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MILITARY SIMULATION CENTRE

Abstract: The article discusses the Military Simulation Centre (CSW) recently established to create advanced military simulators up to platoon level and to market both its own innovative accomplishments in the area of computer simulation and visualisation, as well as those of other research institutions that support the armaments market. The Centre is to become an advocate of Polish technological solutions in the field of advanced computer simulation and training devices for the military.

Keywords: simulator, training, real, testing

1. INTRODUCTION

Polish and European universities and special military units follow the path of the West Point Simulation Center and form their own simulation centres, generating thereby a market demand for professional military simulators, the availability of which in the Polish market is at present scant or none at all. The examples of such centres include the Virtual Flying Laboratory in Gliwice, Centre for the Simulation and Computer Wargames in Warsaw or the Military Centre for Medical Education. All these institutions conduct professional training courses with the use of simulators. They use sets of training devices purchased from Western (mainly American) suppliers.

The use of training simulators with virtual reality (VR) capabilities is at present one of the best methods of increasing the competence of new personnel and of verifying the skills of experienced personnel. Combination of real device controllers with virtual working environment provides a sense of realism, whereas it does not bring about the risk of the impact of mistakes made during a traditional training, including the training of troops.

The Military Simulation Centre put up by OBRUM, which has qualified staff and modern programming and hardware facilities, will enable creating technological solutions and high resolution simulators (up to platoon level) adapted to the needs of the Polish and European customer, and will also enable transferring know-how from partner companies and marketing Polish research and development solutions of the numerous cooperating institutions.

2. DIFFICULTIES AND CURRENT CONDITION OF THE MARKET OF PROFESSIONAL MILITARY SIMULATIONS

Creating advanced computer simulations and training devices requires a wide range of skills and proficiency in applying modern computer technologies, methods of three-dimensional image generation, as well as electronics and industrial automatic control technology. Many research and development centres that are engaged in simulation technology have the necessary expertise, but they lack the production capabilities required to develop a comprehensive product (including service facilities and programme), which translates into a less competitive offer of the Polish simulator industry as compared to existing Western solutions. Another difficulty in creating advanced military simulators results from the fact that military equipment is continually developed and the army equipment is modernised every day. In consequence, new generation training devices require continuous technological development, technical supervision, multidisciplinary skills and implementation of the most recent achievements in electronics, IT, automatic control and computer graphics.

The effect of high requirements imposed by the Polish army on training and simulation solutions is that purchases are made abroad, often at exaggerated prices, without intellectual property rights to IT solutions. Fig. 1 presents an example of a training system (video firing range of special unit in Lubliniec) that shows the absorptiveness of the Polish market and openness to professional training solutions which Polish manufacturers are not able to deliver.

Creation of a strong set of competencies in cooperation with a Polish armaments developer and supplier will help satisfy the expectations of the Polish Armed Forces, and will also open the possibilities of winning foreign contracts, which would otherwise be unattainable for any Polish company without the proper know-how, hardware and technological facilities.



Fig. 1. Virtual live ammunition firing range of special unit in Lubliniec

Foreign design acquired in 2013 [1].

3. CONCEPT AND SCOPE OF ACTIVITIES OF THE MILITARY SIMULATION CENTRE

The erection of an advanced simulation centre with a showroom housing all simulators available under partner agreements, will form a venue for displaying innovative products of the PHO Group and state-of-the-art solutions in computer simulation applied in the army. The Centre will take on the role of a consultation point residing at the science/business interface where, during workshops and product+simulator presentations, solutions and product concepts for the armaments industry could be verified. CSW, as an association of a number of partner companies and research institutions, will form an inspiration for applying modern computer technologies for the military and for the civilian market, being at the same time a prompt

response to the new expectations and inquiries concerning professional training and simulation solutions.

