European Commission, Horizon 2020

D7.2 Field Trial Combined Analysis Report

Deliverable	D7.2
Deliverable Lead	CAMPUS VESTA
Related work package	WP7
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Dissemination level	PUBLIC
Due submission date	30.06.2022
Actual submission	30.06.2022
Project number	833672
Instrument	RIA
Start date of project	01.05.2019
Duration	42 months
Version log	V1.0

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Versions

Versions	Date	Author	Description
V0.1	09/01/2022	Günther Dauwen (VESTA)	First Draft structure
V0.2	22/02/2022	Günther Dauwen (VESTA)	First Draft following peer review D7.1
V0.3	18/03/2022	Günther Dauwen (VESTA)	Second draft following FT1
V0.4	13/5/2022	Günther Dauwen (VESTA)	Third draft ahead of FT5
V0.5	26/5/2022	Günther Dauwen (VESTA)	First Final draft after last FT
V0.6	30/5/2022	Günther Dauwen (VESTA)	Including research contributions
V0.7	1/06/2022	Günther Dauwen (VESTA)	Including first LEA contributions
V0.8	3/6/2022	Günther Dauwen (VESTA)	Including RL contribution
V0.9	7/6/2022	Günther Dauwen (VESTA)	Completing the LEA contributions from internal review
V0.10	10/6/2022	Günther Dauwen (VESTA)	Second Final Draft
V0.11	22/6/2022	Birgit Harthum (USE) Valerie Schlagenhaufen (USE) Gerhard Helletzgruber (USE) Markus Murtinger (USE)	Input Coordinator Team
V0.12	28/6/2022	Valerie Schlagenhaufen (USE) Gerhard Helletzgruber (USE)	Final Formatting
V1.0	30/6/2022	Gerhard Helletzgruber (USE)	Upload

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List of Acronyms and Abbreviations

Acronym / Abbreviation	
AAR	After action review
BR	Breath Rate
DMA	Decision making and acting
DMA-SR	Decision making and acting under stress and in high-risk situations
DoA	Description of the Action
EUFW	End-User Feedback weeks
EUM	End User Management
FT/FTs	Field trial/s
GA	Grant Agreement
HF	Human factor
HRV	Heart rate variability
LEA	Law Enforcement Agency
MMSP	Mobile Multi-sensory platform
QoE	Quality of Experience
PERT	Program Evaluation Review Technique
RAT	Risk assessment tool
SPOC	Single Point of Contact
VR	Virtual Reality
WP	Work Package
SHOTPROS Partners:	
AIT	Austrian Institute of Technology GmbH
BP	LEA Partner – Berlin Police
KUL	KU Leuven
LAFP NRW	LEA Partner – Police NRW (Landesamt für Aus- und Fortbildung)
NCCN	LEA Partner – National Crisis Center Belgium
NPN	LEA Partner – National Police of the Netherlands (Amsterdam)
RMIA	LEA Partner – Romanian Ministry of Internal Affairs
RL	RE-liON
SPA	LEA Partner – Swedish Police
UHEI	Universität Heidelberg
USE	USECON The Usability Consultants GmbH
VESTA	Campus Vesta
VUA	Vrije Universiteit Amsterdam

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Executive Summary

After the planning phase of the Field Trials (FTs) reported in D7.1, the conduction of the FTs, which is reported in the deliverable at hand, started in February 2022. The SHOTPROS field trials present a final **scientific and technological end user validation**, an **evaluation** for future topics as well as an option to end user partners to **conduct VR police training** within their organisation with the SHOTPROS VR solution developed throughout the project, based on scientific results and **end user input**. Furthermore, the FTs were used to **raise awareness** for VR Training within the police management and to reach several relevant target groups via **media**.

Every FT was organised in a different setting with different end users (law enforcement agencies - LEA partners of the project) to be able to cover the planned end user partner premises. Depending on the VR training experience of the LEAs (some already hosted studies throughout the project, where they gathered more experience than others), the FTs where either implemented more as **showcasing** and **try-out** events **or** with a bigger **focus** on **training** sessions. The other need was the integration of suitable studies and feedback options for research and technology partners and general requirement needs of the project. The FT packages were tied individually depending on location, LEA partner and scientific/technology needs.

Based on this, the following 5 field trials were executed:

- Feb 2022 – **Seibersdorf**, Austria
- March 2022 – **Bucharest**, Romania
- April 2022 – **Amsterdam**, The Netherlands
- April 2022 – **Selm**, NRW, Germany
- May 2022 – **Berlin**, Germany

The document describes the set-up, execution, and result of each field trial, focusing on the research perspective (first insights to the scientific results), the end user point of view, technological input as well as communication and dissemination activities to promote the project and its results to the public. For an analysis of all research results, we refer to the following final deliverables: SHOTPROS Final Evidence-based HF Model for DMA-SR (D7.4), SHOTPROS Final Training Curriculum for DMA-SR (D7.5), SHOTPROS Final Guidelines for VR Training (D7.6) and SHOTPROS Final Evaluated VR Training Scenarios (D7.7), Strategies & Toolkits for Policy Makers (D8.5), Reports on Dissemination Activities including 'VR Police Training Network' Report V2 (D8.9).

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1 Added Value

1.1 Relation to the SHOTPROS Work packages (WPs)

WP7 represents one of the **final sequences of the SHOTPROS project**. After bringing together all the requirements (WP2) in order to create the scientific model of decision making and acting under stress and in high risk (DMA-SR, see D3.2) in WP3, a first VR Training curriculum (see D3.3) and a first SHOTPROS VR solution (see WP5) were established. In consequence, the HF studies (WP6) evaluated the relevant factors for a successful training, framework, and guidelines as well as VR features (WP4), scenarios and the current technical VR solution (see D5.1). This has built the foundation to be able to validate the findings applied in training and the VR solution from different aspects throughout the SHOTPROS FTs in WP7.

The FTs will consequently play an essential role in generating **final results and impacts of the SHOTPROS project**.

1.2 D7.2 is informed by the following deliverables

	How did theses deliverables influence D7.2
D1.4	D1.4 describes the process of end user management within SHOTPROS. As the FTs are only possible with end user involvement, this deliverable built the base for the interaction process with LEA partners and other invited end users as Network members, interested end users and advisors.
D3.2	D3.2 outlines the conceptual human factors **model** of the project and therefore had an important influence on the **research** activities for the validation of the model during FTs.
D3.3	The first deliverable on the European Framework for Training and Assessment of Decision Making and Acting under Stress and in High-Risk Situations (DMA-SR) already provides an extensive evidence-based set of recommendations for **implementing VR training**. These results influenced the research activities for validation and evaluation of framework needs as well as the settings of the FT training sessions.
D5.1	The SHOTPROS VR **architecture** provided input for the set-up of the training solution throughout the FTs.

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D5.3	D5.3 describes the **scenarios** developed by the technical partner together with the LEA partners for the planned FTs. These scenarios were, amongst other reasons built to demonstrate the diversity and power of VR for decision making and acting (DMA) training. During the FTs these scenarios were used.
D6.1	The aim to create a future SHOTPROS VR solution is fed by 3 major streams, which are technology development, **human factors** (HF) implications and end user feedback & requirements. To elaborate and answer the human factors stream (WP2-4) related research and innovation questions, all necessary **experiments** and **studies** are listed in D6.1 as an overview. The FTs validate and evaluate all 3 described streams and the preliminary results are reflected in this report and the WP7 and WP8 deliverables listed below. Furthermore, the learnings from the study planning and settings influenced the study setting during the FTs.
D7.1	This FT planning deliverable has laid the **planning foundations** for a successful series of FTs and this analysis report on the results of these FTs. It describes the planning regarding requirements and needs to prepare and organise the FTs. It also describes which methodology and research were planned to be used during the FTs.

1.3 D7.2 consequently feeds into the following deliverables

	How does D7.2 influence other deliverables within SHOTPROS
D7.3	The results of the planned FTs and the used methodology will have a direct impact on the final conference and therefore also on D7.3, the Report on the SHOTPROS Demonstration at the Final Conference. The findings of D7.1 and D7.2 are instrumental to the showcasing moment at the Final Conference.
D7.4	The "SHOTPROS Final Evidence-based **HF Model for DMA-SR**" is one of the first in a series of 4 deliverables that will form the heart of the final SHOTPROS VR solution. The results of the FTs studies will directly lead to final validation of the scientific Human Factors (HF) model.
D7.5	The final results of the training observations executed during the FTs will lead to a scientifically validated training curriculum for decision making and acting under stress and in high-risk situations (DMA-SR).
D7.6	Based on the research data gathered during the FTs, the **"SHOTPROS Final Guidelines for VR Training"** will offer a handbook on the advantages of VR in police training and offer a description of features of an ideal VR solution.

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D7.7	Based on scenarios for training used during the FTs, the deliverable **"SHOTPROS Final Evaluated VR Training Scenarios"** will be set up. Ideal scenario design will be influenced by the trainer actions throughout the FTs.
D8.5	This **Policy maker toolkit** will be influenced by the management and policy-maker involvement throughout the FTs. The discussions, but also the challenges faced by a decision maker, which were part of many interactions on the side of the training field during all FTs, will provide relevant input to upcoming (inexperienced) LEA organisations that want to implement VR training in their didactics.
D8.9	The large media coverage and intensive communication and dissemination work accompanying all 5 FTs will be reported in the **Report on dissemination activities including 'VR Police Training network'.**

1.4 Relation to SHOTPROS objectives

The SHOTPROS field trials have an impact on all 5 SHOTPROS objectives as the FTs present the final opportunity to validate, evaluate and train with the SHOTPROS solution before the final results are summarised and the project will be presented at the final conference to a broad audience.

The validation of the **HF model** (objective 1) will be part of the studies during the FTs, the **final VR training environment** (objective 2) will be used for trainings and research activities as well as showcasing demonstrations. The **final training framework and curriculum** (objective 3) will be validated with trainers and also a lot of final input for the **guidelines for VR training** (objective 4) will be collected and then finally be reported in WP7.

During all FTs **public awareness** of VR police trainings was raised (communication and dissemination). Also, the **great interest from non-SHOTPROS partners** (gained through the already existing VR and police network) to participate in different FTs is notable. This deliverable, and the FTs in general thus directly support the fulfilment of objective 5, the **establishment of a European VR police network**.

