Simulátory v bezpečnostních aplikacích

Simulators in security applications

Bc. Jiří Vlach

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3. **LÁNÍČEK, R. Simulační programy pro elektroniku. 2. vyd. Praha: B.E.N., 2002. 120 s. ISBN 80-7300-051-2.**
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Vedoucí diplomové práce: **doc. RNDr. Vojtěch Křesálek, CSc.**
Ústav elektroniky a měření

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L.S.

prof. Ing. Vladimír Vašek, CSc.
děkan

doc. RNDr. Vojtěch Křesálek, CSc.
ředitel ústavu

ABSTRAKT

V této diplomové práci jsem popsal ucelenou řadu simulátorů vozidel Pandur právě dodávaných do AČR za účelem efektivního vyškolení bezpečnostních odborníků, kteří budou zajišťovat bezpečnost konvojů na zahraničních misích, v současné době především v Afghánistánu.

Některé principy popsané v tomto textu mohou být použity obecně pro výuku v libovolných oborech, zatímco principy popsané ke konci práce již jsou úzce specifické.

Klíčová slova: Simulátor, Pandur, CBT, KBVP, Bezpečnost

ABSTRACT

In this thesis is described complete line of Pandur vehicle simulators recently delivered to Czech Army for effective training of security experts, who will assure convoy safety on abroad missions, at this time mainly in Afghanistan.

Some of the principles described in this text could be used generally for education in various fields of work, while principles described on the end of thesis are very specific.

Keywords: Simulator, Pandur, CBT, Security

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Ve Zlíně …….

podpis diplomanta

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INTRODUCTION

As an expert for simulation technologies in army area I have described up-to-date state of technical level of simulators produced by leading company in this area – SAAB Training systems AB, Huskvarna – for Army needs. As an example I described training systems for **Pandur vehicles**. On the example of recently delivered simulators of various technical and educational levels are described actual possibilities for maximally effective training of security experts.

In the text is described purpose of the simulators, technical solution of used HW and main SW description. It is an overview of different types of simulators, I didn't describe every part of simulators as the goal of this thesis is to introduce the reader to contents which can be understood without previous experiences with the simulation systems. There is a lot of pictures displaying the systems on 3D design models or on photographs where it was possible.

1 CBT CLASSROOM

Computer Based Training (CBT) classroom is designed for training of students. It is a method for interactive learning theoretical base knowledge, tactical training and control of equipment. This part of training goes before practical simulator training and it is one of training methods for given theme.

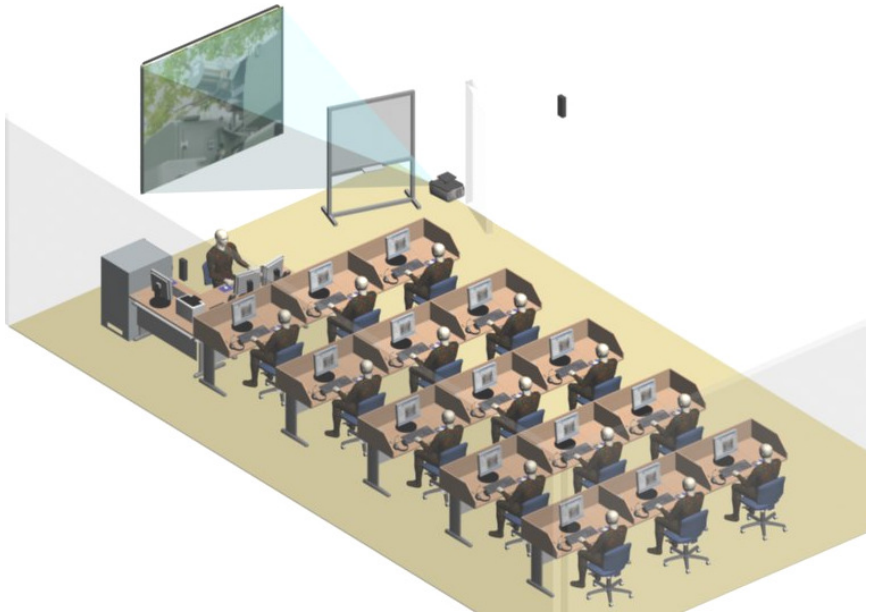

Figure 1: CBT classroom design overview

Basic division of CBT:

- instruction;
- training;
- assessment.

The classroom performs the following:

- using new teaching technology which is designed for self learning of students with minimal instructor interaction;
- use CBT for instructing, training ad accessing trainees in the design, control and maintenance of specified equipment;
- lucidity - lessons used for the teaching are based on multimedia principles, containing images, animations, sounds, texts;
- teaching step by step the training procedures and evaluate the practical results of students;

- testing of students and recording their results;
- project images from external sources by digital projector;
- simple classroom operation.

1.1 Specific requirements for Pandur CBT

The multimedia classroom hardware consists of:

- instructor workplace;
- data server, UPS in Rack;
- students workplaces (15 pcs);
- power network;
- computer network;
- data projector, projection screen.

Figure 2: CBT classroom at work

Main SW parts of modern multimedia classrooms are:

- Learning Management System (LMS) which controls all education;
- Learning Content Management System (LCMS) – tools for lesson creating;
- Classroom Management System.

Learning Management System LMS is a control system which covers set of courses from various fields and controls the learning process. Based on this - instructor can control the training process. Computers are connected via network and communication system and the instructor chooses groups of students, courses, tests, evaluates test results of students and sets various rights and security precautions.

Students can be connected with the other subsystems through the Internet by using a local area network (with the agreement of Administrator).

Learning Content Management System LCMS is a professional system for the creation, sharing and reusing of learning objects and lesson according to the standard SCORM (Sharable Content Object Reference Model).

The base element of learning is lesson. The lesson is compact of blocks and pages. The structural element of page is text, image, animation etc.

The content and the management system should be kept consistently separate. Their mutual interaction should take place only on the basis of an open e-learning standard (SCORM, AICC).

Classroom Management System enable:

- start up and shut down of computers;
- monitoring of students;
- voice communication.

As optimal SW tool for controls of education, lesson creating and system of lesson content was selected product of Kontis company – iTutor.

1.2 Design overview

CBT classroom can be proposed as independent classroom which contains these parts:

- **Instructor workplace (IW)**, which is composed of:
    - **Workplace of instructor -** is meant for management and control of the training – is equipped with tables, chair, computer, LCD monitors, headset;
    - **Data Server –** server computer equipped with UPS unit, LAN Switch, LCD monitor.

- **Student workplaces (STW) -** is meant for active learning and testing of student, is equipped with table, chair, computer, LCD monitor, headset;
- **Audio-video device** included DVD/Video recorder, projection screen, projector, sound system, magnetic white board;
- **Data and Power networks** for power supply for PC and network connection among instructor, students and server computer.

Voice communication between students and lector is provided by Voice Communication System (based on software solution and used HW of given computers).

1.3 Concept of learning and operating

Learning concept is shown in the following diagram.

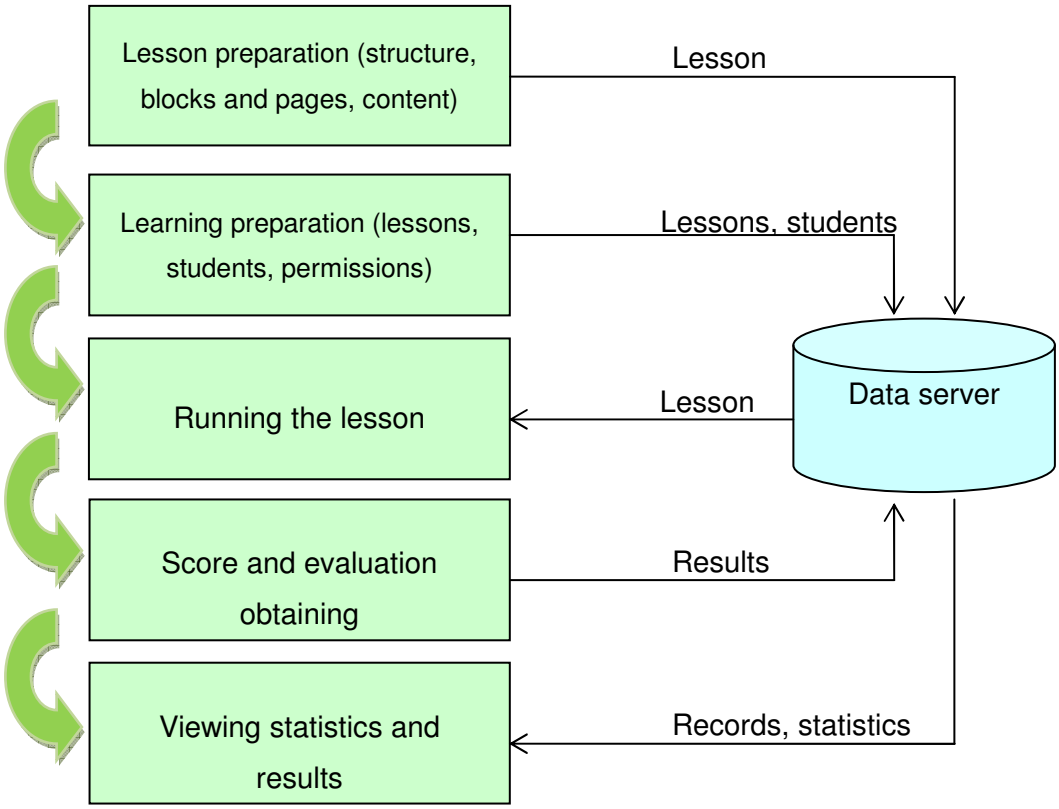

Figure 3: Learning concept diagram

1.4 CBT Classroom Software Design

Modern and perspective solution of CBT supposes that entire SW for CBT is installed on server computer. Every user can use this system via internet/intranet. Every student, instructor, external user has own access, authorization and password. Administrator controls this system.

1.4.1 Instructor workplace software

Main software components of each Instructor workplace (IW) are:

- operating system Windows XP, Internet Explorer;
- additional authoring tools for lesson content:
- MS Office software (Word, Excel, Powerpoint);
- SW for processing of images – Gimp;
- SW for processing of animations and videos– Adobe Flash;
- SW for processing of sounds – Audacity.
- classroom Management software – Vision - enables monitoring of students (parallel image of selected student's monitor), remote control of classroom HW;
- voice communication software.

1.4.2 Data server software

Entire software components for LMS and LCMS are installed on server computer:

- OS for server - Win SBS Std 2003 R2 Cz (included SQL database, IIS – Internet Information Services);
- iTutor LMS – Learning Management System;
- iTutor LCMS – Learning Content Management System;
- MS Office (Word, Excel, Powerpoint);
- classroom Management Software - Vision.

1.4.3 Student workplace software

Main software components of each Student workplace (IW) are:

- operating system Windows XP, Internet Explorer;

- classroom Management software – enables monitoring of students (parallel image of selected student's monitor), remote control of classroom HW;
- voice communication software.

1.4.4 Overall architecture

Overall architecture represents relationship of all user of system – see following picture.

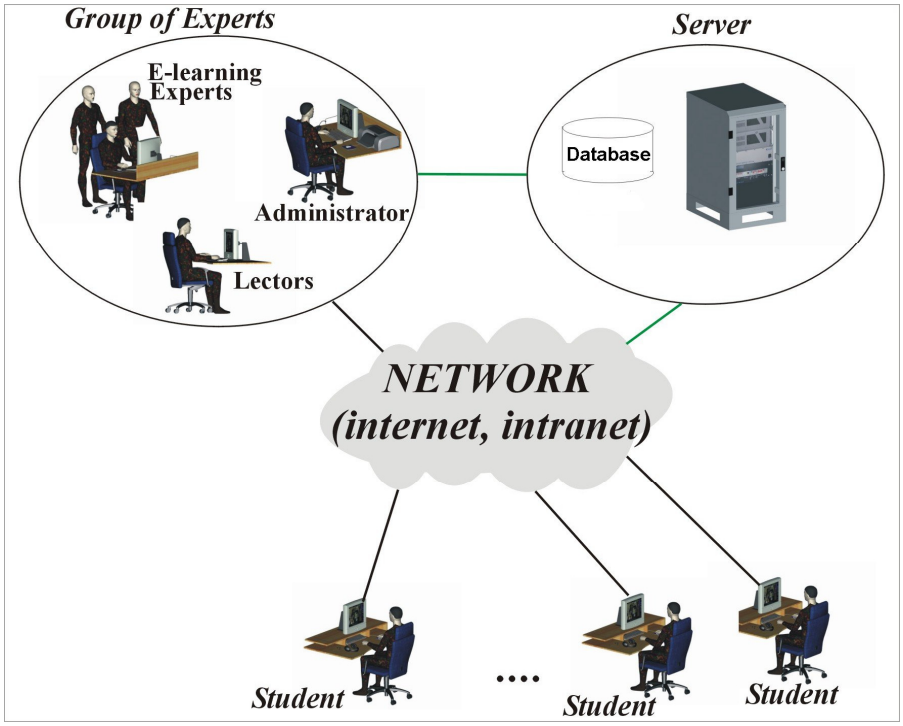

Figure 4: General Architecture of CBT system

The architecture is described mainly by the client – server principle, where all data are stored on local/remote server which has many advantages when the user applies systematic approach of use. The main advantages (when comparing to local databases storage and access) are:

- data is securely stored on server with RAID arrays with automatic backup;
- server is powered via UPS which increases data security and extends time for save;
- data for all students is updated by instructor immediately;
- instructor can work on lessons from his office;
- students can access lessons from different workplace or from home;
- server can be serviced remotely (in some case);
- lector has all evaluation data available from any workplace at any time.

Block SW scheme

Scheme of SW installed on server side (data server) of network and of client side (instructor, student computers) of network is on following image.

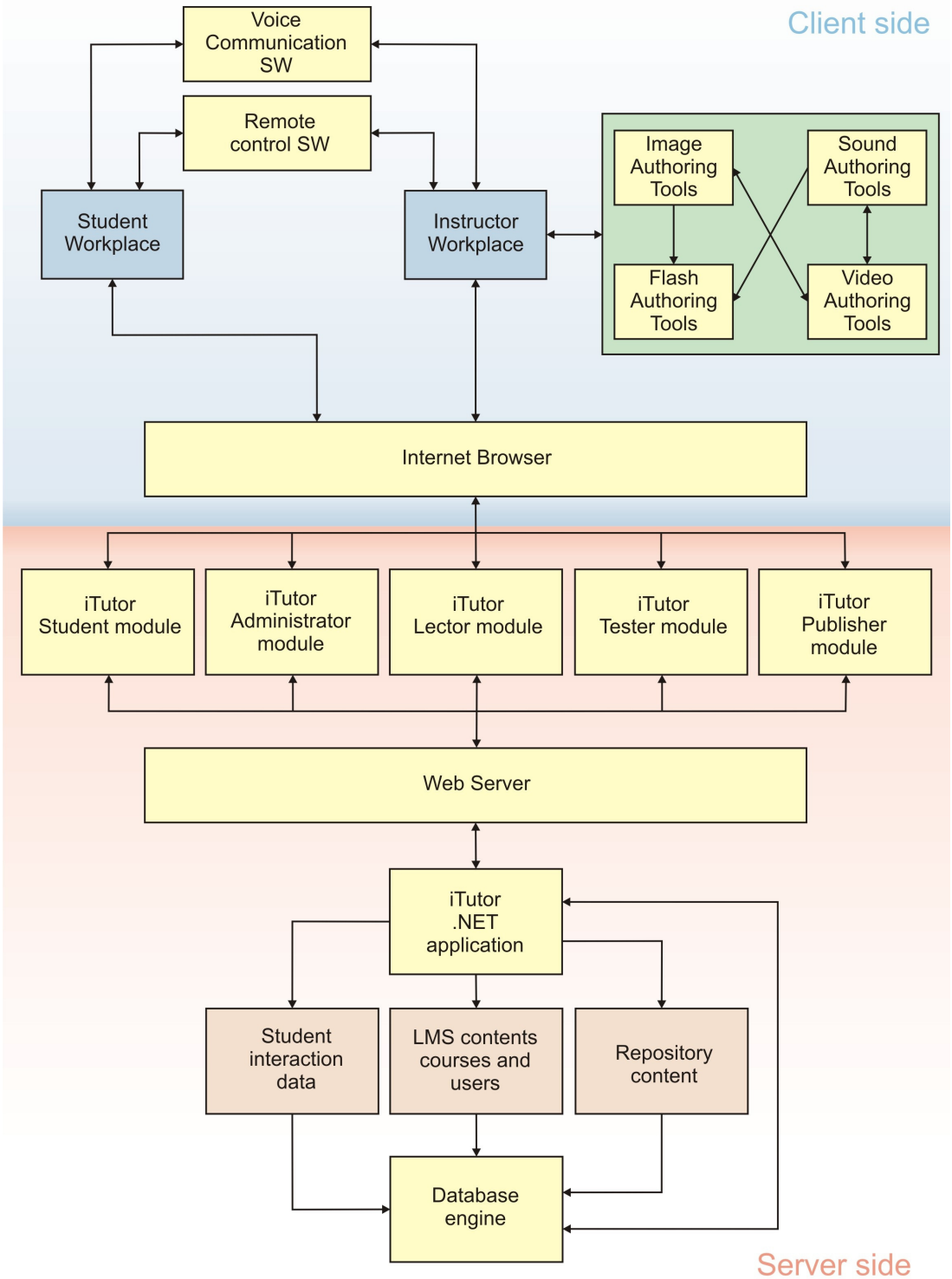

Figure 5: Block SW scheme

1.5 Instructor workplace HW design

Instructor workplace (IW) presents primary point of student control. There is one IW for each classroom. This place is used by group of experts, instructors and other accredited workers.

- Instructor workplace includes:
- table, chair;
- instructor computer;
- LCD displays, keyboards, mouses;
- loudspeakers,headset with microphone;
- DVD/Video recorder;
- colour laser printer.
- server computer with UPS unit in Rack;

Figure 6: Instructor workplace

1.6 Student workplace HW design

Student workplace (STW) presents primary point of student theoretical education. There is 15 STWs for typical classroom.

STW consists of:

- work table and chair;
- student Computer in PC holder;

- keyboard, mouse, LCD Monitor;
- headset with microphone.

3D models of STW is shown on following figures.

Figure 7: Student workplace

1.7 Audio-Video System

Projector is connected to lector computer and is controlled by remote control.

Projection screen is mounted on the wall. DVD/Video recorder is placed on instructor table.

Equipment includes:

- projection screen;
- projector;
- sound system;
- magnetic White board;
- DVD/Video-recorder.

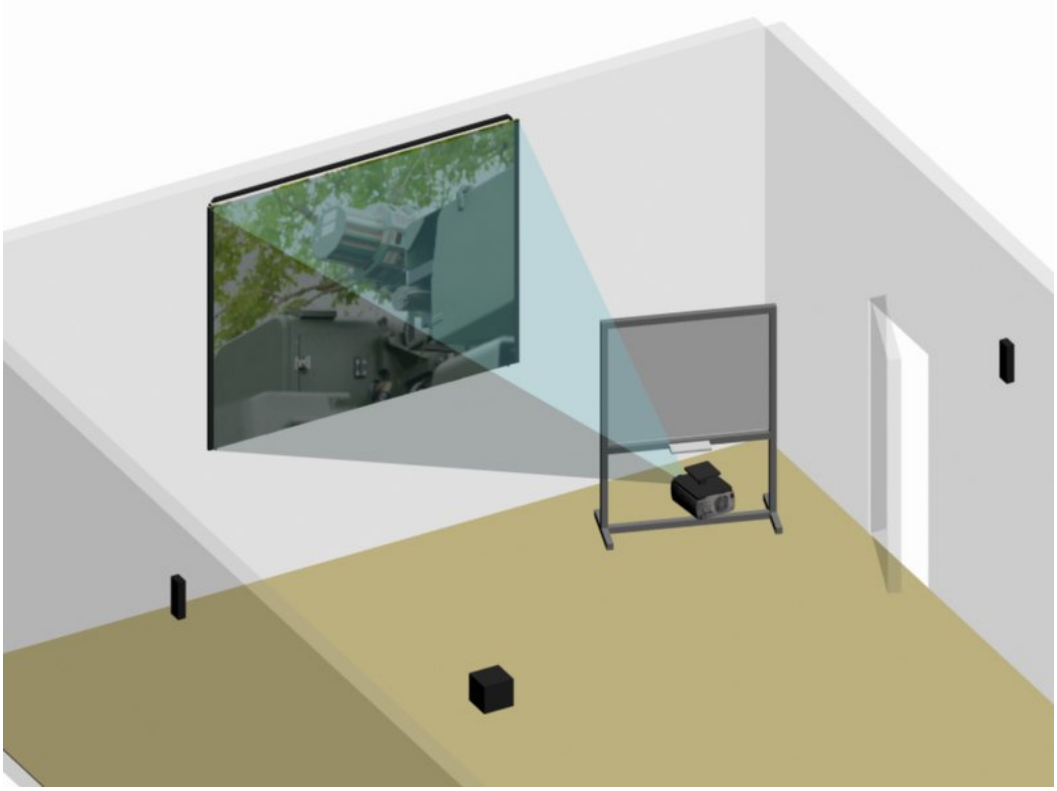

Figure 8: Projection system and whiteboard design¨

1.8 Instructor workplace software design

Software Tools used by administrator, instructors and other authorized workers include:

- on server computer:
    - server Operating System;
    - iTutor LMS - Learning management system;
    - iTutor LCMS - Learning content management system;

Installed Operating system guarantees:

- OS reliability, easy tools and firewall;
- data sharing, printer and application sharing;
- firewall for multi-layer security;
- internal firm web (intranet);
- automated update services;
- powerful, integrated, data management, database.
- on instructor computer:
    - OS Windows XP;

- Office tools (MS Office – Word, Excel, Powerpoint);
- additional authoring tools for lesson creating;
- classroom management SW;
- voice communication software.

Administrator, instructors and other authorized workers use iTutor Administrator module, iTutor Lector module, iTutor Tester module and iTutor Student module.

Voice communication is also based on software solution.

