On the way to high-quality technology-supported training for professional drivers

A synopsis of ICT-DRV project results, conclusions and recommendations

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Lifelong Learning Programme

The ICT-DRV project synopsis „On the way to high-quality technology-supported training within professional driver qualification" provides a synoptic overview about the results of this European project implemented by partners from all over Europe and Canada on the realisation of e-learning and simulator training within professional drivers' vocational education and training in Europe. It provides a summary of the status quo with regard to technology-support in training as well as the related scientific fundamentals and describes the major practical examples worked on during the project realisation in order to test different instructional design approaches for technology-supported training in practice.

Furthermore this synopsis introduces the projects major conclusions and the ICT-DRV quality indicators that have been derived from the allover findings of three years of project work. The quality indicators provide a handy tool in order to develop quality in the overall field of technology-supported professional driver training and for different groups of stakeholders concerned by this topic.

Finally a number of policy recommendations are introduced with regard to a high-quality integration of e-learning and simulator training into regulated professional driver education and training such as under EC Directive 2003/59. The ICT-DRV recommendations aim to facilitate the development of quality and include the following aspects related to e-learning and simulator training as well as technology-support within professional driver training in general:

- Recognition of e-learning as an optional training approach within regulated training for professional drivers.
- Integration of work-based learning practices into e-learning course settings in order to meet the needs and learning characteristics of professional drivers.
- Integration of e-learning into Directive 2003/59/EC through application of the learning outcomes approach.
- Embedding of simulator training into wider training concepts/curricula.
- Complexity of the simulator to be specified based on the aspired learning outcomes.
- Increase education-oriented quality awareness and literacy of stakeholders within professional driver training.
- Cooperation among all stakeholders concerned as key to quality development.

Although specifically addressed to technology-supported training in the context of the ICT-DRV project, the ICT-DRV project results finally underline that learning supported through different kind of media and simulators should not be treated differently from any other kind of training with regard to education-oriented quality. The defined quality indicators should rather be very similarly applied also to classical classroom-based training especially when it comes to didactical aspects. Computers, different kinds of mobile devices or simulators are and remain a tool only in order to facilitate learning and learning processes with the learner and his/her characteristics and needs being in the centre of attention of instructional design considerations.

Contents

A Learning technology within professional driver training … a projects baseline

This publication *"On the way to high-quality technology-supported training for professional drivers: A synopsis of ICT-DRV project results, conclusions and recommendations"* concludes more than two years of project work within the European project *ICT-DRV "Preparing and keeping professional drivers qualification up-to-date for their changing job requirements with multimedia-based learning"*. 11 partners from 9 countries from Poland to Canada investigated within this project the question how e-learning and simulator training can be integrated into professional driver training with high quality in order to realise ideal learning environments for drivers.

ICT-DRV definition: E-learning/ Computer-based training

Computer-based training/ E-learning is a very heterogeneously used term referring to very different kinds of training primarily facilitated by computers or mobile computing devices. There have been no specifications made about computer-based training in the framework of directive 2003/59/EC. A number of European countries developed own guidelines on computer-based training in this context mainly limiting the use of computers-based training to class-room settings. Only in a few cases computer-based training in terms of distance learning/ learning outside the class room is considered as eligible at this point in time.

In the framework of ICT-DRV the terms "computer-based training" and "e-learning" are understood as distance and/or blended learning approach within professional drivers initial and continuous VET facilitated by a computer or other kind of mobile computing device. The computer or mobile computing device enables the interaction between the learner and electronic-based content (courseware/ software) and/or between the learner and an-/other individual/-s (fellow learners, trainer, tutor). It can be self-paced and/or instructor-led and includes different kind of media.

Professional drivers range in Europe on position 6 and worldwide on position 5 of the jobs employers are having difficulty filling with qualified employees (ManpowerGroup, 2015). At the same time this occupation is characterised by a fundamental increase of qualification requirements during the past decades being expected to even further increase also in future following the ongoing technological and organisational innovation within mobility and transport. This situation is especially challenging for the transport industry due to the rather low level of professional qualification and a mostly negative image of the job that characterises this occupation nearly all over Europe.

These circumstances assign the challenging task on initial and continuous vocational education and training (VET) in Europe to prepare professional drivers for the continuously changing job requirements and to keep them qualified for their job once they entered into the labour market. Technology-supported training offers additional possibilities in order to reach the huge number of professional drivers in Europe and to achieve the high quality of training necessary in order to ensure their employability also in times of automated truck loading systems, autonomous driving and traffic flow optimization through networked vehicles.

It has, therefore, been the overall aim of the ICT-DRV project to enhance professional drivers' initial and continuous VET in Europe with the means of technology-supported training under special consideration of e-learning and simulator training approaches. A special focus has been put on the exploration of opportunities, limitations and requirements to enhance professional driver training in the framework of directive EC 2003/59 with learning technology.

So far a widespread integration of technology-based learning into professional driver training is hindered by strong scepticism of involved actors and by legal regulations still applying an input orientation with a focus on traditional training settings. Both barriers are based on missing trust into technology-based tools and their appropriate application within VET for drivers with their special needs and characteristics.

The ICT-DRV project intended to contribute to the formation of trust and a widespread acceptance of technology-supported learning within professional driver training. For this purpose the project consortium developed indicators and recommendations for a high-quality integration of technology-based training into professional drivers initial and continuous/ periodic VET. The project partners aimed to contribute to the development of a culture of quality improvement and innovation at all levels of professional driver training. Perfectly trained professional drivers are key to more safety on European roads and at the same time responsible for the success of today's transport industry. Learning technology and its integration into professional driver qualification are an opportunity as well as a challenge for all those involved.

The integration of e-learning and simulator training into initial qualification and periodic training in the context of EC Directive 2003/59 differs strongly across Europe. Existing regulations are usually limited to requirements on technique and documentation. The European Directive makes no or no sufficient contribution to this discussion. This opens doors for major deficits with regard to learning considerations in the context of technology-supported learning offers. A supportive legal framework is, however, fundamental in order to reach high quality, as it has been concluded by the ICT-DRV project team from the results of their work. The project team therefore proposes to clearly integrate technology-supported learning into Directive 2003/59 as an additional / complementary training option. The learning outcomes approach of the European Qualifications Framework is here considered as the common European basis in order to foster the useful and high quality application of media-supported training. This has been tested in e-learning and simulator training pilot projects within ICT-DRV that focused on reaching of concrete learning outcomes with appropriate instructional design approaches.

ICT-DRV definition: Simulator training/ Simulator-based training

EC Directive 2003/59 (being the regulation primarily referred to in the framework of ICT-DRV) considers simulator training with top-of-the range simulators. However, the term "top-of-the-range simulator" is not further specified, but a number of countries provide additional specifications on simulators in order to be considered as "top-of-the-range simulator" (see among others France, Germany, Finland, the Netherlands, Czech Republic, Hungary). Such considerations are mostly based on and/or include the learning outcomes aspired with the application of simulator-based training.

Therefore, the terms "simulator-based training" and "simulator training" can be specified in the context of ICT-DRV as a training approach within professional drivers initial and continuous VET supported by an artificially created virtual but almost realistic environment that mirrors the "real world" conditions of driving. A simulator replicates relevant external factors and conditions with which a driver interacts as well as scenarios and events with sufficient reality to reach the aspired learning outcomes whilst allowing for the assessment of the drivers behaviour.

At the same time the project results advise against considering technology support within training as an indicator of quality. Technology-supported training – just as training in general - rather needs very concrete quality considerations with regard to didactics in order to be usefully integrated. The project team for instance concluded that e-learning requires a concrete praxis-oriented component in order to provide an added value for the training of professional drivers. While for simulator training the aspired learning outcomes should decide about the applicability of a simulator and about its necessary complexity. Basis for the application of learning technology is in any case a well defined and adjusted instructional design. Especially at this point the project partners identified a large deficit because research and development work with regard to learning, learning technology and vocational education praxis take place separately from each other. Successful practical examples of innovative training solutions resulting from a dialogue between those areas of work have been identified, discussed and documented within the projects' scope.

The results of the project are brought together in this project synopsis. It provides a synoptic overview about the application of learning technology within professional driver training and its scientific framework within chapter B on the "Status quo of technology-supported training within professional driver qualification". Chapter C on "Quality and technology-support within training" provides an overview about the quality indicators that have been developed by the project consortium and how to apply them practically. The e-learning and simulator training pilot applications developed and tested within ICT-DRV are shortly introduced and described within chapter D "Innovative training solutions based on instructional design principles". The conclusions derived from those two years of project work in the context of numerous stakeholder consultations, desk research and piloting are highlighted in chapter E on "Conclusions on the practical realisation of technology-supported training". Finally chapter F provides the policy "Recommendations on the integration of technology-supported training into professional driver training in Europe" as the core contribution of the ICT-DRV project to European vocational education and training as well as road safety policy. Complete reports and documentations of the project outcomes are available on the projects website at www.project-ictdrv.eu.

B Status quo of technology-supported training within professional driver qualification

The integration of learning technology into professional driver training differs enormously from country to country, region to region and between training providers. The differences appear in dimensions such as pedagogical quality of technology use, legal requirements that restrict/permit e.g. CBT and simulator application in the framework of legally regulated VET schemes as those under Directive 2003/59/EC or the general scope of technology integration into professional driver training. Those differences have been subject of the initial project research undertaken within the ICT-DRV project. It investigated current e-learning and simulator training praxis and has been realised through desk research, literature review and stakeholders interviews in the project countries: Germany,

France, Austria, Spain, UK, Finland, Hungary and in addition been enriched with results and contributions from Canada.

