

ACTUATE

Intelligent Energy – Europe programme

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REPORT

D2.1: Report on minimum criteria and learning outcomes for safe eco-driving trainings

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Advanced Training and Education for Safe Eco-driving of Clean Vehicles



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1) Introduction

This report presents the development and the definition of the minimum criteria and learning outcomes for safe eco-driving trainings for clean vehicles in the course of the project ACTUATE.

ACTUATE focuses on the importance of safe eco-driving of clean vehicles and provides public transport operators with the opportunity to introduce and test safe eco-driving trainings. Starting from the principle functions of clean vehicles, ACTUATE develops training materials and raises awareness about the role of drivers in improving the environmental performance of vehicles. Besides technical improvements, the correct vehicle handling in terms of safety and eco-driving has a distinctive influence on both aspects the environment protection and the economics due to energy savings and optimised operation costs.

It's a general expert opinion that eco-driving in terms of skills of vehicle handling and driver behaviour as measure for environment protection will gain in importance in the future (ACTUATE expert questionnaire result progress; in progress).

Therefore, the safe eco-driving training programmes of ACTUATE shall raise awareness for the knowledge, skills and competencies necessary to perform safe eco-driving as a professional driver of the clean vehicle types tram, hybrid bus, trolleybus or ebus equipped with supercapacitors.

The following report describes a set of minimum criteria and learning outcomes – jointly defined by the ACTUATE partners as a minimum quality standard for the development of safe eco-driving trainings for clean vehicles.

How to use this document?

This report is addressed to other public transport operators or driving schools who wants to start a safe eco-driving training programme for their clean vehicles. It explains against which background the ACTUATE partners developed the minimum criteria and learning outcomes for safe eco-driving trainings for clean vehicles and it is meant to be a complete description of the criteria and learning outcomes in a comprehensible way. Furthermore, conclusions are given how to use these minimum criteria and how to amend or modify them, in case particular internal/external circumstances requires it.

2) Background

The arrival of alternative and clean fuels, new and renewed vehicle technologies (CNG, electricity, hybrid etc.) helps reduce energy consumption, greenhouse gas emissions and noise pollution. These new technologies require adaptation of how to use them in the best way. Professional driver training has to consider and to react on these new technologies and other changes in the work organization.

Consequently, the introduction of new clean vehicles, like hybrid buses or trolleybuses, is accompanied by increasing demands into the qualification of professional drivers concerning driving behaviour or new safety standards. But, so far no specific requirements and vocational/further trainings for safe eco-driving of clean vehicles exist (so far only eco-driving training programmes for diesel buses exist and with regard to workshop/maintenance safety regulations)¹.

For this reason, the ACTUATE partners develop safe eco-driving training programmes for clean vehicles on their own initiative to optimise energy use of their clean vehicle types and by this also to contribute to emission reduction.

Even though, the directive 2003/59/EC (Directive 2003/59/EC of the European Parliament and the Council of 15 July 2003 on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers, amending Council Regulation (EEC) No 3820/85), which regulates basic and continuous (vocational) training for professional drivers in Europe, identifies eco-driving as a mandatory further education module², the implementation of the directive varies strongly from country to country and so far did not overcome a diverse qualification and training situation in Europe. In addition, these basic standards for

¹ Besides the introduction of a new clean vehicle by the manufacturers (which varies from several hours to several days).

² Eco-driving is part of the list of subjects of minimum qualification and training requirements (Annex I) of EU-Directive 2003/59/EC.

qualification and vocational training do not cover the challenges of new vehicle technologies, in so far as existing eco-driving trainings and training materials are focused on diesel-engine vehicles and are not adequate for clean public transport vehicles.

Moreover, the directive 2003/59/EC primarily describes input parameters such as contents to be addressed, duration of training or formal requirements on training providers, but provides no information what the (learning) result of the drivers' qualification/training is supposed to be or what kind of abilities the driver should have. Directive 2003/59/EC neither describes learning outcomes nor learning objectives to be reached or assessed by the drivers' training that could provide the necessary common denominator for professional driver qualification. Therefore, directive 2003/59/EC provides not the necessary basis for a real common minimum qualification standard of professional drivers throughout Europe.