1.9 Student workplace software design

Student workplace presents the base of student theoretical learning.

On student computer:

- OS Windows XP;
- classroom management SW;
- voice communication software.

Student uses iTutor Student module for login, learning, testing and other tasks.

1.10 Learning management system – iTutor LMS

Following chapters give information about iTutor LMS – information and possibilities. Detail description of iTutor is in iTutor manual (part of final delivered documentation).

Learning Management Systems (LMS) manage training is used by instructors, administrator, students and other authorized users. Every user use efficient iTutor module.

iTutor is e-learning platform for learning. Thanks to the unified architecture with a central database and integral security infrastructure, it is a unique solution allowing to organize and manage the whole learning process effectively including individual study of electronic courses and materials, synchronous learning in virtual classes and standard learning in classrooms.

Modular architecture enables gradual integration of individual functionalities. iTutor platform would consist of following modules:

- iTutor Administrator;

- iTutor Lector;
- iTutor Tester;
- iTutor Student.

Administrators, instructors, students and courses developers access to iTutor system placed on the data server through web interface – Internet Explorer browser.

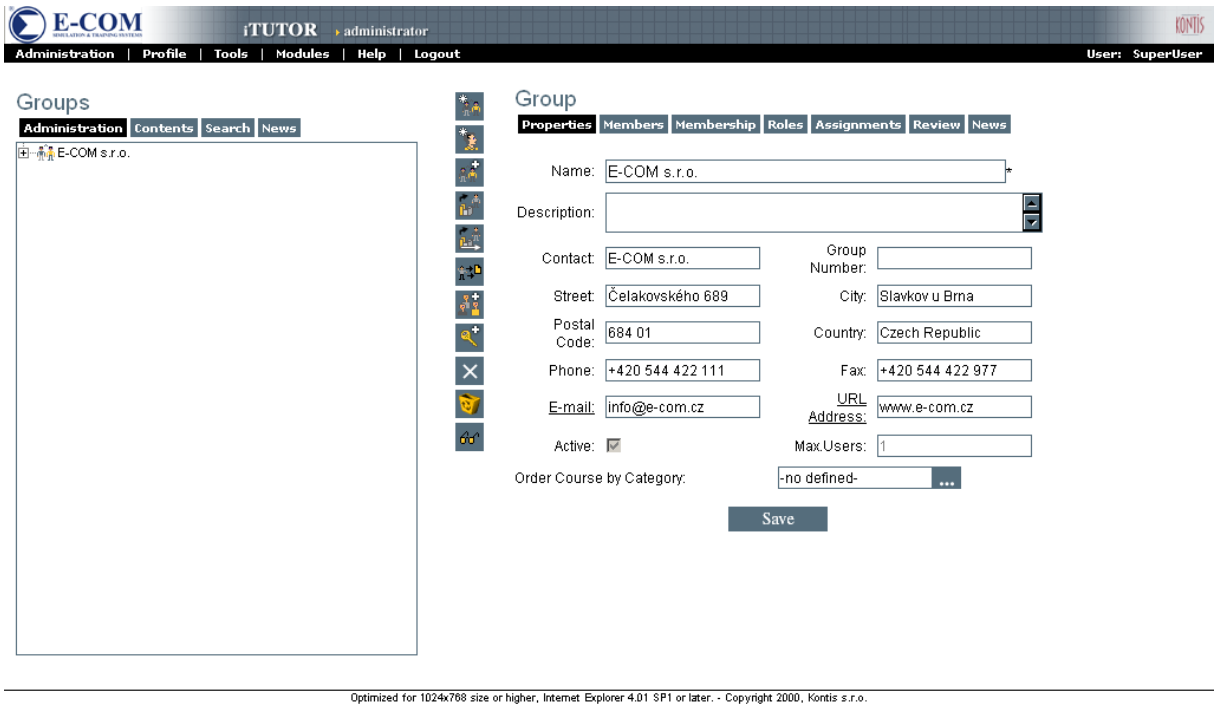

Figure 9: Access to iTutor system through Internet Explorer

1.10.1 Basic terminology

AICC – is complete rule set, which describe individual interactions between learning programs and management system. Course has to meet AICC standard to be able run in LMS compatible systems.

SCORM - (Sharable Content Object Reference Model) is a group of specification created by ADL organization (Advanced Distributed Learning). The key idea of SCORM is categorizing the course content to small segments (learning object). These segments can be used more than once. SCORM is base format for export from iTutor application.

Category – is an element, which can contain courses or other categories. Hierarchic structures can be built.

Course – is learning element teaches a complete topic. Each course consist of lessons.

Lesson – represents a training unit, which you can run – i.e. a training program which students run and study. Individual lessons are organized to courses. Lessons can be set as **synchronous** (running is time limited (for example – one given hour for all group of students), or **asynchronous** – running is time unlimited.

Sco – term used for one page of lesson.

Administrator - worker from user (customer) side, which is trained by producer to administrate the iTutor system. This person is able to create user rights or change settings of LMS.

Instructor - responsible worker from user (customer) side, which is trained by producer to use the CBT classroom. This person is able to lead training in CBT classroom.

1.10.2 iTutor LMS - Module Administrator

This module has been designed for administrators, lecturers, learning managers and all other users organizing, managing, planning and evaluating the learning process. It allows them to create, administer and analyze all subjects and processes related to learning centrally. Administrators take care of the organizational structures, qualifications, course structures, learning time schedules and source capacities as classrooms. Instructors can find here all the data and communication channels necessary for learning.

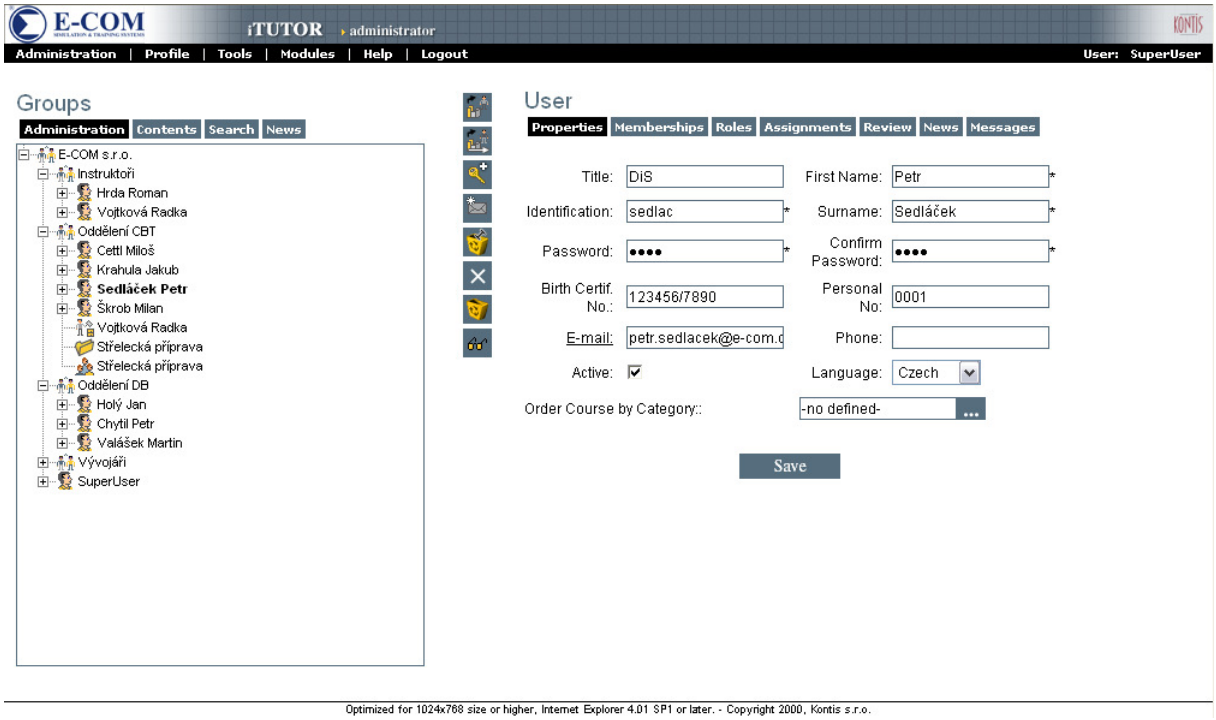

Figure 10: Example of iTutor Administrator window

iTutor Administrator enables to:

- model the school structures from a number of viewpoints as organizational structure, work position, study categories, etc;
- define the required skills, qualifications or knowledge categories and input them into the organization structure;
- model the learning course structure and logical conditions of passing the study;
- assign courses to individual departments, users or qualifications;
- plan time schedule of learning activities and capacities ;
- define and administer a number of communication channels - e-mails and messages;
- set up security rules, roles and rights of the users;
- import data on structure, courses and study from external sources;
- analyze all data, print or export them;
- search through all the data in the system;
- set up features of the system parametrically.

1.10.3 iTutor LMS - Module Lector

This module has been created for instructors. It offers easy, intuitive and instant access to all information, which they need for direction of the learning and students assigned to them. In one place and in a simple and user friendly environment the instructor finds all the data and functions, which he needs for learning in a standard classroom or within electronic learning. Instructor can classify the students, create records on learning in classes and communicate with the students via e-mails.

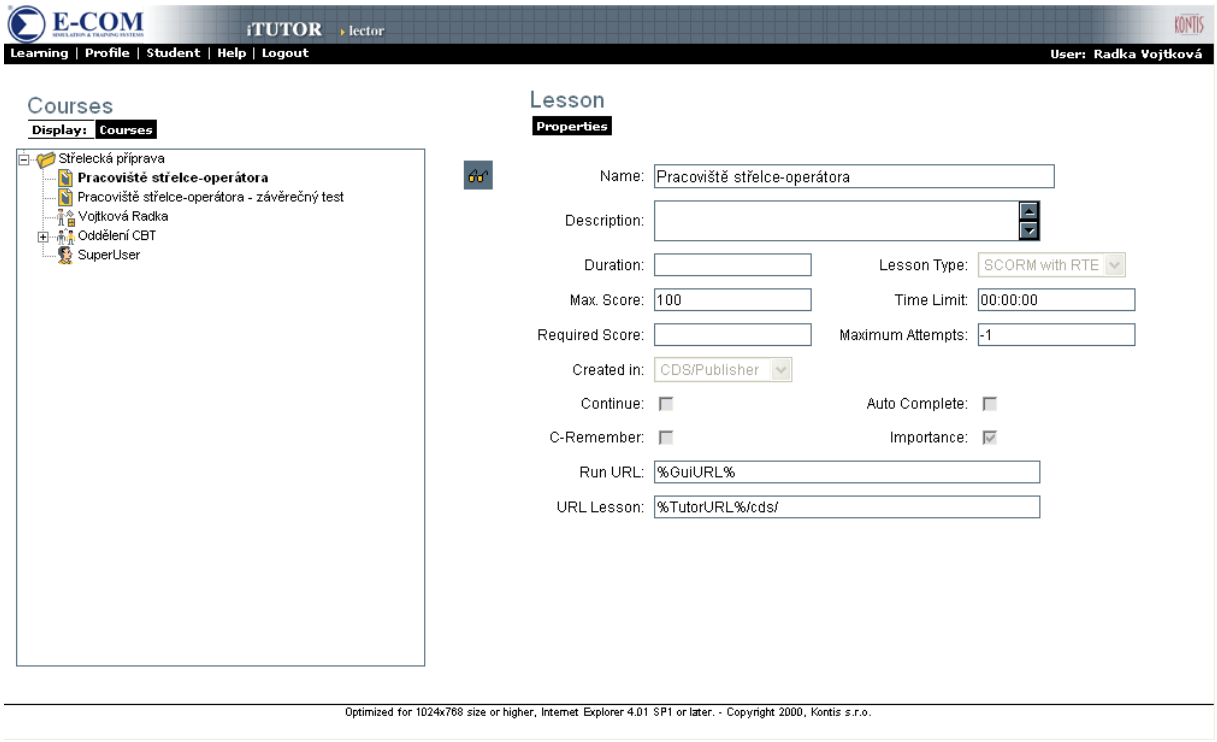

Figure 11: iTutor Lector window example

iTutor Lector enables instructors to:

- view and classify the achievements of the students;
- communicate with students and other instructors via e-mail or personal messages;
- create records on classroom learning;
- analyze study data, print or export data;

1.10.4 iTutor LMS - Module Tester

This module has been developed for test and questionnaire creators. It allows them to organize test questions of different types in the database and then to generate tests from this database based on defined rules. It is possible to organize questions in the database hierarchically. Rules for generating tests from this database allow you to use a number of question selection methods and a number of parameters influencing the final form of the test. Without any knowledge of programming, users can create interactive electronic courses or questionnaires quickly and effectively.

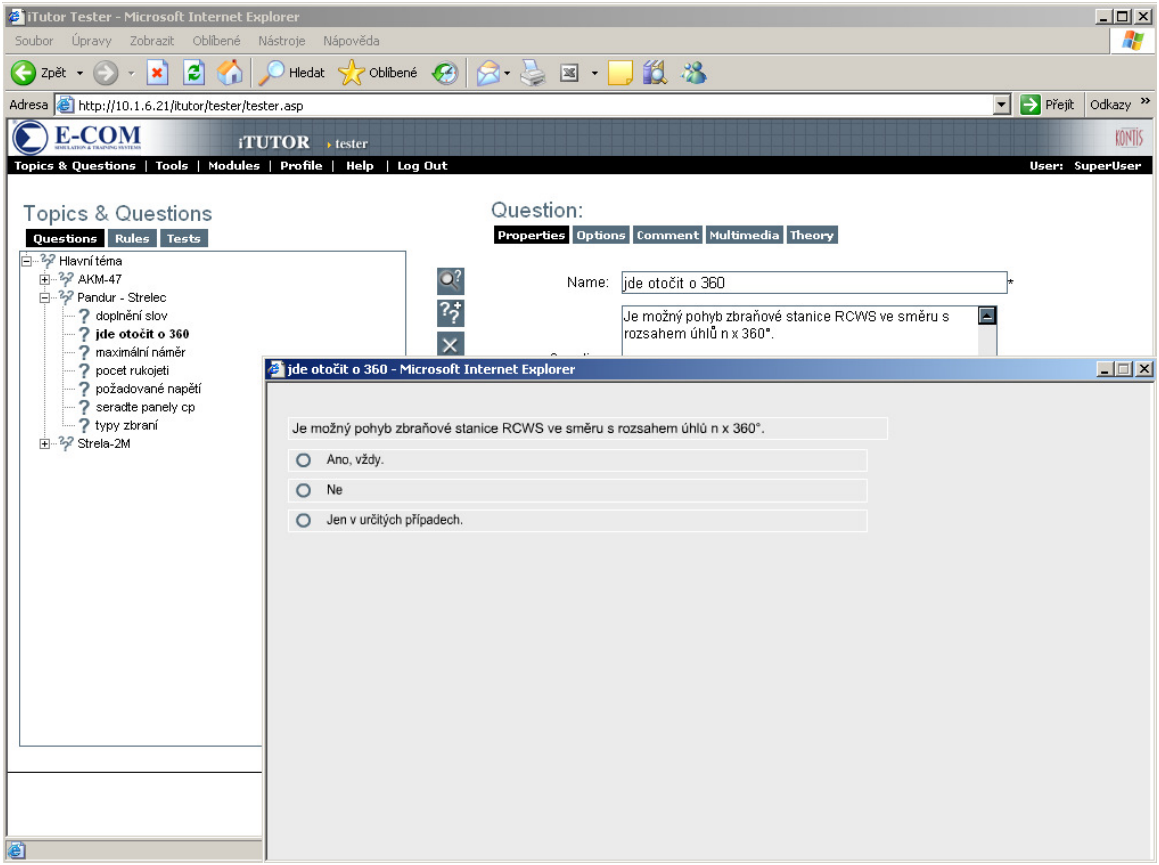

Figure 12: Example of iTutor Tester - Question preview

iTutor Tester enables the test creators to:

- input a number of question types through intuitive forms with e.g. multi-choice answers; input numbers or words, categorize elements, supplementary tables, drag & drop questions or crosswords;
- import question databases from external sources;
- organize and categorize questions in a hierarchic database;
- define rules on test creation from the question database and use rich possibilities of question selection from accidental selection and selection from groups up to marking specific questions to set a number of parameters influencing the final form of the test;
- generate tests including creating and saving records on these generations, print all data on questions and tests.

1.11 iTutor LCMS – Learning content management system

iTutor Learning content management system (LCMS) is a professional system for the creation of course. Development takes place via an internet browser from any connection point. Intuitive user environment, drag&drop creation and WYSIWYG behaviour make this tool a highly effective development.

iTutor is able to export SCORM compatible courses or courses based on AICC. It can also export even courses that do not require a LMS (CD, intranet, Internet). During the simultaneous use of iTutor LMS other advantages arise, such as direct accessibility of the question band iTutor Tester, disappearance of the need to export/import courses and the automatic registration to the students of changes in the contents.

ITutor LCMS is composed of modules of **Publisher** for the visual creation of courses and **CDS** for the consolidation of content in the repository.

Course developer run under web browser both these modules simultaneously – as an **iTutor CDS/Publisher** module.

1.11.1 iTutor LCMS - Module CDS/Publisher

Publisher - This module has been designed for electronic course creation. Without programming or HTML knowledge, the author can take full control over creation of multimedia and interactive presentations, electronic courses and additional materials. They run under the web browser.

CDS - It enables to consolidate all learning contents to a central shared repository place. The content is organized in the repository to shared content objects. The content object can be a simple text document, picture, video or sound, animation, page of the course or complex package of the learning material. All learning objects can be used in other courses and learning objects regardless of their size and complexness.

1.11.1.1 Basic terminology

Base terms from the field of electronic course development are described here.

Learning object – simple text, document, image, video, sound, animation, lesson page.

Sco – represents one page of course (lesson).

Asset – is object, which is drag from toolbox objects and drop into page (sco), it has defined parameters (size, formatting..) and is stored in database.

Drag&drop – methods, how to move object by using mouse.

WYSIWYG – „What You See Is What You Get".

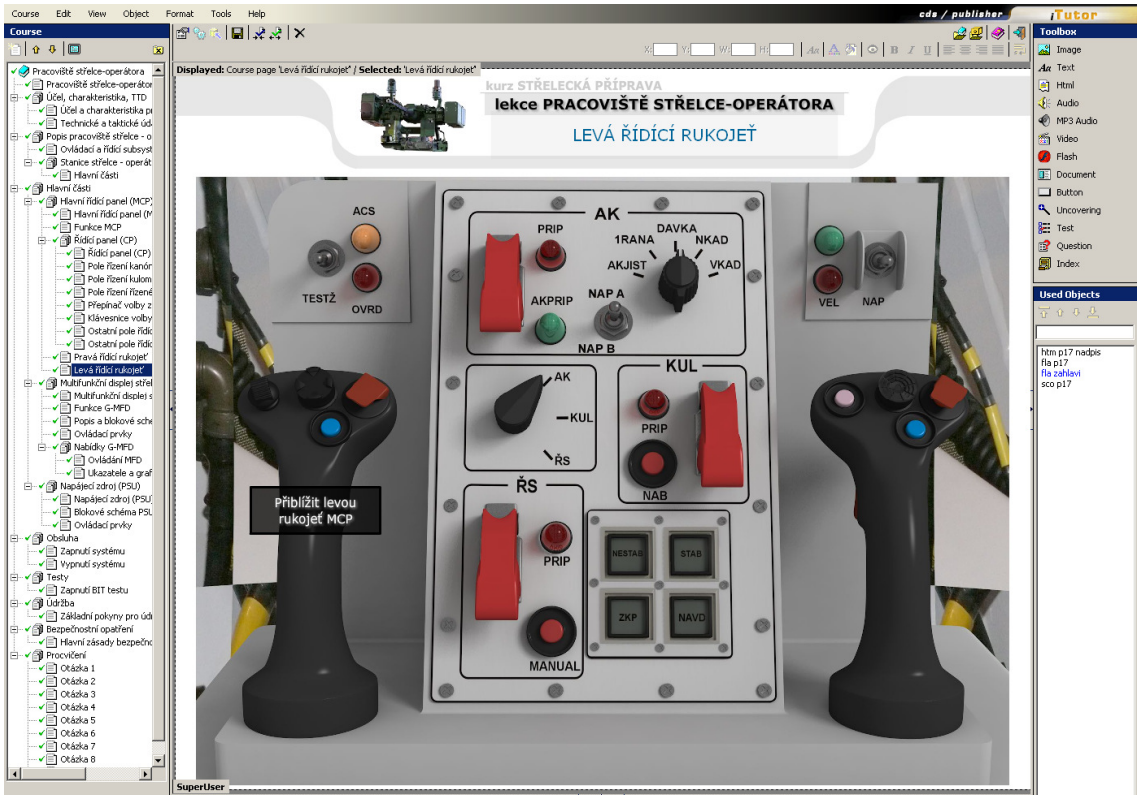

Figure 13: Example window of iTutor CDS/Publisher module

iTutor CDS/Publisher enables to:

- define course structure of pages and blocs;
- drag & drop place a number of objects on the pages – texts, HTML, buttons, pictures, animations, video or sound (such inserting object is called as **asset**);
- set up object features and behavior – size, fonts, colors, key or mouse button shortcuts, add user features to objects;
- drag & drop create interactive questions or interlink the pages directly with tests created in iTutor Tester;
- define behavior and reactions of objects to a number of events as object loading, key click, mouse click or move – using just Wizard with no need of programming;
- check the course functionality in WYSIWYG immediately, export SCORM compatible courses.

iTutor Content Development Server enables to:

- structuralize contents to shared content objects SCO according to SCORM standard;
- edit and organize learning objects within the central repository;
- search and re-use shared content objects in other courses;
- administer shared content objects versions, archive individual use of versions in courses and update courses to new.

