The T-72 tank platoon simulator

The main characteristics

- Design and functional adequacy of T-72 tank dynamic crew simulator
- Realistic communication system
- High quality of visualization
- 3D real terrain models of 5x5 km
- Inbuilt editor of tactical scenarios
- Simulation of virtual weapon systems operations and actions
- A wide spectrum of scenarios for exercises and training events
- The electronic map of the terrain sector with the current tactical situation
- 3D visualization of the area of operations
- After-action-review, results documentation

The main disadvantage of currently existing combat training facilities

Achievement and maintenance of a high level of Army units combat effectiveness is an extremely difficult task, which can be solved through the intensiveness of combat training under complex conditions, typical for the contemporary battlefield. Particularly, under conditions of confrontation with the well prepared and trained enemy.

The essence of combat training physical infrastructure (facilities) disadvantages

Inconsistency of units combat efficiency requirements and characteristics of existing training facilities (infrastructure)

Implications

1. It is impossible to conduct realistic force-on-force training of units acting with the use of organic equipment and weapon systems
2. It is impossible to conduct leaders training to shape and maintain skills to effectively exercise command and control over subordinate units under conditions of active confrontation with a well-trained enemy
3. Absence of real capabilities to conduct collective training of combat vehicle's crews and acquiring by them of steady skills in operating weapon systems and equipment under conditions of a close battle
4. Combat training with the use of existing training facilities and traditional training methods (regardless of intensiveness of training and methodical support) leads not to be trained to fight with likely enemy but to conduct qualification exercises and various inspections under conditions of well-known training areas
5. Unit commanders lack in acquiring skills in planning and execution of battles, command and control skills, as well as crews lack the opportunity to acquire steady skills in operating organic weapon systems under complex conditions of modern combat
6. Military leadership does not possess the tool to objectively assess the level of units cohesion and leaders/commanders abilities in preparation of battle with a well-trained enemy

The ways to solve the main contradictions in combat training

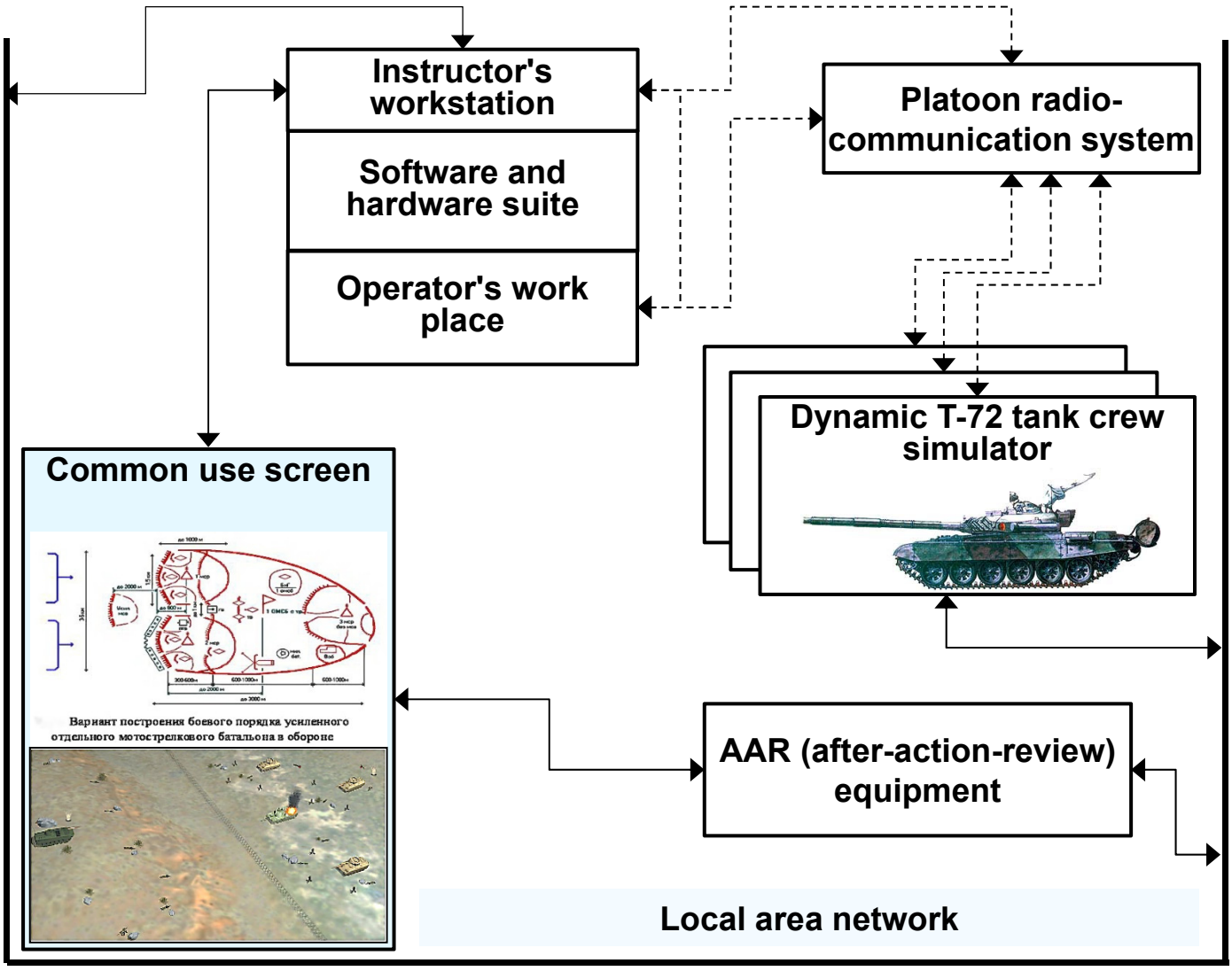
1. **The building of simulation force-on-force capabilities (systems) and its introduction into a combat training system**
2. **Approaching of characteristics of virtual battlespace of force-on-force simulators to real conditions of modern combat**

