D8.5
Strategies & Toolkit for Policy-Makers

SHOTPROS

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List of Acronyms and Abbreviations

Acronym / Abbreviation	
AAR	After action review
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
FT/FTs	Field trial/s
GA	Grant Agreement
HF	Human factor
LEA	Law Enforcement Agency
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

Table of Contents

Table of Figures

List of Tables

Executive Summary

The Horizon 2020 funded project SHOTPROS developed from 2019 to 2022 a virtual reality (VR) training solution for decision making and acting under stress and at high risk (DMA-SR) for police officers. The project is about both, the training, and the technology and therefore both aspects are relevant when deciding to introduce VR as training methodology to an organisation. Virtual training became more and more relevant during the project and end users (law enforcement agencies – LEAs) involved in the project have gained a lot of knowledge about the technology, the training impacts and the processes attached to such technology and training adaptions. This acquired knowledge should be shared with other law enforcement agencies who attempt to introduce VR to their organisation.

The practical challenge for the introduction of VR technology in organisations is often on a logistical, legal and practical level, e.g., scalability, integration in IT infrastructure and security system, the definition of a business model, etc. Therefore, we combined all the knowledge and set up a policy maker toolkit for decision makers in that process. A definition of VR as a technology and the market potential as well as the relation to law enforcement are described. The main part is a step-by-step guideline on how to introduce VR to a law enforcement organisation, considering different aspects. But in addition to the introduction into an organisation, VR as a training methodology also creates needs on higher policy level. These aspects are also tackled with in the deliverable at hand.

To sum it up, there is one necessary mind-set to be considered towards digitalisation: Digital transformation does not magically happen with a snap of fingers or when new applications or policies are integrated with an existing system. Each member of the team, from the decision-making body down to the manpower, have to be ready to adapt to the change to make it successful.

1 Added Value

1.1 Relation to the SHOTPROS Work packages (WPs)

WP7 and WP8 represent the **final sequences of the SHOTPROS project** and WP7 delivers the SHOTPROS final results and consequently builds the most important source for D8.5 at hand. D8.5 itself is part of WP8, as this is the dissemination and communication WP of SHOTPROS. D8.5 can be seen as an executive summary of the main WP7 deliverables enhanced by the strategies we identified with and for policy-makers throughout the whole project with a major focus on policy-maker needs. All end user related events in WP6 (Human Factors Studies) and WP7 (Field Trials) always had the additional agenda of identifying policy-maker needs to be then incorporated into D8.5. Some events were even more focused on that topic (e.g. SIAK or Gimborn or the FTs in general with a focus on policy-makers as participants).

1.2 D8.5 is informed by the following deliverables

	How did these deliverables influence D8.5
D7.3	The report on the SHOTPROS final conference build an important source for additional policy-maker insights. The first version of the policy-maker toolkit was presented at the final conference and discussion with policy-makers found itself back into another version of D8.5
D7.4	The final HF model of the SHOTPROS project for DMA-SR training is an important source for the information on policy-makers about the training approach of SHOTPROS
D7.5	The final VR training framework on DMA-SR delivers, besides the technological guidelines, the most important information for policy-makers when introducing VR training to their organisation
D7.6	The technological guidelines on VR training are the most important source when knowledge on VR technology should be built up in a LEA. Therefore, this deliverable brings detailed information to D8.5.
D7.7	The guidelines on how to build DMA-SR scenarios for VR training are relevant for policy-makers when allocating resources and knowledge during the introduction of VR into their organisation
D5.1	The SHOTPROS VR **architecture** provided input for the set-up of the training solution throughout the project and is a relevant source for policy-maker guidelines

D4.6	The technical requirements of SHOTPROS, which also provide insights on end user feedback during several studies is important to consider when deciding about VR training as a new approach in a LEA.

Table 1: Deliverables influencing D8.5

1.3 D8.5 consequently feeds into the following deliverables

	How does D8.5 influence other deliverables within SHOTPROS
D8.9	D8.5 will also be used as a dissemination document in different formats online and at the SHOTPROS final conference. Therefore, these will be listed in D8.9.
D8.6	As D8.5 dealt with views from policy-makers on the SHOTPROS VR solution, it will also impact the exploitation of the project (D8.6)

Table 2: Deliverables influenced by D8.5

1.4 Relation to SHOTPROS objectives

As D8.5 can be seen as a policy-maker-oriented summary of the project results, all 5 SHOTPROS goals are met by the deliverable at hand. A practical guide on how to introduce VR into my LEA organisation can be seen as a major goal related to the European VR network (objective 5) as this **knowledge** builds an important source for network activities and a reason to apply for the network.

The **HF model** (objective 1) the **final VR training environment** (objective 2), the **final training framework and curriculum** (objective 3), as well as the guidelines for VR training (objective 4), will be summarised in D8.5.
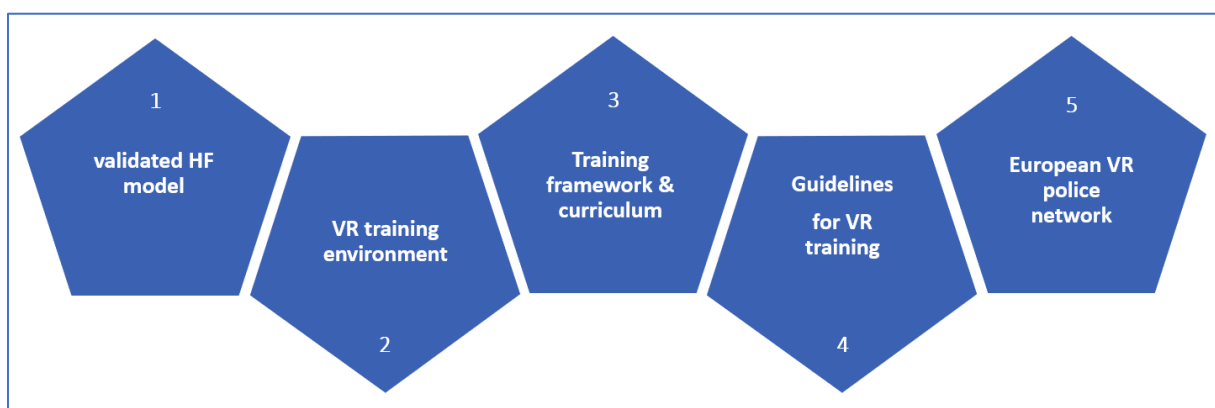
Figure 1: The 5 SHOTPROS Objectives

For a clear overview on the final SHOTPROS deliverables regarding the SHOTPROS solution, the following overview is available in all introduction chapters of the regarding deliverable. Here it is visible which final deliverables influence the SHOTPROS VR solution and where to find which information:
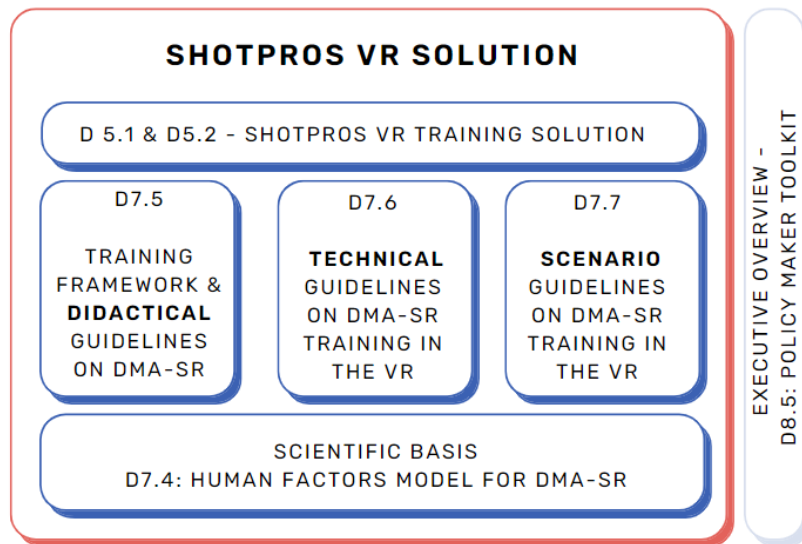
Figure 1: SHOTPROS VR solution – overview on final deliverables

2 Introduction

This document was developed in the course of the SHOTPROS project and provides strategies and toolkits for policy-makers in the field of VR training for law enforcement agencies (LEAs). It also serves as executive summary of all SHOTPROS project results. The main target group of this document are LEAs that are **now in the situation of wanting to introduce VR as a training option to their police organisation**.

SHOTPROS aimed to develop a human-factors-based virtual reality (VR) police training framework for decision-making and acting (DMA) under stress and in high-risk situations for European law enforcement agencies (LEAs). The SHOTPROS project was set up to address different **target groups**: trainees, trainers, management and policy-makers. Throughout the whole project, the first two were the main target groups for the requirements, the scientific studies and the development. Management and policy-makers were mainly targeted with dissemination work to present the plans or results of the project on a higher level, specifically condensed for them. During these sessions (individual or as part of conferences or similar events throughout the project) we identified their needs and are now targeting them in the present document in an executive summary approach.