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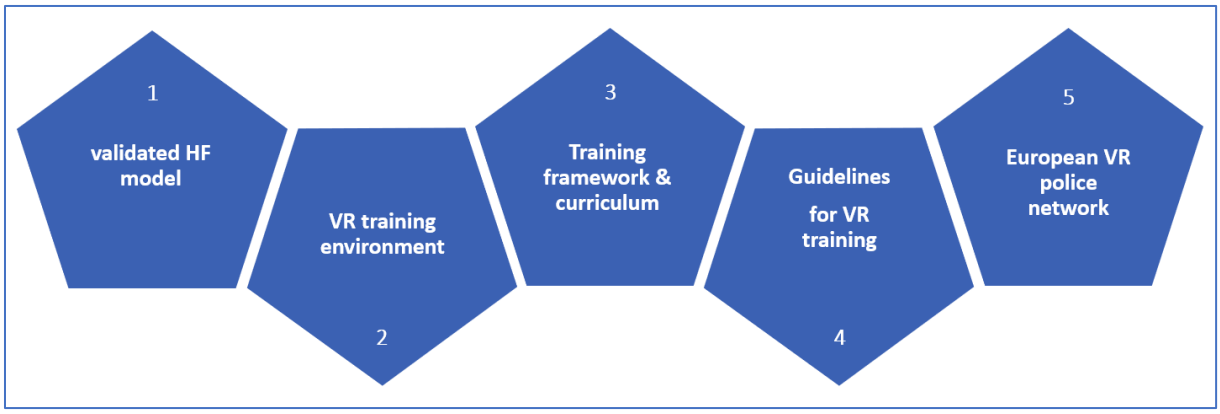

Figure 1: The 5 SHOTPROS Objectives

2 Introduction

According to the Description of the Action (DoA) of the SHOTPROS project, **5 large scale FTs** with the **LEA** project partners to evaluate the fit-for-purpose of the developed VR training solution, were planned in D7.1 and conducted in Winter/Spring 2022. The outcomes of these evaluation will be used to create a validated DMA-SR training curriculum, deriving guidelines (ethical, privacy, user experience, wanted / unwanted side effects etc.) for the integration of VR based training into existing LEA practices as well as policy-maker strategies and final inputs for the technology.

To meet the needs from the **research**, **technology** and **end user partners**, each field trial followed a **certain** agile **structure** regarding planning, organisation, set up and execution.

1. Detailed **preparation meeting** with participating partners
2. **Organisational** planning phase for event
   (Research, technology, training execution, media etc.)
3. **Preparation phase** by the experienced **VR trainer** together with technology partner and LEA partner including a scenario design session and preparation for the train-the-trainer sessions on site.
4. **Communication activities and media coverage**
   (Announcements, invitations and follow up work like provision of additional material, interviews etc.)
5. **Train-the-trainer** session on site to make trainers of LEA partners confident in execution and align all training aspects
6. **Set-up of location** and dry run of training and technology and research activities
   (“test the time plan”)

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7. **Execution** of FT (training & research & media)
8. **Online debriefing** of all partners for **feedback** and learning effects for upcoming FTs
9. **Consideration** of previous FT for upcoming FT in planning phase

After a general kick-off for all FTs, a preparation meeting for each individual FT was hosted. There, the requirements were clarified and aligned in the collaborative teams. Then the preparation and detailed organising and planning phase of each FT started, and finally each individual FT was conducted. Each field trial was supervised, prepared, and executed in addition to the local trainer team by an experienced VR trainer from the consortium to provide a stable training approach throughout all 5 sessions and to be able to well prepare the trainers on site before the execution. The scenarios used were developed based on the requirements of the LEAs according to their experience with VR and training goals for the field trial (see D5.3). As one of the big advantages of the SHOTPROS VR solution is the very flexible scenario designer (see D5.1) and an individual scenario, adapted to the needs of the training groups, is a key success factor in training (see D3.3 and D7.5 due M41), for each FT the scenario was either adapted or completely changed (see D5.3, the description of all scenarios used during FTs). In total 11 scenarios were designed and used. All of them were steered and adapted during training through the Real-Time Training Progress Tool (as defined in D4.5). After each field trial a debriefing and feedback meeting with all partners took place, to be able to learn for the next FT event. This structured format was used for following up of the previous to the next FT and for the present report. Following peer review processes defined in D1.1, the results of the FTs were also discussed together with research and end user partners and formed the base of this report at hand.

The main objectives of the evaluations during the FT as described in the DoA:

- Refine scenarios
- Create a validated DMA-SR training curriculum
- Guidelines for the integration of VR training
- Raising awareness about DMA-SR
- Address stakeholders and create policy-maker strategies to implement VR training

3 Field Trial Reports

Included in this deliverable are 5 FT reports in chronological order beginning with a table overview on all FTs.

- 7.2.2022 – 12.2.2022 – Seibersdorf, Austria – Focus: showcasing & try outs

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- 21.3.2022 – 25.3.2022 – Bucharest, Romania– Focus: showcasing & try outs
- 4.4.2022 – 8.4.2022 – Amsterdam, The Netherlands – Focus: experienced training
- 19.4.2022 – 22.4.2022 – Selm, NRW, Germany – Focus: experienced training
- 16.5.2022 – 20.5.2022 – Berlin, Germany – Focus: experienced training

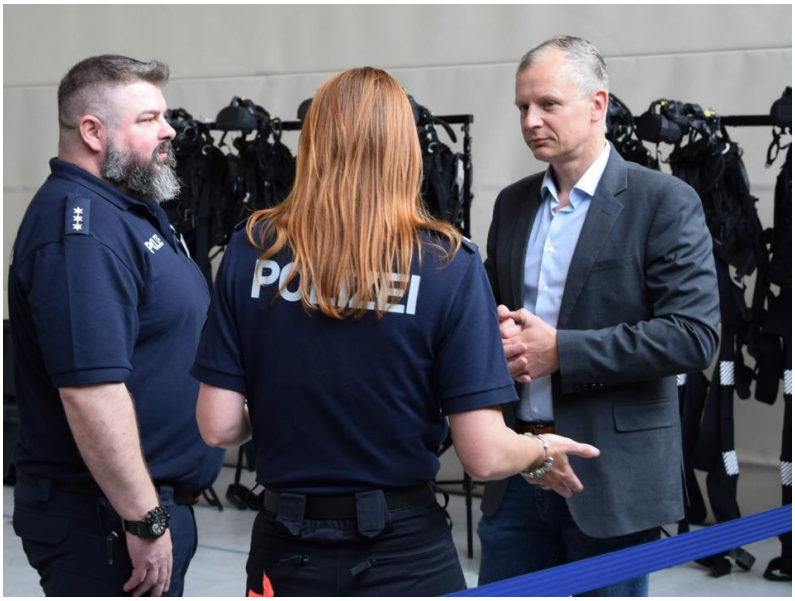

Figure 2: Berlin FTs - management and trainer on the importance of VR training

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3.1 Overview all FTs

	FT 1 - Seibersdorf	FT 2 - Bucharest	FT 3 - Amsterdam	FT 4 - Selm	FT 5 - Berlin
Participation	16 consortium members (9 partners) 52 police officers from the Austrian police. + observing guests from management or other police organisations	18 consortium members (9 partners) 30 trainees from Romanian Police + observing guests from management or other police organisations	27 consortium members (7 partners) 27 trainees from Dutch Police + observing guests from management or other police organisations	31 consortium members (10 partners) 45 trainees from Police NRW + observing guests from management or other police organisations	53 consortium members (13 partners) 48 trainees from Berlin Police + observing guests from management or other police organisations
Trainer and trainees	The VR police trainer from the Berlin Police was in charge to instruct the 13 training groups of each 4 trainees. The background of the trainees was very diverse: street police officers as well as special forces (such as WEGA and COBRA).	4 Romanian trainers were instructed by the VR Police trainer from the Berlin Police, they were in charge of 9 training groups of each 3 trainees	The experienced Dutch trainer team consisted of 5 trainers and was assisted by trainer from Berlin Police and Belgian Police. They were in charge of 6 training groups of each 4 trainees (24 trainees + some 3 extra guest groups). Additional 4 trainers from Belgium and 4 from NRW assisted to prepare for upcoming FTs.	The NRW trainer team consisted of 7 trainers and was led by an experienced trainer from the NRW police who also participated in the FT Amsterdam. They were in charge of 10 training groups of each 4 trainees (40 trainees + 5 extra guest groups on Thursday).	An experienced team of 9 trainers was made ready to lead the FT. They were selected from all different departments of the Berlin Police to have the option of awareness and positioning over all departments. There were 16 groups in teams of 3. (48 trainees)
Profile trainees	Mixed, different backgrounds and without VR training experience (mostly officers and not trainers)	Mixed, police officers with different backgrounds and without VR training experience	Consistent (all students), no VR experience guest groups in the afternoon came from different backgrounds to try-out the system	Police trainers with no or little VR experience	Mixed (mostly street patrol officers, but also one special group and students), no VR experience

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Scenarios	Hotel setting with increasing stress levels (see D5.3)	Hotel setting with increasing stress levels (adaptions in comparison to Seibersdorf). Also, the furniture shop scenario was used (see D5.3)	House clearing scenario (Hallway A) and house clearing scenario with weapons (Hallway E), (see D5.3)	Furniture shop scenarios with increasing stress levels (see D5.3)	Furniture Shop with larger crowd, noise disturbance in apartment building and arrest warrant (see D5.3) were used with different stress levels
Train-the-trainer	Based on the fact that the hosting LEA was not a regular project partner and due to COVID-related issues, the "train- the-trainer" workshop not performed. However, the training was led by an experienced VR trainer and thus stable knowledge and focus was provided.	Was performed on Monday during the dry run and used in all following FTs.	Was performed on Monday during the dry run. The Dutch trainers, 1 Belgian trainer and 3 NRW trainers were trained and prepared for this and for following FTs.	Was performed on Monday during the dry run and proved again to be very useful.	Was performed on Monday during the dry run.
Research	AIT: Questionnaires to trainees, (additional) bio-signals measurement, materialising of stress by: MMSP (wind, heat, mist/rain) – see D5.3), VUA: observations of the training KUL: evaluating RAT with trainers RL&USE: Additional experimenting technology	AIT: Questionnaires to trainees, (additional) bio-signals measurement, materialising of stress by: MMSP (wind, heat, mist/rain) – see D5.3), pain belt, scent VUA: 2 Focus groups and observations on the training UHEI: Saliva samples and quick attention and	AIT: Questionnaires to trainees VUA: 2 Focus groups and observations on the training Final results will be reported in D7.4, D7.5, D7.6.	AIT: Questionnaires to trainees, (additional) bio-signals measurement, multi-sensory platform materialising of stress by: MMSP (wind, heat, mist/rain) – see D5.3), pain belt, scent UHEI: Saliva samples and quick attention and memory-checks after each scenario	AIT: Questionnaires to trainees, (additional) bio-signals measurement, multi-sensory platform materialising of stress by: MMSP (wind, heat, mist/rain) – see D5.3), pain belt, scent VUA: 1 Focus group and observations on the training UHEI: Saliva samples and quick attention and

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	for enhanced graphic and additional applications (Dragonfly – see definitions in D5.1) Final results will be reported in D7.4, D7.5, D7.6.	memory-checks after each scenario KUL: evaluating RAT with trainers Final results will be reported in D7.4, D7.5, D7.6.		KUL: evaluating RAT with trainers Final results will be reported in D7.4, D7.5, D7.6.	memory-checks after each scenario KUL: evaluating RAT with trainers Final results will be reported in D7.4, D7.5, D7.6
Press and media coverage (see D8.9)	International press release resulted in an interview with the leading research partner AIT and 1 private TV channel (Servus TV) 1 public TV channel (ORF) 1 public radio (Ö1) A press release (in German and Dutch) resulted in 4 newspaper articles and a radio interview (Radio2, Belgium) Social media coverage	TV episode in the „M.A.I. aproape de tine" TV show that is broadcasted on TVR1 and TVR International every Sunday Social media coverage Article in the Romanian Police magazine	Vlog report was made by freelance journalist specialised on the police Social media coverage	Journalists from the internal press department recorded an interview for the internal Police newspaper	Internal communication work 1 private TV channel (RTL) Social media coverage
Debriefing & Learning f...	16 February 2022 Exacter distinction between training and showcasing → longer	29 March 2022 Timekeepers needed to be able to fulfil the research and training schedule at the same time	8 and 14 April 2022 Slight adaptions in the positioning of Operators, Trainers and After-Action review (AAR) station	28 April 2022 Showcasing to management went very well – always use experienced trainees for important showcasing	25 May 2022 For high numbers of trainees (next group can put on suits during AAR of previous group) it was very

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	Training slots for non-showcasing slots Keep closer to the framework in training sessions Good organisation (keep it like this)				good to have enough trainers.