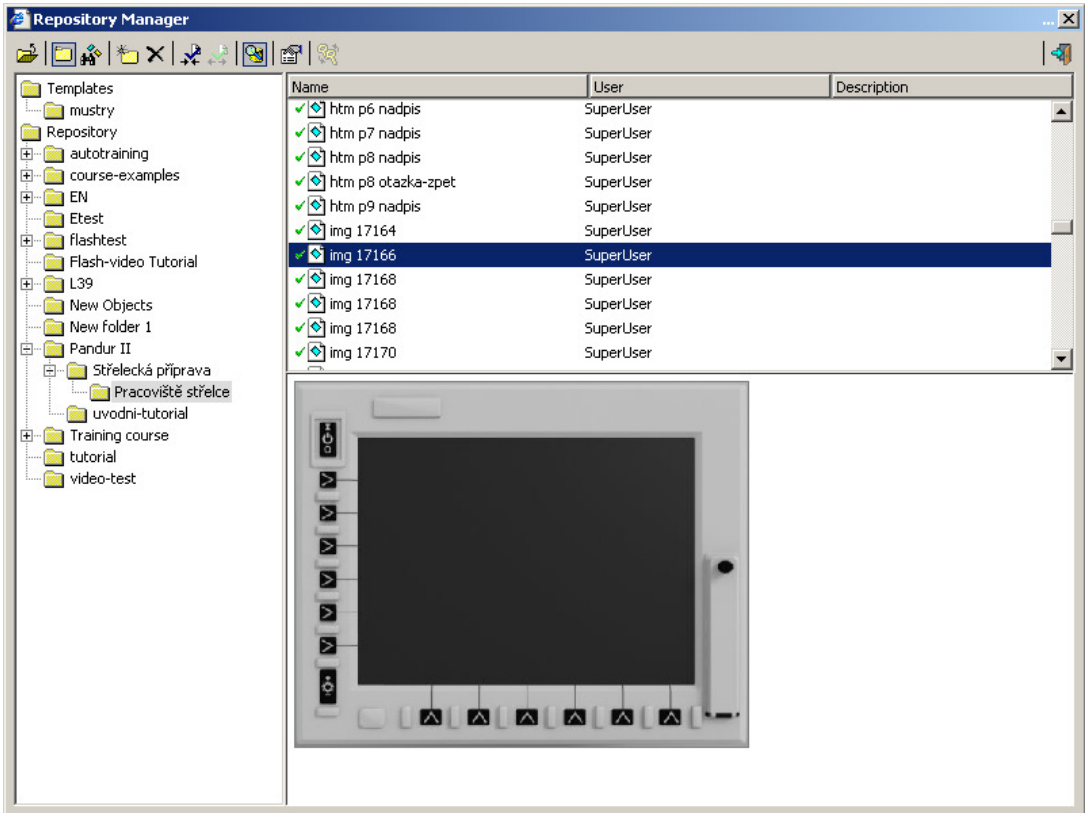

Figure 14: CDS Repository- Storage of all objects in course

1.12 Classroom management system

Classroom management software Vision is installed. Main function via easy icons enables:

- **monitoring of students;**

Remote control software allows instructor to view and interact with one computer (the "server") using a simple program (the "viewer") on another computer anywhere on the Internet. Instructor can see any actions that occur on the student computer by a local user.

SW enables to:

  - monitor and control PC use across entire class;
  - switch over students computer screen;
  - check student activity.

- **classroom Shut Down;**

Shut down and restart of student computers from instructor workplace.

- **file distribution and collection.**

Distribute files or assignments to student computers from instructor computer.

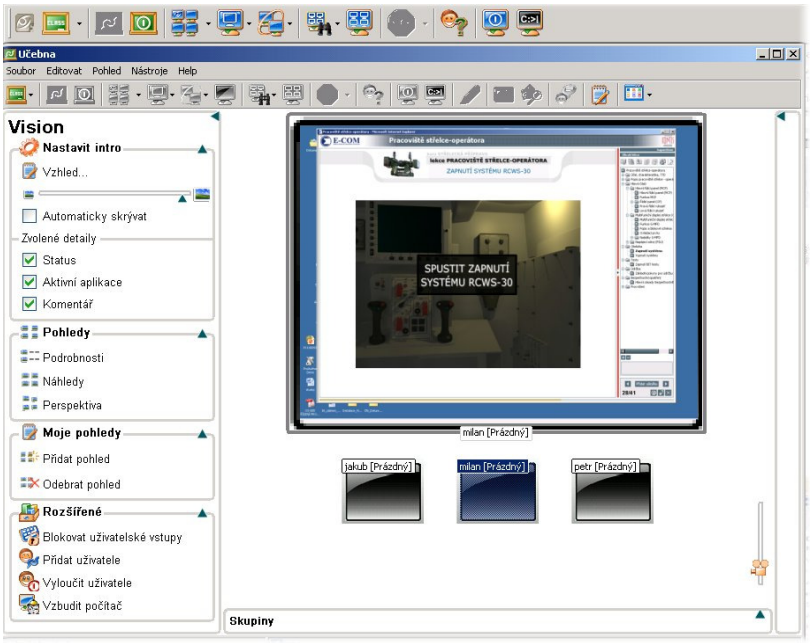

Figure 15: Classroom management software –GUI example

1.13 CBT classroom Voice communication system

Voice communication system provides voice connection between instructor and students.

Communication system uses standard COTS (Commercial Of The Shell) components - headsets with microphones, sound cards, network cards used in standard PC. There is no special hardware used.

Voice is transferred through standard computer network using DIS protocol (IEEE 1278.1). Voice quality is equal standard phone quality - sample rate 8000 kHz, G.711 encoding.

Functionality is provided using E-COM software developed for distributed voice communication.

1.14 Training

At first, this module contains blocks (pages) with general description. Purpose of this part is to introduce the student to function, main parts of workplace, TTD. Next parts are blocks (pages) with functional sequences of actions and safety precautions. Last part is the training block (practice module).

Page navigation is placed on the left part of lesson window.

Processed training pages choice follows:

1.14.1 Instruction

Introduction to main goal of lesson and short overview of processed information – see following figure.

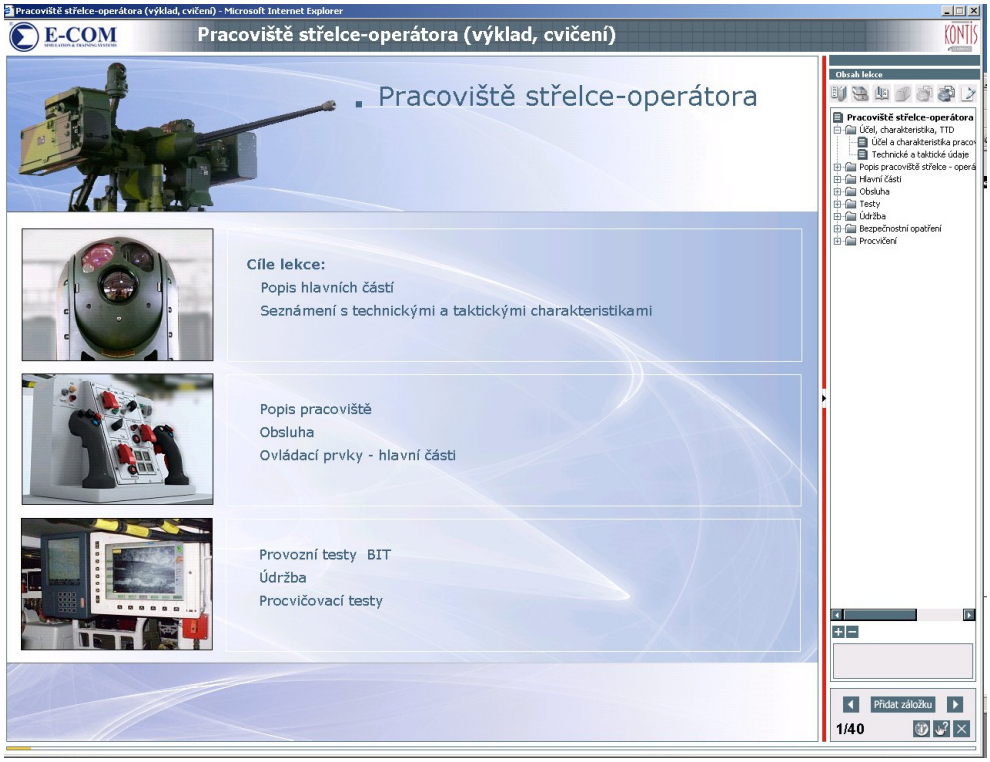

Figure 16: Example – Lesson content

Example of one from introductory pages, there is a comment to introduce student with organization, main functions and parts of workplace – see following figure.

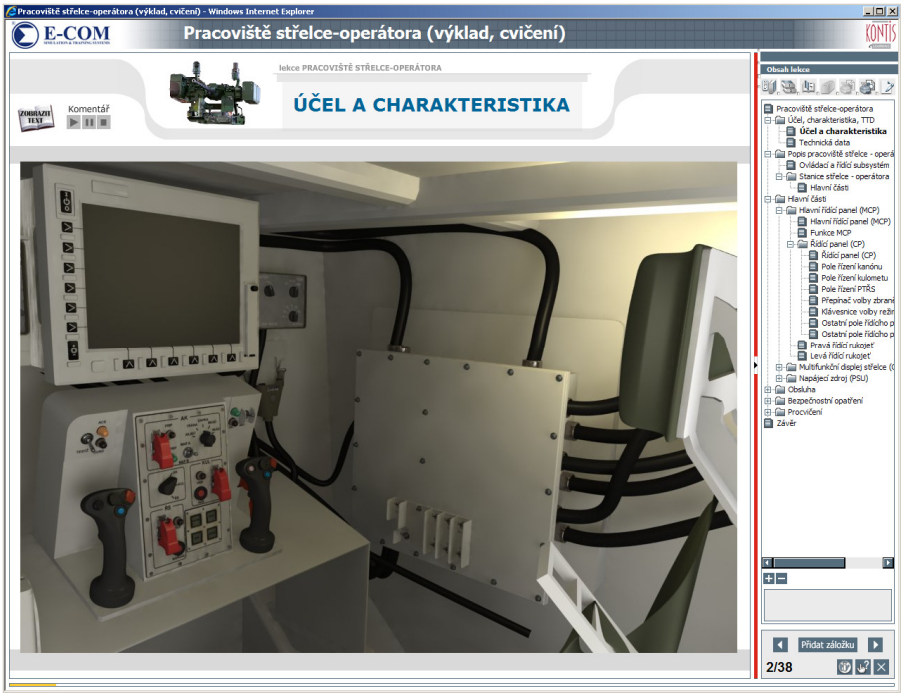

Figure 17: Example – Introduction

Example of page with description, TTD. By clicking on „Zobrazit text“ (Show text) icon is possible to view the comment in text form. By clicking on comment icon is possible to stop the comment or start it again.

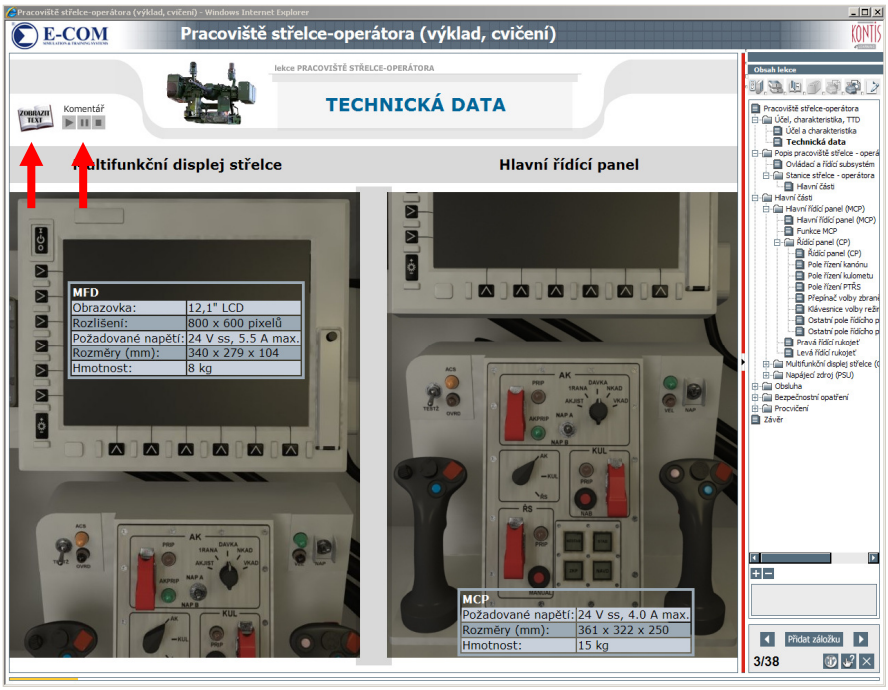

Figure 18: Example – TTD

Description of control items with the possibility to obtain detailed information.

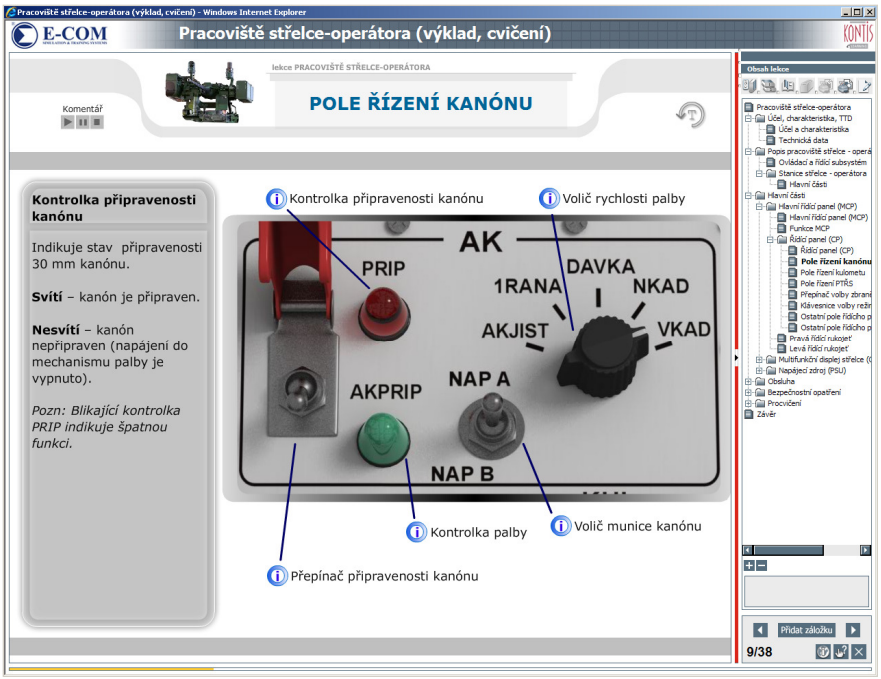

Figure 19: Example – detailed description

After page load, the comment is started and all functions of displayed object are described. Information about object function can be obtained by putting mouse over functional parts of display. Example from operation section - functional actions sequences of system start are performed by commented animation.

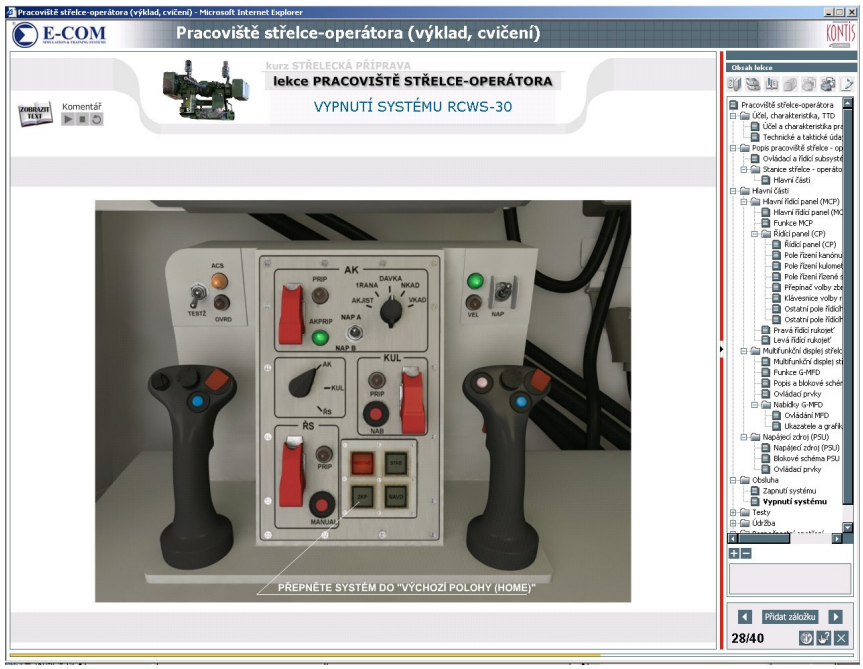

Figure 20: Example – action sequences

Example of page with safety precautions description.

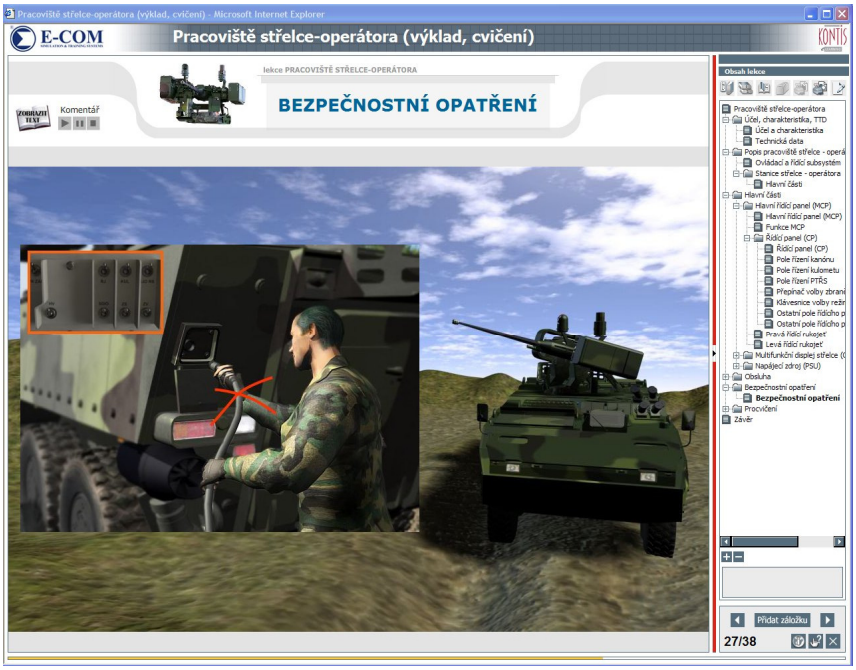

Figure 21: Example – safety precautions

1.14.2 Training

It is the last block of this lesson. There are some questions from theory of this lesson. There are text questions with choose from up to 10 possibly answers. If the answer is not correct, the system displays page with theory, where student can find the right answer. After studying theory again, student can go back to question.

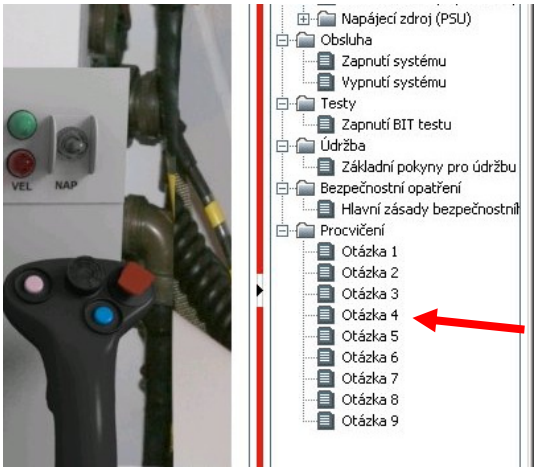

Figure 22: Practice block at end of lesson

Page with question can contain pictures or animations.

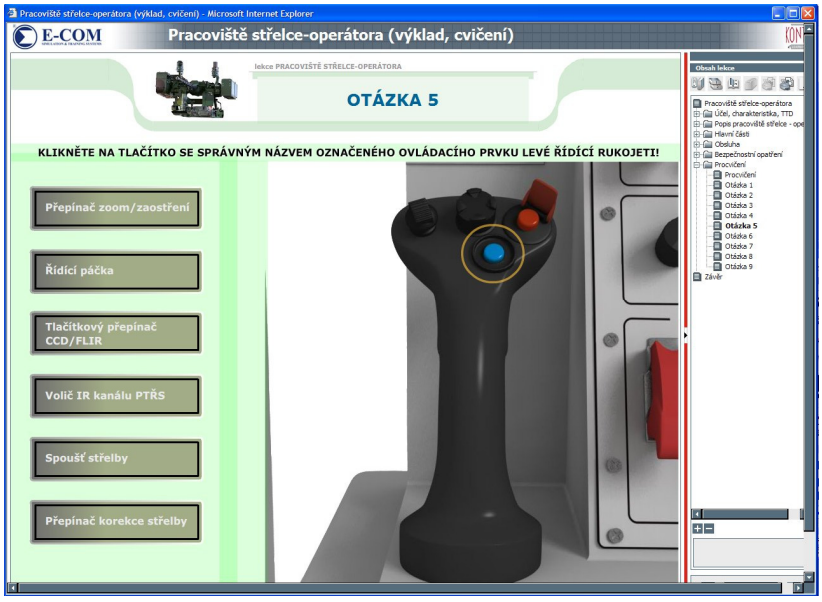

Figure 23: Example – Question from practice block – click on right answer

1.14.3 Assessment

This module purpose is to check-out the obtained knowledge in defined time. Block of test questions contains different type questions (simple choice, multiple choice, text filling, drag the text, items ordering, crossword …).

At the end of test, the result is displayed to student. This result is also stored in LMS database.

