

The TARGET Project: Using VR and AR to improve police training

Lola Vallès
Alicia Moriana
Rotger Garcia

Police School of Catalonia, ISPC, Spain¹



Abstract

This paper aims to provide an outline of an ongoing research project that is funded by the H2020 programme, the TARGET: Training Augmented Reality Generalised Environment Toolkit. The project addresses the need for innovative serious gaming solutions for police and other security agents to train in low probability/high impact events. The ambition of the project is to deliver a pan-European serious gaming platform that combines Mixed, Virtual and Augmented Reality and content for training, and also incorporates a system to assess the skills and competencies of trainees. In addition, the paper provides a description of the technology components and of the six training content scenarios that TARGET has developed up to now.

Keywords: Innovation, training, virtual reality, augmented reality, scenarios

Introduction

H2020 programme

Horizon 2020 is the biggest EU Research and Innovation programme ever, with nearly €80 billion of funding available over seven years (2014 to 2020) – in addition to the private investment that this money will attract (European Commission, 2018). The programme aims to help addressing the main social challenges, promote industrial leadership in Europe and reinforce the excellence of its scientific base.

Within this programme the TARGET project was funded. TARGET stands for *Training Augmented Reality Generalised Environment Toolkit* and it responds to the FCT-07-2014 Framework entitled « Law enforcement capabilities topic 3: Pan European platform for serious gaming and training ». It began in May 2015 and will end in October 2018. It received 6 million euros in funding from the Research Executive Agency (REA) of the European Commission.

¹ Corresponding authors' email: lvalles@gencat.cat

The TARGET project was designed to help Security Critical Agents²(SCA) to:

- engage effectively with the general public;
- minimise risk to SCA and citizens;
- optimise use of available resources (pan-European collaboration);
- use existing tools, systems, and equipment already available at user sites;
- enable SCA to train for low probability / high consequence scenarios (such as a cyber-attack or CBRN incident);
- leverage virtual reality in order to optimise cost effective of current training programmes (importantly, reduce the number of trainers needed for a scenario, saving time and resources);
- empower Security Critical Agents to effectively use new technologies developed in collaboration with the technical partners in the consortium.

The TARGET Consortium

The TARGET consortium brings together sixteen partner organisations from nine EU member states. The consortium gathers the expertise of major users, leading edge technologists and best-of-class experts in technology assessment, dissemination, ethics, security sensitivity and project management. The project is coordinated by the international management services firm ARTTIC, with technical coordination by Luxembourg Institute of Science and Technology (LIST).



As we can see in Figure 1 there are three different groups of partners. In the first place, we see partners responsible for coordination, communication and ethic review. In the second place, there are partners responsible for the technology development. Finally, there are partners who are in charge of developing re-

alistic and useful training contents. The Police School of the Institute for Public Security of Catalonia (ISPC) belongs to the third group that reunites other police research and training institutions, namely from France, l'Ecole Nationale Supérieure de Police (ENSP) at Lyon; from Germany, the Fachhochschule der Polizei des Landes Brandenburg (FH POLBB) and the German Police University (DHPOL) at Münster; from Estonia, the Estonian Academy of Security Sciences (EASS). Other end-users included in the consortium are the Spanish Police Guardia Civil (GU CI); the Cleveland Fire Brigade (CFB) from the UK and the International Security and Emergency Management Institute (ISEM) of Slovakia.