The purpose of the platoon simulator

The T-72 tank platoon simulator (index TTV-72) is designed to conduct force-on-force exercises in the classroom to approach training conditions to conditions of modern combat and to manage the following issues:

- education and training of platoon leaders to plan and execute a battle, to control crews and fires of tanks during a battle;
- coordination of tank platoon crews;
- education and collective training of tank T-72 crews for shaping steady skills in equipment and weapon operating, search techniques, and firing of tank weapon in different ways, under various weather conditions, summer and winter, varied terrain, day and night.

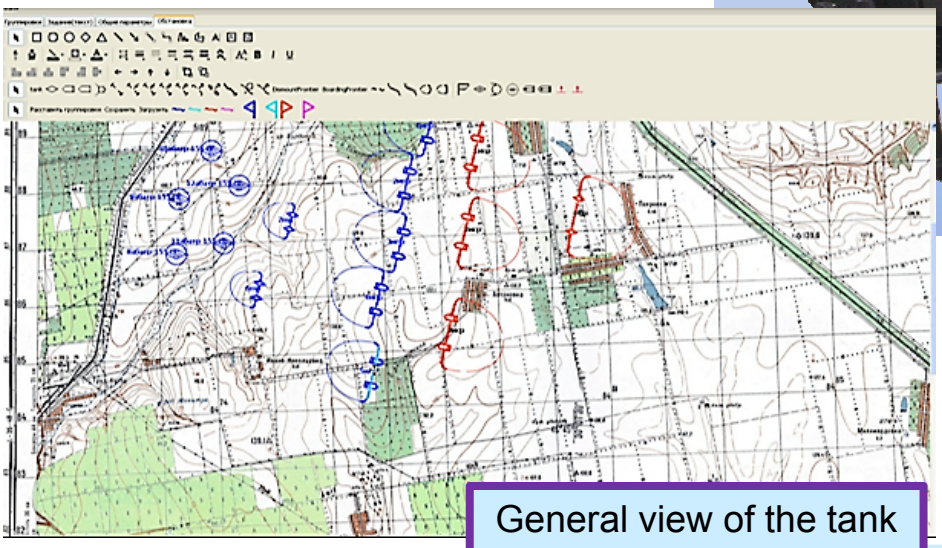
Structure



The components of the platoon simulator

Instructor's work station with software and hardware suite and operator's workplace

Development of the training scenario for the exercise with the use of tactical situations editor



General view of the tank platoon simulator

Local area network and voice communication system support platoon activities within virtual battlespace and coordination with supporting units.

Dynamic T-72 tank crew simulator

General view of T-72 tank integrated crew simulator

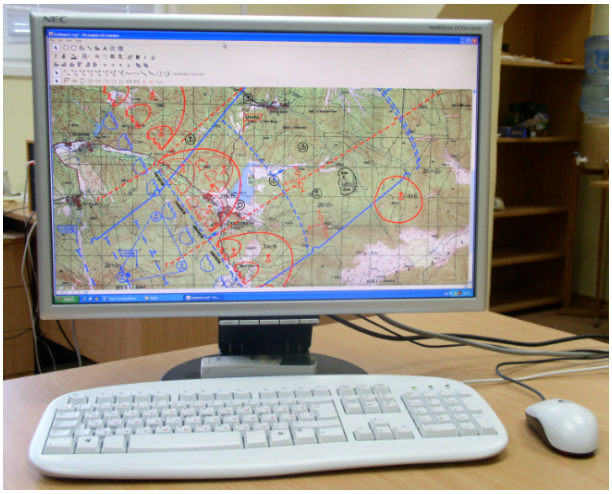
T-72 tank crew simulators' technical characteristics

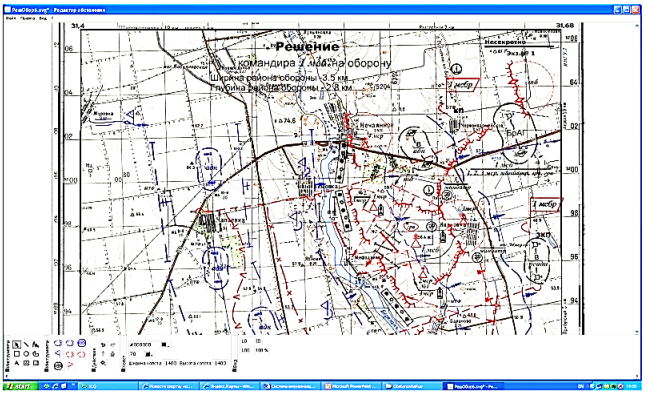
- high level of design and functional adequacy
- an ability to work both online (for participation in tactical exercises and collective training) and offline (for training tank crews)
- Inter-communication system operating adequacy
- A wide spectrum of scenarios for exercises and training events
- Capability to select required terrain (moderately rugged, desert, mountainous) for exercise
- Automated evaluation and assessment of standard driving and firing exercises performance
- Exercise results documentation
- Long duration of continuous work (12 hours without stop)