Therefore, it was from the beginning of ACTUATE the aim of the partners to define a set of minimum criteria and learning outcomes as a minimum quality standard for the development of safe eco-driving trainings for clean vehicles. The ACTUATE partners oriented themselves to the wide accepted European Qualification Framework (EQF)³ approach "knowledge", "skills" and "competences" for the definition of common learning outcomes of safe eco-driving trainings for clean vehicles. The consideration and implementation of the defined set of minimum criteria and learning outcomes as a minimum quality standard is an important factor to ensure sustainability of ACTUATE's safe eco-driving training programmes for clean vehicles in periodic training (and initial qualification) of professional drivers in the public transport sector.

³ The European Qualifications Framework is a common European reference framework which links countries' qualifications systems together. It acts as a translation device to make qualifications more readable and understandable across different countries and systems in Europe. It has two principal aims: to promote workers' mobility between countries (among others in order to overcome skill shortage within Europe) and to facilitate citizens' lifelong learning. The EQF proposes a shift to learning outcomes to overcome this difficulty and to make comparison between qualifications possible based on the learning outcomes they stand for. (The European Qualification Framework for Lifelong Learning. Available at http://ec.europa.eu/eqf/documentation_en.htm (21/06/2013))

3) Development of minimum criteria and learning outcomes for safe eco-driving trainings

The process to define the minimum criteria and learning outcomes included a 1st working session during the kick-off workshop of the ACTUATE project (June 2012), during which all partners brainstormed two aspects of minimum criteria:

1. with regard to their internal requirements and
2. with regard to the specific vehicle type.

In addition, first learning outcomes were suggested during this working session. The learning outcomes are described in the categories of the European Qualification Framework (EQF; see also chapter 4.4): skills, knowledge and competencies (that tram and bus drivers should have achieved at the end of an ACTUATE training).

Subsequent to this, the collected minimum criteria and learning outcomes have been clustered and integrated into one overview table, which has been reviewed by all project partners and additional criteria and learning outcomes could be added (also per vehicle type). After this, a 2nd review started and a first completed draft was discussed during a telephone conference, during which all partners agreed on the criteria and learning outcomes as the basis for the development of ACTUATE's trainings for safe eco-driving of clean vehicles.

It is up to the partner organisation whether more criteria, due to internal reason, or more learning outcomes will be defined for the local trainings. In case an external organisation, e.g. public transport operator or driving school, would like to develop trainings for safe eco-driving of a clean vehicle type, the minimum criteria and learning outcomes defined by the ACTUATE partners could be used as a starting point and supporting document.

The minimum criteria defined by the ACTUATE partners include the following categories:

- Aim of trainings
- Requirements
- Learning objectives
- Learning Outcomes
- Educational principles
- Assessment
- Organisational Framework
- Certification
- Standardisation

In the following for each of these categories the rationale and first conclusions – based on first experiences made by the ACTUATE partners – are described. In this way, the minimum criteria are not only indicators for a minimum quality standard, but the reader can understand against which background(s) the criteria have been developed and – if available – the practicability of these criteria is given. All of these categories, besides “aim of the trainings” and “requirements”, could be specified per clean vehicle type by the ACTUATE partners.

4) Minimum criteria and learning outcomes for safe eco-driving trainings

4.1) Aim of the trainings

Rationale

The ACTUATE partners defined an overall aim for the ACTUATE trainings, which is basis for the design and evaluation of the training. The aim gives a general indication of what may be learnt by the training participants (drivers) in terms of safe eco-driving of clean vehicles, but do not give any details or means of assessing whether the learning has been successful. The assessment of the learning outcomes is used for this purpose.

The overall aim and purpose of ACTUATE's trainings for safe eco-driving of clean vehicles is: *"To impart knowledge and stimulate skills and expertise in energy-efficient, eco-friendly and safe driving of clean vehicles"*.

It is up to the partner organisations whether the training organiser/operator sets up sub-aims which will support the achievement of the overall aim as stated above.

