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ACRONYM: TRAINER

TITLE: System for driver TRaining and Assessment using INteractive Evaluation tools and Reliable methodologies

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1 Executive publishable summary

Accidents related to novice drivers account for approximately 15% of traffic accidents. Therefore, TRAINER intended to develop a new, improved training curriculum for driver trainees, using modern training tools and innovative educational scenarios, which intend to enhance risk awareness and permit a safe use of on-board driver assistance systems. As part of this, TRAINER has developed an interactive, multimedia training tool and two modules of a driving simulator (static and semi-dynamic one), paying attention to their cost-effectiveness. To facilitate the take-up of the project results, TRAINER provided practice guidelines for the deployment of the proposed curriculum and training tools. The project is therefore supporting traffic safety, by promoting the "Road Safety in the EU" policy and the "Common driver training and licensing procedures in the EU" policy.

The project has achieved the following key objectives and milestones:

- Development of a concise compendium of drivers' training and assessment curricula and methodologies in 24 countries, recognising also gaps in the relevant training schemes (within project D1.2).
- Transformation of the above data into a CD-Rom database (D1.1), which can also be located in a www site and be accessed through a standard browser.
- Identification of major gaps and priorities for further improvement of the novice drivers' training, through extensive literature survey (over 250 references analysed), accident analysis of generic data and 3 detailed databases, interviews with 26 driving assessment experts from 24 countries, interviews with 122 driving instructors from 8 European countries; all reviewed at an International workshop with 60 attendants from 15 countries (all data presented within project D2.1).
- Systematic mapping and prioritisation of the recognised gaps and inefficiencies, according to a 4-level driving task model (of GADGET), structuring them in "vehicle manoeuvring", "mastering traffic situations", "goals and context of driving", and " goals for life and skills for living" subcategories (in D2.1).
- Development of approximately 100 detailed scenarios, covering the recognised gaps and inefficiencies, to be taught with the help of TRAINER multimedia training tool and/or TRAINER driving simulators (within project D6.1).
- Review and analysis of driver training tools from 6 EU countries (17 multimedia software and 23 driving simulators), identifying their technical characteristics, costs, market penetration and limitations (within D2.1).
- Wide diffusion of the project concept and creation of user awareness, through the international workshop of Brussels (on 22-11-2000), the distribution of 500 posters and 2000 leaflets, the development of a project site (www.trainer.iao.fhg.de), with discussion forum area, and the publication of 5 articles on the project so far.
- Detailed specifications of TRAINER multimedia tool and 49 scenarios for it.
- Development of TRAINER multimedia tool in 8 languages (D3.1).
- Definition and description of 31 scenarios for all 4 hierarchical levels of the GADGET matrix for implementation in the driving simulators of TRAINER project (within D4.1).
- Detailed specifications of TRAINER low- and mean-cost driving simulators requirements (within D4.1).

- Development of first prototypes of TRAINER low- and mean-cost driving simulators.
- Truck simulator feasibility study (D4.4).
- Proposal for a new TRAINER Assessment Criteria and Methodology (D5.1).
- Update of project www site with interactive demo (D9.2).
- The TRAINER concept has been presented in various events, as well as in the Driving School Association (EFA) General Assembly on June, 30, 2001 in Crete and was there favourably assessed by the vast majority of the national Driving Schools Associations.
- Finalisation of 4 pieces of low-cost driving simulator prototypes (D4.2) and 4 pieces of mean-cost driving simulator prototypes (D4.3).
- Finalisation of user interface of the interactive multimedia tool (D3.2).
- Development of normative driver behaviour database (D5.2).
- Evaluation and analysis of results of pilots with the TRAINER tools (D6.2).
- Proposal for new driver training curricula, best practice and design guidelines and recommendations to authorities (D7.1).
- Study of the cost-benefit ratio and cost-efficiency of TRAINER tools and procedures and definition of consortium exploitation strategy (D8.1).
- Development and dissemination of an educational videotape (D9.3).

2 Objectives of the project

2.1 Project objectives

TRAINER objectives are:

- To develop a new cost-effective Pan-European driver training methodology, which will pay significant attention to the enhancement of risk awareness of learners drivers. It will also familiarise them with emerging Advanced Driver Assistance Systems, like ABS, EDS but also Adaptive Cruise Control, Navigation aids, etc.
- To develop a methodology to assess and support driver's cognitive skills.
- To ***develop a new interactive multimedia training tool*** in 8 languages to support driver training and assessment in strategic and manoeuvring tasks (theoretical driver training improvement), to familiarise novice drivers with the basic principles of driving tasks and to provide a better understanding of risks.
- To develop a ***low cost and enhanced reliability stationary driving simulator*** (4 prototypes) to support driver training and assessment in manoeuvring and control tasks for practical driver training in driving schools, based to the maximum extent on existing elements from the market.
- To develop a ***mean cost and high performance semi-dynamic driving simulator*** (4 prototypes) to support specific needs of selected driver cohorts (novice drivers with enhanced knowledge problems, re-training of drivers in high-risk groups), extending the previous one.
- To develop new training and assessment criteria and methodologies, tools to capture them and a normative driver behaviour database, to allow trainers to monitor driver training and authorities to extract statistical data concerning driver training.
- To verify the above methodology and assess the effect on risk awareness enhancement of learners drivers through tests with 30 novice drivers (and an equal control group) in 4 European countries.
- To provide recommendations and best practice guidelines for the adoption of common European driver training and assessment framework.

2.2 Economic gain forecast

They are summarised at the following Table.

Users (trainees)	Manufacturers (of training tools)	Suppliers (driving schools)	Society
1. Better training, meaning enhanced safety but also better success rate in relevant driving license exams. **2.** Reduction in training cost, due to reduced need of on-road training. **3.** Better objectivity in training and assessment results, through the use of standardised tools.	Estimated tools market in a 3-years horizon has been calculated to 114.2 MEuros.	**1.** By improving quality of service and reducing cost, they are expected to attract more customers. In some EU countries (i.e. Belgium, Sweden) less than half of driver trainees go to a driving school to be trained. **2.** Better working conditions, with more work in the office and less driving around with not yet competent students. **3.** Better qualifications and job satisfaction.	Reduction of social cost of road accidents, calculated as 45 billion Euros annually or roughly 1 MEuro for each fatality.

Table 1: Expected economic (direct and indirect) gains from TRAINER work

2.3 Expected impacts

For the environment and traffic volume: People who are trained within a city account for around 2% of the traffic volume. If TRAINER tools (i.e. the use of simulators) can teach them the basic skills before entering the vehicle, there could be up to 0.6% reduction in traffic volume and subsequent pollution reduction.

For the working conditions: Driving instructors would have neither to suffer from the effects of "bad driving" of trainees at their early training phases, nor undergo the associated enhanced traffic risk. Only between 1993 to 1996 in Sweden, 85 accidents were reported by driver trainees. In addition, the use of standardised TRAINER tools would allow them to offer better training easily, not needing to look for or develop their own tools.

For the society: Reduction of the novice drivers' accidents (which sum up to 15% of the total) would greatly benefit the society.

For norms and standards: Driver training and assessment would become much more objective by the use of standardised tools. Today over 12% of the trainees do not accept the relevant committee verdict and make an appeal.

Furthermore, the development of a standardised database within TRAINER, used Europewide to collect and analyse trainees' errors, will lead to better individual training schemes (i.e. adapted to each trainee's mistakes) but also overall training schemes as well as vehicle/road design data.

TRAINER work is expected to greatly promote the conformity and objectivity of driving assessment and training procedures within Europe.

3 Scientific and technical description of the results

The specific project objectives, milestones, technical progress, comparison to planned work and state of the art review are analysed per work-package.

3.1 WP1 Overview of driver training curricula in Europe and driving instructor needs

Starting date: Month 1 Duration: 12 months

3.1.1 Objectives

- Compare current practices with the emerging EU directive on driver training.
- Systematise all used practise and legislation into a common database.
- Recognise the driving instructors' needs in terms of tools and support.
- Recognise inconsistencies and gaps between driver training curricula of different EU countries.

3.1.2 Work performed (per task)

T1.1 Training curricula and practices
A relevant data-gathering questionnaire has been developed and widely disseminated. 26 questionnaires from 24 countries (from the relevant driving license issuing authorities) were returned and processed. They were analysed per country (in D1.2) and then structured in 6 different models, that are briefly analysed in **Annex 1** of this report (from D1.2). Specific suggestions from driving licensing authorities on relevant training improvements per driving task were identified.

T1.4 Recognition of driving instructors' needs
A driving instructor interview questionnaire has been developed. 122 driving instructors from 8 European countries were interviewed, according to the following training systems, followed in each country:

- Complete compulsory training in a driving school. Example cases: Portugal, Greece and Germany.
- Compulsory training in a driving school, but with also a possibility for group training. Example cases: Luxembourg and France.
- Training not compulsory in a driving school, but followed by nearly all (i.e. over 90% of the people). Example cases: the Netherlands and Spain.
- Training at the driving school or not with at least 20% of the training realised by other family members or privates. Example cases: Belgium and Sweden.

The groups of interest for performing interviews were specified as:

- Boards of national driving school/teacher federations.
- Driving school responsibles (headmasters).
- Individual driving teachers/instructors.
- Driver candidates, before passing the test.
- Novice drivers, after obtaining the driving license.

Relevant results were structured per driving task and included also cost-related and organisational data.

T1.2 Training curricula database

The data collected in T1.1 and T1.4 were included in a CD-Rom based database, that has a user-friendly interface. This database is useful for all actors involved in driver training, such as driving schools, driving assessment centres and licensing authorities. Training procedures models and gaps are also included in a structured way, supported by graphs and tables. Selected extracts from this database follow in **Annex 2** of this report.

T1.3 Recognition of commonalities versus differences

Commonalities versus differences of the various driver training schemes have been recognised, with reference to the different driving tasks, following the 4-level GADGET training task model (see WP2 description for more info on it). The final wishes of driving assessment centres, instructors and experts on driver training improvements follow below.

Task	Assessment authorities	Driving instructors	Experts in the workshop
Defensive driving	X		
Accident analysis / Accidentology	X		
Legislation issues	X	X	
Geography	X		
Vehicle technique	X		
Emergency handling	X		
Airbag system	X		
First aid	X	X	X
On board documents explanation		X	
Dashboard symbols / Use of new ADAS		X	X
Road behaviour		X	X
Road scanning			X
Effect of driver' condition (alcohol/ drugs / stress/ fatigue)		X	X

Table 2: Tasks to emphasise / include in theoretical training

Task	Assessment authorities	Driving instructors	Experts in the workshop
First aid	X		X
Explanation of vehicle subsystems functionalities	X		
Behaviour in case of accident	X		
Night time driving	X		
Behaviour towards other road users	X	X	X
Bad weather conditions	X	X	X
Skid course	X	X	
Highway driving	X	X	X
Tunnel driving			X
Night time driving	X	X	X
Emergency stop	X	X	X
Convoy driving		X	
Obstacle avoidance		X	
Defensive driving		X	
Overtaking			X

Table 3: Tasks to emphasise / include in practical training

Besides the above, the experts participating in the workshop have also suggested the possible use of new tools (driving simulator, multimedia tool) to emphasise / substitute practical and theoretical training of more common tasks, i.e. simple vehicle control tasks, for economical reasons.

3.1.3 Deliverables

D1.1 Training curricula and practices database (planned for Month 8, delivered in Month 9).
D1.2 Overview of training curricula in Europe, recognition of commonalities and differences between them and driving instructors' needs (planned for Month 10, delivered in Month 11).

3.1.4 Milestones

Month 10: Number of completed questionnaires collected.
Criterion: at least 100 questionnaires from European countries.
Actual situation: 122 driving school and 26 assessment centres questionnaires have been collected by Month 10 of the project.

3.1.5 Comparison of actual versus planned work

All actions and goals specified in the Technical Annex were realised with roughly one month delay in total. This delay has not influenced the other WPs, since it was mainly due to the optimisation of the relevant deliverables and the peer review process. Working drafts of the relevant deliverables were ready on time for the rest WPs to proceed. The final bulk of the work delivered (i.e. countries covered, numbers of

questionnaires, etc.) exceeded the planned ones by 20-50% (depending on the activity).

3.1.6 State of the art relevance

The latest review of the driving assessment systems was from 1998 and, although the time frame in between is rather small, the differences in the identified systems were many. This review did not conclude into specific training models, unlike the TRAINER one. Furthermore, the driving instructors' point of view was systematically gathered for the first time within TRAINER. Most important of all, they were for the first time related to gaps and priorities in the training process per driving task.

3.2 WP2 Inventory of drivers' training needs and relevant gaps

Starting date: Month 1 Duration: 12 months

3.2.1 Objectives

- Understand the particular problems of novice drivers in relation to various driving tasks.
- Identify the most important gaps in current training procedures.

3.2.2 Work performed (per task)

T2.1 Bibliographical survey

Initially, a proper driving task model from the literature was selected, modified/extended and adopted. Hence, for structuring the analyses of TRAINER, the Michon driver behaviour model and the recently developed hierarchical model of driving behaviour of the European project GADGET were adapted. As it is fundamental to the work of TRAINER, it is briefly described in **Annex 3** of this report.

More than 250 references from the literature were then systematically analysed, in accordance to the GADGET model's four driving tasks hierarchy levels (behavioural aspects, strategic level, manoeuvring level and control level) and the three skills dimensions (skill and knowledge, awareness of risk-related aspects and awareness of own personal tendencies). For each of the above levels, a recommendations table was created. The overall findings are summarised in **Annex 4** of this report.

T2.2 Accident analysis

Within WP 2.2 of TRAINER project, an overview of results of accident analysis of novice drivers from 13 European countries was presented. There are clear differences between European countries in novice driver injury and fatality rate. Then, some specific country cases are considered in more detail afterwards, following a causal approach.

Firstly, a Swedish database with accident data of a time period of 6 years was used to compare novice driver's accidents with more experienced driver's accidents. Two Belgian databases were also analysed, one with novice driver's accidents, and one

with answers to questions obtained at a post-licence training course for drivers with a licence for maximum 5 years. In Sweden less novice driver accidents happen than in Belgium. Per 100,000 persons between 18-24 years, 15 Belgian fatal accidents happened, compared with only 4 Swedish.
The most relevant findings of this work in relation to specific driving tasks are included in **Annex 5** of this report.

T2.3 Definition of drivers' training needs
The relevant work was carried out in conjunction to T1.4. In addition, a detailed state of the art analysis on existing multimedia tools and driving simulators for drivers' training was performed. 17 questionnaires on multimedia tools and 23 on driving simulators were returned from relevant tools developers, distributors or major users from 6 European countries. They were systematically analysed, in relation to (for the tools):

- presentation media;
- scenarios supported (per GADGET matrix level).

The 8 more common and interesting tools were further detailed, as for their:

- cost;
- input devices;
- actions required from the trainee;
- output modalities;
- output content;
- selected key scenarios.

Driving simulators (23 in total) were analysed in accordance with their functionalities, technical specifications, target market and cost (in fact through 29 different items).
The relevant data greatly influenced the issue of TRAINER tools scenarios and specifications within WP3-6.

T2.4 Recognition of gaps
All data on driver training gaps from T1.1–T1.4 and T2.1-T2.3 were gathered and processed together in a common GADGET matrix format. Then, the preliminary recognised gaps and priorities were presented and discussed at an international workshop, performed on 22-11-2000 in Brussels, with the attendance of 41 external experts and 19 Consortium representatives. During this workshop, particular discussions were held on focus groups level on 5 specific issues. The results were further discussed at the plenary session. The most important findings of this workshop are included in **Annex 6** of this report.
The final synthesis table of this work follows below, with a short conclusion per driving task level. A cross in the column 'Multimedia Tools' means that at least one of the analysed tools includes a lesson or scenario about this task. In the column 'Existing training' the 'O' indicates that the task is trained in all or nearly all European countries as the analysis of the questionnaires showed, the ' Ø' indicates that the task is trained only in few or at least one country, the cross indicates that the driving authorities and driving instructors questioned, indicate that the task is not trained, but should be trained in the particular country. The last two columns depict the experts' proposals, made during the workshop: A cross means that the task could or should be trained with the multimedia-tool and/or with the simulator.

Important findings of the International Workshop in Brussels						
	Literature Survey	Accident analysis	Multimedia tools	Existing Training	Experts' proposals	
					Multimedia	Simulator
VEHICLE CONTROL TASKS						
Knowledge and skills						
Starting				O		X
Shifting gears				O		X
Accelerating/ decelerating				O		X
Steering/ lane following				O		X
Speed control			X	O		X
Braking/ stopping				O		X
Use of new cars control aids (ABS, ACC, etc)	X		X	X		X
Risk increasing factors						
Insufficient skills and incomplete automation	X					
Self-evaluation						
Realistic self-evaluation	X	X	X			
MANOEUVRING TASKS						
Knowledge and skills						
Following	X	X	X	O		X
Overtaking/ Passing	X		X	O	X	X
Entering and leaving the traffic	X		X	O		X
Tailgating	X		X			X
Lane changing	X		X	O	X	X
Scanning the road (eye cues)	X		X	Ø	X	X
Reacting to other vehicles	X	X	X	Ø X		X
Reacting to pedestrians	X		X		X	X
Parking			X	O		
Negotiating intersections	X	X	X	O	X	X
Negotiating hills/slopes	X		X	O		X
Negotiating curves	X	X	X	O	X	X
Road surface (skid, obstacles)	X		X	Ø X		X
Approach/ exit of motorways	X			O		X
Turning off/ over			X	O		
Railroad crossings, bridges, tunnels				Ø		
Reacting to traffic signs and traffic lights	X	X	X	O	X	X
Reacting to direction signs (incl. in-car devices)	X					
Emergency brake				Ø X		
Urban driving			X	O	X	X
Rural driving		X	X	O		
Convoy driving				X		
Motorway driving			X	Ø X		X
Weather conditions	X			Ø X		X
Night driving	X	X	X	Ø X		X
Risk increasing factors						
Insufficient skills and incompletely automation	X	X			X	X
Information overload	X				X	X
Insufficient anticipating skills and wrong expectations	X		X		X	X
Risky driving style	X		X		X	X
Self-evaluation						
Realistic self-evaluation	X	X			X	X
Awareness of personal driving style	X		X	X		X
STRATEGIC TASKS						
Knowledge and skills						
Determination of trip goals,						

Important findings of the International Workshop in Brussels						
	Literature Survey	Accident analysis	Multimedia tools	Existing Training	Experts' proposals	
					Multimedia	Simulator
route and modal choice						
Preparation and technical check			X	O	X	
Safety issues	X	X	X	O	X	
Maintenance tasks			X	O	X	
International legislation				X		
First aid				Ø X		X
Economic driving	X		X	Ø	X	
Risk-increasing factors						
Driver's condition (stress, mood, fatigue)	X	X	X	X		X
Motives for driving	X		X			
Self-evaluation						
Awareness of personal planning skills						
Awareness of typical driving goals and risky driving motives	X		X			
BEHAVIOURAL ASPECTS						
Knowledge and skills						
Knowing about the general relations between lifestyle/age/ gender and driving style	X		X			
Knowing the influence of personal values and social background	X		X			
Knowing about the influence of passengers	X					X
Risk-increasing factors						
High level of sensation seeking	X		X			
Consequences of social pressure, use of alcohol and drugs	X	X	X	X		X
Self-evaluation						
Awareness of own personal tendencies (risky habits, safety-negative motives)	X		X			

Table 4: Findings of the several analyses made in D2.1. The meaning of particular symbols is explained in the text preceding the Table.

The relevant, final conclusions of this work follow in **Annex 7** of this report.

3.2.3 Deliverables

D2.1 Inventory of drivers' training needs and major gaps in the relevant training procedures (planned for Month 10, delivered in Month 12).

3.2.4 Milestones

Month 10: Pan-European workshop in Brussels on drivers' training needs and current technological and legal gaps.
Criterion: Realisation of workshop with at least 30 experts from 5 EU countries.
Actual situation: The workshop was realised in Month 10 with 41 external and 19 internal experts from 15 countries, including Eastern Europe and USA.

3.2.5 Comparison of actual versus planned work

All activities described in the Technical Annex were realised in time and the expected results were achieved. The small delay in D2.1 submission is due to the time required to incorporate also the results of the international workshop of Month 10, which were substantial.

3.2.6 State of the art relevance

This work has combined a thorough state of the art (literature and accidents-based) review with hundreds of expert views (field work within WP1 and 2), synthesising all of them in a concise and driving task related form. Such a concise and driving task related analysis did not exist before.

3.3 WP3 Development of interactive multimedia training tool

Starting date: Month 3 Duration: 15 months

3.3.1 Objectives

- To design and start the development of a user-friendly tool to support drivers in learning driving subtasks on the strategic and tactical / manoeuvring level, according to the Michon model; to familiarise with the interfaces and use of new in-car (driver support) devices and to experience traffic hazards, the impact of their actions to high-risk traffic situations, and recommended ways to overcome them.

3.3.2 Work performed (per task)

T3.1 Development of Multimedia PC scenarios

Based upon the gaps and priorities identified within D2.1, a list of MMT scenarios to be developed has been proposed and is analysed in D6.1 (within WP6).
In this task, the detailed description of each scenario for the MMT is under way, with 49 scenarios specified so far.

For each specified scenario, the following Sections are written:

- Description of the problem that needs to be addressed.
- Description of the aim of the scenario.
- Description of situations to be simulated, with
  - particular sub-scenarios for each;
  - type of each sub-scenario, depending on the data to be gathered for it (road video, animation, photo, crash test video, text, sounds, recorded speech, etc.);
  - text describing each sub-scenario with application details (how many cars, how to interact, positions on the road, even the cars' colours).
- Success estimation (criteria).
- Reference to GADGET matrix.

The selected scenarios cover so far all 4 levels of GADGET matrix and are in accordance to the agreed training scenarios list of D6.1.

T3.2 Scenarios implementation

The development platform for the MMT scenarios has been selected and it is Macromedia Authorware. More specifically, the following modules were used:

- MacroMedia Authorware 5.2: It is a visual authoring tool for programming learning applications. It supports standard assessment interactions and training application with templates and forms.
- MacroMedia Director: It is a software solution for developing multimedia applications. Director combines graphics, sound, animation, text and video to create interactive applications that can be deployed for CD-ROM and DVD.

The relevant software can run in a rather standard PC at a driving school, with the following specifications:

- IBM PC Pentium 133 MHz, 64 MB RAM.
- CD ROM drive.
- Resolution 800x600, 256 Colours.
- Windows Platform: NT 95.
- Soundcard.

The structure of the MMT is rather simple and thus comprehensible by the user. After the selection of the desired language and a login, the user can select a session out of three different levels of severity.

One **session** consists of several **scenarios** and contains a short training and/or objectives presentation. After each user's action, an assessment is performed immediately, so that the user gets an impartial feedback about his/her level of knowledge, performance and suggestions for improvement.

After this assessment the user can either repeat the same session or select another one.

The structure of the MMT is presented below.

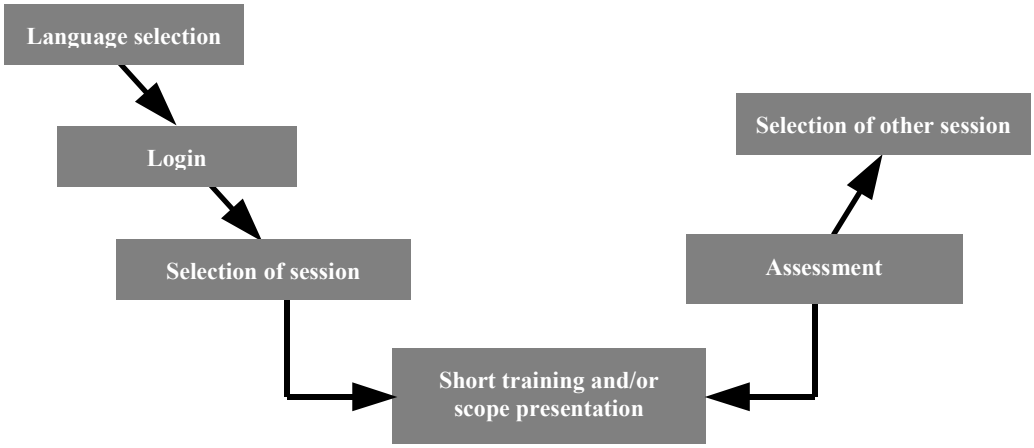


Figure 1: Structure of the MMT

The major TRAINER MMT technical characteristics are summarised bellow:

- user friendly tool in 8 languages: Dutch, English, French, German, Greek, Italian, Spanish, Swedish;
- supports drivers in learning driving subtasks on the strategic and tactical/manoeuvring level - according to "Michon Model" and "GADGET Matrix" – risk awareness, hazard perception, self perception;
- allows novice drivers to familiarise with the interfaces and use of new in-car (driver support) devices;
- allows novice drivers to experience traffic hazards, the impact of their actions to high risk traffic situations and recommended ways to overcome them.

The scenarios have been integrated to the software tool, in the form of 4 blocks. Each block contains various sessions. A training subject is analysed in each session, thus a session contains a number of scenarios, in order to maintain a complete structure regarding the presentation of the scenarios to the trainees. More analytically, the majority of the subjects of the MMT follows the structure below:

1. Presentation of information about the specific subject, which can be given with various ways: text, video, animation, and pictures.
2. Exercise/test for the trainee in various ways: multiple-choice questions based on text or video, interactive videos or pictures.

The MMT records the trainees performance to the exercises/tests. All the results are kept to a database, with the full details per trainee: id, name of test, date, time, performance (correct/wrong or %correct), time in test.

The TRAINER MMT enables the driving teacher ("trainer") to store the required data of his/her learners ("trainees") both for administrative aspects and for monitoring "trainees'" knowledge.

The tool as such fills up a database (the TRAINER database/DB, see WP5) that leads to knowledge about trainees' skills on average as well as in each individual case. Thus the tasks can be customized with respect to this knowledge. If a trainee fails in certain tasks (which are related to defined sessions), these tasks will be repeated until he/she is able to solve the task. Tasks that create problems to a multitude of trainees will always be tested. The statistics allow the trainer to identify such general difficult tasks and from there he/she can put more effort into the explanation of such tasks.

Some indicative screenshots of the TRAINER MMT are presented in **Annex 8.**

The final MMT in all 8 languages was finally submitted in May 2002 (D3.1).

Thus, the TRAINER MMT is a training tool that is complementary to simulator and on-the road training. The trainee will gain experience regarding

- Visual scanning techniques.
- The importance of the safety belt.
- Speed judgement and adaptation in various situations.
- Relative speed and headway judgement to lead and rear vehicles.
- Overtaking and reaction times understanding.

- Interaction with vulnerable road users and other traffic participants.
- Critical situations and their development.
- Ecological driving.
- New car technology systems.

All this experience is gained in a simulated environment, thus relieving the road network and enhancing road safety. It provides a better overview and understanding of road hazards to novice drivers. This is achieved by presenting short videos/animations of complex tasks, emergency manoeuvres and critical situations, while, in many cases, the user is asked to select the right decision in a multiple-choice way.

Furthermore, it includes simulations of new in-car ADAS, like navigation, and cruise control aids. In this way the user is able to experience these new devices and learn their user interface, before actually using them in one's car.

The video-shots and the driver feedback are all integrated into the MMT. It is expected to support the theoretical training and assessment of drivers, in order to extend it from a simple traffic rules check to actual handling of complex traffic scenarios.