In general, policy-makers are defined as persons responsible for or involved in formulating **policies**, especially in politics. In the SHOTPROS context we define policy-makers as follows: Persons who have the authority to introduce training frameworks and guidelines into law enforcement organisations (or adapt them), such as the ministry of internal affairs or the management at European, federal, state or even organisational level of law enforcement organisations. This includes decision-makers who have the authority to decide on purchasing VR training solutions, management of police academies, training provider organisations (private or state), law enforcement authorities, policy-makers responsible for law enforcement and their training on a national and international level and similar.

The next chapters starting 4-9 plus the appendix (chapter 11), will be transferred in a separate document and will be available for download at www.shotpros.eu. Therefore, this information is worded and targeted towards the end-user policy-maker. The information might in some cases be overlapping with already available information of the project, but for practical reasons it is combined and extracted in one document. The final chapter 10 is providing additional information for policy-makers on levels outside the law enforcement organisation such as Ministry of internal affair or national and international similar policy issuing organisations.

3 About SHOTPROS

3.1 Project Description

SHOTPROS (www.shotpros.eu), an EU funded Horizon 2020 project under the grant agreement No 833672, started in 2019 to investigate the influence of psychological and contextual human factors on the behaviour of decision-making and acting of European police officers under stress and in high-risk operational situations (DMA_SR) to design better training for police officers to improve DMA-SR performance. The aim was to find out how training in virtual reality (VR) should be designed so that **"first responder"** police officers can make **optimal decisions** even **under stress**. The VR training increases the decision-making performance of officers, which will **lead to better and more correct decisions** in the field.

But it is not only technology and research that make a project effective –

Figure 2: SHOTPROS in a nutshell

it is also the involved people and the network that are important for a successful technology application. Therefore, as part of the SHOTPROS project, the "VR & Police Network" was established in 2020 to enhance knowledge acquisition and exchange within the police and law enforcement community (www.vrandpolice.eu). With pre-events in 2020 and 2021, the network was officially started with the SHOTPROS final conference in September 2022 in Belgium. SHOTPROS delivers different results for different target groups within the police and security sector.

The reasons why a project like SHOTPROS is important were obvious within the law enforcement community from the beginning. First responder police officers are increasingly involved in threatening situations (e.g., crime, terrorism, CBRNe threats and radicalism) and then need to perform correct decision-making and acting while under stress and performance pressure. This created an urgent need to better prepare patrol officers for unpredictable situations. Police training is merely designed to include physical, technical and tactical skills, with the latter two mainly trained in classroom settings. Additionally, this kind of training does not expose trainees to stressful situations, which results in rather low performance in real-world operations compared to performance following evidence- and experiential-based training concepts where trainees were exposed to close-to-real-world stress levels and situations. Scenario-based trainings is the clear consequence to that and European police organisations more and more include it to their training. But at the same time training time is very limited and training complex scenarios in real-life training resource intensive. To train uncertain and complex events, VR seems to be highly effective. However, VR training is not yet widely used, and organisations are still struggling with the question of where to start on this topic. SHOTPROS was conceived to bring these needs together and we are now in the position to share this important knowledge with the European public. During the project, four innovation areas were addressed. The technology itself, including hardware and software, the training framework based on a scientific human factors model, and the training execution with the two options of in-action monitoring (IAM) and after-action review (AAR) for trainer and trainees.
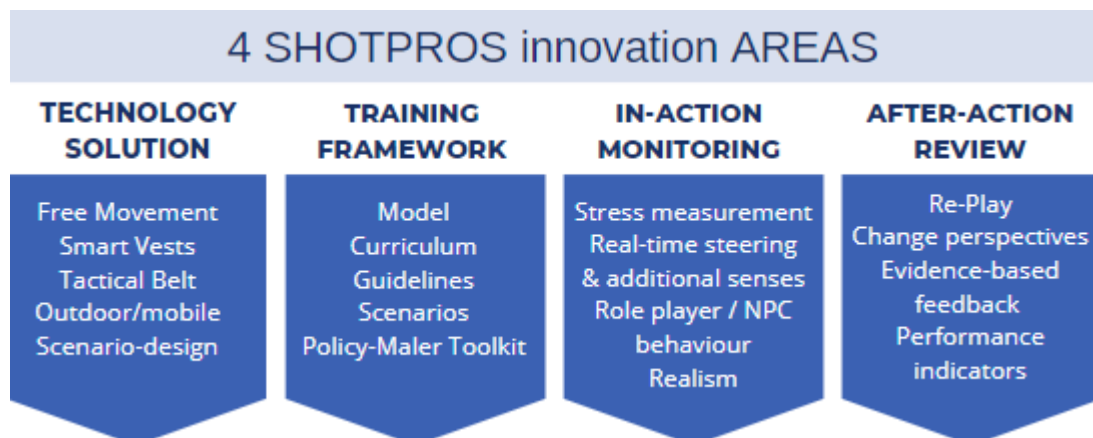
Figure 3: Innovation areas to be addressed during the project

3.2 Project Partner

A consortium of 13 partners from 6 European countries with a scientifically excellent level and high experience in their profession, collaborated on the project. SHOTPROS was from the beginning an end user-oriented research and solution-oriented technology project and therefore also includes an advanced prototype VR solution, which will be exploited into market-ready products. The results will be compiled into a police-oriented product and will be exploited after the end of the project to make the knowledge gained accessible to European law enforcement agencies.

A well-designed agile development process involved the LEA partners from the beginning and also included advisors and external LEA participants in regular try-out and feedback sessions as well as in scientific studies and the large-scale field trials on the premises of the SHOTPROS partners.

Figure 4: SHOTPROS partners

4   What is VR (and XR) - and where is it going?

It was not only through the keyword "metaverse" that different Xtended reality (**XR**) technologies were able to position themselves in different application contexts. Virtual reality (**VR**) has even been a recurring topic for 25 years. Nevertheless, it is only in the last few years that the technology has developed in such a mass way that companies and organisations are increasingly thinking about using it.

VR is a simulated experience that can be similar to or completely different from the real world. Applications of virtual reality include **entertainment** (e.g. video games), **education** (e.g. police or medical training) and **business** (e.g. virtual meetings).

By using a VR headset, the **simulated 360° experience** is made available to the user for **interaction**. VR typically involves **visual** and **audio** simulation. For a **higher immersion** (i.e. describes the effect produced by a VR environment that causes the user's awareness of being

exposed to illusory stimuli to fade into the background to such an extent that the virtual environment is perceived as real. If the degree of immersion is particularly high, we also speak of "presence"), **haptic experience** is also necessary, especially if certain training goals are targeted.

VR and XR are currently often used terms. Simulated environments allow the trainee to experience reality-close situations to better train certain scenarios that might be too risky or too resource intensive to be re-built in real-life training. VR was defined in the 90ies by Paul Milgram and received big technology enhancements in
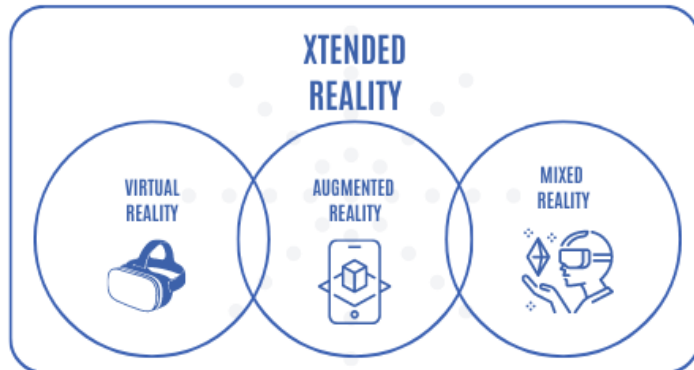
Figure 5: Definition of XR, VR, AR, MR

the last few years by the second wave[1] of VR. Therefore, the umbrella term XR was introduced to summarise different virtual technologies like augmented reality (AR) or mixed reality (MR), both involving the real world in the simulated world, or mixed versions of these. The **combination** of different simulations and options to integrate the real world will be further developed and lead to **even more realistic,** but still simulated training environments and will enhance the advantages of VR (see 0) and probably even overcome the challenges of VR (see 0) and reveal additional topics that need to be addressed.

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[1] Anthes, C., García-Hernández, R. J., Wiedemann, M., & Kranzlmüller, D. (2016, March). State of the art of virtual reality technology. In 2016 IEEE Aerospace Conference (pp. 1-19). IEEE

4.1 VR and XR market potential

The global XR market was valued at around USD 26.7 billion in 2018. The European XR market is expected to **grow** between EUR 35 billion and EUR 65 billion by 2025. In addition to the great benefit for users, the improved and, above all, **cheaper** and more **widely accessible** technology is one reason for the increase. According to a PwC report[2], the number of jobs influenced by XR technologies worldwide is expected to increase from 824,000 to 23.4 million in 2030. The global AR and VR market was estimated at around USD 26.7 billion in 2018 by Zion Market Research. According to the report, the market is expected to reach around USD 815 billion by the end of 2025. This corresponds to a **period growth rate of 63%.** Credit Suisse also forecasts

Figure 6: XR market potential summary

market growth of up to 700 billion USD in 2025. These figures confirm the **global economic potential of XR technology**. According to the International Data Corporation (IDC) report of May 2020[3], spending on the digital transformation of business practices, products, and organisations continues "at a solid pace despite the challenges presented by the COVID-19 pandemic." IDC forecasts that global spending on that technologies and services will grow 10.4 per cent in 2020 to $1.3 trillion. That compares to 17.9 percent growth in 2019, "but remains one of the few bright spots in a year characterized by dramatic reductions in overall technology spending.