Table 1: Overview of all FTs

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3.2 FT1 - Seibersdorf , Austria

Strategic goals of FT1: Showcase the SHOTPROS VR solution to a broader target audience outside the consortium; gather feedback from external LEAs from the advisory board, communication & dissemination (media presentations)

The first FT was organised from **7 to 11 February 2022 in Seibersdorf**, (Don Boscostraße 20, 2442 Unterwaltersdorf- Seibersdorf). It was planned and conducted by AIT and USE in close collaboration with the SHOTPROS project advisors from the Austrian Police Training Academy (SIAK) and the CBRNE Academy Seibersdorf. As the participants from the advisor organisation were less experienced with VR training, the main goal was raising awareness of the topic to a broader target audience (within participants and media), but at the same time conducting trainings to be able to gain research and requirements results for the final deliverables. Therefore, an experienced VR trainer from the consortium pre-defined the training sessions (size, training objectives, scenario etc.) and executed the trainings with the participants. The SIAK provided participants (including COVID back-ups) and also invited relevant policy-makers and management members.

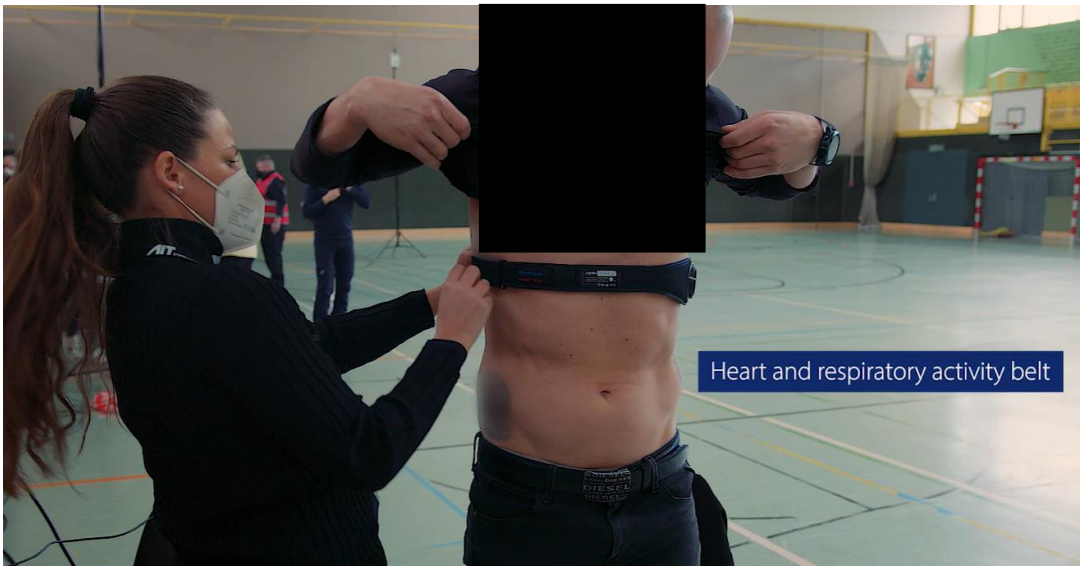

Figure 3: Preparation of participants for additional biosignals measurement by AIT at FT Seibersdorf

During the FT, some adaptations to the used scenarios were made in order to better suit the different (and heterogeneous) groups of trainees. On the first day, after set-up, a test and dry run was done. On Tuesday and Wednesday standardised trainings (see D7.1) were conducted, while Thursday and Friday were foreseen for experimenting. Some of the trainings were

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accompanied by a film team to create TV reports out of them. The options to try out the system without a detailed and standardised training was very well welcomed by management and participants totally new to the topic and resulted in a lot of enthusiasm from all the groups and in a very broad dissemination to the general public in Austria, Germany and beyond.

3.3 FT2 -Bucharest, Romania

Strategic goals of FT2: Showcase the SHOTPROS VR system to police officers with little VR experience within the consortium, demonstrate the added value of virtual scenario-based training and position the SHOTPROS approach and results within the management and policy level of police training in Romania, communication & dissemination (media presentations).

The second FT was organised from **21 to 25 March by the SHOTPROS LEA partner RMIA** at the premises of the **Gendarmerie of the National Romanian Police** (Str. Jandarmeriei 9-11, Sector 1, Bucharest). Based on the recommendations of FT1 and the experience of the trainees with VR training, it was decided to have 2-hour slots for every training group instead of 1 ½ hours. Additionally, there were dedicated time slots for experimenting with additional technology prototypes. To showcase the VR training to 1) national policy-makers, 2) the management of the Romanian Ministry of Internal Affairs (RMIA), the Romanian Police and 3) the media was a major aspect of the FT.

Figure 4: Additional VR experimenting area FT Bucharest

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In close relationship with USE and RMIA a schedule was set up. The first day a train-the-trainer session was organised whereby the VR Police trainer from the Police Berlin instructed a team of Romanian trainers how to execute VR police training. After the set-up day and dry-run, 3 days with standardised trainings (Tuesday-Wednesday and Thursday) were conducted. Each day two groups trained in the morning and 1 group in the afternoon. In the afternoon also experimenting with the multi-sensory platform by AIT (MMSP) was done and feedback was collected. The last day was dedicated to showcasing the system to the management and media. The scenarios used were similar to those used in Seibersdorf with minor changes and adaptions to align better with the context.

3.4 FT3 – Amsterdam, The Netherlands

Strategic goals of FT3: Training police students and police officers of the experienced National Police Amsterdam. Another goal was to test, how the LEA partner could integrate VR into their existing curriculum based on existing results from research and technology. Management awareness was another relevant goal.

Figure 5: Training - FT Amsterdam

The third FT was organised by **the SHOTPROS LEA partner NPN** from **4 to 8 April 2022** in the **Police Academy of the Dutch Police** (Overamstel, Ouderkerkerdijk 150, 1096 CR Amsterdam). Based on their observations in the Seibersdorf FT and their participation in the evaluation

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session of the Bucharest FT, the organisers from the Dutch police decided to work in teams of 4, with police students as trainees, with adapted scenarios that fit into current the learning schedule of the selected students. Media involvement was kept on a low level to enhance the focus of the training and was performed by a Dutch Police vlog-reporter.

Since the Amsterdam FT was organised in the proximity of Selm (FT location 4) and Ranst (where the final conference will be located), delegations (trainer and management) of both SHOTPROS partners visited to gather insights into the conduction and to transfer the knowledge to the next field trial and the final conference.

The program was planned with a set-up and dry-run day, a train-the-trainer workshop and 3 days of standardised training in the mornings and experimenting time in the afternoon.

3.5 FT4 – Selm, Germany

Strategic goals of FT4: Training of trainers from all branches of the VR-experienced LAFP NRW partner. The system was tested to see how VR training could be integrated into their existing curriculum. Trainer and psychologists from LAFP NRW therefore also conducted workshops to position the relevant topic of stress measurement in a virtual training environment. Also, a showcase of the system was conducted to convince the higher management and decision makers of the added value. For internal communication within the LEA organisation, a representative was on site.

Figure 6: High-level workshop to raise awareness on VR training at the Selm FT

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The fourth FT was organised by **the SHOTPROS LEA partner LAFP NRW** in **Selm in North Rhine-Westphalia, Germany** from **18 to 22 April 2022** (Landesamt für Ausbildung, Fortbildung und Personalangelegenheiten der Polizei NRW, Im Sundern 1, 59379 Selm).

For that purpose, the set-up of the system was done on Monday, with a dry-run, a train-the-trainer workshop and a briefing session. On Tuesday and Wednesday 10 groups of each 4 trainees conducted standardised training, while on Thursday training, experimenting and workshops were organised. On Friday a video message from the NRW Minister of Interior was presented and several high-level police chiefs tried out the VR system. The fact that all trainees of the FT in Selm were operational trainers, made the feedback even more precise and provided another perspective to the gathered data.

The organising LEA partner was very pleased with the results, and they succeeded in getting a commitment from the hierarchy to prospect and prepare a future introduction of VR in police training in NRW.

3.6 FT5 – Berlin, Germany

Strategic goals of FT5: Training with the SHOTPROS VR solution to police officers from all areas of the Berlin police and special forces. The aim was, to test the system extensively and to see how VR can be integrated into the existing curriculum. It was also planned as a showcase of the system to their higher management and attending media.

Figure 7: Media coverage FT Berlin

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The fifth FT was organised by **the SHOTPROS LEA partner BP** from 16 to 20 May 2022 at the Police Academy in Berlin, Spandau (Radelandstrasse 21, Berlin). To save resources and to have as many partners on site as possible, the final FT was co-executed together with the bi-annual SHOTPROS consortium meeting (see D1.5, meeting minutes report). This provided the possibilities to observe the FT together with the partners and advisors of the project and at the same time discuss the status of the project and the deliverables as well as the general objectives achievement.

Berlin Police chose to have scenarios for this FT in order to be able to use more role players and train scenarios with more participants.

After the FT, the Berlin Police management decided to initiate a prospection period to start a selection and tendering procedure to have a VR system integrated in future police training.

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4 Preliminary research findings of the FTs

4.1 AIT - usability and acceptance of VR and stressor testing

The purpose of the research during the field trials of AIT was two-fold. For one, the developed **systems usability and technology acceptance** (including the facets ease of use, immersion, interaction, quality of learning and imagination) were evaluated in every field trial, to investigate the main factors contributing the systems acceptance by the LEAs. To achieve this, questionnaires were handed out to the participating police officers after their training. Additionally, if trainers were available at the respective field trial, they would fill out a special trainer version of the questionnaire regarding their acceptance of the training and ratings for different training modalities. **Two thirds of the trainees** (with inclusion of a substantial number of trainers) evaluated the usability and acceptance, **the overall quality of Experience as good to excellent** while **94% of the trainers "can imagine to use VR as a training method"** in the future. Further details about the factors contributing to the systems' acceptance will be detailed in the D7.6.

