DigiRail(VET) Project

TRAINING PROGRAM FOR RAIL SYSTEMS SIGNALING MAINTENANCE PERSONNEL

Blended Learning Model Supported with Digital Training Materials

DigiRail

Co-funded by the Erasmus+ Programme of the European Union

TÜRKİYE ULUSAL AJANSI
TURKISH NATIONAL AGENCY

Project Number: 2020-1-TR01-KA226-VET-097591
Document Number: DigiRailVET.02

DIGIRAILVET

Vocational Training Program for Rail Systems Signaling Maintenance Personnel

BLENDED LEARNING MODEL SUPPORTED WITH DIGITAL TRAINING MATERIALS

www.digirailvet.com

This document has been prepared in the scope of Digitalizing on Railway Training Project (DigiRailVET) with the reference no. 2020-1-TR01-KA226-VET-097591.

DigiRailVET Project has been funded with support from the European Commission in the scope of Erasmus+ Program. However, the Commission and Turkish National Agency cannot be held responsible for any views contained therein.

Contents

Preface

Blended Learning Approach is an effective training model, which has been started to be applied worldwide as of the beginning of 2000s with the development of training technologies. This model has been established by blending the face-to-face training and online training Technologies. During the Covid-19 pandemic, this approach gained importance in terms of sustainability of the education; furthermore, it has provided an innovative impact on the education system, in particular; because it enriches the educational applications by bringing together different learning methods supported with digital training contents.

Blended learning approach aims to prepare the training materials in accordance with the online training process, and to achieve the learning outcomes that is just for the needs of the education by mixing theoretical and practical learning. During the life-long learning, teacher is no longer the only source of information. This is an important strategy of blended learning approach. Purpose of digital materials being used in the model should be transferred to the trainees in advance and they should be made aware of the necessity of learning those materials. Teacher must, as his primary task, no longer treat the information as an issue that is presented only by teacher and must guide the trainees as a facilitator.

This document has been prepared in the scope of Digitalizing on Railway Training Project (DigiRailVET) with the reference no. 2020-1-TR01-KA226-VET-097591. This program contains a blended learning model supported with digital training materials, which is specifically prepared for “Rail Systems Signalling Maintenance and Repair Personnel”, one of the important safety critical professions in railway sector.

Partners of DigiRailVET projects are as follows:

- TCDD | Training Department (Project Coordinator)
- TCDD Transport JSC | Eskişehir Railway Training and Exam Center
- CERTIFER SA | Railway Certification Company
- UNIVERSITY OF ZAGREB UNIZG | University of Zagreb, Faculty of Transport and Traffic Sciences

This project is funded by European Commission in the scope of Erasmus+ Program.

Purpose of DigiRailVET project is to create a blended education system, which brings in-class and digital learning together in railway sector. In the scope of this project, “blended training programs” have been prepared for five different railway professions in conformity with European qualifications framework, and digital training contents have been developed.

DigiRailVET Project Consortium

www.digirailvet.com

References

- Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety
- Commission Implementing Regulation (EU) 2019/773 of 16 May 2019 on the technical specification for interoperability relating to the operation and traffic management subsystem of the rail system within the European Union

  Appendix G: Minimum elements relevant to professional qualification for the task of preparing trains
- National Occupational Standard for Rail Systems Signalling Maintenance and Repair Personnel with reference no. 12UMS0235-4 published on Official Gazette of Republic of Turkey numbered 28402 of 05.09.2012
- National Competency for Rail Systems Signalling Maintenance and Repair Personnel with reference no. 15UY0233-4 of 30.09.2015 published by Vocational Qualifications Authority of Turkey

Terms and Definitions

EU: European Union

Digital Training Material: It is the type of training content, which does not require trainer and trainee to be at the same place at the same time and can be delivered by means of smart phones, tablets, computers or smart TVs in the location to be determined by everyone with internet access, without any physical location or time limit.