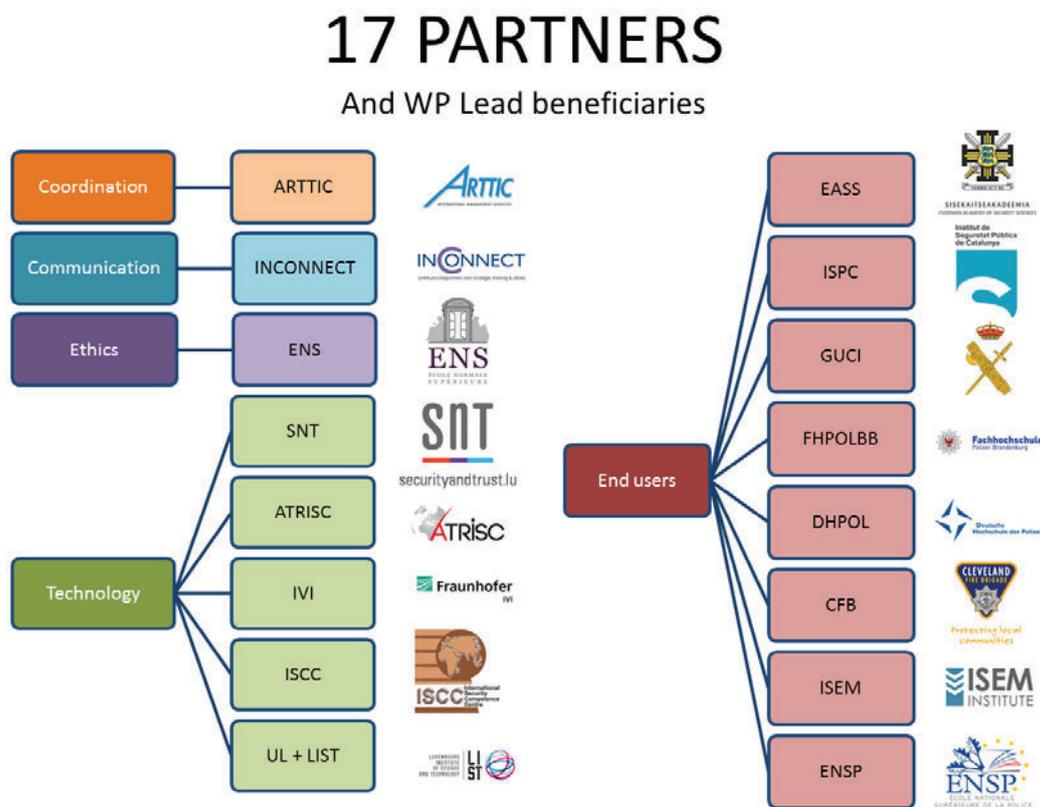
Besides the TARGET consortium there is a group of experts, the TARGET Advisory Board (TAB), who meet regularly with the consortium throughout the project. They provide technical, ethical and legal guidance, input and feedback on the TARGET technology roadmap. The TAB also advises on links with relevant interest groups outside TARGET and propose and encourage the potential interactions of the project with other projects, initiatives or activities.

Aims of the project

The project aims to enable effective Security Critical Agents training by developing pan-European training content through six training scenarios that will be developed in the course of the project. On top of that it will foster a TARGET marketplace in order to buy/sell what is available on the TARGET platform as well as associated TARGET products and services. The TARGET platform consists of architecture, development environment, technology components and a store with training content. The first version of the TARGET is already completed and has been tested at the users' sites.

² Security Critical Agents (SCA) include all security forces such as counterterrorism units, border guards and armoured car guards, first responders such as police, fire fighters, paramedics, civil security agencies and operators of critical infrastructures.