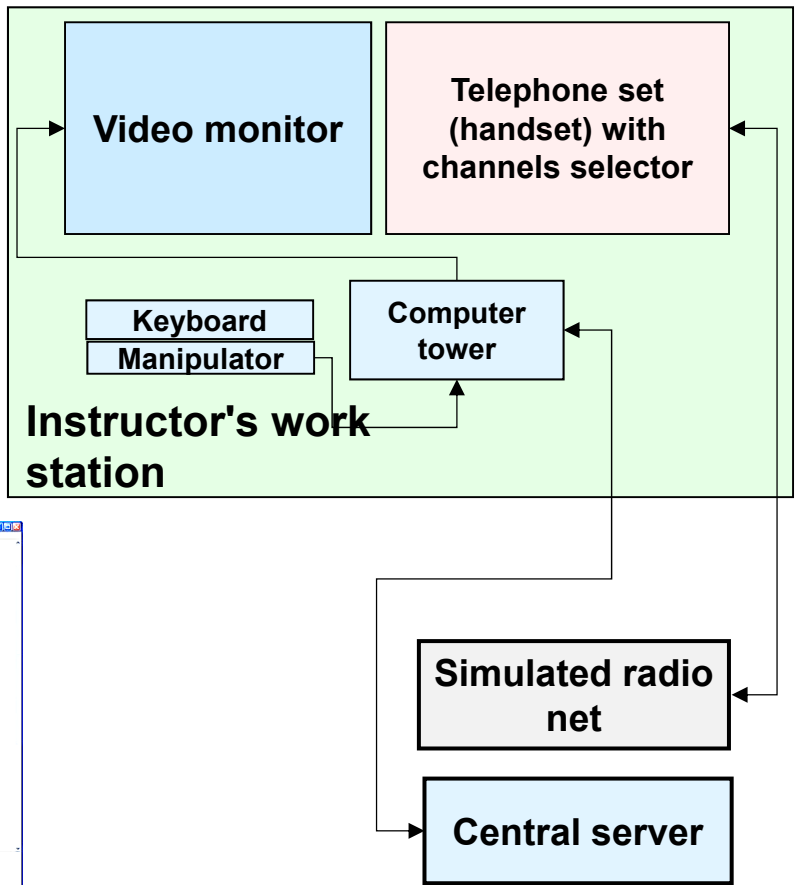
Exercise management

Instructor's capabilities

- Assignment of training objectives
- Selection of required terrain
- Development of exercise design
- E-Mapping of a tactical situation with the use of tactical situation editor
- Assignment of a mission to platoon leader, preparation of e-maps set (if required)
- Arrangement of terrain reconnaissance with use of projection system with cylindric screen and binoculars replicas
- Timing of tactical exercise
- Reproduction of current tactical situation with the use of e-map and 3D images (with scaling and detailing capability, up to single platform)
- Display of current actors (belligerents) actions in progression in the forms of tables and graphs (battle losses, ammunition consumption, etc.)
- Supervision of platoon leader's actions and tank crews. Radio exchange with trainees and monitoring of radio exchange within net net
- Enemy actions play and supporting units activity play (interactive control of imitated units and weapon systems activity)
- Recording of battle drills and exercises progress and AAR Faults analysis and defining of training objectives for the next training events and exercises







Simulation of activities of virtual units

- ✓ Activities of virtual weapon systems are simulated in the form of 3D “intellectual” models
- ✓ Area of responsibility, area of operations (positions) are assigned for each “intellectual” model automatically concerning its place in the battle order and mission, as well as control measures
- ✓ “Intellectual” models, within their respective areas, independently detect, identify enemy entities, set target priorities and engage them with specified weapon and ammunition, adjust fires, and assess battle damage;
- ✓ A decision on fact and level of damage of each object (target) from both sides is made at the central server of the simulator;
- ✓ “Intellectual” models of combat vehicles execute bypass of obstacles and escape from enemy fire within their respective areas of operations

Combined arms battle simulation capabilities

- ✓ Exercise control over virtual units activity with use e-map (tactical symbols)
- ✓ Simulation of combat activity of virtual units (up to single combat vehicle and weapon system platforms);
- ✓ 3D modeling of cross country and urban terrain with different relief, soil, hydrography, vegetation, road net, etc.;
- ✓ accounting of influence of firing, maneuvering, and reconnaissance capabilities, as well as the technical status of organic equipment, allocation of ammunition and fuel, camouflage means, outfit and military personnel of virtual units training level;
- ✓ Considering of influence of terrain relief, radio-electronic, thermal and optical interference, as well as smokes and fires, time of a day, seasons, and meteorological conditions;
- ✓ Interacting virtual units play (adjacent, artillery, missile, air-defense, aviation, reconnaissance, electronic warfare, maintenance, and logistic support);
- ✓ reproduction of force-on-force simulated battle on e-map and within virtual battlespace, as well as in the form of tables and graphs