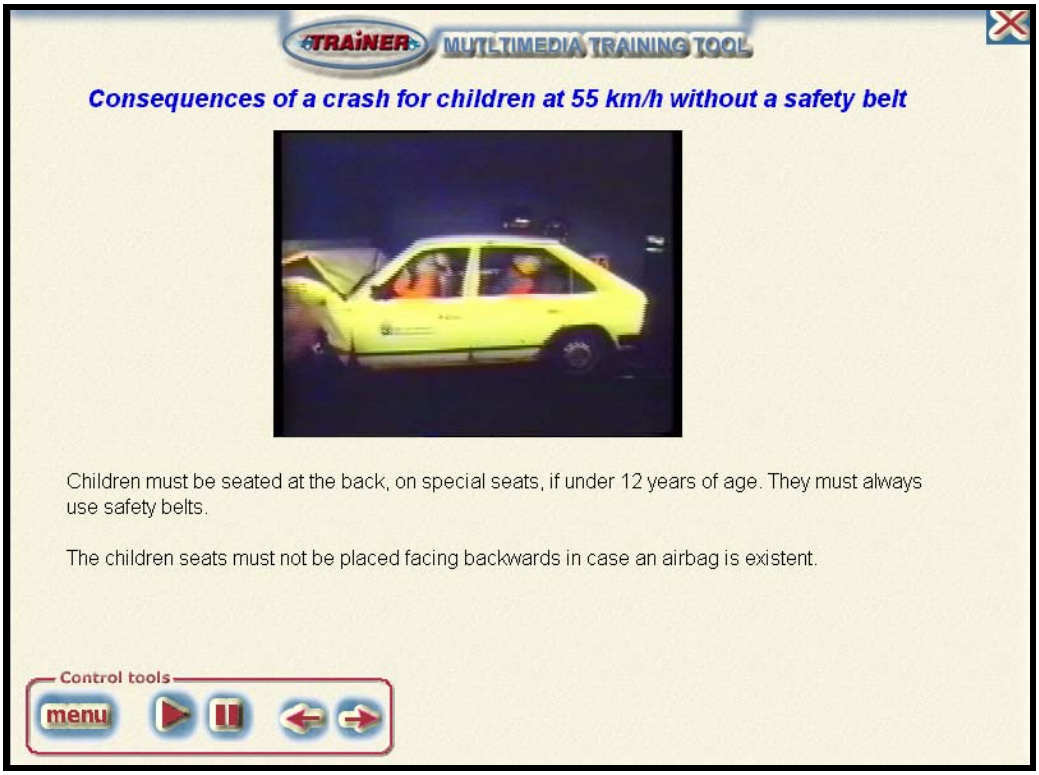


Figure 2: Video-clips allowing theoretical but more vivid experience of traffic hazards

The MMT can be integrated in a form of an information kiosk, to be installed at each driving school. Therefore its UI is designed user-friendly, simple and suitable for the general public.

Two modes of operation are possible for the MMT: a 'Training mode' and a 'Test mode'. A mode selection screen appears when someone is starting the MMT. The 'Test mode' option should only be selected once, after the trainee has completed the training course and with this, it will be determined if the trainee will pass/fail the course.

Test mode description:
This mode contains only tests that cover all the sessions on which the user has been trained (i.e. no theory is primarily given). The order of the tests is different than the training one. Moreover, some questions within the tests have different order and a few, too demanding ones, have been omitted, in order to avoid memorizing effects. In total, there are 26 tests. The different test types are provided in the 'Training mode' description, which follows below. The difference between the 'Training mode' tests and the 'Test mode' tests is that in the second no feedback is provided to the trainee about his/her performance and in case that video/animations are shown, the correct result is not presented to the user after it's answer (as it is the case in the 'Training mode' by clicking the submit button in case of multiple-choice questions or by clicking on the answer he/she thinks is correct). Also, the user does not have the possibility to go back or forward, as the tests appear automatically one after the other.

Training mode description:
Four different topic clusters are identified, called '**Blocks'**. Each block contains several training sessions, with different subject each. The subjects of the four Blocks are the following:
Block 1: Basic control
Block 2: Manoeuvring
Block 3: Personal behaviour
Block 4: Special driving/systems

More precisely, Block 1 has 4 sessions, Block 2 has 8, Block 3 has 3 and Block 4 has 3 sessions. One **session** consists of several **scenarios** and contains a short training and/or scope presentation. The sessions of the MMT are:

Block 1	Block 2
1.Vehicle safety check	1. Braking
2. Traffic signs and rules	2. Gap acceptance
3. Visibility issues	3. Road obstacles
4. Safety belt	4. Safety distance
	5. Hazard perception
	6. Unexpected behaviour of road users
	7. Lane change
	8. Speed choice & adjustment

Block 3	Block 4
1. Alcohol issues	1. ABS issues
2. Effects of drugs	2. Ecological driving
3. Drowsiness effects	3. ADA systems

A 'Course selection screen' is the main User Interface of the MMT. Through this page, the user has access to all the sessions/courses of the tool.

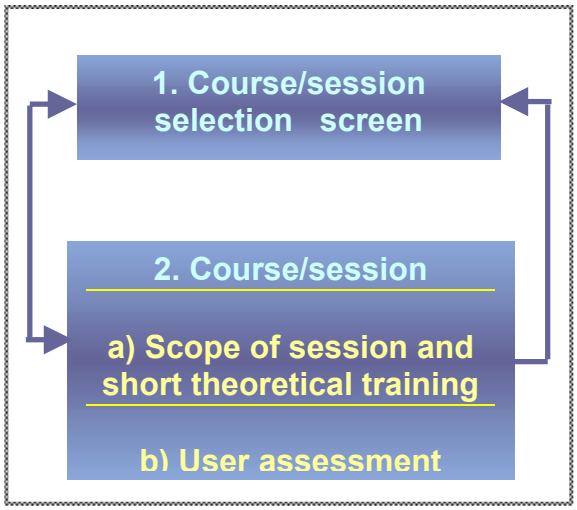


Figure 3: TRAINER MMT structure.

All sessions follow the same format/concept. First, the common driving problem(s) related to the specific session are identified and the main aim(s) of the sessions are listed. After that, the relevant theoretical background is given, in various forms, using multimedia material, such as videos, animations, interactive videos and animations, pictures, interactive pictures and of course text.

The theoretical background is followed by the user's assessment, through appropriate tests. The possible formats of the tests in the MMT are listed below:

- Multiple choice questions
- Multiple choice questions based on a video
- Video only
- Interactive video(s)
- Interactive animation(s)
- Multiple choice questions based on pictures
- Interactive picture

In some exercises, explanations are provided for the correct answers, either in the form of text, or in the form of animations. Also the correct answers are highlighted with green circles. For all exercises there is a feedback message about the performance of the trainee (e.g. well done, correct/wrong, some of the answers are wrong, etc.).

The MMT is designed to work both as a stand-alone tool, and as a tool cooperating with two additional software programs, namely the two databases of WP5:

- a Connecting Database and Measurement Tool (DBT);
- a Statistical Tool for Results Analysis and Presentation (SRAP).

In the first case, the MMT can be operated by anyone, both trainees and trainers, but the log files that are produced with the performance score of each trainee cannot be visualised, thus it is a version for non-professional use.

In the second case, the user has to register in the DBT as a trainee and only then he/she has access to the MMT. In this way, all the trainees' personal data are kept in a database and the trainer can review or modify them at any instance. In addition, each trainees' performance during the training and after the test can be visualised and all the relevant data is stored in the database, available to view it the trainee or the trainer. The trainers can view the data of all trainees, while each trainee can only see his/her own data. Further statistical analysis and presentation of results is possible, with the SRAP. This tool enables visualisation of results on the training procedure per trainee and on the test results for group of trainees.

T3.3 Laboratory user tests

The pre-pilot of the Multi-media tool took place at four locations (as it was prescribed in the project's Technical Annex): Sweden (VTI), Germany (IfADo), Spain (UPV), and Greece (AUTh). Key issues of the evaluation were:

- main problems concerning the operation of the MMT,
- the sessions that most problems occurred,
- comparison of acceptance of MMT before / after the test,
- country specific differences in the results.

In total 51 persons participated in the tests. The following table shows the participants in more details:

	Germany	**Greece**	**Sweden**	**Spain**	**Total**
Trainee	5	10	1	5	**21**
Novice	5	0	4	5	**14**
Expert	2	2	9	3	**16**
Total	**12**	**12**	**14**	**13**	**51**

Table 5: MMT test subjects cohorts per country.

Positive results of the tests included:

- the MMT is fairly easy to interact with,
- it reacts and responds the way the users wants it to, except for the video related bugs that occurred, and
- it is not complicated to understand the symbols.

Negative results of the tests were:

- The TRAINER MMT is not fun to use (but for most trainees it is!),
- it was not considered reliable at the time since it crashed on several occasions (always combined with the videos, and regardless of operative system – Win 98, 2000, XP),
- the general information on the screen is not well organised (stated only in half of the countries though),
- the input to make is not all that evident (which is mostly related to the poor quality of the videos and the animations) and finally,
- the MMT is not considered to be useful for driver training by experienced drivers; however, the target group, i.e. the driver trainees consider the tool to be of good use for driver training.

The pre-evaluation of the Multimedia Tool highlighted some critical problematic areas, which has led to important improvements, as follows:

- Correction of bugs (error messages).
- Replacement of text and correction of errors in specific languages.
- Re-arrangement of information on the screen and omission of data where needed. For example, the left hand picture of the following figure, shows a screen with 6 animations. It was found that the screen had a lot of material. The right-hand picture shows the corrections in the specific screen, where the data on it is reduced.

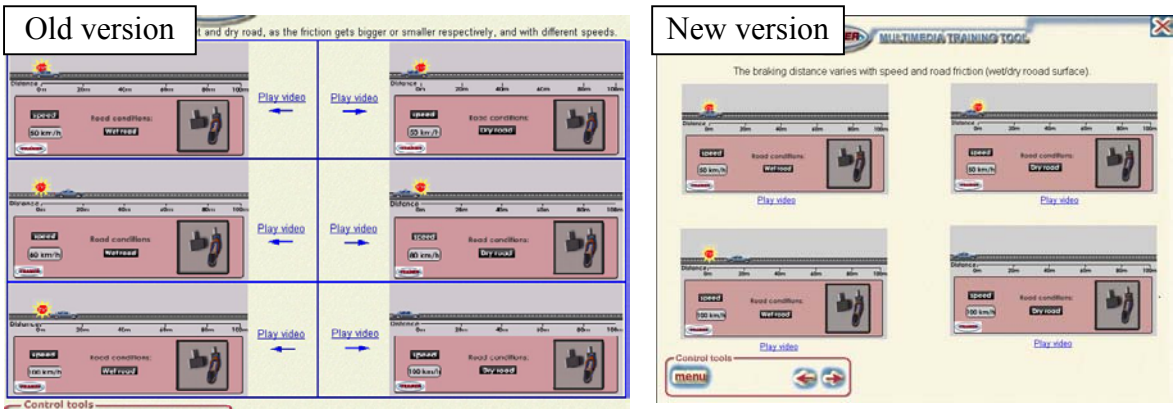


Figure 4: Example of improvement of a UI screen of the MMT, based on the pre-tests comments.

3.3.3 Deliverables

D3.1: Interactive Multimedia Training Tool (4 prototype multimedia boxes in 8 languages) (due for Month 18, finally submitted in Month 26).

D3.2: User Interface of interactive Multimedia tools (due for Month 22, submitted in Month 36).

3.3.4 Milestones

Month 11: Multimedia tool scenarios.
Criterion: Approval by CARA, DKH and EFA.
Actual situation: 49 multimedia tool scenarios have been realised and tested.

Month 16 : First version of interactive multimedia training tool for testing
Criterion : Approval by CARA, DKH and EFA
Actual situation: A first version of the tool was already ready in English in Month 16 and has been approved by all partners. During adequate workshops, the required changes / revisions have been suggested and implemented accordingly.

3.3.5 Comparison of actual versus planned work

Delay in the payment for the first year has resulted in delay in the software development as financial problems of the partners had a direct impact to the scenarios material that was not gathered on time. Also, the need to connect the MMT with the

databases of WP5, which were also delayed, and to perform the tests with users, has led to delay in D3.2 submission.

3.3.6 State of the art relevance

Most of the proposed scenarios are really innovative (especially those dealing with behavioural and strategic issues, and also the ones related to driver support systems); not met in any of the surveyed PC training tools that exist on the Market. Also, the rest are seen from a new perspective and none is met identical in any existing tool.

3.4 WP4 Development of cost-effective driving simulators for training purposes

Starting date: Month 3 Duration: 21 months

3.4.1 Objectives

- To develop appropriate scenarios to support driver training and assessment by the use of simulators.
- To develop a low cost driving simulator to support driver training in tactical and control tasks, according to the Michon model.
- To develop a mean-cost driving simulator with large reliability for support and assessment of particular drivers cohorts.

3.4.2 Work performed (per task)

T4.1 Development of scenarios

Based upon the gaps and priorities identified within D2.1, a list of simulator scenarios to be developed has been proposed and is analysed in D6.1 (within WP6).
In this task, the detailed description of each scenario for the Simulator has been performed. 31 simulator scenarios have been defined in total. They are specified with the same sections, as the MMT ones (see T3.1 description).

T4.2 Driving simulator requirements

After a detailed survey on existing driving simulators specifications (see WP2 description), an analysis of the Consortium simulators, and the mapping of the required simulator functionalities for the selected scenarios realisation with the state-of-the-art technology, optimum driving simulator specifications (for the static and the dynamic one) for training have been issued. Then, they were further analysed for their cost-efficiency, leading to a selection of the actual TRAINER simulators specifications.

After 3 iterations between the wishes of the scenario developers and the cost-related limitations of the software and hardware developers and integrators, the software and hardware specifications for the two types of TRAINER simulators have been finalised. They are included in D4.1, which was submitted in June 2001.

T4.3 Development of low-cost driving simulator

The casing of the simulator is a compact, robust, one-seated lacquered wood construction for choice of any sight system. With its 78 cm width it fits through any door. It comprises a seat with safety belt, steering wheel, manual gearshift, usual operational elements of a passenger car, dashboard with real instruments and a radio. Car parts of a Ford Focus are used. The simulator is easily transportable on rolls.
The seat is adjustable in three degrees of freedom, length position, height and back inclination. The safety belt is equipped with an electrical contact, which supplies a signal to the driving computer for the ride evaluation.
The steering wheel is adjustable in two degrees, depth and height position. At the shaft an electrical direct current motor with incremental angle generator is clutched.
The gearshift lever has the characteristic of a real manual gearshift stick by means of a specific mechanical construction. The five gears and the reverse gear are detected by micro switches. The switches have operational-on contacts. If none of the switches is active, idle signal is supplied. At pre-selection of automatic gearshift in the menu the manual gearshift is not in function. Only the reverse gear may be activated.
The mechanical characteristics of the accelerator pedal, the foot brake and the clutch pedal are in accordance to the Ford Focus forces and strokes. As sensors for the pedals acceleration sensors are used, which supply the angle inclination signals towards the earth axis to the computer. The sensors are adjustable by software. Also the handbrake gives a nature-true feeling. It uses an on/off switch. The force feedbacks of all elements are nature-like. The characteristics may be changed by mechanical means. Other operational elements are ignition key, levers for blinker, windshield wiper and light at the steering wheel. Horn and enter function are combined at the button of the left lever for the headlight.
The real dashboard from a Ford Focus is used. The speed- and the revolvation instrument are controlled by the driving computer.
As simulation computer for the calculation of the driving dynamics, the road geometry, traffic and obstacle dynamics, and program control a personal computer with graphics board, ADIODA and soundboard was used. An input-/output interface board N10E was designed and produced by us. The PC is located in the interior of the casing, front right. From the front side the program-CD and the buttons of the audio-amplifier are accessible. The cables are connected to the rear wall.
Furthermore, the hardware comprises a self-designed relay and connection board N10R including the typical car electronics, power supply units, a 230-V-fuse, a time delay unit for the problem-free on- and off-switching, and cabling. These units are accessible after opening the front door. The key has the number 2 c 18.
For the noises a PC sound card and an audio amplifier with two loudspeakers is used. One loudspeaker in a closed box is mounted in the interior of the cabin. It is connected with one channel of the 20-W-audio-amplifier in the PC. The other channel leads to a loudspeaker plug in the inside of the cabin, which may be used for an external loudspeaker (8 Ohm). The radio uses the same loudspeakers as the driving simulation.
At the left side of the lateral vertical wall there is a light-switch and at the right side a plug for the connection of the menu control unit. It has only two buttons “mode” and “line” and is easily to use.
A gearless direct current motor with excenter weight is mounted to the steering wheel. In order not to influence the PCs operation by unwanted vibrations, the steering wheel shaft bearing is buffered towards the main frame with rubber cylinders. The motor is

controlled via a commercial revolvation control unit by the simulation computer in dependency upon the revolvation of the simulated engine. In the idle running state, especially after starting the engine, the vibration is just to be noticed. It gets stronger, when the motor turns high.
One front monitor with 34``-diagonal in a commercial dark casing, 600 x 800 pixel, with anti-reflex screen is used. It is placed in front of the steering wheel, over the front part of the cabin, in the height of the drivers' eyes. The horizontal view angle is 40 degrees.
The video signal has the resolution of SVHS = 600 x 800 pixels, true-colour, and a frame rate of 20 to 30 frames per second. It is computed in the simulation computer, which means, that the simulation computer is sufficiently powerful to function also as image generator.
The dynamics of the ride are simulated according to the data of the simulated Ford Focus (power, vehicle-mass, wind resistance, roll resistance, max. speed, max. acceleration). Any parameters may be adjusted to adapt to other vehicles. At excessive centrifugal acceleration in curves the tires drift to the outside, so that the barrier may be touched. Especially at low friction in rain or snow the tires slide or turn through at hard accelerating. However, accidental events after the drivers loosing control over his vehicle are not simulated.
As stated above the image generation is proceeded by the simulation computer. The performance is: Picture resolution 800 x 600 pixel, colour depth 24 Bit (True Colour), 30 frames per second. The most important feature is photo texture mapping with anti-aliazing. The virtual objects are generated by means of self-made photos: Landscape, road surface, road lines, crash barriers, green, trees, bushes, houses, cars, cyclists, pedestrians, traffic signs, traffic lights, obstacles, objects for distraction, background, clouds, etc. There are about 40 different fixt and 10 different moved objects. Weather and sight conditions are rain, fog, snow and night. They can be superimposed to any of the courses. The virtual world is shown according to the perspective of the driver.
A collision and the ride section some seconds before are – at choice - repeated in a replay. The replay is not shown as seen by the driver but from the helicopters view. By this the whole dynamical process and the distances are clearly to be recognized.
In the foreground the driver sees the front part of his own car in a colour fitting to the one of his simulator cabin, and the windshield wipers, which function at activation. Furthermore the internal rear mirror with the actual, moving rear image is computed.
The database is about 50 km and offers rural roads, city drive and Motorway. It includes crossings, traffic lights, traffic signs, rises and falls, forest, entrances and exits for motorways, roadworks and graphics details like a sea with sailboats to give a more realistic feeling.
The traffic includes at the most 30 road users with artificial intelligence, comprising passenger cars, trucks, pedestrians and cyclists, who may at the same time appear in the view range. They observe the traffic rules, the distance to the foregoing vehicle and the speed limits, come to a stop before red lights and crossing traffic, accelerate and decelerate in a natural way and may be passed. The approaching cars stop and cause a jam, when you are on the left side of the road. Some may act the wrong way as "bad guys". Obstacles are put into the scene with critical timing, to cause sudden reactions. Collisions between the own car and other road users, trees, the crash barrier, houses or any obstacles are detected and cause reduction of the speed to zero with subsequent picture darkening and text edition. When the driver leaves the road, which may be necessary in critical situations as "flight into the landscape", the car bumps across the green, which causes a heavy movement of the picture and a typical

bumping noise. A run-on accident, a frontal accident and others are detected and indicated.
All sounds are sampled microphone recordings. Therefore the sound is nature-true. This is also valid for the engine sound, which is dependent upon the revolvation between 800 and 7000 rev./min. and the torque of the simulated engine. Other noises are starter, squeaking tires, crashes, rain, drive wind, splash water, scratching tooth reels, traffic and human voice.
The software has a user friendly-interface. Courses, modes, weather- and sight conditions, traffic density and scenarios can be pre-selected by the computer menu. Not only the simulation features can be chosen but also service and adjustment information.
After the ride the user finds various messages by texts and alphanumeric figures on the screen about mistakes he made. There are about 15 driving failure categories.
At calling the operational mode "Service" in the computer menu a diagnosis of all input and output data can be executed.
The simulators technical data are:

- Length: 180 cm, Width: 78 cm, Height: 147 cm, Weight: 300 kg
- Monitor output signal: SVGA
- Picture resolution: 800 x 600 pixel
- Colour depth: 24 Bit (True Colour)
- Frame rate: 30 frames per second
- Voltage: 230 Volt, 50 Hz, Current: 3 Ampere

Figure 5: The low-cost simulator layout with a single monitor.

Figure 6: The low-cost simulator layout using projection beamer.

T4.4 Development of mean-cost driving simulator

The same basic unit is being used as for the low-cost simulator. A gearless direct current motor with excenter weight is mounted to the steering wheel. In order not to influence the PCs operation by unwanted vibrations, the steering wheel shaft bearing is buffered towards the main frame with rubber cylinders. The motor is controlled via a commercial revolvation control unit by the simulation computer in dependency

upon the revolvation of the simulated engine. In the idle running state, especially after starting the engine, the vibration is just to be noticed. It gets stronger, when the motor turns high.
The mean-cost simulator uses a “fixed screen”- sight system with three split-wall-suited front monitors, 34``-diagonal each, anti-reflex surface, 600 x 800 pixels each, 64 Kg each, in commercial dark casings on special stands. They are placed over the front part of the simulator cabin in the height of the drivers’ eyes. The horizontal view angle is 3 x 40 degrees = 120 degrees.
The video signal has the resolution of SVHS = 600 x 800 pixels, true-colour, and a frame rate of 20 to 30 frames per second. The central image is computed in the simulation computer, which means, that the simulation computer is sufficiently powerful to function also as image generator. The two peripheral monitors need an own PC each as image generators.
The stands are designed with the aims,

- that they have sufficient safety distance to the cabin, which moves in longitudinal and lateral direction,
- that the U-shaped bars are stiff enough to hold the heavy monitors in an exactly vertical position,
- and that they have a sufficiently large stand area.

Width of one monitor: 72 cm
Depth of one monitor: 48 cm
Height of the monitors: 57 cm
Weight of one monitor: 84 kg
Height of the monitors with stands: 1,66 m
To improve the driving feeling at acceleration and braking and to reduce the kinetosis, which may occur especially at older drivers and women, the mean-cost simulator is equipped with a specific, one-directional motion system.
A pitch-support serves for the simulation of inclining movements of the vehicle at longitudinal accelerations as well as of transient horizontal longitudinal movements. By aid of a special bearing it is reached, that the top plate is turned towards the bottom plate around a virtual axis in the height of the drivers’ eyes. By this, the fixed installation of the monitors is justified.

Length of the pitch support: 1,20 m
Width: 78 cm
Height: 28 cm
Maximum inclination angle: +/- 6 degrees
Maximum horizontal shift: +/- 11 cm

The pitch support is controlled by the driving computer in accordance to the longitudinal acceleration forces. Two fast reacting electrical direct current motors with sufficiently high acceleration power are used. The fact, that the angle stroke is short, serves for a natural driving feeling in accordance to physics and does not enhance the motion sickness, which might occur at heavy movements of an high cost motion system with large inclination angles.

Figure 7: The mean-cost simulator layout with three single monitors.

Figure 8: The mean-cost simulator screen layout when using three projection beamers.

T4.5 Reliability and Usability tests

Before starting the final assessment of the TRAINER simulators and the TRAINER curriculum in WP6 it was important to decide whether the prototypes provide a sufficient subjective impression of 'realistic driving'. Moreover, it is pressing to know the levels of workload imposed by driving the simulator prototype and to know the degree of simulator sickness that is induced by driving in the simulators. In case of intolerable simulator sickness levels caused by the simulator prototypes, corrective actions might be necessary before beginning the imperative testing phase in WP6.

According to the Technical Annex, the prototypes of T4.3 and T4.4 were tested in T4.5 iteratively, trying to identify the:

- level of reliability, in reference to actual driving (user subjective measurements);
- level of dizziness/workload they may impose to the user (user safety evaluation).

Tests have been performed in two sites: Valencia and Brussels, with 8 instructors and 8 novices in each site. There were 8 expert drivers (ED: preferably driving instructors) vs. 8 learner drivers (LD: 2-4 driving lessons).
The subjects were first getting accustomed to the simulator by driving through a selected sequence of scenarios for a certain amount of time.
The issues inquired were:

- Simulator sickness and workload.
- Realism ratings questionnaire.

For the simulator sickeness results obtained from both simulators prototypes show good values in front of simulator sickness. At the next table we can see total scores obtained for Nausea, Oculomotor and Disorientation effects.

SSQ	Nausea	Oculomotor	Disorientation	Total Score
MC	14	26	14	10'8
LC	23	36	18	31

Table 6: Simulator sickness values

Comparing both simulators, as we can see at the table, LC produces more simulator sickness than the MC version. This is due to LC doesn't have motion platform and the visual field is lower, what it's a problem to perform some scenarios that require a higher one. So in this way, as the scenarios are the same for LC and MC versions, the problem comes from the simulator's architecture and not from the tasks to be done.

Among nausea, oculomotor and disorientation values, the bigger ones are those related with oculomotor, in this way one of the improvements for simulator could be to change the visual screens which seemed to disturb the vision of the tested people. Another visual device with different characteristics on brightness, contrast, luminance, etc. could be a good improvement.

Anyway, the most important is that simulator sickness values are inside normal range levels, so that we could conclude that simulator sickness levels for TRAINER simulator are normal and there's no important problem on that.

Results obtained in front of induced workload by the simulators show that the use of the MC produces less workload than the LC, these means that in general the MC is more satisfactory in using it that the LC that is less effort.

Mean values for MC: 33,7 between little effort and some effort.

Mean values for LC: 63 between rather much effort and considerable effort.

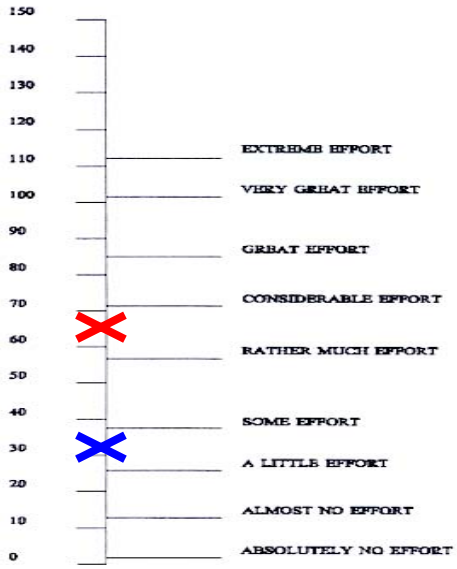


Figure 9: RSME values

In front of realism ratings values have been obtained results for expert drivers (driving instructors) and for learner drivers (2-4 driving lessons). Next we can see the most relevant results.

- Experts:
  - Questions related if the system is easy to use, comfortable and the interface pleasant (colours, pictures, sounds, etc.) → Agree.
  - Questions related if the system is fast enough → Agree .
  - Questions related if the organization of the menus is quite logical → Neutral (It's necessary to number the scenarios in each block).
  - Questions related if the feedback messages to the student are quite adequate → Agree (It could be interesting to have some feedback as voice messages too) Difficulties in driving and reading the messages.
  - About if the system takes into account the user needs → Agree.
  - About 'General Satisfaction' with the system → Everybody are very satisfied with the system and they would recommend it to his colleagues.

- Learners:
  - Questions related if the system is easy to use, comfortable and the interface pleasant (colours, pictures, sounds, etc.) → Agree but Low cost seems to be more difficult to use and learn to use.
  - Questions related if the information in each scenario is enough to accomplish the aim of the scenario → Agree but in the Low cost simulator people said that sometimes was difficult to accomplish the task.
  - Everybody enjoyed on the simulator → Both prototypes.

- Questions related if the system information is clear and understandable → More Neutral (The way in which the information is presented could be improved).
- Questions related if they would want to use the system everyday → Totally Agree.
- Questions related if the system is fast enough → Agree.
- About 'General Satisfaction' with the system → Everybody are very satisfied with the system.

To sum up, the general satisfaction in front of realism of the simulators was very positive for both groups, experts and learners.

T4.6 Truck simulator feasibility study

The truck and bus driver training simulator feasibility study was based on the question: is it feasible to develop a new training methodology utilising low cost and medium cost simulators for truck and bus driver training? The answer is yes. The simulator fidelity is not the issue. The only really important factors for successful training is that the simulator delay is acceptably short and that the simulator can project rear view mirrors. The outcome is however, highly dependent on the curriculum content. There are not many truck and bus driver training simulators operating on the market, and very few of them have provided us with data on the simulators, as well as on their curricula. This study is, hence, a more theoretical study. Future studies in the field of truck and bus driver-training in simulators should focus on whether actual training effects are present, with respect to training efficiency, as well as to the traffic safety impact of simulator training.

Also technical requirements for truck and bus driving simulators has been prepared for non-engineers and provides a clear picture of what is essential when discussing the feasibility of simulator usage in truck and bus driver training.

The relevant results of the work are included in D4.4, which was delivered in Month 22.

3.4.3 Deliverables

D4.1: Driving simulator scenarios and requirements (Month 16, submitted in Month 15).
D4.2: Low-cost driving simulator prototypes (4) (Month 18, all 4 prototypes at the sites delivered in September 2002, report submitted in Month 36).
D4.3: Mean-cost driving simulator prototypes (4) (Month 22, all 4 prototypes at the sites delivered in September 2002, report submitted in Month 36).
D4.4: Truck simulator feasibility study (Month 24, submitted in Month 22).