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[2] Neumann, Uwe, Virtual and Augmented Reality Have Great Growth Potential, 2017, 20.06.2017, Credit Suisse, 29.03.2022, no date

[3] https://www.idc.com/getdoc.jsp?containerId=IDC_P32575

The European study Ecorys (2021)[4] also shows the following about the future market potential:

- Over 93% of XR companies surveyed in Europe predict revenue growth over the next three years, with two-thirds expecting their revenues to increase by more than half.
- XR is estimated to create 1.2 to 2.4 million new jobs directly or indirectly in Europe by 2025.
- Many XR applications have the potential to contribute to environmental sustainability, in line with the European Commission's priority of "a European Green Deal".
- The importance of regulations and frameworks was also confirmed in the Ecorys study.

Even if these **numbers confirm the enormous potential** of VR/XR technologies and the willingness to spend money on that technology, there are **still many challenges** that need to be solved for successful integration. According to a study by Statista[4], more than 58% of XR professionals surveyed said a lack of understanding of the benefits or opportunities is preventing them from integrating the technology. Closely followed by the reasons (with 54%) "lack of a concrete business case or an ROI" and "estimation of (follow-up) costs" (30%). Another relevant aspect during the introduction is the often-unexplained cyber security as well as data protection issues and issues of acceptance and unexplained benefits. Studies mention the importance of clear processes, procedures and guidelines for the successful implementation of XR technologies - but rarely do they provide concrete and evidence-based recommendations.

4.2 Background & relevance of this toolkit

VR has advanced in the last few years after years of popularity in the gaming industry and we are now seeing more companies using it professionally, investing in it and gaining increased knowledge about it. According to Capgemini Research[5], 82% of companies using XR technology report that their expectations have been met or exceeded. According to a report by Zerres Marketing[6], most larger companies are **familiar** with VR/XR technology, **but** still **need** to **educate** themselves. At the same time, VR technologies are currently in various stages of commercial use and companies find themselves **struggling with** the **selection** and

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[4] (Vigkos, Alexandros; Pauer, Andreas; Bevacqua, Davide; Turturro, Luca; Kulesza, Marta, XR and its potential for Europe, 2021, April 2021, Ecorys, 29.03.2022,, no date
[5] https://www.capgemini.com/wp-content/uploads/2018/09/AR-VR-in-Operations1.pdf
[6] https://www.zerres.marketing/wp-content/uploads/2021/02/Extended-Reality-Chancen-Herausforderungen-und-Anwendungsbeispiele-fuer-KMU-low.pdf

introduction. The same is valid for the public sector. LEA organisations are aware of digital transformation in general and VR technology in special, but like many others, they **face many challenges**.

The practical challenge for the introduction of XR technology is often on a **logistical**, **legal** and **practical** level, e.g., scalability, integration into IT infrastructure and security systems, the definition of a business model, etc. At the same time, there are still no standards and concrete guidelines for actual implementation, procurement, and use. In practice, organisations are often faced with unsolved **legal**, **business**, **organisational** and **technical** challenges. Technological developments are changing our daily lives. From a professional point of view, novel technologies like VR can lead to immense improvements and increased efficiency. However, it is of central importance to develop and adapt technologies to the needs of the users and carefully integrate them into existing systems. In a highly complex application area such as law enforcement training, this can be an **extensive process**. In the course of the project, it became clear that on the one hand there are many open questions from the management and policy-makers regarding the capabilities of VR for police training. On the other hand, there is a lack of (inter)national standards and guidelines concerning to this technology and its implementation in an organisation.

The **rapid development** of hardware, software and products based on them, needs to be constantly monitored which is often not easy to be done by non-expert organisations. Therefore, **independent networks** like the VR & Police network (www.vrandpolice.eu) for knowledge and experience exchange will be an essential source for successful policy-makers in the field of police training of the future. The technology, the software and the hardware are **not standardised yet**. There are currently several systems on the market that are trying to establish their approaches. Not all hardware providers also provide software and vice-versa. Therefore, selecting the appropriate tool for your training approach is a task to be executed before the decision is made on a provider.

This document aims to address these issues and to close this gap by compiling the knowledge from the SHOTPROS project and guiding the readers through the world of VR police training – starting with an introduction of the technology, answering relevant questions about the capabilities and advantages, and providing factsheets with implementation considerations, policy considerations, didactical guidelines, and a procurement guide.

5 Virtual Reality and Police Training

To assess and resolve the situation correctly in complex and critical real-life situations, the ability of officers to make the right decisions quickly is a decisive factor for the successful

outcome of the situation. This applies not only to high-risk situations, such as terrorist attacks, gun attacks and rampages, but also to "routine operations", which can dynamically develop into a critical situation.

VR is seen as an ideal instrument to train complex and risky situations that cannot be easily re-built in real-life. This includes the integration of changing environments (even "real" environments used as a model like a certain train station that cannot be closed down for training purposes), the integration of people who cannot be involved in real-life training (children, elderly people or people with disabilities), objects that are risky to train with (CBRN threats, explosions etc, but also animals). VR therefore can be a perfect complement to existing training practices. It should not be seen as virtualisation of existing training, but as an enhancement to train scenarios and processes that cannot be trained so easily in real life, (also see deliverables D7.6 and D7.5 of the SHOTPROS project – downloadable on the website).

Figure 7: VR suit

5.1 General advantages of VR training in comparison to real-life scenario-based training

For a good overview on the advantages of VR training the following table delivers insights the SHOTPROS partner gained throughout the project:

Table 3: Advantages of VR training compared to real-life training - SHOTPROS

Advantage	Description
Flexible	Train "anytime, anywhere, anything" within scenario-based training approaches
Fast	Easy start with a click (no room set up and props preparation, no FX-weapon preparation)
Resource-saving	Time, money, people, space, material Only 1-2 or even no role-player needed (depending on the training goals), no props or rooms or close down of public spaces are needed, fewer people involved, no time-consuming filming and evaluation of the material etc.
Immersion & Presence	First-hand learning close to reality is supported by realistic graphics, sound, vibration sensors or even smell and other sensors (heat, humidity, etc) or pain stimuli
Safety	Threatening situations can be trained in a safe environment with minimal risk of physical harm (injuries) to the trainees (compared to FX training, for instance).
Train the impossible	Train with vulnerable groups (kids, elderly) or difficult options (dogs, crowds, etc.) in places not easy to shut down for training
Infinite scenario environment options – even complex scenarios	Many default environments can be changed very fast (from an apartment to a train station or airport in 1 click). With certain efforts, even real places can be re-build in VR (which are typically hard to shut down for training)
Easy to use scenario designer	Almost infinite props for environments (furniture, plants, cars, objects that can be used as weapons, dogs, sound, explosions, blood traces, etc.) – scenarios can be designed

	to your needs (aligned with training goals – e.g., crowded house, unclear entrances, hiding options, etc.)
Adjustable automatic perpetrator, victim & Bystander behaviour	Visual diverse automated avatars can follow pre-defined scripts (cooperating, aggressive, painful etc.) and react automatically (reaction on triggers, pre-defined paths) or manually (follow a path created on the fly etc.) as a response to the trainee's actions.
Real-time scenario adaptions are possible	Change or adapt the scenarios on the fly with a few clicks or even with pre-defined escalation/de-escalation phases (e.g.: additional perpetrator on a space where no one was watching to show trainees that they did no 360° security; reactions of avatars, additional avatars, props etc.). Aligned with the trainee's needs and their biosignal-measurement.
Repeatability	Scenarios are repeatable at 1 click for other sessions and the conditions for all trainees stay the same (not just a small group can train in a specially prepared space but all have the same options).
Continuity	Training can be interrupted anytime if needed for learning reasons. Interruptions in real-life trainings lead to a need to re-build the scene, place the objects and role players at the correct points and re-load the FX gear – all of this can be done at 1 click in a VR training system.
Stress & performance measurement	React with scenario adaptions to the trainees' needs. Evidence-based feedback options for after-action review.
After-action review (AAR)	Debriefing options - Evidence based feedback via AAR / KPI / statistics / documentation – model learning. All data-based and easy to access (no 6 cameras to be evaluated but change the view on 1 click).

5.2 What are the challenges and risks of VR training?

It is obvious that VR is not a 100% substitute for real-life training. Not all types of training goals can be achieved with VR. Skill training for example and fitness training must necessarily be trained in the real-life – For example handcuffing (the physics part like how you hold the hands, how to prevent the perpetrator from winding out of your hands etc.) can only be trained with other real humans. One project partner explained it very illustratively: The job of a patrol police officer is only 10% physical (running/chasing, using the gear correctly, aiming with a gun or other equipment to detain a perpetrator etc.). The other 90% are communicating with people, tactics and finding solutions. (There is also a big part of organisational stuff, but we leave this out here). Consequently, in training we also need to focus on this "soft-skill" part and not only on fitness, shooting or education in other disciplines. For these situations, VR is an ideal tool.