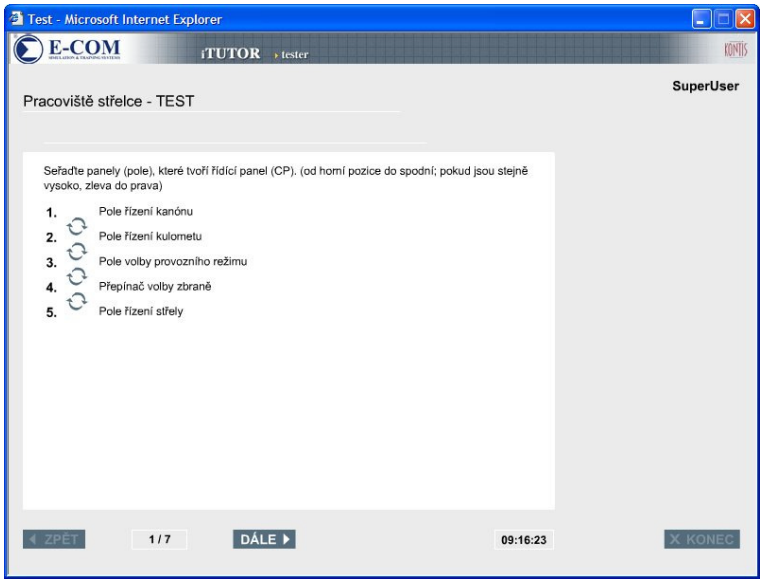

Figure 24: Example – Final test – sort items

Example of “multiple choice” question type:

Question contains picture, which can be displayed in full size by clicking on thumbnail.

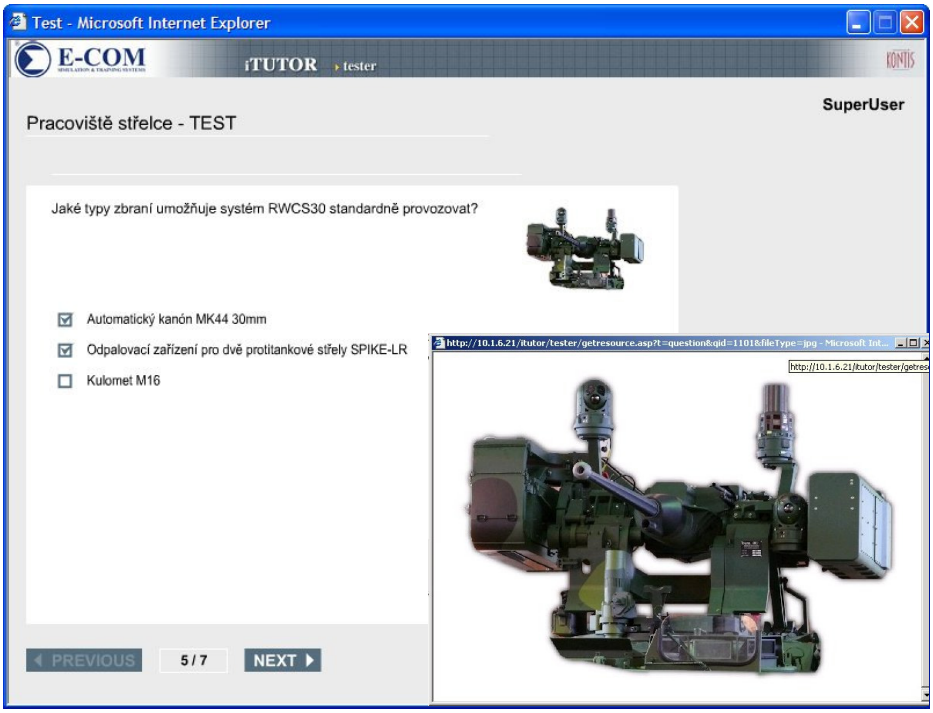

Figure 25: Example – Final test – question with picture

Student results are displayed after finishing the test.

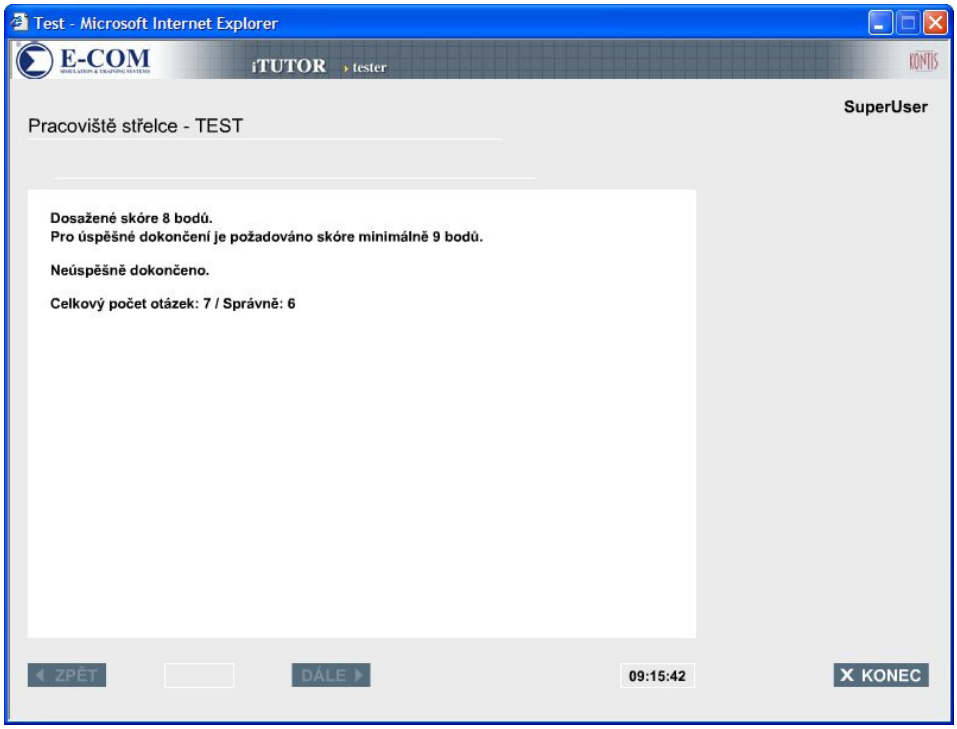

Figure 26: Example – Student results of final test

2 WEAPONS SIMULATOR

2.1 Specific requirements weapon simulator

Weapons simulator is designed for training of commanders and gunners of Pandur vehicle. Training on this simulator is next step after training on CBT and before training on crew simulator. The training is based on practical use of devices and procedures used in real vehicle, but with the benefit of effectivity, safety and ammunition, fuel and other costs saving. One instructor can teach up to three crews simultaneously, so even instructor time is saved.

Figure 27: Weapons simulator

Weapons Simulator “SS-KBVP” is especially designed to train especially controlling of weapon system of RCWS-30 Rafael by commander and gunner-operators.

The main training possibilities are:

- Training of correct handling and operation of commander and gunner-operator devices, including Fire-control system (FCS);
- Acquisition and strengthen of psycho-sensorial and psychomotor behavior in the operating of FCS instrumentation when searching, identifying, aiming and application of fire;
- Individual training of the commander and gunner-operator and the training of mutual cooperation between both crew members in searching, identifying, aiming and application of fire;

- The instructor determines the progress of the training, monitor the fulfillment and evaluation of training exercises. Instructor is able to record training exercise. It is possible to control the training session using the training management system;
- Training solution for the basic firing situations and gain experience in the area of combat decision-making to solve exacting and complex situations of combat scenes in the circumstances of independent combat activity and also under the terms of the platoon combat activity;
- Improvement in fire application at day, night, in low visibility – fog, rain, snow, etc.
- Joint training of all three crews.

2.2 Design overview

Weapons simulator consists of two main parts:

- Three Commander and gunner-operator cabins on fixed base
- Instructor operator station

2.2.1 Commander and gunner-operator cabin

Commander and gunner-operator compartment is a lightweight replica of cabin compartment, designed for integration with fixed base. It is made of fibre-glass laminated non-dismountable to steel superstructure.

Commander and gunner-operator cabin is equipped with all instruments necessary for operating with weapons system, diagnostics, communication system, etc.

Figure 28: Commander and gunner-operator cabin

Basic units of replicated devices of commander place:

- (1) N/C Detection RAID-XP
- (2) VHF radio RF13250 (non-functional replica)
- (3) Display and control unit FVZ-98M
- (4) Tablet PC (non-functional replica)
- (5) Smoke grenade launcher control unit
- (6) Multiple threat and detection system (MTDS) display
- (7) GPS DAGR (non-functional replica)
- (8) Battle management information system CDU-BVIS
- (13) Manual release fire suppression system (non-functional replica)
- Communication system:
    - (14) Master Communication unit VICM-101
    - (15) Control unit VICM-102D
    - (17) Crew Chest Unit VICM-109C
    - Personal Headset
- Commander's seat
- (20) Interior lights
- Emergency lights
- Weapon station RAFAEL RCWS-30:
    - (10) Commander's Multi-functional Display (MFD)
    - (9) Commander's Control unit
    - (23) Basket switch

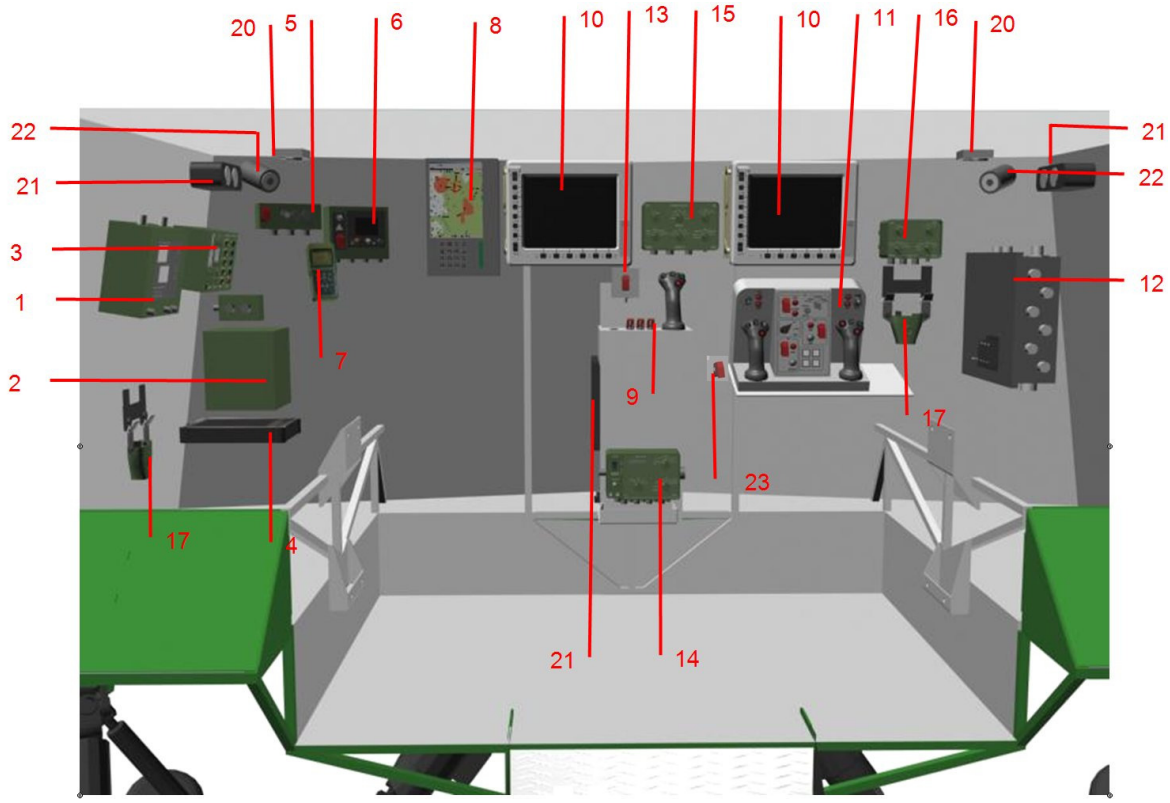

Figure 29: Replicated devices

List of replicated devices of gunner-operator place:

- Communication system:
  - (16) Extended Communication Unit VICM-103D
  - (17) Crew Chest Unit VICM-109C
  - Personal Headset
- Gunner-operator seat
- (20) Interior lights
- Weapon station RAFAEL RCWS-30:
  - (10) Gunner-operator Multi-functional Display (MFD)
  - (11) Main Control Panel (MCP)
  - (12) Power Supply Unit (PSU)

Student activity (positions of controllers) and setting of indicators values is performed by Data Acquisition System (DAS), based on E-COM universal electronics control cards (communicating on RS-485). This system is specially developed and tested for simulators and introduced in Czech army for many years (trainers and simulators T-72M4Cz).

Cabins are also equipped with sound system for simulation of sounds.

Intercom communication is simulated using replicated intercom devices – crew can communicate with each other, with instructor and also with another simulators crew if the simulators are connected to common DIS network.

Installed devices provide full control of observing, weapon and communication system of the vehicle. Description of particular components is not purpose of this document, more important is to explain the other parts of simulator and mainly SW functions as mainly SW makes this equipment useful for effective training.

2.2.2 Instructor Operator Station (IOS)

The whole simulation and related activities are controlled from Instructor Operator Station (IOS).

The following picture shows the design of Instructor operator station.

Figure 30: IOS workplace design

IOS workplace contains:

- **19" Computer rack** with following components:
  - Switch board with main switch
  - IOS computer (IOS PC)
  - IOS Image Generator (IOS IG)
  - Other computers components (LAN switch, etc.)

- **IOS table** holding all instructor tools. The table has cable holder installed in bottom side, which reduces the quantity of cables on top side of the table
- **Color printer** connected to IOS computer
- Three **24" LCD displays** - left and middle monitors are both connected to IOS computer and are used for complete simulation controlling. Right monitor is connected to IOS IG computer and instructor see here virtual terrain database. The view in database is controlled by joystick
- One **17 inch LCD display** connected to quadrator output. It displays the view on single students, or reduced views of more students at once according to quadrator setting
- **Quadrator** into which camera cables are connected from student places (6x) – quadrator output is connected to 17" LCD
- **Joystick** connected to IOS computer for control the 3D view at right instructor's monitor.
- **Keyboard and mouse** connected to IOS computer. Instructor controls the simulation using this keyboard and mouse
- **Headset with microphone** (Headset) for communication with students.
- **Standard loudspeakers** for noises replaying and intercom.
- **Microphone** for communication with students without use of headset.
- **CENTRAL STOP** button for emergency simulator stop.
- Instructor's **wheel chair**

2.2.3 Terminology

Explanation of some terms that are used in following text:

Virtual scene – is an image of virtual world or environment in which is simulated object (Pandur vehicle) in the exercise placed.

Entity – it is an object, which is displayed in virtual scene, but is not permanent part of terrain database, can move (except entity of static type), can be predefined in exercise scenario, it is possible to display its properties (for example position or orientation)

Computer controlled entity – entity its behavior is controlled by computer and which has the detail predefined action plan script – list of commands

Manually controlled entity – vehicle, which behavior is direct dependent on commanders and gunners activities – it is controlled by them

Semiautomatic entity – entity that represent Pandur vehicle - it is manual controlled entity, where is driver missing and his function compensates computer. Movement of the entity is the same as at computer controlled entity

Autonomous mode – only entities predefined in scenario engage the exercise. Simulator is not connected with others simulators

Regime controlled with tactic simulator – regime where simulator entity is part of tactical simulator training via DIS connection (not realized at Weapon simulator)

TMS (Training Management System) - Exercises are grouped into logical packages that have some logical relationship. In automatic TMS are exercises from one package started automatically, in manual TMS are started by instructor

Exercise time – time related to exercise flowing. It is possible to pause it (by exercise pausing), and release

2.2.4 Main Menu Screen

Purpose of this document is not to describe the SW, but to give at least brief information I added at least some basic windows description. The first is Main menu screen. Predefined menu appears after successful log-in in accordance to user rights.

Main menu screen contains following items:

- Exercise Scenario Editor
- Exercise Scenarios Package Manager
- Exercise Configuration and Control
- Exercise Debriefing
- Exercise Result Browser
- User Account Manager
- Student Manager
- HW Status Monitor
- 3D View Control
- Voice Communication Control
- Documentation (user and maintenance)
- Logout
- Shutdown

Main Menu Screen also shows the total simulator running time and the time remaining to the recommended maintenance. A timeout warning displays at every startup of instructor station computer after expiration of this period.

Figure 31: Main menu screen

2.2.5 Main Control Center

Main Control Center is the main part of Exercise control. Its window appears after exercise initialization finish (described in previous chapter).

The window contains basic control elements for exercise flow control (Startup, Pause, Stop, Exercise end) and for showing of other control windows (Exercise Flow Control, Entity List, Action Report, Map, Weather, Virtual Compartment and Malfunctions). Further it displays basic information about the exercise status (actual time of exercise, live exercise/record, status of exercise run).

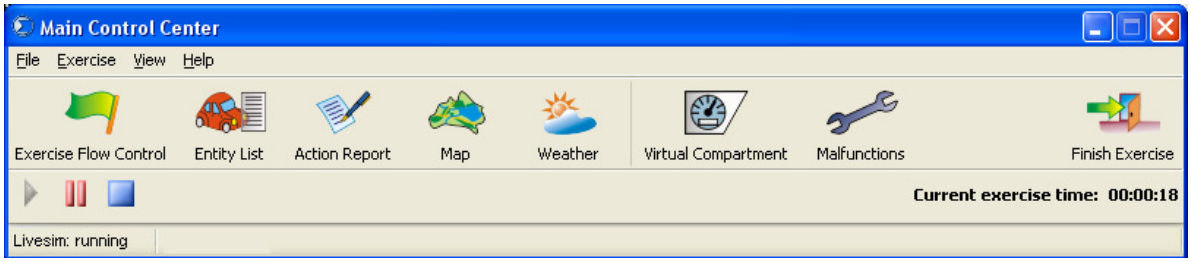

Figure 32: Main Control Center

2.2.5.1 Entity List

It is a list of all entities in running exercise (including Weapons station entity), which offers an inspection of entity properties.

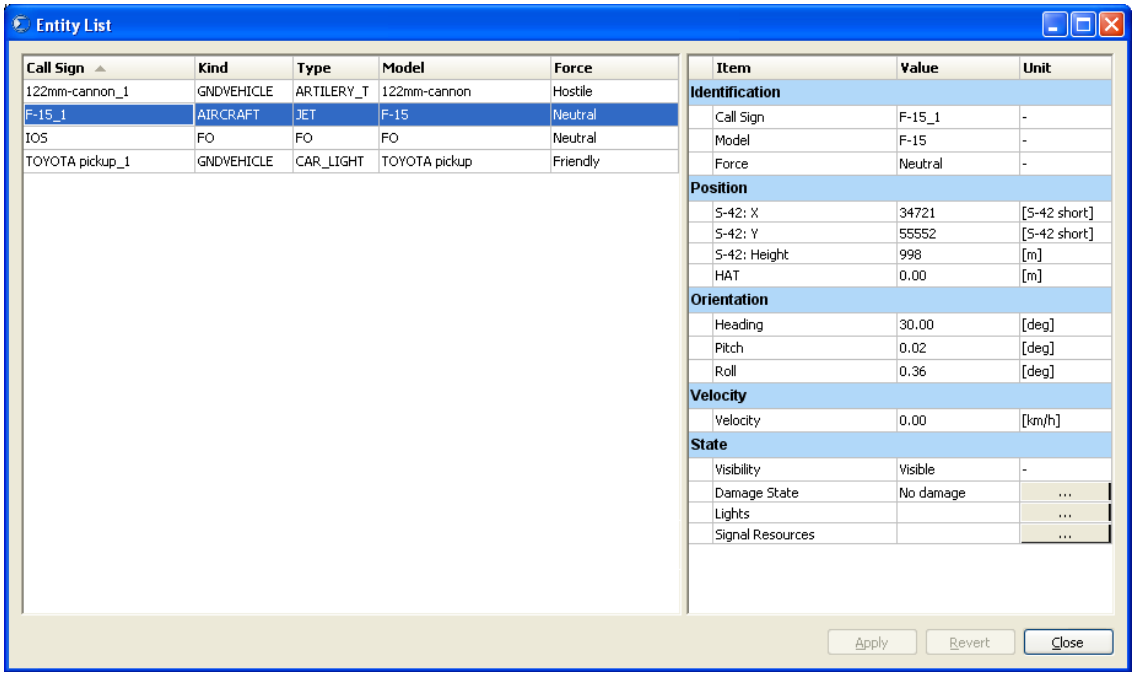

Figure 33: Entity List window

For any entity in the exercise following columns are shown:

- Call sign (unique name defined by user) of the entity
- Entity kind, type and model (the most detail category specification)
- Entity force (friendly, enemy or neutral)

For currently selected entity the detailed entity properties are shown on the right side of the Entity List window. Some of the properties can be modified during the exercise – see next chapter for Entity Properties inspection detail description.

2.2.5.2 Entity Properties

Entity Properties window offers to monitor/set information about particular entity. Entity properties window shows the state and configuration of the particular entity.