The second purpose of AIT´s research at the Field Trials was to investigate the **materialisation of stressors in VR as well as gather additional biosignals data for stress investigation and measurement purposes**. The stressors were explored by means of enhancing the virtual trainings with multi-sensory stimuli, including light pain, wind, heat and the sense of smell. Outcomes included the sense of presence, stress as well as the perception of certain elements in the VR as threatening. Intuitive interpretation of the effect of these stressors suggest that there is a clear effect of multi-sensory applications (like wind, smell) on presence, stress and perception of threat but for a thorough science-based analysis of the result we refer to the final deliverable D7.6 (due by M41).

4.1.1 Trainee questionnaires

The trainee questionnaire started with: "How would you rate the overall quality of your experience with the SHOTPROS system?". Trainees answered on a scale from 1 – Excellent to 5 – Bad.

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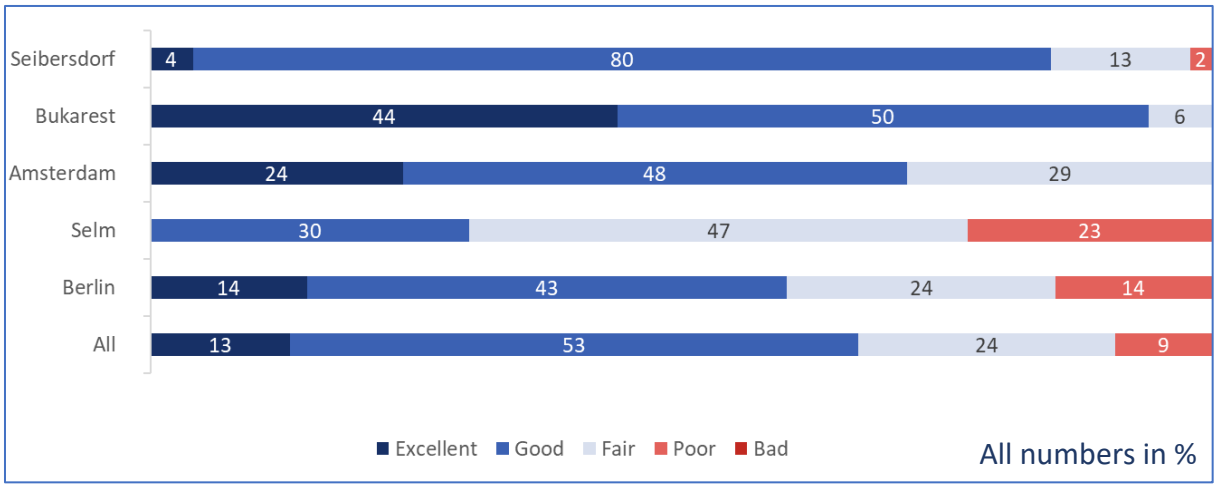

Figure 8: Overall quality of Experience for the 5 Field Trials + Overall (Percent)

Overall data from N = 149 police officers across all FTs was collected and rated their quality of experience with a mean of 2,33. In Seibersdorf, N = 45 police officers completed the questionnaire, resulting in a mean rating of M = 2,1. 16 police officers completed the questionnaire in Bucharest, with a mean rating of 1,6, whereas 21 police officers in Amsterdam rated the overall quality of experience with a mean of 2,1. Selm and Berlin rated the overall quality of experience with 2,5 and 2,3 respectively (with N = 30 and N = 37).

The first page of the questionnaire further consisted of the following open questions:

- If any, what problems did you have with the system?
- What was positive and did work well?
- What was negative and did not work well?
- What improvements to the system would you propose?

The results of this qualitative data from the participants will be presented in D7.6.

The second page of the questionnaire in every field trial consisted of items concerning technology acceptance level, immersion level, quality of learning, intuitiveness and police specific items (“I think virtual trainings are a useful addition to the other police trainings”, “The virtual environment offers better training opportunities than real training.”, “I think the virtual environment is a useful training tool for the police.”). Figure 3 shows the means and standard deviations for the scales of the questionnaire, a full analysis and presentation of the results will be presented in D7.6.

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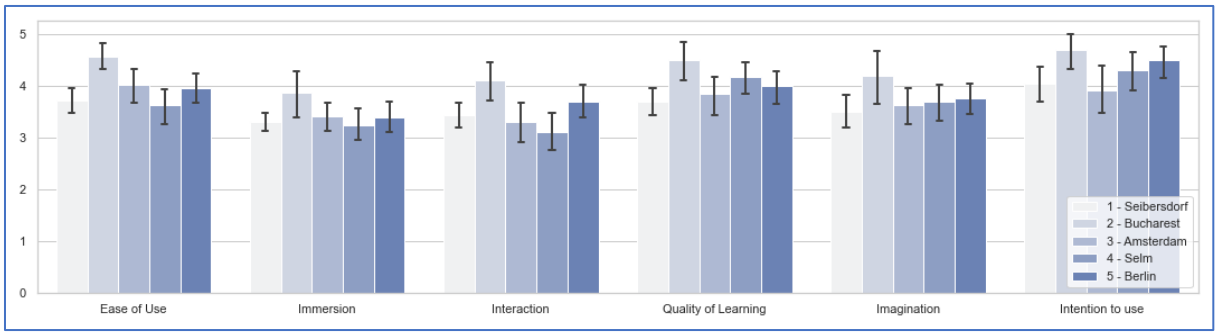

Figure 9: Means and Standard Deviations of the Technology Acceptance Scales & Quality of Learning Scale

4.1.2 Trainer Questionnaires

The trainer questionnaire required the police trainers to rate the suitability of VR regarding different training goals. Results will be reported in D7.6. The rated training goals were: tactical training, personal safety, shooting and weapon handling, fitness training, combat training, law and regulations training, communication training, situation training, perception and action and psychological competency training.

Page two of the questionnaire contained two open questions: “How should performance and the success of a VR training be measured?” and “What is the advantage of VR training in comparison to real life training”.

Afterwards, trainers either chose “Yes” or “No” to the question: “Can you imagine using VR as a training method?”. The results of this question are presented in Figure 4.

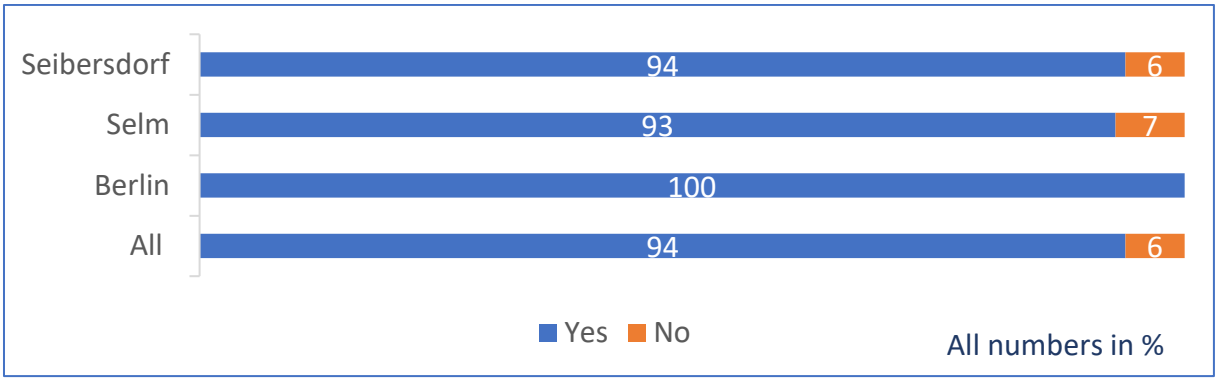

Figure 10: Answers of trainers to: "Can you imagine using VR as a training method?" (Percent)

In total, 63 trainers gave feedback on the system with the questionnaires. From that N = 35 came from the Field Trial in Seibersdorf, N = 28 from Selm and N = 4 from Berlin (the trainer focused FTs). The full analysis of the open questions will be reported in D7.6.

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4.1.3 Materialisation of stressors

To investigate, whether multi-sensory enhancement of stressors leads to an increase in stress, threat perception and presence, AIT conducted a study during the Field Trials in Selm and Berlin. First tests with the multi-sensory prototype (the Multi-Sensory Platform, see Figure 11) were conducted at the Field Trials in Seibersdorf and Bucharest, with learning from there shaping the study in the last two Field Trials. The multi-sensory elements used were heat, wind, olfaction and pain.

Figure 11: The multi-sensory platform built for the SHOTPROS project

These were added in a congruent manner to stressful stimuli in the VR, in order to study its effects. For example, when a perpetrator would stab the participant in VR, an uncomfortable, but not painful electric shock to simulate the stabbing was administered (see Figure 12). The full description and results of the first tests and the study will be presented in D7.6.

Figure 12: Additional materialisation of stress through scent and pain at FT Seibersdorf

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4.2 KUL - Evaluation of the use of the RAT.

The Risk Assessment Tool (RAT- see D4.7) to design different stress levels of scenarios was validated by KUL throughout the FTs. For the focus groups (organised by VUA), print screens were taken from some of the scenarios in most of the FTs to support the discussion between the trainees during the focus group. Based on these print screens, three members of the consortium separately filled out the RAT for each of those scenarios, using the print screens of the scenario as input. Results from these analyses will be presented in D7.6.

Data collected by AIT, VUA and UHEI will be analysed to potentially identify certain stress cues (or combinations of stress cues) that seem to provoke a higher stress perception. Furthermore, trainees were asked to fill out a questionnaire after completing their training session. These questionnaires also comprised questions that asked about their subjective assessment of the level of stressfulness of each of the scenarios trained and about which were for them the most stressful elements in the scenarios. Results of these questionnaires and from the studies conducted by the other partners, will be analysed once they are all available on the SHOTPROS Sharepoint and will be further reported on in D7.6.

4.3 UHEI – attention and memory tests on stress including saliva samples

As described in D7.1, the aim of the research of UHEI was to foster understanding of the link between officers' attention and the subsequent DMA processes. In this context, the specific focus was placed on the officers' perception as well as evaluation of personal, contextual, organisational and societal human factors during the scenarios. According to the model (see D3.2), those factors were expected to determine the demands of the scenarios, ultimately shaping the officers' stress reactions, which were expected to result in an attentional shift from goal-directed towards stimulus-driven attentional control, with subsequent DMA processes.

During each field trial, officers underwent three scenarios which were designed to increase in demand, so the stress level was increasing from scenario 1 to 2 and from 2 to 3 (also see D5.3). In order to capture the DMA processes and identify relevant HFs within the scenarios, the officers **answered three** brief open-ended **questions** following **each scenario**:

- "What did you pay attention to during the scenario?"
- "How did that influence your decision-making?"

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- "How did you behave during the scenario?"

In order to optimise the data collection process and speed, officers read out each question to themselves and answered them accordingly. All interviews were audiotaped using an iPad and analysed with the software MAXQDA22. To compare the qualitative results gained from the open-ended questions with the officers' perceived and physiological stress reactions, the officers indicated their perceived stress and strain levels five times during the data collection: Before the start of the testing (baseline), after each scenario (s1-s3) and 20 minutes after the last scenario (post).

In addition, the officers provided **saliva samples** at the same measurement points (i. e., baseline, s1-s3, post), serving to monitor physiological stress reactions, indicative of the quick and slow hormonal stress axis.