4.2) Basic requirements for trainings

Rationale

The basic requirements defined by the ACTUATE partners can be considered as pre-conditions to start the trainings. The main purpose of the eco-driving training should be to optimise energy consumption through an optimised trained driving behaviour of the clean vehicle (different types). To prove and document such impact of an optimised trained driving behaviour of the clean vehicle, pre-surveys or tests measuring the energy consumption related to different driving behaviours/styles should be carried out before the training development starts.

Training material of course is needed to carry out the trainings for eco-driving and also related to the second aspect of the ACTUATE trainings, to inform about safety aspects that come along with the introduction of new clean vehicles (e.g. safety aspects regarding the safe handling of high voltage components in case of accidents etc.). The training materials for safe eco-driving of clean vehicles will be developed in the course of the ACTUATE project.

Furthermore, pre-instruction and briefing of trainers and technical experts by bus and tram manufacturers about specifics of the clean vehicle types is needed beforehand. ACTUATE will develop a fact sheet for a best-practice handover incl. basic information needed from the industry by trainers and technical experts to use the clean vehicle type optimally and to train drivers to drive the clean vehicle safely and energy-efficiently.

Finally, only drivers that are on duty on the clean vehicles should be trained in safe eco-driving of clean vehicles. This means that a "critical mass" of clean vehicles and drivers has to be reached by a public transport operator to carry out the trainings in-house in an efficient way. E.g., BBG operates 120 buses of which 12 buses are trolleybuses (however, 40% of all passengers of the BBG network are using the two trolleybus lines every day) and the 30 drivers of the total employed 120 drivers at BBG who are driving these 12 trolleybuses will be trained (during two sessions with each 15 drivers). Otherwise, the ACTUATE partners recommend external training for chosen drivers.

Requirements	Trainings shall maximise energy savings by eco driving
	Training material for safety aspects of clean vehicles
	Training material for specific bus types and tram control technology
	Pre-instruction and briefing of trainers and technical experts by bus and tram manufacturers about specifics of vehicle types
	Training only for drivers that are on duty on clean vehicles

Table 1: Requirements for trainings

The requirements were defined by the partnership as shown in table 1.

Conclusions

The following documents/materials can be used by public transport operators and/or driving schools to fulfill the defined basic requirements and to start their internal development of training programs for safe eco-driving training for clean vehicles:

- the ACTUATE pilot training materials,
- the evaluation results in terms of optimized energy-efficiency of clean vehicles as consequence of safe eco-driving trainings and
- the fact sheet providing information needed from the industry (manufacturers and suppliers of electrical equipment) by trainers and technical experts to use the clean vehicle type optimally and to train the drivers.

4.3) Learning objectives of the trainings

Rationale

The learning objectives, as intended information/input for the learner, are the basis for the selection or design of training materials, content and methods.

The ACTUATE partners defined the following learning objectives to be transferred during the ACTUATE trainings:

- Information about dangerous high voltage parts in the vehicles
- Information about energy flow in vehicles and characteristics of electrical parts and losses (incl. energy consumption of different aggregates, e.g. heating and air-conditioning technology)
- Information about the ideal drive-cycle between stops
- Information about interrelation of economics and safety and driving style
- Information about behaviour in the event of malfunctioning or accidents

- Information about environmental impact of safe eco-driving
- Information about efficient braking and accelerating to optimise energy-efficiency of clean vehicle types

It is up to the partner organisations to add additional content to the training(s) if they desire, but all listed topics/information shall be integrated into the ACTUATE trainings as basic content.

Conclusions

A categorisation of the learning objectives could be used as a basis for the structure of the trainings and the development of training materials. For example, the Salzburg AG divided the training material for safe eco-driving of trolleybuses into four important parts of learning objectives:

- Introduction (incl. ACTUATE project presentation)
- System trolleybus
- Eco-driving
- Safety aspects on trolleybuses and their high voltage parts

To ensure well-formed learning objectives and that no important objective is lacking, it is important to involve the target-group "drivers" from the beginning into the training development process to discuss the aim and the learning objectives and how these come across to the learner/driver.