Training event recommended sequence with the use of a platoon simulator

Development and assignment of tactical mission for a platoon leader

Check of technical readiness of simulator components for an exercise

Check of trainees' readiness for an exercise

Exercise conduct

Platoon actions	Enemy actions	Instructor actions
Simulated-training exercise	**training battle**	$T_{tr}=0$
◙ Occupation of workplaces by trainees in the simulator, it actuation, communication setting ◙ Control over tanks, conduct reconnaissance, and T-72 weapon firing ◙ Control over platoon tanks maneuvering and firing during mission accomplishment ◙ Reports and messages exchange	◙ Adjacent and higher headquarters assets operations of both sides play ◙ Reports to the Instructor	◙ Supervision of trainees activities ◙ Current situation analysis and its development ◙ Adjacent and higher headquarters assets operations of both sides play ◙ Documentation and recording of most illustrative tactical episodes ◙ Monitoring of radio exchange in trainees net
		$T_{sim}=T$

Trainees' actions analysis and AAR

- **Reproduction of progress of battle at e-map and synchronized radio exchange recording (with pauses, reiterations, and actions analysis in illustrative tactical episodes)**
- **Platoon leader's and crews' actions analysis and evaluation of results of mission accomplishment (ammunition consumption, own personnel losses, enemy losses, the range of platoon advance, occupation/ failure to occupy assigned line)**
- **Identification of failures (mistakes) and assignment of tasks to eliminate them**