B.1 Application of e-learning within professional driver training in Europe

The results of the ICT-DRV initial research show that in all ICT-DRV project countries, in the framework of Directive 2003/59/EC, CBT is expected to be carried out in a classroom-based setting which also requires the presence of a trainer. Hence no distance learning is accepted, with a notable exception in Austria where, in Tyrol, where the "Land" of Tyrol seems to be the only provincial government that has accepted and regulated e-learning as a modality for periodic training. Outside the context of driver CPC training, no formal restriction related to CBT itself nor to its modality seems to be in place, although should be kept in mind the fact that CBT does require ultimately that competent bodies accept to give recognition to the underlying training. However, distance learning CBT is excluded in Finland where CBT is only accepted in the presence of a trainer.

It has also been investigated whether CBT in the project countries targeted, beyond professional drivers *per se*, learners in the general Vocational Education and Training (VET) system. It turned out that CBT applications are a regular part of the VET system merely in Spain, France, Finland and Austria. Professional drivers, on the other hand, are widely targeted by CPC applications though most of the time outside a driver Certificate of Professional Competence (CPC) context. Sometimes however, CBT is applied in a CPC context but in this case it is implemented in classroom settings associated with SBT applications (e.g. France and Germany), or it is done through e-learning (Austria). Potential drivers – learners who are not yet professional road drivers but who have set this profession as a subsequent goal to their training paths – are indeed offered CBT, though in a smaller proportion than professional drivers and mostly outside the CPC framework. In terms of professional driving-related qualifications that can be partially or totally achieved through CBT, the results show that, outside the context of CPC training, there is a wide variety of available qualifications, some formally referenced to qualification frameworks, others related to more private and "tailor-made" specialty training sessions (*e.g.* eco-driving, safety on board etc.). Most of these qualifications bear classroom settings CBT sessions, whereas in Austria, the Easy Drivers Experts scheme (see below) allows for 3/5 of the CPC periodic training to be achieved through e-learning. There is a wide range of underlying curricular thematics addressed by CBT. The main thematics reported are the following: risk prevention, health & safety, safety on the road, loading/unloading of cargo, language skills, social provisions (e.g. driving and resting time rules) and basic legal provisions

The ICT-DRV initial research also investigated the different forms of CBT applications observed in the project countries. Here, a distinction should be made between a driver CPC context and a non-CPC context. In a CPC context, where a legal framework ensured from Directive 2003/59/EC exists, CBT is performed in classroom settings as the presence of a trainer is required. In a non-CPC context

however, since in many countries no legal framework exists, CBT can take many additional forms and include e-learning applications of CBT as well as embarked CBT[1].

The issue of training the trainers is only relevant when trainers are involved in CBT applications. As hinted hereabove, sometimes no trainers are involved in specific CBT applications. In some instances however, even when e-learning CBT is carried out, tutors can be involved in coordinating and channeling learners' progress. Training of the trainers is not a foreseen in all countries. In Finland, no specific training for trainers involved in CBT is foreseen. Sometimes, though no specific training is required, CBT trainers are still required to prove they have a minimum level of expertise in dealing with ICT pedagogical tools, that they have a certain pedagogical capacity as well as a certain level of experience in transport-related fields of activity (*e.g.* Spain). Most often, when training is formally foreseen for CBT trainers, such training is mostly technical-oriented training mainly focused on the software and hardware to be used rather than on pedagogical considerations.

The question of how quality assurance of CBT is addressed in partner countries has also been researched. As it turned out, in some countries no CBT-related quality assurance system is in place, in other countries it is a matter of ensuring technical maintenance of the equipment used, of handing out quality surveys to be filled out by trainees, of organizing debriefing sessions after the training. The assessment and recognition of the knowledge, skills and competences acquired through CBT is mostly ensured through the fulfillment of the training content, the observation of test results and even through randomly taken screenshots during classroom CBT sessions in order to make sure learners/trainees effectively go through the entire content of the training.

The consortium of partners endeavoured to assess to what extent CBT applications were in use in Europe. Unfortunately, investigations revealed that very few reliable figures on the number of CBT were available. Scarce figures were provided still mentioning in Spain CBT courses gathered 15 to 25 trainees per course, whereas in Finland 6 CBT users were counted per institute. Regarding the length of CBT use, results show CBT sessions usually involve one to two hours in a row of training and add up, for a single particular training, to a maximum of 15 hours in total in Finland.

The description given by partners of CBT users' feedback regarding their appreciation of this form of training is overall positive, with the notable exception of the U.K. where learners regard CBT as having less value because in their eyes professional driving vocations require "hands-on" experience. From the learners' perspective, flexibility is a highly appreciated feature of CBT, whereas trainers mostly share mixed opinions, hesitating between the flexibility of CBT and mistrust stemmed by the need for real life trainers/instructors to handle the relevant contents for professional driving. Transport companies however voice a positive opinion on CBT, especially since this form of training can be done outside business hours, thus safeguarding their competitiveness.

Academic and professional skeptical arguments are known to have been expressed regarding the provision of CBT. In this regard, partners were asked to investigate, for each category of stakeholders, the main arguments invoked in their respective countries. Learners' and trainees'

[1] In France, eco-driving devices are often embarked on lorries allowing for real time measurement and assistance of/to drivers' performance.

skepticism is closely linked to a form of reluctance toward the use of technology in training as they sometimes view CBT as a game, an unrealistic one for that matter. Many trainers on the other hand mistrust and believe CBT does not match human contact-based training, that it is a more expensive provision of training and that the technical skills required from learners to effectively undergo such training can be too complex for professional drivers. Competent bodies have a more neutral stand but do express concern over an effective monitoring of CBT which is paramount to an acceptable assessment and recognition of the training. Finally, employers –though they look at CBT with a favourable eye, have expressed worries about drivers' ability and motivation needed for a successful CBT.

B.2 Application of simulator training within professional driver training in Europe

Within the framework of Directive 2003/59/EC a certain number of binding legal boundaries are imposed on the provision of SBT applications. Firstly, the Directive clearly states that a top-of-the-range simulator needs to be used for CPC SBT. The directive does not however provide a definition for such a simulator. This is left to Member States to define. Hence some countries have established guidelines for SBT application (Germany) while other Member States have decided to regulate its use (Hungary, France, Finland). Moreover, the Directive effectively prevents SBT to cover the total amount of allocated driving time as the use of simulators is limited to:

- 8 hours maximum for initial qualification
- 4 hours maximum for accelerated initial qualification
- The Directive , though it mentions SBT is possible, does not limit the time spent on a simulator during periodic training

Due to the fact the use of simulators is quite limited, our investigations have not led to any consistent data on the relevance for different target groups of SBT application from the United Kingdom, Germany and Austria. In the other partner countries, the information collected tends to indicate SBT application is particularly important for initial qualification trainees/learners and for potential drivers as it is perceived to be the best to start with SBT before undergoing training on real life lorries.

There is a wide range of underlying curricular thematics addressed by SBT. The main thematics reported are the following: basic driving skills (including the use of pedals and gear box), efficient driving and risk prevention, driving under extreme/dangerous weather and traffic conditions, road safety, eco driving.

The initial research also aimed to determine which types of simulators were in use for SBT of professional drivers. The first classifying criterion brought to light is that of mobility as some training institutions resort to mobile simulators, others to non-mobile simulators while the largest training providers use both mobile and non-mobile simulators. Another distinction is stemmed by Directive 2003/59/EC. Though in the framework of drivers CPC only top-of-the-range simulators are allowed, some training providers actually resort to what industry qualifies as medium-range simulators. Some countries (*e.g.* France) have defined – through legislation- what features a top-of-the-range simulator

should bear (real life environment, allow for different pedagogical situations, enable continuous and personalized monitoring).

In most partner countries, training of the trainers does not involve anything specific (as opposed to regular trainers' training) significant other than prior experience in professional driving, in training and training aiming at gaining technical (software and hardware) competences. In some instances however, specific training for trainers, covering specialized topics has been developed such as specialized safety training for trainers involved in SBT. Overall, it appears no didactical special training is offered in the context of SBT.

Simulators appear to be useful for the assessment of learners' daily achievements and to make sure knowledge, skills and competences have been acquired. Regarding learners' daily achievements, simulators can record past experiences and measure learners' progress in terms of reactivity and precision. In France, a camera actually films the trainee while he is driving the simulator so that the trainer can observe his behavior and reflexes (*e.g.* the position of the trainees' hands on the steering wheel). Daily achievements are also assessed when debriefing sessions take place, as these sessions allow a group of trainees to review, together with a trainer, the daily performances of all. Group observation and debriefing sessions are also useful to enhance the acquisition of knowledge, skills and competences (KSC) as trainees can learn from the mistakes they see others make. In some cases the acquisition of KSCs is enhanced thanks to randomly generated situations and real-time modification of the driving situation (Germany).

Academic and professional skeptical arguments are known to have been expressed regarding the provision of SBT. In this regard, the main arguments invoked in the partner countries have been investigated. Results show :

- Some skeptical arguments are based on cultural considerations: some perceive SBT as a game
- Some skeptical arguments are based on psychological considerations: some say simulators provide an unrealistic driving sensation, others highlight the negative connotation of SBT when it is only used for remedial purposes
- Some skeptical arguments are based on physiological considerations: simulator driving can provoke motion sickness
- Some skeptical arguments are based on financial considerations: some argue the purchase and maintenance costs of simulators are too high
- Some skeptical arguments are based on pedagogical considerations: some stakeholders believe SBT is characterized by its inability to demonstrate gained competences.