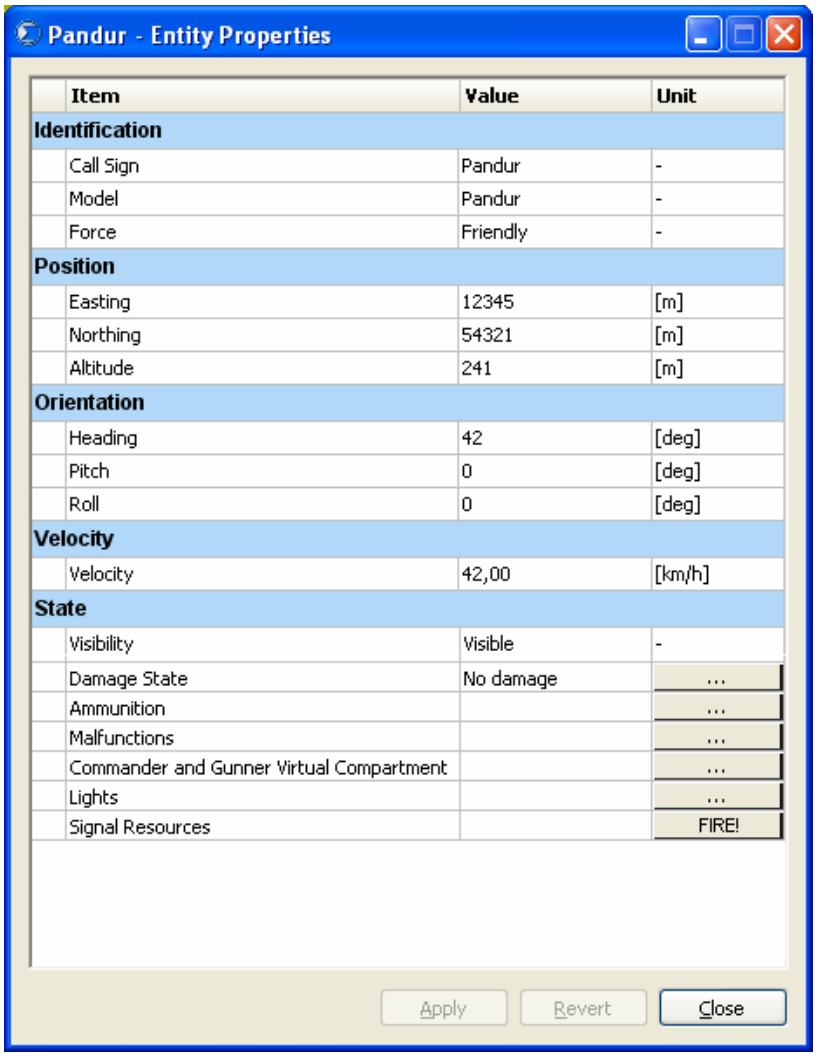

Figure 34: Commander, Gunner-operator Workplace Properties Window

Others windows raised from the Entity Properties window allow instructor to get information about detailed entity state, commander's and gunner-operator's instruments and elements state:

- Virtual Compartment window
- Malfunctions window
- Damage State
- Ammo configuration window

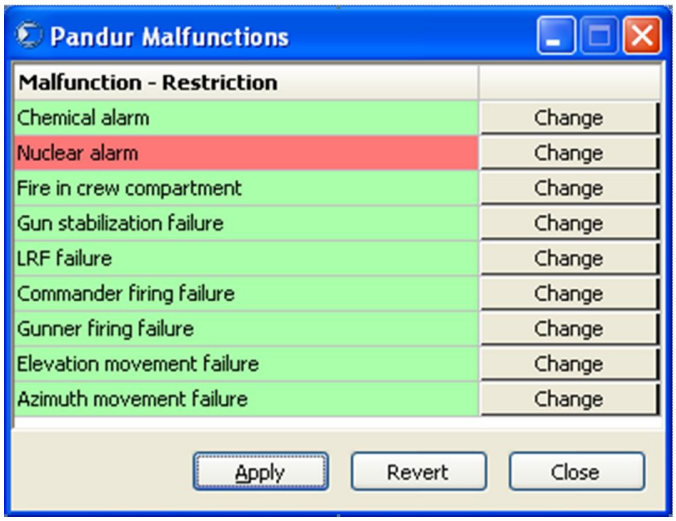

Figure 35: Malfunctions, Restrictions Window

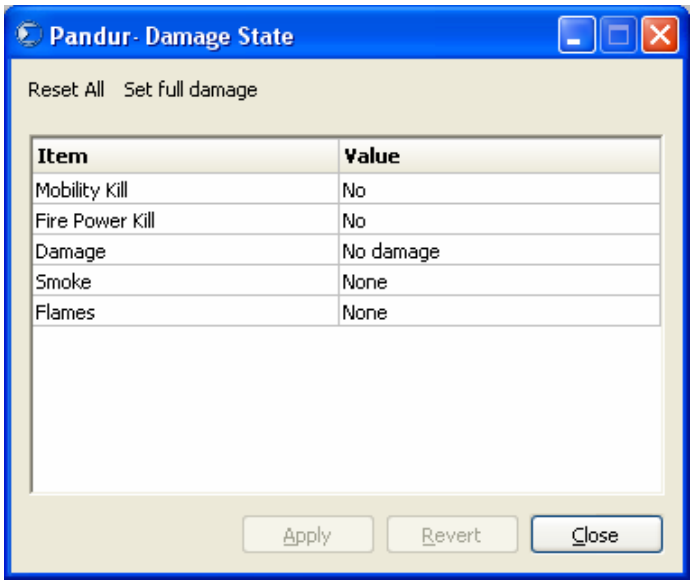

Figure 36: Damage State Window

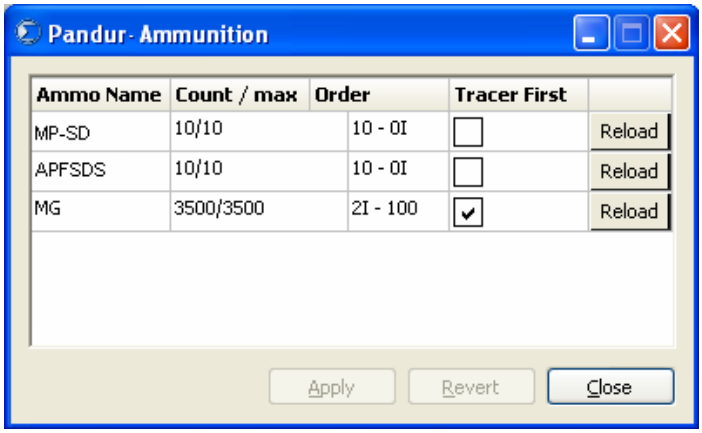

Figure 37: Ammunition Window

Commander and Gunner-operator Workplace Properties Window functionality:

- Shows status and configuration of commander and gunner-operator workplace's entity
- Monitoring current state of instruments and elements in commander's and gunner-operator's compartment
- There are various groups of properties and controls. They are:
    - Unique identification string of the object
    - Entity position:
        - East (in XY, UTM, Lat/Long)
        - North (in XY, UTM, Lat/Long)
        - Altitude (in XY, UTM, Lat/Long)
    - Entity orientation:
        - Heading (deg, rad, mils, dc)
        - Pitch (deg, rad, mils, dc)
        - Roll (deg, rad, mils, dc)
    - Entity velocity (m/s, km/h)
    - Damage State
    - Ammunition:
        - Monitoring type and count of ammunition
        - Allow editing ammunition by instructor during exercise
    - Malfunctions on simulated station - List of malfunctions which can be manually activated/deactivated by Instructor during the exercise is described in chapter Vehicle Systems Mathematical Models
    - Commander and Gunner-operator virtual compartment – shows current state of indication and control equipment for the commander and gunner-operator.

It is possible to change following commander and gunner workplace properties during the running exercise:

- Position
- Orientation
- Malfunctions
- Damage State

- Counts of ammunition
- Signal resources

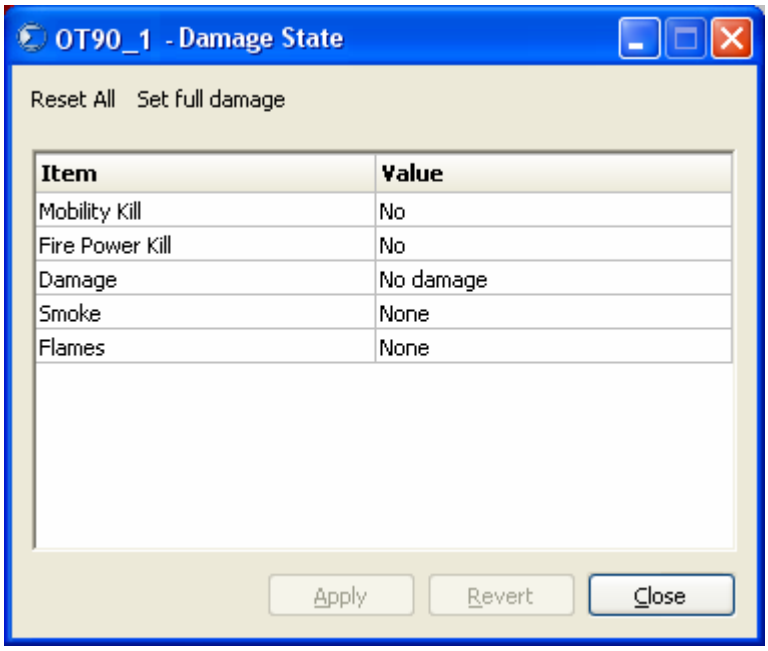

Figure 38: Entity Properties Window – Damage State

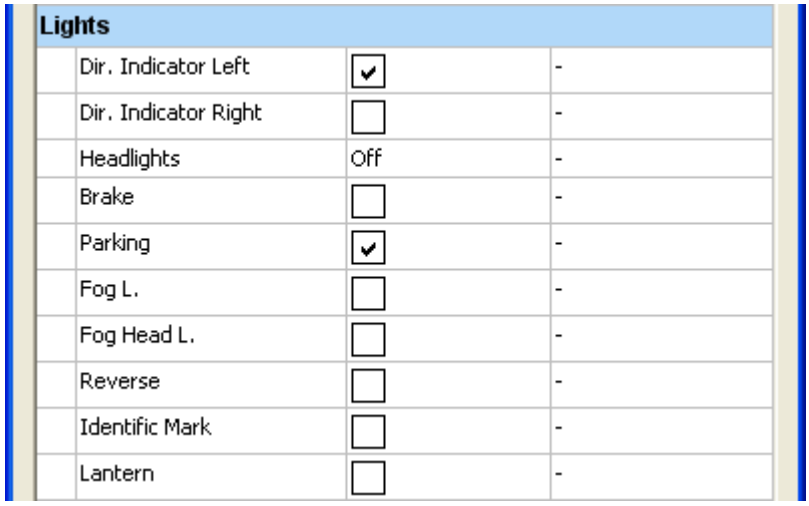

Figure 39: Entity Properties Window – Lights

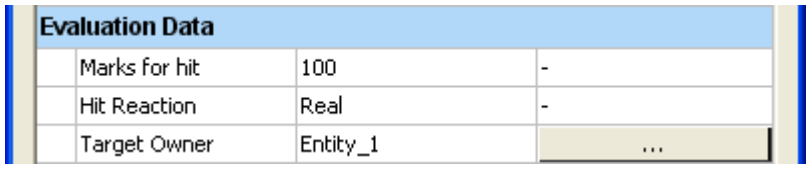

Figure 40: Entity Properties Window – Evaluation Data

2.2.5.3 Weather window

Using the Weather window Instructor defines weather settings for the whole exercise scene.

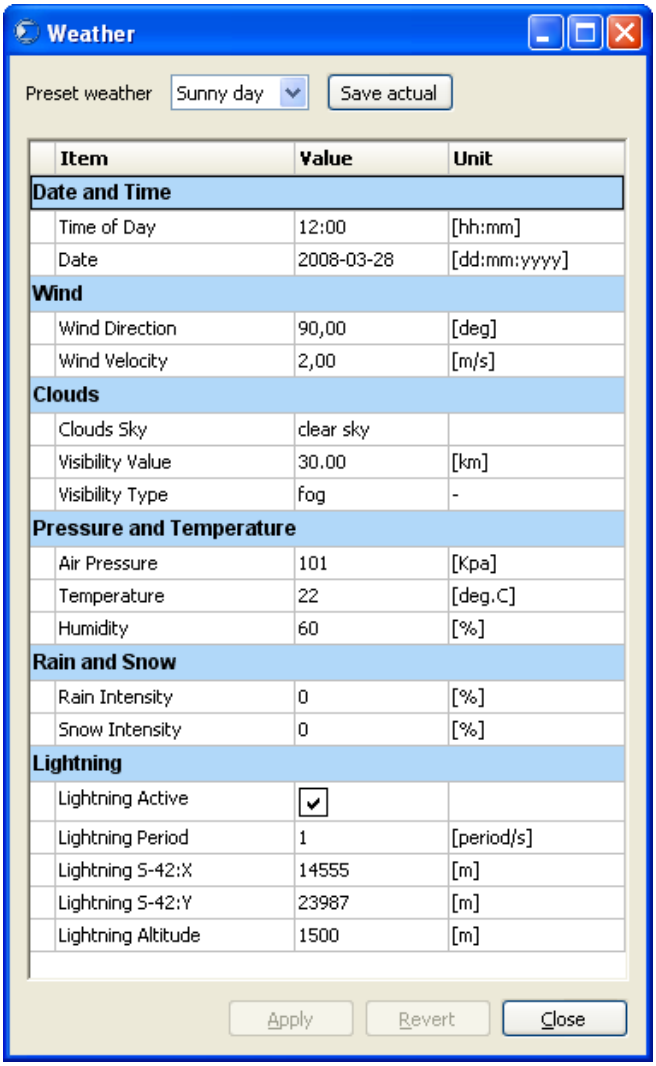

Figure 41: Weather Window

It is possible to set:

- Time of day (0-24) and date
- Wind (direction, velocity)
- Clouds type, visibility distance and visibility type (fog, sand)
- Air pressure, temperature and humidity
- Rain and snow intensity
- Lightning (period, position)

For the weather settings it's possible to use the user-defined set of weather parameters – the Preset weather selection.

1.1.1.1 Map Window

Map window shows the virtual scene map with all entities involved in the exercise. The map is dynamic, and it shows even the movement of entities.

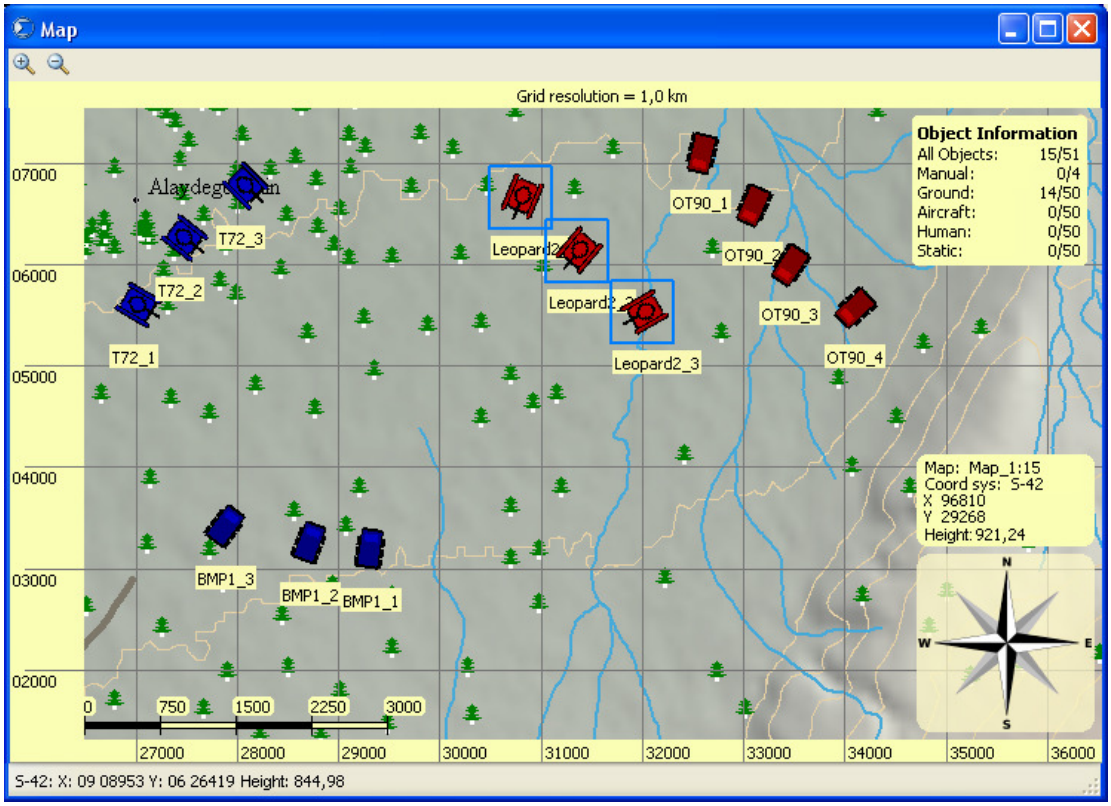

Figure 42: Map Window

Map function list:

- Viewing entity information and entity plan displayed on the map
- Selection of displayed entities
- Zoom out / in
- Auto scrolling
- Measuring:
- Difference of terrain altitude
- Distances
- Heading angle to selected entity or point
- Pitch angle to selected entity or point
- Get coordinates of the point in the map
- Center map to entity position
- Map layers displaying and hiding (manually controlled entity, humans, aircraft, etc).

2.2.6 Exercise Debriefing

After finishing of the exercise training, Instructor selects whether to export and store the exercise records for later debriefing, or not. Format of stored exercise records is generated automatically and it is composed from date and time of exercise starting.

Exercise record contains information about setting of virtual surrounding (terrain and weather environment), tactical situation (entities, events) and the situation changes during the exercise.

During exercise debriefing it is possible to use most of instructor software tools like 3D exercise view, map, entity properties, weather, action report, virtual driver's or commander's and gunner-operator's compartment window, but all in read-only mode, for displaying information – no changes are allowed.

2.2.6.1 Exercise Debriefing Flow Control

Exercise Debriefing Flow Control has similar functionality and design as Exercise flow control. Exercise Debriefing Flow Control provides:

- Controlling the exercise debriefing-flow (e.g. through command buttons it is possible to start, pause / resume or finish an exercise debriefing)
- Rewinding to stored timestamp set by instructor during live exercise
- Rewinding to arbitrary time stamp within the range of recorded exercise
- Displaying the current exercise debriefing time

Disabled are only editing actions – instructor cannot proceed the exercise phases and manage the timestamps.

2.2.7 Exercise Result Browser

Exercise result browser allows displaying the results of previously trained exercises and also the commander's and gunner-operator's performance during the particular exercise.

The results are based on following criteria:

- Result for given exercise - for selected exercise scenario the list of students is shown with their results: amount of exercises, average mark;
- Individual results - after selection of some exercise the results of other crew members are shown;
- crew results after selection of the exercise, the evaluation of all crew members is shown;

- unit results - list of trained exercises for selected unit is shown together with the amount of exercises and average mark for each exercise scenario;
- daily results – shows the list of trained exercises grouped by the exercise scenario with the amount of exercises and average mark.

Also it's possible to provide a summary of time of the simulator usage.

2.2.8 Exercise scenario editor

Exercise scenario editor is used for creation and editing of exercise scenarios. The edited scene is interactively displayed as a map or as a 3D exercise view into the virtual scene of the exercise.

While creating a new exercise it is possible to set following information and do following actions:

- choose a terrain database;
- Enter an exercise description (its name, identification);
- set weather condition (temperature and pressure of the air, wind) and visibility conditions (day, night and visibility);
- create entity:
    - Ground targets;
    - Air targets;
    - Stationary targets (target type and its placement in the battle scene);
    - Terrain obstacles;
    - Orientation points.
- set entity characteristics;
- rename existing entity;
- remove an entity;
- use an entity list;
- plan entity actions;
- define movement of own vehicle entity (in case that the driver does not take part in the particular exercise);
- define the conditions for automatic stopping the exercise and criterions for exercise evaluation;
- store exercise scenario;

- entity action plan: The behavior of computer controlled entities in scenario is controlled by commands given to the entities. Commands can be predefined in the entity Action Plan.

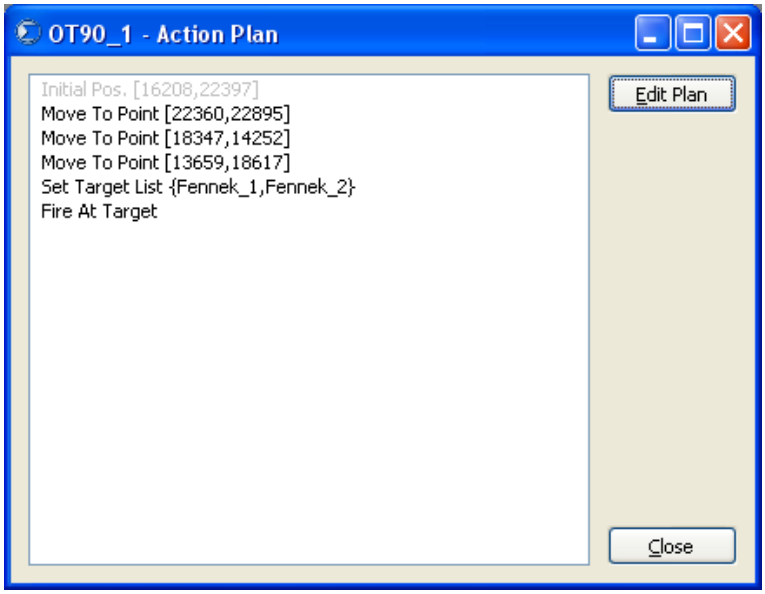

Figure 43: Entity Action Plan

  - move to a point;
  - move to an area;
  - return to a point backwards;
  - move to a point with a random speed;
  - wait a predefined period;
  - wait until a predefined action happen;
  - wait a random length period;
  - fire at an entity;
  - reaction on a hit;
  - set a target damage.

- adding command to entity action plan.