Some challenges and risks and how they should be addressed are listed below:

Table 4: Challenges of VR police training - SHOTPROS

Possible challenge or risk	How to address
General technology-related issues	
The technology is not accepted by the management	Involve relevant stakeholders from the beginning and follow the provided policy-maker toolkit to support the introduction process. Show relevant advantages, make clear, trainers are not at all substituted, their role becomes even more relevant but, on another level, and clarify that technology can be a great support. Spread knowledge where possible.
Low Demand	VR training applications are still no off-the-shelf product and therefore organisations struggle with the acquisition efforts – the lower the demand, the fewer options available in the market – but this is currently changing completely, and even bigger companies are looking to enter the training market which is good for the demand side.
Affordability	On first sight the acquisition of a VR system is perceived as very expensive and often no budgets are foreseen for new training methods (and technologies) – more awareness

	raising, and persuasion efforts are needed to visualise the ROI on VR technology.
No technology standards	There is no standardisation as it is still no day-to-day product. Although this situation starts currently changing, this makes it more challenging for the providers (to have reliable and affordable hardware at hand) and more difficult for the customers to choose the right technology for their certain needs.
The technology is not mature enough	Indeed, VR and XR technology are in development. But at the same time this is a chance as you can get closely in connection with providers and define contracts where your needs as an organisation are better considered than within mature technologies as also providers are still in the developing phase. And if it feels better for you as an organisation, think about a training-as-a-service solution rather than purchasing a solution to be able to adapt your selection later.
It feels unfamiliar and is not realistic enough	This is normal as the trainees (or trainers or management) need to get used to it. But the focus is on showing them the advantages and still listening to their uncertainties – they need to feel heard. Everything new feels unfamiliar at the beginning and technology often causes acceptance topics. Well-educated trainers can address these uncertainties. Provide information material, clear and short videos and talk actively about the uncertainties. For example, also real-life trainings are not 100%as the environments only change when re-structed, role-players are mostly the same persons and can not play kids or elderly realistic enough etc. Explanations like these lower the rejections.
Health & Data Safety	
Risk of non-observance of new health and privacy risks that come with the introduction	As VR training is not standardised in police or security organisations, this risk needs to be considered from the beginning. Both areas need to be clarified as much as possible. For further details see in the step-by-step introduction.

| Health concerns | There are no incidents indicating negative long term health effects of VR on health, but this might still be used as an argument against VR. In addition, motion sickness can cause problems to trainees and thus be a cause for VR training to be perceived as a non-integrative training method (also see D7.5 – downloadable on the website).

In addition, most of the real-life trainings bear health-risks that can be avoided in VR training (TBI caused by blast, lead poisoning, mix up of real vs. training munition etc.) |
| --- | --- |
| Motion sickness excludes certain trainees | Motion sickness can occur among trainees to a very low percentage. This needs to be accepted and considered from the beginning. The policy-maker toolkit offers options how to deal with the trainees concerned. |
| **During training** | |
| A full suit is not comfortable to wear – why do I need a backpack PC? | This is a typical trade-off in technology. There are technologies where tracking can be done without a suit and with no PC on the back. But then the activity radius is quite small (typically 15m x 15m). If this is enough, this can be a solution. But to be more realistic and immersive a broad radius like a full gym hall or even more is much better. To show the user the haptic and other responses, a vest with simulation options is needed to be worn. |
| Sweating or heat keeps the goggles steamed | Indeed, this can be a drawback of the masks. But with well-used ventilation and the ever-improving hardware, this is a negligible issue in practise. |
| Stairs or similar overcoming of hight feels strange | For the human brain it is sometimes harder to virtualise stairs or other height differences. But for police training stairs are not highly important and can be avoided in the scenario design to remain immersive. Stairs and shooting is again more a topic to be trained in real-life training set-ups. |
| Restricted multisensory realism | Most VR systems do not focus on the additional senses. But there are solutions on the market and options available. Each addition to the senses makes the training even more realistic. |

Mimics and gestures still restricted	Realism is an important topic, therefore all options to enhance it are relevant. Regarding this topic, technology is still evolving and due to enhanced processing resources, this aspect will be enhanced year by year in the future.
Police equipment	
Missing police duty gear	Tangibility and haptics are important for VR training. If the police tools that are used in real-life are available in a suitable form for VR training, the learning effects will be more successful. This does not mean that weapons need to be working 1:1, as exact shooting training is better done in real life than virtually, but if the tools do not fulfil basic requirements, the results will not be satisfying (e.g., decreased motivation in trainees, heightened risk for gamification).
Inexact weapon handling ("it is not the same as in reality") – possible options of training the "wrong" muscle memory	VR training cannot substitute real-life weapon handling and shooting training. But police work is most of the time tactics, perception and decision-making and VR training should focus on these points. If weapon handling is not exact enough in VR and officers train too much with it (which would not be the case for patrol officers for example but should be considered with special units), it could cause irritations in the engrained movement patterns of the weapon handling. This needs to be avoided by not focusing on weapon handling training in VR, by adapting the training objectives definitions and the scenario design. Weapon tracking and precision will become more exact with each technology development phase, and this will not be relevant anymore in a few years.

5.3 Training types relevant in VR

Several SHOTPROS studies and workshops with LEAs have shown that the practicability of VR differs. Some objectives can be trained well in VR while others will need some more years of technological improvement, and some can never be trained in a virtual environment with the same results as in reality. But for tactical training, VR is very effective, and situations can be presented much more realistically that in real-word trainings, where training is limited with training artefacts.

Table 5: Overview of suitable training types regarding VR

Training Area	Use-fulness	Observation and recommendation
Tactical training	*****	The possibility of quickly varying location and scenario context in VR creates the groundwork for the training of tactical strategies in many different situations.
Perception and action	*****	In real-life, trainers must adapt their training to the training location's infrastructure. VR does not have this limitation, making VR extremely useful for perception and action training.
Law and regulations training	****	The AAR (visual debriefing of the training session) is an excellent VR-specific feature to provide feedback on information regarding law and regulation that cannot be monitored and reviewed in real-life training.
Communication training	***	VR is helpful for communication training because it allows quick customisation of the avatar's appearance (gender, skin, cultural aspects) and how trainees respond to and communicate with the avatar (for communication using a role-player with different visualisations).
Shooting and weapon handling training	**	The AAR provides information about hit rates, shooting lines, cross-fire, positioning in reference to others and other performance measures that cannot be monitored easily in real-life. But for exact aiming etc. VR is (currently) not the best tool.
Physical training (combat, fitness training)	*	All actions involving physical contact (e.g., handcuffing) are not suitable for VR training and should be trained in real-life set-ups. However, the decision when to execute this is best to be trained in VR (tactics, decision-making etc.)

6   SHOTPROS VR solution – components

SHOTPROS VR training follows a simple 3-phase approach. The preparation, where the trainer defines the objectives and makes sure the VR scenario is well designed, the execution, where the trainer can monitor the trainees and adapt the scenario and the flow to their needs, closing with the review phase that depicts the trainees' performance and includes well-considered feedback provided to them. Finally, the results of the 3 phases can be re-used to enhance the training for the next time.

Figure 8: Phases of VR training within the SHOTPROS solution

As SHOTPROS was a very end user-oriented research project with 6 LEA organisations as project partners, it was clear from the beginning that a usable VR solution will be part of the deliverables and not a demo dummy only. The technology partner of the project entered with a mature product (at this moment not focusing on the police industry), and this was used as the base to develop the SHOTPROS solution in an agile way including the research and end user input throughout the whole project. **6 European police organisations** as partners and **5 police advisor** organisations make a significant contribution with their knowledge and experience from everyday life, but also throughout the research (human factors studies and field trials) hundreds of officers from these organisations but also from other organisations outside the project were involved. Ongoing cooperation and regular feedback meetings were part of the agile end user focus of the project.

6.1 Components VR solution

The **SHOTPROS VR solution** is technically based on the VR training solution from the technology partner RE-liON (www.re-lion.com). In an agile process throughout the project the requirements from research and expert partners and particularly the needs of the end user partners were evaluated to innovate and develop a usable training solution within the SHOTPROS research project to be able to test with real trainees throughout European field trials. Although it is a research project, the result was an almost market ready product. After

the end of the project, the solution will be exploited and turned into a product for European LEAs.

One idea of the **SHOTPROS Virtual Reality (VR) solution** is "**train as you fight**" - this means that despite the technical VR equipment, the trainee should move and behave as naturally as possible - as much as possible as in real operations. Therefore, there is for example no controller or cabling to a stand-PC, as is often the case with VR trainings, but rather "replica" equipment that can actually be used ("tangible devices" in the "tactical belt"). With the SHOTPROS VR solution it is possible to train on a field of 30x30 meters (up to 100x70 meters) and use gym halls or similar locations available in almost all police training environments. A standalone wireless network operating within this training area allows for positional determination, 1:1 simulation of the scenario to the real-world expanses. The SHOTPROS system uses Wi-Fi tracking and is not disturbed by sunlight. Therefore, it would be technically possible to operate VR trainings outdoors, especially if larger space is needed. The SHOTPROS VR solution works with a client-server architecture, with the server running at the Exercise Control (EXCON) Station and the Smart Vests set up as clients. The set-up of the system (indoor and outdoor) is done quickly within 1-2 hours. If already set-up, the system can be ready to train within 15 min.

