

# HUNGARIAN COMBAT SIMULATORS

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## ABSTRACT

*I think the constant improvement of the military training systems is inevitable if we want to face the challenges of the 21st century. I think the integration of different kinds of simulators is a good way to improve these systems. In my scientific work I tend to introduce two simulators, MARCUS and KRONOS. Both of them are used by the Hungarian Defence Forces and were developed by the Artifex Simulation and Training Systems Ltd.*

**Keywords:** military training system, simulator, Hungary

*„Si vis pacem, para bellum!”  
"If you want peace, prepare for war".<sup>1</sup>  
(Publius Flavius Vegetius Renatus)*

## Introduction

The writer of the above quotation is not motivated by the "arms lobby" and is basically not trying to encourage the leaders of the states and armies to start an arms race, but it tries to point out that the stronger and more prepared the state is, the less likely it is to get attacked by anyone. At the same time, the strength of an army lies not only in the number of soldiers, weapons and military technical equipment, but in their quality as well, so the level of the training, the technical development and the quality of the commanders are also important aspects. In the complex system of training, in addition to the continuous development and improvement of the skills acquired in the basic training, it is necessary to acquire and practice higher and higher level of knowledge too. In peacetime, one of the most effective means of tactical training can be the various combat simulation systems, which, with the advancement of technology, provide increasingly realistic conditions for the execution of individual or even more complex tasks.

Combat simulator systems are not the inventions of the 21st century. They have been used since the 1960s in the training of military forces to help preparing soldiers to work in war environment. Over the past decades, these solutions have undergone spectacular technical advances, and nowadays they do not only make simulation programs for services, but also for different branches of the army, or even for specific tasks. Combat simulators have been designed for all spaces where military operations can happen including land, air, water, underwater, space, and cyberspace. In my point of view the opportunity lies in the young generation (currently Z generation), who have grown in the digital world, can carry out tasks

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<sup>1</sup> Vegetius: De re Militari, 3<sup>rd</sup> book, 1473.

naturally in the virtual space and would be more susceptible to this type of education and training system than older generations. This is particularly true for the officer cadets who are going to be the future commanders of the army. For them the widespread of this type of training could be a significant motivational factor.

In my research, I primarily studied the combat simulator systems used by the land force, since I have personal experience. I participated several times in the Ludovika Battalion's field exercises and in an international exercise in Hohenfels, Germany, where MILES<sup>2</sup> technology was used. In Hohenfels I also had the possibility to try out the EST<sup>3</sup> 2000 and was able to gather information from American soldiers about this technology. I got to know more about MARCUS and KRONOS systems with the interview of the developers from Artifex Simulation and Training Systems Ltd. My university possess more simulator systems so I had the chance to try out MARCUS, KORNOS and VBS<sup>4</sup> 3 simulators with the instruction of the university teachers. In my opinion my experience provides a good basis for making a scientific work of combat simulator systems and for making suggestions of their use.

### **Benefits of using combat simulators**

Generally, the use of more sophisticated systems, such as simulators, should be the hallmark of modern education and progressiveness in all organizations because the instructor (trainer) actively involves students in the process of learning opposing the conservative teaching methods. There is a growing demand for this, as the development of a network society and the acceleration of world processes make the traditional education and training processes unattractive for students, since they cannot learn the subjects on the appropriate level. This is why there is a need for a complex method of learning that involves more senses. This requirement is met by simulator systems. Their use has several advantages.

One of the most important things in any military training, exercise is to ensure safe execution and avoid injuries. Using combat simulators, most of the exercises can be carried out while keeping risk taking at a low level and can also save us a lot of time and energy. Time saving comes from the fact that preparatory activities for exercises like shooting take too much time so there is not enough time for the implementation. In the case of simulators, there are no such problems because they do not require long preparation and but still we are able to achieve the same results. Money saving is also an aspect that needs to be highlighted. Instead of high-cost weapon systems or other kinds of equipment software-based simulators should be used because only the cost of maintenance; which includes the power consumption, the elimination of potential program errors and regular maintenance; must be paid. However, this problem can be approached from a different view. Quoting the words of Lieutenant General Zoltán Orosz: I see savings in efficient task execution and in the rational use of the power. I consider the lack of simulator training a wrong kind of saving. Some simulators also allow us to control units from squad to even army level providing opportunity for leaders to command higher level units that could not be executed in reality because of the limited capacity. [7] [8]

A soldier needs to be ready for fighting under any circumstances. This sentence also refers to that a soldier has to maintain his combat readiness, but this is not always the case due to the lack of practical training. Combat simulators can solve this problem because they can be used independent of time and space. Not to mention the advantage that we can set the environment with different parameters, providing a more versatile experience than the actual implementation itself.