Officers HRV was additionally monitored throughout the complete testing session using a Zephyr belt (as part of the SHOTPROS solution – see D5.1).

Figure 13: UHEI team gathering saliva samples and questionnaires at Bucharest FT

Following each scenario, police trainers conducted an AAR with the officers. Here, police officers and trainers discussed the team's behaviour during the respective scenario, focusing on the use of relevant cues and the subsequent justification of the behaviour demonstrated.

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Hence, to enrich the HF and DMA model (D7.4), AARs were videotaped and analysed to gain a more in-depth understanding of attentional processes responsible for (in-)appropriate police behaviour as well as the didactical means applied by police trainers to foster correct police behaviour.

4.3.1 Preliminary FT data

UHEI conducted data collection in three field trials: Bucharest, Selm and Berlin.

In **Bucharest,** a total of 9 male officers was tested. The officers were aged between 27 and 38 years (M = 32.78; SD[1] = 3.07). Service experience ranged from 5 to 22 years (M = 13; SD = 5.05). Grades were mixed and included patrol men, instructors, majors and special forces agents. During this field trial, officers provided a total of 45 saliva samples[2]. Results and experiences gained during the Bucharest field trial were also used to optimise the testing procedure.

In the **Selm**, a total of 30 officers was tested. The officers were aged between 28 and 54 years (M = 38.3; SD = 6.61). Of this total, 28 officers were male, 2 officers were female.

Service experience ranged from 5.5 to 38 years (M = 16.92; SD = 7.49). All participating officers were also police trainers. During this FT, a total of 150 saliva samples were collected from the officers. Self-reported stress measures indicated that the stress manipulation caused by the VR scenarios was successful, as both perceived stress and strain levels of officers increased throughout the scenarios and differed significantly between scenarios.

[1] Standard deviation, the average amount of difference from the mean, it shows the diversion from the mean, a high SD means a lot of variance in the data, a low SD means less variance. 68% of all data points is between the range of Mean +/- SD

[2] Note that the data analysis of saliva samples requires professional laboratory tasks. Therefore, no preliminary results can be reported to date, just as for HRV data, which requires complex manual analyses.

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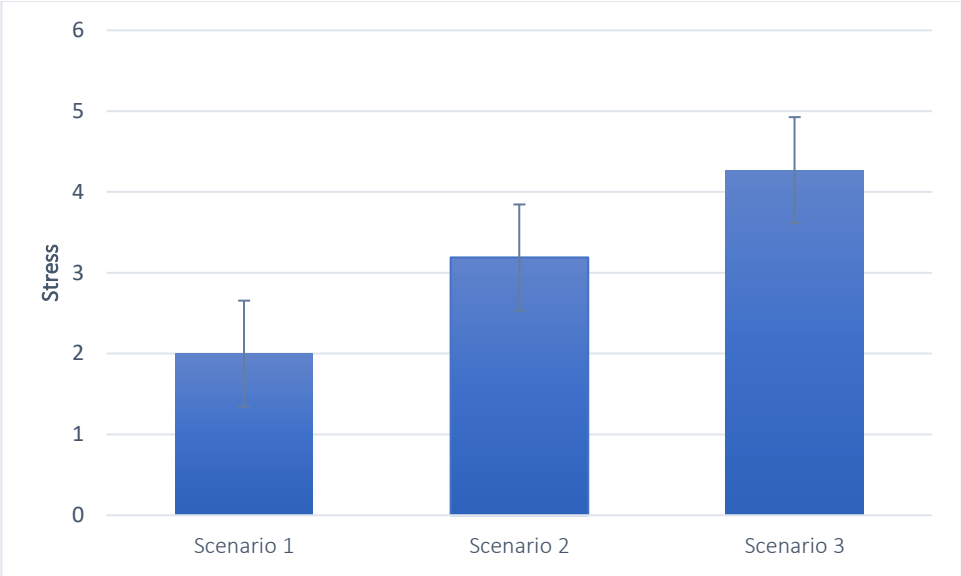

Figure 14: Self-reported stress during the scenarios differed significantly (rated on a scale from 1 = low stress to 6 = high stress). Error bars represent 95% confidence intervals

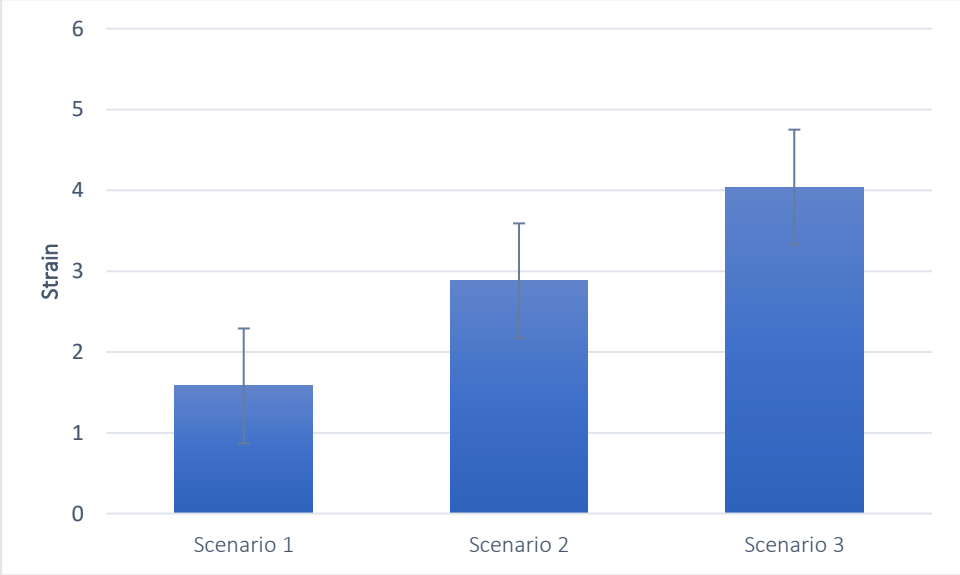

Figure 15: Self-reported strain during the scenarios differed significantly (rated on a scale from 1 = low strain to 6 = high strain). Error bars represent 95% confidence intervals

It needs to be pointed out that the first description of the qualitative date below gathered by UHEI, will complement the data gathered by VUA in the focus groups and will serve as input for D7.64 and D7.6. Specifically, when data substantiates the basic principles of the model as discussed in the different focus groups and when the data relates to task relevant and task irrelevant action. We also refer to the fact that the quotes below are input to validate and

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enrich the HF-DMA model" (defined in D3.2) which will ultimately result in a more complete presentation of the final deliverable SHOTPROS Final Evidence-based HF Model for DMA-SR (D7.4).

Qualitative data comprised a total of 617 data units (i. e., separate content components). The officers generally most frequently mentioned **stimuli relating to the perpetrator** (122 data units). This was followed by **space and position** (118 data units) and **involved parties** (116 data units). Hence, attentional, and subsequent DMA processes were generally influenced by situationally apparent stimuli during the scenarios.

- More specifically, the officers most frequently paid attention to the **perpetrator** ("*I was obviously looking for the perpetrator, as this was a clear priority. "* 3);
- Followed by the **environment** ("*I was explicitly paying attention to trip hazards. Looking around, where are the doors, hidden rooms. Checking sight and which resources I could use.")* and;
- **Unclear parties** (*„In the beginning, the situation was not clear. Whether that was actually an injured person or someone else…"*).
- DMA was most frequently influenced by the **position of colleagues** (*„That had an influence on my decisions because I couldn't always see my colleagues."*);
- Followed by the **environment** *(„[…] and that led me to neglect my surroundings a little more."*) and;
- **Weapons involved in the scenario** (*„I felt more alarmed than usually, when we got the note, armed perpetrator, accordingly more careful.").*

Resulting behaviour was most frequently described by the officers as appropriate or realistic (*„I think I didn't behave differently than I would have done in real life. […] I think it was adequate, just like one would have done in everyday situations.").* This data has yet to be compared with qualitative data from the after action review (AAR) in order to categorize stimuli into relevant and irrelevant and police behaviour as appropriate or inappropriate as classified by experienced police trainers.

Finally in **Berlin**, a total of 29 officers and police students were tested during the field trial. Participants were aged between 20 and 43 years (M = 29.9; SD = 6.39). Of this total, 20 participants were male, 9 participants were female. Service experience cannot yet be reported. 7 participants were police students, while the remaining 22 participants were patrol forces. During this field trial, a total of 145 saliva samples was collected for analyses from the

[3] Quotes were translated from German into English by the authors of this work.

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participating officers and police students. Apart from the previously indicated descriptive data, no preliminary results have been drawn from this field trial to date.

4.3.2 Preliminary conclusions

In conclusion, preliminary results suggest that the stress manipulation through the design of the VR scenarios was successful as indicated by self-reported stress and strain levels of the officers. Physiological stress data (i. e., cortisol and alpha amylase) as well as heart rate variability (HRV) data, informing of the officers' self-regulatory capacities in the face of stress, are currently analysed and will be reported in WP7.

Results of the preliminary qualitative data analyses hint at a variety of relevant and irrelevant cues perceived by the officers during the scenarios that were used for DMA. In this context, especially the temporal order of DMA as separated by the interview questions offer fruitful insights into the DMA processes undertaken by officers during the scenarios. Hence, interview data can be employed to undermine and illustrate the integrated nature of DMA as proposed by the model. Moreover, data gained from the interview question relating to the officers' attentional processes can be used to further explain the proposed link between attention, decision-making and action to investigate the proposed attentional shift from goal-directed to stimulus-driven attentional control during stressful encounters and enrich this relationship with real-life data and citations. This could ultimately be used to foster both didactical guidelines for the creation of realistic training scenarios in VR as well as support and evaluation of police officers through their trainers, resulting in an increased training and subsequent performance quality in real life.

4.4 VUA – validation on the training framework and curriculum

The VUA team gathered information to validate the HF-DMA model (based on D3.2) and the European Training framework (based on D3.3). and will report results in D7.4, the final model and D7.5, the final framework. VUA evaluated the users' (i.e., trainees') experience with the VR training through focus groups in the FTs, to prepare a final deliverable D7.5 with rich examples from end users. As such, information was gathered to validate/enrich the final HF-DMA model for DMA-SR (D7.4). Through training observation, VUA also collected examples of the implementation of didactical guidelines in VR. These examples will substantiate the final training curriculum for DMA-SR (D7.5).

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4.4.1 Focus Groups

During the FTs, VUA conducted **seven focus groups** in which a **total** of **24 trainees** participated**.** The focus groups took place in a separate room with trainees after their VR training. VUA selected three topics of the conceptual model and its implications for VR training to further evaluate in focus groups during the field trials:

1. **Stress mitigation**: does the VR training provoke stress and allow trainees to train in mitigating attentional processes under stress?
2. **Task-relevant and task-irrelevant information**: does the VR training allow trainees to practice with task-relevant and task-irrelevant information?
3. **Cognitive and sensory information**: can trainees in VR perceive **both** cognitive and sensory information in a natural way?