Trainees wear the textile SHOTPROS Smart Vests for tracking within the training pitch which is strapped around the trainee's body and also includes haptic feedback devices. Besides the head-mounted display for the VR experience and the backpack for the PC and batteries, additional features such as the SHOTPROS tactical belt (including e.g. a replica gun), physiological measurement devices for the SHOTPROS stress

Figure 9: SHOTPROS VR solution - body-worn suits

assessment or communication devices (e.g. radio), are also part of the body-worn equipment.

The trainer has different options to follow the training, typically using the Trainer Station to follow the execution audio-visually. Bookmarks can be set anytime to later find this event in

time more easily. The trainer can communicate via microphone with (each) trainee, and the stress level can be monitored, and suitable stressors can be activated or deactivated according to the needs of the trainees. However, it is also possible for a trainer to wear a Smart Vest and participate in the training as an active user in form of the trainer or a role player. After the field-based physical training, the trainees gather at the Trainer Station for a debriefing session, the After-Action Review with the trainer. The trainer is given a variety of tools at this station to review the training from various angles and based on evidence.
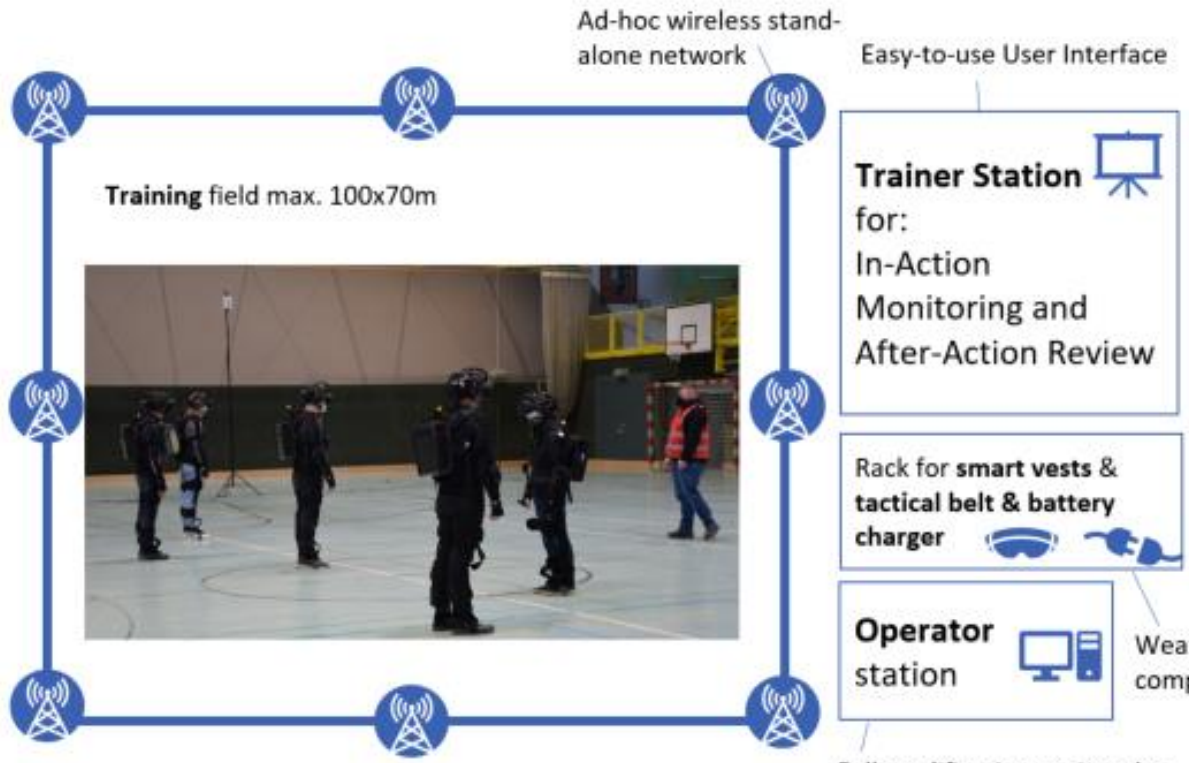
After Action Review
(Change Perspectives, Performance, Stress Visualisation, Event-based etc.)

In Action Monitoring
(Touch Screen, Audio Video, Interaction etc.)

Ad-hoc wireless stand-alone network

Easy-to-use User Interface

Training field max. 100x70m

Trainer Station
for:
In-Action
Monitoring and
After-Action Review

Rack for **smart vests** & **tactical belt** & **battery charger**

Operator station

Wearable computer device

Full modification options (e.g. scenario edition)
Data Administration
Connection to vests & sensors

Operator Station
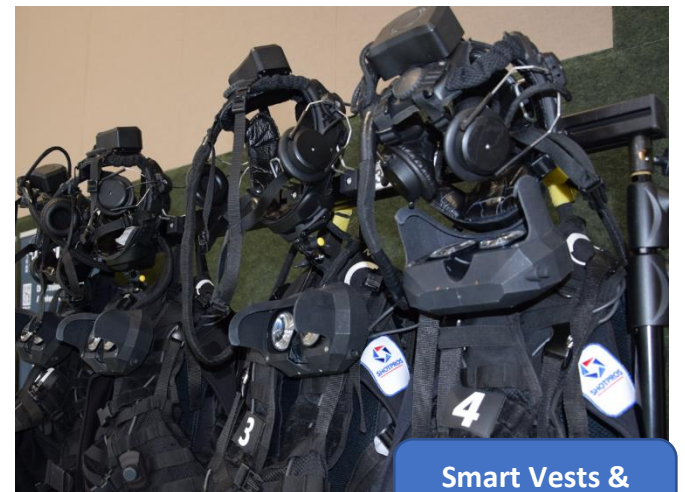
Smart Vests & Tactical Gear

6.1 Advantages SHOTPROS VR solution

In addition to the above-described advantages of VR as a technology in police training, the SHOTPROS VR solution specifically delivers the following advantages for future users.

Table 6: Overview SHOTPROPS VR solution advantages on the market

Advantage SHOTPROS solution	Details
Mobile & location independent	The system fits in 1 van, easy to set up at any gym hall or similar location close to your trainees
360° free movement	Cable-free, realistic movement (train as you fight)
Role-player mode	People or crowds that are not relevant for the actual operation but are necessary for the real progress of the training can be represented by automated avatars based on non-plying characters (NPCs). But role-players can be used with different visual representations in the scenarios for more detailed communication or sophisticated interaction.
Multi-User / group training	Training in groups size like on duty
Trainer Ghost mode & change of roles	The trainer can walk through the scenario during training while not seen by others and can slip into any role if needed (e.g.. make avatar reactions even more realistic)
Haptic & realistic tactical belt to use	Tactical training with realistic police gear duty belt – All relevant police equipment can be Individual placement of gear on a duty belt and correct representation in VR including left-hand use of equipment
Stress & performance measurement	React with scenario adaptions to the trainees' needs, Evidence-based feedback options for after-action review

7 Digitalisation as a success factor for law enforcement

Digitisation, in its simplest form, is the act of converting information into digital data. And by this improving business operations. The aim is to create value using digital technology and increase the productivity per person of the organisation. In law enforcement organisations this includes many areas (for example internal processes, tools on duty, communication with citizens, etc.), but also training. Digital learning or e-learning is a general approach that needs to be discussed in these organisations when introducing VR as a training tool. Digitalisation is a tool that can be best harnessed when the members of the organisation are prepared and ready to take on transitions and the challenges that come automatically with technology introduction. Although VR as technology might only be an addition to existing training, introducing a VR training solution (i.e. digitalisation of certain training types) to a law enforcement organisation also means introducing a new or additional training framework and many new roles and processes, approaching acceptance and knowledge topics as well as the technology integration itself. In organisations that are already vey process driven and to some extent bureaucratic, such a **process involves a lot of preparational planning and internal alignments before it could be successfully rolled out to users**.

But when all these challenges are tackled by professional project management and a guided process, digitalisation (or digital transformation) of LEA organisations can offer wide options to create a more professional, modern, efficient, productive and scalable version of itself. The introduction of a VR training solution will not transform the whole organisation. But at the same time, you need to be aware that the introduction of this digital learning tool can trigger many other processes and transformation needs which sometimes feel as opening too many doors at the same time. Therefore, the introduction needs to

Figure 10: Advantages of digital transformation in the police

follow well-prepared steps to avoid such a situation and to successfully introduce VR into your LEA organisation.

8 How to introduce VR training to my organisation

8.1 Phases

The introduction of VR training in a law enforcement organisation can be described as a digital transformation process. Even if it only starts as a small try-out project, it affects many areas of a law enforcement agency and needs to be prepared in detail and also accompanied in its execution to be successful. Clear objectives, responsibilities and involvement are the key success factors. The following phases describe the necessary steps. They are described as a sequence but

How to sucessfully introduce VR training to my law enforcement agency?