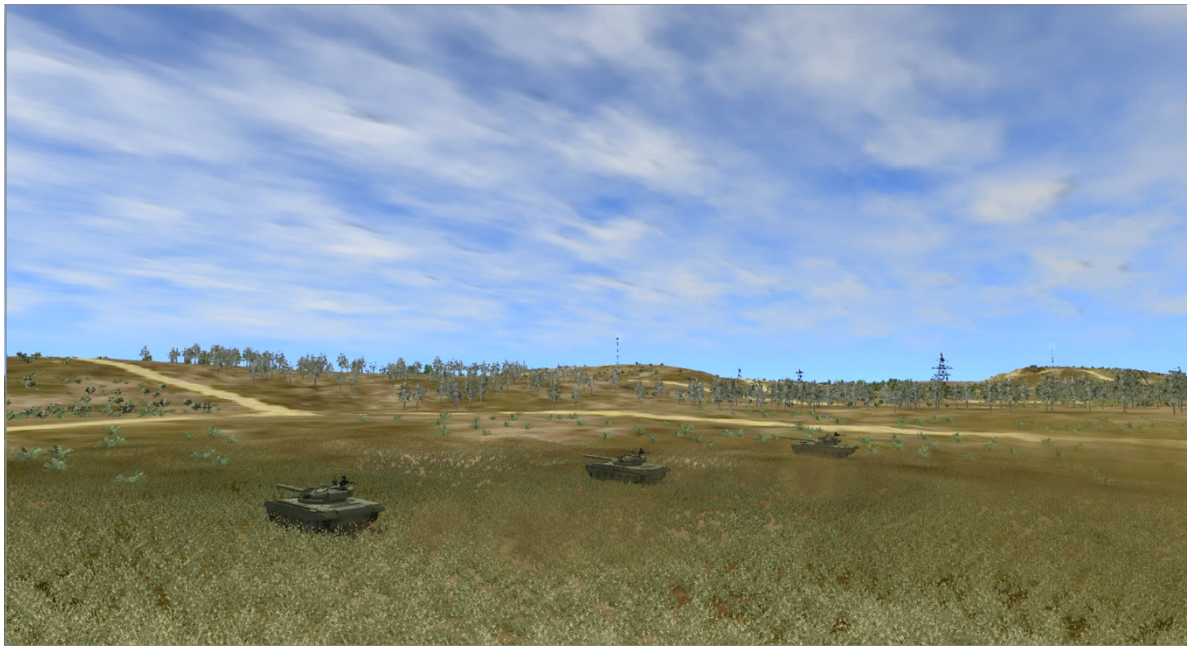
3D terrain models

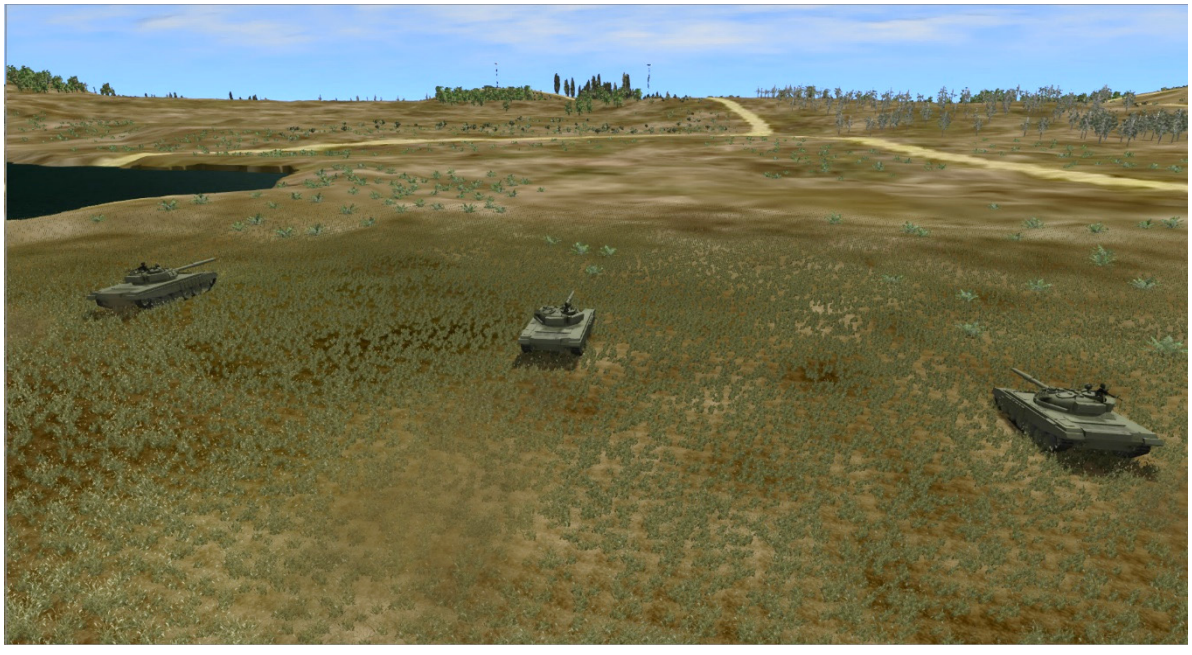
There are 3 types of 3D terrain models in the simulator's library, ensuring exercise conduct - moderately rugged, desert, mountainous. The development of a similar terrain sector is considered.

Visualization system characteristics

- High level of specification and drawing of terrain relief, correspondence of image color scale to the real background
- Compliance of angular size, shape, color, a contrast of local vegetations and object, ground and aerial targets to real objects within the field of view of optoelectronic tank devices
- Adequacy of dynamic characteristics of moving objects (targets) and simulated weapon system

External controllable camera view of the tactical field at instructor's work station





Adequacy of simulated models of tanks and virtual weapon assets of friendly and enemy forces

Simulated tank model ***provides***

- adequacy of functional algorithms of simulator's instruments and equipment in operating and emergency modes and simulator reaction on trainees controlling actions; simulator ensures coverage of combat procedures of at least 90%
- adequacy of the tank motion model as per terrain relief features, type of soil, and surface conditions
- adequacy of visual, sound, and dynamic effects of simulator operating and firing of various types of ammunition
- accurate accounting of gun wear ratio, ammunition type, speed and direction of a wind, atmospheric pressure, air and charge temperature and its influence on projectiles and bullets flight range
- conduct of surveillance with the use of optical, and optoelectronic devices, and all kinds of ammunition firing following optical visibility, obscuration of optical observation devices field of vision, the hull inclinations during movement and gun firing;
- adequacy of the ground and aerial targets (dimensions, color, character and parameters of movement, fixation the fact of target hit or miss when firing from tank weapon;
- accounting of terrain conditions, time of a day, season, air temperature

Simulated model of virtual weapon systems ***provides***

- determination of fact and computing of range of platoon detection by virtual enemy's optical and optoelectronic means concerning the range of line of vision from positions of enemy reconnaissance assets
- decision making on the engagement of tank by virtual enemy's assets concerning its command-and-control cycle, types of projectiles fired, antitank missiles, and an organic load of ammunition
- correspondence of firing range and armor-penetration ability of virtual enemy weapon systems (tanks "Leopard-2", M1A2 "Abrams", T-80U, T-90, infantry fighting vehicles BMP-2, BMP-3, armored personnel carriers BTR-80, BTR-82A, BTR-3E1, artillery battery in position, infantry groups in the trenches, anti-tank missile systems "Javelin", "Milan-2») to its real characteristics
- presence of typical features of reconnaissance assets and weapon systems of the virtual enemy on positions (fortification, silhouettes and vehicles painting, combat vehicles operating features)
- allocation of available weapon systems and remaining ammunition to engage detected targets, decision making on bypassing of terrain sectors and minefields overcoming

Simulator's database

- ★ database of characteristics of combat vehicles and weapon systems, missiles and ammunition, organizational structures of units, strength, and status of belligerents
- ★ database of terrain sectors
- ★ program suite to generate and visualize terrain and tactical situation
- ★ the interface for the setting of initial positions and status of belligerents, battle conditions, and management of exercise progress
- ★ interface of OPFOR and friendly forces play
- ★ modeling block of adaptive actions simulated units and weapon systems
- ★ service modules, required for AAR

New methods of tactical training

Platoon simulator expands tactical training capabilities and objectively stipulates the appearance of new training forms, were general features are:

- the force-on-force character of exercises and training events
- force against force activity within one 3D terrain model under conditions of the single tactical situation and unified time scale
- adequacy of T-72 tank platoon simulators and virtual weapons, supporting and interacting units play, as well as an enemy activity play
- full algorithm of platoon leader's actions to plan and execute a battle and exercise control over platoon maneuvering and firing
- portraying the course of battle and results of opposition forces activities, and their relative firing impact
- reproducing of the real structure of command-and-control radio-net
- provision to conduct simulators-based and simulated battle during the offense, defense, reconnaissance in force and combat security actions, and pursuit
- Possibility to repeatedly reiterate tactical situations, conduct AAR

Simulated battle types, implemented in simulator

Simulators-based battle - training battle, in which units act against each other with the use of integrated crew simulators of combat vehicles (tanks, IFV, APC) and ATGM systems

Simulated battle – *training battle, in which units act with use of simulators, and supporting and interacting units are virtual and their operations are simulated by pole players (and OPFOR) concerning inbuilt the artificial intellect of virtual models*

New methods of tactical training, implemented in the simulator

1. Firing and fire control exercises with the use of platoon simulator - the form of platoon collective training, education of tank commanders to execute fire control TTPs.