4.4) Learning Outcomes of the trainings

Rationale

In the EQF (see chapter 2) a learning outcome is defined as a statement of what a learner knows, understands and is able to do on completion of a learning process. The EQF approach emphasises the results of learning rather than focusing on inputs such as the length of study. The information collected on the different national implementation approaches of directive 2003/59/EC show that the directive is implemented very heterogeneously across Europe (and the partner countries of the ACTUATE project) and that this heterogeneity, even based on input-oriented standards, does not lead to

a common level of professional driver abilities (Ball, Konings, van Rijn 2011). Therefore, the learning-outcomes approach of the ACTUATE trainings can help to ensure minimum criteria and comparability of driver qualification in the field of safe eco-driving of clean vehicles across Europe.

Thus, the ACTUATE partners elaborated what a driver should know and understand to properly carry out his job to the benefit of the passengers, of the environmental impact of his driving behaviour and of the economic situation and image of his PT employer. The ACTUATE “learning outcomes” describe what a driver knows, understands and is able to do after finishing the safe eco-driving training for clean vehicles.

The learning outcomes will guide the development of dedicated trainings and educational material in ACTUATE and ensure a common minimum level of tram and bus driver abilities with regard to safe eco-driving through ACTUATE trainings.

The EQF categories skills, knowledge and competencies describe what a bus/tram driver can do (skills), knows (knowledge) and applies/considers (as right handling) in certain situations (e.g. in case of an emergency with high voltage components of a clean vehicle). The learning outcomes of the ACTUATE trainings only describe which additional skills, knowledge and competencies a bus/tram driver should achieve by attending the trainings. Thus, the ACTUATE learning outcomes can be considered as a joint definition of common learning outcomes based on minimum standard for the qualification of professional bus and tram drivers in the field of safe eco-driving of clean vehicles. Furthermore, the description of learning outcomes in EQF-categories allows integration into specifications of a core profile (based on qualification requirements) for professional drivers (e.g. as developed for freight transport in the EU project ProfDRV; see www.project-profdrv.eu) and into national qualification frame works (NQF) in the future.

Conclusions

The ACTUATE learning outcomes can be prioritised for the development of the training programmes based on a joint review with all driving instructors

and the management regarding questions like: Are all learning outcomes essential for us? Will they be important five years from now? etc.

The partner Salzburg AG for example, divided all agreed learning outcomes into three categories (category +++, category ++, category +). Each category shows the importance of learning outcomes for the Salzburg AG, beginning with most important learning outcomes as "+++" (see below).

Knowledge	+	Knowledge about characteristics of different clean vehicle types	Skills	To be able to brake and accelerate in the most energy efficient way
	++	Knowledge about characteristics of electrical parts and losses		
		Knowledge about path of the current (electricity) from substations via the network to the vehicle		
	+++	Knowledge about the differences between electrical power unit and diesel engine		
		Knowledge about kinematic vehicle		
		Knowledge about the ideal drive cycle between stops incl. topographic conditions		
		Knowledge about behaviour in the event of malfunctioning or accidents		
		Knowledge about dangerous high voltage parts in vehicles		
		Knowledge about environmental impact of eco driving		

Table 2: Prioritisation of learning outcomes

Furthermore, the learning outcomes should be defined broadly enough in order to allow adaptation without losing impact on the specific learning outcome or training respectively.

4.5) Educational principles

Rationale

A survey on the implementation of the directive 2003/59/EC laying down the initial qualification and periodic training of professional drivers (CIECA 2010) shows that didactical approaches applied within training differ strongly. The same applies for the testing of the learnt topics (learning outcomes) and the integration of practical parts into trainings. Actual driving is only on rare occasions a part of periodic training, e.g. in the Netherlands, Sweden or Spain.

Current training practice concentrates strongly on providing theoretical knowledge, such as fuel-efficient driving for diesel buses. However, it only rarely supports drivers in actually accumulating necessary skills and competences; that means using theoretical knowledge in real working practice.