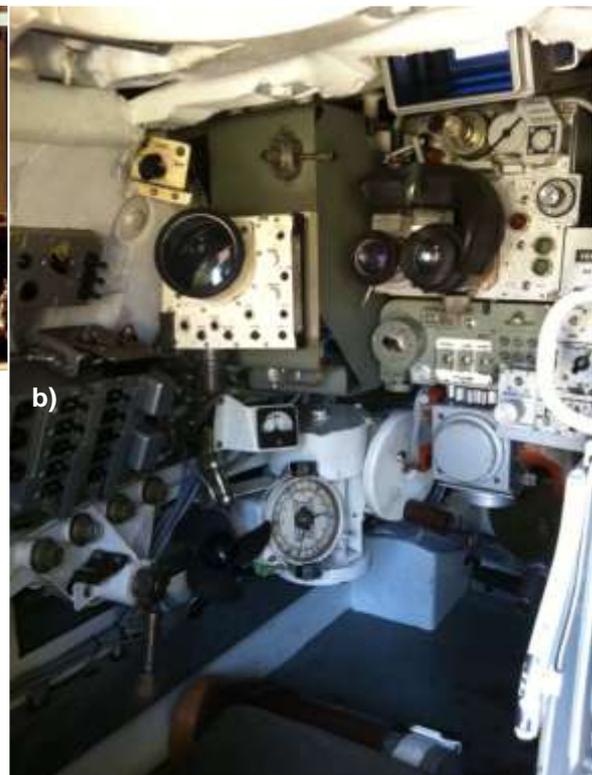
It is anticipated that every product created at OBRUM, and later on within the PHO Group, will have a corresponding simulator for training in its operation and interactive operating instructions. Such approach will help build a strong position of the Centre on the global market of military computer simulations, and raise the competitive power of the products offered by the Polish armaments industry in relation to products of other companies. A simulator that is an integral part of the product and is furnished with elaborate diagnostic and repair software is often a convincing argument for a customer to buy a product. High requirements imposed on the staff of the Centre enable to create proprietary solutions that meet global standards and the requirements of even the most demanding clients, with whom cooperation in the area of military simulations has already been initiated.

The scope of activities and competencies of the Military Simulation Centre is as follows:

- **Construction of self-designed simulators and training devices**, by delivering training tools and high-resolution devices (simulators, up to platoon level), featuring high degree of real environment representation, basic operations on the device or individual steps of the process and activities, among them:
 - operating virtual vehicles and devices using real control devices (SK-1 Pluton simulator, MG-20 bridge, PL-01 tank concept);
 - procedural and test applications (such as "approach, start, move, check...");
 - training systems to supplement field training exercise: virtual firing range, parachute jump simulator, Irys virtual battlefield, LSS laser shooting system;
- **Implementation of AR (Augmented Reality) technology** for military purposes, that is supplementing the image perceived by the observer with computer-generated information, both in the form of additional image, as well as additional information on the object or process [2]; among them:
 - maintenance, information and diagnostic applications for various hardware platforms (LCD displays, glasses, mobile devices, tablets);
- **Creation of interactive multimedia instructions** to form an intuitive and easily comprehensible computer documentation in place of elaborate hardcopy manuals [3]:
 - e-learning applications that allow to interactively conduct training courses in product use and also to evaluate user's skills by computer-generated tests.
- **Creation of computer animations and simulations of products** that facilitate familiarisation with more advanced functions of the device, requiring more extensive knowledge of its operating principles or processes, among them:
 - interactive presentation based on an arbitrary scenario;
 - training materials (films, flyers, leaflets) publicising the advanced functionality of the product;
 - conceptual works (sketches, designs, structure verification).

- **Adapting models and CAD assemblies for use in real time engines**, to enable "enlivening" of structural assemblies and models, product implementation based on virtual prototype of a fully operational device, among them:
 - format conversion and stereoscopic projection of 3D models of any type;
 - displaying objects using various projection technologies (2D, 3D) in any scale, including also true scale using CAVE type immersion systems.

- **Research in computer graphics and simulation**, as part of in-house projects or in collaboration with numerous other research institutions and businesses associated with CSW, in such areas as:
 - conducting research and joint development projects;
 - exchange of experience at conferences, fairs, and organising topical seminars;
 - research internships, dissertations, scientific treatises.



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Fig. 2. Professional training device manufactured by OBRUM

- a) BESKID 3 training system for PT-91 tank in a container enclosure developed and implemented for use in 1999, b) BESKID 3 - view of the interior, c) SK1 training system implemented at WSOWL in 2013, view of the turret module interior.



Fig. 3. Virtual laser firing range from OBRUM (2013)

4. RESEARCH ACTIVITIES OF THE MILITARY SIMULATION CENTRE

The scientific objective of the Simulation Centre will be the development of the methodology of using advanced display techniques in engineering design. All of this will be based on technological facilities not available elsewhere in Poland, and on interdisciplinary skills and expertise of the staff.