The feedback received by project partners indicate competent bodies are often ignorant of SBT features, while haulage companies, trainers and trainees/learners are much more often familiar with SBT applications. SBT is viewed as:

- Allowing for safe training under extreme (weather and traffic conditions)

- Allowing for trainees to be placed in various combined situations that real life driving would take a long time – if ever- to encounter
- Allowing for individualized training of drivers
- Enabling precise and immediate measurement of performance
- When the simulator is mobile, allowing for training within company premises
- From companies point of view, a practical training format as lorries remain available for business and drivers' driving time is not consumed

C Innovative training solutions based on instructional design principles

Systematic instructional design considerations are so far only very rarely part of the development of training for professional drivers neither in classical class-room settings nor in the context of e-learning and simulator training. However research clearly shows (see among others van Emmerik, 2004; Pardillo Mayora, 2008; de Groot, de Winter, Mulder & Wiering, 2007; Kappé, 200?; Parkes, 2005) that instructional design considerations contain a huge potential in order to improve effectiveness of training designs with and without the application of learning technology. The ICT-DRV project therefore implemented four technology-supported training solutions based on instructional design principles in order to (1) elaborate requirements on the integration of learning technology into professional driver training and (2) to test the practical applicability of instructional design models developed in a research framework in practice. The results of this work clearly show current training praxis can strongly profit from the application of such ID principles especially with regard to training quality, effectiveness of learning and transfer of learning into praxis.

C.1 A simulator training on "Defensive driving" ... four components for complex learning

Defensive driving is a topic regularly addressed in the framework of simulator training either as part of a training course or as an overall course topic. It has therefore been the aim of this ICT-DRV pilot course development and testing to explore how such a course should ideally be instructionally designed in order to facilitate learning of the course participants and therefore to make best use of the simulator in the most effective way.

The instructional design model selected in order to realise this course has been the 4C/ID-model (Four Components Instructional Design Model) which has been explicitly developed for the training of complex cognitive skills[2] (van Merriënboer & Kirschner, 2013). Driving - especially defensive driving - can be considered as such a complex cognitive skill. The overall 4C/ID-models approach has further been considered to be an instructional design model that ideally fits in with the training potential of the simulator. (van Emmerik, 2004) This is the case because, compared to real-life practice, simulators allow for a fit-to-purpose design of "whole-tasks" and "part-tasks" with different levels of complexity as proposed by the model. The matching of the 4C/ID-models approach and

[2] Please note that the term „skill" used in the 4C/ID-model is not equivalent to the term "skill" in the context of the European Qualifications Framework also applied in this pilot course!

simulator training in this pilot has therefore be considered as a very promising combination in order to make best use of the learning/ training opportunities offered by simulators.

The developed course has furthermore been based on a set of predefined learning outcomes to be reached with the course and corresponding to the learning outcomes concept of the European Qualifications Framework (EQF, 2008/C 111/01). A reference to the ProfDRV profile for professional drivers "freight transport" has been put in place in order to ensure connectivity of the course to a broader related profile. (ProfDRV, 2012)

Participants and training during group coaching session on the simulator

The 4C/ID model is based on four components a training of complex cognitive skills should consist of. Those four components are (see also van Merriënboer & Kirschner, 2013)

- Learning tasks

  … are authentic whole-task experiences based on real-life tasks aiming to integrate knowledge, skills and competences. The whole set of tasks is organised in task classes from simple to complex and include learner support within each class. Learning tasks in the same class always build on the same set of knowledge.

  A learning task in the context of defensive driving is for instance a driving exercise of a certain predefined route with a number of parameters/ events relevant in the context of defensive driving. The number and difficulty of parameters/ events determine the level of complexity.

- Supportive information

  … directly relates to the learning and performing of the learning tasks and is specified per task class. It fills the gap between the learners already existing knowledge and the knowledge needed in order to perform the learning tasks. It relates to problem-solving, reasoning, and decision-making aspects of learning tasks.

  In the field of defensive driving this can for instance relate to information necessary in order to assess different kinds of weather conditions with regard to the own driving.

- Procedural/ Just-in-time information

  … is necessary in order to learn and perform "routine aspects" of learning tasks. It is best presented and practiced just in time during the learning process in order to reach an automation of the routine aspect.

An example for “routine aspects” within defensive driving is for instance the screening of surrounding traffic or the approaching of a crossing in a defensive/economic way.

- Part-tasks practice

  … addresses the automation of “routine aspects” usually reached through repetition exercises. This should only start after a routine task has been introduced in the context of the whole meaningful learning tasks.

  In the context of defensive driving this applies for instance to exercising the screening of surrounding traffic or the slow approaching of red traffic lights.

In order to set up the pilot course based on the 4C/ID-model the models four components have been elaborated for the topic of defensive driving and in relation the predefined learning outcomes. As a result a training course has been drafted that has been structured around those four components that have been realised in the following way:

- Learning tasks
  Learning tasks have been realised in the form of predesigned simulator drives of increasing complexity using a top-of-the-range simulator. They contain different parameters and events relevant for the development of a defensive driving style. Task classes have been identified as (class 1) “Driving in interurban areas on motorways and country roads”, (class 2) “Driving and maneuvering in yard (terminals, depots, car parks, etc.)” and (class 3) “Driving in urban areas”. This classification already contains an increasing complexity of tasks but also within each class of tasks different learning tasks with different levels of complexity have been designed in order to introduce additional learning steps. In this way learning tasks on four levels of complexity have been realised from entry to high-complexity level.

- Supportive information
  Supportive information is provided in the scope of theory sessions that enable the derivation of the supportive information from the experience of specifically designed simulator drives in dialogue between trainer and learners. A specific set of learning contents has been developed for this purpose based on the predefined learning outcomes and analysis of the real-life tasks. The supportive information is provided in relation to the three task classes introduced above.

- Procedural/ Just-in-time information
  Procedural information is introduced in the context of specifically designed exercises on the top-of-the range simulator introduced within coaching sessions and in the context of additional screening sessions that practice screening and evaluation of the vehicles surrounding.

- Part-tasks practice
  Part-tasks practice is realised in the context of small-groups sessions included into training related to each task class. This includes coaching sessions on the top-of-the-range simulator as well as screening exercises. Additional training elements in order to practice part-tasks on

low-end simulators or e-learning elements in order to practice screening of the surrounding are possible additional development steps of this pilot course in order to further foster learning.

The alignment of exercises on the simulator and theoretical information/sessions has been evaluated as a crucial element of the overall course design. The possible added value of the simulator as a training tool can be used in the best possible way when both training parts interlock content-wise and possibly even methodically within the overall course schedule as described above. A very precise coordination of both elements is indispensible in this regard.

Deriving supportive information as part of debriefing in the whole group of participants

Also the application of group coaching incl. expert and peer feedback within simulator sessions proofed to be a very efficient training approach within simulator training. It opened up additional learning opportunities for those participants observing the simulator exercises of others and led to a very diverse and rich feedback for the participant driving the exercise. Especially the possibility to learn from mistakes plays a key role here. However, the moderation of such group coaching session incl. the integration of just-in-time information and relation to supportive information required very advanced abilities from the trainer in terms of subject-expertise but especially coaching, moderation and facilitation abilities.

The overall piloting also raised the question of alternatives to training on the top-of-the-range simulator especially when it comes to part-task practice and therefore repetition exercises such as useful for a number of eco driving techniques. It has been concluded that especially for such part-task practices also less advanced simulators or even serious gaming can be options in order to reach the aspired learning outcomes. However, the top-of-the-range simulator cannot be replaced by less advanced simulators in the context of learning tasks and therefore whole-task practice because here the experience should be as authentic as possible in order to provide the necessary learning context.

Additional training techniques such as described above on the example of the screening exercises can be very useful or even necessary complementary to training on the simulator and in order to practice abilities (routine and non-routine) that do not necessarily require the application or cannot effectively be trained on the necessary level on the simulator. This applies especially to part-task practice and can be implemented using different kinds of media. However, the selection of such tasks requires an in depth analysis of the aspired learning outcomes and tasks to be trained within the course.

All in all it can be concluded that the application of a simulator in such a training setting has clear advantages compared to practical training on the road because the simulator allows for a modification of learning tasks as well as part-task practice as required by the training processes and in order to foster the aspired learning outcomes. The full potential of a top-of-the-range simulator

(as well as other types of simulators) as a training tool can therefore optimally be used in such a setting and leads to a clear improvement of the training and learning process of the learners. In this way the “Y” in the formula “Simulation = (Reality-X) + Y” (Dieckmann, 2009 and Kappé, 2013) and therefore the surplus of simulator use within training can be identified and used in order to optimise training for professional drivers.

C.2 Simulator-based coaching on "Passenger safety and comfort"

If safety is a concern most professional drivers encounter during their training – continuous or initial- comfort assurance appears to be less widely tackled for an unexplained reason. ITS and AFT have chosen to put place these two notions at the center of this piloting endeavor entitled *Passenger safety and comfort assurance training for professional bus drivers* in order to test a SBT course aimed at providing answers to a certain number of questions including :

- How can a SBT course be developed in order to address an uncommonly referred to topic in the usual professional bus/coach driver training offer ?
- What kind of training material should support the course knowing it mostly focuses on a hands-on learning process?
- How can we develop satisfactory assessment procedures of the abilities and competences acquired ?
- How should the interaction between trainer and learners be organized in order to make sure information and thus adjustments are flowing back and forth in a timely manner in order to allow swift and adaptable learning?
- Through what means can the drivers’ skepticism towards the SBT courses be significantly reduced? Which factors associated with the learning process provide the biggest change change in their attitude?