ERTMS: European Rail Traffic Management System

ETCS: European Traffic Control System

Blended Learning: It is, as a simple definition, to enrich, in other words, to blend the traditional training method with online (digital) training materials, which is also called mixed learning and hybrid learning.

Interlocking: Control unit of the signalization systems.

Switch Control Systems: The control systems for switches in the signaling systems.

Signaling systems; It is a qualified person who has the knowledge and skills to carry out assembly and disassembly works of signaling systems in accordance with the project, to carry out periodic maintenance of all equipment belonging to the systems in order to keep them ready for operation, to detect and repair faults.

Train Detection Systems: It is the sub-system that detects the presence of vehicles moving in rail systems and transmits them to the control/monitoring system with the signaling system.

TSI: European Union Technical Specifications for Interoperability.

Qualifications: Quality and experience required for undertaking the task to be performed in a safe and reliable way.

1. Introduction

Railway infrastructure operators and train operators are responsible for educational level and qualifications of the personnel who conduct safety critical tasks in accordance with Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety. Member States should make available the necessary training and licensing process for railway personnel in order to meet the requirements in the scope of national rules.

Training programs are prepared in line with the national qualifications planned for railway vocations based on directives, TSIs and national rules. It contains the subjects such as information on railway infrastructure, operational rules and procedures, signalling and control-command systems and emergency procedures.

Training the personnel performing safety critical personnel constitutes great importance in railway transport activities. These personnel work on the components that may have direct impact on the safety. Therefore, all railway operators are obliged to define safety critical tasks in the scope of safety management system in their companies taking into account their scope of activities and possible risks. Safety critical personnel must have certain qualifications such as training, health and psycho-technics.

Rail Systems Signaling Maintenance and Repair Personnel is responsible for the assembly and disassembly works of the signaling systems in accordance with the project within the framework of occupational health and safety, environmental protection, quality rules and methods. It is a safety critical job that covers keeping the signaling system ready for the operation, making the periodic maintenance of all equipment of the systems, the detection and repair of malfunctions. Rail Systems Signaling Maintenance and Repair Personnel is responsible for the accuracy, timing and quality of his/her work. He/she works in accordance with the work instructions while conducting of the transactions, and when faced with extraordinary situations, he/she uses a limited amount of initiative in matters that fall within his/her area of responsibility. Informs the relevant people about the matters that fall outside of his/her area of responsibility. It is also among their responsibilities to take their own work safety measures and contribute to the work safety of other people they work with.

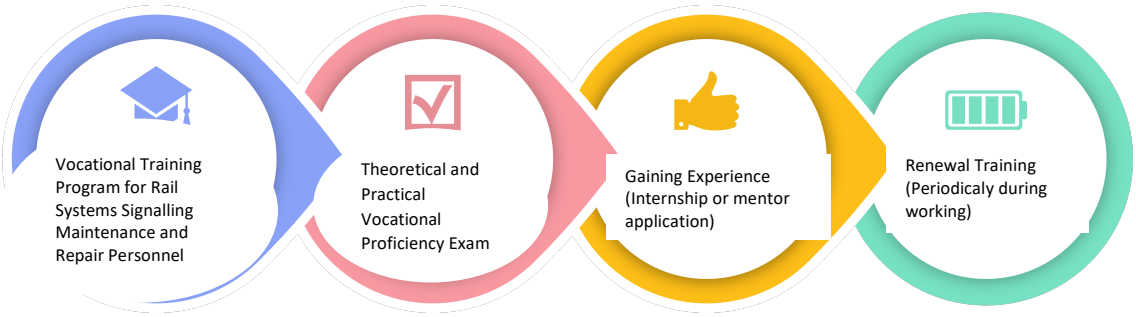
General program structure of theoretical and practical training for Rail Systems Signalling Maintenance and Repair Personnel's profession, qualification units, knowledge, skills and competency to be obtained as well as the blended learning program supported with digital training contents are described in this document. The document hereby defines technical knowledge and skills required by Rail Systems Signalling Maintenance and Repair Personnel in accordance with directives, TSIs and national rules.