3.4.4 Milestones

Month 6: Scenarios for the VR simulation to be provided to VIRTUAL project.
Criterion: Agreement of the two Consortiums on a minimum number of selected scenarios.

Actual situation: VIRTUAL selected scenarios were supplied to TRAINER at Month 6 and were commented by TRAINER. VIRTUAL modified them accordingly. TRAINER provided its scenarios list to VIRTUAL on Month 12 and VIRTUAL took it in consideration for the fine-tuning of its scenarios. The cooperation and synergy between the two projects is developing well.

Month 14 :Testing protocols for VE simulation to be provided to VIRTUAL.
Criterion : Agreement of the two Consortiums on a minimum number of selected scenarios.
Actual situation: Performed. 4 common scenarios agreed.

Month 16 : Anticipated cost of the two types of simulators
Criterion : Low-cost no more than 10.000 Euros, mean-cost not higher than 30.000 Euros
Actual situation: 23.000 Euros for low-cost and 40.000 Euro for mean cost. Thus, this criterion has been slightly violated.

Month 22 : Reliability and usability results of both types of simulators.
Criterion : Approval from CARA, CIECA, DKH and EFA, avoidance of dizziness creation to the users.
Actual situation: According to the tests of T4.5 the simulator sickness values are inside normal range levels and there is no important problem on that.

3.4.5 Comparison of actual versus planned work

Again, as in WP3, the delay in the payment for the first year has resulted in delay in the hardware and software development for the simulators, and therefore to the delivery of all 4 prototypes and the relevant tests of T4.5.

3.4.6 State of the art relevance

Today, even low-cost simulators for passenger cars are more expensive than real cars. They are offered in Europe, for use in driving schools, mainly by Rousseau/Faros France, Simutec Switzerland and by Foerst Germany. But their users are mostly research institutes, which do not claim economical use for training.

In Germany, simulators for driving schools are only sold by Simtec/Simutec. Simtec is a former licensee of the Dr. Foerst GmbH. The Simutec-simulator uses video films instead of computer graphics and is therefore not suitable for future demands.

Today, personal computers are so powerful, that their real-time computer graphics performance nearly catches up with the one of the formerly used graphical workstations. This enables the development of very good simulators at low hardware costs.

TRAINER simulators are the first attempt to bridge high-end applications and complex scenarios to the low-cost simulators. And, for this reason, it involves a wide number of really innovative subsystems (especially for the motion system, but also for the supported graphics realisation).

3.5 WP5 Normative Driver Behaviour Database and Assessment Criteria

Starting date: Month 7 Duration: 20 months

3.5.1 Objectives

- To devise objective criteria for the assessment of the driving task by TRAINER tools.
- To design and develop a database as a tool to gather and statistically process all measurements taken by TRAINER tools.

3.5.2 Work performed (per task)

T5.1 Development of a training and assessment methodology

The TRAINER project's main objective is to improve young novice drivers' road behaviour through a new training methodology. The new training concept includes the use of a Multi-Media Tool (MMT) and of low- and/or a mean-cost-simulator (LCS and MCS). These tools are developed in order to improve novice driver training using new technologies. Special emphasis is on gaining insight in road hazards and complex traffic situations in simulated traffic environments. Thus, a new curriculum has been developed, taking into consideration the advantages and disadvantages of already existing methods of driver training.

The starting point of the new curriculum is the analysis of existing curricula from the four pilot sites. The session content, the progression, the duration and the number of sessions have been analysed for each curriculum. Designing a common curriculum is not possible when considering the differences existing between each country, given national legislations and habits. Thus, the new TRAINER-based curriculum has to be considered as a general structure (like a 'template') specifying the items to be trained. Inside the structure of the new TRAINER-based curriculum, changes concerning the number and/or the duration of sessions are added in order to adapt the curriculum as a function of the national legislative requirements of each country.

In most European countries theoretical and practical trainings are separately performed. Trainees have often to succeed the theoretical driving exam before beginning driving training. In this way, trainees have a minimum of knowledge about the driving code and/or the basic safety rules before starting driving training. Thus the new TRAINER-based curriculum also involves two distinct parts for theoretical and practical training, respectively.

i. TRAINER proposed curriculum for theoretical drivers training

The Multi-Media tool has been developed with the aim to provide traditional theoretical training with a support, in order to extend it from a simple traffic rules check to actual handling of complex traffic situations. The theoretical TRAINER

template curriculum is designed with the content of the existing curricula and the MMT blocks. It is hoped that trainees can get a better understanding of risks and road hazards. In this new curriculum, Multi-Media scenarios have been embedded into traditional driving curricula, by grouping theoretical lessons and Multi-Media scenario blocks dealing with the same theme. Theoretical lessons precede corresponding MMT blocks in order to allow the trainee to immediately put the matter previously seen into practice.

The TRAINER-based template curriculum is presented in the following table:

	Content
Items:	items: acquaintance with the car (driving instrument, knowledge about vehicle construction), checking elements, traffic rules, traffic signs, road marking.
	MMT Block: Basic knowledge.
	items: Braking (techniques), interaction between road users, security rules, manoeuvres (overtaking, changing lane,...).
	MMT Block: manoeuvring and safety.
	items: Human limitation (alcohol, fatigue, drug, stress, medicine,...), special conditions (darkness, fog, rain, snow,...)
	MMT Block: particular situations: special states.
	items: new technologies (ABS, ACC,...), new way of driving (economical and ecological driving), preparation and travel development.
	Block 4: Particular situations: new technologies.
	items: Risks related to driving (accidents, breakdown, penalties,...). => Synthesis.

Table 7: TRAINER proposed curriculum for theoretical drivers training.

ii. TRAINER proposed curriculum for practical drivers training

The TRAINER simulators have been developed with the aim to provide traditional practical training of trainee drivers with a support. The low-cost simulator can be helpful in training and assessment of manoeuvring and control tasks, while the mean-cost simulator can additionally support specific needs of selected driver cohorts.

As for the theoretical TRAINER template curriculum, simulator scenarios have been embedded into traditional driving curricula, by grouping lessons and simulator scenario blocks dealing with the same theme. Contrary to the theoretical curriculum, practical lessons don't precede but follow corresponding simulator blocks. Using the simulator for teaching basic handling skills before moving up to practice with real vehicles is indeed particularly indicated with inexperienced drivers. Young novice drivers have the possibility to be first trained in a safe environment. It has been decided to group two blocks inside each simulator session.

The proposed practical curriculum is presented in the following table:

	Content
	Block 1: Basic control. Block 0: Acquaintance with the simulator.
	items : Acquaintance with the car (checking elements, sitting position, mirrors, safety belts,...), driving on easy road (handling the car).

	Block 2: Manoeuvring and safety (divided attention). Block 3: Manoeuvring and safety (hazard perception).
	items : * Driving in traffic (position on the road, scanning strategies,...), manoeuvres (changing direction, overtaking, intersection negotiation,...). * Driving in traffic (more complex situations), interrelation with other road users (pedestrians, bicycle, ...), different type of road (highway, motorway, rural road, urban road,...).
	Block 4: Particular situations with higher risk. Block 5: Particular situations: new technologies, personality aspects.
	items : * Special conditions training (darkness, rain, fog, snow, low friction, driving on a hill,...). * Conclusion, attitudes (concentration, attention, emotion, social driving), taking decisions in traffic..

Table 8: TRAINER proposed curriculum for practical drivers training.

In summary, the content of the new TRAINER-based curriculum, involves all important elements needed to train safe driving. Educable qualities include the information processing and vehicle handling skills that young novice drivers use while driving, as well as the enduring personal traits, such as knowledge, motives, and social influence.

Finally, each curriculum from a given driving school is completed with MMT and simulator sessions. The existing curricula are not modified but completed with the TRAINER tools. The MMT block corresponding to the lesson content is placed after the lesson in the theoretical curriculum, whereas the simulator block is placed before the lesson in the practical curriculum.

These adapted curricula were tested during the project Pilots. In this way, a common 'general' training structure is retained, allowing comparison between experimental and control groups during the tests.

All these are included in TRAINER D5.1: TRAINER Assessment Criteria and Methodology (due for Month 22, submitted in Month 23).

T5.2 Development of training and assessment criteria

i) MMT performance criteria

TRAINER MMT scenarios are predominantly closed multiple choice questions in combination with their corresponding right or wrong answers (MMT scenario clustering category **A**). Several scenarios have in addition an instructional purpose, and aim at educating a certain understanding of a given topic (MMT scenario clustering category **C**). For scenarios of category A and C it is not necessary to specify special thresholds, i.e. performance criteria, because the correct answer is already defined by the scenario description itself. Multiple choice scenarios (category A) and instructive scenarios (category C) are, thus, completed correctly when the trainee gives all correct answers demanded by the scenario description.

Those MMT scenarios requiring a kind of 'active', procedural reaction (MMT scenario clustering category **B**) to moving images apply the same thresholds as proposed for the TRAINER simulator. In MMT scenario cluster B a 'right' answer corresponds to avoiding an accident, to accepting the right gap or to avoiding line crossing. 'Wrong' stands vice versa for causing an accident, taking a wrong gap or crossing the line.

New number	Scenario description	Assessment criterion[1]
1	Brake / Crash at straight road, high friction.	No accident / Accident
2	Brake / Crash at straight road, low friction.	No accident / Accident
3	Brake at curved road, for low friction.	No line crossing / Line crossing
4	Stopping distance with and without ABS	No error / Error
5	ABS	No error / Error
6	Traffic lights	No error / Error
7	Dirty windshield	No error / Error
8	Dirty headlights	No error / Error
9	Car safety check	No error / Error
10	Gap acceptance	Gap accepted > 5 s and < 10 s / Gap accepted < 5 s or > 10 s
11	Gap acceptance, lorries	Gap accepted > 5 s and < 10 s / Gap accepted < 5 s or > 10 s
12	Detection of road-side dangers	No error / Error
13	Learning the traffic signs	No error / Error
14	Foreign signs	No error / Error
15	2-second rule explanation	No error / Error
16	2-second rule following	No error / Error
17	Car following	Time headway > 2 s / Time headway < 2 s
18	Car following situation on a country road	No error / Error
19	Multi-vehicle platoon driving	No accident / Accident
20	Unpredictable behaviour of children	No accident / Accident
21	Roadworks visibility, safe merging	No error / Error
22	Relation of speed to stopping distance under different road conditions	No error / Error
23	Response under influence of alcohol	No accident / Accident – No error
24	BAC	No error / Error
25	Questions about alcohol	No error / Error
26	Effects of drugs, and combination with alcohol	No error / Error
27	Fatigue	No error / Error
28	Safety belt use	No error / Error
28 A	Economical driving	No error / Error
29	Ecological driving	No error / Error
30	Ecological driving	No error / Error
31	ADAS	No scenario description yet

Table 9: MMT scenarios and performance criteria.

The TRAINER MMT is basically an educational software for theoretical driver training. The MMT framework for performance evaluation adopts therefore the performance classification scheme of a theoretical driving test.

[1] Before slash: correct answer / after slash: incorrect answer.

CIECA provided a figure for 15 different countries, representing the relationship between the total number of questions asked in the theory test and the number of correct answers that is demanded to pass the official driving ability test.
The mean percentage of correct answers required to pass the exam was used as a baseline for the scoring system of the TRAINER MMT.

Mean percentage of correct answers required to pass the theoretical test is 87.5%. Following a conservative, cautious strategy the threshold to pass the TRAINER MMT test is set accordingly at 90%. This means that a trainee driver needs at least 90% of the highest possible score to pass the TRAINER MMT test.

The performance in the individual MMT scenarios has to be integrated into a total score for the MMT test mode, in order to indicate whether a MMT user has passed or failed the theoretical test of the TRAINER curriculum.

The educational objectives of each individual scenario differ in general relevance for the curriculum. These variations have to be considered in the final scoring system. The specific relevance of a given scenario will be expressed as a weight assigned to the scenario in question. The total sum of the scenarios' weights indicates the highest possible score attainable during the MMT test mode.

The importance of individual MMT scenarios was judged among members of the TRAINER consortium. Experts representing different geographical areas (Northern, Central, Southern Europe, etc.) and with different professional backgrounds (traffic safety, driving instruction, driver performance research, etc.) judged the importance of individual scenarios in order to get a combined mean weight for each scenario. Weights were given for each scenario: **1** indicates a less important skill, **2** an important skill, **3** a very important skill, and **4** an absolutely important skill. The result of the rating is provided as mean weight in the table below:

New number	Old number	Scenario description	Weight -mean-
1		Brake / Crash at straight road, high friction.	2,72
2		Brake / Crash at straight road, low friction.	2,71
3		Brake at curved road, for low friction.	2,85
4	7, 8	Stopping distance with and without ABS	2,57
5	9	ABS	2,14
6	5	Traffic lights	1,14
7	5	Dirty windshield	1,57
8	4	Dirty headlights	1,43
9	1, 3	Car safety check	1,43
10	24	Gap acceptance	3,43
11	24	Gap acceptance, lorries	3,14
12	63	Detection of road-side dangers	3,57
13	23	Learning the traffic signs	1,85
14	23	Foreign signs	1,57
15	39	2-second rule explanation	2,71
16	39	2-second rule following	2,86
17	39	Car following	3,00
18	34, 31	Car following situation on a country road	3,00
19	34, 31	Multi-vehicle platoon driving	2,86
20	51	Unpredictable behaviour of children	3,43

New number	Old number	Scenario description	Weight -mean-
21	57	Roadworks visibility, safe merging	2,57
22		Relation of speed to stopping distance under different road conditions	3,43
23	73	Response under influence of alcohol	3,86
24	75	BAC	3,14
25	75	Questions about alcohol	3,14
26	76	Effects of drugs, and combination with alcohol	3,57
27	17	Fatigue	3,29
28	79	Safety belt use	3,00
28 A	86	Economical driving	1,86
29	84	Ecological driving	2,29
30	82	Ecological driving	2,57
31		ADAS	2,33
		TOTAL SCORE	85.03

Table 9: MMT scenarios and mean weights.

The sum of the individual scenarios' weights, and, thus, the maximal score in case a MMT user makes no error at all during the MMT test mode is roughly 85.

The TRAINER MMT test mode should have a high ecological validity, i.e. the simulated theoretical test has to resemble a 'real' theoretical driving test. Given that the highest possible score (all scenarios completed without any error at all) is 85.03, the 90% threshold to pass the MMT test of the TRAINER curriculum is 76.53 points, rounded to 76 points.

Any MMT user with 76 and more points at the end of the test mode has passed the TRAINER MMT theoretical test. Every scenario not answered correctly causes a reduction of the final score. The amount of reduction corresponds to the specific weight of an erroneously answered scenario.

ii) Simulator performance criteria development

The first step towards any kind of objective driver performance assessment is a definition of 'normative', i.e. desirable driving behaviour for each individual simulator scenario. Criteria for training and performance assessment are required which are able to distinguish between safe and unsafe driving behaviour of the trainee, in order to monitor his/her progress during the simulator sessions.

As a second step, the scenario-specific indicators for good and bad driving have to be combined in a total score for the complete simulator test, in order to decide whether a trainee has passed or failed the -simulated- driving test of the TRAINER curriculum.

The technical capabilities of the TRAINER simulator hardware allow principally to monitor nearly all 'objective' driver performance values during a simulator session (speed, gear position, headway, time-to-contact for obstacles or oncoming traffic, etc.). An absolute criterion representing the 'red line' between safe and unsafe driver behaviour for each relevant and less relevant driver performance dimension is, however, neither practical nor appropriate to achieve psychological, i.e. functional validity of the TRAINER curriculum.

As the individual simulator scenarios are designed to teach particular driving skills only those performance values corresponding to the educational goal of a scenario are of major importance for training purposes. For this reasoning only the performance indicators immediately associated with a particular scenario's educational objective are regarded as crucial for the assessment of a trainee's performance in a given scenario. E. g., gear shifting errors are regarded as major errors in the scenario devoted expressly to teaching basic car control skills, while gear shift errors are naturally only of minor importance in any other kind of scenario.

All minor errors, which are not immediately associated with a scenario's educational objective, are monitored as well, but they are regarded as tolerable. Critical errors associated with the educational objective of a scenario, i.e. the skill in focus of a given scenario, are intolerable errors, because they indicate that a trainee has failed to learn the lesson of this scenario. A third class of errors regards major traffic violations which are on the one hand not immediately related to a scenarios educational aim, but which indicate on the other hand that a trainee still lacks other fundamental driving skills, like compliance to traffic rules or rudimentary car control skills.

Following this logic three types of errors are distinguished for each scenario:
A) General errors - tolerable: Unspecific minor errors, not related to the educational objective of the scenario, trainee performance is regarded as sufficient. The trainee has learned a scenario's lesson in absence of Type B and Type C errors.
B) Specific errors - intolerable: Scenario-specific errors, associated with the educational objective of the scenario trainee, performance is not sufficient. The trainee has failed to learn the scenario's lesson.
C) General errors - intolerable Major traffic violations, not immediately related to the educational objective of the scenario trainee, performance is regarded as not sufficient. The trainee lacks fundamental driving skills.

A type A error would be for example a short time headway to the car in front without consequences (crashes, etc.) in any kind of scenario but scenarios teaching to keep safe headways.

An example of a type B error is vice versa a short time headway in a scenario devoted to learning safe headways.

A type C error would be exceeding the legal speed limit by more than 10 km/h in any kind of scenario.

Given that the TRAINER performance criteria will be used in a curriculum tailored to a driving simulator with unique technical and physical characteristics, and moreover a particular simulated traffic environment, the best way to develop the criteria would be to define them based on quantitative, empirically validated driver performance data gathered with TRAINER simulator prototypes, because 'objective features of the driving situation provide the limiting conditions under which a driving task has to be carried out, and the permissible thresholds for fulfilling the driving task'.

However, due to logistic reasons the corresponding empirical procedure could not be carried out during the current project stage. For this reason the initial criteria for the

assessment of learner driver performance have to be based on corresponding literature on normative driver performance in different traffic situations.

To ensure a high educational effect it was decided to select and formulate the criteria, i.e. the error thresholds in a conservative way. E.g., although it is well known that experienced and expert drivers choose headways to the car in front well below two seconds trainee drivers in the TRAINER simulator still have to follow the two-seconds rule, as standards for driver risk-management propose headways up to four seconds while following a car at the same speed.

As the TRAINER curriculum puts strong emphasis on teaching higher-order skills not covered by common driver training no normative standards, which could be applied for weight-assignment, exist. Therefore it was decided to judge the importance of the individual scenarios with expert ratings from within the consortium of TRAINER project. Traffic experts from a variety of geographical regions (Northern Europe, Central Europe, Southern Europe, etc.) and with different expertise (traffic safety, driving instruction, driver performance research, etc.) rated the individual scenarios in order to get an integrated score for each scenario.

Weights were given for each scenario: **1** corresponds to a less important skill, **2** to an important skill, **3** to a very important skill, and **4** to an absolutely important skill.
The final results are indicated as mean score in the table below:

New number	**Scenario description**	**Weight -mean-**
4	Negotiating a curve	3,14
5	Stopping distance on low friction	3,14
6	Skid control on low friction	3,00
7	Split friction	2,57
8	Aquaplaning	3,28
10	Gap acceptance (for turning left)	2,72
11	Left turn at light regulated junction	2,28
12	Left turn at light regulated junction with oncoming car	2,85
13	Following situation on a country road	2,43
14	Following situation on a country road, following distance and tailgaiting	2,85
15	Platoon situation with oncoming car, which overtakes in a risky manner on a country road	2,71
17	Overtaking manoeuvres – higher risk	3,00
18	Overtaking manoeuvres – varying the risk	3,14
19	Overtaking manoeuvres – darkness	3,00
21	Car stopping on the road in darkness	2,28
22	Pedestrians crossing in a junction when dark and rainy	3,15
23	Speed adaptation when turning	2,71
24	Parked car with cue for hazard perception	2,43
25	Parked car without cue for hazard perception	2,43
26	Search strategy	3,72
27	Reaction time and stopping distance during normal driving	3,29
28	Reaction time and stopping distance applying brake alertness	3,72
29	Ecological / economical driving	2,15
30	Mental workload and use of stereo and mobile phone	3,29
	TOTAL SCORE	69.28

Table 10: Mean expert judgements on TRAINER simulator scenario weighting.

Adding up the individual scenario's weights results in 69.28 points as the highest possible score in case a driver makes no error at all during the TRAINER simulator test mode.

The TRAINER simulator test mode should have a high face validity, i.e. the simulated driving test should be as realistic as possible. Therefore the test mode has to be comparable to the general structure of a practical driving exam. For this reason any kind of type B or type C error during the TRAINER simulator test mode leads to immediate failure of the simulated driving test.

Even in complete absence of type B and type C errors individually tolerable type A errors must not be frequent in order to pass the simulated driving test. In addition to the definition of intolerable type B and type C driving errors a threshold for the upper frequency of Type A errors during the test mode is required. Taking the scenario-weighting of the previous chapter as a basis, an optimal test mode drive, without any kind of type A, B or C error, would end with a total score of 69.28 points after driving through all 24 individual scenarios.

Any kind of tolerable type A error leads to a reduction of the final score corresponding to the mean weight a scenario has been assigned based on the expert judgements. Given that less than 90% of the total score indicate bad performance, the border differentiating between passing and failing the test mode is set at roughly 62 points.

Consequently, any trainee without intolerable type B and type C error, and 62 or more points at the end of the test mode would have passed the TRAINER simulator driving test session.

The structure of the TRAINER test mode can be summarised the following way:

- Intolerable Type B or Type C error, anywhere during the test mode: failed.
- In absence of type B and type C errors: performance assessment corresponding to the scheme outlined above.

All these are included in TRAINER D5.1: TRAINER Assessment Criteria and Methodology (due for Month 22, submitted in Month 23).

iii) Final acceptance criteria

The pilot results (TRAINER D6.2) have proved that the score thresholds that were determined for the trainees' evaluation have been rather too high and strict for the new curricula' s demands, and due to this fact, most trainees have failed to pass the test mode of the MMT and the Simulator. Of course, this can not stay as it is, since the TRAINER tools must be adapted to the real driver training system and not result to extremely high driver failure rates. The actual purpose of the TRAINER tools is to improve the knowledge level of the trainees and to train them to prevent and confront with traffic danger effectively. This does not imply that the majority of the trainees should not obtain their driving license. Besides that, the adapted curriculum is much more enriched and complex and inevitably the performance of the trainees could not be the same. Thus, it was decided that the pass-threshold of the test mode should be lower.

In order to determine a new acceptance threshold, more realistic this time, we have estimated the average score that trainees have achieved in each scenario, per pilot site in the tools test modes. The average score of these four average scores has given the final value, which represents the pass threshold level and is about 75%. The previous corresponding value for it was 90%. The following template has been created, where the different performance levels have been adapted respectively to the new pass threshold.

What we should state here, is that the pass threshold has been derived from the performance of the training group and that the produced template is also considered to be valid for the simulator, since the simulator results have not been detailed enough to allow us form a separate template.

TRAINER TOOLS SCORE LEVELS	**SCORE %**
Grade A: 'Excellent ! No error at all, brilliant performance. You passed the test with distinction.'	100%
Grade B: 'Very good! Your performance was almost perfect. You passed the test.'	81,1%-84%
Grade C: 'Good. That's alright. You passed the test.'	78,1%-81%
Grade D: 'Okay. Your performance was not really good, but still sufficient. You passed the test, but better improve your theoretical skills!'	75%-78%
Grade E: 'Sorry, too bad! You made too many errors. Please improve your theoretical skills and repeat the test later on.'	Less than 75%

Table 11: MMT and SIMULATOR adapted performance levels.

T5.3 Measurement tools

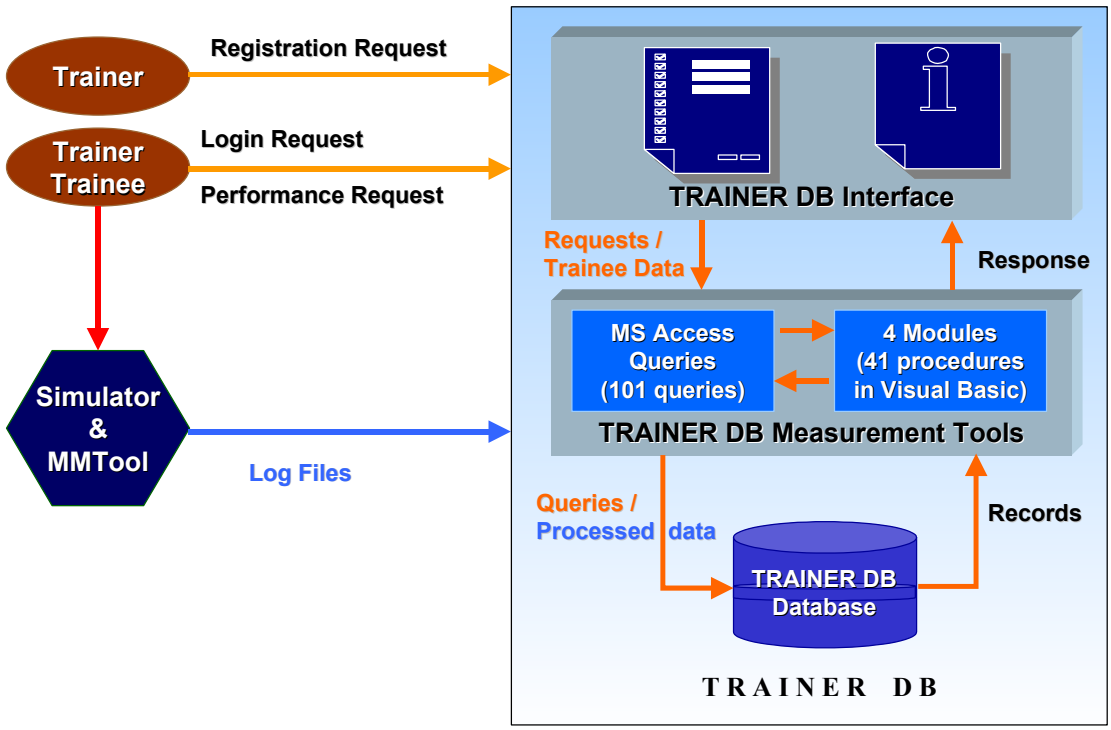


Figure 10: TRAINER measurement tool process

The *Measurement tools* is the part of the application that process the log files according to the performance criteria and contains:

- a set of SQL queries which retrieve the data from the tables, produce the final scores, formulate and introduce data to the tables and check the compliance of all the parameters or exercises of each scenario to the performance criteria;
- a set of software modules in Visual Basic that control the execution of the queries.

The trainer at first registers a trainee or another trainer and his/her personal details are stored into the database along with his/her user name & password.

When a Trainee logs into the database he/she has the following options:

- Access directly the MMTool application and produce new log files.
- Request the process of the new log files produced either by the Simulator or by the MMTool.
- View his/her performance in textual or graphical format for the log files that have already been processed by the measurement tools.

When a Trainer logs into the database he/she has the following options:

- Modify a Trainer's or a Trainee's personal details.
- View a Trainee's performance.
- Access directly the Statistics application.

This tool is described in detail in D5.2.

T5.4 Design and development of a normative driver behaviour database

The access to the Statistics tool is automatically guaranteed through the Database interface if the user is logged as a trainer.

The user can choose between two modalities:
- Single trainee (for the visualization of the results of the "training" sessions in the Trainer tools)
- Group of trainees (for the visualization of the results of the "test" sessions in the Trainer tools)

The Single trainee modality allows the user to visualize the improvement of a single trainee during the training in the Trainer tools: MMTool or Simulator.
With this option, the results of the "training" sessions are taken into account.

The modality Group of trainees allows the user to compare the results of groups of trainees during the testing sessions in the Training tools and to extract data concerning driver training that could be useful for Road Safety Authorities. With this option, the results of the "test" sessions are taken into account.

This tool is described in detail in D5.2.

T5.5 Database testing and optimisation

The database of T5.4 was tested with 20 users from relevant authorities and 20 driving instructors. The results of the tests are included in D6.2.

3.5.3 Deliverables

D5.1: TRAINER Assessment Criteria and Methodology (due for Month 22, submitted in Month 23).
D5.2: Normative Driver Behaviour Database (due for Month 26, submitted in Month 36).

3.5.4 Milestones

Month 16 : Results on criteria evaluation from Pilot tests.
Criterion : Correlation above 80%.
Actual situation: Realised, in relation to visual scanning tests, performed within T6.2.

Month 21 : Database effectiveness.
Criterion : Correlation with experienced trainers opinion higher than 80%.
Actual situation: The results were correlated in almost 100% of the trainees.

3.5.5 Comparison of actual versus planned work

T5.4 was delayed due to the lack of raw data from the simulators (WP4).