A step-by step introduction on digital transformation

STEP 1. VISION & BENEFIT
Define what you relly **want** to achieve
Define what you **don't** want to achieve
Identify fans and refusers

STEP 2. SKILLS & COMPETENCIES
Define project team & authorities
(IT, legal, deciders, externals etc.)
Gain as much knowledge as possible

STEP 3. CALL FOR TENDER
Identify criteria and start the process (regulations)
Try out providers & challenge them

STEP 4. SELECTION & CONTRACTING
Clarify your needs in written form
Define involvement & responsibilities
Involve legal dep. &working council

STEP 5. INTERNAL PROCESSES & REGULATIONS
Clarify data protection and ethics
Implement a VR training framework
and train-the trainer courses

STEP 6. ASSESMENT & IMPLEMENTATION
Clarify final requirments with provider
Receive trainings for software
Design scenarios

STEP 7. ROLL-OUT
Invest in internal communication
Identify supporters
Prepare first training excellently

STEP 8. USAGE & FEEDBACK
Make sure it is used (training plans)
Gather feedback & share with provider
Show the success & Raise money

SUCCESSFUL INTRODUCTION
ongoing process

Figure 11: Septs to implement VR training in a LEA

obviously need to be re-checked regularly and adapted if necessary. This very hands-on guide
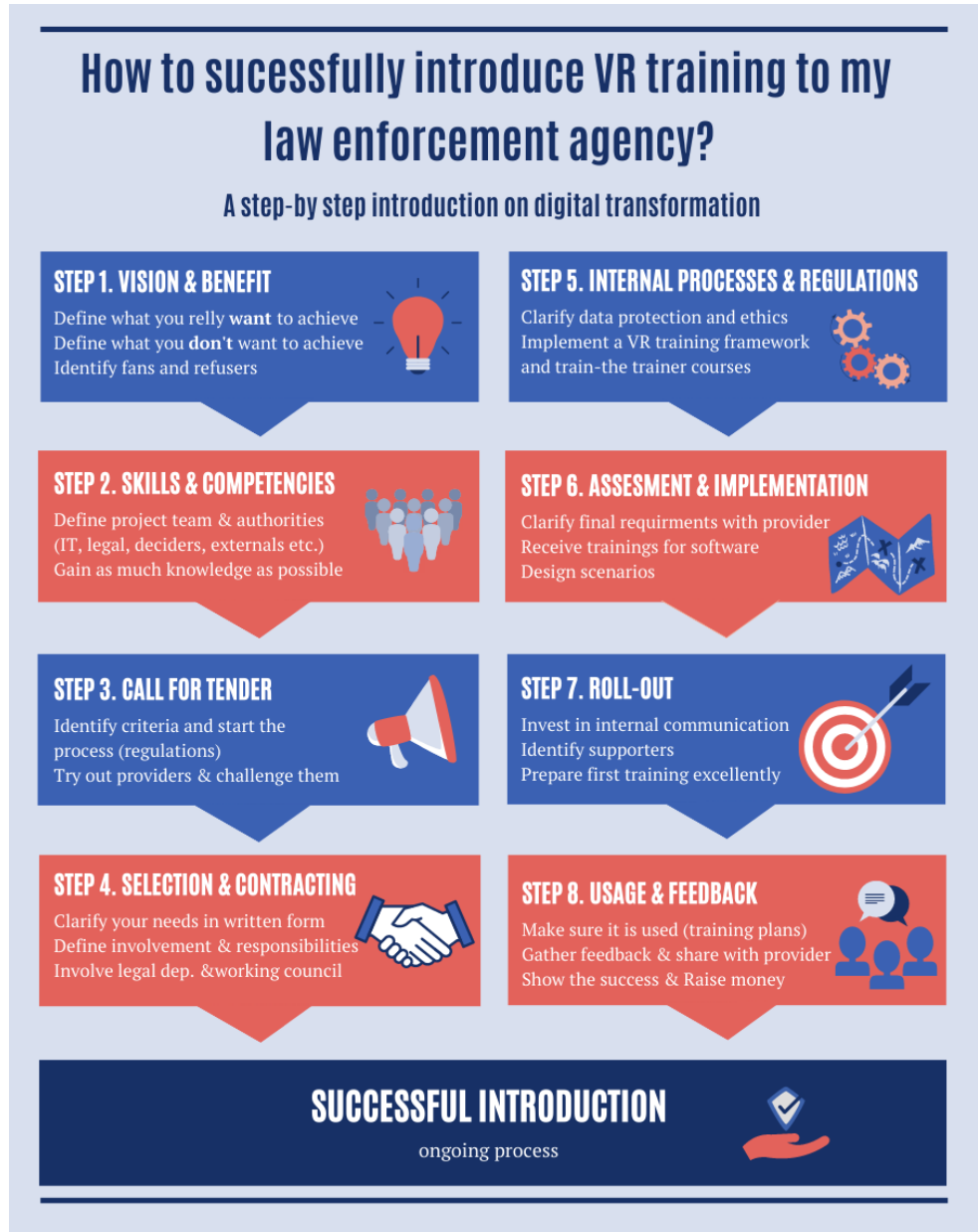
on how to successfully introduce VR training to my organisation can be used straight from scratch and supports with examples and knowledge gained throughout the 3.5-year SHOTPROS Horizon2020 project and its long-time experience in this field by the project partners:

8.1.1 STEP 1 - Vision & Benefit

This phase **starts even before the project team is set up** and long before an external VR provider is involved. In this phase it is important to find persons in the organisation who are willing to participate (actively or as "passive" but supportive multiplicators) in the introduction of new technology. It is important to find out the **willingness** in the organisation to **sponsor** the project from a financial but also from a content side. Identifying the ones open to new technology and decision-making authority is a key success factor. This phase is crucial and needs to be staffed with a strong willing, focusing and empathic seller personality with the will to get people enthusiastic for new technology and change. An evangelist is necessary to spread the word and do a lot of lobbying and fundraising during the whole project. Then a team of supporters needs to be gathered to find the way to a first decision or at least a "go for it"- mission. For this, the definitions of objectives are important as well as a description of current problems within your training. What cannot be trained at the moment? Why is this so much effort? What does the organisation not achieve without this introduction? If the need is clear (i.e. the questions are answered), the way there as well as the targets are clearer and ready to be described. If the gains and pains are known and well described, there is higher chance to fund the project. Raising budget is a very important task and needs a good preparation of the content. A description of a "business plan" is needed. The **advantages for the organisation but also for the budget-sponsor must be clear** and describable in 3 minutes or on a one-pager but also must have the potential to be described in detail with a qualitative content if needed.

To be able to execute expectation management throughout the whole process of transformation but also to be able to measure the success of a project and to show these results internally, this phase must not be skipped. An organisation should invest time to make clear what they expect and also what not.

This phase is the initial step and **can also be accompanied by external consultants** with experience in this topic. Externals have another view on the topic and might bring in competencies you do not want to build up internally. External views can help to convince the top management. But even if you involve externals, internal resources need to be available as the internal knowledge is the most important and can never be substituted by externals.

8.1.1.1   VR advantages in a nutshell

To support in this phase, a list of advantages identified throughout the SHOTPROS project by LEAs is listed in chapter 0 – They might be useful arguments in discussions with management or decision-makers. Additionally, you find the advantages of the SHOTPROS solution in particular, in chapter 7.1.

8.1.1.2   How to describe the organisation challenges and the wished solution

To make sure the goals and needs are clear, start with describing the **problems** your organisation is **currently facing** regarding training.

Examples are:

- We as an organisation need a lot of time and money in building up realistic real-life scenes in our training environments. Still some situations cannot be re-built in such training scenes (involving kids, dogs, change of daytime, light sources, sounds etc.).
- We spend a lot of money in FX weapons and munition for trainings.
- Our real-life trainings do not consider stress measurement of the trainees and a live adaption of the scenario according to their state.
- After-Action Review is difficult to execute if you only have 1 camera view and need to search the situation to be discussed manually.
- Etc.

Furthermore, describe **what advantages a VR training solution could bring the organisation** and **how the above-mentioned problems can be solved** by introducing this project. Examples are:

- With a VR training solution our organisation can train more different scenarios and select them according to the trainee's needs
- With a VR training solution, we can have more focus on the review and give evidence-based and individual feedback to the trainees.
- With a VR training solution our organisation can attract younger applicants for the further
- Etc.

8.1.1.3   Worst case results and how to mitigate them

If this initial phase is skipped, the impacts on the project might be huge – here are some examples and mitigation strategies:

- **Buying the wrong product**

  To avoid this: Be clear in the goals and select according to features, options and plans. Try out all products yourself and do not decide according to a marketing-showcase story only.

- **Investing money and nobody wants to use it**

  To avoid this: Make sure all relevant stakeholders are involved from the beginning and listen to and consider their doubts. Have a list of arguments ready in all discussions to counter any ambiguities.

- **The organisation is not prepared enough and the roll out is delayed or not done**

  To avoid this: If this is happening, users will be disappointed, expectation management will be difficult or impossible and the money is misused and the probability to get another technology project (even without the VR context) funded shrinks enormously. Therefore, the roll-out phase also needs to be planned and accompanied by the project manager to make sure the users are not let alone with the product following a "you wished it now you have it" approach only. The users need to be asked for their experience and feedback during the first usages to make sure they feel comfortable, all doubts are addressed, first "teething troubles" can be resolved, and the users feel heard. Moreover, this phase is also important to plan the next steps in the journey of digital training.

After reading this first step, it might become clear that the introduction and project management are hard work. Therefore, **resources** (time, money, persons) must be made available for this role(s) **from the beginning**. If this task is only set up as another additional task, it will not get the focus sit needs. Organisations, like some SHOTPROS advisors already introducing VR, made the experience that their own units or responsible accounts are necessary for success. Make sure these tasks are clear to the management and the relevance of this job is visible to the decision-makers. Resources can be enhanced step by step – not all have to be clear from the beginning, but it must be clear that after a "go" for the project, several resources will be definitively needed (also see Step 2).

