symulator jazdy, szkolenie kierowców, samochodów ciężarowych i autobusów, Europejski projekt Leonardo da Vinci

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SYMULATOR AUTOBUSU I SAMOCHODU CIĘŻAROWEGO JAKO ELEMENT SZKOLENIA KIEROWCÓW – WYKORZYSTANIE W PROJEKCIE EUROPEJSKIM – LEONARDO DA VINCI – TRANSFER OF INNOVATION (TOI)

W referacie przedstawiono zagadnienia związane z symulatorem jazdy, będącym w posiadaniu Instytut Transportu Samochodowego – produkt firmy AUTOSIM – model AS 1300. Symulatory jazdy są coraz powszechniej wykorzystywane na całym świecie w procesie szkolenia kierowców. Są praktycznym i efektywnym narzędziem do wzmacniania bezpiecznych zachowań kierowców na drodze.

Referat zawiera także założenia projektu Leonardo da Vinci Transfer of Innovation – Trening dla Trenerów do obowiązkowego okresowego szkolenia kierowców. Celem realizacji projektu jest poprawa jakości szkolenia, a w konsekwencji podnoszenie bezpieczeństwa na drogach. W projekcie zastosowano nowoczesne metody szkolenia korzystając z doświadczeń różnych krajów biorących udział w projekcie (Polska, Hiszpania, Francja, Belgia).

TRUCK AND BUS SIMULATOR AS AN ELEMENT OF THE DRIVER TRAINING SYSTEM –USED IN THE EUROPEAN PROJECT- LEONARDO DA VINCI – TRANSFER OF INNOVATION – TOI

The paper refers to some issues related to the driving simulator at the Motor Transport Institute - AUTOSIM product - AS 1300.

Driving simulators are increasingly used for training of the drivers almost all over the world. They are practical and effective educational tools to encourage safe driving training techniques for all drivers.

The paper also includes the assumptions of EU Leonardo da Vinci project - Transfer of innovation (TOI) entitled - Training of Trainers for the obligatory periodic training (« TOT to FCO ») of truck drivers for the carriage of goods (transfer of EU directive 2003/59/EC as of September 10, 2009) which was created to improve the quality of driver training and to increase road safety. It was designed

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to help adapt existing innovative practices for use in new settings, through working with transnational partners (Poland, Spain, France, Belgium).

1. INTRODUCTION

Simulator is an equipment, which imitates drivers' working environment. It is very useful in training and advancement of the drivers' skills, in the research connected with drivers' behaviours and various kinds of dysfunctional influences on the safe driving. The impacts of fatigue, medications and drugs are also take into account.
Because of the possibilities to take measurements, it is useful in designing road infrastructure.

Driving simulators are increasingly used for training of the drivers almost all over the world. They are practical and effective educational tools to improve driving training techniques for all drivers. Compared with training in vehicles in real traffic, truck driving simulation training has many advantages and benefits. It increases quality and efficiency of training, as well as, it is beneficial for traffic safety, for example by improving driving skills in risky situations.

Training on the simulator is also environmentally friendly and can be useful in teaching eco-driving. The effect is lower fuel consumption in real vehicle operation and air pollution reduction (1000 of training trucks in Europe produce 40 000 tons of CO_2 a year, 50% use of simulator for training may reduce pollution by 20 000 tons).

2. DRIVING SIMULATOR – THE ELEMENT OF TRAINING

The real world environment can be unpredictable when it comes to weather, road or traffic conditions.
Training on the simulator offers:

- Exposition to a wide variety of traffic situations - specific training scenarios can be made in such a way that they offer many educational moments in a short period of time.
- Repetition of the scenarios (or only difficult moments) - the trainee-driver can practice dangerous and unexpected situations in safe conditions many times.
- Training control - the type and level of driving task elements and demands can be specified.
- Environmental protection and resources use optimisation, reducing the environmental pollution.
- Different weather conditions (fog, rain, snow), road environment (city, village, motorway, country roads, mountain roads) and risk level – all conditions can be selected from the list and mixed according to the required scenario.
- Computerized and objective assessment – the evaluation is done by the program or/and by the instructor, the trainee-driver' behavior can be measured very precisely and objectively.

- Feedback from different perspective - driving simulators have the possibility to provide audio and visual feedback after training, while a learner is driving – from the trainer and a bird's eye (helicopter) view or another road user's viewing point.