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<sup>2</sup> Multiple Integrated Laser Engagement System

<sup>3</sup> Engagement Skills Trainer

<sup>4</sup> Virtual Battlespace

## **Grouping of combat simulators**

There are more kinds of grouping, but the most logical option is to examine the participants' relationship with reality. We can separate the following areas: Live Simulation (LS): both the participants and the environment are real, for example, the MILES system; Virtual Simulation (VS): the real participants work in a virtual environment, such as EST 2000, KRONOS; Constructive Simulation (CS): includes those simulators that lead virtual units, control a virtual person in a virtual environment, for instance: MARCUS; Game Simulation (GS): corresponds to a virtual and/or constructive simulation that has been complemented by a multi-user, interactive gaming interface, like VBS3, ARMA. These four simulator groups together form the integrated training environment (ITE) in which these functions are combined. This will represent a new generation of simulators. [2] [3] [6]

### **MARCUS - Primary goal**

MARCUS is a comprehensive constructive simulator that has a joint forces model. It provides conventional combat and urban operations, combat service support, CBRN<sup>5</sup> and electronic warfare modelling, air warfare and air defence simulation, disaster relief, stability and support operation an effective system of practice. Its purpose is to ensure the ability of the commanders and his/her staff to practice their military and OOTW<sup>6</sup> within NATO and other international organizations. Its tools include planning the combat, developing scenarios, and evaluating them. [4] [9]

### **MARCUS - Structure and operation**

To use MARCUS, a PC<sup>7</sup> or laptop is needed with Windows operation system intalled. The simulator system consists of user workstations, server stations, Internet network elements. The number of these depends on which version of MARCUS we use. We distinguish MARCUS/B/Z/D/H<sup>8</sup> versions, which mean different tactical levels. To build up a MARCUS/Z/D/H system approximately 50 user workstations are necessary that are run by one or two Windows servers. For MARCUS/B, it is enough to provide 8-10 workstations with one server. We distinguish three important kinds of user workstations, the commanders', the staffs' workstations, and the operators' workstations of the organizations that are involved in the exercise and can act friendly, hostile or natural depending on the situation.

The commander/supervisor has access to all other user workstations at his/her workstation, even for opposing forces (OPFOR) teams, and for ongoing processes. They may have assistants who can monitor the activities of reconnaissance, gunners, aircraft, air defence, and logistics in monitoring mode. The staff manages the map of simulation and the documents. They are in constant contact with the sub-players who are responsible for implementing the decision of the commander with the subunits the lead. Operators translate the supervisor's commands into the simulator language and execute them on the virtual battlefield. Sub-players are responsible for the activities of the operators. [9] [10]

APP-6/A<sup>9</sup> has been integrated into the system so it is capable of conducting international training exercises. Within the simulator you can switch between a map (even a world map) and a 3D view. The maps used in the system are in the same format as the standardized topographic maps of the Hungarian Defence Forces. The largest map view covers a 1500 x 1500 km operation area, which is mainly used in large-scale exercises, but it can also be limited to smaller geographical units that are optimized for smaller tasks. The

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<sup>5</sup> Chemical, Biological, Radiological, Nuclear