Three different focus group protocols were used, each focusing on one of the topics. This means that one protocol (and thus one topic) was chosen for each group of trainees. In the following, some first insights (i.e., examples and quotes) from the preliminary analysis of the focus groups are presented and discussed separately per topic.

4.4.1.1 Does the VR training allow trainees to train in mitigating attentional processes under stress?

Stress should be provoked in VR training (Trainer Dashboard, role-players, and scenario design), and the VR training should allow for **practicing mitigation strategies** as proposed by the model: i.e., restoring or maintaining goal-directed attention and thus action despite elevated stress levels. Therefore, the VR scenarios in training should include factors that induce stress and several elements of task-**relevant** information (e.g., weapons) and task-**irrelevant** information (e.g., a loud TV) that may draw attention.

As such, the VR training can facilitate trainees to train their attentional processes and subsequent actions while immersed in a stressful scenario. VUA asked the trainees in the focus groups to indicate factors that induced stress in the VR training scenarios, thus facilitating them to practice their attentional processes and subsequent actions under stress. In addition, VUA asked trainees to indicate **factors** that could **create more stress** in the VR training scenarios. Table 2 presents a selection of factors indicated by trainees in the focus groups.

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Stressful factors in the VR training scenarios
Entering a new room that you need to scan
Interactions with characters in the scenarios without prior information about the characters
Seeing blood on the floor
Having to work around bystanders/hostages
A suspect that was out of sight
A flashbang
Factors that could create more stress in the VR training scenarios
More bystanders and interaction with them
More furniture and clutter in the buildings/houses
TV that is on and/or reflects onto something
Shadows
Mirrors
Placing NPCs/avatars in blind spots in corners or behind a door

Table 2: A selection of factors that trainees identified as stressful factors in the scenarios

4.4.1.2 Does the VR training allow trainees to practice with task-relevant information and task-irrelevant information?

VR training should include both task-**relevant** and task-**irrelevant stimuli** to allow trainees to **practice focusing on the goal-relevant stimuli**. VUA asked trainees about task-relevant information and task-irrelevant information they observed during the VR training scenarios. Table 3 presents a selection of examples. Trainees stated that practice in focusing on task-relevant information is essential for **scanning or evacuating** a room, making their **own decisions** (rather than just following orders), and making **faster** and **more accurate decisions** according to the legal framework.

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Task-relevant information
The absence or presence of blood
The weapons held by the suspect (e.g., broken bottle, lighter)
The response by the suspect (e.g., aggressive, distressed, cooperative)
The movement of the suspect (body position and language of the suspect, control over body movement).
Task-irrelevant information
The small spaces to manoeuvre, avoiding hindering colleagues
Surprises or a sudden attack of the suspect, while the situation was under control
Doors that were difficult to open or doors that are already open without knowing what is in the room
Environmental sounds perceived as dangerous (swearing of suspect, ambient noise, loud bangs)

Table 3: A selection of examples of task relevant and task irrelevant information observed by trainees in the VR training scenarios

4.4.1.3 Can trainees in VR perceive both cognitive and sensory information in a natural way?

VR training should enable trainees to use both **cognitive** and **sensory information**, meaning that trainees can perceive, move and process information in a **natural/realistic way** in VR. Cognitive information refers to the thoughts, knowledge, and memories that trainees can cognitively recall, such as judicial use of force or the threat of a knife. Sensory information refers to anything the trainees feel in their bodies, such as the speed at which they are moving backwards or a perceived threat that affects their alertness and stress level. Table 4 contains a selection of quotes from trainees on how they experienced the use of cognitive and sensory information in the VR scenarios during the field trials.

Cognitive information in VR training scenarios
Procedures were easy to practice and not very different from real-life (e.g., clearing areas)
Taking cover in VR feels less naturally than in real-life. In real-life there is a real cover (object or wall). In VR, you are only pretending that you are behind a wall.
The VR environment does mimic a situation well (“If someone comes to be with a knife, I do have that ‘oh help’-feeling”)

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The goals mentioned by the trainer were very clear, which helped with the realism of my thoughts
Sensory information in VR training scenarios
The gear felt 90% like the right gear
It felt strange that your VR character cannot bend their fingers
The walking/movement patterns (protocols) are really anchored in our minds, and it felt very realistic to apply them

Table 4: A selection of quotes from trainees on how they experienced the use of cognitive and sensory information in the VR scenarios during the field trials.

4.4.1.4 Outlook to Final Results and Conclusions in D7.4 (Final DMA-SR Model)

The results of the focus groups will be further elaborated in **D7.4 (final DMA-SR model).** Final results and conclusions will be presented on:

- The relevance and implications of three focal tenets of the conceptual model for VR training (*stress mitigation, task-relevant and task-irrelevant information, cognitive and sensory information*) addressed in the focus groups.
- The effectiveness of VR training in improving DMA skills
- The extent to which the current system and the curriculum fulfils the implications following from the model.
- Implications of the final conceptual model for VR training for end users and areas for further improvement.

4.4.2 Training Observation

To enrich the didactical guidelines and to make the guidelines and criteria more concrete for trainers, VUA systematically observed the training sessions conducted in the field trials and collected best practices (and, if informative, bad examples) for each guideline. The guidelines were based on seven criteria for optimal training *(i.e., clear assignment, training instruction, well-designed practice situation, model learning, variation and differentiation, self-management of the learning process and feedback, see D3.3*).

During the field trials, VUA collected **217 unique observations**. Figure 16 presents an overview of the number of observations per didactical criterion for optimal training. Table 5 presents

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for each of the didactical criteria two examples of best practices observed during the SHOTPROS field trials.

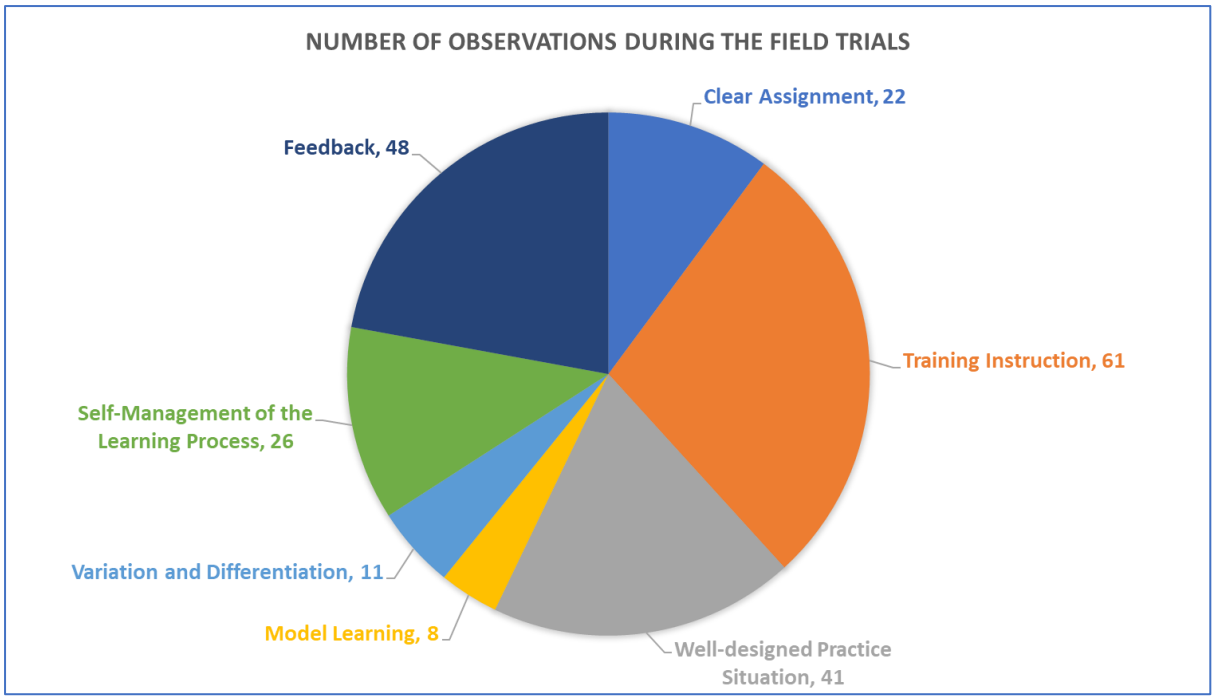

Figure 16: 217 training observations collected during the FTs per criterion for optimal training

Clear assignment
Instructor provided the precondition that all trainees needed to be aware of the basic standards of tactical procedures and knowledge
Instructor introduces the aim of the training session with VR by briefly describing the structure of the training session
Training instruction
Instructor gives instruction to role-player according to performance of previous scenario
Instructor ensures that trainees do not move to the next step of the gear procedure before they have completely finished the current step
Well-designed training design
Training scenarios are selected according to the experience of trainees and the problems they encounter on the street (trainees special forces: different scenarios than academy trainees)
Model learning

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Model learning used during undressing: peer model on how to take off the gear in procedural fashion (step-by-step)
Instructor demonstrates tactical procedure before participants enter VR environment
Self-Management of the Learning Process
Trainees ask the instructor to review the scenario from the aggressor's perspective
The instructor asks the group to reflect on their own decisions based on what is visually observed on the AAR
Feedback
Instructor leaves the feedback round with positive feedback: "Overall, I really liked it"
Instructor shows the levels of stress over the scenarios: asks trainees how they perceived their level of stress throughout the scenario

Table 5: Examples of best practices observed during the FTs per didactical criterion

4.4.3 Preliminary conclusions in D7.4 (Final DMA-SR Model)

The results of the focus groups will be further elaborated in **D7.4 (final DMA-SR model).** In D7.4, final results and conclusions will be presented on:

- The relevance of the key points of the DMA-SR model for VR training (*human factors, cognitive and sensory information, attentional processes, range of option for decision-making and action)*
- LEA's perspective on how they incorporated the key points of the DMA-SR model in their VR training during the five SHOTPROS Field Trials.
- Technology partner perspective on the application of the DMA-SR model in the VR system.
- Trainees' experiences in the SHOTPROS Field Trials. Trainees' experiences were collected in focus groups (VUA) and short interviews (UHEI) and provide insight into the extent to which the current system fulfils the implications following from the DMA-SR model.
- Implications of the final DMA-SR model for VR training for end users and areas for further improvement.

4.4.4 Preliminary conclusions in D7.5 (SHOTPROS final Training Curriculum)

The results of the training observations will be further elaborated in D7.5 (SHOTPROS final training curriculum). In D7.5, final results and conclusions will be presented on:

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- Generic training **manual** information for LEAs that want to adopt VR training (also for LEAs that are currently not a partner in the project).
- Incorporation of **good practices** observed during the Field Trials into seven didactical concepts for high quality training and how to apply these didactical concepts in VR training.
- Short information **clips/videos for each didactical concept**. The videos will provide trainers with relevant information on the implementation of the didactical concepts in VR training.
- Individual contributions from all LEAs on how they see each of the didactical concepts applied in VR training, tailored to their specific organisation.
- Insights and conclusions based on LEAs view on the use of the seven didactical concepts for their specific organisation.