A driving simulator allows drivers to practice dangerous situations in a safe environment. It's very important, because about 3 thousands people die in road accidents everyday world wide. This brings it to a number of 1,2 million people every year. The total costs (mental, social and financial) of the accident, which people have to pay are so high that European Union shows a greater interest in the phenomena.

The form of regulation of driver training on simulator is Directive 2003/59/EC of the European Parliament and of the Council on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers, amending Council Regulation (EEC) No 3820/85 and Council Directive 91/439/EEC and repealing Council Directive 76/914/EEC. This Directive obligates the Member States to change the system of drivers training (buses and trucks). The emphasis is on the road safety, reducing emissions and fuel consumption. This regulation predicts training in a special area or on a high-class simulator in order to control the driving skills in various road and weather conditions as well as during day and night.

The trainee-driver after training on simulator is able to demonstrate practical knowledge in the following areas:

- respect traffic regulations,
- use the power-assisted braking and steering systems,
- use on-board monitoring devices,
- recognition of traffic dangers and evaluation of their seriousness,
- understanding attitudes of other road users,
- avoiding causing dangerous situations and to react appropriately when dangerous situations happen,
- performing necessary manoeuvres accurately and safely,
- driving efficiently and with minimum fuel consumption in the city and when driving for a long time with the set speed,
- identifying specific risk factors related to the lack of experience of other road users and to various road conditions,
- proper use of the vehicle in respect to the environment.

2.1. Description of the Motor Transport Institute (ITS) simulator

ITS simulator - AS 1300 (AutoSim production) [9] is a full-scale, top-of-the-range, truck and bus simulator training system, designed to fulfil the future European heavy vehicle driver trainings need. In this simulator a special attention has been paid to the realistic visualisation and replication of traffic with vehicles, cars, motorbikes, cyclist and pedestrians. To achieve "real-life" traffic behaviour, all objects in the simulator react to traffic and traffic situation as it would be expected in real-life traffic situations. The vehicles interact with each other to give a natural flow of traffic. The traffic has been programmed to follow the normal traffic rules, which can also be overridden by the exercise system to cause the driver to perform unexpected manoeuvres.

Fig. 1. The photo of ITS simulator, visualisation of the surroundings and driver's cabin

The Bus and Truck Driving Simulator [9] is a fully functional, pre-configured simulator that contains all necessary HW and SW modules, Visual System, Visual Database, a three-axes motion system and a fully functional truck cabin with instrumentation to provide a 'real-life" truck driving environment. The sound is provided by a four-channel high fidelity sound system with loudspeakers inside the cabin. The system provides sound from the driver's vehicle and from other vehicles, and lets the driver experience both directional and Doppler effects.

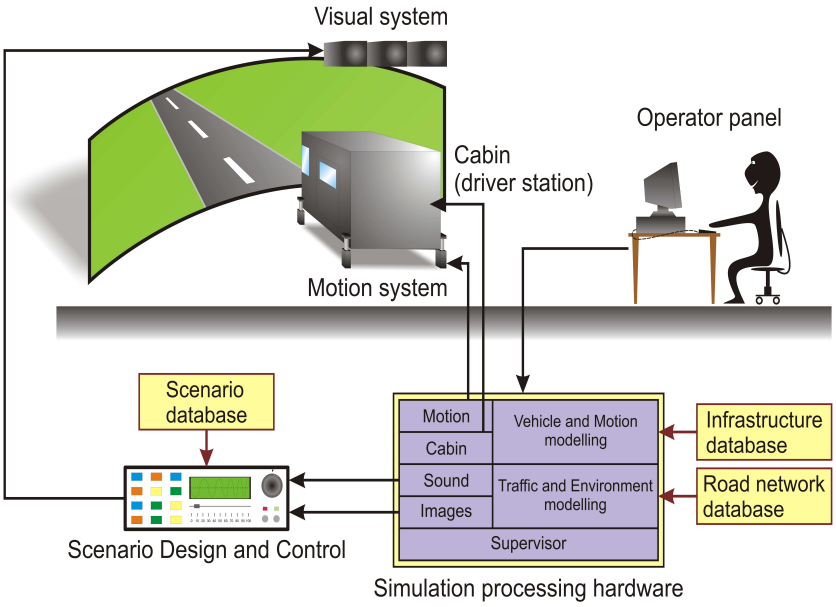

Fig. 2. Construction of the simulator

The simulator provides a fully immersive environment, comprising a SCANIA truck cabin with large panoramic visual front screens covering 180^0 field of view as the main hardware elements. This high level of visualisation reality is necessary for training drivers in risky situations and ones that are impossible to recreate safely in the normal traffic, as well as for scientists who want to carry out complex and accurate traffic and human factor experiments [9].