This document also describes the knowledge and skills to be obtained, purpose, time, content (scope) of each sub-qualification units (unit) of the training program that will be

implemented in the form of qualification units (modules) as well as the teaching method and digital training materials to be used.

2. General Structure

It is necessary to get the theoretical and practical training and to pass the theoretical and practical exam that is made by an independent competent certification body in order to have the qualifications that are required by Rail Systems Signaling Maintenance and Repair Personnel's profession and to obtain Vocational Qualification Certificate. For obtaining the certification in this field, it is also required to have a certain work experience apart from the vocational qualifications. It is suggested to have this experience through on-the-job apprenticeship activity or mentor system. Moreover, it is important to monitor the qualifications of personnel and keep those qualifications updated by means of refresher trainings.



The most important innovation on the Rail Systems Signaling Maintenance and Repair Personnel training and certification process that is introduced by DigiRailVET Project is digital education practices. It is advised to use digital training materials prepared in the scope of the project efficiently during the basic vocational training and refresher trainings. In this project, a learning approach that is supported with the developed digital training materials and mixed with the face-to-face and online training process has been adopted.

Blended Learning Program for Rail Systems Signaling Maintenance and Repair Personnel contains various digital training materials. A slot of 59 hours is planned for the digital training in this program. Trainees will be able to access the asynchronous training contents, by means of their personal computers, which will be available on the online training platform, besides, a part of other digital training materials, which are

prepared with VR, and video technologies may be used in the classroom as well. Around 40 per cent of the basic vocational training program is allocated for utilizing the digital training contents.

- Rail Systems Signaling Maintenance and Repair Personnel will have opportunity to access the digital training contents whenever, wherever and to the extent, they want.
- Furthermore, it will allow them learn at their own pace and control their learning process.
- They will be able to access the sources related to the lesson in a flexible way thanks to the active learning medium.
- It will help candidates (learners) consolidate the knowledge they get during the face-to-face education and make them prepared for the next lesson.
- Therefore, they will be able to make more group activities, discussions, creative problem solving etc. in the classroom, and this will allow using the duration of the lesson efficiently.

3. Conditions for Participating the Training

It is assumed that health and mental conditions as well as physical conditions of the candidates are on a certain level that may not avoid them joining the training. However, the candidate must certify that he/she meets the health and psycho-technic requirements that are specified according to related directive, TSI and national rules for taking the theoretical and practical exams after the training.

It is obligatory to hold a diploma of secondary education and to be at least 18 years old for joining the training. Participants must have good knowledge on the language of the lesson both in written and verbal form.

4. Instructional Schedule

Training Program for Rail Systems Signaling Maintenance and Repair Personnel contains 93 hours of theoretical and 42 hours of practical training sections as seen in Table-1. Both sections are divided into units that are composed of the proposed training durations.

The duration proposed for having a certain lesson in the practical training section shows the approximate duration that is needed for reaching the expected knowledge level. This amount of time may change in order to receive the required knowledge and skills depending on the potential of the trainee.

Each lesson hour consists of 50 minutes where the training is done directly. It is not necessary to follow the subjects according to the order given in this guide.

Among a total of 135-hour of training duration, it is planned to have 42 hours of practical and 34 hours of theoretical training face-to-face in a classroom environment. Theoretical

training in the classroom, it is aimed to consolidate the knowledge obtained during the online training which is supported with digital trainings. Trainer will focus on ensuring the permanence of the information obtained from online training and comprehension of the theoretical subjects effectively.

It is important that the trainer must plan the online training process in a suitable way and guide the trainee. Trainer must frequently check whether the trainees reach the desired knowledge and competency level by using digital training contents in asynchronous and synchronous training environments.

