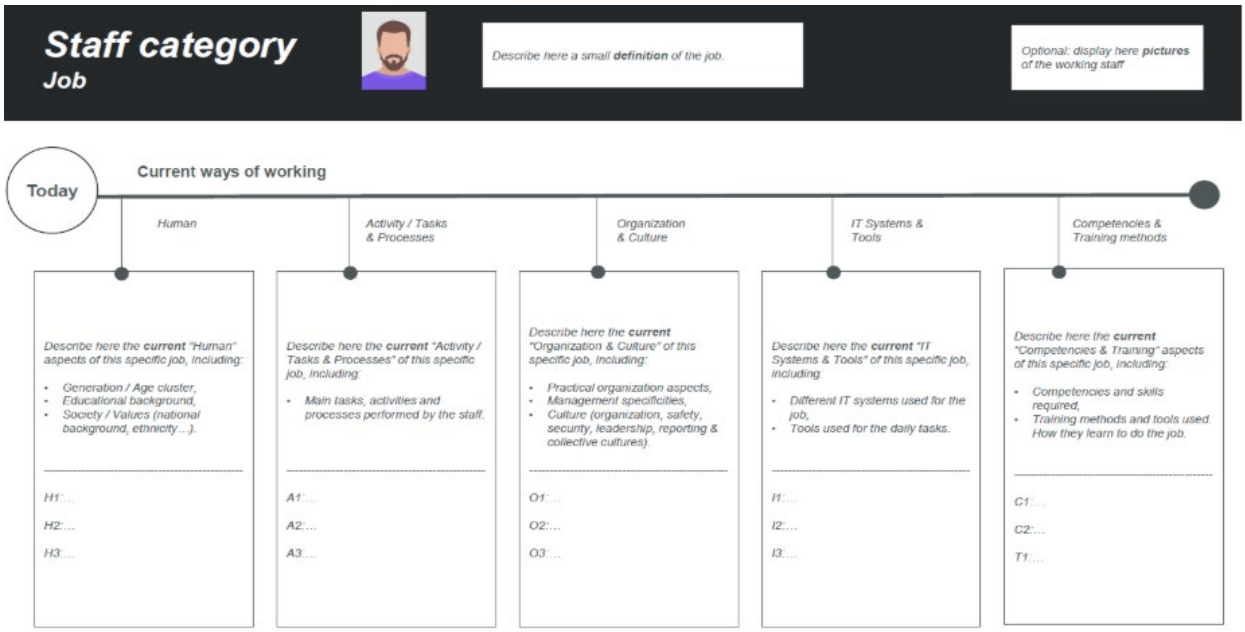

Figure 1 - Today's leaflet format for a specific job profile

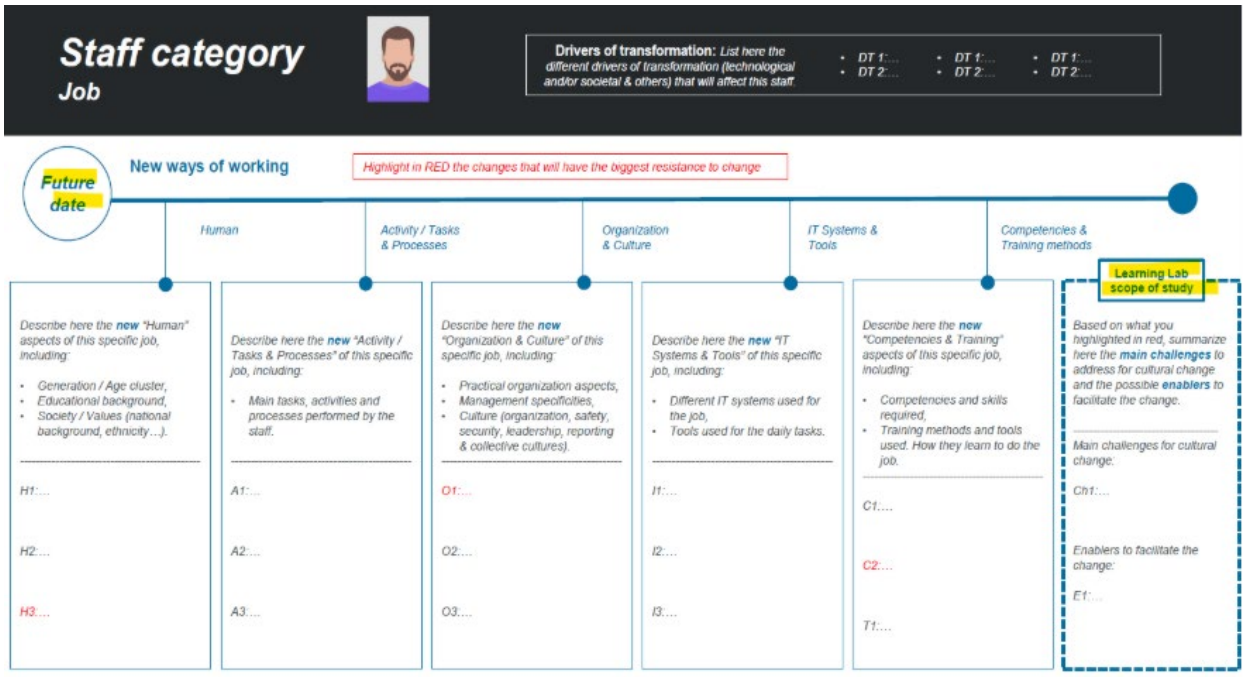

Figure 2 - Future leaflet format for a specific job profile

LIST OF FIGURES

LIST OF ABBREVIATIONS

PDCA	Plan, Do, Control, Act

CONTACT

Ignacio Hernández Vallhonrat

G. de Planificación, control de Sistemas y Análisis

Dirección de Planificación e Inspección de Seguridad en la Circulación

Madrid, Spain

ignaciohv@renfe.es