3.5.6 State of the art relevance

It is the first time that advanced tools for theoretical training support (multimedia) and practical training support (simulators) are connected through a common database, that will allow the storage and comparative analysis of errors and learning patterns of driver trainees from all over Europe.

3.6 WP6 Pilot tests

Starting date: Month 1 Duration: 33 months

3.6.1 Objectives

- To test the reliability and usability of TRAINER multimedia tool and driving simulators.
- To assess the reliability and correlation to the actual driving task of TRAINER assessment methodology and criteria.
- To assess the TRAINER tools (interactive multimedia s/w and driving simulators) actual impact to driver training and ability assessment.

3.6.2 Work performed (per task)

T6.1 Pilot plans

Specific plans for all project Pilots (of tasks T6.2, T6.3 and T6.4) have been derived, including the necessary indicators and tools to be used (questionnaires, evaluator forms, etc.).
However, the most important work within this activity has been the definition of approximately 100 scenarios to be used in the three different TRAINER tools and tested during the Pilots. They have been structured in accordance to the four hierarchical levels of the GADGET matrix (analysed in WP2), and for each of them it has been written:

- A scenario (application) short name (i.e. safety belt, eco-logical driving, etc.).
- A short scenario aim description.
- A reference number of the relevant D2.1 and / or D1.2 Sections, where the need for such a scenario has been defined.

In this way, D6.1 has acted like the bridge between the user needs and system requirements definition of WP1 and WP2 and detailed scenario layout of WP3 and WP4, safeguarding that what is applied is needed and that it is also dully tested within WP6.

T6.2 User problem assessment Pilots

In order to find quantitative, normative data on proper driving behaviour, the visual search strategies of the two control groups, i.e. the learner drivers not trained in the TRAINER tools and the experienced drivers were in focus of a test performed. The aim of this test was thus to test the hypotheses that inexperienced drivers in comparison to experienced drivers:

1. fixate closer to the vehicle;
2. fixate more often on in-vehicle objects;
3. spread their fixations less along the horizontal meridian;
4. show different fixation duration;
5. fixate more often on relevant traffic cues, with respect to:
   a, fixation duration;
   b, number of fixations;

6. fixate more often on objects classified as potential hazards.

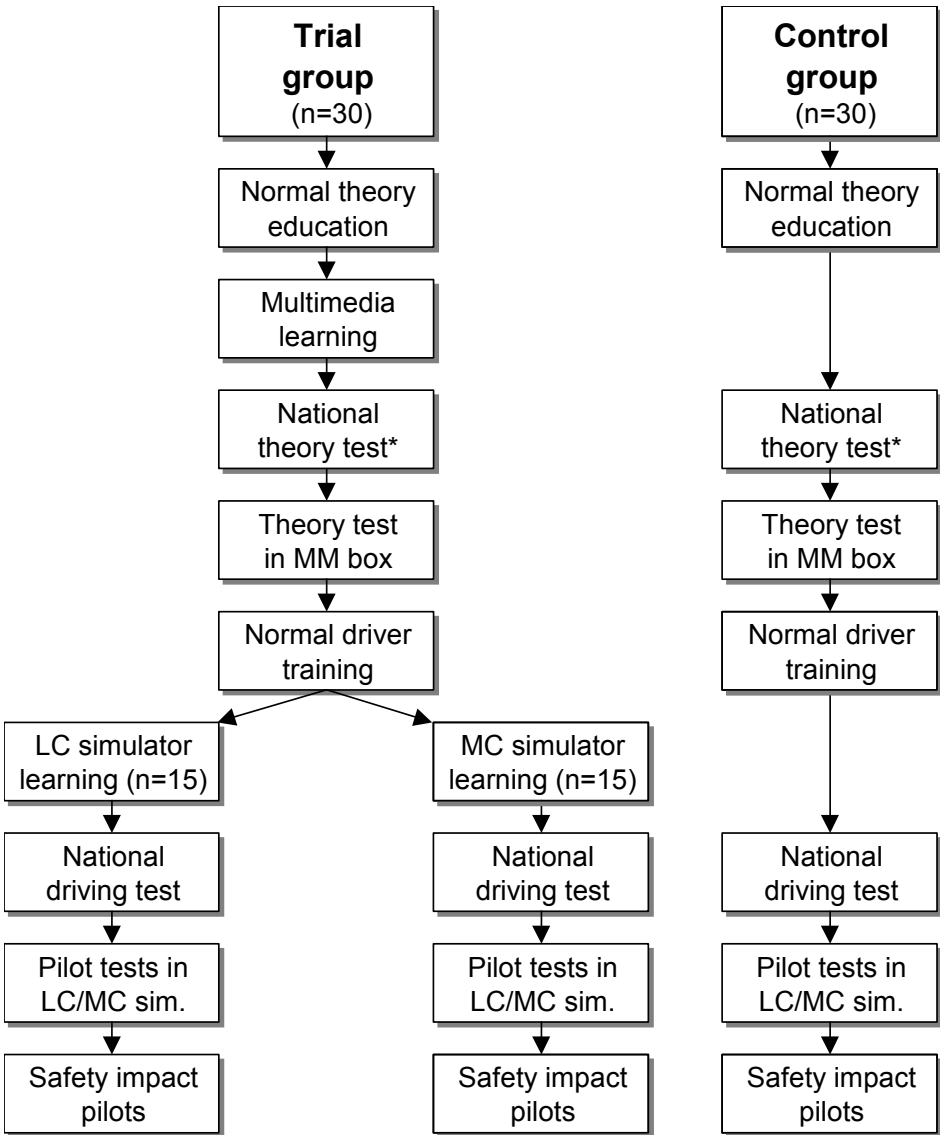
An additional aim was to establish the correlation between the fixation durations and the number of fixations for inexperienced drivers as well as for experienced drivers.

Data collection and anticipation of potential hazards, i.e. hazard perceptual skills, have been assessed by data from eye-tracker recording of visual search strategies of the driver in real world traffic. This video based eye movement data have been analysed frame by frame for those sets of frames clustered into a fixation. The fixation durations have been noted. Each fixation was labelled in one of three categories, in order to identify the focus of the presumed "visual attention" of the subject while driving. In a second step, fixations were assigned to one of the two categories traffic relevant and not traffic relevant fixations.

The results show that inexperienced drivers in comparison to experienced drivers fixate closer to the vehicle, fixate more often on in-vehicle objects, spread their fixations less along the horizontal meridian, show different fixation durations, fixate more often on relevant traffic cues and fixate more often on objects classified as potential hazards. This first study provides normative data for the forthcoming testing of the TRAINER tool impact on inexperienced drivers' hazard perception.

T6.3 TRAINER tools evaluation Pilots

The evaluation of the TRAINER products was carried out in a series of experiments where performance on different types of tests in trial groups and control groups are compared. The design of the tests is shown in the following figure.



*) National theory test will be conducted at this point or at any other point as regulated in each participating country

Figure 11: Design of the evaluation of the training tools.

Four full sets of TRAINER tools were developed and installed at Belgium, Spain, Sweden, and Greece. Each set consists of a multimedia info-box and a low-cost/mean-cost (both versions) driving simulator. Tests were conducted in each site a trial group and a control group. The groups were matched by age, gender and education level. The tests in 4 different countries account for social and mentality differences between different EU regions.

In the test procedure both groups initially underwent the standard theoretical driver education in a local driving school. The trial group was then trained for an additional 2-3 hours using the multimedia tool. All people were then tested using the multimedia s/w for about 15 minutes and also underwent the normal driving license theoretical test.

In the second stage, all learner drivers were trained on the road by the local driving school using a driving school vehicle. The training time of each lasted until the driving instructor was satisfied that the candidate is fit for the driving license test. After this training, the trial group was randomly divided into two groups. Both groups achieved an additional 2-3 hours training, one in the low-cost and one in the mean-cost driving simulator. All these drivers and the control group were tested in the low cost and the mean-cost simulators. All drivers also underwent a driving license practical examination.

These tests were delayed because of the delay in the availability of the simulators at the sites.

T6.4 Traffic safety impact Pilots

A full set of TRAINER tools was installed at VTI in Sweden. The set consisted of a multimedia info-box and a low-cost/mean-cost (both versions) driving simulator. Training were conducted with 18 learner drivers in the mean cost simulator and 18 in the low cost simulator. The learner drivers were provided by three local driving schools and randomly divided in three groups as follows:

1. The mean cost (MC) simulator group, n=18 (followed a normal driver education, but in addition was trained in the multimedia tool and the mean cost simulator)
2. The low cost (LC) simulator group, n=18 (followed a normal driver education, but in addition was trained in the multimedia tool and the low cost simulator)
3. The control (C) group, n=18 (followed a normal driver education, no simulator or multimedia training)

The simulator study was performed with the aim to compare driving behaviour in 6 different scenarios and to test the general hypothesis that the MC-drivers would behave in a safer way than the LC-drivers, who in its turn will behave in a safer way than the C-drivers.

The results have shown that there are benefits from using the TRAINER simulator in driver training. Not all the dependent variables were improved, but some. This also shows that in spite of some good results, there is still a potential for improvement and further analysis of why some types of scenarios did not show effect.

The results in the fog test-scenarios show that the experiment groups drove more careful when there was an obvious and well visible hazard on the road. Everyone could see the fog. Our interpretation is that the experiment group was better in realising the possible consequences of low visibility, something that had been directly in focus in several of the training scenarios. The concept of mental workload had also been directly in focus in the training scenarios. Not as SMS, but as adjusting the car radio during driving. The purpose of that training scenario was to make the subjects realise how this type of secondary task diverts the attention from the road and the car control.

Concerning the other two test-scenarios, the bus and the moose family, there were similar situations in the training scenarios, but not with the same direct transfer possibilities as in the others. The moose scenario in the test had a corresponding deer

scenario in the training, but the occurrence of the deer during training was not shown in the same type of environment as the moose in the test. The moose situation was emerging when approaching a very typical Swedish edge of a forest where moose typically crosses the road. An assumption from the start was that the subjects would be able to transfer the deer experience to the moose situation, but this was not the case. The bus scenario is somewhat more difficult to explain. There was a training scenario where the students approached a junction in which a car suddenly drives out in front. In that situation, however, the approaching car has the right-of-way. In the test scenario with the bus, the bus crosses the road in front of the subject even if it should have stopped. The results may thus also be a lack of transfer from the training to the test, since the situations were different. There are still many questions that need answers in order to understand the results fully.

T6.5 Pilot evaluation

The aim of the tests performed in the four pilot sites using the TRAINER MMT and the LC and MC simulators was to see the impact of these tools on driving training of novice drivers, paying significant attention to higher order skills, like hazard perception, risk anticipation, which are important from a safety point of view.
The results presented in details in the previous sections generally show a better performance of the trial group than the control group, thus suggesting a positive impact of the TRAINER methodology.

The data gathered from the MMT test mode on the one hand and from the simulator test on the other hand, show that some improvements can be still brought to the tools, and especially regarding the algorithm allowing to calculate a score for each tested subject. The different sub-tasks included in the tests seemed particularly difficult to be succeeded, even with an appropriate training period. The thresholds used were also probably too high.

The results also tend to indicate the MCS is a better training tool than the LCS. As control Group subjects also had better results for some scenarios when using the MCS than the LCS, it would seem the MCS simulates driving conditions in the test in a better way than the LCS giving the trainees more useful information while driving allowing them to reach a better performance even if they have not been trained.

Two different questionnaires were developed for the capture of the trainees and trainers opinions regarding the usability of TRAINER tools. The general conclusions that could be extracteds are the following ones:

- The general impression of TRAINER tools is good. A remarkable preference has been observed for the MCS among other tools.
- MMT has been estimated as a tool, which is useful in theoretical terms but as rather incapable of transferring the trained skills to real driving situations.
- An instructor is necessary for the MMT and simulator sessions' realization.
- The training should preferably be private for each trainee and not realized in groups.
- MMT and simulators do not inspire self-training with them.
- The content of TRAINER tools should be richer according to trainers' opinion and the common additional material, which have suggested is the following one:

MMT additional material

- First aid for accidents.
- Aquaplaning-snow-ice.
- Lateral visibility.
- Give way and parking.
- Roundabouts.

SIMULATOR additional material

- Defensive driving.
- First aids in accidents.
- Air loose from tires.
- Give way, parking and tuning.

In order to capture the experts opinion on the strengths, weaknesses, opportunities and threats of TRAINER project and consequently of its tools/products, a special questionnaire was formulated, covering all possible areas, but also allowing the target group to express its own opinion and adding personal beliefs accordingly. The main conclusions from this analysis are presented below:

The strongest points of TRAINER project and conclusively TRAINER tools are the following ones:

- Multi-linguality of the tools.
- Usefulness of info and data on novice driver errors/needs through the database.
- Good usability of TRAINER tools.
- Very useful driving simulator scenarios.
- Potential for driver safety enhancement.
- Driver trainee enthusiasm.

However attention should be given to the following ones, which in general gathered the less votes:

- Usefulness of guidelines and test results for vehicle design.
- Low cost of TRAINER simulator in relation to its functionality (for the mean cost one).
- Low cost of TRAINER simulator in relation to its functionality (for the low cost one).

The Trainer weakness analysis has proved once again that the weakest points of TRAINER are:

- Cost of its low-cost simulator (in relation to its functionality).
- Cost of its mean-cost simulator (in relation to its functionality).
- No possibility to check the environment in depth (180 degrees).
- Low simulation of forces (centrifugal forces are missing).
- Better products in the market for MMT s/w.
- Quality of simulator scenarios (i.e. missing scenarios).
- Depth of its curriculum (i.e. missing issues).

TRAINER Opportunities

- Established trend for use of new media in driver training.
- Gradual reduction of tools cost and enhancement of their reliability, due to technological advances.
- Mature technological transfer of tools, from post to pre-license training.
- Positive results from professional drivers training with the use of new tools.
- National policies for zero or near-zero road casualties.
- EU Policy for 50% reduction of road casualties by 2010.
- Multinational character of its tools supporting consortium.
- Participation of end-users (Assessment Centers and Driving instructors).

TRAINER Threats

The most important fears of experts are about the following:
- Trends in the driver training market (i.e. lack of investment funds).
- Lack of relevant standards.
- High competition.

The most significant conclusions from the above mentioned concern mainly the general market adaptation of TRAINER tools and the necessity of TRAINER tools improvement.

Simulators' cost is the main issue that should be discussed and given attention to, since survey has confirmed that there is not yet a market versatility for their insertion and normal use in training as a complement to traditional training, which driving schools provide.

Besides that, the quality and mainly the content of the TRAINER tools should be elevated in order to be competitive to similar, already existing, market products and also justify their cost.

3.6.3 Deliverables

D6.1 Pilot Plans (due for Month 10, delivered on Month 12).
D6.2: Pilot Evaluation (due for Month 33, submitted in Month 36).

3.6.4 Milestones

Month 12: Identification of people to participate in the training through TRAINER tools.
Criterion: 30 persons (test group) in 4 EU countries and another 30 persons (control group).
Actual situation: The profiles of the control and test group subjects have been defined. The relevant local contracts and sub-contracts (i.e. with driving schools to cooperate locally) have been established, all in time.

Month 33 : Evaluation report to VIRTUAL on comparison of their VE tests with relevant TRAINER tests.
Criterion : Acceptance of evaluation report by both Consortiums.
Actual situation: A report has been prepared and submitted to VIRTUAL in Month 36. This report compares the results of the TRAINER and the VIRTUAL project with

regard to the training of novice drivers and subjective user assessment of acceptance and comfort when using the two different simulator systems. Both the TRAINER and the VIRTUAL simulators have shown positive effects on behaviour of novice drivers. The VIRTUAL study focused on driver performance increase within a simulator-specific scenario. The TRAINER traffic safety study could in addition and on top of that also show an effect when practice is transferred to a different and more sophisticated simulated traffic simulation with alternative traffic scenarios.

3.6.5 Comparison of actual versus planned work

The delay in the payments for the first and second year has resulted in delay in the hardware and software development for the MMT and the simulators, which has also delayed the relevant pilot tests.

3.6.6 State of the art relevance

All state-of-the-art data from relevant project evaluations (i.e. from GADGET, SAVE, CONVERGE) have been considered when developing the D6.1. The selected scenarios, correlated to the user needs identified in D2.1 and D1.2, formulate a major innovation, as such a complete and user needs' founded scenarios list, covering the whole driving task spectrum, has not been issued before.

3.7 WP7 Development of recommendation and best practices guidelines

Starting date: Month 28 Duration: 9 months

3.7.1 Objectives

- To provide training schools with a new training curricula, incorporating the new tools, and best practice guidelines on training procedures.
- To provide recommendations to authorities on the improvement of the driver training and assessment.
- To provide recommendations on further steps towards relevant tools for professional drivers.
- To provide design guidelines on vehicle design, based on novice drivers problems and behaviour.

3.7.2 Work performed (per task)

T7.1 Design of new training curricula and best practice guidelines

The objective of this task was the definition and presentation of the finally proposed training curricula incorporating TRAINER tools and the formulation of Best Practice Guidelines. The work has been mainly based on the Pilot results of TRAINER D6.2. However, input relevant to novice drivers' problems and needs derived from the total TRAINER documentation.

25 Best Practice Guidelines have been developed, included in the first chapter of Deliverable 7.1 and addressed to the driving instructors, regarding several training issues and issues relevant to the training with the TRAINER tools. Additionally to them, a short drivers' training checklist has been developed, which includes reference to MMT and simulator scenarios, in parallel to Gadget matrix levels. Moreover, within the first chapter of D7.1, four new driver training curricula examples (for the four pilot sites) are presented, with updated structure and content, according to the experts' comments during TRAINER Pilots. They are included in **Annex 9** of this report. Also the user manuals of the TRAINER tools. Finally, some criteria have been defined for the market acceptance of the TRAINER tools.

T7.2 Recommendations to authorities

Standards from three bodies were analysed in relation to TRAINER results. The ISO Norms, the CEN norms and the EU directives. The ISO and CEN norms apply to the simulator and Multimedia Tool.

Concerning SIM and MMT, most of the relevant items from the CEN and ISO norms are covered. Some small deviations from strict norms can be explained by the fact that some items are too much demanding towards a low or mean cost simulator.

Concerning the MMT, the found norms apply to a multimedia learning interface but not specifically to a tool like the MMT, therefore, once again, few items are too much demanding for the Multimedia tool.

The EU directives are completely inline with the proposed TRAINER curricula. It only happens that curricula examples are summarised by titles and those titles do not permit all of the times to confirm that a specific item is included inside a learning block.

Recommendations from 4 existing projects were retained: the GADGET, DAN, ADVANCED and the "Cool Driving" (national Belgian initiative). These four Projects bring proposals at different levels of actions. A synthesis of their relevant recommendations was made.

The second chapter of TRAINER Deliverable 7.1 includes the analysis of the several relevant standard bodies and the comparison to TRAINER findings. Also, 20 new recommendations regarding pre-training, post-training and assessment of novice drivers stemming from TRAINER work, have complemented this survey. They are included in **Annex 10** of this report. Likewise, recommendations towards relevant tools and procedures for professional drivers training are proposed in Chapter 3 of D7.1.

T7.3 Towards recommendations for training professional drivers

The original TRAINER scenarios were commented with respect to general aspects of driver training for professional drivers, i.e. truck drivers, bus drivers, taxi drivers, emergency vehicle drivers, and agricultural machinery drivers (including tractor drivers). The comments were based on the knowledge gained from D4.4., and performed in parallel with the survey on existing curricula for the above mentioned

driver categories' driver training. A clear need has been identified to develop a new pan-European truck, bus and agricultural machinery and emergency vehicles driver training methodology based on training in a low cost simulator, as a complementary tool to training in closed course areas and real traffic environments.

T7.4 Guidelines on vehicle design

The work resulted in the development of 10 Guidelines for Vehicle Design for novice drivers. They are included in **Annex 11** of this report. These guidelines refer to the support of the overall task taking into consideration the specific difficulties of novice drivers.

Other important recommendations of D7.1 refer to the need for a long evaluation period of trained drivers with TRAINER tools and the further research on training issues and mainly on training of professional drivers, like truck drivers, bus drivers, drivers carrying dangerous goods, emergency vehicles' drivers, etc. in relation to the impact and use of new tools, following the TRAINER iterative concept.

3.7.3 Deliverables

D7.1: New driver training curricula, Best Practice and design guidelines and Recommendations to authorities (due for Month 34, submitted in Month 36).

3.7.4 Milestones

Month 34 : Deliverance of guidelines for driving instructors.
Month 36 : Deliverance of recommendations to authorities.
Criterion : Approval by CARA, DKH and EFA.
Actual situation: Guidelines and recommendations were delivered and approved in Month 36.

3.7.5 Comparison of actual versus planned work

This work was delayed as it had to be based on the results of pilot tests which were also delayed.

3.7.6 State of the art relevance

This work is really innovative, as it resulted in new guidelines on driver training and vehicle design.

3.8 WP8 Cost-Benefit Analysis and Exploitation

Starting date: Month 1 Duration: 36 months

3.8.1 Objectives

- To establish the cost-benefit ratio of each tool and procedure proposed within the project.
- To device plans to exploit the project results and bring them near to the Market.

3.8.2 Work performed (per task)

T8.1 Cost-Benefit analysis

The TRAINER main products are:
- Multimedia Tool (MMT).
- Low-cost simulator (LCS).
- Mean-cost simulator (MCS).
- Connecting Database and measurement tool (DBT/SRAP).

The possible products configurations are listed below:

- Product Configuration A: TRAINER MMT as stand-alone
- Product Configuration B: TRAINER SIS as stand-alone (used within any simulator of FOERST GMBh)
- Product Configuration C: TRAINER MMT and DBT
- Product Configuration D: TRAINER (SIS) and DBT
- Product Configuaration E: TRAINER MMT, DBT and SRAP
- Product Configuration F: TRAINER (SIS), DBT and SRAP
- Product Configuration G: TRAINER MMT, SIS and DBT
- Product Configuration H: TRAINER MMT, SIS and DBT and SRAP

Both an a priori and an a posteriori questionnaire survey have been conducted among driving instructors, to capture their willingness to purchase the TRAINER tools. According to the results of this survey and a market survey of relevant products already in the market, the target sales price and expected sales volumes of the various TRAINER products have been estimated, trying always to avoid being over-optimistic.

The estimated annual revenue and profit for each TRAINER product are summarised below. They refer to first three years of marketing and do not consider the impact of any relevant supporting legislation and/or standardization activities on the use of such tools for drivers' training.

TRAINER product	Expected annual sales	Cost per item	Expected annual cost	Suggested price	Expected annual revenue	Expected annual profit
MMT	2,333 full licenses and 23,333 trainee licenses	6.4 Euros	164,267 Euros	300 Euros full licenses and 50 Euros trainee licenses	1,866,667 Euros	1,702,400 Euros
LCS	20	10,416 Euros	208,319 Euros	23,000 Euros	460,000 Euros	251,680 Euros
MCS	15	26,111 Euros	391,659 Euros	40,000 Euros	600,000 Euros	208,341 Euros
DBT/SRAP	2,368	6.4 Euros	15,157 Euros	100 Euros	236,833 Euros	221,676 Euros

Table 12: Expected annual sales and profit for TRAINER products for the first three years of exploitation

By combining the above results with the proposed exploitation shares, we conclude to following return of investment scheme per partner.

Role	Specific organisation	Proposed share in gains	Expected annual profit (first three years)	Partner's own funding	Payback period
Product developers	IAT for MMT	84%	1,430,016		
	Foerst for LCS/MCS	84%	386,418.3	232,800	7.2 months
	CRF/SIEM for SRAP/DBT	100%	221,676	280,695	15.2 months
Share-holders (shares to MMT and LCS/MCSs)	CARA	6%	129,745.3	230,304	21.3 months
	VTI	6%	129,745.3	231,249	21.4 months
	EFA	2%	43,248.44	74,800	20.8 months
	DKH	2%	43,248.44	77,000	21.4 months

Table 13: Expected payback period of TRAINER partners in the first 3 years of exploitation

According to the above, the payback period is short, less than 2 years in all cases.

Based on the discount rate of 8%, the NPV is:

TRAINER product	Discounted benefits	Initial TRAINER investment	NPV
MMT	6797190	319144	6478046
LCS	1004888	531907	472980.9
MCS	831845.9	638288	193557.9
SRAP/DBT	885088	319144	565944

Table 74: NPV for the TRAINER products

Since NPV is well above zero, the TRAINER is a financially acceptable project in the predefined 5 years horizon and under the accepted assumptions.

Based on the above assumptions, the internal rate of return for each TRAINER product is presented below.

TRAINER product	IRR
MMT	533.35%
LCS	37.7905%
MCS	18.912%
SRAP/DBT	63.518%

Table 85: IRR for the TRAINER products

The IRR derived is well above 8% which is the return rate used for all TRAINER products. Therefore, the introduction of TRAINER products proves to be financially justifiable.

T8.2 Exploitation Plans and Market analysis

The TRAINER products and developers are:
- Multimedia tool -IAT
- Low-cost simulator -FOERST
- Mean-cost simulator -FOERST
- Connecting Database and measurement tool –CRF/SIEM

In addition, specific partners that offered self-finance to the project, are interested in the further development and/or marketing of the products, namely: CARA, VTI, DKH, EFA.

The rest Academic and non-academic partners may hold full rights for the produced knowledge dissemination, namely IAT, AUTH, CIECA, UPV, RUG, IfADo.

3.8.3 Deliverables

D8.1: Cost-Benefit ratio and cost-efficiency of new assessment tools and procedures. Consortium Exploitation Plans (due for Month 36, submitted in Month 36).

3.8.4 Milestones

Month 5: Collection of cost-benefit questionnaires.
Criterion: At least from 100 driving schools in total from 6 EU countries.
Actual situation: 122 questionnaires had been collected from driving schools, from 8 EU countries by Month 5.

Month 6: Exploitation agreement among Partners.
Criterion: Preparation and signature of relevant agreement.
Actual situation: Exploitation agreement has been formulated and signed by all.

3.8.5 Comparison of actual versus planned work

The relevant work was slightly delayed, so as to include results from the pilots tests.

3.8.6 State of the art relevance

The Consortium was able to gather key data on Market penetration and business plan data from major training tool developers as well as to assess widely the users (driving schools) WTP, thus obtaining non public and even strictly confidential data. That helped to produce a realistic and effective marketing scheme for its own products. In the existing literature nearly none of these data was available, due to their confidential but also very dynamic nature. Of course also TRAINER won't publish such acquired or produced data.

3.9 WP9 Dissemination plans and training video development

Starting date: Month 1 Duration: 36 months

3.9.1 Objectives

- To widely disseminate project concept and achievements.
- To develop a 15 minutes training videotape to be used by training schools as hazard perception stimulant.

3.9.2 Work performed (per task)

T9.1 Dissemination Plans and Activities

A Clearing House database has been developed for the project, which already includes 350 entries. This is being updated every 3 months and is downloadable by the project www site (only for the Consortium members).
A project logo, leaflet and poster have been prepared. 500 posters and 2000 leaflets have been printed and disseminated. Their layout is briefly described in **Annex 12** of this report.

The TRAINER website has been designed. The following technical accomplishments have been reached:
- production of various alternative structures, look and feel proposals for the project web site and logo, for review by the partners;
- web-site content collection, editing and fine-tuning;
- processing and fine-tuning of web images;
- implementation in HTML and Java scripts.

The TRAINER www site address: www.trainer.iao.fhg.de. It is a living place where the project achievements and outcomes become known and available to a broader audience all around the world. Statistical analysis of site visits shows that numerous users from all around the world have visited the electronic place of TRAINER in order to be informed about the latest progress of the project.

In addition to the above, the project site serves as an internal reference place where partners can share their work among them. Through an internal ftp site, which is accessible from the www site, partners can download and review the latest internal documents as well as progress reports.