Table 1: Blended Training Program for Rail Systems Signaling Maintenance and Repair Personnel

Qualification Unit	Unit	Proposed hours		Method	
		Theoretical	Practical	Face-to-face	Online
OCCUPATIONAL HEALTH AND SAFETY	Occupational Health and Safety	9	-	-	9
	Basic First Aid	2	-	-	2
	Environmental Protection	1	-	-	1
	Total Lesson Hour of Qualification Unit	**12**	**-**	**-**	**12**
RAILWAY SYSTEM COMPONTENTS	Railway Infrastructure/Superstructure	6	-	2	4
	Rolling Stock	6	-	2	4
	Basic Railway Traffic	6	-	2	4
	Basic Railway Signalling	6	-	2	4
	Basic Railway Electrification	6	-	2	2
	Total Lesson Hour of Qualification Unit	**30**	**-**	**10**	**20**
MAINTENANCE OF SIGNALIZATION SYSTEMS	Signaling System Center and Track side Equipment	12	6	$6_{(T)}$ $6_{(P)}$	6
	Maintenance and Repair of Signaling Systems	12	18	$6_{(T)}$ $18_{(P)}$	6
	Energy Resources of Signaling System	6	6	$3_{(T)}$ $6_{(P)}$	3
	Train Protection and Control Systems	6	6	$3_{(T)}$ $6_{(P)}$	3
	ERTMS/ETCS	6	6	$3_{(T)}$ $6_{(P)}$	3
	Total Lesson Hour of Qualification Unit	**42**	**42**	**63**	**21**
RAILWAY SAFETY	Operational Safety and Communications in Railways	6	-	3	3
	Emergency Procedures	3	-	-	3
	Total Lesson Hour of Qualification Unit	**9**	**-**	**3**	**6**

Total Hour	93	42	76	59
	135			

5. Digital Training Materials

In blended learning system, face-to-face education should be supported and enriched with online materials. In Blended Training Program for Rail Systems Signaling Maintenance and Repair Personnel, trainers are expected to use digital training materials and web 2.0 technologies efficiently.

Approximately 40% of the Blended Training Program for Rail Systems Signaling Maintenance and Repair Personnel consists of online trainings. Trainer is expected to follow online training process, come together with the trainees by means of virtual classroom activities, benefit from the digital training materials, and web 2.0 technologies in the classroom as well.

Trainers must be supported on the usage of web 2.0 technologies and developing the new materials apart from the digital training materials that are already prepared in the DigiRail Project.

By implementing the Blended Training Program for Rail Systems Signaling Maintenance and Repair Personnel effectively, it may be possible to create a dialogue and discussion environment instead of transferring the information solely, create opportunities for students to express themselves, and allow a learning experience that conforms to the target groups, quality and aims of the training by means of digital materials.

- It is allowed to increase the readiness and knowledge levels of trainees before face-to-face training.
- Trainees perform a face-to-face site activity with the trainer for practicing the knowledge they received, after the completion of an online module.
- Trainees interact with each other by sharing the knowledge about the training program on an online platform.
- Trainer and trainees who gather by means of virtual classroom applications may proceed the lesson in a live and interactive way or questions of the trainees may be answered simultaneously.
- Using the digital materials results in active participation, improving the thinking skills, increasing the attention and motivation of the trainees for the lesson.
- Using these materials in the classroom is important because it concretes the subject, which is assumed to be abstract, simplifies the contents, presents an economic and a multiple learning medium etc.