AFT-owned bus simulator (left) and CARGO Training Center mobile driving simulator which was made available to ITS for piloting purposes

This course was designed using a learning outcomes approach compatible with the EQF (European Qualifications Framework).

Based on the topics addressed and on the analysis of the projected target groups, the course was built on *Gagnès’ Nine Events of Instructions*, essentially because this approach allowed for the

regular flow of information and feedback all along its duration while also recalling prior knowledge and thus speeding up the process of mobilization of learners' pre-acquired abilities.

The course itself was conducted according to the following schedule:

1. Presentation of the course introduction material
2. Adaptation drive on the driving simulator
3. First part of the driving simulator training - taking relevant exercises in order to provide the initial assessment of trainee's skills
4. Discussion on performance of a trainee, presentation of the relevant course material
5. Second part of the driving simulator training – providing the exercises in order to assess the progress in overall performance
6. Presentation of the final results to the trainee, extended review regarding his/her improvement
7. Provision of follow up material to foster learning, taking into account the overall results

In order to implement the **Nine Events of Instruction** the aforementioned events have been conducted in the following manner:

1. Gain attention and *2.Describe the objective*

The implementation of these two events is realised by delivering a visually attractive material (most likely a pdf-document providing the introduction in the 'infotainment' form) which will help the trainee in being introduced into the thematics of a course. The material can be sent via e-mail to the trainee before the training itself or presented at its very beginning. Despite this, the trainer is obliged to discuss the principles of the course again during the physical meeting, The adaptation drive itself does not intend to realise any of these two events, yet it is highly possible that the very event of driving a driving simulator will help in gaining attention of a trainee and focusing onto following tasks.

AFT (left) and ITS (right) experts during the pilot implementations

3. Stimulate recall of prior knowledge

This event is implemented both by the adaptation drive and initial simulator training. Even though the adaption drive with its main aim being to adjust the driver to the simulation environment, does not represent any pedagogical value, it stimulates the recall of particular driving abilities.

Additionally, the adaption scenario can be itself designed in a way that can recollect the desirable skills of a trainee.

During the first training unit specific skill-focused tasks are addressed by the trainer to a trainee, in order to gather the indicators for the initial skill assessment. It is also permissible to implement a scenario with subsequent tasks, in which the trainee will be guided by a voice of a pre-recorded attendant. Still, the real-time feedback provided by the trainer is compulsory. This stage's aim is a direct recall of prior abilities and acquisition of data which values directly affect the following steps of the course.

4. Present the material and *5. Provide learner guidance*

After the first training unit, the driver is guided by trainer through his/her performance and told about positive and negative aspects of his/her drive. Depending on the results obtained in each of the tasks, the emphasis in the discussion is placed on the ones performed poorly. Also, the content of learning material provided to a trainee is depend on this as well as the following steps of the course. Customized material is delivered in a form of a structured printed handbook or via e-mail. A certain amount of days (approx. 1-3 days) between the training units is necessary because of the need for resting between subsequent simulator training sessions and giving the trainee enough time to study the learning material.

5. Provide learner guidance, 6. Elicit performance and *7. Provide feedback*

The second training unit is implemented in the timeframe of few days after the previous one, according to availability and readiness of a trainee. It is yet not recommended to prolong the gap as it may become necessary for the learner to get adapted to the simulation environment once again. The driving tasks themselves are similar or the same to the ones previously taken and addressed to elicit the performance delivered in the learning material This way it becomes possible to get most efficient results regarding each of the assessed skills. The same as in the first training unit, a constant learner guidance is provided throughout each task. Also, the trainer delivers detailed feedback and, if necessary, repeats the scenarios with more complex and difficult tasks. This stages aim is to gather the final performance indicators in order to compare them to the initially acquired ones.

7. Provide feedback and *8. Assess performance* and *9. Enhance retention and transfer*

After the second training unit, the trainer leads a summary discussion regarding trainee's final training results. Each of the performed tasks is thoroughly discussed both in terms of obtained progress and the driving behaviours that still needs improvement. Depending on trainee's performance it is be possible to provide additional training session that focus on his/her major undeveloped skills in a few following days or even the same day, depending on his/her comfort. The overall progress made in scope of each skill is be delivered to a trainee in a short summary together with the certificate confirming the completion of a course. Additionally, in order to foster the transfer of learning the trainee is provided with the learning material regarding the weakly performed elements of the training. He/she may also be called to take an additional, more detailed, simulator training.

Though evaluators generally provided positive feedback as regards the methodology intended to implement (e.g. two-day training sessions, providing collective feedback to participants, group observations of other trainee's performance etc.), the first series of evaluations carried out before the end of the implementation of the pilot course pointed to the usefulness of putting an emphasis on certain elements in order to ensure a more profitable learning experience.

An indication that these initial evaluation points were effectively taken into consideration lies in the act the evaluations provided by the instructor as well as those provided by the participants after completion of the course no longer raised the usefulness on stressing these points any further.

However, final evaluation did point the need for an extra day or two of training (with extra simulator drives) in order to more reliably assess the extent of the learning provided to each participant. Overall, the question of assessment of comfort-assurance-related skills was raised and lead to the consideration of the need for the definition of specific indicators in this regard.

The pilot implementation confirmed the majority of target groups' needs as accurate. It still yet has to be tested whether sharing the examples of effects of the aggressive driving style on the passengers provides any educational benefits, as this matter was not discussed with the drivers, due to organizational reasons. Also, the need for raising awareness on punctuality vs. passenger safety and comfort issue has to be considered individually with each driver, due to the fact that different transport companies implement various policies regarding punctuality of their services. However, this still does not change the necessity for teaching efficient methods of passenger safety and comfort assurance.

The course revealed a great importance of providing trainees with preliminary theoretical materials as a mean to attract their attention to the course thematics. Yet, it still has to be considered whether handing out the materials right before the training gives the best results in this matter. Also, a certain improvement in feedback quality made by driving instructors was noted thanks to using the questionnaires. As it was noted, a reliable system of providing objective driving performance assessment helps the instructor to refer to certain elements of the training session while discussing it with the trainee and more precisely address the improvements that need to be made. Such form of the assessment significantly helps to structure the instructors' supervisory role and, what was observed during the pilot, it transfers directly to overcoming the drivers' skepticism towards SBT courses – drivers seem to have a perception of a high-quality, professional educational service, what was also seen through the fact of greater engagement into the training.

The lack of specific training of trainers, focusing on group training and on collective debriefing sessions was also expressed. Trainers usually are trained on the technical features of a simulator, but no such training ails directly at the didactical aspects of SBT. Though the trainer of this pilot is familiar with SBT which he runs on a regular basis, the lack of specific training on characteristics of learning with a simulator (as opposed to real-life driving) constitutes a shortcoming that can and should be avoided, especially considering the fact SBT is now common place in France when training professional drivers and also because the topic of security and comfort assurance for bus passengers is deemed to be better served through the use of a simulator, rather than through purely theoretical

teaching. In this regard, a special focus could be made on the organization and implementation of debriefing sessions addressing groups of learners, as this has been one of the most highly valued aspects of our pilot.

Though security is a notion that regularly pops up in training courses devoted to professional drivers, it has become clear from the feedback received from all evaluators that comfort assurance has been widely overlooked in the training offer for bus and coach drivers. This could warrant the development of a more consistent course on this subject, with enhanced written training material to be developed under the constant consciousness that the use of a simulator is highly adequate for such training as it allows for energy-efficient group training under maximum levels of safety.

C.3 Different simulators for different learning outcomes ... the example of a "Defensive driving simulator training

The main objective of this TTS (FI) simulator pilot course has been to increase awareness of professional drivers for the fundamental principles of defensive driving and on learn how to avoid dangerous situations, which the driver can prepare for in advance. In addition, the training aimed to apply a practical approach to defensive driving learning and teaching. The training program was expected to create clear mind-maps for urban and rural environments, where bus drivers do their daily work.

Piloting methods were: instructor-led theoretical learning in the classroom, trainer-led simulator training tasks, independent peer learning, as well as peer-learning from the experience of other students driving in the driving simulator and independent learning in low-end simulators. The pilot project was carried out by three different groups. In the pilot two state-of-the-art driving simulators, as well as four low-end driving simulators have been used. Two simulator instructors have been involved: one for the state-of-the-art simulator and one for the low-end simulators. The piloting has been implemented according to plan, and only minor corrections had to be made after the first piloting (the familiarization period on the first day and splitting of the group into smaller sub-groups). However, a shortcoming has been observed regarding implementation of individual independent exercises on the low-end simulators which had to be transferred to by instructor-led sessions, while only the tasks were rolling independently. An additional asset was the opportunity to pilot the course structure not only with novice drivers as originally planned but also with experienced professional drivers.

Participants during the TTS pilot training

The course design has been evaluated to be the best educational model for initial (novice driver) training and for continuous training for experienced professional drivers.

General observations due training:

- Scheduling is really important when working with large groups.
- Simulator and defensive driving instructors had been surprised about the amount of resistance to the implementation of this training model.
- Low-end simulators and exercises must be really well designed if the equipment is intended to operate independently. This time, it was found that the exercises are followed by the learners seriously as long as the trainer is in the room, but if the trainer leaves, "rally-driving" and other non-pursue action begins immediately.
- Student's feedback was very positive and in particular low-end simulator have been appreciated as additional training tools.