Figure 17: VUA team collecting data by observation at Bucharest FT

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5 LEA point of view on the FTs

Within each debriefing session, but also as a dedicated workshop session on the last Consortium Meeting in Berlin (in parallel to the FT5), the needs and inputs of the end users were put in focus to establish a successful series of FTs and gather feedback for the upcoming final conference (see D7.3) and final deliverables. The structured feedback for each debriefing session covered the following topics and questions:

1. What are the results from the field trials you visited?
2. What are the results from the field trials you hosted?
3. What were your training goals for the trainees, and did you achieve them?
4. What were your training goals for the trainees, and did you achieve them?
5. What were your FT goals as an organisation? Did you achieve them? (e.g.: knowledge, acceptance, awareness, learning, trying out etc.) and how?
6. What are the advantages for you as an organisation caused by the field trials?
7. What could have gone better?
8. What did you learn as a trainer?
9. What did you learn as an organisation?
10. All other input or feedback…?

Figure 18: Preparation of Belgian trainers with Dutch trainers at Amsterdam FT

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In the following the overall feedback is summarised and enhanced with quotes from LEAs. All feedback will be used for the reporting of the D7.5, 7.6 and 8.5 as the voice of end users is very important for future end users and successful introduction of new technology.

> *"Even though some of our team-members were sceptical at first, having only known VR in a gaming sense, the FT in Amsterdam proved that it can be a tool to complement and **enhance** the training offered to law enforcement. The VR suit and equipment do not hinder the immersion into the scenario and the system allows for the creation and training of certain scenarios that are difficult to achieve in current training. The possibility of variation in environment, opponents and bystanders can help us prepare our officers for a multitude of future interventions." **(Police Belgium)***

The overall view on the FTs by the project LEA partners was very positive. The opportunity to learn from the participation in the WP6 studies and to be able to apply the knowledge gathered throughout the SHOTPROS project in the hosting of FTs as part of WP7, were very well received and lead to a successful European roadshow on the topic of VR training to manage stress. The involvement from the beginning of the project until the FTs drew circles in higher management areas as well as ministries of internal affairs or other relevant policy-maker organisations.

> *"**Introducing** the technology to the top **management** and the **end users** and being well seen and praised, that were our biggest results. We got **media** coverage on different canals, social media, TV etc. **Good feedback** on the organisation of the field trial itself resulted in good practice methods for the following field trials." (**Romanian ministry of internal affairs**)*

The challenge of hosting full VR training days and at the same time include technology and research activities, was very well achieved by all partners and built-up significant knowledge that will be reported in the WP7 and WP8 deliverables with the voice of the end users. This phenomenon was already used in communication and dissemination activities. The view on VR introduction is even more valid if it comes from a peer and so this will be a crucial part for a successful implementation of a training solution.

> *"In **preparation** of the FT in Selm we visited the FT in Amsterdam, where we were **able to use the open and experimental atmosphere** to get our trainers trained by our Dutch LEA-Partners. This helped us enormously to prepare our trainers and set up for the **successful** conduction of the FT Selm. We were also able to learn from the "do´s and don'ts" to **optimise** our setup and the location." **(LAFP NRW)***

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For successful training, organisation, preparation, and knowledge was seen as the main success factor of the FTs and consequently for effective training. The need to establish train-the-trainer session (or later if a VR solution is introduced into an organisation to include additional trainer courses on the VR topic) is a necessary investment.

> *"Our training goals for our trainees were to give them **a challenging, realistic training experience** in a field that is one of the most complex in a police context. We also wanted to use the immersive strengths of VR-Technology to further deepen the real-world training experiences that our trainees already have. From a subjective point of view none of our participants underperformed or quit the training due to motion sickness effects or other unwanted effects like lack of representativeness of the VR-Scenarios. In addition to that due to the objective stressors we could use in the VR-Scenarios we found out that our shoot/non-shoot-real world training has worked since no innocent victims or bystanders were harmed by police officers during the scenarios.* ***(Berlin Police)***

> *"Our didactical design was efficient and we could see a rising learning curve throughout our FT."* ***(LAFP NRW)***

The (real-life) training approaches of LEAs are currently very organisation-individual, based on local guidelines. This creates another need for European guidelines and a framework when it comes to VR training and is an important result that is awaited by the LEA partners and their management. LEAs appreciated the option to design the scenario and the training flow according to the created scientific model and framework in the project, but at the same time individualised for their trainees. In the dedicated sessions, trainees should have the option to get used to the new technology, but in the end also to learn something out of the training as it was intended to be a training and not a try-out only.

> *"One of our training goals was to test out the system to the limits and to see how extended the immersion was by using more people in a scenario. This was a success since all groups (including special forces) were triggered and distracted by the number of people and the interaction they caused."* ***(Berlin Police)***

More experienced trainers also set up scenarios with more challenges to the system (number of avatars for example).

> *"We were able to positively convince our organisation on the highest levels to invest into this kind of training in the future."* ***(LAFP NRW)***

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Another topic in the discussions during the field trials was how to convince top-management and policy makers on introducing a VR training to their organisation. The discussions were supported by attending advisors of the project with VR systems already in use and will be reported in the D8.5, policy-maker toolkit. Involvement of management throughout the project and especially planned showcasing and demonstration during the FTs were already successful for some organisations and further internal steps are planned after the end of the project with all final results available.

"By far the best innovation of this VR training system is the AAR." ***(Police Berlin)***

"The immediate and complete feedback with the AAR has so much potential and most of all, it is objective and indisputable." ***(LAFP NRW)***

Figure 19: After Action Review at FT Bucharest

Regarding the VR solution the incredible value of the AAR options was again mentioned by all participants. To not loose time explaining decisions and actions to a trainee after the training but to visualise it enhanced with evidence based KPIs is seen as one of the biggest advantages. Train the "impossible" by involving children, dogs or bystanders as well as just interrupt and

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start again without the task of re-set up is another very well received plus on VR technology in training.

> *"In the real life of an officer, only 10% of the work is physical (exercising, use of arms etc.) but 90% is communication, attention, decision making, perception etc. and this can be very well trained in VR"* ***(Dutch Police)***

But at the same time, it becomes clearer that VR training is not a full replacement of real-life training, but a complementation with the option to create environments and challenges that cannot be trained in real life.

> *"The system was tested intensively in Berlin, with a bigger number of suits and NPCs, proving that it can sustain that and identified challenges were able to be tackled by the technology partner. The procedure of separating the after-action review from the training room is good in the sense of not disturbing the activities of the trainers and trainees, but it resulted in a need for a second screen in the training room."* ***(Police Sweden)***

Through the intensive testing of the solution, all possible challenges were also discussed. For example, skill training (weapon handling, actual handcuffing etc.) are not ideal for VR training, but VR training rather needs to focus on communication and the perception of a situation and environments with different challenges that can better prepare trainees for street operations. Another need to achieve optimal training results and at the same time to provide an efficient training organisation is the idea to separate the AAR from the training room. This provides the option that other training groups can already start with the training. But to follow the learning model based on D3.3 and which will be further elaborated in D7.5, it is important to have the option to steer the training via the Training Dashboard (D4.5) and to give the trainees the possibility to experience the behaviour also directly after a first scenario and not only in a compact form at the end. This would provide the need for a second screen within the training area if it is necessary to save resources and separate the AAR station in another room.

> *"To see the networking activity, grow during the FT and to see the VRPN come into being was a reassuring thing to see. The network is essential for us to continue to learn from others and to be able to share our expertise with others."* ***(Police Berlin)***

> *"What we learned? To accept new challenges; To work in collaboration with different people from various backgrounds; To use new technology and training technics; That the VR system is a very versatile tool, especially in the evaluation process."* (***Romanian ministry of internal affairs***)

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Networking with international experienced trainers was another positive aspect for the LEAs within all FTs. The exchange and visits for preparation for upcoming FTs was raised by each FT and lead to higher networking rates amongst the LEAs (partners and invited LEAs).

6 Report from technology partner RL on the FTs

After every FT, RE-liON (RL) was part of the evaluation and feedback process based on following questions:

- How did the FT go from a technical point of view?
- What are your main findings?
- Lessons learned during the FTs?
- Adaptations, adjustments, improvements made to the system along the way…?
- Recommendations towards final deliverables and future use?

6.1.1 Seibersdorf, AT

The first and the second FT were clearly aimed at showcasing the VR system in combination with a training. Therefore, the technology partner also made a distinction between training, demo and/or showcase. Research that interferes more with the flow of the training needs to be more aligned beforehand to avoid adaptions during the FTs. Even more detailed instructions to the trainers are necessary (train-the-trainer session, suiting instructions etc.)

6.1.2 Bucharest, RO

Although again a less experienced host location, the organisation was again very qualitative and successful. More room and dedicated slots for the experimental environments was very well received.

6.1.3 Amsterdam, NL

This was the first FT in a country where VR is already used in police training. A part of the test for the organisers was to work with VR-scenarios that could fit into the learning curve of the police students who were testing the system. The positioning of the operator and monitoring stations need to have more space if the FT is crowded (which was not for training reasons, but for showcasing reasons and will mostly not be applicable in real trainings but needs to be considered for showcasing situations.

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6.1.4 Selm NRW, DE

The second time the SHOTPROS solution was used in a VR-experienced organisation. Ideal set up of training system and experimenting area. The preparation intention of the Selm trainers in Amsterdam and the fact that all trainees were also operational trainers (and officers) themselves, made the execution of the training much easier and the time plan was much easier to fulfil.

Figure 20: Experimental area to evaluate requirements within graphically advanced VR solution at FT Selm

6.1.5 Berlin, DE

This was the third FT in a VR-experienced country and the last in the row of all FTs which made it easy to execute with all learnings in mind.

It proved again very useful that we were revisiting a police organisation where we had worked before prior (Berlin, July 2021). The main trainer had also been participating in all 5 FT and he oversaw the implementation of all lessons learned. Also the level of the experimental environments was suitable for scenario experience.

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7 Report on communication and dissemination of the FT

The overall communication and media attention throughout the field trials was very high. In order to achieve the strategic goal of communicating the project results to the broad public, several representatives of the mass media (e.g. ORF Austria, RTL Germany, etc.) were invited to the VR trainings during the field trials. These media have reported very positively about the SHOTPROS project, and a high media coverage was achieved.

Figure 21: TV team filming training scenes in Seibersdorf, Austria

Besides the communication in the mass media, the project results were also positioned in special interest media (e.g. in the police blogs of the police partners or in magazines like the one of the Austrian Ministry of the Interior). Also, internal communication of the LEA partners received high involvement from management and policy makers (e.g. a video message about the importance of technology and VR by the minister of internal affairs NRW, Germany to the training participants of FT4 and many management appearances and acknowledgements throughout all FTs).

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Figure 22: Video message by Minister of Internal Affairs NRW, Germany at the Selm FT to high-level participants from ministry and police management

Furthermore, the first results of the field trials have already been presented at special police and security events or conferences (e.g. at the GPEC conference in Frankfurt) or the scientific results are being used in the form of scientific publications. A list of media coverage is defined in chapter 3. The details on communication and dissemination throughout the field trials can be found in D8.9 (due M41).