4.1. Investing in innovations - CAVE

At present the design engineer in a design team works on a fragment of an assembly using an individual computer and a CAD-type engineering tool without seeing the functionality of the entire device related to his/her part. Moreover, the entire design process is extended in time to months or even years, wherein several engineers work on one assembly simultaneously, and possibilities of consulting with decision makers and clients (using a flat screen) are limited or even none at all. CSW intends to optimise this process by applying design integrated with a CAVE-type real-time visualisation system, wherein the design engineer and the client can enter the visualisation system and find themselves virtually inside the computer model (engineering assembly) under development and displayed using 3D technology. Therefore the designer can see the element being designed as an element of the entire device in true scale (1:1), and can make changes in the design or make sketches by moving his hand (holding a special controller). CAVE-type 3D projection systems are at present used across the world on a mass scale as tools

for visualising products and simulating their functionalities. However, due to their price and level of sophistication, they have not been used before in Poland in everyday design procedures. OBRUM's investment in modern design tools signifies the innovativeness of the Polish armaments concern and of its competitive power as related to the leaders of the world market. The CAVE immersive projection system has already been successfully used by CSW to build a virtual prototype of the concept vehicle PL-01 Concept, verify its ergonomics and develop its weapon configurator and basic mechanical systems. The OBRUM team intends to commercialise the gained knowledge and experience, and to use the developed methodology to create further large-sized mechatronic devices for both the military market as well as for the civilian industry.

4.2. Cost reduction - virtual prototyping

Another objective pursued by OBRUM in CSW is the application of modern computer modelling methods and 3D imaging tools in the simulation of the complete functionality of the future product at the stage of design. Such approach, as yet applied in the industry very fragmentarily, will allow to significantly reduce costs and eliminate design flaws. The development of a methodology that would enable shifting product tests from the prototype stage to the structural design stage will be a significant achievement of the entire machine building industry and armaments market. Before, if defects in design or functional specifications were detected in relation to initial specifications, any corrections involved costly changes or modifications of the design, which often led to the abandonment of the project. After the new methodology of work is implemented in the Polish armaments industry, it will be possible to make all changes, corrections and improvements within a few hours, saving thereby time and, often, the reputation of a project. Additionally, initial tests and digital simulation of a prototype in virtual environment will help eliminate all defects and enable presentation of all functionalities to the potential client. It will also now be possible to make all decisions concerning the acceptance of a given functionality at a much earlier stage, which is very important when designing new devices and shortens the delivery time of the anticipated solution.



Fig. 3. 3D (CAVE) projection system used by OBRUM in the construction of a virtual prototype of PL-01 Concept



Fig. 4. AT technology used by OBRUM to develop a maintenance programme for military vehicles

4.3. Augmented Reality - new generation maintenance service

The Military Simulation Centre has access to software library and other tools of augmented reality technology and expands its use to fulfil the needs of professional maintenance and vehicle servicing workshops. CSW focuses on contriving proprietary solutions and technologies of producing intuitive military equipment maintenance applications for soldiers without technical education, and for professional repair services, providing an up-to-date technology that substantially shortens repair and maintenance duration times.

There are now a number of AR solutions and components available on the market. But no comprehensive solutions in the form of a complete tool or product enabling creation of a complete service application have been found. A proprietary methodology of creating multimedia maintenance applications with the use of components available on the market will be developed by OBRUM's research team and implemented by PHO, starting from acquiring a computer model of a device, its graphical optimisation, introduction of maintenance instructions, and compilation in the form of an application for the selected mobile device or projection system. The usefulness of the application and of the method as a whole will result from the elimination of the need to use any markers for model positioning and from the use of model geometry and edge detection techniques in AR information positioning. This will be a repetitive and partly automated process, and military equipment products from PHO will be offered with interactive maintenance instructions as a standard option.

5. SUMMARY

In 2013 OBRUM acquired a number of modern IT solutions. With the help of many Polish and foreign partners an effort was made to promote the idea of establishing a National Simulation Centre. As a result the Military Simulation Centre was opened at OBRUM in December last year. It must be noted, however, that the present state, technology and methodology developed by CSW personnel, is only a starting point in the creation of a fully independent and modern centre which, after gathering the necessary funds, will be able to compete with the global leaders in the area of professional military simulations.

6. REFERENCES

- [1] Photo DWS
<http://wiadomosci.radiozet.pl/Polska/Wiadomosci/Supernowoczesna-wideostrzelnica-dla-ko-mandosow.-Zobacz-zdjecia>. March 2014.

[2] http://pl.wikipedia.org/wiki/Rzeczywisto%C5%9B%C4%87_rozszerzona. March 2014.

[3] <http://pl.wikipedia.org/wiki/Elearning>. March 2014.