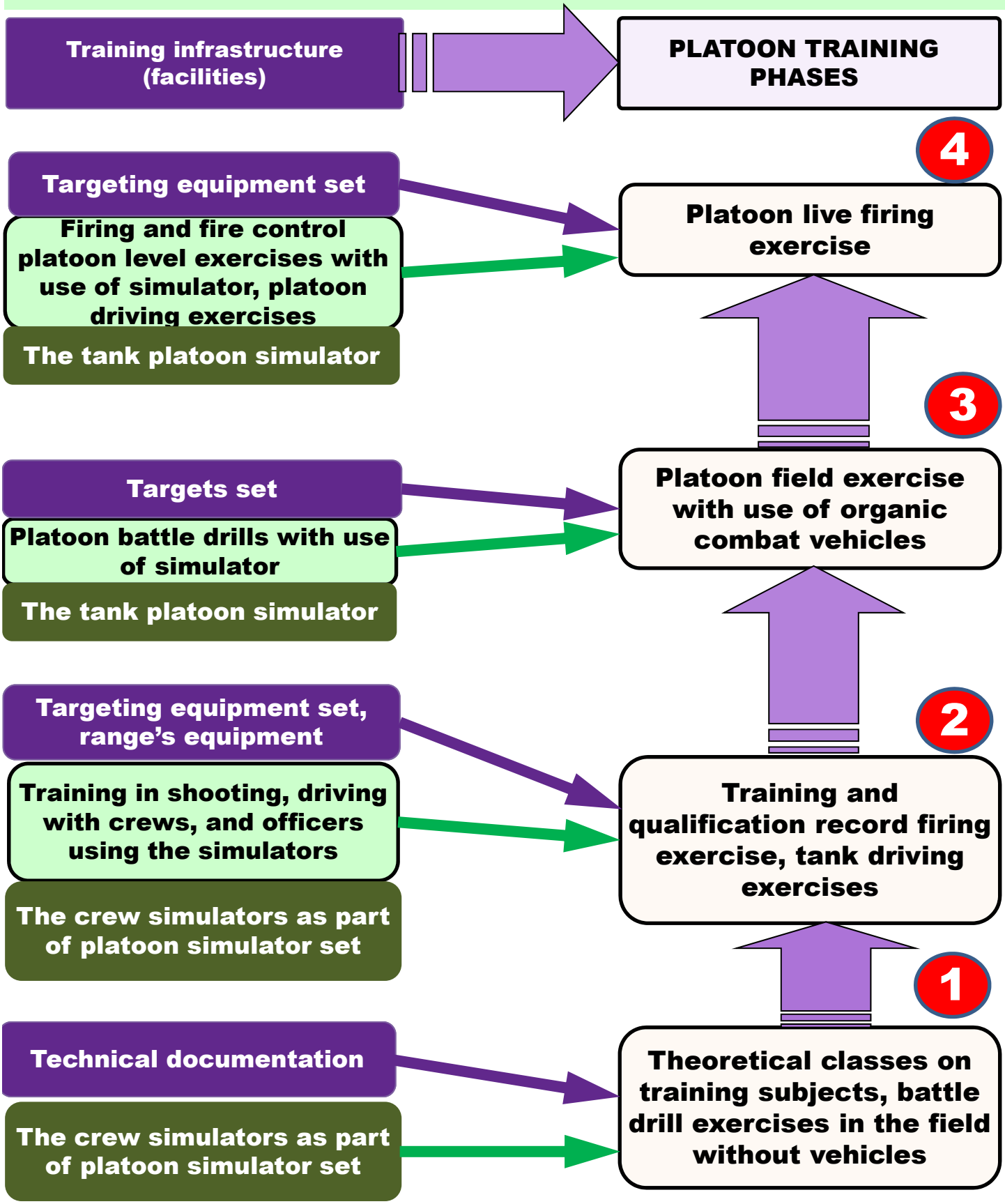
Those training events are conducted by practicing of fires planning and fire control in the course of close (force-on-force) simulators-based or simulated battles

2. Tactical exercises with the use of platoon simulator – the form of platoon collective training, improvement of skills and proficiency of leaders to plan battle, and exercise control over the unit during the battle.