The simulator comes with a set of standard driving scenarios. They replicate specific road conditions - as the road environment looks like (exact specification of the road geometry, road surface, and weather condition). In addition, an advanced and easy to use scenario-building tool is also included, allowing the instructor to tailor-make individual driving situations for different simulator applications. The Operator Station employs a user interface system that allows the operator to monitor the driver's behaviour and see how he is dealing with potentially hazardous driving situations. To allow for a wide variety of customer adaptations, the simulator is designed to be "open" by using a modular approach and all available industry standards.

Fig. 3. Examples of simulator's scenarios [9]

Although simulation can eliminate a crash risk, the use of simulation introduces another risk – simulator sickness. As long as simulators have existed, people have exhibited symptoms similar to motion sickness. Due to these symptoms, simulator sickness is often associated with motion sickness. Although simulator sickness and motion sickness have similar symptomatology, they are not the same phenomena and can be caused by different situations. Motion sickness is usually caused by the travelling in almost any modern transportation system that includes air, rail, road or water. However, simulator sickness can occur in situations involving illusion of motion, such as provided by driving inside vehicle simulators. This is a result of the central nervous system receiving mixed messages from body sensors, both visual and those motion related, detecting body's position. It is caused by the disagreement between the eyes and the inner ear. This sickness was initially documented by Havron and Butler in 1957 in a helicopter trainer [2].

There are quite large individual differences in susceptibility to simulator sickness. Not everyone who experiences the same simulation gets sick. People, who experience virtual simulation, often have a wide range of symptoms (general fatigue, eye strain, and headaches, sleepiness, sweating, apathy, dizziness, and loss of skin colour) – apart from a lot of symptoms being commonly observed, there are some non-observable and subjective

ones. They can arise within minutes to a period of hours. Some people may get sick one day and the next day everything would be fine [4,5].

With driving simulators, the degree of simulator sickness can be related to particular driving environments and particular scenarios. Another factor that may trigger simulator sickness is the amount of optic flow that driver experiences [6]. Vehicle speed and type of road (e.g. motorway, city and rural road environments) may be also perceived as a factor in driving simulator sickness. When driving on straight roads in the country and suburban environments, subject experiences significantly lower symptoms of simulator sickness than when driving in the city and hills environments, that require many turns and manoeuvres. Manoeuvring combined with visual cuing can contribute to an onset of sickness. It is reported that making turns in a driving simulator increased the degree of simulator sickness [7,3].

Older adults tend to be more susceptible to simulator sickness than younger participant [8]. Simulator sickness symptoms steadily increase for up to one hour during exposure to a virtual environment before returning to nominal levels 15 min. later.

There are large individual differences in susceptibility to simulator sickness, such as: age, concentration level, belonging to a particular ethnic group, experience with the real-world task, experience with the simulator (adaptation), the flicker fusion frequency threshold, gender, illness and personal characteristics, mental rotation ability, perceptual style, and postural stability [1]. There's is no unique solution to avoid simulator sickness.

2.2. The European Leonardo da Vinci project - Transfer of Innovation – TOI

Transfer of innovation project (TOI) entitled - Training of Trainers for the obligatory periodic training (« TOT to FCO ») of truck drivers for the carriage of goods (transfer of EU directive 2003/59/EC as of September 10, 2009) was created to improve the quality of driver training and to increase road safety. It was designed to help adapt existing innovative practice for use in new settings, through working with transnational partners.

The project started in October 2009 and it will finish in September 2011 (duration - 24 months). There are 4 partners in the project: Poland - ITS (Motor Transport Institute) and ZMPD (Association of International Road Transport Operators in Poland), Spain – ASTIC (association del Transporte Internacional por Carretera), Belgium – IRU (International Road Transport Union) and France – Groupe Promotrans.

The three main objectives of the project are as follows:

- adopt innovative content,
- produce tangible products,
- transfer the results to new setting.

It will happen by:

1. Implementing an e-learning and face-to-face training programme for trainers based on the observation and needs analysis during mobility weeks in Poland and Spain.
2. Training Spanish and Polish trainers thus contributing to their professional development through cross-border co-operation.
3. Accompanying trainers via e-learning with a view to facilitating transfer of innovation in Spain and in Poland.
4. Developing and delivering “TOT to FCO” on a European level through dissemination and exploitation of results.