Figure 1: Partners and their role at TARGET consortium

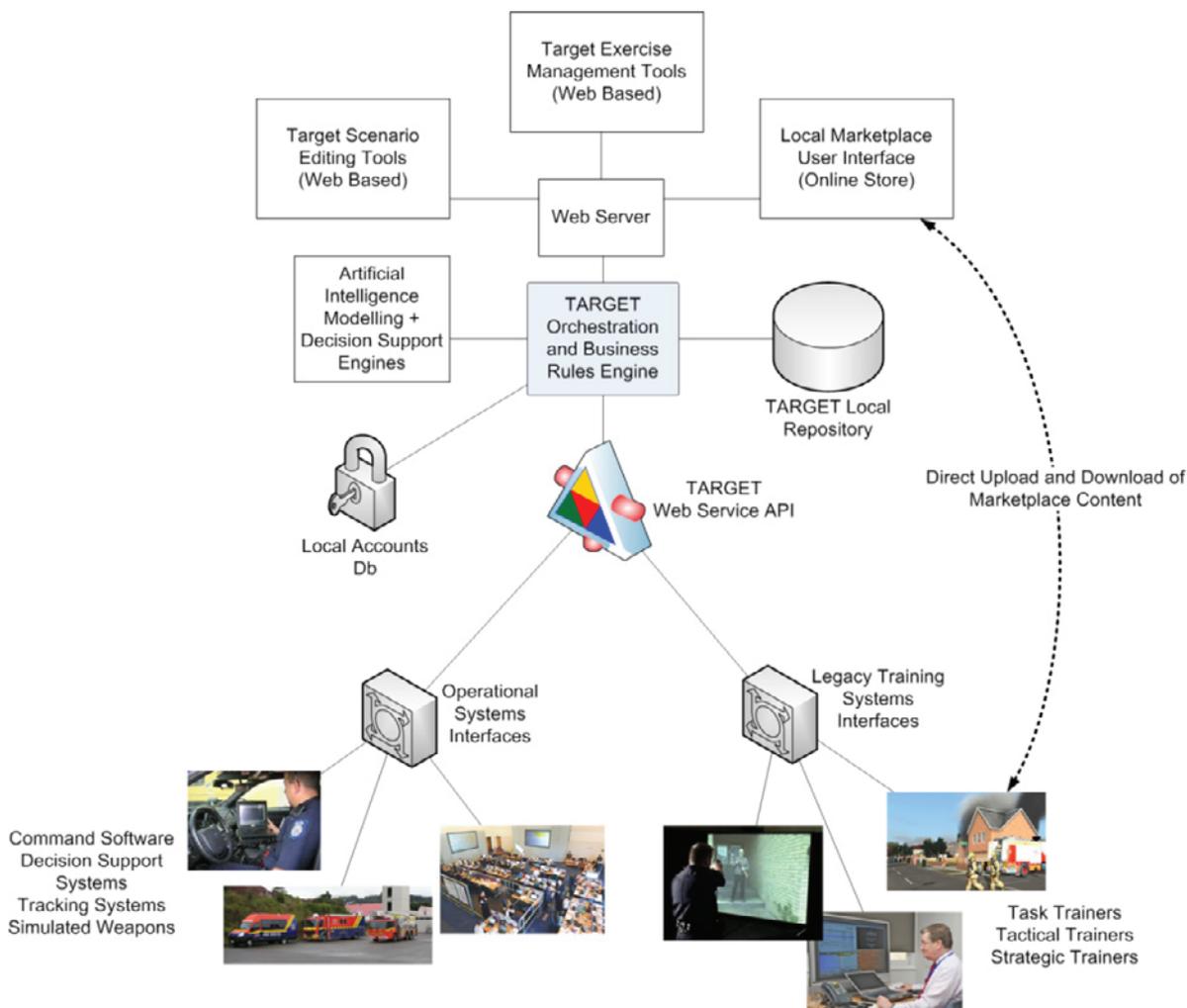


Pan-European Platform

The TARGET pan-European Platform for hybrid serious gaming includes training case development tools, standard interfaces, effective integration for third party technologies and content, support for content and technology sharing, licensing and payment.

The Platform will be customisable into local languages, legal contexts, organisational structures, existing IT systems, ensuring personalised scenarios and technologies which are useful and relevant to the user organisation.

Figure 2: TARGET System Architecture Diagram



Technology components

The TARGET Platform supports the design of training narratives, corresponding scenarios and role players, the collaborative training activity, as well as the assessment of competencies developed in TARGET. The TARGET narration builder incorporates a library of virtual threat scenarios for 3D virtual reality training and augmented reality training.

The TARGET technology components cover a number of external systems, including third party simulation systems and third party operational systems, which will be integrated into the system via the TARGET training web Application Programming Interface (API) as seen in figure 2. It includes real world command and control systems or already existing training environments, real world modelling engines (chemical plumes, power grids, or wildfires) and links to already consolidated training systems. Therefore, the TARGET system com-

municates directly with existing systems, and augmented and virtual environment support which can be integrated into legacy systems³ by the TARGET API.

Training scenarios

The training content scenarios are used to improve the platform and to demonstrate it to third parties. They respond to specific needs for training law enforcement agencies (LEA) and Security Critical Agents, infrastructure operators and crisis managers. They address complex needs concerning technical skills, operational management, social (communicating with the public) and ethical issues (making the « sound » decision). The training content scenarios are led and defined by end-users from six European member states and some involve multi agency cross-border collaboration, in

³ A legacy system is an old method, technology, computer system, or application program, in other words, it is a previous or already existing computer system.

particular those related to cyber-attack and road accidents which are scenarios three and six.