Training events are conducted through tactical tasks accomplishment by squads and platoons under conditions of force-on-force simulator-based (simulated) battle

The position of simulator in combat training process

Infantry platoon simulator fully ensures preparation of platoon for field exercises



SIMULATOR TECHNICAL CHARACTERISTICS

Serial №	Characteristics	Quantity, pcs.
1	***Quantity of simultaneously trained platoons***	1
2	Quantity of virtual interacting units	
	Infantry platoon	1
	Artillery battery	1
	Tank platoon	1
3	***Quantity of simulated ground targets (including active)***	Up to 80
4	***The types of virtual (simulated) weapon systems***	
	Tanks “Leopard-2”, M1A2 “Abrams”, T-80, T-90	+
	Infantry fighting vehicles BMP-2, BMP-3	+
	Armored personnel carriers BTR-80, BTR-82A, BTR-3E1	+
	Antitank missile complex “Fagot”, “Kornet”, “Milan”	+
	Artillery battery “Hwozdika”, “Akacia” on positions	+
	Combat helicopters AH-64, Mi-24	+
	Assault aircrafts A-10, SU-25, “Alfa-jet”	+
5	***Terrain***	
	Dimensions of 3D terrain models, km	5x10
	Terrain types - plain, desert, mountainous	+
	real terrain (1 sector)	+
	3D terrain models mesh interval, m	1-2
6	***Exercise conditions***	
	Day, night, twilight	+
	Winter, spring, summer, autumn	+
	Meteorological conditions - fog, cloudiness, precipitation, wind	+
	Smokes and aerosol	+
	Radio-electronic interference	+
7	***Simulator's operating modes***	
	autonomous T-72 crews training	+
	Tactical training: simulated and simulators-based training battle	+
8	***Required space, m^2***	110
9	***Consumed Power, kW (single-phase circuit 220 V, 50 Hz)***	112
10	***Actuation time, min***	15
11	***Duration of continuous work, hours, at least***	12
12	***Error-free running time, hours, at least***	500
13	***Specified resource, years***	12
14	***Warranty period, years***	3
15	***Integration with simulators of higher-level (company)***	+

EDUCATIONAL AND METHODICAL CAPABILITIES OF THE SIMULATOR

Issues to be solved

- firing and fire control exercises, one-sided and force-on-force platoon-level exercises under various situations
- supporting and interacting friendly units play
- enemy units activity play
- accomplishment of various tactical training objectives: from platoon approach march till simulated close fight (offense, defense, meeting engagement, reconnaissance in force, combat security)
- ensuring realistic platoon command-and-control radio-net operating during tactical events and exercise
- portraying of close fight dynamics on e-map
- supervision of leaders and crews actions
- integration into simulation systems of company and battalion level

Supervision capability

- by positions and status of tanks at the field (terrain e-map, view from the external controllable camera in 3D format)
- by the current tactical situation
- by tactical event protocol (tank and virtual weapons firing, battle losses from both sides)
- by conversations between platoon leader and crews via communication means
- by duplicate field of vision of platoon leader and crew commander's optical observation and aiming device

Capability to develop training conditions

- selection of terrain type (moderately rugged terrain, mountainous, desert), season (winter, summer) and time of a day (day, night, twilight)
- selection of meteorological conditions (sunny, cloudiness, rain, snow, a wind of various directions and speed) and ballistic firing conditions
- determination of structure, strength, and initial positions of forces

Training results processing and storing capability

- recording of training event progress
- training results e-documenting
- training results archiving for a day or training period

Training results

- shaping, consolidation and improvement of platoon leaders practical skills to plan and execute battle, to control vehicles and fires (development of *independent tactical thinking*)
- Collective training of infantry platoons during simulated close battles in class-room

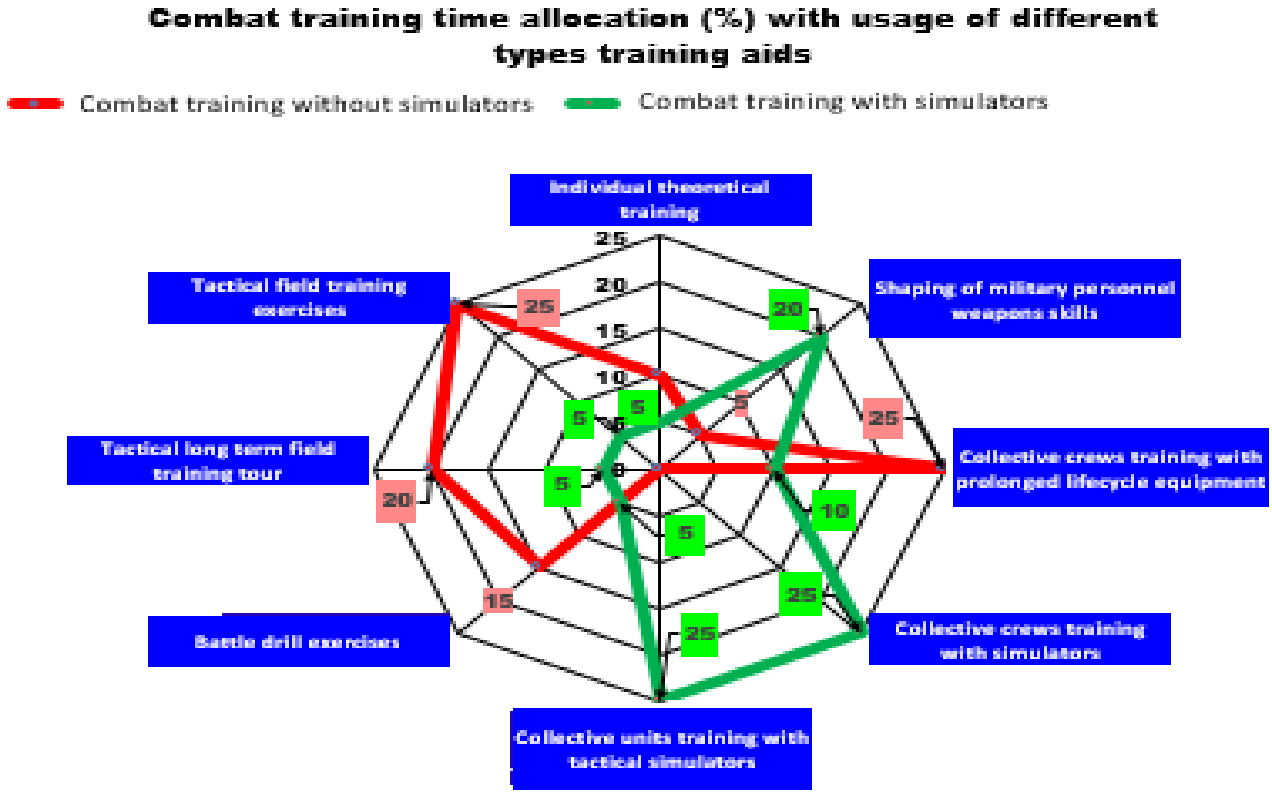
The outcome of the introduction of simulator into the training process