The project aims at transferring a training course intended for FCO trainers in Poland and Spain by taking into account the partners' national requirements and by associating them with the modules designed right from the start. Three modules are being prepared:

1. technical (the objective: "Trainers should have full operational command of FCO technical content in order to train truck driver for the carriage of goods"),
2. pedagogy (the objective: "Have a good command of andragogy principles with a view to designing, teaching and evaluating training course"),
3. methodology (the objective: "Identify the e-learning environment and training characteristic as well as acquire knowledge of the distance-learning platform").

Each partner has own role and contribution to the project. France (PROMOTRANS) role is to designethe e-learning technical and pedagogy modules. Spain (ASTIC) is designing methodology module. The role of Poland - Motor Transport Institute (ITS) - in the project to design a driving training module for use on the simulator. Belgium (IRU) is a core partner, which role is exploitation of the results.

The project consists of 9 phases. Each of them includes key activities, deadline, duration, partners engaged in the phase, output and deliverables.

Training module on the simulator created by ITS is prepared for drivers' trainers. Trainers play a very significant role in providing high level and effectiveness of training. They share the basic knowledge and practice on simulator with trainee-drivers. Desired skills include a high standard of driving ability, a sound knowledge of the subjects related to instructing others, how people learn, interpersonal and communication skills. Because simulator is a unique equipment, besides features required in street training, the trainers who provide training with the use of the simulator should have a special competences: pedagogic qualifications (the best candidate is a person who has been a trainer in real situations for some time), general and specific knowledge of all the areas of training and practical experience. Personal skills are also important.

Motor Transport Institute prepared proposal of training strategy. The basic goal is to practice driving safety (according to road safety rules) and in eco- (economy, ecology) way. Using such training, drivers will become aware of the risky situations that can occur in traffic and may develop a cautious attitude.

The strategy has been prepared for periodic training and divided into eight units:

Unit 1: Practical skills inside the simulator–adaptive training
Unit 2: Basic manoeuvres in a work area
Unit 3: Driving on a motorway
Unit 4: Driving in a village
Unit 5: Driving in urban area – town
Unit 6: Driving in the hills
Unit 7: Manoeuvres
Unit 8: Eco-driving

All Units are described in the same way and has own aims, duration, exercises (scenarios), the map of each exercise, skill acquired after training, and methodological advices for trainers. Almost each unit offers a few scenarios. The trainer has the possibility of selecting scenarios and adjusting them to time, knowledge and experience of trainee-drivers. The level of difficulty will increase with time and other units.

In each Unit, there are some hard or risky situations, which can happen on the road (tyre puncture, deer/bicyclist cross on the road, drunken pedestrian cross on red light, road

works, brake failure, accident etc.). Trainee-drivers have the possibility of driving in fog, snow, rain on slippery road, at day and at night. Each scenario is evaluated by the trainer or computer program. The trainer checks if all tasks are performed according to instructions. He/she also does the pedagogical observation of a driver behaviour in the simulator, and a trainees engagement in doing exercises.
Below is the example of first unit.

Tab. 1. Unit 1

UNIT 1	
Title:	Practical skills inside the simulator–adaptive training
The aim:	The trainee-driver practices basic skills inside the simulator
Duration:	8 minutes
Difficulty level:	Very easy
Scenario:	Parking/manoeuvring place + rural road
Traffic:	None or very small
Weather conditions:	Excellent
Time:	Day
Learning:	1. Functioning inside driving simulator: seat adjustment, adjustment of the steering wheel, pedals, automatic/manual gearbox, air controls 2. Smooth acceleration/braking 3. Reversing
Description:	A trainee-driver gets familiarized with the truck. The scenario is divided into two parts. The first one is an interactive training (instruction) for handling car equipment inside the cabin. During trainer's cabin presentation, the trainee-driver is asked to use named devices. The second part is practicing some basic maneuvers: moving off, stopping and reversing the vehicle.
Scenario:	The exercise starts at the lay-by on the road. The task is to move the vehicle, drive straight, stop the vehicle and reverse. The next step is to drive straight at suburban road without other road users, where trainee-driver practices starting the engine and moving the vehicle smoothly as well as stopping the car, accelerating using higher and lower gears and using split gears and then stopping the car. It is important to locate the vehicle in one lane. These manoeuvres are repeated for the second time. The exercise ends at the car park (for example in front of the store). The trainee-driver has to park the car between the vehicles, using mirrors.
After the exercise the trainee-driver is able to:	• Adjust the seat as necessary, use the seat belts, use the vehicle controls (steering wheel, accelerator, clutch, gears, handbrake and footbrake, split gear, crawl gear). • Start the engine and move the vehicle smoothly. • Use the mirrors during driving as well as parking. • Brake and reverse.