The ACTUATE partners see the basic necessity to integrate a practical session as a basic part of the trainings to let the participating drivers experience the newly-learned eco-driving style in "real working practice". To experience the difference and the impact of the new safe and eco-friendly driving behavior, each driver should have two short practical driving sessions to enable a comparison between the "old" driving style and the "new" eco-friendly driving style. Therefore, the practical part of the trainings will normally take approx. 50% of the total training session (e.g. for trainings with 12 drivers and 15 to 20 minutes practical driving experience during a training session). To support the learning effect and to have evidence for the impact of the "new" driving style on energy-efficiency optimisation of the clean vehicle, the practical sessions should be evaluated together with the drivers by measuring the energy consumption during the training courses.

An educational principle which supports this experience-based learning approach is the Kolb learning cycle (Kolb 1984). This "experiential" approach means that learning is relating to or resulting from experience. Kolb differentiates between four modes in his learning cycle (see also :

- Concrete experience (feeling): Learning from specific experiences
- Reflective observation (watching): Observing before making a judgment by viewing the environment from different perspectives
- Abstract conceptualization (thinking): Logical analysis of ideas and acting on intellectual understanding of a situation
- Active experimentation (doing): Ability to get things done "in the right manner" by using reflective observation and abstract conceptualisation.

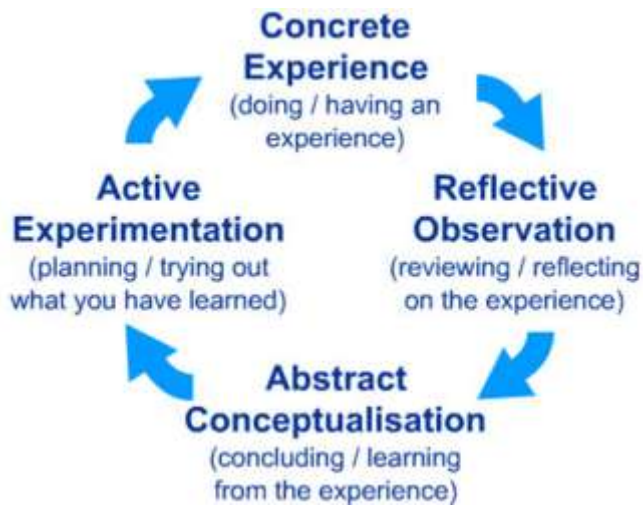


Figure 1: Kolb's experiential four stage learning cycle (available at: <http://www.simplypsychology.org/learning-kolb.html>)

Transferred to the ACTUATE trainings for safe eco-driving the learning cycle will have the following 4 modes.

Educational principles	Experiential Learning Model (Kolb)	<ol style="list-style-type: none"> 1. concrete driving experience, 2. observation of and reflection on that driving experience, 3. formation of abstract new concepts based upon the reflection and theoretical input on safe eco driving, 4. testing the new driving concepts, 5. (repeat).
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Table 3: Four modes of ACTUATE trainings according to Kolb's learning cycle

Conclusions

The first ACTUATE pilot trainings for trolleybuses and hybrid buses showed already that the biggest "aha-experiences" were achieved during the practical sessions of the first ACTUATE trainings for safe eco-driving. The drivers learning effect was mainly based on concrete driving experiences regarding the comparison of the old driving behaviour and testing the new eco-friendly driving style (incl. the debriefing with actual energy consumption data). The "simulation" of highest possible real working practice" during the practical part of the training sessions (incl. stops at bus stops etc.) was very helpful to analyse and learn an effective driving behavior, but also to check the practicability of safe eco-driving under "real" operation conditions. E.g., the trained eco-driving style of hybrid buses led

to a delay in the timetable of 5 to 10 minutes in average. This dilemma will be addressed by the management level as a result of the trainings.

4.6) Assessment

Rationale

The learning outcomes are the basis for the assessment and the assessment or evaluation methods shall ensure that all kinds of learning outcomes are addressed. Because often used multiple-choice-tests, for example mainly assess knowledge, but neither skills, nor competences. The ACTUATE trainings have to be orientated toward knowledge, skills and competences as defined in the learning outcomes and therefore practical "tests" and debriefings/discussions about the new eco-friendly driving style should be integrated into the training sessions.