Improvements proposed for the pilot course

After testing the pilot course design required only minor changes to the first day of the course which therefore proved to be successful for both target groups. In future the possibility of independent-training will be increase with the low-end simulators. Written pilot course material – handed out to the learners for background reading will be transferred into an electronic format, in order to have it available as e-learning material on a PC or even more convenient tablet computer

A SWOT analysis on the pilot course experience

Strengths	Weaknesses
A practical model of education, a good framework for giving feedback, powerful and intuitive way to learn. New variety of exercises can be drawn up indefinitely. Adaptability of the exercises. Different types of vehicles to use in practices.	Requires a large amount of equipment (simulators) and experienced instructors.
Opportunities	**Threats**
Development of technology will enable smaller simulators and training in customer premises with portable devices.	If a student does not experience training "realistic" enough, then he/she may not be able to transfer to practice what they have learned. All are not able to study in a simulator for example because of visual problems.

All in all the pilot design and implementation have been very fruitful, because it allowed to realise an entire course in such a new model: transfer of a three-day theoretical training into a three-day

simulator-based model. This model of simulator training has already been started to be tested by TTS also in the context of other thematic training elements.

It has been evaluated to be especially important to take the simulator's strengths into consideration: versatility and performance ability, or usage in feedback. The simulator supports the addressing/ training of such topics and exercises, which are meant change driving behaviour and performance, or in which the own driving performance is supposed to be reflected. The simulator also provides a lot of different measurements for driving performance, incl. equipment options such as cameras that can be used to examine the drivers' focus attention (eg. where's the driver's gaze is directed in the murky/dark when driving and when meeting another vehicle). Mixing state-of-the-art and low-end simulators is also recommended in training as the state-of-the-art driving simulator worked out to be better for training aspects such as vehicle controls and adjustments. While low-end simulators are more suitable for all other training, where control of the vehicle doesn't play a central role.

Control panel of TTS simulator during piloting

C.4 Supporting continuous work-based learning of drivers through e-learning ... a course on "Load Security" on the distance

E-learning for professional drivers is a subject of very controversial and multifaceted discussions. This e-learning pilot has therefore been implemented in order to explore requirements on e-learning resulting from the characteristics of professional drivers and their work environment. The following questions have been addressed:

- What support structures are necessary in order to effectively implement e-learning in the context of professional driving?

- How can e-learning be documented in order to receive recognition within the relevant national legal regulations on continuous/periodic training for professional drivers?
- How can e-learning fit into the regular work of professional drivers under consideration of legal limitations?
- What framework needs to be provided in order to make learning adaptable to individual learning needs and prior abilities and/or employers requirements?

The course development has been based on EQF-based (European Qualifications Framework) learning outcomes described on the topic of "Load Security" within the ProfDRV profile for professional drivers (freight transport) (ProfDRV, 2012) in order to ensure connectivity of the course to a wider vocational profile and draw back to a set of already existing learning outcome described for this part of a professional driver qualification.

Based on an initial target group and content analysis Gagnès Nine Events of Instruction (see also Niegemann et al, 2008, Gagné, Golas & Keller, 2004) have been chosen as the underlying instructional design model. This approach explicitly refers to prior abilities of the learners and strongly supports instructor led distance learning through the nature of the Nine Events enabling a back and forth between instruction, self-study, practical application, guidance and feedback.

The overall course has been realised applying a blended learning approach combining online course elements, course elements with direct interaction between the learner and a tutor as well as work-based learning elements has been chosen in order to provide a suitable training environment.

The overall course follows six implementation steps:

I. Introduction into the course through online material and first go through the overall self-study material for the course (see III)
II. Initial tutoring call[3] with a tutor
III. Self-study of major online course material
IV. Guided learning alongside work with regular praxis tasks to be implemented at the workplace
V. Final tutoring call with the tutor
VI. Provision of follow up material to foster learning and further transfer to the workplace

Following this schedule the Nine Events of Instruction are applied:

(1) Gain attention and
(2) Describe/ present the objectives/ aspired learning outcomes
In order to realise the two events of instruction a multimedia based online introduction into the overall course serving both purposes has been prepared. A link to this introduction is provided to the learner prior to the first tutoring call as introduction into the overall course. The tutor takes up on these two events of instruction again in the initial tutoring call.

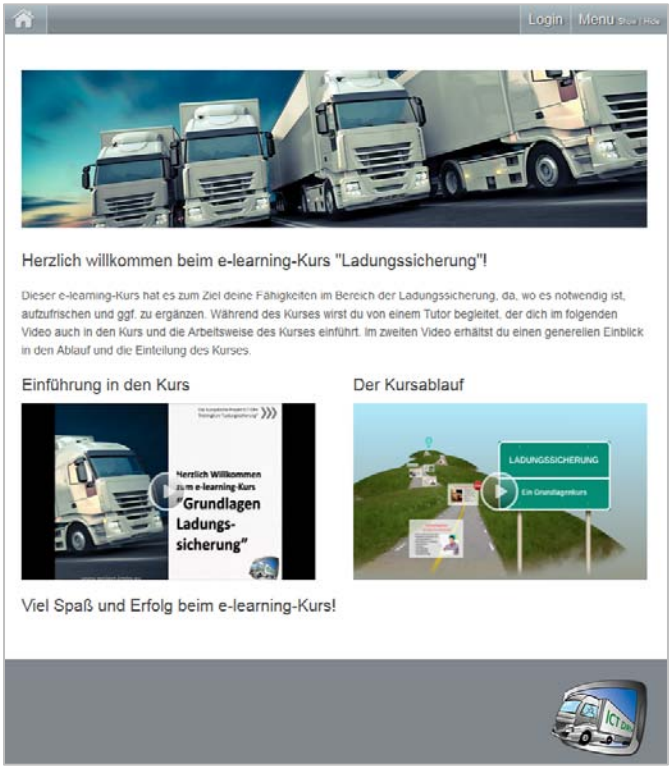
(3) Stimulate recall of prior knowledge

[3] The „call" can also be realised as a face-to-face meeting dependent on the possible setting.

This is the major aim of the initial tutoring call with the tutor that aims to stimulate the recall of prior abilities and lays grounds for connecting the following learning steps to these prior abilities of each individual learner. A set of guiding questions for the tutor has been developed for this purpose. This initial tutoring call is further used in order to introduce the self-study material and the work approach during the self-study period. It also serves in order to agree on the individual learning emphasis of the learner based on his/her prior abilities and fields of work.

(4) Present the material

The actual learning material is presented as a series of short video lectures in order to allow for learning in very small bits and pieces (mobile learning) such as within small time windows. If necessary, additional tutoring calls with the learner are possible in this part of the course and also other means of communication with the tutor have been integrated. Generally the work with this course material is only an offer to the learner in order to implement the praxis tasks in the following events of instruction. It is not compulsory to work through it.



The course material can be accessed online and is therefore easily accessible at any time. It adapts easily to mobile devices.

(5) Provide learner guidance, (6) Elicit performance (practice) and (7) Provide feedback

Step IV (see schedule above) is implemented in a timeframe of 10 to 20 days (to be decided upon together with the learner). During this time the learner receives regularly small praxis tasks related to load security that require the learner to apply the content presented in the learning material practically. They are clearly related to the learners regular work tasks in order to foster learning and learning transfer. For this pilot only one set of tasks has been developed but for further development steps further sets of praxis tasks should be defined. Those should reflect the prior abilities of the learner, their specific learning needs as well as the load and goods they usually work with in order to further individualise and adjust the course to different work contexts and learners.

(7) Provide feedback and (8) Assess performance

After completion of the “self-study” period the events (7) and (8) are implemented in the framework of a final meeting/ call with the tutor. This tutoring call is used in order to reflect on the overall “self-study” material, evaluate the implementation of the praxis tasks and open questions of the learner. Also for this purpose guiding questions for the tutor have been developed. In addition this call contains an element of performance assessment assessing the learners learning progress with regard to the originally defined learning outcomes. This assessment is implemented dialogue-based supported by a set of guiding questions to be applied by the tutor. The reflection part of this tutoring

call fades smoothly into the assessment part without difference that can be recognised by the learner. A “non-passing” of the assessment because of obvious non-implementation of the praxis tasks and/ or clearly missing of the aspired learning outcomes leads to a repetition of another set of praxis tasks incl. an additional tutoring call.

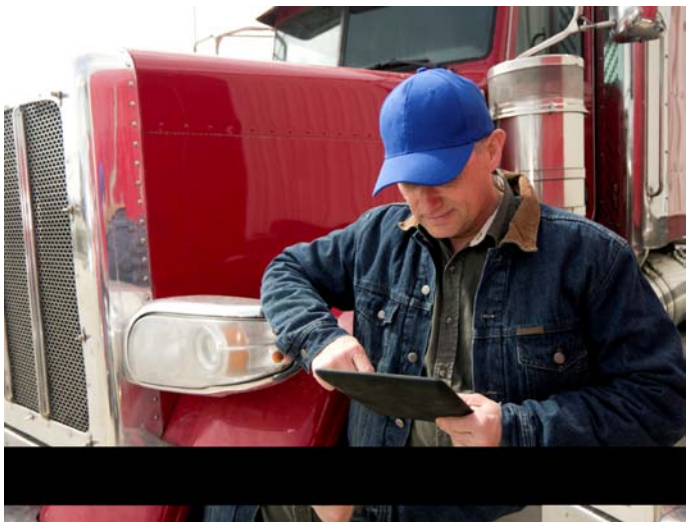
(9) Enhance retention and transfer

Retention and transfer of learning is fostered by providing the learner after the final tutoring call with a summary of his/her performance and possible further fields of learning prepared by the tutor. A feedback template has been developed for this purpose and in a further development step of the course advanced learning material is added to this instructional event.