<sup>6</sup> Operations Other Than War

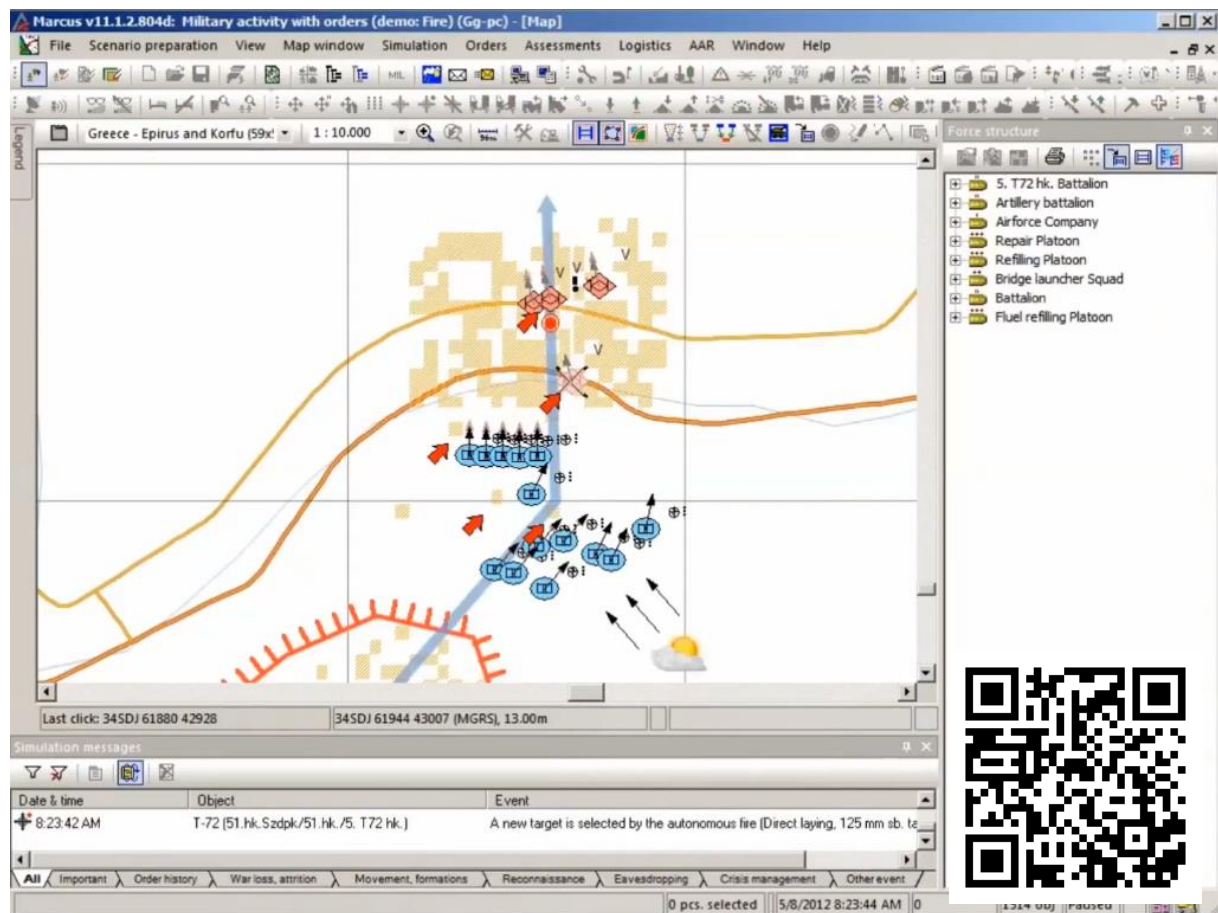
<sup>7</sup> Personal Computer

<sup>8</sup> B – platoon, Z – battalion, D –brigade, H – division

<sup>9</sup> Allied Procedural Publication 6 (A) – NATO Joint Military Symbolology

simulator has a high resolution digitalized terrain database that can be expanded with standard format data and can be modified by the user. MARCUS can use vector databases such as DTA50<sup>10</sup> 2.0, NGA<sup>11</sup> - DFAD<sup>12</sup>, VMAP<sup>13</sup>, OSM<sup>14</sup> (you can plan exercises all over the Earth), DXF<sup>15</sup>, DDM<sup>16</sup>, DTED<sup>17</sup>, and raster graphics, georeferenced images (satellite images, aerial photos, scanned maps). It has field analysing feature that tests visibility, terrain and coverage. When displaying the surface, great emphasis is placed on different objects and people whose properties can be customized depending on the task. Field modelling is very detailed and can be supplemented by additional natural and artificial elements such as environmental effects (light, wind, rain, snow, temperature) or changes in the status and condition of human resources (fatigue, food, clothing etc.). [1] [6] [9] [10] [11]

The tactical database contains not only the characteristics of Hungarian units, weapons, ammunition, and various technical data, but also the equipment of NATO member states and other countries. It has tactical evaluation tools too that include power and loss estimates. The



**1. Figure:** Marcus during use + QR code of the related video

<https://www.youtube.com/watch?v=cFakXUTzH1A> (Downloaded: 2018.11.07.)

<sup>10</sup> Digitális Térképészeti Adatbázis 50 - Digital Cartographical Database 50

<sup>11</sup> National Geospatial-Intelligence Agency

<sup>12</sup> Digital Feature Analysis Data

<sup>13</sup> Virtual Map

<sup>14</sup> OpenStreetMap

<sup>15</sup> Drawing eXchange Format

<sup>16</sup> Digitális Domborzatmodell – Digital Terrain Model

<sup>17</sup> Digital Terrain Elevation Data

system also has a built-in AAR<sup>18</sup> function, which allows us 100% replay and the use of graphs, signal etc. Various events can be scheduled during execution, which can influence the leading. The decision-making process of the commanders is based on the flow of information. This information includes the organizational structure, terrain, reports that can be even printed so you can work not only on computers, but also traditionally on paper, thus increasing the realism of the exercise. [1] [6] [9]