The structure of the site is designed to accommodate both dimensions mentioned above (i.e. dissemination channel for the project results and internal working place). The structure of the www site is summarized in the following illustration:

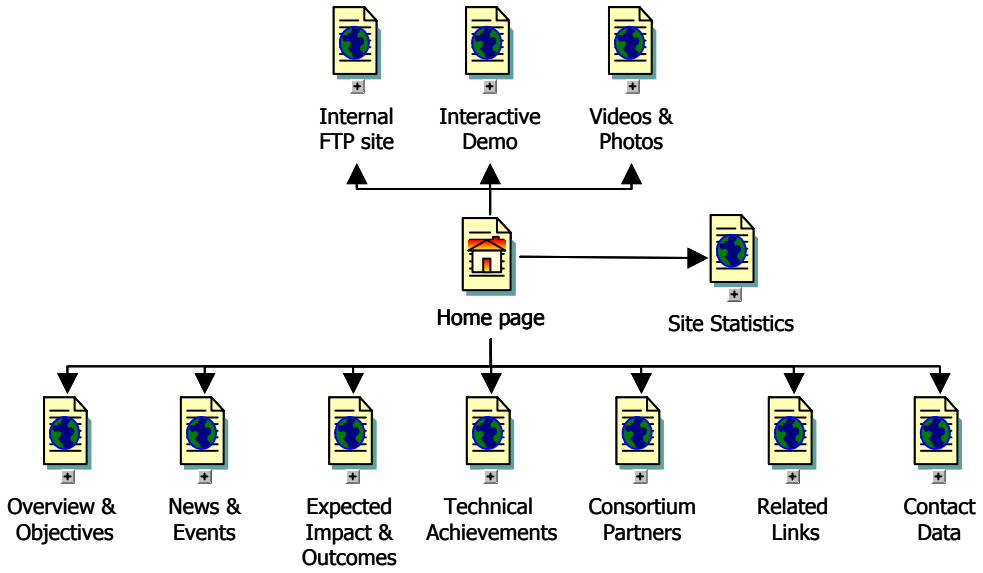


Figure 12: TRAINER www site structure

Figure 13: TRAINER www site demo entrance

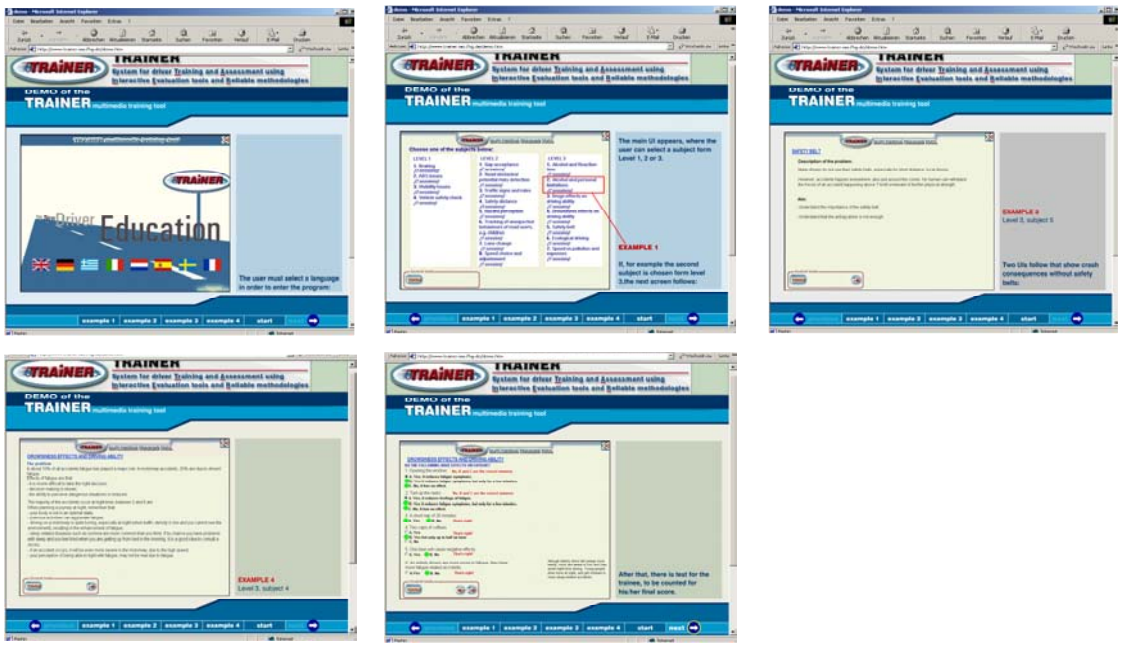


Figure 14: TRAINER www site: MMT demo pages

Figure 15: TRAINER www site: demo video page

The site statistics from the start until Month 24 of the project are as follows:

- Total number of requests: 18.681
- Total Number of Visitors 2.442
- Total Number of Visits 5.688
- Average Visits Per Day 11,4
- Average Requests Per Visit 3,3
- Average Time Per Visit (Seconds) 192,75

Various publications have already taken place and the general situation is as follows.

	YEAR				
	2000	**2001**	**2002**	**2003**	**TOTAL**
Congresses	3	7	5	5	20
Scientific articles in journals	-	-	2	2	4
Oral pres. without published article	5	-	11	-	16

Exhibitions	1	1	1	2	5
Journals, newspapers, radio, TV.	-	-	18	10	28
Total	**9**	**8**	**37**	**19**	**73**

Table 16: TRAINER publications per category

PARTNERS	YEAR				
	2000	2001	2002	2003	TOTAL
AUTH	4	2	4	1	11
CARA	3	2	3	1	9
CDV	-	-	2	-	2
CIECA	1	1	1	1	4
CRF	2	-	1	1	4
DKH	-	1	-	-	1
EFA	1	-	2	-	3
FOERST	1	2	1	-	4
IAT	-	1	1	2	4
IFADO	1	2	4	1	8
RUG	-	2	-	3	5
SIEM	-	-	-	1	1
UPV	-	4	19	5	28
VTI	-	4	7	9	20

Table 17: TRAINER publications per partner

T9.2 Development of an educational videotape

For the realisation of the videotape several images were taken from the four different pilot sites, which are Belgium, Greece, Spain and Sweden. Those images showed the TRAINER new procedure used at driving schools and laboratories where TRAINER tools were installed. Moreover, several interviews were realised with different driving instructors and students to express which are the advantages and opportunities about the introduction of these new tools inside the traditional novice driver's curriculum. These conclusions have been observed and extracted during these last months, with the realization of the corresponding pilot tests, and all the people interviewed have actively participated in the project.

The video was produced in Spain, as it was agreed by the consortium, taking into account the collaboration of the test sites, providing professional images in DV-CAM format and with the collaboration for the translation of a final subtitled version which was developed 8 languages. A professional video production company was subcontracted; nevertheless in a first version the storyboard was developed at IAT by Christian Knoll and later adapted at UPV by Juan Pardo once the video material was received at UPV.

The video, in VHS format, was realised in English with a total duration of 15 minutes and a shorter version of 5 minutes, for Project Coordinators use, was realised too. Several copies in BETACAM were sent to the Coordinators to have a master copy for future presentations to the mass media.

About the subtitled version, finally UPV adopted the decision to develop it in DVD format. This format allows to have two versions subtitled in 8 languages, in the same physical substratum. One copy of the DVD and VHS formats were sent to the EC and the rest of the partners. Translations were made by AUTH, CARA, CRF, IAT, RUG and VTI, thus the video has subtitles in Greek, French, Italian, German, Dutch and Swedish.

3.9.3 Deliverables

D9.1 : Project logo, pamphlets and posters (due for Month 8, delivered on time).
D9.2: Project WWW site with interactive demo (due for Month 20, delivered in Month 21).
D9.3: Educational videotape (due for Month 34, submitted in Month 38)

3.9.4 Milestones

Month 16 : Dissemination level of project WWW site.
Criterion : Statistics of users and usability rating of the site.
Actual situation: An analysis of the www site statistics reveals that both goals were successfully accomplished, since numerous visitors from all over the world have spent considerable time getting informed about the TRAINER project and its achievements.

Month 36 : Dissemination of project products.
Criteria : At least 20 scientific publications and presentations in international events.
Actual situation: TRAINER has published 4 articles in scientific journals and has presented papers in 20 international congresses, thus surpassing the set goal.

3.9.5 Comparison of actual versus planned work

All forms of dissemination mentioned in the T.A. have been realised. In addition, a Clearing House database has been realised (for internal use). The success of the followed dissemination scheme is proved by the request of external international authorities on drivers training to become associated or members of TRAINER (i.e. CDV from Czech Republic, Carnegie Melon University from USA), the high participation rate of external experts to TRAINER workshop (41 in the first workshop and 54 in the second workshop, instead of 30 required) and the many hits to TRAINER web site.

3.9.6 State of the art relevance

Irrelevant to this WP.

3.10 WP10 Project Management

Starting date: Month 1 Duration: 36 months

3.10.1 Objectives

- To provide management of all administrative and non-technical aspects of the project.
- To provide technical management of the project.
- To provide quality control and assurance to all project deliverables.

3.10.2 Work performed (per task)

T10.1 Administrative Management
Relevant work performed includes:

- Planning and organization of 13 Project meetings and one workshop.
- Various other technical meetings have been organised in parallel to the plenary meetings or separately.
- Analysis of 4 three-monthly reports of the Partners so far. Any major deviations from the planned resources are automatically located and discussed with the relevant Partners.
- Preparation of administrative part of Quarterly Management Reports.
- Preparation of administrative part of Periodic Progress Reports.
- Preparation of administrative part of Final Report.

T10.2 Technical Management
Relevant work performed includes:

- Issue and circulation of Minutes for all project meetings .
- Preparation of technical part of Quarterly Management Reports.
- Preparation of technical part of Periodic Progress Reports.
- Preparation of technical part of Final Report.

T10.3 Quality Control
A Peer Review Form has been devised and is composed for each Project Deliverable by different Partners. Peer Review process has been successfully applied to all project Deliverables (except the leaflets / posters of D9.1) and provided valuable input for their optimisation.

3.10.3 Deliverables

- All necessary Administrative and Technical reports to the Commission Services.
- Minutes of Project meetings.
- Peer Review reports of project deliverables

3.10.4 Milestones

Month 6: Six-monthly report (delivered, as Management report, on time).

Month 12: Annual review report (delivered, as Progress report, on time).
Month 18: Mid-term report (delivered in Month 16).
Month 18: First draft of TIP (delivered in Month 16).
Month 24: Annual review report (delivered, as 2nd Periodic Progress report, on time).
M30 : 6-monthly report (delivered on time).
M36 : Final report (delivered in Month 36).

3.10.5 Comparison of actual versus planned work

All relevant work has been performed on time.

3.10.6 State of the art relevance

All state-of-the-art Management Report tools for EU sponsored projects have been utilised. Furthermore, additional forms from the EU requested ones (i.e. 3-monthly progress reports, peer review forms) have been devised and used for the effective monitoring of the project.

4 List of Deliverables

Deliverables	Due date	Responsible	Status
D1.1: Training curricula and practices database	11-2000	CIECA	Submitted in 12-2000
D1.2: Overview of training curricula in Europe, recognition of commonalties and differences between them and Driving instructors needs	1-2001	CIECA/EFA	Submitted in 2-2001
D2.1: Inventory of drivers training needs and major gaps in the relevant training procedures	1-2001	IfADo/EFA	Submitted in 2-2001
D3.1: Interactive Multimedia Training Tool (4 prototype multimedia boxes in 8 languages)	9-2001	IAT	Submitted in 5-2002
D3.2: User Interface of interactive Multimedia tools	1-2002	IAT	Submitted in 5-2003
D4.1: Driving simulator scenarios and requirements	7-2001	VTI / UPV	Submitted in 7-2001
D4.1: Driving simulator scenarios and requirements (Month 16, submitted in Month 15)	7-2001	UPV	Submitted in 6-2001
D4.2: Low-cost driving simulator prototypes (4)	9-2001	Foerst	Submitted in 3-2003
D4.3: Mean-cost driving simulator prototypes (4)	1-2001	Foerst	Submitted in 3-2003
D4.4: Truck simulator feasibility study (Month 24, submitted in Month 22)	3-2002	VTI	Submitted in 1-2002
D5.1: TRAINER Assessment Criteria and Methodology (due for Month 22, submitted in Month 23)	1-2002	CARA/IfADo	Submitted in 2-2002
D5.2: Normative Driver Behaviour Database	5-2002	CRF/SIEM	Submitted in 5-2003
D6.1: Pilot plans	1-2001	VTI	Submitted in 4-2001
D6.2: Pilot Evaluation	12-2002	CARA	Submitted in 5-2003
D7.1: New driver training curricula, Best practice and design guidelines and Recommendations to authorities	1-2003	CARA	Submitted in 5-2003
D8.1: Cost-Benefit ratio and cost-efficiency of new assessment	3-2003	AUTh	Submitted in 5-2003

Deliverables	Due date	Responsible	Status
tools and procedures. Consortium Exploitation Plans.			
D9.1: Project logo, pamphlets and posters	11-2000	AUTh	Submitted on time
D9.2: Project WWW site with interactive demo	11-2001	SIEM	Submitted in 12-2001
D9.3: Educational videotape	1-2003	AUTh/IAT	Submitted in 5-2003

Table 18: List of deliverables

5 Management and Coordination aspects

5.1 Overview

A document entitled "TRAINER Management and Quality Plan" has been produced early in the project, which defines in detail the following subjects:

- ➔ Management structure, namely definition of responsibilities of administrative and technical project management and project quality control manager.
- ➔ Definition of format for three-monthly reports to be submitted to the coordinator for quality control of project execution.
- ➔ Definition of detailed quality control procedure for project deliverables and or relevant forms.
- ➔ Project communication protocol, namely software, internet, etc.
- ➔ Definition of templates for internal reports (among Consortium Partners) and naming codification.

The following project plenary meetings have been conducted:

Project meeting location	Meeting type	Date
Brussels	Plenary	10-11/4/2000
Valencia	Plenary	15-16/6/2000
Linkoeping	Plenary	14-15/9/2000
Affligem	Plenary	23-24/11/2000
Dortmund	Plenary	1-2/2/2001
Gummersbach	Plenary	16-18/5/2001
Crete	Plenary	12-14/9/2001
Stuttgart	Plenary	29-30/11/2001
Brussels	Plenary	19-20/03/2002
Brno	Plenary	6-7/6/2002
Turin	Plenary	26-27/9/2002
Brussels	Plenary	5-6/12/2002
Valencia	Plenary	2 and 4 /3/2003

Table 19: TRAINER plenary meetings

A cooperation agreement has been agreed between TRAINER and VIRTUAL projects. The representative of University of Regensburg has participated in the Valencia meeting of TRAINER. IfADo has attended a VIRTUAL workshop in May 2000. VIRTUAL has submitted deliverable WP1/T1.5 to TRAINER for comments on August 2000. Comments have been sent back by early October 2000.

The two projects have established a good and close cooperation. The training scenarios to be used for the VR-based training within VIRTUAL have been commonly selected by the two projects. A detailed list of comments on the overall development and test strategy of VIRTUAL has been sent by TRAINER, in order to support the relevant VIRTUAL activities.

Finally, Centrum Dopravniho Vyzkumu of the Czech Republic have expressed their interest to participate in TRAINER as Sponsoring Partners. This has been accepted by the TRAINER Consortium and a relevant agreement is pending to be signed.

5.2 Updated contact list

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Table 20: updated contact list

6. Results and Conclusions

As shown in the previous sections, TRAINER project has achieved its technical objectives. The final impact of TRAINWR, besides the directly exploitable products, are the guidelines and recommendations generated. These contribute to the realization of the fact that a constructive review of the driver training system should take place in order to improve novice drivers' driving behaviour, risk awareness and generally the normal introduction of them in the real traffic.

The guidelines and recommendations generated by TRAINER focus on the following points:

- The way trainers should carry out the training procedure and the main training issues that they should give attention to, during the training.
- The way that trainers should take advantage of the TRAINER tools and integrate them with traditional training.
- The way a training curriculum should be structured and of which content it should be consist, to be sufficient for training.
- The advantages and disadvantages of using new technology driver training procedure, like simulators.
- The required multimedia tools additional content for the training curriculum.
- The training issues that novice drivers show weakness at.
- The driving issues that are not covered by the current training procedure.
- The prerequisites for the TRAINER concept mitigation to various types of professional drivers.
- The vehicle adaptations that should take place in order to improve professional safety and comfort.
- Training measures and curricula recommendations for driver training enhancement.

In general, TRAINER has recommended a series of actions towards research, regarding training and general driver support objectives in order to implement TRAINER project's main purpose, which is to develop a globally accepted system for driver training and assessment using interactive valuation tools and reliable methodologies.

Two sets of guidelines regarding novice drivers have been developed. One of them addresses to driving instructors and consists of guidelines on general training issues (8 guidelines) and of guidelines regarding training with TRAINER tools (17 guidelines,). These guidelines are complemented by the generic training curricula that have been developed for each TRAINER pilot site in addition to each country's traditional curriculum.

The other set of guidelines, regarding vehicle design addresses to manufacturers, and highlights all the issues that should be taken into account for the novice drivers' easier and safer impact with the produced vehicles.

After the TRAINER project effectuation, a long period evaluation of trained drivers with TRAINER tools is recommended to be realized. In this way, the

effect of TRAINER tools in novice drivers will be detected and will enable the further improvement of the TRAINER tools and the overall training procedure.

Conclusively, TRAINER project highlights the need for a further research on training issues regarding several other categories of drivers, such as professional drivers (truck drivers, bus drivers, dangerous goods vehicles' drivers, emergency vehicles' drivers, etc.). The improvement of their training is a very important issue, since, very often, the integrity of many human lives depends on them or is directly influenced by them. Thus, the improvement of training courses may clearly offer some potential solutions to one of the most intense and unwelcome social phenomena, which is the unjustified loss of human life due to accidents caused by improper driving behaviour.

6 Annex 1: Driver training models identified within TRAINER D1.2

When overviewing the descriptions of the training possibilities in the different countries, six different training models can be extracted. It is possible that countries apply more than one model. In that case, a student usually has free choice between the models and chooses the most appropriate one for his personal situation.

Model 1: Theory and practical training at a driving school is compulsory

In this model, all students have to take a minimum number of theory and practical lessons at a driving school. The compulsory number of theory lessons varies from 1,5 up to 54. The compulsory number of practical lessons varies from 8 up to 40. In general, the compulsory and the average number of lessons taken matches.

The majority of the countries described here know this model. In alphabetical order: Algeria, Austria, Bulgaria, Croatia, Denmark, Estonia, Finland, Germany, Hungary, Latvia, Luxembourg, Norway, Portugal and Switzerland.
In France and in Israel only practical training is compulsory.

In Bulgaria, Croatia, Denmark, Germany, Hungary and Portugal, this model is the only way to learn how to drive. In these countries, no other training models exist.

Model 2: Theory and practical training possible at a driving school, without obligations

In this model, a student can learn to drive at a driving school. However, there is no obligation to take a minimum number of theory or practical lessons. The average number of theory lessons taken varies from 5 to 25 hours. The average number of practical lessons varies from 25 to 35 hours.

This model exists in the following countries:
Great Britain, Monaco, the Netherlands, Northern Ireland, the Russian Federation, Spain, Sweden and Tunisia.

In Monaco, the Netherlands and Tunisia, this model is the only way to learn how to drive. In these countries, no other training model exists.

Model 3: Theory and practical training must begin at a driving school, followed by training with a non-professional supervisor

In this model, a student starts his or her theory and practical driver training at a driving school, taking a minimum number of theory and practical lessons. After having completed the minimum number of lessons, the student continues his or her driver training with a non-professional supervisor. The minimum number of lessons

generally corresponds to the minimum number of lessons that are compulsory for students doing their full education in a driving school (model 1).
In most countries that apply this model, both the student and the non-professional supervisor must meet certain conditions, varying from having reached a minimum age up to some form of extra training for the supervisor. In many countries, a special permit for such training is necessary.
In several countries certain restrictions exist for the student training with a non-professional supervisor: speed limitations, prohibition from driving at night, in weekends or with passengers, etc.

This model exists in following countries:
Algeria, Austria, Israel, Luxembourg, Norway and Switzerland.

Model 4: Theory and practical training must begin at a driving school, followed by training with a non-professional supervisor; obligation to report regularly to the driving school

In this model, a student has to start his or her theory and practical driving tuition at a driving school. After having completed a compulsory minimum number of theory and practical lessons, he or she continues the training with a non-professional supervisor. During this second stage, the student has to report regularly to the driving school, sometimes with the non-professional supervisor. The minimum number of lessons generally corresponds to the minimum number of lessons required for students doing their full education at a driving school (model 1).
In most countries both the student and the non-professional supervisor have to meet some conditions, like a minimum age, the possession of a special permit or insurance, etc. to be allowed to train with a non-professional supervisor. In many cases, there are also some restrictions for the student training with a non-professional supervisor, like speed limitations, prohibition from driving at night, in weekends or with passengers, etc.

This model exists in the following countries:
Austria, Estonia and France.

Model 5: Training with a non-professional supervisor, without the involvement of a driving school

In this model, a student can do his or her complete (theory and) practical training with a non-professional supervisor. A driving school is not involved in the training.
In some of the countries using this model, there are however some conditions, which both the student and the non-professional supervisor have to meet: a minimum age, a special permit or insurance, a minimum number of lessons or training kilometres, etc. Often, the non-professional supervisor has to be a relative of the student.

This model exists in the following countries:
Belgium, Finland, Great Britain, Latvia, Northern Ireland, the Russian Federation, Spain and Sweden.

Model 6: Training at a driving school or with a non-professional supervisor, followed by a non-accompanied internship

In this system, a student starts his or her theory and practical driver training at a driving school. There is no obligation to follow a minimum number of theory or practical lessons at the driving school.
After having finished the initial training, the student has to do an internship of a fixed time period, during which he or she is allowed to drive alone.
During this period of internship there are some restrictions, like prohibition from driving at night, with passengers, in weekends, etc.

This model only exists in Belgium.

7 Annex 2: Extracts from D1.1 database of TRAINER

TRAINER database starts with the following introductory screen.

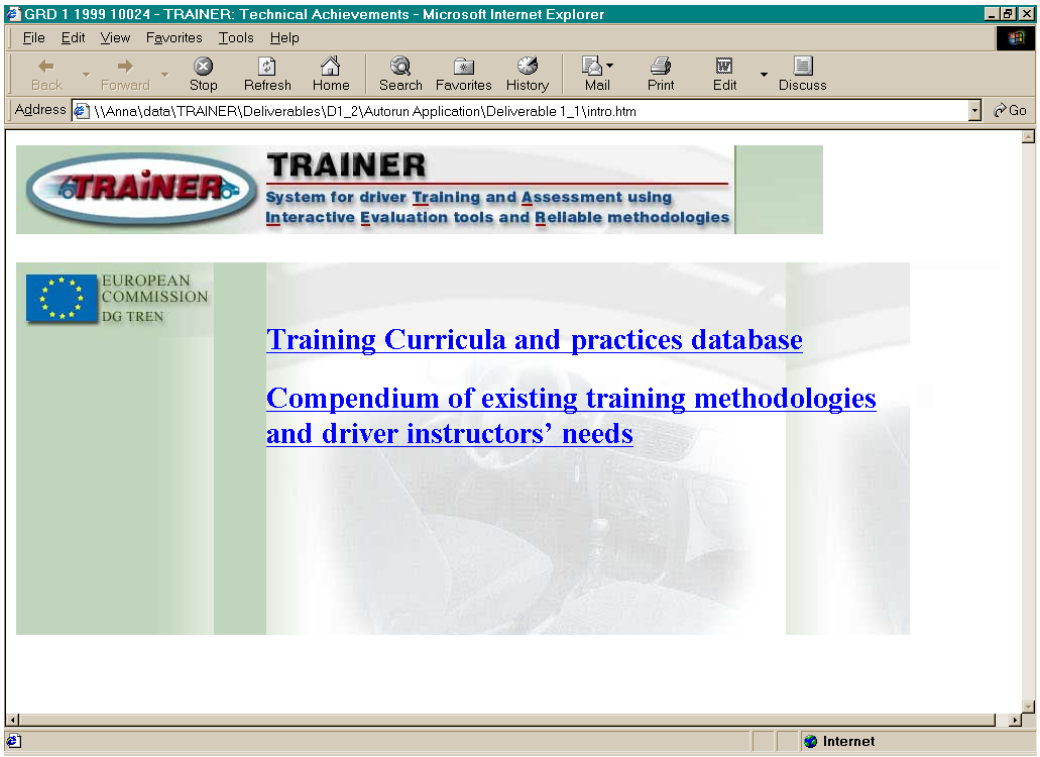


Figure 16: Introductory screen

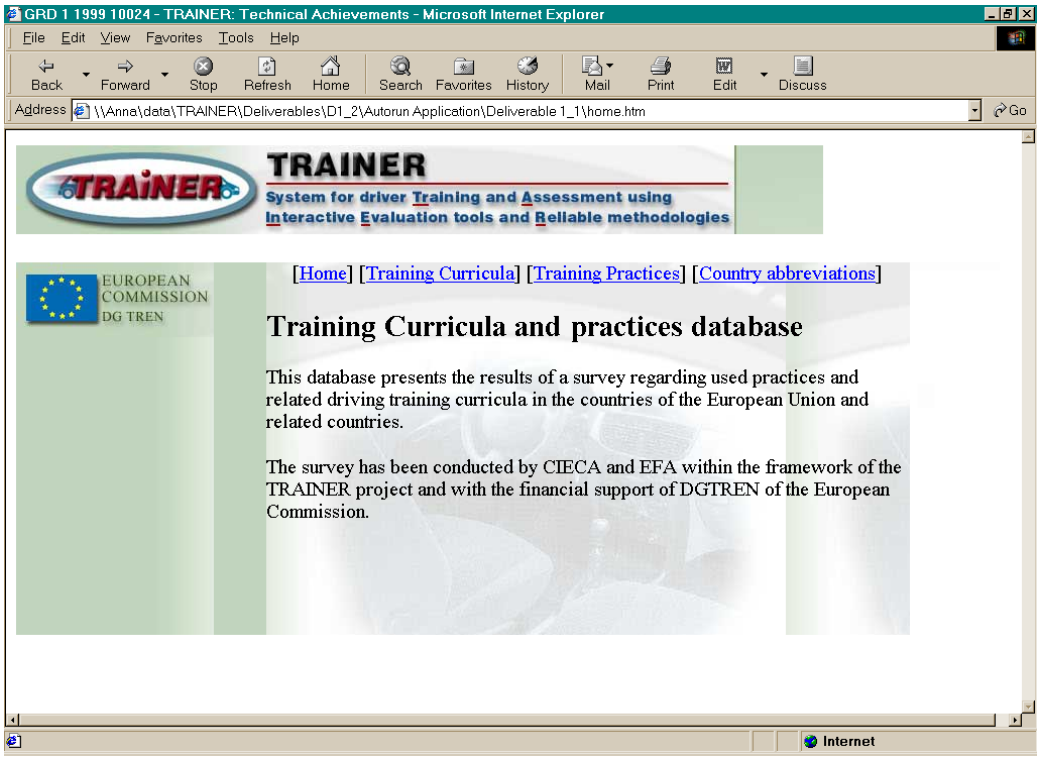


Figure 17: Introductory screen to the training curricula and practices part

The Training Curricula contains information from 24 European countries, as it is described below.

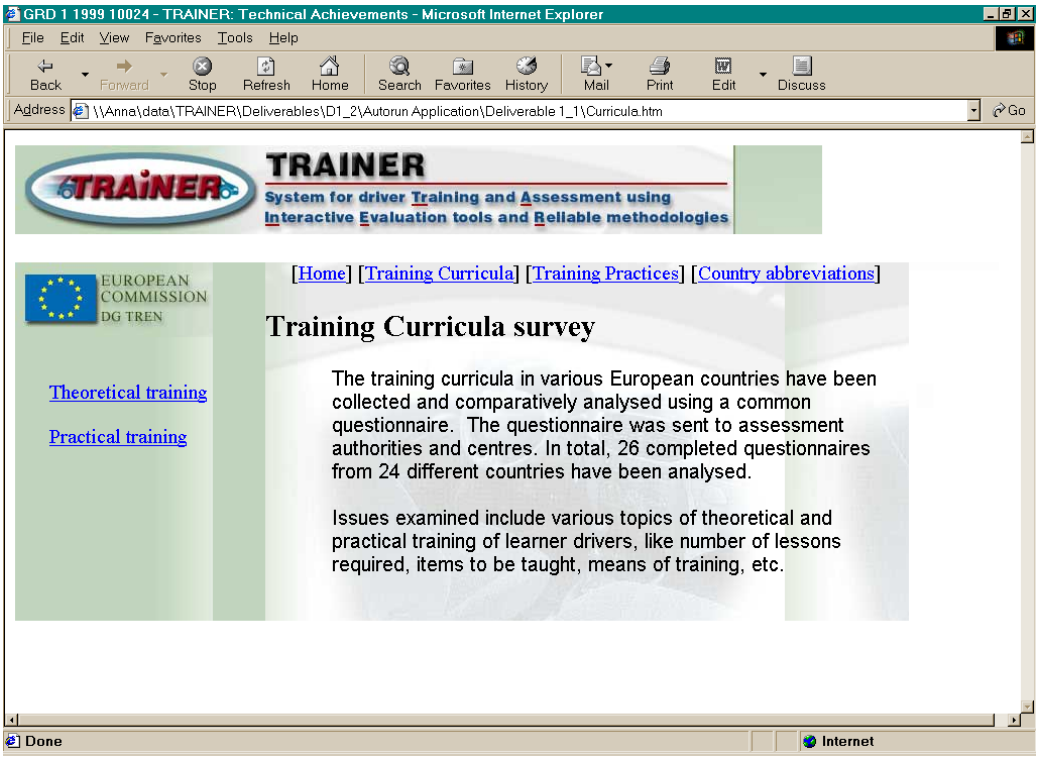


Figure 18: Introductory screen to the training Curricula part

By selecting the theoretical training, the user has access to the subjects of the following list. A relevant list will come up if the user wishes to see information about the practical training.