The training environments of the scenarios are as realistic as possible by combining Augmented Reality (AR) and Mixed Reality (MR). They are flexible and use existing equipment of user organisations. The individual and team performance is recorded in real time and pluggable to any simulation platform. Finally, the MR environments improve the field of pervasiveness, use real world environments (existing training facilities) as effective as possible, and provide capability to assess fundamental human behaviour. The six scenarios are described in the chapter “Scenarios”.

Assessment

To ensure best practices, TARGET is testing both the platform and the training content scenarios in dedicated sessions including single user and team sessions. The purpose of these trials is to improve the platform and the training content’s iteratively through trial and learning. It encompasses:

- Train the trainers to prepare them to customise the scenarios to the local context, dispense and administer the serious gaming-based training to selected end-users.
- Customisation of specific usage contexts (language, legacy systems ...) to ensure that the TARGET environment will be truly generic and customisable to the particularities of different EU member states and, more generally, be competitive in the global market place.
- Comparison of experiences in different cultural and organisational settings to develop best practices, some of them generic, others more specific to particular organisational categories.
- Security Critical Agents training as such.
- Evaluation of the results and feedback to the developers of the platform.

Dedicated European ecosystem

The TARGET project intends to have a significant impact by becoming the European ecosystem for European Security Critical Agents training. It intends to be a hub with easily sharable scenarios and serious games which can be modelled to local specifications. It will provide training tools for police officers, fire brigades, civil protection officers and other security professionals. In this way, it will build capacities of Security Critical

Agents and contribute to EU member state security by supporting the fight against national and transnational crime.

The cornerstone of this strategy will be the set-up and development of a heterogeneous TARGET Community including practitioners-users (Security Critical Agents), their trainers, scenario providers, technology suppliers and policy makers.

Challenges of serious gaming

Nowadays Security Critical Agents are mostly carrying out virtual reality (VR) training based on “video juke-box” solutions in classroom environments. However, these solutions tend to be neither immersive nor non-linear, therefore a workaround has to be used to present to the participants the missing information. This is typically provided by the trainer taking up too much time and attention and deteriorating the evaluation (Vidal, 2011).

A possible solution for this problem can be found on VR environments. Nevertheless, those can suffer from a number of specific pitfalls: lack of maturity of the simulation models, much of the interaction within a 3D visualisation is either or is effectively puppeteered by human operators, substituting for the lack of modelling and simulation. This results in either a linear and uninvolved scenario, or huge loads on human operators having to deliver inconsistent, non-repeatable and expensive experiences. In many cases integration with existing equipment is very limited. Most training centres do not even have the adequate equipment or are designed to train only one command tier at a time. As such, they are less than immersive in their nature and tend to support only a scripted route through a particular scenario.

In addition, content dealing with social and ethical issues is generally weak. Tactical, operational and strategic decisions influence - often instantly - public opinion and behaviour. In training and exercises this influence is hardly recognised or visible. This is in spite of the increasing recognition of the importance of an effective Security Critical Agents-citizenry interface, be it to engage directly with citizens, to communicate through the media or to make difficult ethical decisions affecting individuals or groups of citizens.

Finally, the cost of developing new serious game-contents can be very significant and such investment is often subject to difficult cost-benefit trade-offs. Sharing tools, contents and best practices across different target Security Critical Agents populations, international borders and training situations would represent a significant advancement in this area, but is either ad-hoc or simply not done. A pan-European serious gaming repository for Security Critical Agents is a major step forward to support the implementation and evolution of EU policies in this field.

TARGET wants to be a turning point in VR/MR Security Critical Agents training providing a solution with the following characteristics: non-linear and immersive scenarios; able to be carried out with real tools and taking into account social and ethical issues.

The specific challenges to the TARGET project include:

- Taking experimental approaches of photogrammetry and the EU-wide geospatial dataset and merging them into a useable solution.
- Devising and implementing a simulation service that allows pre-existing decision support tools and modelling technology to be added and integrated flexibly.
- Devising easy-to-use toolsets to combine exercise snippets into rule clusters that make up a simulation.
- Providing multilingual capabilities and localisation of scenarios to local languages throughout the system.
- Supporting localisation to adapt to command & control structures and procedures, and to easily connect local classified content.