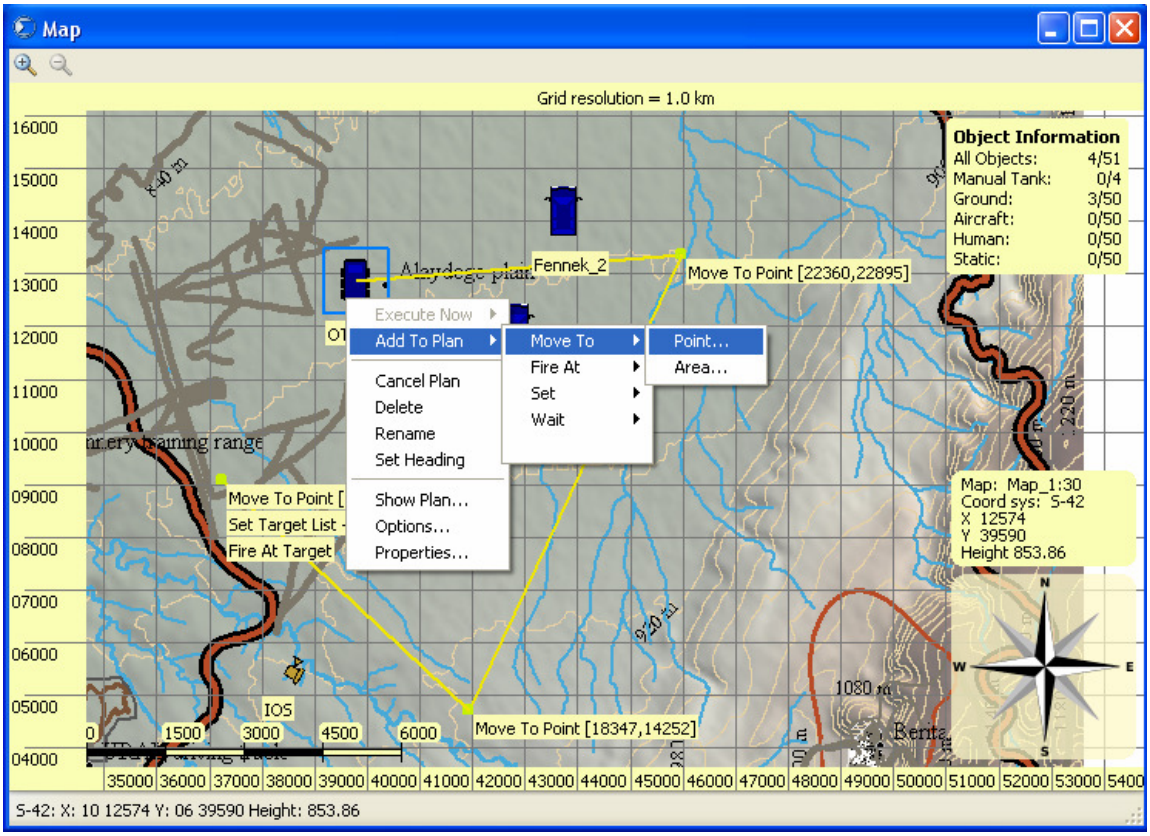

Figure 44: Add Command Entity Map Context Menu

- define movement of own vehicle entity (in case that the driver does not take part in the particular exercise).
- define exercise phases: For each exercise scenario the different set of exercise phases can be created. The exercise phases help to organize the scenario into logical parts on which for example the entities actions or evaluation can be bound. There are three categories of exercise phases:
    - Preparation phase (Preparation);
    - Main Phase (Main);
    - Finishing phase (Finishing).
- define the conditions for automatic stopping the exercise and criteria for exercise evaluation: in Evaluation Criteria window is defined the current exercise scenario type and values of corresponding evaluation limits.

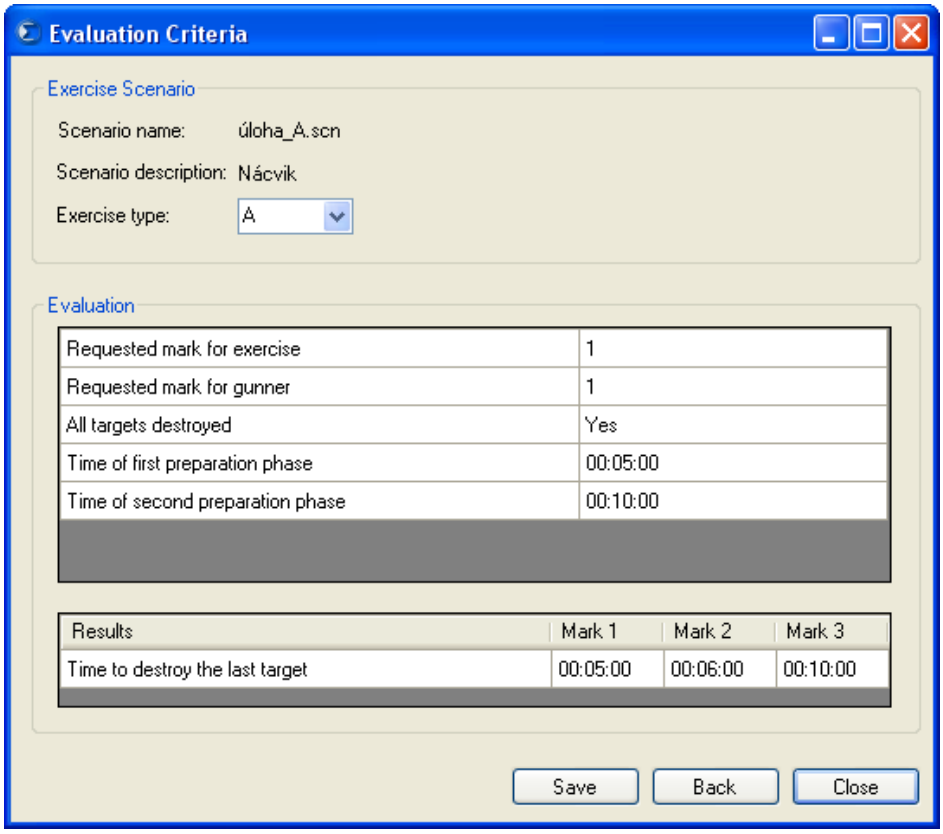

Figure 45: Evaluation Criteria Window

- Saving exercise scenario

3 DRIVING SIMULATOR

3.1 Specific requirements driving simulator

The driving simulator is intended to support basic and advanced training of Pandur drivers. It is intended to substitute driver training in real Pandur vehicles and simultaneously provide driving conditions that are as similar as possible to those experienced during actual combat. The driving simulator simulates a range of incidents that can arise in both combat and peacetime environments. The training controller has the option to simulate selected Pandur engine and transmission defects from his control panel in order that the correct driver responses are practiced. The driving simulator enables the training controller to halt the training program in the event a driver fails a practice task in order to instruct remedial action and permit resumption of the program.

The driving simulator is on the same simulation level as weapon simulator described above and uses common HW and SW parts here is just simple overview.

Figure 46: Driving simulator

Brief technical description

- 1:1 Driver cabin replica;
- 6 DOF motion system (electric);
- instructor Operator Station (IOS);
- driving simulation with closed hatch:
    - two side periscopes;
    - combined device for day/night vision with 21“ LCD monitor;
    - uses 3 visual channels.
- driving simulation with open hatch:
    - three 21“ LCD monitors firm connected to cabin;
    - uses three visual channels.
- 1 visual channel for DDU system (rear view camera);
- fully replicated cabin.

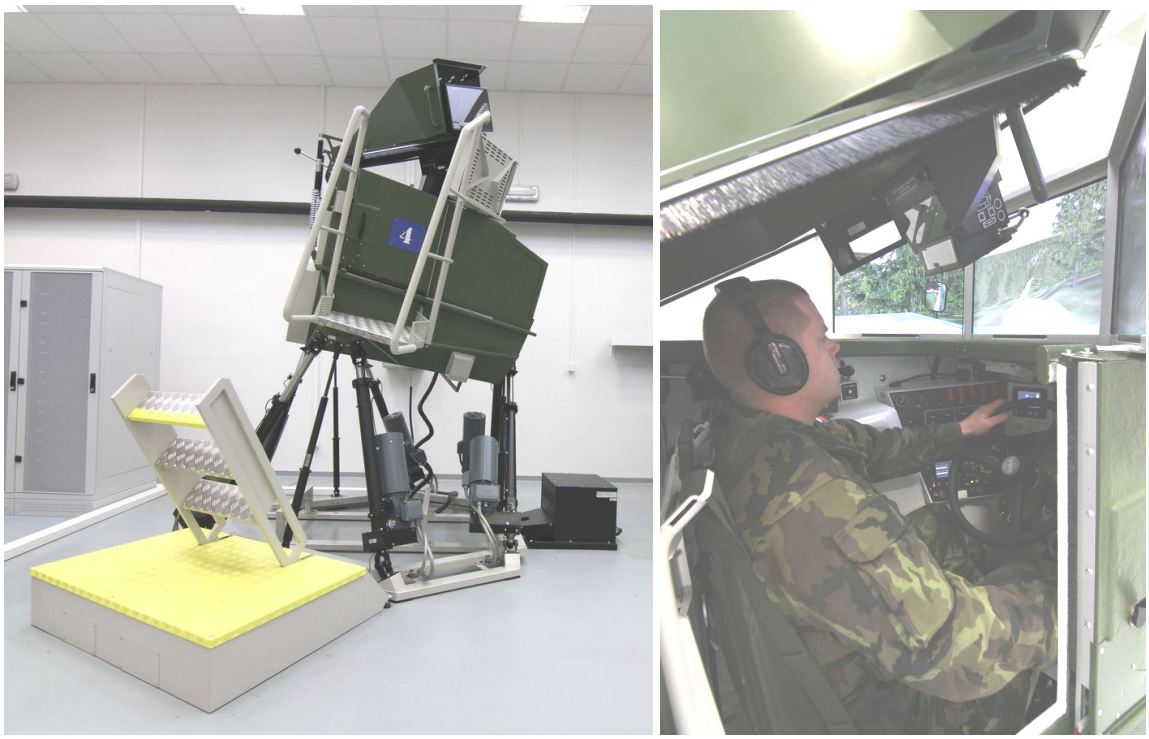

Figure 47: Drivers cabin on 6 DOF motion base

4 CREW SIMULATOR

4.1 Specific requirements crew simulator

Crew simulator is the highest level of training on virual simulators. In the case of Pandur simulators it can be simply described as driving and weapon simulator connected to one exercise – the crew is virtually sitting in one vehicle. Actually they are in two separate cabins (to save weight on motion base), but they are moving thru the same virtual terrain and they communicate on simulated radio like in real vehicle.

Figure 48: Crew simulator

To allow tactical training the simulator can be connected to other simulators of the same type, or even to simulators of other types of vehicles. The crew then fights against very smart enemy as in the other simulator (which could be tanks, BMPs, helicopters, RPG equipped solders or any other simulator) is driven by soldiers too. The exercise for tactical training usually has hundreds of entities, from which some are cooperating and some are enemies. This feature allows effective training of complex battle situations without the need of great number of fighting vehicles in actual battlefield. The cost saves are great.

4.2 Virtual terrain databases

For crew training it is important to train in terrain as much similar to terrain of the territory where the real fight is expected. The crew simulator is equipped with set of terrain databases compatible with databases on tactical trainer, which are copy of real training

areas and cities. Generic geo-typical terrain European type Databases are delivered in OpenFlight format.

One of the databases is divided to three basic areas (driver part, part for weapon simulator and part for crew simulator). Each simulator can use every part of database. Scheme view of database is shown on map and includes:

- Mountains with mountain roads, combs, bare and wooded rocks;
- Roads around rocks without chance ride to the side from road (for example: rock is on left, deep scarp on right);
- Wooded terrain with cuttings and wood roads;
- Desert with village and shape T crossroad;
- Town type area (high and small buildings, crossroads);
- Rail junction;
- Roads with bridges over river;
- Water courses, water areas like dam, lakes, ponds;
- Roads with crossroads, railway junctions, railway tunnel

This allows the user to train all possible terrain situations.

Summer and winter version of the same database is simulated, and it allows day and night simulation.

Database is developed using geo-specific aerial photos. Repeated textures are used for some parts of database such as mountains, desert, which are represent these parts of terrain. Display of terrain with details according to visibility and visual sense in day is minimal 6 000 m and in night is 4 000 m.

For the purpose of the crew simulator for commander, gunner-operator and driver, all objects are modeled with high detail up to 750 polygons/model (if applicable). There is LOD (Level Of Detail) technique used for displaying objects in large distances.

Figure 49: Examples of terrain databases

4.3 Virtual terrain databases

4.4 Moving models library

In the simulator are used models in OpenFlight format. Simulator supports models for simulation of different moving vehicles, targets and simple models of live force (not animated). There is also supported dynamically added static models – dynamic feature models (DFM). These DFM models can be added into the database during creation of the mission. Simulator supports up to 200 moving models, static models and models of live force uniformly scattered in running mission.

1.1.2 Moving models

Examples of models:

- Tanks
  - T72
  - T72M4
  - T55

- Infantry fighting vehicle
  - BVP1
  - BVP2
  - BRDM2RC
  - OT90
- Cars
  - UAZ496
  - PV3S
  - LANDROVER
  - TATRA815
- Helicopters
  - MI24

Figure 50: View on moving model T72M4 / T72M4 Winter/ T72M4Thermo

Figure 51: View on moving model UAZ469 / UAZ469 Winter/ UAZ469 Thermo

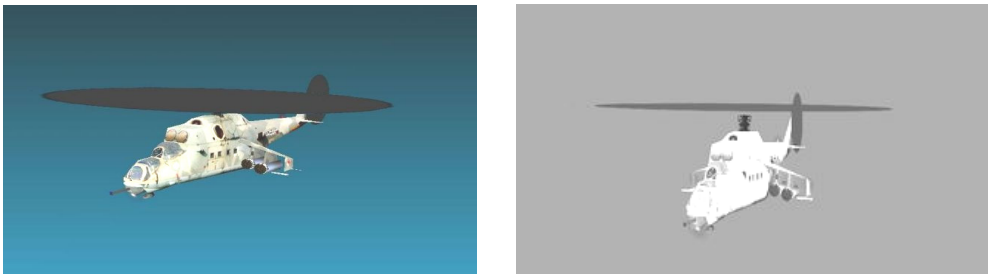

Figure 52: View on moving model Mi 24 / Mi 24 Thermo

1.1.3 Live force

Figure 53: Examples of live force including thermo versions

1.1.4 Targets

Thermo version of practice targets models is automatically generated by image generator.

- **Target number 6**

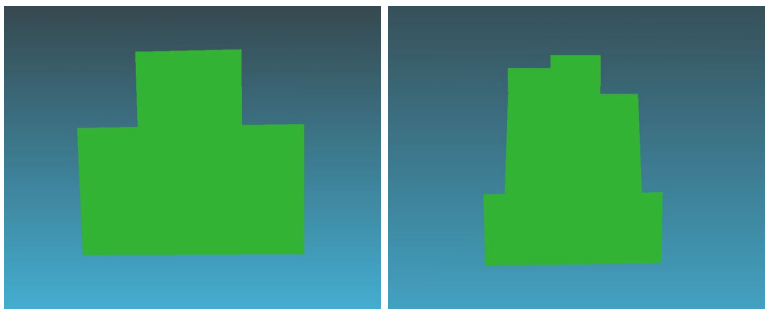

Figure 54: Target number 6 and 9

5 COMBAT SIMULATOR

5.1 Specific requirements for combat simulator

The Combat Simulator (SSS-BV) uses components such as modern computer technology, electronic systems, optical, laser and electromechanical devices. This is in order to carry out the tactical training of crews and support staff, at platoon and company levels, in conditions that are close to actual combat using real vehicles without using live ammunition.

The Combat Simulator is intended to firing and tactical training of crews and support staff, at sub-unit level up to company level (tactical group), on real fighting vehicles without the need to fire. Although blank ammunition is used instead of live ammunition, the operating characteristics of the BV weapon systems are maintained and generate conditions similar to live firing and tactical training.

In tactical training, training rounds (using blind ammunition) are used to de-mask (reveal) vehicles when firing.

The Combat and Weapons Simulator set is sufficient for an armored infantry company of ten Pandurs.

All vehicles are equipped with their appropriate weapon systems in order to conduct battle in both day and night conditions.

All Pandurs are equipped with a laser emitter, a control system for the laser emitters, a system for recording and indicating hits to range-based mechanical lifting targets, a system indicating hits to enemy BVs, a system indicating hits to other vehicles and objects; a system to inform when an enemy BV has been hit, by data transfer in real time.

It has a portable control unit for the training controller and one that is located in the Control Tower.

The system consists of:

- SW to control targets, controls units that open fire, ensures data communication between individual elements before training begins;
- SW to collect data about targets successfully hit;
- SW to assess training;

- SW to manage the progress of combat training and to control the automated targets (fixed and moving);
- SW to analyse the progress of training as a whole and in part;
- SW to generate new training exercises.

Furthermore, the set contains moving targets for training a strengthened platoon (including targets for fighting vehicles and PTRK).

The set contains 91 PCs of sensors, placed on existing target actuators.

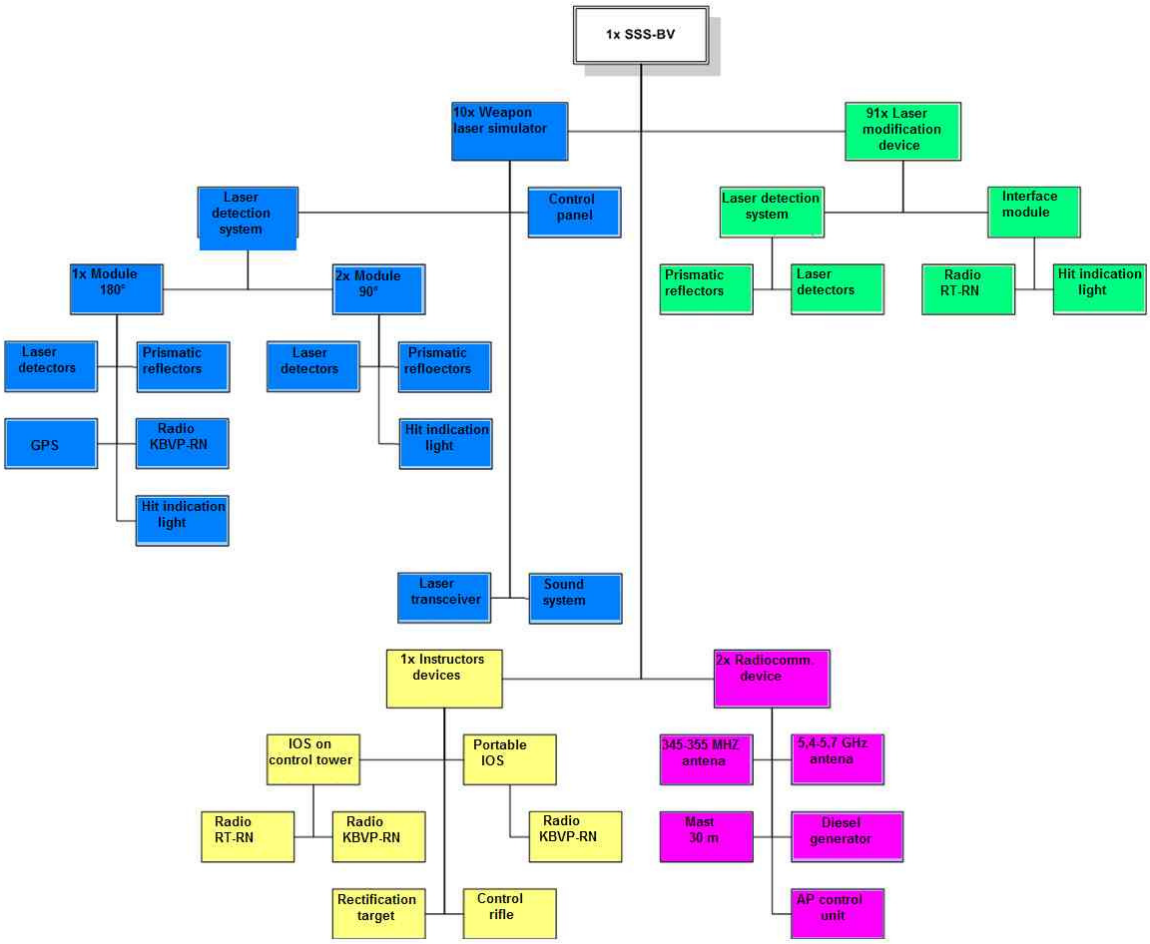

Figure 55: SSS-BV structure

SSS-BV provides Gunnery Training (GT) with up to 10 Pandurs and up to 91 Range Targets (RT) and Tactical Training (TT) with up to 10 Pandurs. GT provides shooting skills training with all weapons systems of RCWS-30 for Commander and Gunner against different Range Targets. TT is created by groups of Pandurs divided in to opposing forces. Actual status of each Pandur and target hit status are remotely controlled from instructor

stations and status data are stored for possible playback analysis (After Action Review AAR).

SSS-BV is characterized by this modern functionality:

- Two-way ballistic simulation
- Precise impact position evaluation
- Unconditionally eye safe laser Class 1
- Real shooting simulation from 30mm cannon and 7,62mm machine gun/ Full simulation of canon and coax shooting
- Spike aiming and triggering procedure simulation/ Simulation of aiming and shooting PTŘS SPIKE
- Portable radio communication system with fast response and coverage area min 25 km^2 in hard terrain
- Workstation for training supervisor - Control Tower IOS (CT-IOS)
- Workstation for training observer – Portable IOS (P-IOS)
- Exercise control SW and After Action Rewiew

5.2 Principle of two-way ballistic simulation

Pandurs are equipped by Laser Transceiver (LT2) aligned under RCWS-30 main gun barrel and by Laser Detection System (LDS) positioned on MTDS sensor holder and on the commander camera holder.

LT2 consists of laser transmitter generating scanning lines and laser sensor. LDS consists of laser Prismatic Reflectors (PR) and Laser Sensors (LS), which are both located close to each other.

During simulation of virtual projectile flight, operates on the attacker side Laser Transceiver (LT2) and on target side Laser Detection System (LDSV). LT2 scans its FOV by horizontaly moving of first and second skew scanning lines and measures by laser sensor distance between LT2 and PR and PR position related to virtual projectile. If measured distance between LT2 and PR corresponds to actual distance of virtual projectile from LT2, LT2 sends message with impact data to LS on target. Impact data contain information about attacker, ammunition, projectile position related to prismatic reflector, projectile approx speed and projectile impact angle. From impact data target WLS Main

Control Unit evaluates exact position of impact and damage status (based on Pandur or Range Target vulnerability model).

Ballistic calculation differs for burst shooting with cadency lower than 240 rounds/min (rpm) and higher than 240 rpm. For burst shooting with cadency lower than 240 rpm is bullet flight simulation provided for each round separately. For burst shooting with cadency higher than 240 rpm is bullet flight simulation provided for every N round, where N = actual cadency / 240. To keep real effect of burst shooting, simulated impact power of every N round is increased to N times of single round power.