8.1.2 STEP 2 - Skills & Competencies

After the first steps within the organisation are done and the need for the VR training system is awakened, it is time to **define a dedicated project team**. Besides a project manager and evangelist, there is a need for participants from the departments regarding technology, training (execution, planning, psychology), legal, internal deciders, project manager and even externals (depending on your organisation and the internal competencies and resources). The participants don't need to be involved in all meetings and decisions but need to have a clear overview and need to be considered in decisions when necessary and informed about the progress. **Responsibilities** of all team members as well as their power of **authorisation** (or the definition how decisions should be made) should be **defined** from the **beginning** and clarified in a kick off meeting attended by all team members.

8.1.2.1 Set up a project team

As soon as the project objectives are defined (including time, general budget and responsibilities) you need to set up a dedicated project team with several roles.

Table 7: Overview on relevant project-member roles to introduce VR into an organisation

Role	Knowledge and tasks
Owner of the project & evangelist	Might be the same person as the project manager or a separate manager, supervising the project manager. It is important that this person is keen in convincing, explaining, managing expectations, networking and has a good internal acceptance in different units or is able to create this.
Project manager	This position needs to be able to keep everything running, knows everything ongoing or is able to find it out fast. Technology know-how is not a must prerequisite, but the person needs to be willing to gain knowledge in this area.
Implementing team members	The role(s) above need support (if the team consist of more than 1 person, make sure the different skills are spread in this group)
Trainer & Psychologists Education developer	This person(s) will define the new training framework (D7.5, the SHOTPROS Final Curriculum, downloadable on the website is a good example for this) and adapt it to the needs of the

	organisation. Furthermore, this person(s) will establish a suitable train-the-trainer program for VR police training.
IT department	A person from the internal IT unit, needs to be involved to make sure the later introduced technology works with the internal process – if the technology is dealt with separately, it will be more difficult to include the training in the curriculum later. Therefore a early involvement is necessary.
(Supportive) End users (trainer)	Future end users of a new technology, in this case especially trainers, should be involved from the beginning to make sure, their needs are considered, and they feel heard. Otherwise, the acceptance of the technology will be very low.
Legal support	Especially for data issues like GDPR but also for the tender process and contracting, the legal department needs to be involved.
(Internal) Communication	Internal communication over different channels (intranet, internal newsletter or magazines) but even external channels like social media or press, help to support the introduction process.
External consultants	For processes and technology adaptions to your requirements, it makes sense to get help from experienced consultancies. Sometimes new technology is more accepted within an organisation if the advice comes from external experts. Additionally, it makes also sense to buy expertise at the beginning or whenever needed to build up knowledge internally. If used, the externals could act as advocates and help you to position the topic towards management or departments that are not open enough or new technology.
Sponsors	Authorities with the power to decide on adapted guidelines or to provide budget are always important to be part of the team or at least provide support when needed.

8.1.2.2   Gain competencies

Before being able to define all relevant needs of an organisation, make sure you gain all relevant knowledge. Engage in topic relevant networks, join conferences, search for relevant research projects or studies to engage ourselves and/or keep in touch with other organisations on their knowledge by attending fairs and exhibitions. Try out products if possible but make sure to follow all your organisation's regulations regarding call for tenders (check this with your legal department). This phase is not ending on a certain point but needs to be active throughout the whole project.

Examples for networking groups are:

- www.vrandpolice.eu
- www.enlets.eu
- www.xr4europe.eu
- www.ileanet.eu
- www.h2020-enotice.eu
-

Examples for VR and LEA relevant conferences, exhibitions and organisations are:

- https://www.gpec.de/en/ & https://www.gpecdigital.com/
- ITEC - https://www.iitsec.org/
- IITSEC - https://itec-conf.com/
- OSCE Network meetings
- CEPOL
- https://www.european-police.eu/
- Neue Technologien für die Polizei – Symposium Würzburg (German)

8.1.2.2.1   About the VR and Police Network

The VR and Police network was **created by the SHOTPROS consortium** to enhance and encourage the use and development of **virtual reality for police** and to **raise awareness for VR topics**. The network is intended to support police organisations in questions concerning VR and specifically to establish exchange between practitioners as well as contact between **end users, decision-makers, researchers** and **experts**. After first events in 2020 and 2021, the network was officially kicked-off at the final conference of SHOTPROS in September 2022.

> **APPLY NOW**
> **and become a network member**
>
> https://vrandpolice.eu/join/

Mission of the network

- Providing access to **new knowledge and future trends** in VR and police
- **Connecting stakeholders** and facilitating **exchange** and communication within a special interest group of VR
- Organising and providing access to special **events and workshops** to experience actual and **future possibilities of VR**

8.1.3 STEP 3 - Call for tender

After internal definitions are done properly, the next project step is to prepare and issue a call for tender to VR providers. To ensure that all relevant companies on the market have a fair chance to post an offer, authorities must make a call for bids. This call for tender phase needs to be led together with authorities from the legal department of your organisation to make sure to follow all regulations. To consider the organisation's needs throughout the whole phase, make sure that tender phase is not taken over exclusively by the legal or purchase department of your organisation; the project team needs to be still involved. Otherwise, a product might win that is not ideal for the organisation (also see: Worst case results and how to mitigate them 8.1.1.3).

For the selection of a suitable VR tool and also the suitable provider that fits best to your organisation's needs, a lot of **criteria** need to be defined (based on the needs and results defined in step 1 and 2). In the following different criteria (sub-grouped in

Figure 12: Top 5 VR provider checklist

14 sections) for VR training tool selection are listed. This list was developed with the SHOTPROS consortium and then reviewed in detail with the SHOTPROS external Advisors as some of them already introduced VR to their organisation and this feedback is very valuable for other organisations.

But the criteria need to be **filtered** towards your **organisation's needs**. If the vision and your needs (see step 1) are not clear (enough), the different answers by the providers will not be helpful for you and you cannot ask the correct questions during the tender phase. This consequently means some first try-outs and the knowledge gaining phase will need to be carried out even before the actual tender phase (e.g. during exhibitions or other events and networks) to make sure the project team knows their own needs based on some first experiences.

Then the **official call for tender process** should start (depending on your organisation's regulations, the call for tender must be provided to the public). The defined criteria and how they are met by the individual provider and its product are now answered in a call for tender document. If the provider offers different product versions that are suitable for your company, make sure the provider offers a clear overview on what product type offers which features, options, process etc.

As soon as the answers to your questions are available, start meeting as many providers as possible. Let them arrange personalised training sessions and challenge them and the system according to your needs. This phase is important and make sure you still consider the goals and visions defined and you do not let yourself being distracted from marketing and shiny presentations. You will work together with these people in the future, so make sure the system and the service work is professional and not the power point or the video looks nice only (although this is a good sign for professional companies if both works).

8.1.3.1   Criteria for provider / tool selection

Please note that the criteria list is already in a wording how it would be integrated in a call for tender document – so the providers are addressed here. The **selection** which **criteria** are useful for your organisation is essential – **not all criteria are useful for all organisations**.

8.1.3.1.1   Product and use

- Provide a short description of your company
- Provide a (short) product description
  What does the product comprise? What products are available? If more than 1 product-type of your company fits, please answer all questions for each product type separately or mark the different alternatives.

- Since when is the product on the market?
- What type of training is offered (e.g. operational training, leadership training) and in which training level?
- Are user manuals available? In which languages? For what part of the product (trainer and operator of the system vs. for the user/trainees)?
- What training do the police trainers need to be able to execute a training with your system? Is this training provided by you (train the trainer or super user training)?
- What is the data security concept? Can it be adapted to the local law? What is your experience with this process with other customers?
- What security concept in general is implemented (also regarding local regulations like BSI in Germany (Guidelines from the Federal Office for IT Security) for example)?

8.1.3.1.2   Target Group and Customer

- Who is your main target group of the product?
  (Patrol police, special units, students during academy etc.)
- Who are your customers? Please provide examples or testimonials.
- How often with how many officers do your customers typically use your product?
- Is the product usable for interdisciplinary training with for example medical or fire rescue teams? Or can only the police train with it?

8.1.3.1.3   Purchase Model and Pricing

- What is the usage model (purchase, as a service etc.?)? Please describe details.
- What is a start price and what is included? What will be the average yearly costs for the system?
- Is (technical) support available? In which form and at which price?
- How are trainings provided by you as a provider? Do we need an internal operator to execute a VR training (number of trainers, operators, support for one training session) or is the system operated by you? What are the options and the pricing?
- How often are new versions of the software shipped? Bug releases etc.? What is the policy and how is it shipped?
- What IT knowledge is necessary on our side?

8.1.3.1.4   Hardware

- What hardware is used? What is needed in general and for each trainee?