Scope of the TARGET platform

TARGET delivers an extremely realistic and flexible Augmented and Virtual Reality (AVR) simulation solution, incorporating a range of dynamic and variable scenarios. Trainees use a combination of both real and training weaponry, radio equipment, command and control software, decision support tools, real command centres and vehicles (Munro, 2017). This leads to improving the field of pervasiveness within MR by effectively using the real-world environment and its objects, and by exploring fundamental human behaviour within MR environments. TARGET facilitates new tools

for joint training for police interventions with a variety of agencies.

Social and ethical content also plays an important role throughout all aspects of the project. The project supports inter-agency Security Critical Agents exercising across the EU and acts as a serious gaming repository and brokerage facility for authorised agencies to share training material and maximise re-use and efficiency in delivering complex exercises. Mixed Reality experiences immerse trainees at operational, tactical and strategic command levels with scenarios that include tactical firearms events, asset protection, mass demonstrations, cyber-attacks and CBRN (Chemical, Biological, Radiological, Nuclear) incidents (Munro, 2017).

The vision of the project is to make the TARGET Open Platform the reference for Security Critical Agents training using serious gaming across Europe creating a much needed hub for the sharing of training content and serious games that can be quickly modelled to local specifications within the European Union. A multi-language, online exercise creation and management tool will be available, allowing agencies throughout Europe to use the training content. Special support will also be provided to translators to assist the creation of local language versions of the training content modules.

TARGET covers a huge range of current European training needs. This is possible with the participation of end-users, Security Critical Agents training professional organisations, which advise technological partners in scenario edition and needs assessment. Needs Assessment reflect the real needs of TARGET trainees/end users, as well as the needs of the relevant end-user organisations. End-users have provided deep needs-analysis, which has helped them to build the efficient training content.

Scenarios

TARGET has developed six training content scenarios based on the requirements capture phase, the key training objectives and MR components. Training issues were also taken into account, the number and roles of the people involved and their interaction and interconnection throughout the command structure. It also identified the real objects and tools required,

training evaluation processes, social media injects and relations with the general public.

That is why the scenarios are prepared very carefully. Development processes have to be assessed from all possible sides and aspects. Every incorporated detail must be thought out and discussed many times. Timeline of the story in a scenario must be real but allowing sufficient time for decision-making.

The six scenarios are led by end-users from five different EU countries: France, Germany, Slovakia, Spain and United Kingdom, with the contribution of the Estonian Academy of Security Sciences. The School of Police of Catalonia is leading the scenario on fire arms training. Each training content scenario leader has paid attention to all aspects of the work (security, currently existing trainings standards, ethical and societal questions) and has taken into account all the needs defined in the needs assessment. The scenarios were prepared from the end user point of view and based on end user needs. A short description of the six scenarios is presented below.

Scenario 1 - Major HAZMAT / CBRN event

Figure 3: TC1 trial in October 2017 in Bratislava, Slovakia



Training content scenario 1 is led by the International Security and Emergency Management Institute of Slovakia in cooperation with police and military experts. It focuses on a major HAZMAT (Hazardous Materials)/ CBRN incident. The scenario develops operational/tactical level exercises for police first responders. The idea is that two trainees enter a suspicious room, a clandestine terrorist laboratory, after having gathered intelligence about its existence and without meeting any terrorist. Supposition is that SWAT and EOD units are not needed in this case. A binary team has to follow the main steps before the Crime Scene Investigation (CSI): check the suspicious area and recognize the threats

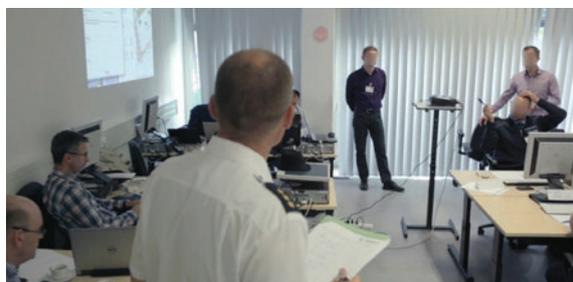
with regards to radioactive and chemical substances; find them (detect, identify, mark, sample if necessary for the identification purposes); provide safety zoning and mark sectors for CSI; make reconnaissance pictures and do all necessary actions properly without destroying evidences in order to prepare the crime scene for CSI investigators. These are the main objectives to train.