The very heterogeneous nature of professional drivers’ prior abilities is a key challenge within continuous/periodic training. The course therefore contains the opportunity for drivers to add, skip and/or adjust course elements based on their prior abilities and in dialogue with the tutor. This approach is strongly supported by the application of the EQFs learning outcomes approach because this approach moves the focus away from time spend in training (as currently part of the legal requirements for periodic/ continuous training of professional drivers) and to the reaching of a common minimum standard allowing for an adjustment of the course content.

The following of an e-learning course has been evaluated as an often difficult task for the pilot target group because of missing abilities with regard to learning strategies, self-motivation, self-organisation and self-evaluation. The course has therefore been designed as a tutored course with at least two fixed tutor contacts and additional tutor contacts on demand via verbal or written communication. Additional tutoring elements should be explored within further development steps of this pilot course. Furthermore, contact with the learner is kept through the provision of the praxis-tasks in regular intervals rather than at once in order to facilitate continuous work on and with the learning material.

Just as the prior learning also the work reality of professional drivers differs strongly even in a field such as “load security” as addressed in the pilot course. While the background/ basic contents of the course remain the same (in order to ensure a common minimum content of the course as required by the legal framework of professional drivers’ periodic training) the praxis-tasks have been designed in order to be adaptable to (a) the learners’ prior abilities and (b) the different work realities of the learner. If necessary, it is even possible to use an individual set of praxis-tasks for a learner or a group of learners in order to adapt the course.



E-learning for professional drivers is more than the provision of study material. (©shotbydave, iStock)

Praxis transfer is a key challenge for the application of the learning outcomes approach because the EQFs learning outcomes approach requires the development and proof of knowledge, skills and competences. Especially the development of skills and competences often requires practical training elements that are often difficult to realise within e-learning. In order to address this aspect the pilot course has been given a strong work-based learning component by introducing the praxis tasks that are to be implemented in the learners' daily praxis in order to apply their knowledge and foster the development of skills and competences. This process is facilitated by the tutor.

So far the legal framework for professional drivers' continuous/ periodic training requires professional drivers to attend a course for a certain number of hours while the required learning outcomes are not specified. The application of the learning outcomes approach shifts the focus away from time spend in training towards reaching of a common minimum standard of knowledge, skills and competences being a fundamental requirement for the recognition of non-class-room-based courses. The pilot course makes use of this opportunity in order to provide an alternative proof for learning by integrating a dialogue-based assessment into the final course evaluation with the tutor based on a common interview guideline incl. indicators for the tutor to measure the reaching of this minimum standard.

D Conclusions drawn from project work on the practical realisation of technology-supported training for professional drivers

The initial review of scientific sources revealed that theoretical and instructional design principles should be part of any computer- or simulator-based training intervention. Computer- or simulator-based training for professional drivers should build on the rich sources of educational theory and instructional design as this enhances content retention and facilitates the transfer of learning into practice. However, the suitability of a theory and/or instructional design model is dependent on the learning objectives and learning outcomes to be achieved. From the findings of the literature and praxis review conducted and the piloting implemented within the ICT-DRV project several conclusions can be derived with regard to findings to be considered in the framework of the integration of learning technology into professional driver training.

Learning is a social process - therefore CBT/SBT should allow student/tutor exchange

The research undertaken and the testing of the ICT-DRV pilots courses revealed that interaction between learners and/or a tutor has a positive influence on the learner and their learning process. Currently, however, unplanned interaction during breaks is often the only form of exchange between learners in CBT/SBT, and impact of the social process on learning is rarely considered in the development and implementation of CBT and SBT programs. Therefore, anticipating some kind of exchange between learners (in the form of a peer learning activity) during training could have a positive impact. In SBT peer-learning could be organised in which learners observe one another during driving simulation and exchange feedback afterwards within group sessions. In CBT social exchange is slightly more difficult to implement, but exchange and discussion could be organised

through discussion platforms, phases of personal attendance, or team assignments. The opportunity to exchange experience with other individuals (be it a tutor or other learners) during the learning process (online, via phone, or face-to-face) proved to provide a clear added value in the four pilots tested in the ICT-DRV project.

Provision of some kind of tutoring in CBT/SBT for professional driver

On the basis on the interviews conducted and the literature review undertaken, the provision of some form of tutoring is recommended when implementing CBT/SBT. This is especially relevant for professional drivers as they are a very heterogeneous group, with diverse backgrounds and educational needs. The success of training through CBT/SBT depends on the students having access to guidance in the event that they require assistance.

In CBT tutoring can be organised electronically, from distance, via a computer (e-mails, chats, video conferences, telephone calls, webinars etc.), or in the form of classroom tutoring sessions. In CBT therefore, online course elements, course elements with direct interaction between the learner and a tutor, and work-based learning elements should be combined to provide a suitable training environment. Consequently, a blended learning approach – where computer-based training sessions are intertwined with classroom or online training sessions – seems to be most promising for CBT. Tutoring sessions can also be beneficial in terms of motivating students using CBT in general and particularly before exams (i.e. prior to driver CPC exams).

In SBT training sessions should always be conducted by a tutor who explains the learning objectives and learning outcomes at the beginning of the session. Furthermore, the tutor should provide feedback to the trainees both during and after the simulator training. Without some form of tutoring (briefing, debriefing) trainees are more likely to perceive training on a simulator as a game (or panelty) rather than a real learning experience. Hence, briefing at the beginning of the training session, debriefing after the session, and peer learning are important aspects to be considered in the development and implementation of SBT.

CBT and SBT should have clearly defined learning objectives and (aspired) learning outcomes

Without an awareness of what the desired outcomes of instruction are, CBT/SBT programs are likely to be *'unfocused, confusing to the end-users, and quite possibly, useless'* (Chappell). Learning sequences in computer-/simulator-based training should ideally be outcome-oriented in terms of the EQF descriptors knowledge, skills and competences. Focus should be placed on the learner rather than on how the trainer will convey his/her knowledge to the learner. Furthermore, the application of the learning outcomes approach shifts the focus away from the amount of time spent in training (as currently part of the legal requirements for periodic/ continuous training of professional drivers) towards the attainment of a common minimum standard of knowledge, skills and competences, which is especially relevant for the recognition of non-classroom-based courses or prior knowledge.

Furthermore, the learning outcomes approach allows customisation of a course to the skills shown by the learners.

The definition of learning objectives/ aspired learning outcomes to be achieved with a concrete course is a milestone within instructional design for any kind of training incl. e-learning and simulator training. The learning outcomes approach of the European Qualifications Framework comes in handy at this point because it requires the definition of knowledge, skills and competences associated with a certain qualification and at the same time aims to ensure connectivity of individual learning elements to a wider vocational certificate. But in the context of instructional design the definition of learning objectives / aspired learning outcomes builds the basis for all following design decisions that also include decisions about the appropriateness of certain methods in order to reach the aspired learning outcomes. In this way the learning outcomes approach strongly facilitates the development of quality within training because it helps to come to decisions what kind of method is necessary in order to reach certain learning outcomes.

In the context of the ICT-DRV pilot courses the defined learning outcomes let for instance in the case of one of the simulator training courses to the design decision to integrate additional training elements complementary to the simulator training in order to address the whole set of aspired learning outcomes. It can therefore be concluded that the application of learning technology (as well as any other training methods) needs to clearly correspond with the learning outcomes aspired and needs to be appropriate in order to reach the aspired learning outcomes, solve a certain competence-based problem and/or address the learners' characteristics properly. This will mostly lead to a mixture of different methods to be applied in order to reach a certain set of learning outcomes rather than pure e-learning or simulator training.

All in all the projects evaluation results clearly underline the necessity to apply a learning outcome oriented approach to training in order to design training for professional drivers supported by learning technology and to appropriately address training and learning needs of professional drivers within such training settings in the most effective and learning-supportive way.

Consideration of prior abilities and the work reality of professional drivers in CBT/SBT

The project results lead to the conclusion that e-learning and simulator training strongly benefits when modularised and described in terms of learning outcomes. This guarantees that the learner can, depending on his/her prior abilities and learning needs, individually choose those training modules/levels that best fit his/her individual requirements. However, the heterogeneous nature of professional drivers' prior abilities is a key challenge within continuous/periodic driver training. Therefore, CBT and SBT courses should allow course elements to be added, skipped and/or adjusted, in dialogue with the tutor and on the basis of the prior abilities/experiences of the individual. This approach is strongly supported by the application of the EQF's learning outcomes approach because it moves the focus away from the amount of time spent in training towards the attainment of a common minimum professional standard, while allowing for adjustment of the course content.

Gagnè's Nine Events of Instruction proved to effectively support the integration of learner's prior abilities within the pilot training schemes developed in the ICT-DRV project. This approach strongly supports instructor-led distance learning as it enables a back and forth between instruction, self-study, practical application, guidance, and feedback. Furthermore, due to the fact that the work reality of professional drivers differs considerably, a number of constant background/basic elements of the course should be defined in the design of SBT (in order to ensure the common minimum course content as required by the legal framework of professional drivers' periodic training), while individual practice-tasks should be designed in order to be adaptable to (a) the learners' prior abilities and (b) the different work realities of the learner. Exercises should be prepared in such a way that they account for the prior knowledge of the student and their working context. Moreover, they should be neither too easy nor too difficult.