Table 2: Digital Training Applications for OHS Qualification Unit

Qualification Unit	Content	Target Achievements	Digital Training Material
OCCUPATIONAL HEALTH AND SAFETY	1. Occupational Health and Safety 2. Basic First Aid 3. Environmental Protection	B1. He describes the legal regulations about occupational health and safety. B2. He describes the importance of cleaning and tidiness of the workplace. B3. He knows the risk factors and ways of protection. B4. He recalls the reasons of occupational accidents and protection techniques for them. B5. He recalls the security and health signs. B6. He knows the importance of using personal protective equipment. B7. He tells the emergency, evacuation and rescue rules. B8. He describes the reasons and protection methods for occupational diseases. B9. He describes the environmental protection standards and methods. B10. He recalls the importance of first aid and basic first aid rules.	- **Interactive Content:** Interactive contents, which include sample practices for shunter profession, will be presented to trainees on a platform to let them obtain the target achievements. - **Online Test:** These are interactive tests which aim to improve the awareness as well as the comprehension of basic concepts of OHS (drag-drop, matching etc.).

Table 3: Digital Training Applications for Railway System Components Qualification Unit

Qualification Unit	Content	Target Achievements	Digital Training Material
RAILWAY SYSTEM COMPONENTS	1. Railway Infrastructure/ Superstructure 2. Rolling Stock 3. Basic Railway Traffic 4. Basic Railway Signalling 5. Basic Railway Electrification	B1. He describes the basic concepts about infrastructure and superstructure of railways. B2. He describes the main parts, functions and types of railway switches. B3. He describes the visible irregularities and failures that occur on the tracks. B4. He describes the types and dimensions of railway gauges. B5. He describes the types and varieties of locomotives and wagons. B6. He describes the inscriptions, signals and symbols on the wagons. B7. He describes the main parts and functions of wagons. B8. He describes the traffic operation systems and their general characteristics. B9. He explains the development of signaling systems. B10. He knows the types of signals, color aspects and their meanings. B11. He remembers the components of railway electrification systems. B12. He explains the working rules in the electrification zone	- **Interactive Content:** Interactive contents which include sample practices will be presented to trainees on a platform to let them obtain the target achievements. - **WebGL:** These are 3-d learning concepts for allowing the trainees walk around on the railway line virtually and recognize the basic railway components, look into the railway vehicles and know the signalling and electrification installations as well as signals by means of their personal computers. - **VR:** These are gamification activities that have been prepared for detecting the visible irregularities and failures along the railway line, in a classroom environment. - **Modelled Line:** This is a video training content of a modelled line that has been prepared for learning the signs, signals along the railway line and their meanings. - **Online Test:** These are interactive tests, which aim to facilitate the learning of basic concepts and signals (drag-drop, matching etc.).

Table 4: Maintenance of Signaling Systems Qualification Unit Digital Training Applications

Qualification Unit	Content	Target Achievements	Digital Training Material
MAINTENANCE OF SIGNALIZATION SYSTEMS	1. Signaling System Center and Track side Equipment 2. Maintenance and Repair of Signaling Systems 3. Train Protection and Control Systems Energy 4. Resources of Signaling System 5. ERTMS/ETCS	B1. He knows the central and track side equipment of the signaling system. B2. He explains the assembly and disassembly processes of signaling systems. B3. He explains the points to be considered in the periodic maintenance and repair of signals. B4. He explains the points to be considered in the periodic maintenance and repair of train detection systems B5. He explains the points to be considered in the periodic maintenance and repair of switch control systems. B6. He explains the maintenance processes of central and local control monitoring systems and subsystems. B7. He explains the points to be considered in the periodic maintenance and repair of interlocking systems. B8. He knows the general features of train protection and control systems. B9. He explains the points to be considered in the periodic maintenance and repair of train protection and control systems. B10. He knows the specifications and levels of ERTMS/ETCS. B11. He explains the points to be considered in the periodic maintenance and repair of ERTMS/ETCS system components.	- **Interactive Content:** Interactive contents, which include sample practices, will be presented to trainees on a platform to let them obtain the target achievements. - **Video Training:** These are the video training contents, which explain the shunting process, coupling and uncoupling of railway vehicles, introduction and usage of railway switches. - **VR:** These are virtual reality activities that have been prepared for allowing the trainees couple and uncouple the railway vehicles safely in a classroom environment. - **Online Test:** These are interactive tests, which aim to facilitate the learning of shunting operations (drag-drop, matching etc.).