Trainees use virtual devices and dangerous (CR) substances that are virtually simulated as well. To create conditions as much real as possible, trainees have to work in protective suits on which the HoloLens are tagged. Thereafter, virtual stress triggers are used (time running, dosimeter alarm, oxygen time count down).

Using virtual items in combination with real objects brings a whole new level of training and increases greatly the ultimate effectiveness of the entire training process. This is a way to succeed in reaching Research, Development and Innovation requirements requested in projects like TARGET.

Scenario 2 - Protecting a critical infrastructure and dealing with crowds during a mass demonstration

Figure 4: TC2 trial in September 2017 in Oranienburg, Germany



Training content scenario 2 is led by the Fachhochschule der Polizei des Landes Brandenburg. This training scenario is aimed at preparing police officers as members of command post bodies for large scale police operations to deal with crowd control and protection of a critical infrastructure. The target group for this exercise are commanders and command and control personnel at a tactical as well as strategic level.

The scenario deals with crowd management and protection of an airport: an alliance of anti-immigration groups announced a public gathering in front of the terminal building of the Berlin-Brandenburg Airport in Berlin-Schönefeld. The organisers expect several thou-

sand attendees. The aim of this demonstration is to protest against the entry of further refugees and asylum seekers into Germany. Once this information becomes public, an alliance of pro-immigration groups and politicians announces another public gathering also on site in front of the terminal building.

As in scenario 1, this scenario focuses on the management of personnel and resources. In this scenario of approximately 3 hours, we are training to work under pressure to make decisions about unexpected events.

SCENARIO 3 - Response to a massive cyber-attack

Figure 5: TC3 trial in October 2017 in Hartlepool, UK



Training content scenario 3 is led by Cleveland Fire Brigade from the UK. The exercise is targeted at the strategic and tactical command levels and is based in a joint operations/emergency operations-centre environment. The emphasis is not in managing any attack technicalities, but in the response and recovery operations necessary to deal with a sustained power outage.

The scenario trains on appropriate deployment of assets, reactions to the collapse of distribution-networks, management of medium and long term aftermath, management of media injects, and public response and resilience to stress injects.

The script is based on discussions with energy distribution companies operating in the United Kingdom. It is designed to be generic so that it can be adapted quickly to any part of the European Union. The objective of the simulation is to practice teamwork and coordination among the different representatives of many different services. It has a fictitious duration of about 10 days.

SCENARIO 4 - Using personal fire arms in small tactical vignettes

Figure 6: TC4 trial in October 2017 in Mollet del Vallès, Spain



Training content scenario 4 is led by the Police School of the Institute for Public Security of Catalonia with the contribution of Guardia Civil. This is a decision-making scenario in firearms situations. The objective of the training is not to have a virtual shooting gallery, but train above all the decision making about using firearms. Security forces can find themselves in situations in which they need to use firearms. The challenge is to achieve a realistic, dynamic and safe training system with fewer resources.

The trainees have to access a building where they can find people armed or disarmed (perpetrators and victims). The trainees have to interact with these people, aiming to protect the victims and arrest/neutralize the perpetrators. It is a decision-making scenario, therefore the avatars (AR characters) have many possible reactions: obey, take a nearby weapon, drop the weapon they already have, shoot against the trainee, etc. These reactions are not pre-established; the trainer can choose the avatars' action depending on the situation.

Shooting or not shooting and the way to do it will be the most important decision trainees will have to make. The use of firearms is tracked and assessed. When the situation is escalating, one offender can take a victim as a hostage and then, if the police patrol takes the right decision, the SWAT will be required and from that moment the training will be focused on this team. SWAT is supposed to intervene in the final stage, release the hostage/s and neutralize the offender without victims.

SCENARIO 5 - Arrest of suspects after their car crash

Figure 7: TC5 trial in October 2017 in Saint Cyr au Mont d'Or, France



This training scenario is led by l'Ecole Nationale Supérieure de Police at Lyon (France). The script starts with two police officers who are in a police car, driving through the city. A car advances at very fast speed and turns in a corner crashing. The police car also turns and police officers notice that the car that had advanced them has suffered an accident. The driver is unconscious, but after a few seconds the passenger opens the door and leaves the car. From here there are multiple situations where the trainees are asked to assess the threat and neutralise suspects.