The ACTUATE trainings shall be assessed/evaluated with regard to two aspects:

1. The quality of the training: surveys and feedback forms regarding usefulness of trainings, teaching performance and used training materials should be used. The ACTUATE partners have defined a common set of ACTUATE-specific questions for the quality control of the trainings (see Annex I), which will be integrated into the customarily used feedback questionnaire of each partner. By this, also a comparison between the different training sites will be possible.
2. Learning success with regard to eco-driving: two practical driving sessions, during which the energy consumption will be monitored/measured, shall be carried out to compare the driving behaviour and its impact on energy-efficiency before and after theoretical input (steps 1 and 4 of Kolb model); this won't be possible for the specific clean vehicle type tram during the trainings, but shall be carried out over a longer period before and after the training by measuring energy consumption between sub-stations on a certain

network line (the same environmental conditions, e.g. with regard to weather situation, should be assured)

During the practical part of the training (not for trainings for safe eco-driving with trams), the energy consumption will be measured and recorded by customised software and subsequently displayed on a protocol. Also the protocol will include general driving data (trip duration, trip length, average speed).

Regarding the measurement of the impact of safe eco-driving two indicators are crucial: total energy consumed for each kilometre in operation and energy consumption per kilometre solely related to driving operation.

Conclusions

To stimulate learning success and motivation of the attending drivers with regard to learn a safe and eco-friendly driving behaviour the practical parts of the trainings could include incentives like contests. To support the maintaining of this safe and eco-friendly driving behaviour in the long-term, also incentives like contests (e.g. driver of the month) or financial incentives like the distribution of bonuses to drivers based on energy savings through optimised safe eco-driving. Therefore, a long-term monitoring of the driver's performance or with regard to the energy consumption per vehicle etc. would be needed. Incentive based concepts, like for example the "driver of the month" award, will be tested by the ACTUATE partners in the course of in-house campaigns to sustain the impact of the safe eco-driving training programmes.

4.7) Organisational Framework

Rationale

The ACTUATE trainings shall mesh with the requirements given by the directive 2003/59/EC (e.g. on length of study) to integrate them into general training practice of public transport operators, which will improve the sustainability of ACTUATE's training programmes. However, organisational

aspects like the size of training groups differ widely in training practice across Europe. Training groups in Germany are for instance quite big and accommodate between 20 and 40 participants, while the average group size in Austria, Italy or the UK ranges between 5 and 15 participants. Therefore, the ACTUATE partners defined a common organisational framework for the safe eco-driving trainings, which is described in the following.

The ACTUATE trainings should have at least two different modules: one theoretical and one practical. Furthermore, pre-tests and pilot trainings by instructors/trainers (and maybe management representatives as well as a few drivers) should be carried out as part of a training quality assurance.

The rooms for training, the training material(s) and the requirements to be fulfilled by the teacher/trainer have to be in line with the national educational law (e.g. "Berufsbildungsgesetz" in Germany) or widely accepted guidelines, e.g. by national associations like the "VDV-Kompetenzhandbuch" (Competence handbook by the German Association of Public Transport Operators (VDV)). Furthermore, the training organisation has to provide the respective clean vehicle for the practical parts of the training courses (either from the operator's own fleet or by "hiring" the clean vehicle from an external operator).

The group size per training session should not exceed 12 to 15 drivers (participants) to ensure the experiential learning approach (see above) and an appropriate time window for the practical sessions.