### **MARCUS in the military training**

MARCUS is not designed for basic training, as it is mainly for commanders to lead subunits, units, and higher units and this is not included in the subjects of basic training. However, it would be possible to demonstrate different movements such as manoeuvres to recruits when they learn the certain topic. The simulator could be used in the non-commissioned officer and officer training as the platoon-level combat is taught at both levels, and the MARCUS/B system is suitable for the simulated execution. The system could be used also to show tactical manoeuvres and to lead more complex exercises by the cadets. APP6/A must be trained for the cadets which they can practice with the simulator. The simulator is usable in mission preparation and during missions too as it is NATO-compatible, this is why the simulator is able to promote international cooperation between the nations. [4] [6]

MARCUS's planned developments are the following: complete transformation of military formations; developing MARCUS-KRONOS joint exercises technology; changes based on user/operator experience; technical expansion; air defense extension; simulation of a civil environment; functions related to terrorism and migration. [12]

### **KRONOS - Primary goal**

KRONOS is a reconfigurable virtual simulator for the use and practice of different weapons with various activities in a simulated real-time, virtual 3D environment (terrain, objects, realistic effects of sound and light). It allows training from individual to platoon-level exercises. [6]

### **KRONOS - Structure and operation**

To use KRONOS a PC or laptop is needed with Windows operation system, multifunctional joystick and headset. The simulation system was basically designed to perform platoon-level tasks, but it can also carry out the training of individuals. Tasks performed on company-level can be taken into account as well, but the purchase of the required workstations would be expensive. At higher levels the expected cost increases further.

Typically the following tasks can be executed on the simulator: firing with collective and individual weapons; firing on stationary and moving targets; firing while standing and while moving; firing during day and night; observe the results of the firing; practice aiming; orientation, target spotting; driving; work division, work schedule; communication. The system simulates a combat vehicle and its interface with realistic sound effects and modelled radio communication between the subunits. It is suitable for infantry, field artillery and armour units to practice fire control and various tactical manoeuvres. [1] [5] [6]

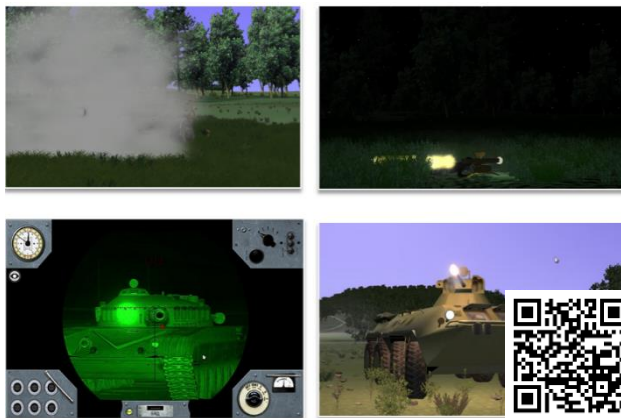
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<sup>18</sup> After Action Review

Its structure is basically very similar to the MARCUS simulator. The system consists of four computer groups that can be separated from one another, which are servers, commanders', operators', and supporters' workstation. The entire simulation is based on the servers because the program runs on these devices and the differentiated data and tasks are stored there that can be designed, archived and repaired. The commanders manage the processes and have access to the screens

of all the workstations, so they are always aware of the recent events. If it is necessary they can also intervene in the practice. When creating tasks, one has to take into account how many workstations the subunit / unit has, so that they can distribute the tasks. Operator workstations has to perform tasks against a group of enemy, so there is a need for supporter workstations who represent the enemy. [1]

The terrain can be modified with standard digital maps, satellite photos in order to perform the activity in diverse areas and to update the maps in the database. The simulator uses the DTA50 or OSM vector database and the DDM2 elevation database. It is also possible to display the terrain in continental and desert views for practicing activities in different environment. Both versions contain typical plants, buildings, objects and other field elements.