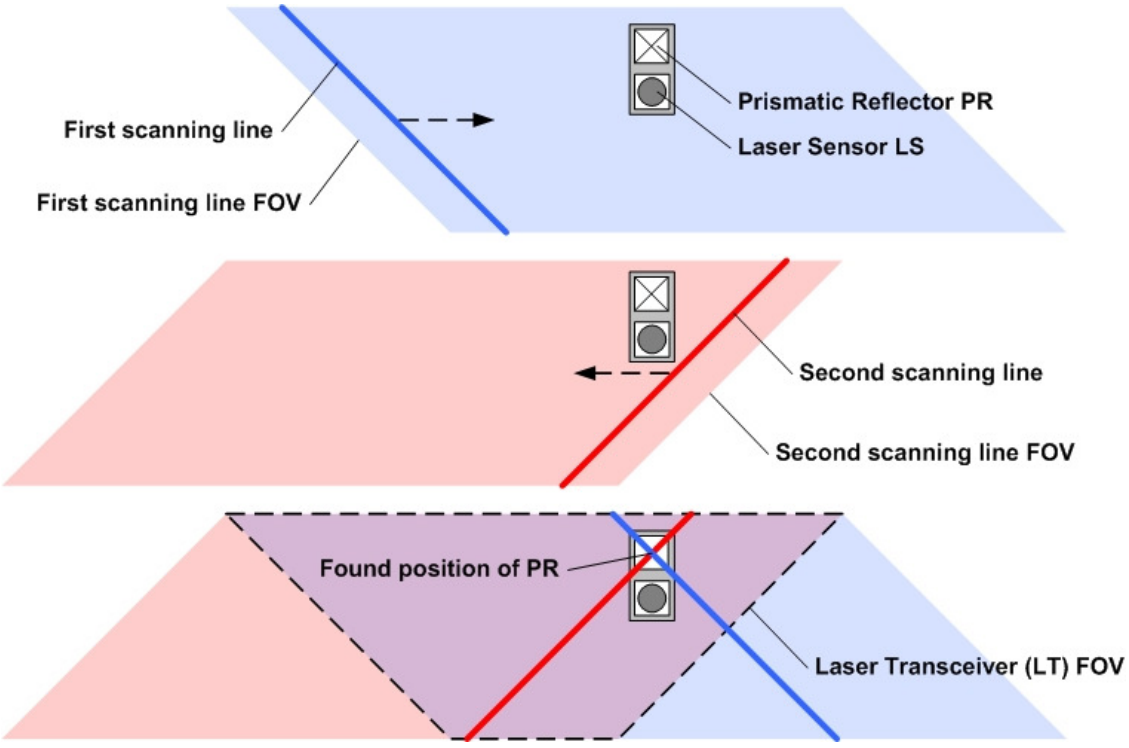

Figure 56: Scanning principle of two way ballistic simulation

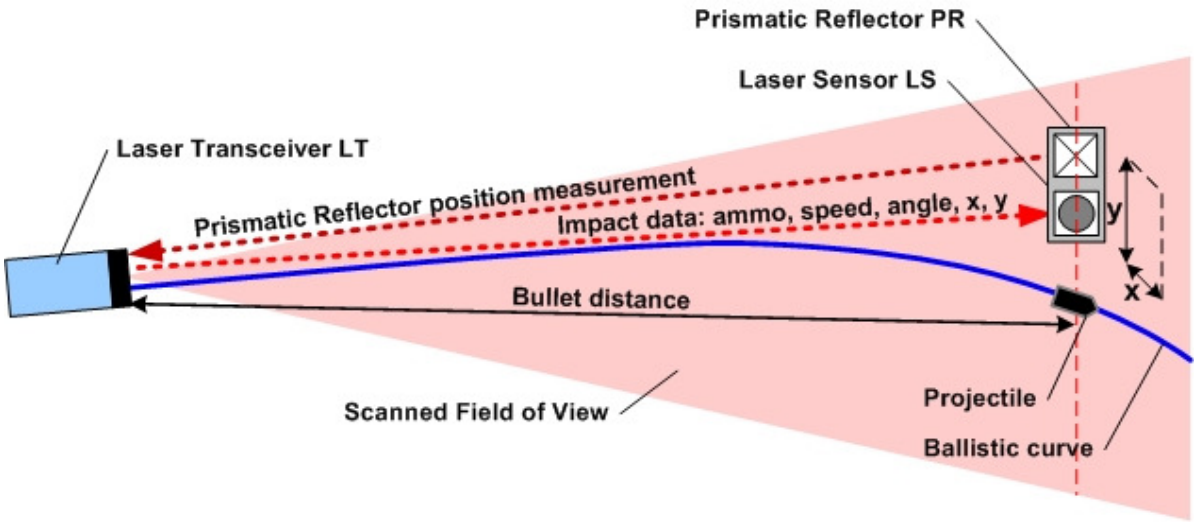

Figure 57: Ballistic simulation principle (two way)

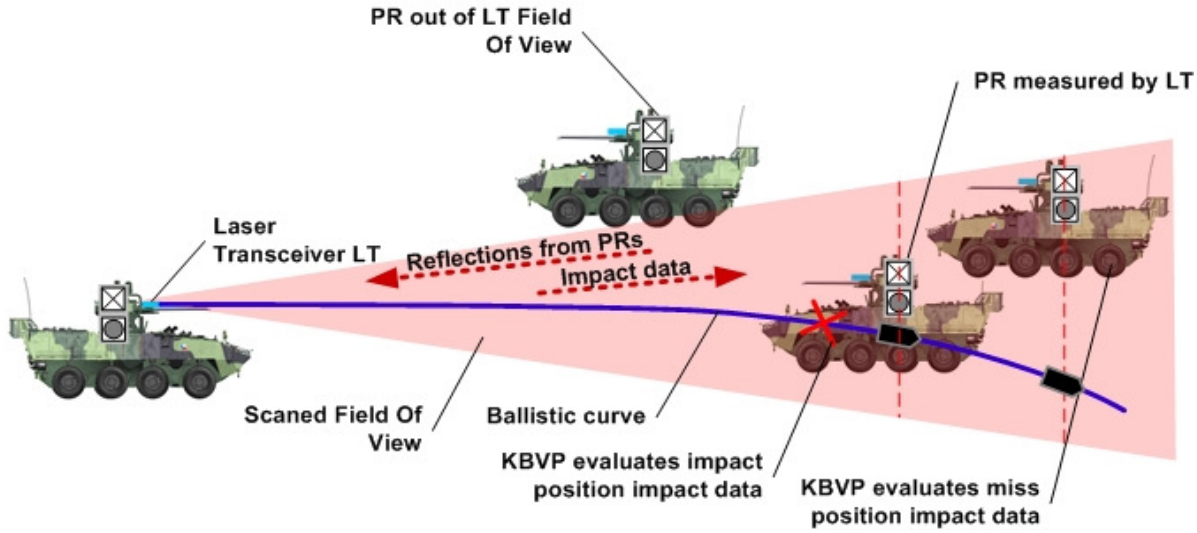

Figure 58: Evaluation of hit/miss

Two-way ballistic principle ensures realistic shooting training which simulates influence of firing conditions corresponding to reality:

- Firing during Pandur movement
- Target movement
- Lead angle
- Superelevation angle
- Ammo type.

5.3 Mechanical connection of WLS with Pandur

Supposed location of LT2, LDSV and Audio Unit is shown on models.

LT2 is fixed on cartridges ejector under the gun barrel. LDSV are situated on the MTDS sensor holder and on the commander camera holder.

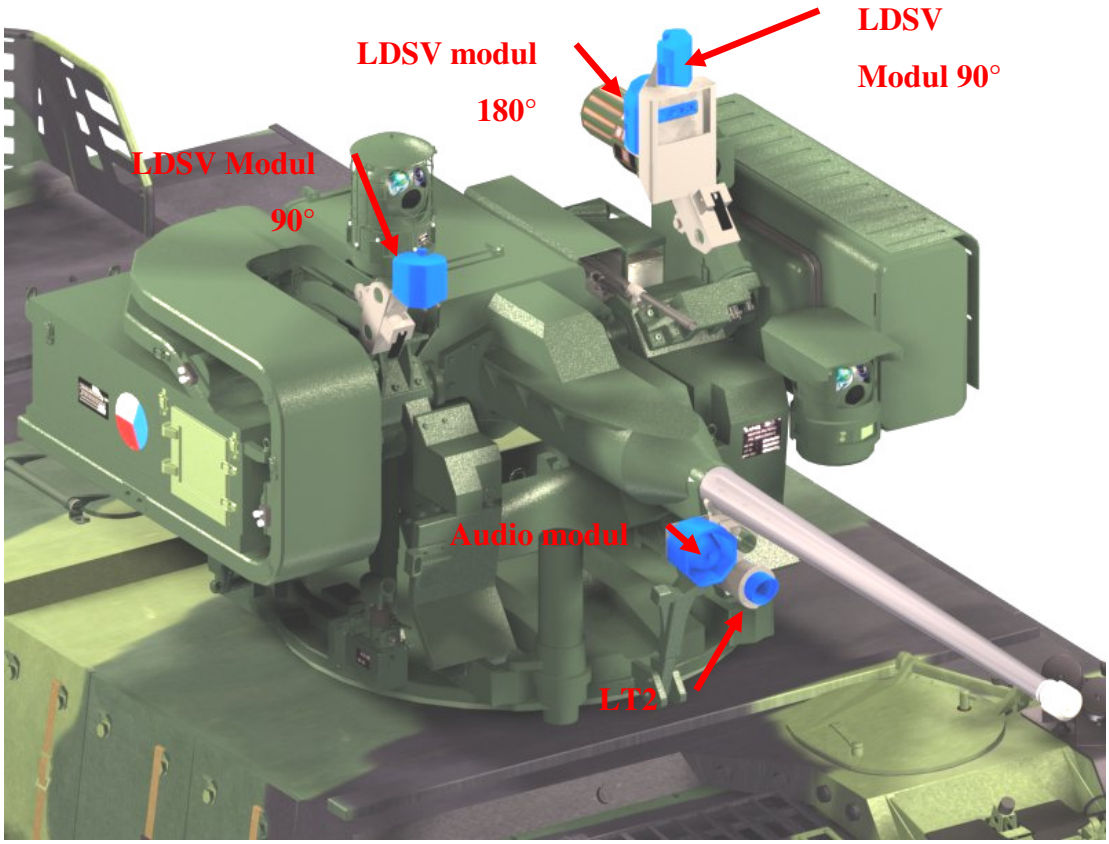

Figure 59: Location of WLS parts on the RCWS-30 turret

Mounting of WLS all parts to Pandur are made by clamp mechanisms without need of permanent modifications at Pandur and without damage of Pandur original parts.

LDS Modul 180° reflects and receives attacker laser beam under horizontal angle 180deg and vertical angle 45 deg. LDSV Modules 90°reflect and receive attacker´s laser beam under horizontal angle 90°and vertical angle 45°. Following figure shows horizontal coverage of 360° for Pandur.

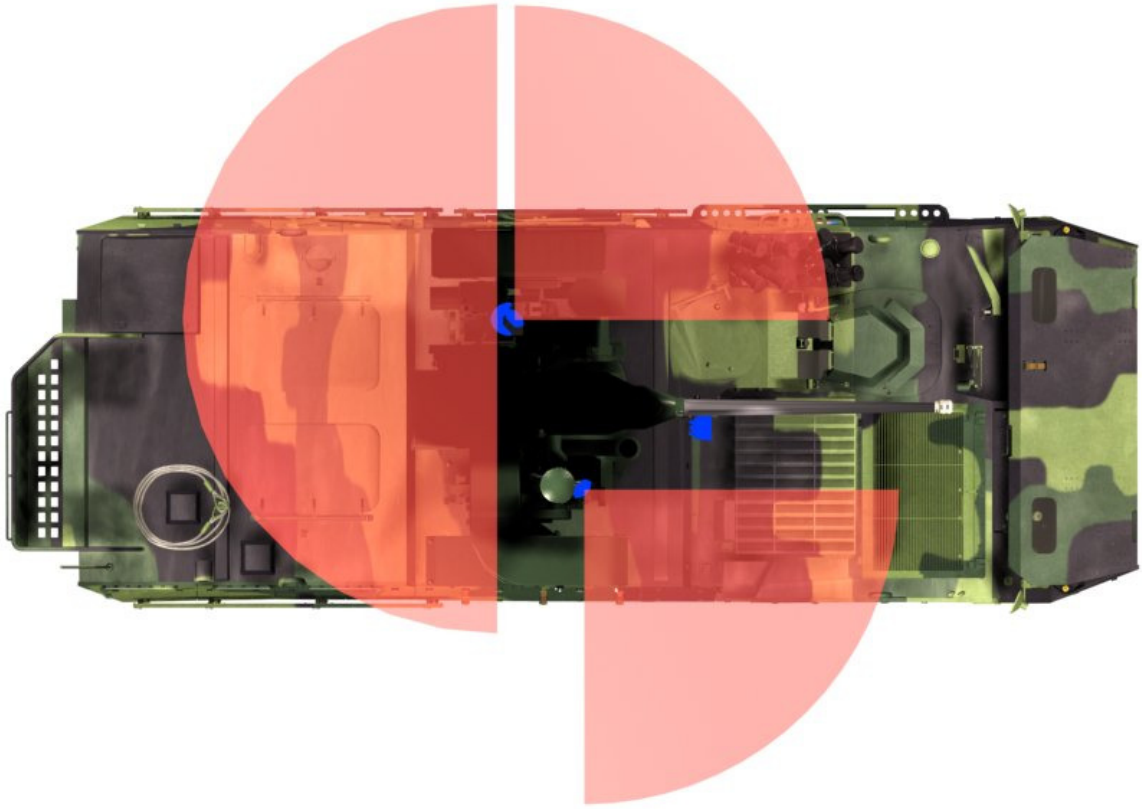

Figure 60: Horizontal coverage of 360° for Pandur

5.3.1 Laser Detection System on Vehicle (LDSV)

There are three Laser Detection Systems (LDSV) mounted on RCWS-30, 1x LDSV Module 180° and 2x LDSV Module 90°. Both types of Modules consist of Prismatic Reflectors (PR), Laser Sensors (LS) and Flash Light. LDSV Module 180°contains additional GPS, Radio Module for connection into the KBVP-RN, Radio Module for communication with LDSV Wireless Module 90°and computing unit for evaluation of Pandur hit. Location of LDSV Modules is shown on models in the chapter “Mechanical connection of WLS with Pandur”.

Prismatic Reflectors (PR) of LDSV are equipped by IR filters to avoid direct reflection of beam of original Laser Range Finder (LRF). Direct reflection of LRF beam could cause damage of LRF detector. IR filter placed in front of PR will stop LRF beam wavelength.

Figure 61: LDSV Module 180°

Figure 62: LDSV Module 90°

LDSV Wireless Module 90° is used for Pandur hit detection in case, that an obstacle avers the LDSV Modules located on the turret RCWS-30. LDSV Wireless Module 90° uses radio communication in open band 2,4 GHz for data transmission within WLS. LDSV Wireless Module 90° is connected through radio into LDSV Module 180°.

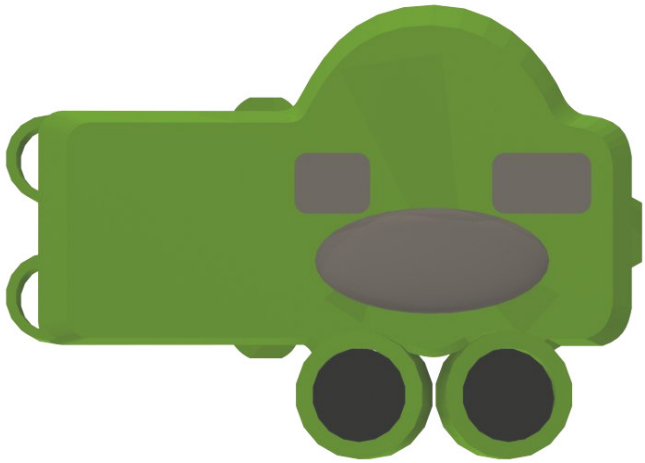

Figure 63: Model of LDSV Wireless module 90°

5.3.2 GPS Module

GPS Module is integrated in LDSV Module 180°. Pandur GPS data are provided via radio network KBVP-RN to CT-IOS and P-IOS for real-time exercise control and for After Action Review.

5.3.3 Radio Module

Radio Module is integrated in LDSV Module 180°. Radio Module connects Pandur via Pandur Sim Radio Network in to Instructor stations.

5.3.4 Flash light

Flash lights are integrated in both Primary and Secondary LDS. Flash light provides visual indication of Pandur hit status to other Pandur and observers.

Figure 64: Flash Light

5.3.5 Audio Module

Audio Module is located on the turret of RCWS-30 on the common holder with LT2 and provides firing sound simulation. Volume of speaker sound could be controlled, maximal simulated shot level is 115 dB.

Figure 65: Audio Module

5.3.6 Control Unit WLS

Control Unit collects data from all involved subsystems in Pandur and controls simulation. Functions provided by Control Unit are:

- Power filtration
- Evaluation of commands received from KBVP-RN a Control Rifle
- Connection to fire control system of RCWS-30

- Control of sounds in intercom

Figure 66: Control Unit in rubber case

The control unit is located left from the commander station, it is mounted with Velcro to the instrument holder construction.

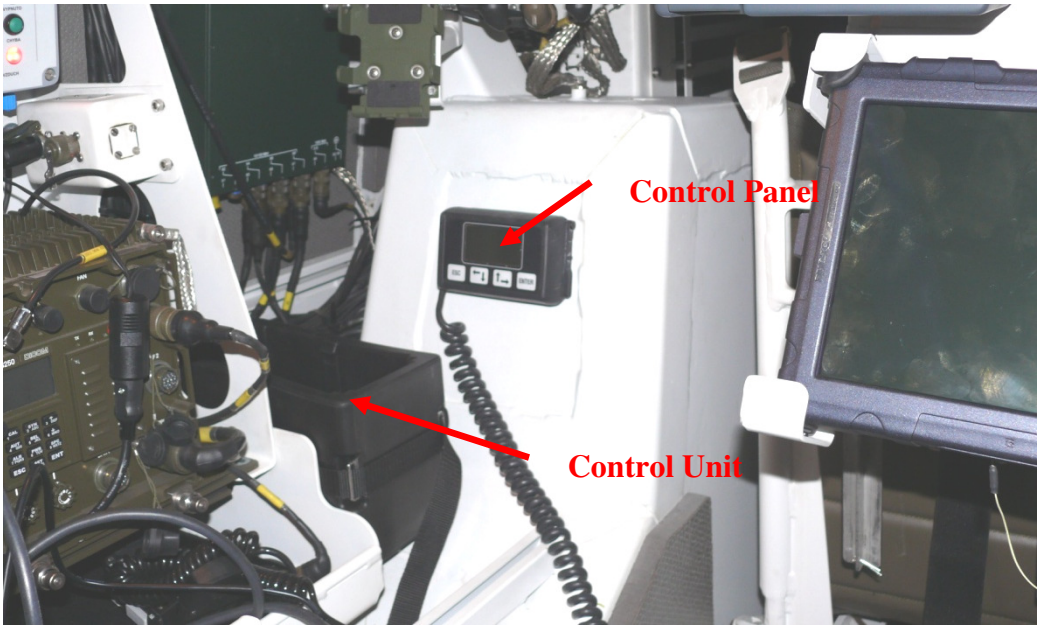

Figure 67: Location of Control Unit

5.3.7 Control Panel of commander and gunner-operator

Control Panel provides via its menu information to crew about exercise, Pandur status and allows reloading of ammunition.

The control panel is placed left from the commander station.

Figure 68: Control Panel

Examples of proposals and status information shown on the display are presented in following chapters.

5.4 Simulated Functions by WLS

5.4.1 Firing simulation

WLS provides simulation of firing from following Pandur weapons systems:

- 30 mm cannon
- 7.62 machine gun
- PTŘS SPIKE.

Combat and Weapon Simulator simulates appropriate weapon systems in range of functionality described below.

30 mm cannon:

Simulation of all functions and parameters of 30 mm cannon is provided:

- Different shooting cadences
- Single round

- 5-rounds burst
- Continuous low cadency burst 100 rpm
- Continuous high cadency burst 200 rpm
- Shooting in all RCWS-30 modes
- Shooting from Gunner and Commander station
- Simulation of four different ammunition types and their ballistics.

7.62 machine gun:

Simulation of all functions and parameters of 7.62 mm machinegun is provided:

- Continuous burst shooting with cadency 700 rpm
- Shooting in all RCWS-30 modes (stabilized and non-stabilized)
- Shooting from Gunner and Commander station
- Simulation of four different ammunition types and their ballistics.

PTŘS SPIKE:

Shooting of PTRS SPIKE is partially simulated. Launching and guiding of PTRS SPIKE is depended on camera image from missile in reality. During simulation there is no real missile in launcher and no real missile is shooting.

5.4.2 Ammunition control simulation

Weapon Laser Simulator (WLS) allows aiming and firing operations on Commander and Gunner station as in reality (except for limitations of PTŘS SPIKE and Smoke Grenade Launcher).

Using of ammunition and its status handling is realistically simulated too. On beginning of exercise is the Pandur virtually loaded by the crew through the Control Panel by necessary amount of ammunition. Ammunition can be virtually loaded into RCWS feeders and launchers and into ammunition stock in hulls. Crew also has to specify on MFD number of loaded ammunition and ammunition type as in reality. Weapon Laser Simulator (WLS) simulates corresponding ammunition ballistic, decrement corresponding to ammunition counter. From WLS Control Panel can the crew control the transfer of ammunition between stock in hulls and RCWS-30 stock like loading of new ammunition or ammunition exchange.