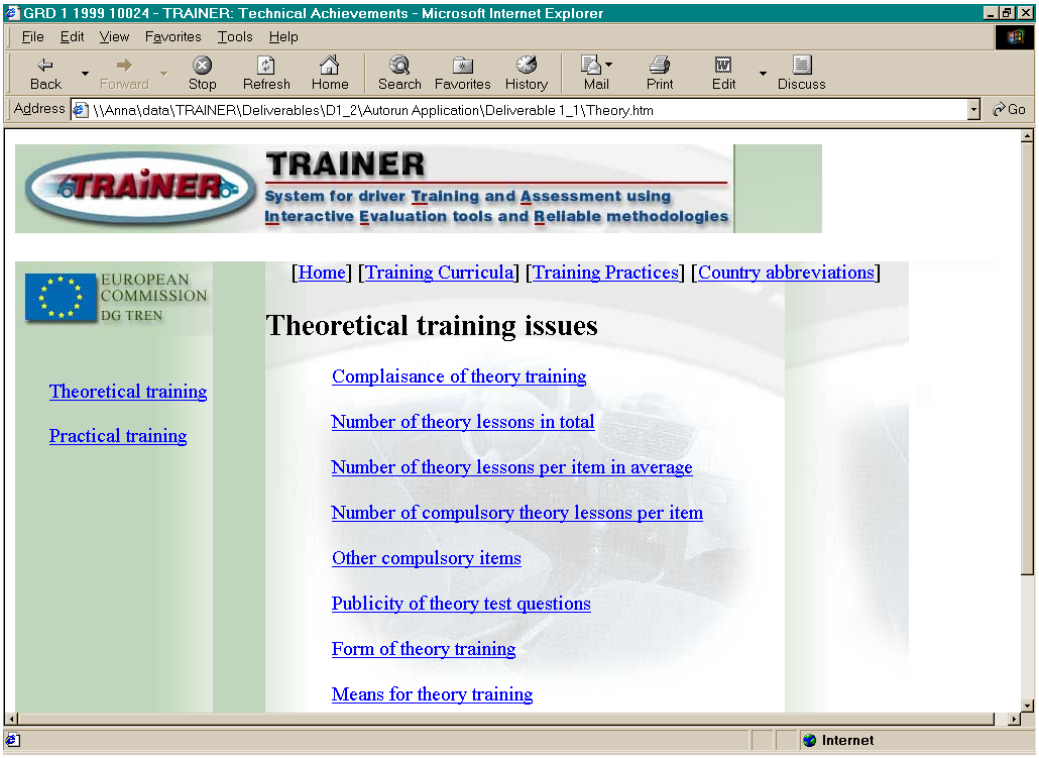


Figure 19: Theoretical training subjects

Similarly, if the user selects the Training practices, the next UI will appear, where he/she can see information about theoretical and practical training:

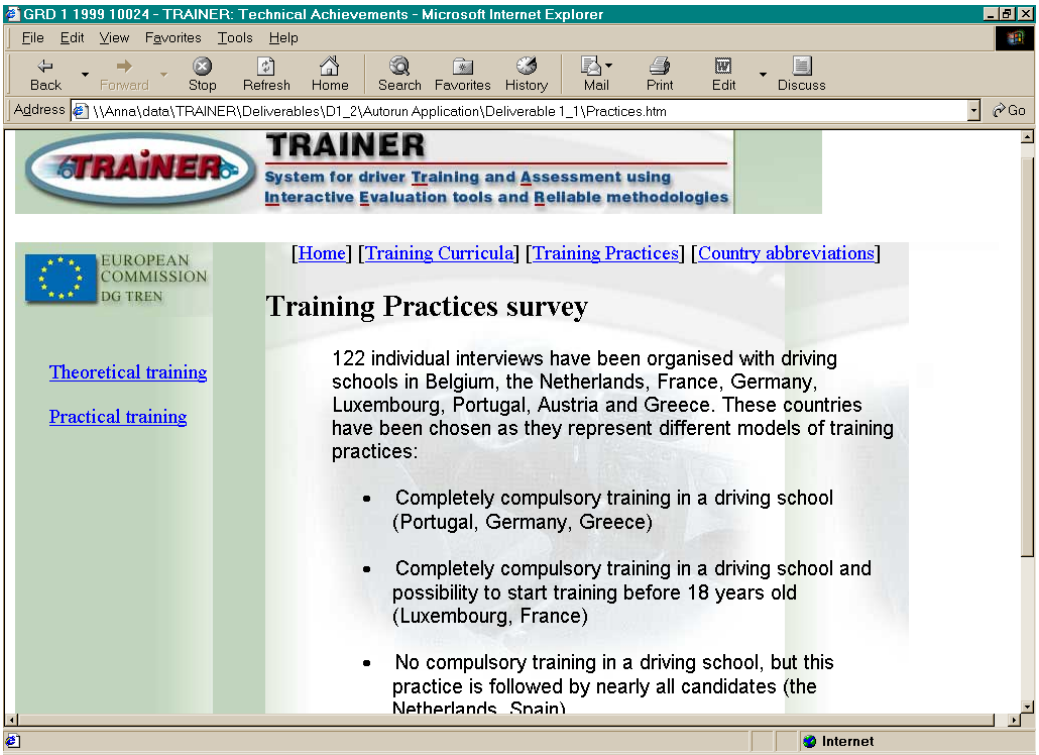


Figure 20: Introductory screen to training practices part

If, for example one selects theoretical training and then ‘Number of trainees in a classroom’, the following information will be given:

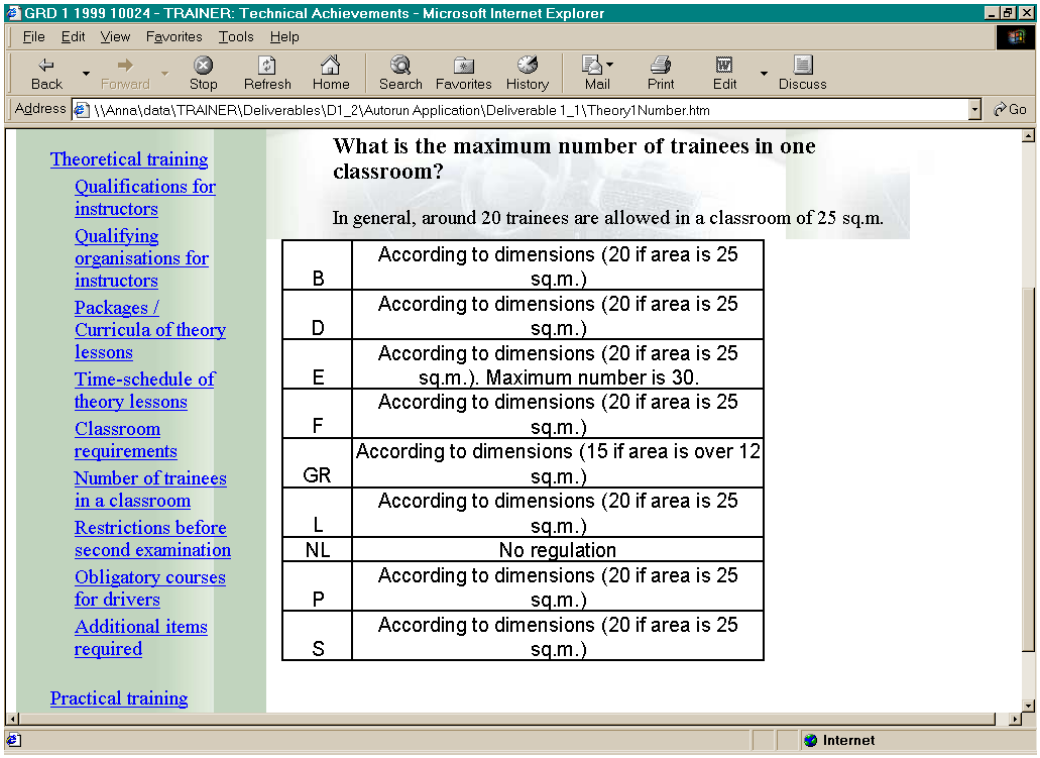


Figure 21: Database information for the subject ‘Number of trainees in a classroom’ for the theoretical training

8 Annex 3: The GADGET hierarchical driver-training model, as adapted by TRAINER

The GADGET-matrix is based on the assumption that the driving task may be described as an hierarchy. The idea of the hierarchical approach is that abilities and preconditions in a higher level influence the demand and preconditions on a lower level. The hierarchy is developed by Keskinen (1996) and shows many similarities with the Michon hierarchy. The most important difference is the addition of a fourth level relating to personal preconditions and ambitions in life in general, which have shown to be of great importance for driving and road safety. The following four levels are described by Keskinen and were later also applied in the EU-project GADGET (Hatakka et al. 1999):

- Goals for life and skills for living.
- Goals and context of driving.
- Mastering traffic situations.
- Vehicle manoeuvring.

The highest level refers to personal motives and tendencies in a broader perspective. This level is based on knowledge that lifestyle, social background, gender, age and other individual preconditions has an influence on attitudes, driving behaviour and accident involvement.

On the next level, the focus is on the goals behind driving and context in which driving is performed. The focus is on why, where, when and with whom driving is carried out. Examples on more detailed aspects are the choice between car or bus, day-time or night-time driving, rush-hours or not, decision to drive under the influence of alcohol, fatigue or stress etc., all in relation to purpose of the trip.
The next level is about mastering driving in traffic situations, which are defined as more limited than driving context above. A driver must be able to adjust his/her driving in accordance with the constant changes in traffic, for example in junctions, when overtaking or when encountering unprotected road users. To be able to identify potential hazards in traffic is also on this level. Driver education and training is traditionally focussing on this level.

		Essential curriculum		
		Knowledge and skills	**Risk-increasing factors**	**Self-evaluation**
Hierarchical levels of behaviour	**Goals for life and skills for living** (general) *this level will further be called 'Behavioural aspects'*	**Knowledge about/ control over how life-goals and personal tendencies affect driving behaviour** • lifestyle/life situation • peer group norms • motives • self-control, other characteristics • personal values ...	**Risky tendencies** • acceptance of risks • self-enhancement through driving • high level of sensation seeking • complying with social pressure • use of alcohol and drugs • values, attitudes towards society...	**Self-evaluation/ awareness of** • personal skills for impulse control • risky tendencies • safety-negative motives • personal risky habits ...
	Driving goals and context (journey-related) *this level refers to the Michon-level 'Strategic tasks' and will further be called this way*	**Knowledge and skills concerning** • effects of journey goals on driving • planning and choosing routes • evaluation of requested driving time • effects of social pressure inside the car • evaluation of necessity of the journey...	**Risks connected with** • driver's condition (mood, BAC, etc.) • purpose of driving • driving environment (rural/urban) • social context and company • additional motives (competitive, etc.) ...	**Self-evaluation/ awareness of** • personal planning skills • typical driving goals • typical risky driving motives ...
	Mastery of traffic situations *this level refers to the Michon-level 'Manoeuvring tasks' and will further be called this way*	**Knowledge and skills concerning** • traffic regulations • observation/selection of signals • anticipation of the development of situations • speed adjustment • communication • driving path • driving order • distance to others/safety margins ...	**Risks caused by** • wrong expectations • risk-increasing driving style (e. g. aggressive) • unsuitable speed adjustment • vulnerable road-users • not obeying regulations/ unpredictable behaviour • information overload • difficult conditions (darkness, etc.) • insufficient automatism or skills...	**Self-evaluation/ awareness of** • strong and weak points of basic traffic skills • personal driving style • personal safety margins • strong and weak points for hazard situations • realistic self-evaluation ...
	Vehicle manoeuvring *this level refers to the Michon-level 'Control task' and will further be called this way*	**Knowledge and skills concerning** • control of direction and position • tyre grip and friction • vehicle properties • physical phenomena ...	**Risks connected with** • insufficient automatism or skills • unsuitable speed adjustment • difficult conditions (low friction, etc.) ...	**Awareness of** • strong and weak points of basic manoeuvring skills • strong and weak points of skills for hazard situations • realistic self-evaluation...

Table 21: The GADGET-matrix (Hatakka et al. 1999)

The bottom level is focusing on the vehicle, its construction and how it is manoeuvred. To know how to start, shift gears and stop the car good enough to be able to use the car in traffic belongs to this level as well as more complex evasive manoeuvres, reducing skids on low friction and understanding the laws of nature. The functioning and benefits of injury preventive systems such as seat belts and airbags also belong here.

A safe driver is, however, not only skilled but also aware of risks and of own abilities and preconditions. In order to cover these different dimensions the matrix includes three dimensions as follows:
- Knowledge and skills
- Risk increasing factors
- Self assessment

The content of the first column describes the knowledge and skills that a driver needs for driving under normal circumstances, that is, on the lower hierarchical levels how to manoeuvre the car, how to drive in traffic and what rules must be followed. On the higher levels the column relates to how trips should be planned and how personal preconditions may influence behaviour and safety.

In the second column about risk increasing factors the focus is on awareness of aspects of traffic and life that can be associated with higher risk. On the basic level it may be worn-out tyres, poor brakes, lack of routine in performing basic manoeuvring etc. Higher in the hierarchy the column refers to risky driving in darkness, on low friction, among unprotected road users, excessive speeding, mental overload, etc. It also relates to dangerous motives and risk increasing aspects of lifestyle and personality.

The third column is about how the driver is assessing his/her own situation on the four levels. It points out the calibration of own skills on the basic levels and awareness of own personal preconditions and tendencies as well as abilities in decision making about trips and in life in general on the upper levels.

9 Annex 4: Summary of findings and conclusions of TRAINER bibliographical survey

9.1 Control tasks

Training the basic vehicle handling skills is a natural feature of driver training. But in order to enable trainees to cope with new technical devices, like ACC or ABS, it is necessary to implement lessons which take these new developments into account. The simulator is a useful device for training the very first steps of vehicle handling. The advantages are not only safety related – trainees could learn these skills without endangering themselves or other road users (like learning with a real car in a fenced off driving-instruction range), but also ecological related: fuel is not consumed, the use of a simulator is absolutely exhaust-free.

Trainees should learn to know or better experience the risk increasing aspects of the tasks, especially underestimation of speed and of TTC, as well the interaction of these two parameters. To enable trainees to evaluate their skills in a realistic way they should have the possibility to compare their estimates with the real outcome. Especially the connection between reaction, braking and total stopping distance should be understood.

9.2 Manoeuvring tasks

Insufficient skills and incomplete automation of manoeuvring skills lead to a greater involvement of novice drivers in accidents. Furthermore, research shows that novice drivers (and for some tasks drivers in general) lack essential perceptual skills. On the one hand they don't use peripheral vision and on the other hand they underestimate the time needed for many manoeuvring tasks, like overtaking, merging, lane changing, reaching an intersection, stopping, turning off. They have problems to estimate the behaviour of other road users as well, i.e. how much time these drivers need to perform the tasks mentioned above. When an unexpected and unusual situation does occur, they do not know how to react adequately. To train these **cognitive skills** it is suggested to use filmed clips, videos or digital media, where the trainee has to detect certain cues, to predict, what could happen and what he/she would do. Trainees should also be given comprehensive feedback whether the task is an estimate or a performance prediction. It is also possible to train this with simulators. The main **advantages of simulators** compared with real cars are that trainees can experience scenarios which are too dangerous to create on the road, and that trainees can train cognitive skills without fully automated manoeuvring skills. Recent developments in software make it possible that drivers in a simulator could behave in very realistic way. Automatic Traffic Generation and Autonomous Driver models reproduce the circumstances in real traffic, and enable the users to repeat and therefore train certain tasks in changing environments, with varying risk, and different road users, with variable behaviour. With these devices it is possible to train anticipating skills, like risk or hazard perception, which are highlighted by recent research as very important for safe driving. Through the combination of opportunity

to practice and obtaining feedback on those skills trainees can come to their own understandings of how cues in traffic and outcome are related. Moreover, trainees can experience the results of their own risky choices. However a **risky driving** behaviour results not only from poor perception, but also from **overestimation** of own skills. In order to increase driving skills without increasing the confidence in these skills the manoeuvring component should not be overemphasised. As some projects and methodologies in Sweden, like 'Pilot' and 'Insight', have shown it could be better to use more demonstrations and exercises in which novice drivers fail in order to develop a **realistic self-evaluation** of their capabilities.

9.3 Strategic tasks

Demonstrations should also be used to convince trainees on following safety instructions (e.g. use of seat belt). Trainees should know or better experience (in a simulator) which harmful influences on driving behaviour factors like stress and mood could have and how drivers can cope with these risk increasing aspects. Techniques like mental practice and group decision could influence the behaviour of novice drivers due to the fact that trainees are forced to make known their own attitudes and reflect them. So trainees are aware of their own conditions and can discuss the influence of their and other road-users' conditions on the interactive task of driving. They should know that certain motives for driving, like competing or showing off have serious effects on driving performance.

9.4 Behavioural aspects

Knowing the relations between driving style on the one hand and personal tendencies, social pressure and lifestyle on the other hand, could enhance the trainees' awareness of their higher risk in accident involvement. Feedback during training, self-assessment tools like questionnaires and scales, discussions with other youngsters about personal experiences and evaluations made by instructors or examiners seem to be appropriate educational methods.

It should be beared in mind that every training of manoeuvring skills (and probably this is as well relevant for cognitive skills like e.g. hazard perception) may result in overconfidence of young drivers. Therefore, training safe driving strategies can only be successful, if driver training covers the whole range of contents, and consequently it should also include motivational and self-evaluative aspects.

10 Annex 5: Summary of findings and conclusions of TRAINER accidents review

In the following the results of the accident analyses are summarised on the basis of the subtasks in the Gadget matrix.

10.1 C Control tasks, operational level

C.1 Control tasks: Knowledge and skills

C.1.4 Steering / lane following
The predominant cause for novice driver's accidents is 'loss of control' during driving. The accidents happened only along the road, not near a junction. Although steering and lane following (be it on a straight or curved road) are required, and perhaps (but this is guessing) factors such as steering with one hand may play a role, the actual cause for losing control is likely to lay on a higher than operational level.

C.1.5 Speed control
In combination with steering performance, speed control is important, simply because high speed, losing control and serious accidents go together. However, the problem of high speed is not mastering of control of speed, but the higher level decision to drive at that speed.

C.2 Control tasks: Risk-increasing factors

C.2.1 Insufficient skills and incompletely automation
As mentioned above, not the skills as such, but the decision for a certain driving speed is important.

C.3 Control tasks: Self-evaluation

C.3.1 Realistic self-evaluation
This is probably the key factor, the idea that a curve can be driven at high speed, resulting in loss of control, reflects a lack of a realistic view on one's own skills, and a lack of experience with the vehicle's behaviour.

C.4 Summary and conclusions

A relatively high involvement in accidents on road segments without junctions, in combination with loss of control as main factor leading to the accident, indicate that control level skills are not correctly *judged*.

10.2 M Manoeuvring tasks

M.1 Manoeuvring tasks related to traffic conditions: Knowledge and skills

M.1.1 Following (distance keeping)
Rear end accidents are the second important accident type for novice drivers in the Belgian accident database (23 %), and the third reason in the Swedish database (15%). Obviously this following behaviour could benefit from training, however, on the basis of accident analysis alone the exact conditions that need training cannot be determined. It is not clear if rear-end accidents origin from failure to estimate distance, from dual task performance while following, or by any other specific cause.

M.1.2 Overtaking
Belgian and Swedish accident data show that in 4% of the cases drivers were overtaking another vehicle at the time of the accident. From the Swedish database it appears not to be an accident typical for the young novice driver, but the skills required for safe overtaking are not to be ignored in training.

M.1.3 Entering and leaving the traffic
Accident data do not reveal an overrepresentation of novice drivers in accidents related to merging into and leaving traffic, although in the Swedish database 5% of all accidents are reported at that location.

M.1.4 Lane changing
Lane change manoeuvres may be important, judging from the 39% of flank accidents in the Belgian database. However, within this accident category, accidents at junctions are included. In the Swedish database overtaking and changing lane are combined, and accidents in this category account for 4% of all novice driver's accidents.

M.1.5 Reacting to other vehicles (cars, bicycles)
In 75 % of the accidents in the Belgian database there were other vehicles involved. Obviously this is all about interacting with other traffic… The Swedish database showed that particular situations, described as "no conflict", are important in novice driver's accidents (compared with accidents of more experienced drivers).

M.1.6 Reacting to pedestrians
In 4 % of the accidents in the Belgian database and 5% in the Swedish database pedestrians were involved. There is however no specific conflict situation with pedestrians that emerges from the accident databases available.

M.1.7 Parking
Relatively less novice drivers than experienced drivers in Sweden are involved in parking accidents. The total amount is 1.4% of all novice driver's accidents

M.2 Manoeuvring tasks related to roadway characteristics: Knowledge and skills

M.2.1 Negotiating intersections, junctions and roundabouts
Accidents at junctions form a large proportion of all accidents(in the Swedish database 45% happened at a junctionwhile less than 2% at a roundabout). Not yielding priority is the second important cause for the accidents, according to the police and to the trainees in Belgium, leaving the cause "unknown" out of consideration.

M.2.3 Negotiating curves
In both the Swedish and Belgian database negotiation of curves is not separated from driving straight on, as both are in the category "no junction". As loss of control is an important factor, and most accidents outside the built-up area happen on secondary roads it is likely that negotiation of curves plays a role when losing control.

M.2.4 Road surface and obstructions (skid control, obstacle avoidance)
There are no indications from (Swedish) accident statistics that these skills are more important for novice than experienced drivers to prevent an accident. Most accidents happened during clear weather.

M.2.5 Turning off
The Swedish data do not reveal an overrepresentation of novice drivers in accidents when performing a turning manoeuvre. 12-15% of the Swedish and 11% of the Belgian novice driver accidents happened during turning. Training of the manoeuvre however should incorporate all that goes with turning, such as potential conflicts with pedestrians, cyclists, and problems with yielding priority.

M.2.6 Turning over
Again the Swedish data do not reveal an overrepresentation of novice drivers in accidents when performing a U-turn. The proportion of accidents is below 2% in Sweden (but in this percentage reversing is also included) and below 1% in Belgium.

M.2.7 Approach/ exit of motorways
No clear accident data on this manoeuvre can be obtained, as accidents related to this manoeuvre are classified as "wrong position in carriageway", "insufficient headway", "late avoidance manoeuvre" and "did not yield priority". The Belgian student drivers mentioned "Changing lane" in 5% of the cases as a manoeuvre that causes problems.

M.2.9 Reacting to traffic signs and traffic lights
This category covers such a wide range of manoeuvres that it is difficult to give useful accident data. Accident-prone behaviour that fits into this category is speeding, red light running, entering a one-way road from the wrong direction, and not stopping at a stop sign. Not yielding and red light running preceded (according to the police) 16% of the novice driver's accidents in Belgium. Unfortunately speeding is not a separate category (see table 19), which makes it difficult to fill this cell of the GADGET matrix with accident data.

M.2.11 Urban driving
On average one in every two accidents happens in the built-up area. However, the Swedish database did not reveal an overrepresentation of novice drivers in accidents on these roads.

M.2.12 Country road driving
The Swedish database revealed that on secondary and lower road categories novice drivers have more accidents, and driving on this type of road may deserve more attention in training.

M.2.13 Motorway driving
Relatively few accidents happen on motorways, and there are no indications that driving on this type of road is leading to much problems for novice drivers.

M.3 Manoeuvring tasks related to the environment: Knowledge and skills

M.3.1 Weather conditions (fog, rain, snow)
The Swedish data show no effect of weather when comparing novice drivers' accidents with more experienced drivers' accidents. The largest proportion of accidents happen during clear weather. In Belgium also most accidents happen during clear weather.

M.3.2 Night driving
The Swedish data indicate that novice drivers have more accidents than experienced drivers during the hours of darkness. Remarkable is the comparison of Swedish with Belgian data. In Sweden, a bit more than 7% of the accidents happen during dusk, whereas in Belgium as much as 35% of novice driver's accidents happen during night driving. In Belgium the "weekend night"-accidents are notorious.

M.4 Manoeuvring tasks: Risk-increasing factors

M.4.1 Insufficient skills and incomplete automation
As mentioned before, loss of control is the major factor leading to accidents. Evidently this is an indication that either skills are not completely acquired, or that novice drivers cannot assess their capabilities correctly.

M.4.2 Information overload
Although information overload may play a role in novice driver's accidents, most accidents happen in non-complex environments (driving straight on, no junction present).

M.4.3 Insufficient anticipating skills and wrong expectations
See M.4.1

M.4.4 Risky driving style
See M.4.1

M.5 Manoeuvring tasks: Self-evaluation

M.5.1 Realistic self-evaluation
See M.4.1

M.6 Summary and conclusion

Manoeuvre level related accidents, in which novice drivers are strongly represented, includes skills as distance keeping and negotiating intersections. During adverse weather conditions there is not a higher involvement in accidents of novice drivers than of experienced drivers. On the basis of accident analysis, motorway and urban driving are not problematic for novice drivers, but driving on secondary roads may be. 'Loss of control' is most frequently indicated as factor preceding the accident, which is an indication that either skills are not sufficiently crystallised, or of serious lapses in assessment of one's own skills.

10.3 S. Strategic tasks

S.1 Strategic tasks: Knowledge and skills

S.1.1 Determination of trip goals, route and modal choice (evaluation of the costs and risks involved)

S.1.2 Preparation and technical check of the vehicle, bearing road safety in mind
The technical state of the vehicle is seldom a cause of accidents. Novice driver's behaviour in terms of checking the vehicle does not become apparent from accident analysis.

S.1.3 Safety issues (loading, using safety belt etc.)
Of the 525 Belgian students who followed an one day course, 8 had received fines for not wearing the seat belt (two of them two fines or more). These are self-reported data, but the two recidivists may be representatives of a small group of young drivers that continue to neglect to follow safety guidelines, such as wearing safety belts.

S.1.4 Maintenance tasks (routine car serving, periodic inspection and servicing, repairing car subsystems)
See S.1.2

S.2 Strategic tasks: Risk increasing factors

S.2.1 Drivers condition (stress, mood, fatigue)
In 5% of the novice driver's accidents the Belgian police officer judged that the driver was ill or fatigued. This high proportion makes it an important subject to be included in driver training.

S.4 Summary and conclusions
The main conclusion that can be drawn on the basis of accident data, and with respect to strategic tasks, is that awareness of the effects of an impaired driver state on performance is an important issue for driver training. An impaired driver state as a result of fatigue, but also as result of alcohol and other drugs (see above), are important topics to focus on.

10.4 B Behavioural aspects

B.1 Behavioural aspects: Knowledge and skills

B.1.3 Knowledge about the influence of peers
Very often (67%) the novice driver was the only one present in the car when he or she got an accident (Belgian data). Causal relations, however, in other conditions where more people were in the car cannot be determined on the basis of accident data

B.2 Behavioural aspects: Risk increasing factors

B.2.2 Consequences of social pressure, use of alcohol and drugs
The Belgian data showed that in 4.3% of the accidents an alcohol test gave a positive result, while in 3.7% the driver was evidently drunk. This means that actual use of alcohol may even be higher. In 0.2 % of the accidents the driver was under the influence of drugs.

B.4 Summary and conclusions
It is difficult to draw conclusions about the Behavioural aspects level on the basis of accident analysis. Accident analysis can only reveal indirect cues for these aspects, such as whether other passengers were present, and if the driver had used alcohol or drugs. From accident analysis it turns out that the effects of alcohol and other drugs is a subject that should receive (more) attention in training.

11 Annex 6: Major findings and suggested gaps according to the TRAINER international workshop

1. **Driver state** (i.e. fatigue, alcohol) related **scenarios** are not adequate for training in the simulator, as young drivers are not convinced by demos, unless they experience them.

   To solve this problem in USA an experiment has been performed, where novice drivers were allowed to drink one glass of alcohol, under medical supervision. Then they drove a simulator and were exposed to traffic risks. It seems that this experience influenced them, as during a year of driving after it, they did not combine driving and drinking (reported through self evaluation and absence of accident data).

   The implication for TRAINER would be to present theoretical data on driver's state effect using the multimedia tool and to consider in the simulators training curricula drink and drive session.