Combination of theoretical and practical training elements in CBT/SBT for professional drivers to facilitate practice transfer

In the context of the ICT-DRV pilot courses the coherent application of instructions design decisions led to the complementary application of a work-based learning approach in order to enable reaching of the defined and necessary learning outcomes to act competently in a practical situation, while theoretical background information has been sufficiently addressed through the application of online learning resources. However, the integration of a work-based learning component can be postulated to be generally a very important, if not even indispensible, training component in the context of e-learning for professional drivers. The term "work-based learning" is used as learning in the context of the workplace, in settings simulating the workplace or off workplace with learning tasks directly applied in the workplace and reflected upon training (CEDEFOP, 2014). The evaluation results clearly show that pure e-learning in terms of study of learning material does rarely sufficiently address the characteristics of the target group "professional drivers" because a strong practical component is necessary in order to reach and engage the target group into training and is rather unlikely to address a whole set of abilities usually associated with the professional driver vocation. Nevertheless, also the postulation of such a work-based learning component needs to be reflected based on the set of learning outcomes to be achieved in order to design an appropriate learning environment.

This similarly applies to simulator training with the simulator providing the work-learning component in order to ensure the praxis transfer (see pilot cases above). However, a stand-alone application of simulator training without accompanying additional training measures appeared not as useful because the overall set of learning outcomes defined as necessary in order to perform the researched driving tasks competently required a whole set of further knowledge, skills and competences. Those have been evaluated as more adequately addressed through other training sessions to be delivered through class-room training, different kinds of e-learning or other learning approaches. Also here again the combination of approaches ensured the training success.

Documentation of learning outcomes of professional drivers in CBT/SBT

It is important that the learning outcomes acquired by trainees through CBT/SBT are evaluated and documented. A formative approach where the competences of the trainees are evaluated at the beginning of the training, at the mid-point of the training, and at the end of the training seems to be very effective in terms of facilitating successful learning. An evaluation of learning outcomes undertaken before implementation of the training allows the learner to articulate his/her training needs and to individually plan his/her learning pathway. A mid-point assessment allows the learner to obtain an overview on his/her understanding of the training content and articulate open questions. Finally, an evaluation of the learning outcomes at the end of a course allows the learner to understand what knowledge, skills and competences were acquired during the course and where there is still room for improvement. The documentation of learning outcomes in computer- and simulator-based training for professional drivers does not refer to testing or examinations taken at the end of the training course, but to the process of making the learning progress visible to the to the students, as this informs and motivates them. Furthermore, continuous professional development is only possible if a learner knows what he/she is able to do and where there is a need to develop his/her competences further.

Train-the-trainer in the use of CBT/SBT as a learning medium

The success of SBT and blended learning strongly depends on the quality and abilities of trainers who must have a thorough understanding all aspects of the use of a simulator or an e-learning programme to ensure that the training approach allows learners to achieve the defined learning outcomes and guarantees the transfer of learning to practice. Moreover, trainers need to be able to apply the learning technology so it supports their instruction as effectively as possible to ensure that technology-based training provides an added value for the learners. Furthermore, instructors also have an important role to play in motivating and guiding learners. However, the moderation of group coaching sessions, including the integration of just-received information and its relation to supportive information, requires not only very advanced subject-expertise, but also expertise in coaching, moderation and facilitation. Therefore, trainers / tutors should not only be competent with regard to the technical part of learning technology (how to use a simulator or e-learning programme), but in the pedagogical domain (how to effectively teach with a simulator or E-learning program).

Bur e-learning and simulator training require not only a complementary set of trainer competences with regard to working with learning technology in general but also assign also a new role to the trainer that does not longer focus on providing and presenting expertise but rather on facilitation and moderation of learning processes. Especially in the context of e-learning the task of delivering facts, figures and further theoretical background knowledge is taken over by the technology while the trainers major role is to support self-learning of the learners, facilitate learning in a media-based environment and provide coaching to the learner. Similarly also the role of a simulator trainer shifts away from the provision of theoretical knowledge to the one of a moderator of group and individual

learning processes. At the same time also requirements on the subject-related expertise of the trainers increase strongly because they are taking over the tasks of a coach who delivers his/her expertise just in time and without a predefined set of contents for a session. In this way the application of learning technology requires the reconsideration of the knowledge, skills and competences to be required from a trainer in order to facilitate such learning technology supported learning processes. This is especially relevant because trainer competences – not only within technology-supported training but within training in general – proof to be a fundamental contribution to the successful implementation of training.

Supportive legal and organisational framework

In order to reach transfer of learning from a learning environment to work praxis a supportive work environment in terms of work conditions that support the application of learning outcomes also in praxis is indispensible regardless of the kind of training (with or without technology-support). However, this requirement even increases when it comes to learning taking place on the distance and close to or at the work place or has a strong praxis component as the case within simulator training. The necessary framework conditions such as time and infrastructure (including the applicable legal framework which is a special aspect with regard to the professional driver occupation) for learning are fundamental in order to implement e-learning on the distance. At the same time praxis also needs to provide a supportive environment in order practically apply newly gained knowledge, skills and competences. As mentioned before this is a topic applying to every kind of training but it became especially evident in the context of the ICT-DRV pilot courses. Also relevant in the context of supportive framework conditions is the formal recognition (incl. a supportive and quality focused legal regulation) of especially e-learning courses but also simulator courses primarily due to motivational aspects.

E Quality and technology support within training

The question “What is high-quality within technology-supported training?” leads to very different answers dependent on the perspective of the one answering the question. This indicates already that the definition of quality indicators for technology-supported training within vocational education and training for professional drivers is a task requiring the consideration of different stakeholders’ perspectives. Technology-support within training, therefore, always asks for the consideration of economical, technical and educational aspects. In the specific case this triangle has to be even extended by a fourth dimension being legal/ policy related requirements playing a role as soon as the technology support is embedded into regulated training as often the case within professional driver training.

Nevertheless, the ICT-DRV quality indicators clearly follow an education-oriented approach and put the learner and his/her learning into the centre of attention. In this way they follow one of the basic principles of nowadays education philosophies building the backbone of European education debate

and policy. Technology, therefore, serves as a mean only in order to facilitate learning in the concept of the ICT-DRV quality indicators. The application of technology within professional driver training cannot be considered as criteria for quality in itself but rather asks for separate quality considerations in order to ensure an education-oriented integration of technology into training.
Educational and technological concepts as well as economical and legal/policy-based considerations underlying the application of technology in order to facilitate learning within professional driver qualification have therefore been the focal point of investigation throughout the ICT-DRV project. Based on those investigations the ICT-DRV consortium drafted a set of quality indicators. Those have been presented to a number of stakeholders representing the different perspectives outlined above and let to the ICT-DRV indicators for high quality technology-support within professional driver qualification:

Quality Indicator 1: A supporting and regulating legal and organisational framework

Legal regulations as well as the organisation of work provide the necessary framework for the implementation and, if applicable, recognition of CBT and SBT. This applies especially to the legal framework provided in the context of EC directive 2003/59 and, if necessary, further legal regulations having influence on the implementation of such training alongside regular work as a professional driver. Besides legal aspects also the work organisation provides the learner with the necessary time and framework to participate in CBT/SBT and with the necessary support to transfer newly gained abilities into practical work.

Quality Indicator 2: Comprehensive information and counselling

here are information and counselling measures put in place in order to:

- inform end-users and decision-makers objectively about CBT and SBT,
- enable learners, employers and competent-bodies to decide if a CBT/SBT offer meets their requirements,
- enable learners and employers to decide if a the training format CBT/SBT is suitable for an individual learner and/or for a certain learning need,
- select and adapt courses to individual training needs of a learner and/or a company and
- provide learners and contact persons in their company with the necessary guidance and facilitation before, during and after the course attendance/ implementation.

Quality Indicator 3: Specifically trained trainers and tutors

Trainers/ tutors facilitating technology-based training are – besides regular training for trainers and in professional topics – trained in a number of additional abilities that are based on the characteristics of the technology they are working with in its learning context. This includes among others specialised training:

- for simulator trainers in the characteristics of learning with the simulator/ simulation, individual and group coaching and debriefing, the design and selection of scenarios and the operation and application of the simulator, its various features and additional tools and

- for e-learning tutors in the characteristics of distance learning, e-tutoring, learner motivation and instruction, e-communication and coaching as well as interviewing and feedback techniques.

Quality Indicator 4: Application of the learning outcomes approach

The learning outcomes approach with its implications on the quality of training is applied on SBT and CBT. SBT and CBT courses are described in terms of learning outcomes (knowledge, skills and competences) associated with a course, learning environments are adequate to achieve those learning outcomes and, if applicable, assessment takes all kinds of learning outcomes into account and applies appropriate assessment measures.

Furthermore the application of the learning outcomes approach allows the recognition of prior/ non- and informal learning and the recognition of learning outcomes acquired within those CBT/SBT courses in the framework of other (formal) learning outcomes based vocational education and training courses/ certificates.

Quality Indicator 5: Provision of an added value to the learning process

The application of computer- and simulator-based training has a clear added value for the learning process and/or the achievement of the aspired learning outcomes. Technology-based courses are therefore exclusively offered for the achievement of learning outcomes that can clearly benefit from the application of such learning approaches and/or that can be equally be achieved through classical as well as through technology-based training approaches.

Quality Indicator 6: Sound and thorough instructional and technological interface design

The design of CBT and SBT is based on instructional design considerations taking into account the aspired learning outcomes and the needs and characteristics of the learner. This leads to the development of learning environments providing best conditions to stimulate and facilitate learning. Pedagogy drives the choice of instructional technology, not the other way around.

Quality Indicator 7: Continuous evaluation and further development of CBT/SBT courses

CBT/SBT courses are continuous subject for review, change, improvement and further development in order to adapt to changing needs and requirements and to the state-of-the-art of educational technology. Learning is the leading factor within all evaluation and development efforts.

Quality Indicator 8: Research, sharing and networking on the realisation of SBT and CBT

The implementation of SBT and CBT requires a continuous dialogue and close cooperation between education providers, developers of CBT and simulators as well as researchers, therefore, continuous sharing, networking and joined research activities are taking place in order to further work on the improvement of SBT and CBT.