It is a scenario of decision-making under stress and good practices in detention. The scenario has a linear introduction that has no variations except for the amount of information the officers have. After the passenger of the injured car comes out of the car, different developments can occur. The agents must determine (under difficult environmental conditions) if the passenger is armed, is dangerous and the best way to arrest him/her.

SCENARIO 6 - Dealing with a major road accident involving multiple cars, victims, and high risk of explosion

Figure 8: TC6 trial in September 2017 in Münster, Germany



This training content scenario is led by the German Police University at Münster. The objective of the training is to provide a realistic training situation to encourage confidence building in large scale operations. The story line is based on a real multiple collision that took place on a German motorway with about 51 cars and more than 100 injured persons involved. The scenario setting is a rural area. The accident is caused by a rear-end-collision of two cars due to heavy fog. Fifty cars, a minivan with fifteen children and a tanker truck, loaded with more than 30.000 litres of petrol / flammable liquids, are involved. There is a high risk of explosion

In this scenario, the decision-making process and the coordination of the specialist teams in an emergency situation are sought. It combines at the same time the training of the staff of a command centre and a mobile police unit at the accident site.

Moving forward: The TARGET Place

The TARGET project finishes in October 2018. This means that the European project phase will be over, but that will not be the end of TARGET. After October 2018, a commercial phase will begin and the TARGET solution will be further developed and brought into market by TARGET Place. The objective of this commercialization is to offer the opportunity to acquire TARGET to all public and private entities that work in the training of Security Critical Agents.

This is an innovative opportunity that completely revolutionizes the traditional training system in these types of scenarios. Traditionally, LP/HI (low-probability high-impact) training has led to a great investment in preparation (time, resources and personnel).

With TARGET solutions Security Critical Agents will no longer have to prepare simulations with months in advance, hire a stack of helpers or invest in infrastructure and material. Thanks to TARGET the outlay will be limited to the initial investment in equipment (hardware) of AR/MR and acquisition of the content (software) that is wanted to train. Once this initial investment has been made, the simulation can be reproduced endlessly at no extra cost. TARGET, as a product, will not only include hardware and software but also maintenance and guidance in good practices to learn how to use it correctly.

References

- Albiero, S. (2017) *First project progress report*.
[Online] Available at: <http://www.target-h2020.eu/wp-content/uploads/2017/12/171207-TARGET-DL-ART-D8.05-First-Project-Progress-Report-R0.0.pdf>
[Accessed 29 Jan. 2018].
- European Commission. (2018) *Horizon 2020*.
[Online] Available at: <https://ec.europa.eu/programmes/horizon2020/en> [Accessed 13 Feb. 2018].
- McCall, R. & Braun, A.-K. (2008) Experiences in Evaluating mixed Reality Games. *Psychology Journal*, 6(2), pp. 157-172.
- Munro, R. (2017) TARGET: realistic training through Augmented and Virtual Reality simulation. *Emergency service times*, XVIII(3), 25.
- TARGET Consortium. (2016) *Target H2020: Deliverables & Reports*.
[Online] Available at: <http://www.target-h2020.eu/wp-content/uploads/2015/10/160126-TARGET-DL-ART-WP6-TC-scenario-overviews-R0.0-FINAL.pdf>
[Accessed 2 Feb. 2018].
- Vidal, R. (2011) *Training Incident Management Teams to the Unexpected: the benefits of simulation platforms and serious games*. Paris, France: ARMIR.
- Vidal, R., Frerson, C. & Jorda, L. (2001) Training Incident Management Teams to the Unexpected: The benefits of simulation platforms and serious games. In: P. Fauquet-alekhine & L. Soler, eds. *Serious Games & Simulation for Risks Management*. Paris: Dans A., 43-48.
- Wetzel, R., McCall, R., Braun, A. & Broll, W. (2008) *Guidelines for the Design of Mixed Reality Games*. Toronto, Canada: ACM.
- White, M. D. (2008) Making good cops in the twenty-first century: Emerging issues for the effective recruitment, selection and training of police in the United States and abroad. *International Review of Law, Computers & Technology*, 22(1), 119-134.