2. All **driving simulators** (even the most advanced research ones) **are good for training on how to avoid dangerous situations but not on how to handle them**. Simulator technical limitations in low speed manoeuvring would not allow such tools to be used for teaching for example obstacle avoidance manoeuvres.

   The implication for TRAINER is to avoid implementing emergency negotiation scenarios and hypothesise that an accident has occurred in any case that the driver is involved in a high risk situation (not allow avoidance manoeuvres to be simulated and undertaken).

3. In USA driving **simulators** are **used** also **to recognise the driver's driving style and even to influence/change it**. Algorithms on driver style extraction from combined simulator and real car data exist but are not commercially available.

   TRAINER Consortium will undertake further contact with Carnegie Mellon Institute in USA to get more information on this subject.

4. The **simulator** should not be used for a complete driver training but **only for specific tasks**, in order to avoid learning and automising skills in an artificial environment.

   The implication for TRAINER is to devise specific simulator scenarios and integrate them into the training curricula, combining them with actual car driving in between.

5. **Car control** would be interesting to be exercised also using the simulator, especially **in high traffic density** (where actual driving, without good control skills, could pause accident danger or influence the traffic flow).

The implication for TRAINER is to add one or more high traffic density scenarios in its control scenarios group.

6. **Different countries** have **different lane markings and** sometimes even **differences in traffic signs**. One further example of such problems is, the different law on using fog lights between neighbouring countries, such as Belgium, France and the Netherlands.

   The implication for TRAINER is not to restrict the tool and simulator s/w translation to only the language, but also replace some videos, pictures and even surrounding traffic participants behaviours in accordance to national practices.

7. During actual training, **some trainees go too slowly and avoid overtaking**. That is even more evident during their on-road evaluation. The simulator should allow them to expose themselves in higher speeds.

   The implication for TRAINER is to devise some scenarios were the trainee is requested to reach and maintain a certain speed (i.e. 30, 50, 70, 90 km/h) and to include into the evaluation criteria one for the trainees mean speed (should be above a certain minimum).

8. The **marketing of TRAINER tools** should take into account different business models (i.e. leasing, pay per time of use, pay per client) and not only purchase schemes. Also economies of scale should be taken into consideration. Anyway, even today a relevant market seems to exist, since only one producer (FAROS) stated to have sold 400-500 driving simulators so far in UK and France (mainly).

   The implication for TRAINER is to consider different business models in its marketing strategy.

9. The idea of **part-task training simulators** was presented, where different simulators are used to train different driving functions and/or tasks.

   The implication for TRAINER is to follow modular design, considering that different simulator versions might be used for training different tasks.

10. The issue of **simulator motion sickness** was discussed. Interesting data seem to exist from USA (for further details contact gmeyer@dtsi.org). Such motion sickness is more often met in women and elderly (over 50) people. However, sometimes it is more related to simulator operators errors (inappropriate scenarios and unnatural situations) than to the simulator technical capabilities.

    The implication to TRAINER is to extensively test an early simulator prototype against motion sickness, before developing the final prototype (both static and dynamic).

11. A **driving simulator developed by a Dutch Consortium, with the cooperation of ANWB,** was presented. The first prototype will be installed within two weeks in a driving school and will be tested for six months. It is a static one, consisting of three beamers and half a VW. The relevant project is called INTRASIM

(Intelligent Training Simulation). 55 different scenarios are supported and the aimed price is around 15 kEuro.

12. Driving instructors in the discussion panel and simulator providers agreed that **the trainer education to use a simulator** is today between 0,5 to 4 hours, depending upon simulator complexity but also trainers knowledge on PC operation (Windows, etc.)

    The implication for TRAINER is to consider producing a good manual both for the multimedia s/w and the simulators and devise a training procedure for them.

13. The current **price for using a simulator in a driving school** is around the standard pon-road training hour (±10%). In many cases the trainees use the simulator alone and ask help from the trainer, if needed. Thus, one trainer can oversee more trainees, if more than one simulators exist. The ratio of one instructor per 8-12 trainees had been recommended both for the multimedia tool and the simulator and an organised training centre approach was suggested.

    The implication for TRAINER is to put emphasis on the developed database for automatic storage of trainee data, to allow trainers to evaluate trainees behaviour after the training session automatically and thus support one trainer in instructinge more than one trainees simultaneously.

14. It has been underlined that more than the creation of adequate scenarios it would be interesting to **develop an open s/w architecture, where the trainer may add/ change scenarios, videos or tests**.

    The implication for TRAINER is to consider better the s/w architecture of the multimedia and the simulator s/w and evaluate the feasibility of supporting such a functionality.

15. It has been suggested that **the involvement of insurance companies and ministries** should be targeted, in order to secure additional direct or indirect funding for the market introduction of such aids. It was proposed to offer to driving schools that are equipped with such tools a special status.

    The implication for TRAINER is to plan further contacts with insurance companies and ministries and try to propose legal/insurance schemes that would provide further incentives to driving schools to use such tools.

The suggestions of the discussion groups were matched to the initial scenario selection by TRAINER Consortium. In the following Table, the TRAINER Consortium initial proposals are denoted by red crosses and the round table proposals by ticks.

	Theory	Multimedia	Simulator	Practical
VEHICLE CONTROL TASKS				
Knowledge and skills				
Starting			✓×	✓
Shifting gears	✓		✓	✓
Accelerating/ decelerating			✓	✓
Steering/ lane following			✓	✓
Speed control		×	✓×	✓
Braking/ stopping		×	✓×	✓
Use of new cars control aids (ABS, ACC, etc)		×	✓×	
Using the dashboard		✓		
Risk increasing factors				
Insufficient skills and incomplete automation		×	×	
Self-evaluation				
Realistic self-evaluation		×	×	
MANOEUVRING TASKS				
Knowledge and skills				
Following		×	✓×	✓
Overtaking		✓×	✓×	✓
Entering and leaving the traffic			✓	✓
Tailgating			✓×	
Lane changing		✓×	✓×	✓
Scanning the road (eye cues)	✓	✓×	✓×	
Reacting to other vehicles	✓	×	✓×	✓
Reacting to pedestrians	✓	✓×	✓×	✓
Parking	✓			✓
Negotiating intersections		✓×	✓×	✓
Negotiating hills/slopes			×	✓
Negotiating curves		✓	✓×	✓
Road surface			✓×	✓
Approach/ exit of motorways			✓×	
Railroad crossings, bridges, tunnels	✓			
Reacting to traffic signs and traffic lights	✓	✓	✓×	✓
Reacting to direction signs and in-car devices	✓		×	✓
Emergency break		×	✓×	
Obstacle avoidance technique			×	
Urban driving		✓	✓×	✓
Rural driving			×	✓
Convoy driving			×	
Motorway driving			✓×	
Weather conditions (fog, rain, snow)	✓	✓×	✓×	
Night driving	✓		✓×	
Risk increasing factors				
Insufficient skills and incompletely automation		✓×	✓×	
Information overload		✓×	×	
Insufficient anticipating skills and wrong expectations		✓×	✓×	
Risky driving style		✓	✓×	
Self-evaluation				

	Theory	Multimedia	Simulator	Practical
Realistic self-evaluation		✓✗	✓✗	
Awareness of personal driving style	✓		✓✗	
STRATEGIC TASKS				
Knowledge and skills				
Determination of trip goals, route and modal choice		✗	✗	
Preparation and technical check	✓	✓		
Safety issues	✓	✓✗		
Maintenance tasks		✓		
Economic driving	✓	✓	✗	
Risk-increasing factors				
Driver's condition (stress, mood, fatigue)	✓	✗	✓✗	
Motives for driving				
Self-evaluation				
Awareness of personal planning skills				
Awareness of typical driving goals and risky driving motives				
BEHAVIOURAL ASPECTS				
Knowledge and skills				
Knowing about the general relations between lifestyle/age/gender and driving style				
Knowing the influence of personal values and social background				
Knowing about the influence of passengers			✓✗	
International legislation				
First aid			✓	
Safety belts			✓✗	
Alcohol consumption, drugs, fatigue	✓	✗	✓✗	
Risk-increasing factors				
High level of sensation seeking		✗	✗	
Consequences of social pressure, use of alcohol and drugs		✗	✗	
Self-evaluation				
Awareness of own personal tendencies (risky habits, safety-negative motives)				

Table 22: Proposals of TRAINER consortium and experts for the use of tools for particular tasks

12 Annex 7: Final conclusions on training gaps and inefficiencies per driving task level

12.1 General conclusion

Taken the results of the previous chapters together the main conclusion seems to be that future driver training should take into account or intensify the training of perceptual and cognitive skills, i.e. scanning skills, and hazard detection. With regard to the GADGET matrix the driving task should be understood as a task involving also decisional and motivational aspects. That these higher level (i.e. strategic and behavioural) aspects play an important role in the involvement of novice drivers in accidents is clearly stated by recent research literature as well as by those experts participating in the TRAINER workshop: Novice drivers can have superior manoeuvring skills and still have many crashes. Teaching scanning and anticipating as well as self-evaluation skills appear to be promising ways to reduce accident rates with novice drivers.

12.2 Conclusions: Control tasks

Training basic vehicle handling skills is a natural feature of driver training. As stated by the experts, the simulator is a useful device for training the very first steps of vehicle handling. The advantages are not only safety related – trainees could learn these skills without endangering themselves or other road users (like learning with a real car in a fenced off driving-instruction range), but also related to ecological and economical issues: fuel is not consumed and the use of a simulator is absolutely exhaust-free. As well, the simulator offers the possibility to enable trainees to cope with new technical devices, like ACC or ABS. Trainees should be aware that they might adapt their behaviour with these car control aids. It was also proposed on the workshop that trainees should experience different simulated car types (size, front vs. rear wheel etc.), because trainees may have some difficulties to transfer their skills trained usually in one specific driving instructor's car to those cars used after training.
Due to the opportunity to give feedback about task performance in the simulator, trainees could experience risk increasing aspects of the tasks, especially underestimation of speed and of TTC, as well as the interaction of these two parameters. Trainees can evaluate their skills in a realistic way by comparing their estimates with the real outcome. As literature highlights, drivers have to know how speed influences certain parameters of visual perception, which are important prerequisites for a safe performance of all manoeuvring tasks. The connection between reaction, braking and total stopping distance should be understood by the trainees. These important issues could also be mediated by multimedia PC devices, as the analysed tools show.

As the accident analysis indicates, the predominant cause for novice drivers' accidents is loss of control during driving. Most accidents happened along straight roads in good weather conditions. That young people fail in these simple driving tasks may result from a shift of attention to other tasks not related to the driving task, i.e.

listening to music or to passengers, making a phone call etc., and/or from the overestimation of the own driving skills, and/or simply from the decision to drive very fast. Training of realistic self-evaluation and mediating knowledge about risk-increasing factors should be increased in training curricula.

12.3 Conclusions: Manoeuvring tasks

Various sources in the literature emphasise the fact that learning manoeuvring skills does not contribute to safe driving and reduction of accident rates of novices drivers. Literature, as well as experts, suggest that scanning and anticipating skills play a more important role in safe driving. Therefore training of particular manoeuvring skills should also include training of perceptual skills relevant for the particular tasks, e.g. for a safe turning manoeuvre drivers have to scan the intersection for certain cues, which enable drivers to anticipate the behaviour of other road users and to detect possible hazards. Furthermore, novices and drivers in general seem to underestimate the time needed for many manoeuvring tasks, like overtaking, merging, lane changing, etc. To train these cognitive skills it is suggested to use filmed clips, videos, digital media or the simulator, where the trainees have to detect certain cues and/or predict, what could happen and what they would do. This could be done with multimedia tools and with simulators as well. Performance of trainees can be monitored and evaluated in a more objective manner than in real car. In addition, both devices should give feedback about performance, in order to enable trainees to acquire knowledge and experience.

Another main advantage of simulators, compared with real cars, is that trainees can experience scenarios which are too dangerous to create on the road, and that trainees can train cognitive skills without fully automated manoeuvring skills. Attempts to teach trainees safe-driving strategies during training often failed, probably because the information processing capacity of novice drivers is already overloaded by vehicle control and interacting with other traffic participants: Trainees have to make conscious decisions for every move and every action they take, so they are not able to use improvements of defensive or risk minimising strategies.

Recent developments in software make it possible that drivers in a simulator could behave in very realistic way. Automatic Traffic Generation and Autonomous Driver models reproduce the circumstances in real traffic, and enable the users to repeat and therefore train certain tasks in changing environments with varying risk and different road users with variable behaviour. The influence of distractors (in-car: mobile phone, driver support systems, out of car: ambulance horn) on attention and behaviour to cope with them could also be highlighted using simulators without real risk. Through the combination of opportunity to practice and obtaining feedback on those skills trainees can come to their own understandings of how cues in traffic and outcome are related. As well trainees can experience the results of their own risky choices.

The use of PC-multimedia tools offers the advantage that training and learning can be self-paced, both regarding learning of certain tasks and regarding the moment of learning due to the fact that especially young people in general have PC access. Besides, motivation to learn is enhanced: Young people are attracted by multimedia

applications, they enjoy learning using them, they are more instructive and realistic than books.

For all manoeuvring tasks it is important to state that simulators should be used only for a limited time. Trainees should not learn and automatise skills in an artificial environment. For that reason, simulator training should be preceded or followed by real car training sessions. The training curricula should combine specific simulator scenarios with actual car driving.

However risky driving behaviour results not only from poor perception, but also from overestimation of own skills. In order to increase driving skills without increasing the confidence in these skills the manoeuvring component should not be overemphasised. As some projects and methodologies in Sweden, like 'Pilot' and 'Insight', have shown it could be better to use more demonstrations and exercises in which novice drivers fail in order to develop a realistic self-evaluation of their capabilities. Participants of the workshop suggested that in post-training discussion groups trainees could have an opportunity of understanding their errors, gaining expertise by errors of other trainees and enhancing self-awareness.

12.4 Conclusions: Strategic tasks

The strategical level defines the general planning stage of a trip. The goals of a journey as well as the motives and the personal conditions have an influence on actual driving task performance. So driver training should not be restricted to vehicle control and manoeuvring skills. Novice drivers should understand safety-negative consequences of certain motivations for driving (e.g. competing, showing off, sensation seeking) on actual driving performance. They should also know, or better experience, that factors like stress and mood could influence driving behaviour in a harmful way and they should learn how to cope with these risk increasing aspects. The knowledge about theses issues can be mediated by multimedia tools showing videos and animations. Techniques, like mental practice and group decision, could influence the behaviour of novice drivers due to the fact that trainees are forced to explain their own attitudes and to reflect them. The use of self-evaluation techniques is proposed, in order to enable trainees to be aware of their own conditions and to discuss the influence of their and other road-users' conditions on the interactive task of driving. The main problem is to motivate trainees to think and to discuss about their typical driving goals and risky driving motives, because young drivers estimate their own probability of being involved in an accident as lower than the risk of other young drivers, as well as of other drivers on the whole.

12.5 Conclusions: Behavioural aspects

Many authors of road safety literature emphasise, that it is not crucial for safety how skilled a driver is, but to what extent drivers use their skill in driving safely. There are certain attributes of young people which influence and/or cause their involvement in accidents. Trainees should learn that certain factors as lifestyle, social background, gender, age and other individual preconditions have an influence on attitudes, driving behaviour and accident involvement. Young drivers often have risky habits (e.g.

testing limits of own skill), safety-negative motives (like competing or pleasure), and are prone to social pressure by peers (use of alcohol and drugs etc.). Exercises should be developed to make trainees aware that assessment of their own abilities to negotiate critical situations may be false, especially in the beginning.

Driver education has to make them realise their own personal tendencies (risky habits, safety-negative motives). Proposals for appropriate educational methods derived from the literature are feedback during training, self assessment tools like questionnaires and scales, discussion with other youngsters about personal experiences and attitudes, and evaluations made by instructors or examiners. The training strategy 'Insight' in Sweden shows, that demonstrations and discussion could help trainees to realise their endangering.

Finally, it should be kept in mind that every training of manoeuvring skills (and probably this is as well relevant for cognitive skills like e.g. hazard perception) may result in overconfidence of young drivers. Therefore training safe driving strategies can only be successful if driver training covers the whole range of proposed contents and therefore should also include motivational and self-evaluative aspects.

13 Annex 8: Screenshots from the TRAINER MMT

Figure 22: Start screen with language selection

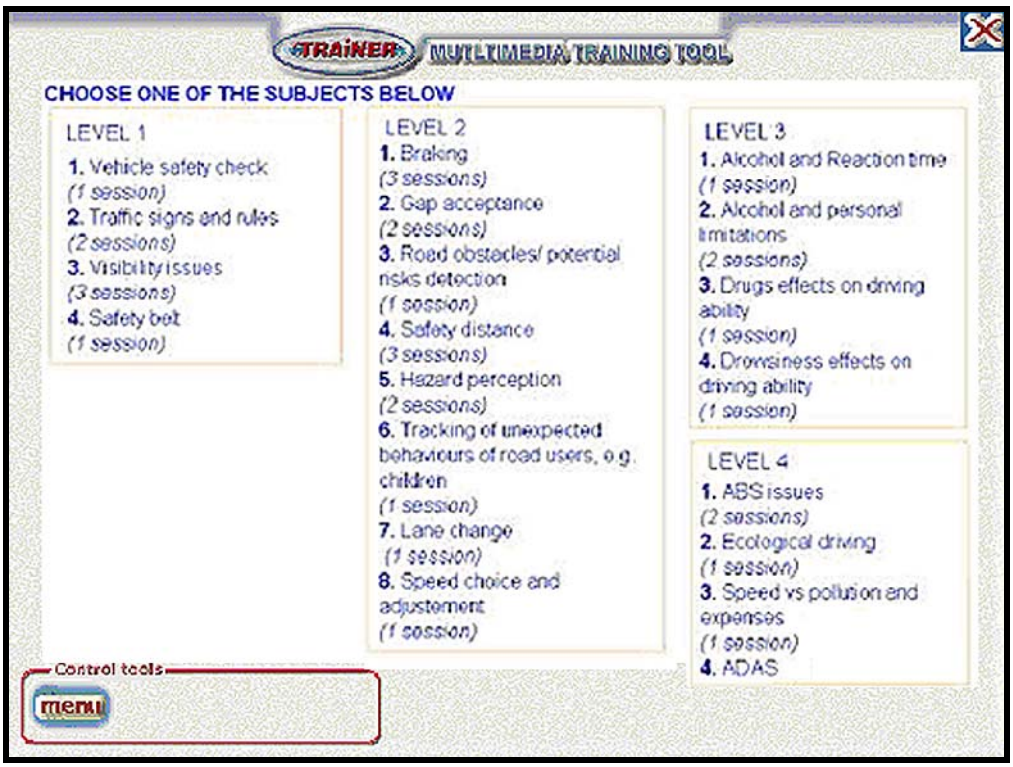


Figure 23: Session selection screen

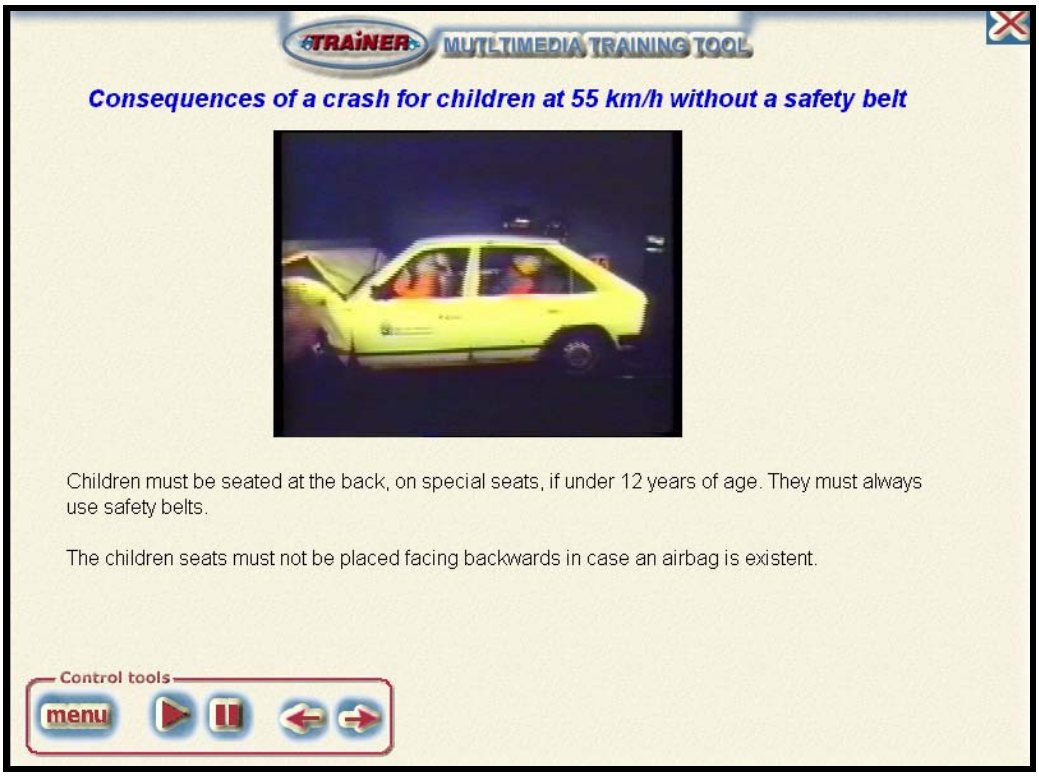


Figure 24: Video-clips allowing theoretical but more vivid experience of traffic hazards

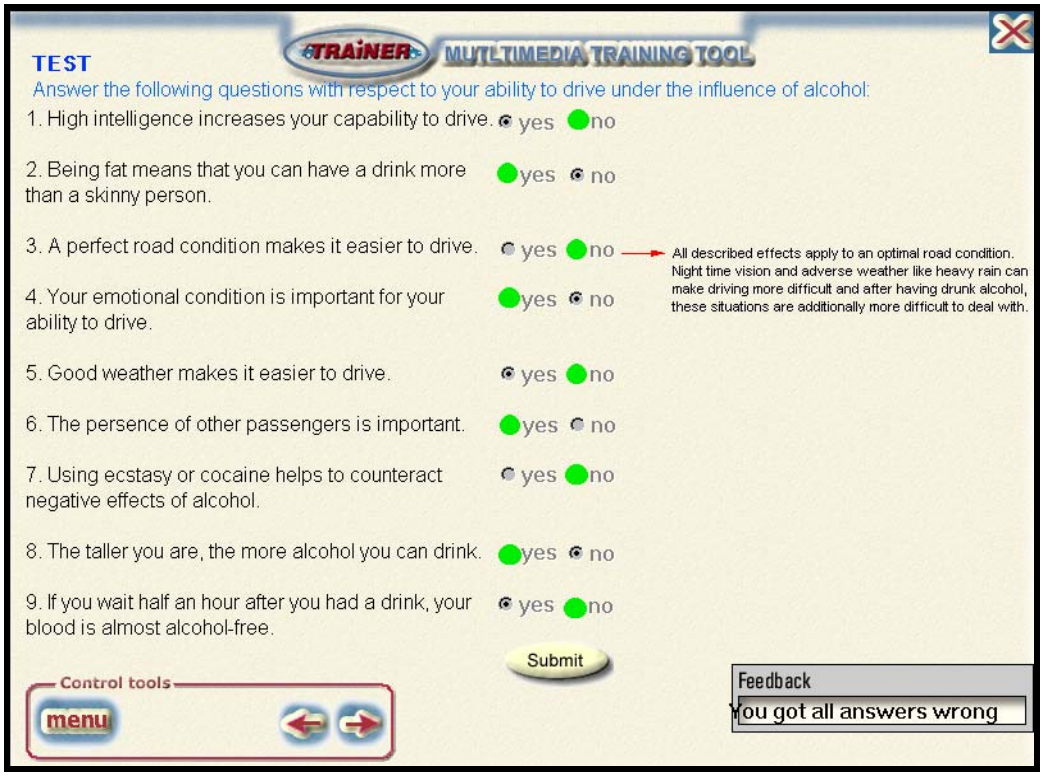


Figure 25: Example for direct assessment of the user's performance

14 Annex 9: TRAINER new driver training curricula examples

FINAL GREEK THEORITICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
1	Acquaintance with the car (car instruments).
2	Acquaintance with the car. Traffic signs, traffic lights, road signs, road crossing, priorities, etc.
3	Speed limits, safe headway, braking/stopping distance, vehicle positioning on the road.
4	Stop and parking on the road (traffic signs). Oncoming traffic. Overtaking. Driving in curves.
5	Handling other road participants. Handling road maps and definition of road. Traffic signs in Highway-Motorway. Highway driving. Preparation of driver for longer trips.
	MMT block 1: Basic control. + MMT block 2: Manoeuvring and safety (40 minutes minimum-no maximum limit). **Block 1** - **Car safety check.** - **Traffic lights.** - **Dirty windshield.** - **Dirty headlights.** - **Learning the traffic signs.** - **Foreign signs.** - **Safety belt use.** - ***Lateral visibility.*** - ***First aid in accidents.*** **Block 2** - **Brake / Crash at straight road, high friction.** - **Brake / Crash at straight road, low friction.** - **Brake at curved road, for low friction.** - **Relation of speed to stopping distance under different road conditions.** - **Detection of road-side dangers.** - **Unpredictable behaviour of children.** - **Gap acceptance.** - **Gap acceptance, lorries.** - **Car following situation on a country road.** - **Multi-vehicle platoon driving.** - **2-second rule explanation.** - **2-second rule following.** - **Car following.** - **Roadworks visibility, safe merging.** - ***Give way and parking.*** - ***Aquaplaning-snow-ice.*** - ***Roundabouts.***
	Repetition of specific scenarios in case of trainees' weakness.

FINAL GREEK THEORITICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
6	Driving under reduced visibility. Driving under reduced friction. Driving on rural roads. Fatigue and hypo vigilance.
7	Behaviour in case of an accident. Car insurance.
8	Car maintenance. Active and passive safety. Economy driving. Emergency situations (car malfunction).
	MMT block 3: Personal behaviour. + MMT block 4: Special driving systems ***(no maximum limit).*** **Block 3** - **Response under influence of alcohol.** - **BAC.** - **Questions about alcohol.** - **Effects of drugs, and combination with alcohol.** - **Fatifue.** **Block 4** - **Stopping distance with and without ABS.** - **ABS.** - **ADAS.** - **Economical driving.** - **Ecological driving.**
	Repetition of specific scenarios in case of trainees' weakness.
9	Car documents. Driving license categories. Penalties. Mechanical issues of cars. Special rules for facilitation the transportation of people with special needs.
10	Repetition.
11	Repetition.
12	Repetition.
13	Repetition.

Table 23: Finally proposed Greek TRAINER theoretical driver training curriculum.

FINAL GREEK PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
	Simulator, block 0: Acquaintance with the simulator. **Simulator, block 1: Basic control.** **Block 1** - **Traffic rules.** - **Start and gear shift straight on.** - **Negotiating a curve.** - **Reaction time and stopping distance during normal driving.** - **Reaction time and stopping distance applying brake alertness.** - ***First aid in accidents.***
	Repetition of specific scenarios in case of trainees' weakness.
1	Acquaintance with the car. Driving in easy conditions.
2	Driving towards a city peripheral road.
	Simulator, block 2: Manoeuvring and safety (divided attention). **Simulator, block 3: Manoeuvring and safety (hazard perception).** **Block 2** - **Following situation on a country road.** - **Following situation on a country road, headway as a consequence of a car behind.** - **Speed adaptation when turning.** - **Overtaking manoeuvres-learning sequence.** - **Overtaking manoeuvres-higher risk.** - **Overtaking manoeuvres-varying the risk.** - **Overtaking manoeuvres-darkness.** - ***Give way, parking and turning.*** - ***Defensive driving.*** **Block 3** - **Search strategy.** - **Gap acceptance (for turning left).** - **Left turn at light regulated junction.** - **Left turn at light regulated junction with oncoming car.** - **Parked car with cue for hazard perception.** - **Parked car without cue for hazard perception.** - **Pedestrians crossing in a junction when dark and rainy.** - ***Defensive driving.***
	Repetition of specific scenarios in case of trainees' weakness.
3	Driving in urban road.
4	Driving in urban road. Reverse driving.
5	Driving in urban road. Reverse driving..
6	Parking in the right side. Reverse driving.
7	Parking in the left side. Reverse driving.
	Simulator, block 4: Particular situations with higher risk. **Simulator, block 5: Particular situations: new technology-personality aspects.**

FINAL GREEK PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
	Block 4 - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influence of dangerous motives on driving.** - ***Air loose from tires.*** **Block 5** - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influences of dangerous motives on driving.**
	Repetition of specific scenarios in case of trainees' weakness.
8	Parking. Reverse driving.
9	Repetition.
10	Repetition.