The positive spirit towards new technology was impressive and again showed the large impact of good preparation and knowledge development within organisations to be able to integrate a possible digital transformation. The difference visible throughout the FTs in comparison to the LEA partners at the beginning of the project (with no or very little VR experience) was remarkable. Well-experienced partners easily explained the advantages and challenges of VR police training to attending external police organisations and made a significant contribution to the future VR and police network (see D8.10). The requirements towards a product became clearer and management was involved regarding policy-making and budgeting of future projects. This feedback and experience will also be included in D8.5, the Policy-Maker toolkit.

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8 Conclusion

After intensive preparation, planning and expectation management, the FTs were a great success on several different levels. Despite different COVID-19 measures, all 5 planned FTs could have been successfully implemented (which was a potential risk to be mitigated at the beginning of the FTs roadshow). But all alternatives or restrictions in attendances or research activities were not necessary and all activities could be executed as planned. The planning and organisation were intensive as almost every 3 weeks another event took place. This was challenging but also very satisfying for the whole consortium as the results were impressive and the presentations, trainings and management interactions were all very well received by the participants. During the FTs, **24 training days** were executed, with in total **54 trainings** (3-4 members per team). A total of **191 trainees** participated, guided by **25 trainers** using **11** different **scenarios**.

The cross-partner exchange and preparation visits also showed how important an intensive groundwork is. Research and LEA needs aligned well over the time and constructive feedback in the debriefing sessions made each FT even better organised. Research had well profiled test groups available and received many data that will make an important input to the final deliverables of WP7 and WP8. VUA organised **7 focus groups** and collected **217 unique observations** with regards to the use of the training guidelines. AIT received **149 filled out questionnaires**, they collected **bio-signals from 156 trainees** plus **88 extra bio-signals (EEG etc.)**. **139 trainees used the MMSP** for additional immersion and stress perception**.** UHEI collected **68 quick-questions and 340 cortisol saliva samples**.

An extensive effort has also been done to **collect feedback from the end users and RL,** resulting in a number of highlighted quotes as answers to specific questions concerning their individual experiences aggregated during the FTs. Furthermore, a preliminary list of do's and don'ts identified by LEAs was drafted that will be integrated in D7.5 and D7.6 and D8.5.

To finalise the preliminary analysis of the 5 FTs, these field tests were **also instrumental to the VR and Police network that is emerging**. In fact, the FTs can be seen as network events and as a possible model for future network events. The guests and contacts, the conversations and ad hoc assessments of the VR training system and the exchange of views on how we can work together will prove invaluable to further build a sustainable co-operation of LEAs throughout Europe using VR and learning how to integrate into the existing training.

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9 Annex

The schedule of all 5 FTs is presented below:

Monday	Tuesday	Wednesday	Thursday	Friday
Set up & dry run **Start**: 09:00 **Participants**: CBRNE Academy, SHOTPROS Partner, SIAK **Schedule** Set-up 09:00 – 12:00 Lunch 12:00 – 13:00 VR Demo 13:00 – 17:00 End approx. 17:00 - 17:30 60 min per VR Group 4 persons per Group	**SIAK Training + Studies** VR Demo @school Lunch @CBRNE Academy **Start**: 08:30 **Participants**: SIAK & SHOTPROS Partner **Schedule** Arrival at school: 09:00 Group 1 09:00 – 10:30 Group 2 10:30 – 12:00 Lunch 12:00 – 13:00 Group 3 13:00 – 14:30 Group 4 14:30 – 16:00 Group 5 16:00 – 17:30	**SIAK Training + Studies** VR Demo @school Lunch @CBRNE Academy **Start** 09:00 **Participants**: SIAK & SHOTPROS Partner **Schedule** Arrival at school: 09:00 Group 6 09:00 – 10:30 Group 7 10:30 – 12:00 Lunch 12:00 – 13:00 Group 8 13:00 – 14:30 Group 9 14:30 – 16:00 Group 10 16:00 – 17:30	**SHOTPROS & Friends Day** VR Demo @school Lunch @CBRNE Academy **Start** 09:00 **Participants**: SHOTPROS contacts, partners & further guests **Schedule** Arrival at school: 09:00	**Media session** VR Demo @school **Start**: 09:00 **Participants**: see Journalist list, SHOTPROS partner (also LEAs) **Schedule** 09:00-09:30 Welcome 09:30-11:30 VR Experience 11:30-12:00 back to CBRNE Academy 11:30 set-down

Figure 23: Schedule FT1 - Seibersdorf

Monday	Tuesday	Wednesday	Thursday	Friday
Set up & dry run + TRAIN the Trainer @Jandarmeria **Start**: 09:00 **Participants**: SHOTPROS, RO Police trainers and 1 team special forces **Schedule** Set-up 09:00 – 12:00 Lunch 12:00 – 13:00 VR T&T 13:00 – 14:00 Test group 14:00 – 16:00 Debriefing 16h30 End approx. 17:00	**Training + Studies** VR Demo @Jandarmeria **Start**: 08:30 **Participants**: RO LEAs **Schedule** Arrival at school: 08:00 Group 1 08:30 – 10:30 Group 2 10:30 – 12:30 Lunch 12:30 – 13:30 Group 3 13:30 – 16:30 Debriefing 16h30 – END 17:00	**Training + Studies** VR Demo @Jandarmeria **Start** 08:30 **Participants**: RO LEAs **Schedule** Arrival at school: 08:00 Group 4 08:30 – 10:30 Group 5 10:30 – 12:30 Lunch 12:30 – 13:30 Group 6 13:30 – 16:30 END 16h30 Dinner and debriefing 20h	**Training + Studies** VR Demo @Jandarmeria **Start** 08:30 **Participants**: other RO LEAs **Schedule** Arrival at school: 08:00 Group 7 08:30 – 10:30 Group 8 10:30 – 12:30 Lunch 12:30 – 13:30 Group 9 13:30-16h30 Debriefing 16h30 – END 17:00	**Media session** VR Demo @Jandarmeria **Start**: 09:00 **Participants**: Internal communication, SHOTPROS partners (also LEAs) And management **Schedule** 09:00-09:30 Welcome 09:30-11:30 VR Experience 11:30-12:00 Debriefing 12:00-13:00 Lunch 13:00 Set-down

Figure 24: Schedule FT2 - Bucharest

Monday	Tuesday	Wednesday	Thursday	Friday
Set up & dry run + TRAIN the Trainer **Start**: 9:00 **Participants**: NP Academy + SHOTPROS **Schedule** Set-up 9:00 – 12:00 Lunch 12:00 – 13:00 VR T&T 13:00 – 14:00 Test group 14:00 – 16:00 Debriefing 16:30 End approx. 17:00	**Training + Studies** (morning) + **Experimenting** (afternoon) VR Demo **Start**: 9:00 **Participants**: Learning team of 2 groups or 8 students **Schedule** Arrival at academy: 8:00 Training: 9:00-12:00 Lunch 12:00 – 13:00 Flex Time* 13:00-16:00 Debriefing 16:30 END 17:00	**Training + Studies** (morning) + **Experimenting** (afternoon) VR Demo **Start**: 9:00 **Participants**: Learning team of 2 groups or 8 students **Schedule** Arrival at academy: 8:00 Training: 9:00-12:00 Lunch 12:00 – 13:00 Flex Time* 13:00-16:00 Debriefing 16:30 END 17:00	**Training + Studies** (morning) + **Experimenting** (afternoon) VR Demo **Start**: 9:00 **Participants**: Learning team of 2 groups or 8 students **Schedule** Arrival at academy: 8:00 Training: 9:00-12:00 Lunch 12:00 – 13:00 Flex Time* 13:00-16:00 Debriefing 16:30 END 17:00	**Build down and evaluation and debriefing** **Start**: 9:00 **Participants**: all **CLOSE latest 12:00**

Figure 25: Schedule FT3 - Amsterdam

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Easter Monday	Tuesday	Wednesday	Thursday	Friday
Set up & dry run + TRAIN the Trainer **Start**: 15:00 **Participants**: RL, UHEI and other SHOTPROS partners **Schedule** Set-up VR T&T Debriefing End approx. 18:00	NRW **Training + Studies** **Start**: 08:30 **Participants**: NRW police trainers and SHOTPROS **Schedule** Arrival at school: 08:30 **Group 1** 09:00-10:30 **Group 2** 10:30-12:00 *Lunch 12:00 – 13:00* **Group 3** 13:00-14:30 **Group 4** 14:30-16:00 **Group 5** 16:00-17:30 END 18:00	**NRW Training + Studies** **Start**: 08:30 **Participants**: NRW police trainers and SHOTPROS **Schedule** Arrival at school: 08:30 **Group 6** 09:00-10:30 **Group 7** 10:30-12:00 *Lunch 12:00 – 13:00* **Group 8** 13:00-14:30 **Group 9** 14:30-16:00 **Group 10** 16:00-17:30 END 18:00	**Experimenting Day** **Start**: 08:30 **Participants**: FBsT Leiter, Polizei NRW, Dezernatsleiter LAFP, Dezernatsleiter LZPD **Schedule** Arrival at school: 08:30 **Group 1** 09:00-10:00 **Group 2** 10:00-11:00 **Group 3** 11:00-12:00 *Lunch 12:00 – 13:00* **WS1** 13:00-14:30 (Group 1-3) **Group 4** 13:00-14:00 **Group 5** 14:00-15:00 **WS2** 15:00-16:30 (Group 4-5) END 17:00	**Presentation to NRW Police Management** **Start**: 09:00 **Participants**: Behördenleitung LAFP NRW, Abteilungsleiter LAFP, LZPD, LKA, IM NRW Debriefing – END 13:00

Figure 26: Schedule FT4 - Selm

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Set up & dry run Start: 14:00 Participants: SHOTPROS Schedule Set up 14:00 Test group Debriefing End 17:00	TRAIN the Trainer (T&T) + Training Start: 08:30 Participants: police officers & students from the regional police Schedule T&T 08:30 - 13:30 *Lunch 13:30 - 14:30* Group 1 14:30 - 16:30	Training + Studies VR Demo Start: 08:30 Participants: police officers & students from the regional police Schedule Group 2 08:30 - 10:30 Group 3 10:00 - 12:00 Group 4 11:30 - 13:30 *Lunch 13:30 - 14:30* Group 5 14:30 - 16:30	Training + Studies VR Demo Start: 08:30 Participants: police officers & students from the regional police Schedule Group 6 08:30 - 10:30 Group 7 10:00 - 12:00 Group 8 11:30 - 13:30 *Lunch 13:30 - 14:30* Group 9 14:30 - 16:30	Training + Studies VR Demo Start: 08:30 Participants: police officers & students from the regional police Schedule Group 10 08:30 - 10:30 Group 11 10:00 - 12:00 Group 12 11:30 - 13:30 *Lunch 13:30 - 14:30* Group 13 14:30 - 15:30	Training + Studies VR Demo Start: 08:30 Participants: police officers & students from the regional police Schedule Group 14 08:30 - 10:30 Group 15 10:00 - 12:00 Group 16 12 11:30 - 13:30 *Lunch 13:30 -14:30* Set-down 14:30

Figure 27: Schedule FT5 - Berlin

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