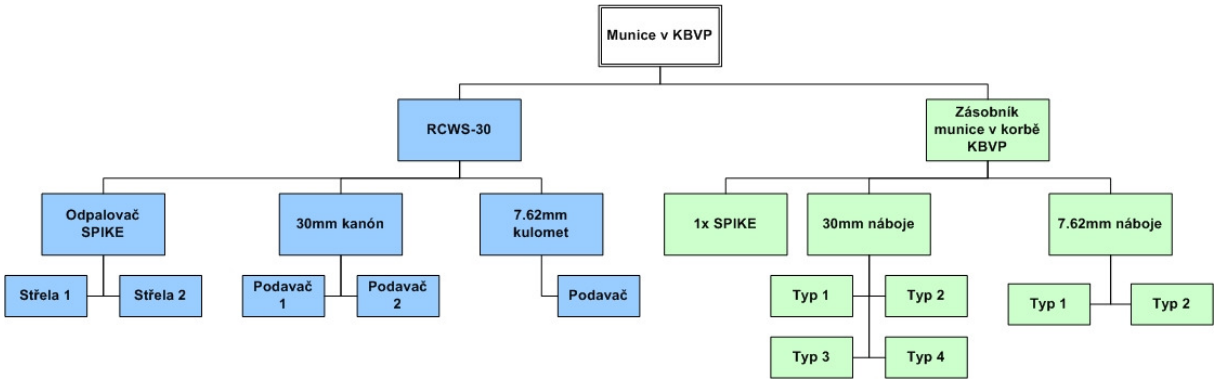

Figure 69: Ammo distribution in Pandur scheme

5.4.3 Hit simulation

Various damage status are evaluated for each hit of Pandur based on its vulnerability model and ammunition code. All damage status are shown on the control panel of Pandur and on the CT-IOS. Damage status is signalized to the gunner and the other participants of the exercise only by light signals.

Possible damage status:

- Near miss
- Hit but no damage effect
- Communication lost
- Mobility loss
- Fire power loss
- Total destruction

Figure 70: Damage Status of Pandur – hit

5.4.4 Sound Simulation

WLS generates firing sound by Laud Speaker placed on turret. Additionally WLS generates audio messages in to Pandur intercom for whole crew. In intercom are provided following sounds:

- Explosion in case of Pandur damage
- Bullet hit sound
- Damage status message (in English).

5.5 Equipment for Range Targets modification

Existing Range Targets with lifters, which are introduced in AČR and which are produced by SPAME company, can be included into the training with SSS-BV simulator.

The targets are extended by for Laser Detection System Target (LDST), which is similar to LDSV.

LDST target consists of following parts:

- LDST Modul 115°, which includes:
- Prismatic reflectors
- Laser detectors
- Light for hit indication
- Control unit of the target (RTCU) – hit evaluation
- Communication Modul providing functions:
- Interface between RTCU and existing target lifter
- Radio communication for connection into RT-RN

On the following figure is block diagram explaining target lifter upgrade. Existing radio communication of target lifters (producer Spame) with IOS-CT is used for control. LDST includes new Communication Module working on the same radio frequency 448 MHz with long range up to 4 000m, for recording data about shooting details into computer.

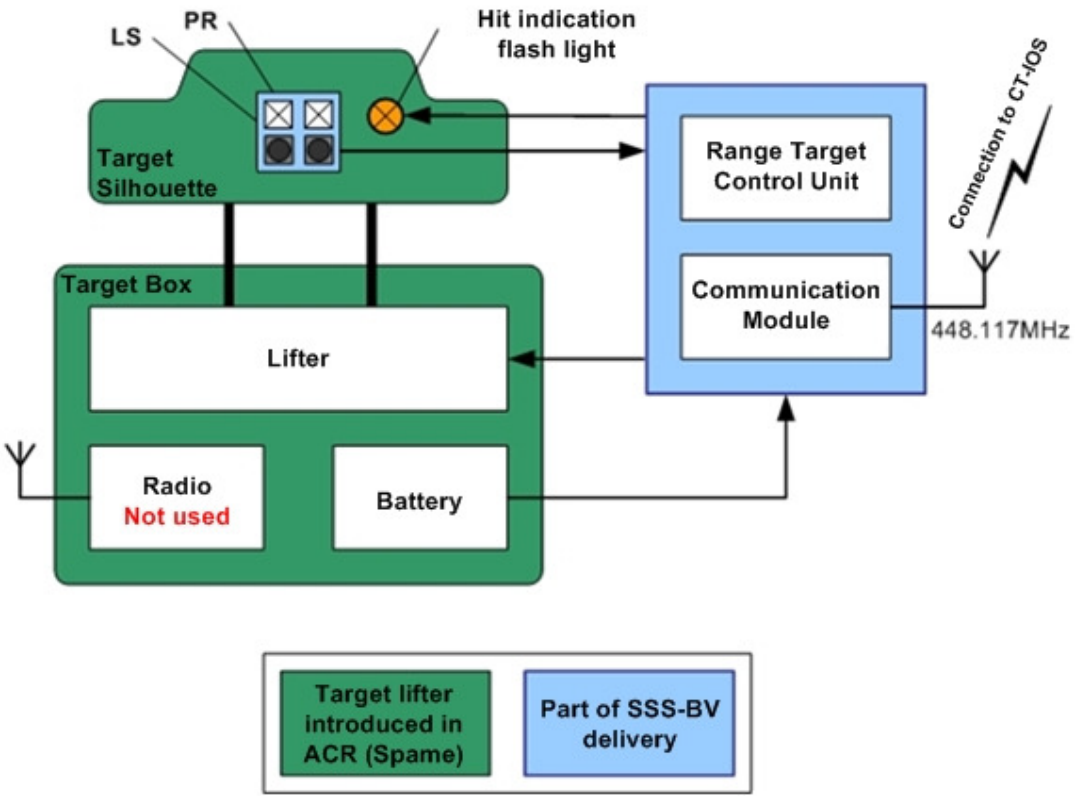

Figure 71: Range Target upgrade

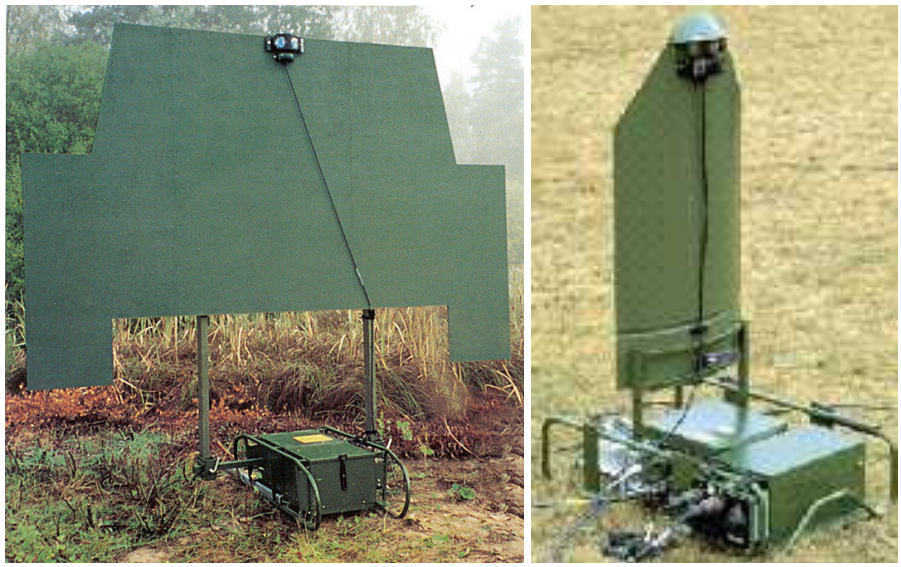

Figure 72: Range Target examples

Target Control Unit receives data about shot transit from Laser Detectors and evaluates damage status of target. On Control Unit could be selected the type of target.

Damage status is signalized to Pandurs or observer by Flash light integrated or by target silhouette tilt (target lifter is not part of delivery). Target lifters and range targets are not included in SSS-BV delivery.

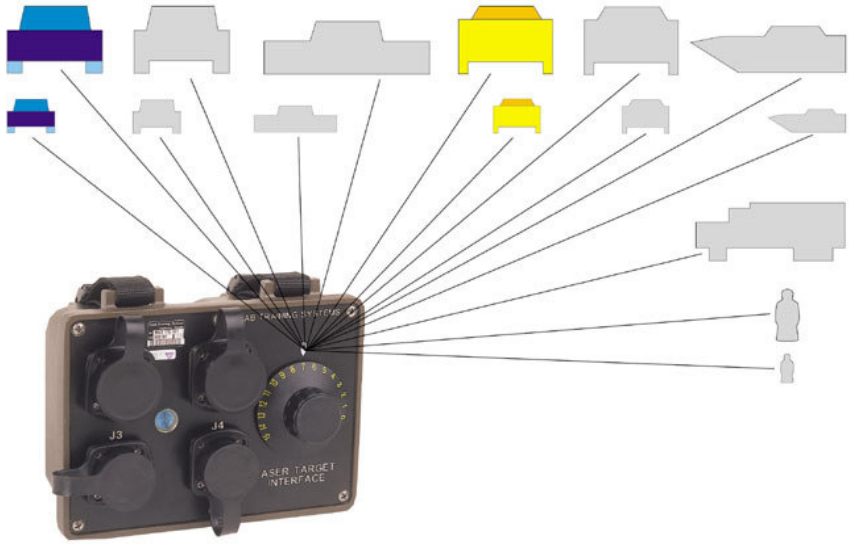

Figure 73: Target Control Unit with selection of target type

5.6 Instructor Stations

Combat and Weapon Simulator is delivered with two Instructor Operator Stations (IOS):

- Control Tower IOS (CT-IOS) – main workstation
- Portable IOS (P-IOS) – observer workstation in the field.

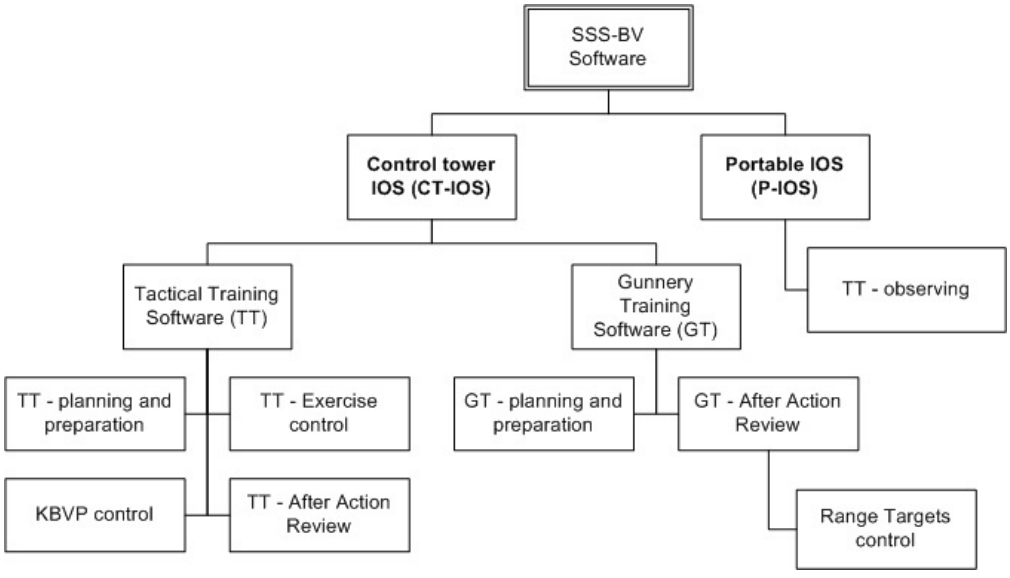

Figure 74: IOS software structure

5.6.1 Tactical Training (TT) Control Software

This functionality allows the user to define basic scenário parameters of the exercise:

- Drawing of tactical map for exercise prebriefing
- Creation of own and opposite units
- Initial configuration of Pandur ammumition.

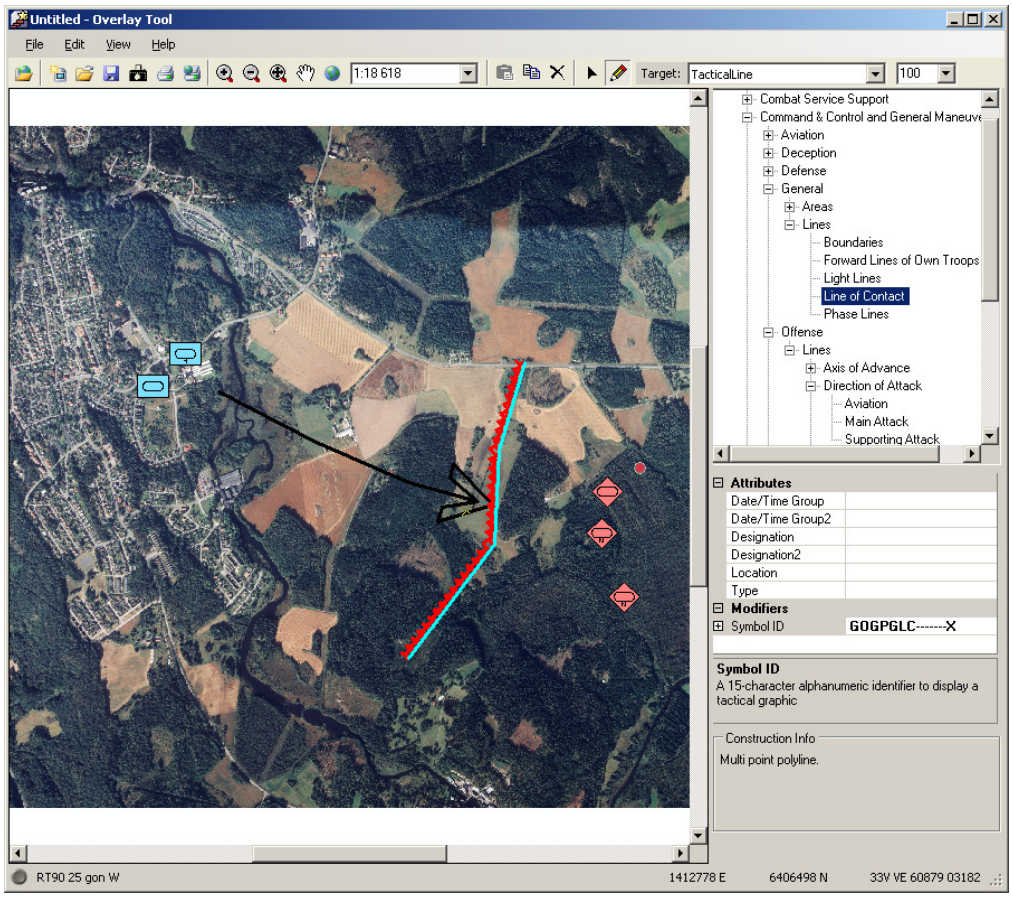

Figure 75: Tactical Map for scenario preparation

Exercise control functions are used for real-time training course monitoring:

- Pandurs position observing on 2D map or in 3D view
- Firing result report
- Timeline with marked events
- Generation of reports about important events.

Pandur control functions allows to observe and change Pandurs settings in real-time:

- Reload of ammunition – system allows to do Pandur Reset, which causes ammunition recharging into the initial setting, which is stored in Pandur.

- Kill state change (return Pandur back to battle after it was damaged)

After Action Review (AAR) allows to instructor and trainees to analyse finished trainining and evaluate performed task and reaction to event occuring during exercise. Whole training data are stored on computer and can be replayed.

AAR provides following functions:

- Playback of finished and saved exercise
- Detail evaluation for each trainee
- Generating of evaluating lists in MS Office format
- The figure 47 is an example of shooting statistics evaluation.

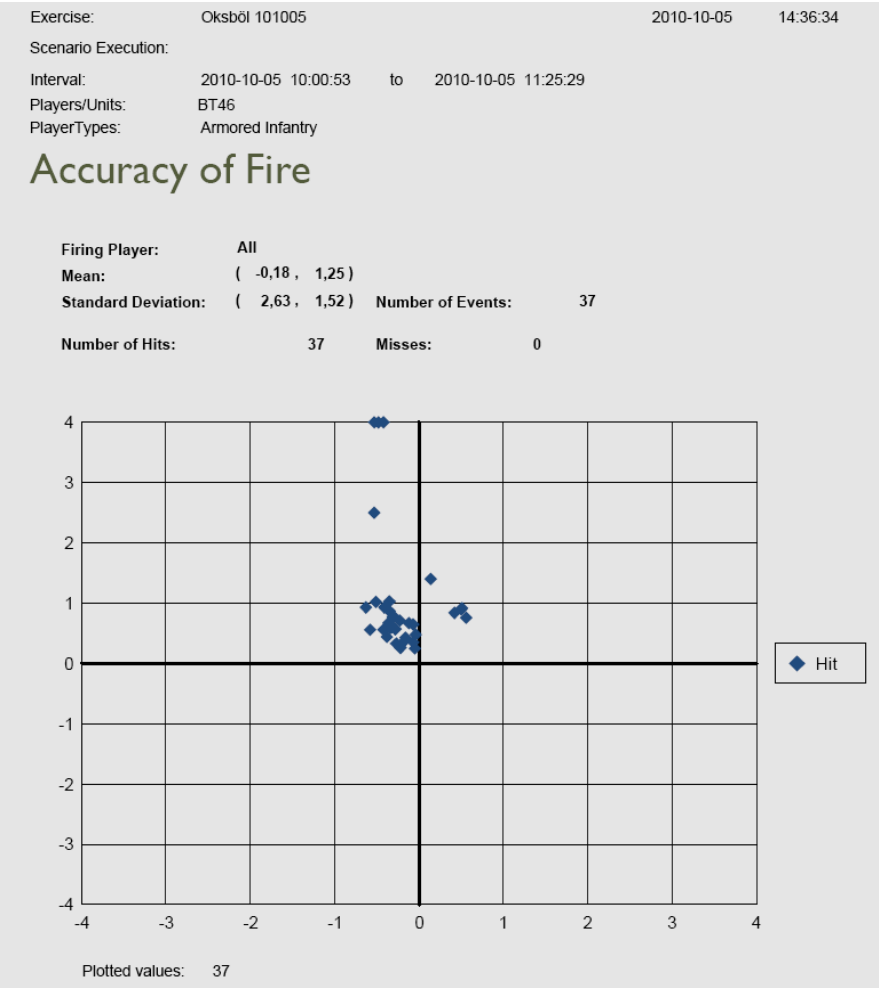

Figure 76: Shooting statistics evaluation

ZÁVĚR

Jako odborník na simulační technologie ve vojenství jsem popsal aktuální stav technické úrovně simulátorů vyráběných vedoucí firmou v tomto oboru - SAAB Training systems AB, Huskvarna – pro potřeby Armád. Jako příklad jsem vybral výcvikovou základnu pro vozidla Pandur. Na příkladu právě dodávaných simulátorů různé technické a výcvikové úrovně jsem popsal aktuální možnosti pro maximálně efektivní výcvik bezpečnostních odborníků.

CBT učebna popsaná v první části práce může být efektivně využita jak v průmyslu komerční bezpečnosti, tak například i při studiu na FAI UTB ve Zlíně. Z dostupnosti studijních materiálů na dálku by těžili především studenti kombinovaného studia. Podobný systém je na UTB již využíván, ale mnou popisovaný systém je mnohem komplexnější a možná ukazuje směr, kterým se budou výukové programy ubírat.

V dalších částech jsem popsal jednoúčelové simulátory používané pro výcvik specialistů, kteří používají velmi drahá vozidla ve vypjatých situacích. Výcvikem na těchto simulátorech získají studenti dovednosti v intuitivním používání vozidlových přístrojů aniž by museli ve velké míře podstupovat nebezpečí poškození vozidel, utrácet za palivo a munici a hlavně je celý výcvik prováděn naprosto bezpečně

CONCLUSION

As an expert for simulation technologies in army area I have described up-to-date state of technical level of simulators produced by leading company in this area – SAAB Training systems AB, Huskvarna – for Army needs. As an example I described training systems for Pandur vehicles. On the example of recently delivered simulators of various technical and educational levels are described actual possibilities for maximally effective training of security experts.

CBT classroom described in first part of thesis can be effectively used both in commercial security industry and in FAI UTB study in Zlín. If CBT principals are used, especially distance students can profit from distance access to learning materials. I must say that similar system is already used in university, but the system which I described is much more complex and shows the way which the learning SW may follow.

The other parts describe single-purpose simulators, which are used for very special training of specialists using expensive vehicles in physically extremely hard conditions. With this kind of simulators the students learn using vehicle instrumentation intuitive way without danger of vehicle destruction, ammunition and fuel expenses and mainly safe way.

LIST OF USED LITERATURE

[1] Company materials and figures of E-COM s.r.o., Slavkov u Brna

ABBREVIATIONS

3D	Three Dimensional.
AAR	After Action Review.
AC	Alternating Current.
AČR	Armáda České republiky
CAN	Controller Area Network.
CBT	Computer Based Training.
CCU	Central Communication Unit.
COTS	Commercial Of The Shelf.
DAS	Data Acquisition Ssystem.
DC	Direct Current.
DIO	Digital Input / Output.
DIS	Distributed Interactive Simulation.
DOF	Degree Of Freedom.
DS	Desktop Simulator.
EEPROM	Electronically Erasable Programmable Read Only Memory.
FCS	Fire Control System.
GB	Giga Byte.
GUI	Graphic User Interface.
HF	High Frequency.
HLA	High Level Architecture.
HOTAS	Hands On Throttle And Stick.
HUD	Head-Up Display.
HW	Hardware.
I/O	Input / Output.

IG	Image Generator.
IOS	Instructor Operating Station.
KBVP	Kolové Bojové Vozidlo Pěchoty.
LAN	Local Area Network.
LCD	Liquid Crystal Display.
LED	Light Emitting Diode.
MB	Motion Base.
MFD	Multi Functional Display.
MMI	Man-Machine Interface.
OFS	Operational Flight Simulator.
PC	Personal Computer.
PKB	Průmysl Komerční Bezpečnosti / Industry of commercial security.
PS	Procedural Simulator.
PSU	Power Supply Unit.
PTT	Push To Talk.
RF	Radio Frequency.
SW	Software.
TCP/IP	Transmission Control Protocol / Internet Protocol.
TMS	Time Management System.
UPS	Uninterruptable Power Supply.
USB	Universal Serial Bus.
UTB	Universita Tomáše Bati / Thomas Bata University.
VFD	Vacuum Fluorescent Display.
VGA	Video Graphic Array.
WiFi	Wireless Fidelity.

WST Weapon System Trainer.

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