Table 24: Finally proposed Greek TRAINER practical driver training curriculum.

FINAL BELGIAN THEORETICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
1	How to get a driving licence. Techniques and principles of defensive driving. Accidents (what, types, consequences).
2	Types of license (validity). Special states (alcohol, drugs, medicines, stress, fatigue,…). Highway code. Traffic rules.
	MMT block 1:Basic knowledge. - **Car safety check.** - **Traffic lights.** - **Dirty windshield.** - **Dirty headlights.** - **Learning the traffic signs.** - **Foreign signs.** - **Safety belt use.**
	Repetition of specific scenarios in case of trainees' weakness.
3	Speed (what, following distance...) .Speed limits. Braking techniques. Priorities.
4	Manoeuvres (what, what to do,...). Road crossings. Crossing. Overtaking (what, how). Changing direction (what, when, how).
5	Particular situations: - Highway - Motorway - Residential area - Speed ramp - Zone 30
	MMT block 2: Manoeuvring and safety. - **Brake / Crash at straight road, high friction.** - **Brake / Crash at straight road, low friction.** - **Brake at curved road, for low friction.** - **Relation of speed to stopping distance under different road conditions.** - **Detection of road-side dangers.** - **Unpredictable behaviour of children.** - **Gap acceptance.** - **Gap acceptance, lorries.** - **Car following situation on a country road.** - **Multi-vehicle platoon driving.** - **2-second rule explanation.** - **2-second rule following.** - **Car following.** - **Roadworks visibility, safe merging.**
	Repetition of specific scenarios in case of trainees' weakness.
6	Waiting and parking (what, rules, signs and defensive aspects).
7	Traffic lights. Use of the horn. Safety belt and child protection.
8	Behaviour towards other road users.

FINAL BELGIAN THEORETICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
9	Risks (passengers, load, caravans,...). Breakdown (precautions). Accident with physical injury (first aid). Accident with material damage.
	MMT block 3: Particular situations: special states. - **Response under influence of alcohol.** - **BAC.** - **Questions about alcohol.** - **Effects of drugs, and combination with alcohol.** - **Fatifue.**
	Repetition of specific scenarios in case of trainees' weakness.
10	Traffic signs.
11	Road markings.
12	Heavy penalties. Technical requirements (brakes, tyres, windscreen, car documents...).
	MMT block 4: Particular situations: new technologies. - **Stopping distance with and without ABS.** - **ABS.** - **ADAS.** - **Economical driving.** - **Ecological driving.**
	Repetition of specific scenarios in case of trainees' weakness.

FINAL BELGIAN PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content** **Session of 120 minutes (total duration: 20 hours)**
	Simulator block 1: Basic control. **Simulator block 0: Acquaintance with the simulator.** **<u>Block 0</u>** - ***Start/stop the simulator.*** **<u>Block 1</u>** - **Traffic rules.** - **Start and gear shift straight on.** - **Negotiating a curve.** - **Reaction time and stopping distance during normal driving.** - **Reaction time and stopping distance applying brake alertness.**
	Repetition of specific scenarios in case of trainees' weakness.
1	Security (go in and go out the car, rear view mirror, safety belt,...). Driving instruments (steering, starting, clutch, handling the gear box,..).
2	In the traffic (positioning on the road, visual scanning, curves, crossroads,...) Crossing (speed, direction, priorities,...).
	Simulator block 2: Manoeuvring and safety (divided attention). **Simulator block 3: Manoeuvring and safety (hazard perception).** **<u>Block 2</u>** - **Following situation on a country road.** - **Following situation on a country road, headway as a consequence of a car behind.** - **Speed adaptation when turning.** - **Overtaking manoeuvres-learning sequence.** - **Overtaking manoeuvres-higher risk.** - **Overtaking manoeuvres-varying the risk.** - **Overtaking manoeuvres-darkness.** - ***Enter/Quit a motorway/junction.*** **<u>Block 3</u>** - **Search strategy.** - **Gap acceptance (for turning left).** - **Left turn at light regulated junction.** - **Left turn at light regulated junction with oncoming car.** - **Parked car with cue for hazard perception.** - **Parked car without cue for hazard perception.** - **Pedestrians crossing in a junction when dark and rainy.**
	Repetition of specific scenarios in case of trainees' weakness.
3	Changing direction (speed, priorities, left or right turn...). Overtaking (visual techniques, etc.)
4	Highway (positioning on the road, changing lanes, speed,...). On the training ground (manoeuvres). In the traffic (parking, turning...).
5	In the traffic (defensive driving, visual scanning, signs...).
6	Crossing (defensive driving, visual scanning, signs,...). Changing direction (defensive driving, visual scanning, left or right turn,...).
	Simulator block 4: Particular situations with higher risk. **Simulator block 5: Particular situations: new technologies, personality aspects.**

FINAL BELGIAN PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content** **Session of 120 minutes (total duration: 20 hours)**
	Block 4 - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influence of dangerous motives on driving.** **Block 5** - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influences of dangerous motives on driving.**
	Repetition of specific scenarios in case of trainees' weakness.
7	Overtaking + manoeuvres (defensive driving, visual scanning, positioning,...).
8	Recapitulation + Manoeuvres.
9	Traffic notions (taking a decision...). Attitudes (concentration and attention, emotion, social driving).
10	Recapitulation and Synthesis .

Table 25: Finally proposed Belgian practical driver training curriculum.

FINAL SWEDISH THEORITICAL AND PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
1	Vehicle knowledge. To provide knowledge about vehicle construction and maintenance and to enlighten the environmental and economical factors that are related to road traffic. *(function and maintenance of engine, electrical system, steering, brakes, wheels/tyres, 2-/4- wheel drive; how load the car; influence of trailer on driving; fuel consumption; pollution).*
1'	The vehicle Provide skills in detecting errors and wear, to repair minor errors, and to load the car in a safe way. *(Perform controls and detect errors on steering, brakes, wheels, tyres, lights, electrical system, exhaust system. Change bulbs, fuses, wipers and wheels. Check fuel, oil, brake fluid, battery fluid, cooling fluid etc. Perform safety control. Load the car safely.)*
2	Traffic rules To provide knowledge about the traffic rules, which is a necessary precondition for cooperation between road users. *(the learner is expected to know all traffic rules).*
	Simulator block 0: Acquaintance with the simulator. ***Simulator block 1: Basic control. (35 minutes approximately)*** **Block 1** - **Traffic rules.** - **Start and gear shift straight on.** - **Negotiating a curve.** - **Reaction time and stopping distance during normal driving.** - **Reaction time and stopping distance applying brake alertness.** - ***First aid in accidents.***
	Repetition and discussion of specific scenarios in case of trainees' weakness.

FINAL SWEDISH THEORITICAL AND PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
	Simulator block 2: Manoeuvring and safety (divided attention). **Simulator block 3: Manoeuvring and safety (hazard perception).** ***(35 minutes approximately)*** **Block 2** - **Following situation on a country road.** - **Following situation on a country road, headway as a consequence of a car behind.** - **Speed adaptation when turning.** - **Overtaking manoeuvres-learning sequence.** - **Overtaking manoeuvres-higher risk.** - **Overtaking manoeuvres-varying the risk.** - **Overtaking manoeuvres-darkness.** **Block 3** - **Search strategy.** - **Gap acceptance (for turning left).** - **Left turn at light regulated junction.** - **Left turn at light regulated junction with oncoming car.** - **Parked car with cue for hazard perception.** - **Parked car without cue for hazard perception.** - **Pedestrians crossing in a junction when dark and rainy.**
	Repetition and discussion of specific scenarios in case of trainees' weakness.
	MMT Block 1: Basic knowledge.+ MMT block 2: Manoeuvring and safety. (35 minutes approximately) **Block 1** - **Car safety check.** - **Traffic lights.** - **Dirty windshield.** - **Dirty headlights.** - **Learning the traffic signs.** - **Foreign signs.** - **Safety belt use** **Block 2** - **Brake / Crash at straight road, high friction.** - **Brake / Crash at straight road, low friction.** - **Brake at curved road, for low friction.** - **Relation of speed to stopping distance under different road conditions.** - **Detection of road-side dangers.** - **Unpredictable behaviour of children.** - **Gap acceptance.** - **Gap acceptance, lorries.** - **Car following situation on a country road.** - **Multi-vehicle platoon driving.** - **2-second rule explanation.** - **2-second rule following.** - **Car following.** - **Roadworks visibility, safe merging.**
	Repetition and discussion of specific scenarios in case of trainees' weakness.

FINAL SWEDISH THEORITICAL AND PRACTICAL DRIVER TRAINING CURRICULUM

Training session number	Training session content
2'	Manoeuvring Provide a high level of skills concerning choice of measure, co-ordination, quickness and carefulness concerning manoeuvring of the car. *(Posture, controls, mirrors, safety belts, start, stop, slow driving, steering, precision driving, reversing, start in sloops, gear shift, braking, turning, parking, co-ordination of tasks.)*
3	Unexpected situations in traffic Provide larger risk awareness through knowledge about the risks that are present in the traffic. To show hidden hazards and provide awareness of small safety margins. *(typical accidents, accident development and distributions, accident causes, consequences, and countermeasures).*
3'	Driving in traffic (defensive driving) Provide such knowledge, skills and attitudes that the learner reaches a clear willingness to carefulness and consideration towards other road users. Use and realise the advantages with a defensive driving style and chose the correct speed in different traffic situations. *(Starting from the road side, positioning, speed choice, meeting, platoons, lane shifting, car following, parallel driving, junctions, roundabouts, one-way streets, zebra crossings, bicycle paths, turning, stopping, parking, overtaking, motorways and highways, railway crossings, road works, unprotected road users, animals, emergency vehicles, attention, risk awareness.)*
4	Human limitations Provide better self-assessment through knowledge about human limitations, overestimation and by pointing out that a good driver is recognised by personal maturity and respect towards other people. *(Prediction, rules, moral, human capacity, interpretation, decision making, locomotion, maturity, personality, social aspects, disabilities, fatigue, alcohol, drugs, learning principles.)*
	Simulator block 4: Particular situations with higher risk. **Simulator block 5: Particular situations: new technologies, personality aspects.** ***(45 minutes approximately)*** **Block 4** - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influence of dangerous motives on driving.** **Block 5** - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influences of dangerous motives on driving.** - ***Eco-driving (Repetition).*** - ***Influences of dangerous motives (Repetition).***
	Repetition and discussion of specific scenarios in case of trainees' weakness.

FINAL SWEDISH THEORITICAL AND PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
	MMT block 3: Particular situations: special states.+ MMT block 4: Particular situations: new technologies. (45 minutes approximately) **Block 3** - **Response under influence of alcohol.** - **BAC.** - **Questions about alcohol.** - **Effects of drugs, and combination with alcohol.** - **Fatifue.** **Block 4** - **Stopping distance with and without ABS.** - **ABS.** - **ADAS.** - **Economical driving.** - **Ecological driving.**
	Repetition and discussion of specific scenarios in case of trainees' weakness.
4'	Driving in special conditions Provide knowledge, skills and attitudes concerning driving in low visibility, darkness and low friction. *(Fog, rain, snow, darkness, low friction.)*
5	Others aspects and application of certain regulations Provide knowledge about rules and driving in certain environments such as city traffic, rural roads, driving in darkness, low friction. Provide knowledge about important regulations concerning load, driving license and violations. *(stopping distance, special rules and demands for driving in cities, motorways, highways. Shifting beams, visibility darkness, risks and demands for driving in low friction, winter equipment, winter tyres. License regulations, rules for practising, mandatory car controls, control sticker. Passengers and load, safety belts, use of trailers. Measures at accident site, first aid. Responsibility rules in traffic. Insurance, car registration…)*
5'	Skid course (4 hours)

Table 26: Finally proposed Swedish theoretical and practical driver training curricula.

FINAL SPANISH THEORETICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
1	Basic concepts.
2	Administrative requirements to drive a car. Factors which decrease the driver aptitudes. Other users.
3	Drive controls and adjustments of the vehicle; Visibility: Transparent elements of the car; Light systems and optical signalling; Other systems and signalling devices on vehicle; Number plates, signs and distinctive on vehicles; Tyre and adherence; brakes; passive safety.
4	The road: fundamental notions; general rules about traffic signs; road marks; vertical signs; traffic lights; road work signs; signs and commands of police traffic.
5	Normal Progression. Traffic Direction. Placement on the Road. Lane uses; Speed; Traffic Incorporation and Lateral Displacements; Overtaking; Intersections. Train passing and drawbridge; Direction Change. Reverse; Stopping, stop and parking; Car immobilization by Traffic Police; Road Dangers: their signalling; Highway and main roads driving; Night and bad conditions with decreased visibility driving.
	MMT block 1: Basic knowledge. + MMT block 2: Manoeuvring and safety. (40 minutes minimum-no maximum limit). **Block 1** - **Car safety check.** - **Traffic lights.** - **Dirty windshield.** - **Dirty headlights.** - **Learning the traffic signs.** - **Foreign signs.** - **Safety belt use.** - ***Lateral visibility.*** - ***First aid in accidents.*** **Block 2** - **Brake / Crash at straight road, high friction.** - **Brake / Crash at straight road, low friction.** - **Brake at curved road, for low friction.** - **Relation of speed to stopping distance under different road conditions.** - **Detection of road-side dangers.** - **Unpredictable behaviour of children.** - **Gap acceptance.** - **Gap acceptance, lorries.** - **Car following situation on a country road.** - **Multi-vehicle platoon driving.** - **2-second rule explanation.** - **2-second rule following.** - **Car following.** - **Roadworks visibility, safe merging.** - ***Aquaplaning-snow-ice.*** - ***Roundabouts.***
	Repetition of specific scenarios in case of trainees' weakness.
6	Transport people factors and vehicle load.
7	The Special Vehicles.

FINAL SPANISH THEORETICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
8	Traffic Accident Factors; What to do in an accident.
	MMT block 3: Personal behaviour. + MMT block 4: Special driving systems (no maximum limit). **Block 3** - **Response under influence of alcohol.** - **BAC.** - **Questions about alcohol.** - **Effects of drugs, and combination with alcohol.** - **Fatifue.** **Block 4** - **Stopping distance with and without ABS.** - **ABS.** - **ADAS.** - **Economical driving.** - **Ecological driving.**
	Repetition of specific scenarios in case of trainees' weakness.
9	Vehicle mechanics; Accessories, spares and tools. Periodic inspections.
10	Economical Driving, the Environment and Environmental Pollution.
11	Preparation and Travel Development.

Table 27: Finally proposed Spanish theoretical driver training curriculum.

14.1.1.1

FINAL SPANISH PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
	Simulator block 1: Basic control. **Simulator block 0: Acquaintance with the simulator.** **Block 1** - **Traffic rules.** - **Start and gear shift straight on.** - **Negotiating a curve.** - **Reaction time and stopping distance during normal driving.** - **Reaction time and stopping distance applying brake alertness** - ***First aid in accidents.***
	Repetition of specific scenarios in case of trainees' weakness.
1	Learning with the vehicle stopped: **Previous Checking. Vehicle Verification** (To be done everyday; To be done periodically; Other things that the student has to know about the car). **Before starting the vehicle engine** (Adjustments and Regulations; Finding and knowledge of the vehicle controls; Start and stop the vehicle engine).
2	Driving Learning: **Acquisition of the driving basic automatisms.** **First step**: Exercises to start to handle the vehicle controls.
3	Driving Learning: **Acquisition of the driving basic automatisms.** **Second step:** Exercises to complete the acquisition of the basic automatisms.
	Simulator block 2: Manoeuvring and safety (divided attention). **Simulator block 3: Manoeuvring and safety (hazard perception).** **Block 2** - **Following situation on a country road.** - **Following situation on a country road, headway as a consequence of a car behind.** - **Speed adaptation when turning.** - **Overtaking manoeuvres-learning sequence.** - **Overtaking manoeuvres-higher risk.** - **Overtaking manoeuvres-varying the risk.** - **Overtaking manoeuvres-darkness.** - ***Defensive driving.*** **Block 3** - **Search strategy.** - **Gap acceptance (for turning left).** - **Left turn at light regulated junction.** - **Left turn at light regulated junction with oncoming car.** - **Parked car with cue for hazard perception.** - **Parked car without cue for hazard perception.** - **Pedestrians crossing in a junction when dark and rainy.** - ***Defensive driving.***
	Repetition of specific scenarios in case of trainees' weakness.
4	Driving Learning: **Improving and domain of the vehicle control handling.** Exercises to obtain the improving of the gearshift handling. Exercises to obtain the improving of the steering wheel handling. Exercises to obtain the improving of the clutch handling. Exercises to obtain the improving of the brakes handling. Exercises to obtain the domain of the vehicle in reverse.

FINAL SPANISH PRACTICAL DRIVER TRAINING CURRICULUM	
Training session number	**Training session content**
5	Learning with Traffic Situations. **Training and practice with traffic in a normal progression and basic traffic manoeuvres .**(Normal progression; Incorporation to the traffic; Lateral displacement and lane changing; Stopping and parking; Overtaking; Intersections negotiation; Direction change).
	Simulator block 4: Particular situations with higher risk. **Simulator block 5: Particular situations: new technologies, personality aspects.** **Block 4** - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influence of dangerous motives on driving.** - ***Give way, parking and turning.*** - ***Defensive driving.*** **Block 5** - **ABS and steering ability in critical situations.** - **ABS and braking distance.** - **Economical/ecological driving.** - **Mental workload and use of stereo and mobile phone.** - **Influences of dangerous motives on driving.** - ***Defensive driving.***
	Repetition of specific scenarios in case of trainees' weakness.
6	Learning with Traffic Situations: **Driving adaptation of the vehicle to special and/or particular conditions** (Highway and main roads driving; Urban driving. Saturated roads; Adverse atmospheric conditions driving; Night driving; Driving on a hill).

Table 28: Finally proposed Spanish practical driver training curriculum.

15 Annex 10: TRAINER recommendations to authorities

Pre-training TRAINER Recommendations

1. The training should be oriented towards the necessity of the prevention and the successful confontation of traffic danger and not just towards the improvement of trainees'driving skills.
2. The training curricula should be especially adapted to each country's driving environment and driving code.
3. Useful new technogical tools could be added to traditional training tools (e.g. simulators), which would contribute in safe training and special driving tasks training, which real car training miss.
4. The training issues that should be included in theoretical curriculuman tools as a minimum are the following:

Block 1: Basic Knowledge

- Car safety check.
- Traffic lights.
- Dirty windshield.
- Dirty headlights.
- Learning the traffic signs.
- Foreign signs.

Block 2: Manoeuvring and safety

- Brake / Crash at straight road, high friction.
- Brake / Crash at straight road, low friction.
- Brake at curved road, for low friction.
- Relation of speed to stopping distance under different road conditions.
- Detection of road-side dangers.
- Unpredictable behaviour of children.
- Gap acceptance.
- Gap acceptance, lorries.
- Car following situation on a country road.
- Multi-vehicle platoon driving.
- 2-second rule explanation.
- 2-second rule following.
- Car following.
- Roadworks visibility, safe merging.

Block 3: Particular situations:special states

- Response under influence of alcohol.
- BAC.
- Questions about alcohol.
- Effects of drugs, and combination with alcohol.
- Fatifue.

Block 4: Partcular situations: New technologies

- Stopping distance with and without ABS.
- ABS.
- ADAS.
- Economical driving.
- Ecological driving.

5. The training issues that should be included in practical curriculum adn tools (real car training or simulator training), as a minimum, are the following:

Block 1: Basic control

- Traffic rules.
- Start and gear shift straight on.
- Negotiating a curve.
- Reaction time and stopping distance during normal driving.
- Reaction time adn stopping distance appluing normal driving.

Block 2: Manoeuvring and safety (divided attention)

- Following situation on a country road.
- Following situation on a country road, headway as a consequence ofa car behind.
- Platoon situation with oncoming car, which overtakes on a risky manner on a country road.
- Speed adaptation when turning.
- Overtaking manoeuvres-learning sequense.
- Overtaking manoeuvres-higher risk.
- Overtaking manoeuvres-varying the risk.
- Overtaking manoeuvres-darkness.

Block 3: Manoeuvring and safety (hazard perception)

- Search strategy.
- Gap acceptance.
- Left turn at light regulated junction.
- Left turn at light regulated junction with oncoming car.
- Parked car with cue for hazard perception.
- Parked car without cue for hazard perception.
- Pedestrians crossing in a junction when dark and rainy.

Block 4: Particular situations with higher risk

- Stopping distance on low friction.
- Skid control on low friction.
- Split friction.
- Aquaplanng.
- Shifting beams.
- Car stopping on the road in darkness.
- Overtaking manoeuvres-darkness.

- Pedestrians crossing in a junction when dark and rainy.

Block 5: Particular situations: new technology-personality aspects

- ABS and steering ability in critical situations.
- ABS and braking distance.
- Economical / ecological driving.
- Mental workload and use of stereo and mobile phone.
- Influence of dangerous motives on driving.

6. The above training issues should be also included in the driving license testing schemes.

7. Theoretical curricula should give special attention to the following driving issues (these concern scenarios that most of the TRAINER trained group persons have failed in) :

- Vehicle safety check.
- Traffic signs and rules.
- Gap acceptance.
- Lane change.
- Alcohohol and personal limitations .
- Drugs effects on driving limitations.
- Drowsiness effects on driving ability.
- Advanced Driving Assistance Systems.

8. The driving issues that should be added to the above theoretical and practical curricula of each country are the following:

Theoretical Curricula

- First aid for accidents.
- Aquaplaning-snow-ice.
- Lateral Visibility.
- Give way and parking.
- Roundabouts.

Practical Curricula

- Defensive driving.
- First aid in accidents.
- Air loose from tires.
- Give way, parking and tuning.

9. The training tools should be multilingual, to be able to be used Eurpwise and promote training standardization in Europe.

10. Trainees should be always monitored by the driving instructor(s), even when using advanced training tools (i.e. multimedia s/w or simulators).

11. Training in groups and self-training should be avoided, especially when using simulators.

12. Training means should be safe for the trainees.

13. Trainers should focus on the special weaknesses of each trainee and retrain him/her according to them.

14. When the trainee must redo a failed scenario, it is better to be with an alternative of the scenario, in order to avoid memory effects.

15. Each training scenario, either theoretical or practical should be accompanied by clear instructions.

16. The aim of the training issues should be defined and discussed.

17. The results (especially errors) of each training or testing sessions should be thoroughly discussed in groups, to learn from other students mistakes.

Post-training TRAINER Recommendations

The time and funding limits of the TRAINER project has not permitted a post-training evaluation. However, based upon the Pilot results, what is recommended, is the retesting of the trainees after a semester or a year of the acquaintance of their driving license and the record of the accidents they have had within 2-3 years after. The reason of such a post-training evaluation and an accident record, is to estimate the sustainability of the training effects and their performance and knowledge level, especially in scenarios that are rare in general or that have not occured to them during this period.

Assessment TRAINER Recommendations

1. Trainees' performance in several training tool scenarios is not indicative of their actual performance level. It just depicts their awareness level regarding the training tools. For this reason, trainees should always be finally tested on the road.
2. Simulators are a good complement to traditional training, but the real-driving feeling may not be achieved by low to medium cost training simulators. Thus, its use should be combined with actual on-road training.
3. The fact that trainees succeed to pass the driving test and obtain their driving license does not necessarily imply that they are completely ready to handle real driving situations. Therefore, there should be a novice drivers' monitoring and/or retesting period.

16 Annex 11: TRAINER guidelines for vehicle design

Guideline 1: Provide audio warnings for speed limit violations to novice drivers.
Reasoning: Novice drivers tend to develop high speeds without sometimes understanding it and such a system can help them realize it.

Guideline 2: Provide support in monitoring the vehicle status (engine oils, etc.) and guiding the driver to oversee it.
Reasoning: Novice drivers are usually not familiar with vehicle check and such a system would be useful for them

Guideline 3: In order to decide the location of a visual output inside the vehicle, the manufacturer should take into consideration the novice drivers' tendency to focus on different visual areas than the experienced drivers.
Reasoning: Novice drivers usually focus on the middle area of the driving lane (right-hand driving), while experienced drivers focus mostly on expansion area. The visual output should not abstract novice drivers from their driving tasks.

Guideline 4: Inform novice drivers about forthcoming obstacles.
Reasoning: Especially novice drivers do not have a quite developed perception of the obstacles around them.

Guideline 5: Navigation systems are especially important to novice drivers, provided their interfaces are good enough not to enhance their workload.
Reasoning: Typically novice drivers drive in unfamiliar traffic environments.

Guideline 6: A cruise control system could be used to support the safety distance keeping of novice drivers.
Reasoning: Appropriate to use keeping difficulties in several novice drivers.

Guideline 7: When a novice driver gets in the vehicle, a message should be heard reminding him/her the fixations of the safety belt, the mirrors and the seat.
Reasoning: Such habits are not yet acquired by novice drivers.

Guideline 8: An extra mirror or ADAS should be positioned in order to cover the *blind spot* area.
Reasoning: Lane departure or deviation without noticing another vehicle may well happen to novice drivers.

Guideline 9: When the car is stationary and the driver tends to open the door, a warning sensor should be activated in case that an obstacle is moving near the vehicle.
Reasoning: To protect other drivers from the frequent novice drivers' mistakes not to reduce speed and enhance attention when overtaking a parked car.

Guideline 10: Sensors to help the parking phase would be useful.
Reasoning: Many novice drivers have problems to park efficiently and cause several small accidents/ damages.

17 Annex 12: TRAINER logo and leaflet layout

What is TRAINER all about?

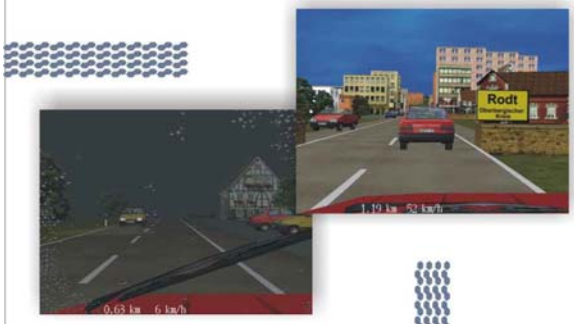
In accidents in the European Union around 42,500 people are killed and 1,700,000 are injured each year. From them, 150,000 become permanently disabled. Novice drivers' related accidents (of people with less than two years driving experience) accounted for 15% of traffic accidents in 1995 in Great Britain alone. A mere reduction of 1/3 of such accidents would mean 4,125 less fatalities, 12,750 less injuries and 560 MEuros less expenditure for medical treatment annually in Europe.

TRAINER is a project co-funded by DG TREN of the European Commission. TRAINER aims to effectively address the traffic accidents of novice drivers through a series of initiatives, leading to a new, improved and yet cost-effective Europe-wide driver training methodology, which will also make use of and familiarise the driver with emerging Advanced Driver Assistance Systems (ADAS).

Approach

The project approach combines a thorough review of driver's training curricula and tools used Europe-wide, with a concise analysis of driver instructors' needs and opinions, a bibliographical and an accident survey and analysis, to conclude to a single, multiparametric and adaptable driver's training system.

Furthermore, it develops a number of innovative tools to support this system, such as an interactive multimedia training tool to support the theoretical training of novice drivers. In order to be close to reality, a video based application will be implemented. Among other things emphasis is put on risk awareness and new system interaction.



Furthermore, TRAINER develops by means of modular design, two types of cost-effective driving simulators (a static and a semi-dynamic one) for driving schools, able to support the driver in understanding the basic control actions, learn to drive in an economic and ecological way, acquire the right visual cues patterns and to provide him/her with some didactic feedback on situations with enhanced risk (i.e. low visibility and/or friction due to rain, fog, snow; obstacle avoidance manoeuvres, including interaction with vulnerable road users and animals, simulation of drunk driving and tunnel vision, etc.). The semi-dynamic one supports an enhanced visual field and simulates also lateral forces effect, to make its use more realistic.

Expected Results

Driver data resulting from the use of the multimedia tool and the driving simulator(s) will all be stored into a concise database, together with key driver characteristics (such as nationality, gender., age, etc.), in order to provide a pan-European overview of most frequent drivers' errors and lead to new training procedures and/or vehicle aids to avert them. Extended testing of all the tools with 30 novice drivers in each of 4 European countries (Belgium, Greece, Spain and Sweden) in comparison with 30 others that are tested but not trained with such tools, will lead to the recognition of the traffic safety effects of the newly proposed methodology and to proposals for its improvement.

Based on the experience gained, the TRAINER Consortium, that encompasses all key actors of the field (Traffic safety Institutes, driving education tools developers, unions of driving schools and driving assessment centres, a car manufacturer), will conclude to best practice driver training guidelines as well as recommendations to authorities.