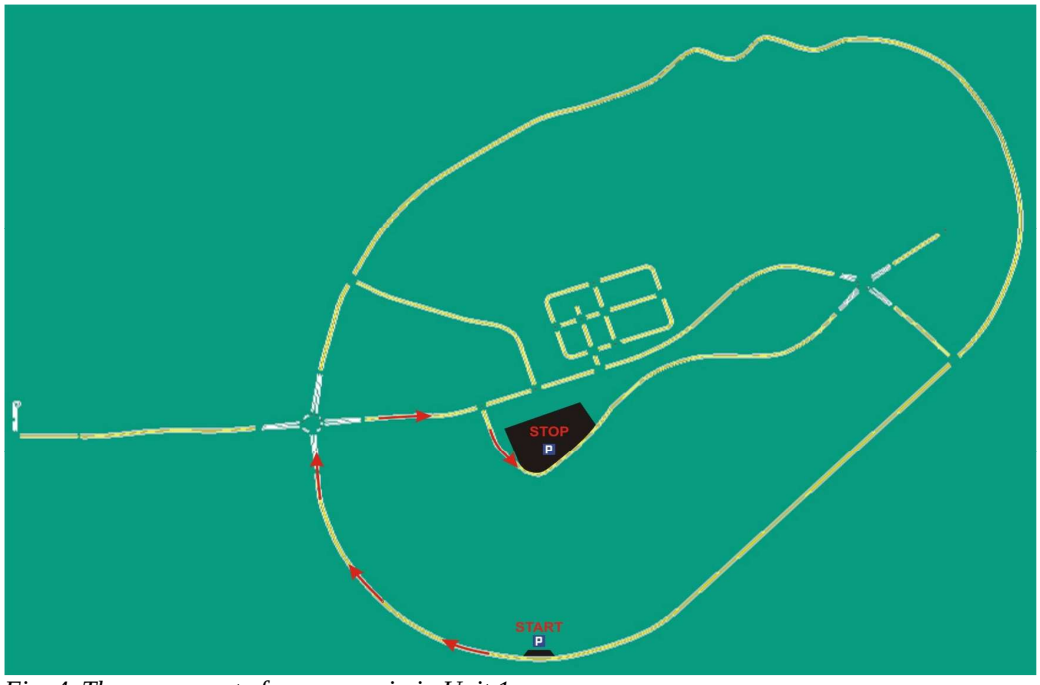

Fig. 4. The map - route from scenario in Unit 1

The trainer sits by the control station, using only an intercom and screen view from camera inside the cabin. He/she supervises training process and pays a special attention to trainee-driver behaviour (simulator sickness symptoms). The important, from the trainee-driver point of view, is to get feedback about the results of the exercises.

Unit' scenarios prepared by ITS, were tasted in July/August by several driving instructors with long practical experience as well as by others trainer and drivers with C driving licence category. They were satisfied. Now the driving guidebook for use on simulator is preparing.

3. CONCLUSION

A lot of research noticed that the simulator is a good tool to support drivers training. It doesn't have to replace practice in real road traffic but it is useful in combined training.

The driving simulator complies with EU directive 2003/59/CE with regard to driving based on safety regulations. This directive suggests refresher training for bus and truck drivers (continuing demonstration of competence and professionalism, 35 hours of refresher training over a 5 years period). TNO showed that simulators at VTL can be used more efficiently than a real vehicle - Ratio 4 = 7 based on expert judgments.

The goals are to increase training quality, or increase cost-efficiency of training. Driving simulator allows to check trainee-drivers qualifications and driving progress. It also

optimizes safety driving and eco-driving practices, allows to repeat training scenarios practiced by trainee drivers.

One of the most important goals of the TOI project is Pedagogy applied to driving simulator. Training of trainers will take place in October. 4 Polish and 4 Spanish trainers will go to Paris to practice relevant teaching methods and processes:

- to drive simulators in both normal and difficult situations,
- to focus on fuel-efficient driving,
- to design driving learning programmes by using various parameters,
- to analyse trainees' learning outcomes,
- to assess driving performance.

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