The realisation of those indicators requires contributions from all stakeholders involved into the realisation of technology-supported professional driver training. This includes the drivers themselves, employers, education providers, social partners, e-learning and simulator/ software developers, researchers in this area, authorities and policy makers. It needs to be a joined effort in order to realise high-quality within technology-supported training in order to finally lead to improved training environments, better learning of drivers and therefore also safer roads across Europe.

F Recommendations on the high-quality integration of technology-supported training into professional driver training in Europe

The ICT-DRV project aimed to pave the way for high-quality integration of e-learning and simulator training into professional driver qualification in Europe by emphasising considerations on the facilitation of learning within the discussion on e-learning and simulator application in professional driver training. At the same time it aspired to foster the overcoming of scepticism and reservations against technology-supported training through emphasising quality and the added value of technology in order to reach a best possible learning result. To reach those aims the project partners investigated the status-quo of learning technology within professional driver training across Europe, reviewed existing research results related to learning considerations and technology-supported training, implemented and evaluated instructionally designed pilot e-learning and simulator training courses and developed under consultation with numerous stakeholders a set of quality indicators in order to provide a handy tool for quality development and improvement within different practical contexts related to professional driver training.

All those efforts undertaken within more than two years of project work led to a set of policy recommendations intended to support policy makers in making decisions about the future consideration of e-learning and simulator training within regulated professional driver training especially in the context of EC Directive 2003/59. The ICT-DRV recommendations put a special emphasis on quality considerations aiming to improve the learning process and the learning outcome in order to provide an added value oriented towards the overall aim to increase safety on European roads.

Integration of e-learning as (optional) recognised training approach within regulated training for professional drivers.

E-learning (on the distance) can bring a great added value to professional driver training. This applies especially to training flexibility with regard to learning pace, place and time as well as to the individualisation of the learning process. The individualisation of learning can be considered as very beneficial with regard to learning and in order to overcome the challenges resulting from the heterogeneity of professional drivers as a target group especially within continuous/periodic training. E-learning enables in this context the adaptability of learning to for instance different levels and sets of prior knowledge and learning needs which is usually a challenging task within class-room training

and influences strongly motivational aspects of learning as well as the potential outcomes of a learning process.

However, in order to avoid low quality e-learning solutions, learning-related quality considerations need to be a major criterion for accreditation. This includes among others the development of e-learning under clear consideration of the target groups' (learning-related) characteristics and needs and of predefined learning objectives/ outcomes. Both need to be clearly reflected in the instructional design that puts a clear emphasis on the facilitation of the professional drivers learning and considers the learning technology as a means to facilitate learning only. The pure application of (innovative) technological/media solutions within training may not be considered as an indicator of quality. Quality results from the appropriateness of technology/media application in a learning context in order to address learners' needs and characteristics with regard to learning and/or the aspired learning outcomes.

A sound legal basis of such training is, however, an indispensible fundamental requirement in order to enable the development of such high quality e-learning solutions that require in most cases a high financial investment in order to lead to e-learning solutions appropriate for the target group and the aspired learning outcomes.

Integration of e-learning and work-based learning practices.

Professional drivers can especially benefit from e-learning when classical e-learning approaches are replaced by or interrelated with some kind of work-based learning in order to ensure a high relevancy to practice. "Work-based learning" is in this context understood as learning in the context of the workplace, in settings simulating the workplace or off workplace with learning tasks directly applied in the workplace and reflected upon training (CEDEFOP, 2014). In this way the practical relevance necessary for high quality training solutions is ensured.

Such work-based learning elements can for instance be realised through the application of blended learning approaches. This can for instance be a combination of e-learning for studying the theoretical background content and practical training in a group setting focusing on the practical application of the e-learning material and the training of skills and competences. Also the approach applied within the ICT-DRV e-learning pilot course is conceivable by integrating learning tasks to be applied at the workplace and afterwards reflected within an (virtual) individual coaching/tutoring or in a classroom setting in a group of learners. Further possibilities to realise such a work-based learning element is the integration of simulations into an e-learning environment such as a simulation of practical load security situations through a virtual or augmented reality. Similarly serious gaming applications such as simulation games simulating for instance logistical processes can provide such a work-based component within an e-learning setting.

However, also the postulation of such a work-based learning component needs to be reflected based on the set of learning outcomes to be achieved in order to design an appropriate learning environment.

Embedding of simulator training into wider training concepts.

Simulator training is not an end in itself but is a tool to train certain abilities in the context of a wider field of training. Training on a simulator therefore needs to be methodically and content wise embedded into a wider training / instructional design concept in order to make use of the simulators full training potential. Such a full training concept can for instance be a curriculum that contains also certain training elements on a simulator in order to reach a specific set of learning outcomes but includes complementary also supporting elements such as (e-)learning elements providing training to obtain supportive theoretical background knowledge, training sessions to train specific tasks related to driving for instance with serious gaming techniques or practical tasks in order to practice newly gained competences in the context of practical driving. Such an embedding into a full curriculum strongly increases effectiveness of the simulator application because supporting training measures are in place as well as transfer of learning into praxis due to the feasibility of an immediate practical feedback within the simulator training elements.

Complexity of the simulator to be specified based on the aspired learning outcomes.

Different learning objectives/ aspired learning outcomes have different requirements on the complexity of the simulator. While some objectives require the application of a top-of-the-range simulator others can be achieved with serious gaming solutions. Decisions on the technical requirements on a simulator, therefore, need to be based on the aspired learning outcomes rather than on the technical state of the art. It is not the aim of simulation within training to replicate reality in the best possible way but to support the achieving of certain competences in the best possible way.

A top-of-the-range simulator is indispensible in order to train certain driving skills and competences or to fulfill certain purposes within training such as shown within the ICT-DRV pilot simulator training courses on defensive driving. But also training elements exist that can equally (or even more efficiently) be implemented with a less complex simulator such as the case for repetition exercises in order to internalize a certain behavior or practice. The choice of simulator complexity is therefore strongly dependent on the learning outcomes to be achieved and the simulators role within the overall curriculum.

In this way the full potential of a top-of-the-range simulator as well as other types of simulators as training tools can optimally be used and lead to a clear improvement of the training and learning process. Similarly, the surplus of simulator use within training can be identified and used in order to

optimise training for professional drivers. However, further learning-oriented research is certainly beneficial and necessary in order to elaborate in more detail what kind of simulator with what level of complexity is appropriate in order to address certain learning objectives and to apply the simulator for certain training purposes effectively and efficiently.

Integration of e-learning and simulator training into EC Directive 2003/59 through application of the learning outcomes approach on the European Directive.

The application of the European Qualifications Frameworks' (EQF) learning outcomes approach on Directive 2003/59/EC has already been recommended in the context of the ProfDRV project in order to facilitate comparability and reaching of a common qualification level across Europe. But the learning outcomes approach at the same time leaves more freedom with regard to different training approaches such as e-learning and simulator training while keeping the learning outcomes as the actual object of comparison and centre of attention.

The focus of training is moved from input factors such as duration and place of learning to output parameters by relying on the learning outcomes to be achieved at the end of a learning process. This approach leaves on the one hand far more freedom to education providers and learners regarding individual choices on the way learning takes place and the methods chosen. On the other hand it strongly increases requirements on the quality of training because it requires reaching of a specific predefined set of learning outcomes that also builds the basis for a common (minimum) level of qualification across Europe rather than defining the pure learning content regardless of the learning that finally took place. The aspired learning outcomes likewise build the basis for any instructional design considerations in the context of technology-supported – and any other kind of – training postulated as a fundamental requirement on training within the ICT-DRV project.

The EQFs learning outcomes approach therefore has in the context of EC Directive 2003/59, if applied properly, the potential to foster at the same time the realisation of a common minimum level of professional drivers' qualification across European as well as the improvement of quality within professional driver training.

Increase education-oriented quality awareness and literacy of stakeholders within professional driver training.

So far considerations on technical and documentation requirements are primarily in the centre of attention when it comes to quality considerations on e-learning and simulator training. But since learning is the aspired goal, the facilitation of learning and the outcomes of learning should be the leading factor with regard to quality assurance, too. Education-oriented quality awareness and literacy of all stakeholders involved are therefore fundamental in order to foster a culture of quality within professional driver training and to make a difference regarding more safety on European roads through training measures.

In order to realise such a shift in paradigms education providers, trainers, accreditation bodies, developers of learning technology (e-learning and simulators) as well as policy makers need to be

reached with and educated about education-related quality aspects as they have been among others defined in the ICT-DRV quality standards. This among others concerns the competence requirements on trainers and officers at accreditation authorities, the requirements on quality management/ assurance measures at VET providers and learning technology developers as well as the legal framework and accreditation requirements that need to clearly incorporate education-related quality considerations in the first place. The ICT-DRV quality standards are meant as a tool to support such a continuous process of quality development and improvement in those contexts.

In order to integrate technology-supported training on high-quality and in order to realise those recommendations, the cooperation from all stakeholders, including employers, education providers, social partners, learning technology developers, researchers, policy makers, and the drivers themselves is fundamental. Such cooperation provides the basis for ongoing exchange of expertise and dialogue about the continuous improvement of learning technology which is the basis for a coherent quality development within vocational education and training for professional drivers. The ICT-DRV project served as an initial platform in order to bridge the gap between those stakeholders with the topic of learning-related quality as the central point of common interest. It is now up to the European and national stakeholders to take on the baton and make use of the project results because only a joint effort between all stakeholders to improve training environments and facilitate better learning for drivers will ultimately lead to safer roads across Europe.

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