The ACTUATE trainings for safe eco-driving of clean vehicles fit in a 7-hour module with regard to directive 2003/59/EC. An example for a training agenda is given in the following:

Agenda for training for safe eco-driving of trolleybuses (by Salzburg AG):

Time	Task/ Activity
07:15 – 07:30	Welcome address
07:30 – 9:00	Classroom training (introduction, the

	trolleybus system
09:00 – 09:30	Coffee break & exchange of experiences with training instructor
09:30 – 11:00	Practical training: safe eco-driving (measuring energy consumption)
11:00 – 11:30	Classroom training: eco-driving with trolleybuses
11:30 – 12:30	Lunch break
12:30 – 14:00	Practical training: safe eco-driving (measuring energy consumption)
14:00 – 14:30	Coffee break
14:30 – 15:00	Evaluation, debriefing, measurement results
15:00 – 16:00	Classroom training: Safety aspects, procedures in case of emergency and/or service interruption
16:00 – 16:30	Feedback and question and answer session

4.8) Certification

Rationale

The ACTUATE partners will analyse possibilities of quality control and certification of the safe eco-driving trainings in each partner country (DE, AT, IT and CZ). Therefore, communication with national authorities responsible for certification of initial qualification and periodic training of professional drivers will be started.

The ACTUATE partners see a need for a certification procedure in order to provide trainings for safe eco-driving of good quality. Possible certification procedures per partner country will be described at a later date in this document. Furthermore, information on possible ways for the integration of

safe eco-driving trainings into existing ISO certifications will be analysed, e.g. the Quality (ISO 9001) or Environmental (ISO 14001) Management system.

4.9) Standardisation

Rationale

The ACTUATE partners aim for standardisation on three different levels: in-house, national and European level. The ACTUATE partners have agreed that the trainings for safe eco-driving of clean vehicles will become a standard part of their periodic training of drivers in the future. In order to enable a common minimum quality level of safe eco-driving trainings to be reached within the course of the ACTUATE project, the partners will discuss the represented minimum criteria and the learning outcomes (based on the EQF categories skills, knowledge and competencies) with suppliers of professional education and training, trainers and developers/publishers of learning materials and committees responsible for the validation of learning outcomes with regard to sufficiency of the criteria and learning outcomes (also as part of the DELPHI process in the course of the ACTUATE project).

With regard to a national and European standardisation, the ACTUATE partners will start a communication process with political decision-makers and competent bodies of national education systems involved in implementation of directive 2003/59 EC and authorities responsible for driving licence exams of professional drivers. For example, a first analysis of the given exam procedures and relevant authorities in the partner countries as well as in the Netherlands, Poland and Hungary have demonstrated a diversity of driving licence exam procedures and responsible authorities (national, regional etc.).

The final result of this communication process will be the deliverable D2.3 "Plan for the standardisation of safe eco-driving in future driving licence exams", which will be the basis for possible standardisation approaches as minimum criteria for the ACTUATE trainings. These will be described later in this document.

5) List of references

- 2003/59/EC (Directive 2003/59/EC of the European Parliament and of the council of 15 July 2003 on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers, amending Council Regulation (EEC); No 3820/85 and Council Directive 91/439/EEC and repealing Council Directive 76/914/EEC)
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- Kolb, D. A. (1984): Experiential Learning: Experience as the Source of Learning and Development. Prentice-Hall, Inc., Englewood Cliffs, N.J.
- ACTUATE: result report on DELPHI expert interviews with 16 experts on clean vehicles and education of professional drivers (publication in progress)

Annex I: ACTUATE-specific set of questions to evaluate quality of trainings

Dear employee/ colleague,

With your help we would like to evaluate the quality of our education and training programme. We would appreciate if you can take some time to go through this questionnaire and answer the following questions:

1. How do you assess the overall quality of the training?
(1 excellent/ 2 very good/ 3 average / 4 poor/ 5 very poor)

1 2 3 4 5

remarks:.....

2. Were you already aware of the topic of eco-driving before the training?

Yes, through..... No

3. How do you rate the relevance of this topic?

- for the public transport operator:
very relevant/ relevant/ less relevant/ not relevant/ I don't know
- for your daily work routine:
very relevant/ relevant/ less relevant/ not relevant/ I don't know

4. How do you assess the quality of the written training and education material being used?

- Amount/scope: *exactly right/ too little/ too much/ useless/ did not receive any*
- Quality: *very good/ good/ sufficient/ poor/ very poor*

5. How do you assess the content of the training and the way it was brought across?

(1 excellent/ 2 very good/ 3 average / 4 poor/ 5 very poor)