2. **Figure:** Comparison of the continental and the desert versions

These can be supplemented by different meteorological conditions. Visual displaying is realistic since they take into consideration several factors, for example dust and smoke, sight of night vision goggles, illuminating projectiles. Modelling of tanks is photo-realistic. [1]

There is a wide range of tools that can be used in the simulator. Vehicles include BTR-80, BTR-80/A combat vehicles, BRDM-2 armoured combat vehicles, T-72 tanks, other off-road vehicles, civilian and delivery vehicles, aircrafts, unmanned aerial vehicles (UAV). There are several

3. **Figure:** Visual effects in KRONOS + QR code of the related video

weapons and weapon systems available, such as the AK-47 assault rifle, the PKM machine gun, the Glock 18 semi-automatic pistol, the “Gepárd” M1 sniper rifle, the RPG-7 grenade launcher, the Fagot and Metis anti-tank missile, the Konkursz self-propelled anti-tank rocket complex, the D-20 cannon and the hand grenade. [6]

Because there are lots of types of devices and weapons in the system, it provides a wide range of uses for planning exercises and performing in a simulated environment. However, the simulator can display not only technical tools but also people. Soldiers from other nations and the local population living in these areas have been integrated into the program.

### **KRONOS in the military training**

In my opinion, KRONOS is a simulator that should be used much more for training purposes within the army According to my idea, this should be extended in the near future so that soldiers can use this modern virtual training environment as widely as possible. The KRONOS can provide a useful information to non-commissioned officer and officer cadets.

Some branches can benefit from the use of simulator too for instance: infantry, field and air defense artillery, electronic warfare, armour, reconnaissance. [5] [12]

In the previous chapter, at the introduction of KRONOS, we have read that it is suitable for displaying a diverse environment, so it can also help in mission preparation. We need to think primarily about mission areas in the Middle East, as it is possible to simulate the desert environment. It can be stated that the dynamics and efficiency of the lessons and training sessions would be significantly enhanced by the use of the KRONOS and would also help the acquisition of theoretical study materials, thus significantly improving the quality of education. As a result of the complex stimuli, the curriculum would be better fixed for the people to be prepared. The effects of applying this training method and system can positively influence the overall career of the soldiers. MARCUS's planned developments are the following: developing MARCUS-KRONOS joint exercises technology; changes based on user/operator experience; further development of Hungarian instruments; development of the HLA connection; more diverse terrain; modelling of helicopters with armaments and winged devices; displaying an intense civil environment; transformation of the scenario editor; further; use of a laser target marker; English version due to international practices.

### Summary

In my article, after the general characterization of combat simulators, I wrote about the combat simulator systems mainly about their goals, structures and operations. Afterwards, I took into account the possibilities of application within the army, concluding that the integration of any simulator, either alone or with other simulators into the system of military training in any most of the countries, would significantly increase the quality and efficiency of the training of the soldiers.

*„When you have exhausted all possibilities, remember this: you haven't.”*

Thomas Alva Edison

[1] Tamás Attila: Kiképzés-felkészítés virtuális (szimulációs) környezetben, In: Krajnc Zoltán – Csengeri János, A hadtudomány és a hadviselés komplexitása a XXI. században, Nemzeti Közszolgálati Egyetem, Budapest, 2015, ISBN 978-615-5527-47-0, 175-194. oldal

[2] Colonel John T. Janiszewski, U.S. Army Combined Arms Center Training, Panel 1: Future Holistic Training Environment – Live/Synthetic, 18 June 2014

[3] David Vergun: 'Live synthetic' Army's next generation of simulation [https://www.army.mil/article/122165/live\\_synthetic\\_armys\\_next\\_generation\\_of\\_simulation](https://www.army.mil/article/122165/live_synthetic_armys_next_generation_of_simulation) (Downloaded: 2018.09.15.)

[4] <http://artifex.hu/hu/marcus> (Downloaded: 2018.09.14.)

[5] <http://artifex.hu/hu/kronos> (Downloaded: 2018.09.25.)

[6] Kállai Attila: Felkészítés és kiképzés virtuális környezetben, In: Csengeri János - Krajnc Zoltán, Humánvédelem - békeműveleti és veszélyhelyzet-kezelési eljárások fejlesztése, (Tanulmánygyűjtemény I., e-book), Nemzeti Közszolgálati Egyetem, Budapest, 2016, ISBN 978-615-5305-35-1, 4-55. oldal

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[10] Márkus József: Kiképzés - Felkészítés, A logisztikai vezető állomány felkészítése MARCUS/MARS szimulációs program támogatásával, Katonai logisztika 16. évfolyam 2. szám (2008.)

[11] <https://honvedelem.hu/szervezet/mhbhk> (Downloaded: 2018.10.03.)

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[13] Artifex Szimulációs és Kiképzési Rendszerek Kft., Szimulációval támogatott kiképzés diabemutató

QR code for 1. Figure: <https://www.youtube.com/watch?v=cFakXUTzH1A>  
(Downloaded: 2018.11.07.)

QR code for 3. Figure: <http://artifex.hu/upload/files/videos/kronos1.mov>  
(Downloaded: 2018.11.06.)