Table 5: Digital Training Applications for Railway Safety Qualification Unit

Qualification Unit	Content	Target Achievements	Digital Training Material
RAILWAY SAFETY	1. Operational Safety 2. Safety Critical Communications 3. Emergency Procedures	B1. He recognizes the importance of working safely in railways. B2. He recalls the railway safety management system components and requirements. B3. He describes the safe distances. B4. He recalls the safety critical tasks and requirements. B5. He describes the rules and procedures to be followed in safety critical communications. B6. He recalls the emergency procedures. B7. He describes the emergency notification process.	- **Interactive Content:** Interactive contents, which include sample practices, will be presented to trainees on a platform to let them obtain the target achievements. - **Sample Accident Animation Films:** These animation films have been prepared for working on the sample accidents in an individual and group activity in order to create a safe working awareness and safety culture. Here, the main purpose is to learn from accidents. - **Online Test:** These are interactive tests, which aim to facilitate the learning of shunting operations (drag-drop, matching etc.).

6. Practical Training

In the blended training approach, main purpose is to arrange the training materials in compatible with the online process, and to target the achievement that fits the needs, by mixing the theoretical and practical learning. In this scope, learning process must be supported by handing the digital materials to the trainees in advance and as well as with the theoretical trainings in the classroom. In this process, teacher must no longer treat the information as an issue that is presented only by teacher and must guide the trainees as a facilitator. However, it is necessary that a “Rail Systems Signaling Maintenance and Repair Personnel” which is among the safety critical tasks in railway sector should take a comprehensive practical training accompanied by a trainer and a qualified instructor. Training process of Rail Systems Signaling Maintenance and Repair Personnel whom conducts duties that may have a direct impact on the personnel and operational safety should be planned to allow them learn by practicing and experiencing. Therefore, one third (42 hours) of the blended training program is allocated completely for practical training.

Rail Systems Signalling Maintenance and Repair Personnel must participate personally in the following practical trainings in the framework of occupational health and safety:

i. Signals Maintenance and Fault Detection
ii. Maintenance and Fault Detection of Switch Systems
iii. Maintenance and Fault Detection of Train Detection Systems
iv. Maintenance of Energy Resources
v. Maintenance and Fault Detection of Train Protection and Control Systems
vi. Maintenance of ERTMS/ETCS Components

The Rail Systems Signalling Maintenance and Repair Personnel is responsible for accuracy, timing and quality of the works he is performing. He must be subject to an on-the-job training accompanied by a qualified instructor following the practical training in order to conduct the works according to the work instructions, accurately, timely and safely.

Practical training that is suggested in this guide to be delivered must allow the trainees achieve the skills that they may need during their working life.

7. Qualifications of Trainers

Trainers must have the following qualifications:

- Full competency on the specific field,
- Experience on adult education,
- Good skills of preparing digital training materials and in-class Web 2.0 applications,
- Competency on presenting the theoretical knowledge and practical skills together with digital contents in accordance with “Trainer’s Guide to Blended Learning Model Supported with Digital Training Materials”.

8. Exams and Certification

Candidates who intend to have Rail Systems Signalling Maintenance and Repair Personnel Certificate are subject to theoretic and practical exams that are defined in the scope of national rules of the Member States.

In case of non-availability of any defined national rules, it is suggested to realise an evaluation process according to the following conditions:

- A theoretical exam must be done for each qualification unit. Theoretical exams must be prepared to include all target behaviours on knowledge level that are desired to be achieved with the training program.
- The candidates who passes the theoretical exams must be subject to a single exam that is prepared comprehensively and based on performance.
- Candidates must accomplish all theoretical and practical exams in order to get the qualification certificate.
- Program completion certificate must be issued for all candidates who accomplish the exams. Furthermore, the candidates must be informed about other certificates that are required for working in railway sector in accordance with national rules.