1 2 3 4 5

Annex II: Overview of minimum criteria and learning outcomes for trainings for safe eco-driving of clean vehicles

		specifications for			
		tram	hybrid bus	trolleybus	supercaps
Aim of trainings	To impart knowledge and stimulate skills and expertise in energy-efficient, eco-friendly and safe driving of clean vehicles				
Requirements	Trainings shall maximise energy savings by eco driving		optimisation of the fuel consumption	optimisation of energy recuperation and consumption in(to) the network	maximise performance of supercaps
	Training material for safety aspects of clean vehicles				
	Training material for specific bus types and tram control technology				driving license for trolleybuses > 18m as prerequisite (TEP)
	Pre-instruction and briefing of trainers and technical experts by bus and tram manufacturers about specifics of vehicle types				
	Training only for drivers that are on duty on clean vehicles				
Content	Information about dangerous high voltage parts in the vehicles		Influence of overhead lines on energy flow	Influence of overhead lines on energy flow	supercaps are permanently energised
	Information about energy flow in vehicles and characteristics of electrical parts and losses (incl. energy consumption of different aggregates, e.g. heating and air-conditioning technology)				
	Information about the ideal drive-cycle between stops				
	Information about interrelation of economics and safety and driving style				
	Information about behaviour in the event of malfunctioning or accidents				
	Information about environmental impact				
	Information about efficient braking and accelerating				
Learning Outcomes	Skills	To be able to brake and accelerate in the most energy efficient way		To be able to use hybrid bus drive train most efficiently when braking or accelerating	
	Knowledge	Knowledge about characteristics of different clean vehicle types			
		Knowledge about characteristics of electrical parts and losses	Knowledge about the control technology of different types of trams		
		Knowledge about path of the current (electricity) from substations via the network to the vehicle		N/A	
		Knowledge about the differences between electrical power unit and diesel engine	N/A		
		Knowledge about kinematic chain	incl. dynamics of vehicle movements of trams		
	Knowledge about the ideal drive-cycle between stops incl. topographic conditions				

		Knowledge about behaviour in the event of malfunctioning or accidents				
		Knowledge about dangerous high voltage parts in vehicles				
		Knowledge about environmental impact of eco driving				
	Competence	Ability to apply knowledge about ideal drive-cycle between stops and recuperate highest possible amount of energy based on knowledge about topographic conditions				
		Responsible and autonomous acting in cases of accidents with electric-driven vehicles (input for mandatory safety at work trainings)				
		Ability to communicate to passengers the importance of eco-driving				
Educational principles	Experiential Learning Model (Kolb)	1) concrete driving experience, 2) observation of and reflection on that driving experience, 3) formation of abstract new concepts based upon the reflection and theoretical input on safe eco driving, 4) testing the new driving concepts, 5) (repeat)				
	Training	Surveys and feedback forms regarding usefulness of trainings and teaching performance				
Assessment	Learning success	Two practical tests: comparison before and after theoretical input (steps 1 and 4 of Kolb model)	for tram only possible over a longer period before and after the training by measuring energy consumption between sub-stations under certain framework conditions			
		Stimulate learning success by motivation/ incentive system for practical parts				
	Pre-Tests of "Pilot Trainings"	Instructors and few drivers conduct a test run of trainings				
	Modularity	Two modules: one theoretical and one practical module				
	Theoretical part	Theoretical parts (sub-modules) about all knowledge fields to be gained as described under learning outcomes for all clean vehicle types				
Organisational Framework	Practical part	Test runs and evaluation (evaluation could also be a separate third module)	evaluation will be a third module due to limits of realising the evaluation during the trainings or right before and after the trainings respectively			
	Time frame	Basic mandatory parts should fit in 7 hours module with regard to directive 2003/59/EC				16 - 20 hours: 8 to 10 hours for theoretical part and 8 to 10 hours for practical part of training with trolleybuses equipped with supercaps in Parma

Certification	in-house	???				
	accredited	EU-certificated (check possibilities)				
Standardisation		trainings will become standard part of driver trainings in future				
	in-house	???				
	national	???				
	Europe-wide	???				