№	Outcome	The ways to achieve
1	**Increase of responsiveness and quality of units tactical training**	Simulator special program (to conduct computing and development of required graphic and text documents, 3D terrain models)
2	**Increase of relevance level during exercise conduct**	Capability to develop various tactical situations, selection of terrain and meteorological conditions. Adjacent, supporting, and interacting units play. Provision to conduct a force-on-force simulated battle
3	**Increase of tactical training intensiveness Mastering of effective tactics, techniques and procedures (TTP) under various situations**	Capability to reiterate tactical situations to master effective TTPs and ways to solve tactical mission and firing tasks under conditions of a specific situation against well trained and equipped enemy
4	**Increase of quality and reduction of time for tank platoons collective training in full strength**	High intensiveness of tactical exercises and training events, comprehensive monitoring of leaders, and crews' actions
5	**Shaping, reinforcement, and improvement of platoon leaders' skills in planning and execution of battle, exercising control fire and tank**	Conduct of tactical exercises under difficult conditions of force-on-force battle, exclusion of simplification of tank control, and control of fire actions. Capability to conduct a detailed analysis of leaders actions, preparation, and execution of AAR
6	**Increase of responsiveness and quality of teaching instructions and papers for AAR**	Capability to record received and given commands, orders and reports, leaders' and crews' actions to accomplish assigned missions. Recording and reproduction of conducted battles (episodes)
7	**Improvement of platoon's preparation quality to conduct field exercises**	Ability to conduct preliminary and full-scale practicing of tasks accomplishment with the use of simulator, which will be solved during tactical and live firing exercises
8	**Increase of safety of tactical exercises with live firing, reduction of traumatic level when operating organic vehicles and weapon systems**	Conduct of certification exercises with the use of simulators to accomplish tactical and firing tasks, which expected to practice during tactical exercises with live firing
9	**Provision of objectiveness in the assessment of tactical training level of platoon leaders and unit cohesion**	Capability to comprehensively evaluate leaders' and crews' actions in the course of battle Availability of special program to conduct analysis and evaluate trainees' actions

Amendment of time allocation for combat training with the use of simulators

Employment of simulators heavily influence allocating of time for various training events methods:

- 75-80% of the time is allocated for shaping and maintaining weapon operating skills at the required level with the use of simulation systems
- 20-25% of the time is allocated for testing of individual skills and collective proficiency during firing exercises, as well as units collective training during tactical exercises.



Achievements from the employment of simulators in combat training

- Effective managing of at least 80% of units firing training objectives
- Practicing of firing exercises under various training conditions (cross-country, mountainous, swamp, desert terrain, day and night, in summer and winter, under various meteorological conditions)
- Support of main phases of training periods - individual training, collective crew, and platoon training.
- Support of training methods “crawl, walk, run”, individual approach to trainees, continuity of training.
- The organizational and methodical interrelation of training events and exercises with the use of simulators with training in the field.
- The objectiveness of training level evaluation of each crew member apart and units as a whole, determination of progress rate in skill level, and unit cohesion.
- Manageability education and training process, modification of training process intensiveness.
- Increase of relevance level of training events, an approximation of training conditions to combat ones.

Designer and manufacturer of T-72 tank platoon simulator
LLC “Research and production company “Energy-2000,
Ukraine, Kyiv, Povitrophlotsky avenue, 94-A
www.simulator.ua

Developer and manufacturer provide:

- fabrication and delivery of simulator to the place of intended use
- assembly, adjusting, commissioning and acceptance testing at the site of intended use
- training of user's technical personnel
- warranty service for 2 years
- Post-warranted maintenance (subject to separate contract)
- author's supervision and software modernization during the entire simulator operation period