- Is the hardware used off-the-shelf available? Will the VR provider provide it or does the customer need to buy it – or both options?
- What happens if hardware updates are available – describe the process.
- What is the gear for each trainee – e.g. HMD, controller, sensors? How does it work?
- What if a hardware part is broken or not working – support options, replacement parts policy, pricing?
- What type of tracking is used?
- How exact is the tracking?
  (Especially regarding shooting and regarding contact with other trainees)
- Is there finger tracking?
- How is movement tracked?
- Is the individual size of the trainee considered by the system?
- Is the equipment ergonomically tested?
- What gender and diversity aspects are considered regarding hardware?
- What is the size of the training field in the VR and what is the size of the real field needed?
- Can all trainees train in the same field (with body contact)?
- Can the training be done in split locations? E.g.: Can the trainer operate centralised? What are the online capabilities?
- Can the training and the after-action review be used at the same time by 2 different groups (e.g.: Group 1 is doing the review and group 2 has already started their training session – to train more groups a day)? What are the strengths of your system to provide high training numbers per day?

8.1.3.1.5   Set up of the system

- What is the necessary basic room requirement or room condition (materials, size of the hall, height, etc.), vibration, humidity, internet connection (power), power connections, temperature, etc.? Who is responsible for the providing?
- Who sets up the system for training? (Provider or local Police organisation)
  If by the police organisation itself – how is support during set-up provided if necessary? (Additional higher SLAs?)
- What is the set-up time for a training day?
- What is the set-up time (or time to get started) on an additional training day if the basic set-up is already done on the first day?
- Is the system mobile?

- Is it possible to use the system outdoors? Lighting conditions, light rain, etc.

8.1.3.1.6 Preparation for each training group

- How long is the calibration/dressing time for each trainee or trainee group?
- What training duration is recommended? What is the typical schedule for training and what is the flow? How many groups can be trained in 1 day?
- Is there a guided process (e.g. within the VR, instruction video?) or is the instruction done by operators?
- Is a tutorial scenario available – what is the focus of this tutorial?

8.1.3.1.7 Bio signal measurement

- Is mental load measured within the system?
- What is measured and why?
- Is there a certain calculation or algorithm in the background or just the visualisation of the plain results?
- How (by which device) is it measured – what has a participant to wear?
- How is it visualised and is it stored?

8.1.3.1.8 Graphic/Visualisation & Scenario Editor

- What scenarios are available?
- How can scenarios be created? How often?
- What is the process if I need an adaption to an existing scenario or a new scenario (completely new or just with adaptions to the already used scenario) – Process & pricing
- Can scenarios be adapted on the fly right before the training? Even during training?
- Who can adapt scenarios before training and during training?
- What graphic engine is used in the software?
- What police-specific environments are available?
(objects, cars, avatars, surroundings etc.)
- Is the integration of "self-built" environments (e.g. local streets) possible?
- What gender and diversity aspects are considered regarding the software?

8.1.3.1.9 During the training – trainee interaction etc.

- Is the system multiplayer capable? How many people can train at the same time?
- How does the movement within the scenario work?
- What type of communication is used: Radio communication in the team – with the trainer – with the dispatcher etc. How does it work?
- Is there haptic feedback for the user? In which situations?
- Is there a pain simulation? How does it work? Who can steer it? Can it be deactivated per trainee? What are the safety measures for this feature?
- Are any other supporting senses used? Like heat, wind, scent etc.?

8.1.3.1.10 Police-related equipment

- What police gear is available?
  (handgun, long gun, pepper spray, electroshock gun, flashlight etc.)
- Which weapons (real life) are they representing? (e.g.: model Clock 17 or AR15 etc.)
- How is the equipment tracked and can the own equipment be used?
- Is there a duty belt used and a holster?
- Can you place the gear on the belt individually? And is this represented correctly in the VR?
- Is there additional equipment like a ballistic helmet, ballistic protection etc. available
- In which configuration will be trained, resp. which equipment (e.g. officer's own radio set, own holster etc.) and which clothing will be worn during the training?

8.1.3.1.11 NPCs/Avatars

- What types of characters are available?
- How are NPCs used? Can they be steered? In which way? By whom?
- Is role-playing of avatars (perpetrators, bystanders) possible? How many at the same time?

8.1.3.1.12 Trainer Options

- How many trainers are involved in 1 training (typically)?
- What can a trainer do during the training – monitoring, intervention etc.?
- Does the software follow a certain training model?
- What types of training are possible with the system or typically done?

8.1.3.1.13 After-Action Review

- Is there a debriefing – After-Action Review – available?
- If yes – how does it work – which perspectives, how to use etc.? Please also provide video examples.
- What is the advantage of the After-Action Review in your product?
- Which performance-based statistics are tracked and visualised?
- Can AARs be stored and re-played outside the system by a trainer? Where are they stored and are they accessible without the system set-up?

8.1.3.1.14 Pros & Cons

- What do you see as the big 3 advantages of your system and what are the big 3 challenges?
- What is the added value of this system (also in comparison to real-life training or other training)?
- What are the main developments planned in the future? What is the direction this company is heading?

8.1.4   STEP 4 - Selection & Contracting

Now that all providers are known and you also have personal experience with the different systems and services the decision needs to be made. A professional comparison of the providers in a presentation considering all internal needs will help the management to be faster.

When it comes to contracting, all needs of the organisation should be clarified in a written form. This includes pricing, availabilities, or service level agreements, but this also means "promised" further developments of certain software or hardware components (include a reliable roadmap in the contract if certain features are relevant for you). Manifest involvement and integration in the future development of the provider. But at the same time, you also need to clarify internal responsibilities. This means resources for these processes with the provider, the power to make decisions (or a defined and quick process to make them) and also the commitment to the provider to define relevant needs or requirements from your side in time according to a defined release schedule - that is a plan at which time which component of the product and in which size is available to train with). This step is important as the

technology is still changing a lot and providers are developing their solutions constantly. Consequently, it is important to be involved to get the most out of the system. But the intensity of your involvement depends again on your needs and available resources. This phase could be supported by experienced external consultants.

During the contracting phase, it is also necessary to clarify data and other ethic issues with your legal department and the internal working council (see next phase). Selected needs (especially regarding data and ethical VR design) should be considered in the contract.

8.1.5   STEP 5 - Internal Processes and regulations

Based on the previous step a lot of definitions that need to be done in this rather internal phase are already evaluated and now need to be bundled into internal regulations. This step delivers output for the contract with the VR provider but also a lot of information material for the roll-out phase. The phase needs to be started early enough to make sure all internal processes can be executed in time before roll-out.

- Define all **ethical** requirements and regulations
- Define an adapted **training framework** for digital learning and the usage of VR training and include it in the current curriculum
- Set up an internal **train-the-trainer program** and include them in the current curriculum
- Provide **guidelines** for the future VR trainer

8.1.5.1   Ethics in VR training

As VR as a training tool is still novel to many organisations, the aspect of ethics is also not defined in detail and no standards and guidelines are available in most organisations. The traditional guidelines regarding ethics in scenario-based real-life training can be applied, but some aspects have to be considered additionally.

On the one hand, the provider should already follow a standard for ethical development in VR, but it is not only the task of the vendor as it concerns the trainers and the execution too. It is therefore important to consider the internal ethics during selection and preparation phase of the project. There are 3 aspects within the area of ethics in VR training:

ETHICS IN THE VR

USER PROTECTION	WELL-BEING	VR DESIGN
Data privacy, security, transparency: focus personal data (What data is where stored, for how long and who has access) letter of content for trainees	Physical safety (first-aid kits, suitable location, stress monitoring) Psychological safety (realistic worlds can cause more psychological effects)	Representation of the avatars (the trainees and role-players) as well as diversity of non-playing characters (NPCs) & non-stigmatisation

Figure 13: Overview of the 3 areas of ethics being considered in VR police training

8.1.5.1.1 User protection

For the functioning of a VR training solution, it is essential to collect a large amount of data. This can also be important for reaching specific goals like stress measurement during training, but also performance data for debriefing as well as the data throughout the use (movement, localisation etc.) is collected by the system. Spending 20 minutes in a VR situation leaves just under 2 million unique records of body language (= kinematic fingerprint).

It should be noted that there is a distinction between having a "closed" VR training program within your organisation versus an "open" online VR platform where access and usage are much more unknown. Most doubts on GDPR and ethics consider the "open" platforms, as the usage cannot be controlled. But for a "closed" system within an organisation ethics and data usage should be defined as part of the introduction into the organisation. In the open online platforms, access to these platforms is often open for everyone and data is collected and stored online, which makes it more susceptible to hacking and misuse. "Closed" VR training tools can be used without the need to make a Wi-Fi connection, and as such the data is stored locally. Furthermore, access is usually limited to personnel of the organisation who acquired the VR training tool and potentially to employees of the VR provider. Therefore, the danger is much higher in "open" platforms, but this does not mean that user protection is not necessary when working with a closed VR training tool.

It is important to set up a transparent agreement with the provider on data, considering the following aspects:

- **What data is collected and which of them is stored?**
  (Haptic data, biophysiological data (e.g., heart rate), audio-visual data, eye-tracking data, personal data, performance data, timestamps, etc.) – For example, personal data can be stored on an extra hard drive and only the organisation can use this data – the provider has no access etc. The principle to follow here is that of 'data minimization'. That is, only data that is necessary to make the VR tool function properly and that is needed for the LEA organisation to achieve their (training) goals. A transparent discussion between the VR-provider and the end user about which data will be collected is recommended, because this will also serve as valuable input concerning what kind of security measures need to be taken (e.g., if there is a lot of personal data collected or not. Where is the data stored and how is it secured there Most VR-providers of police training tools keep all the data with the customer, as they understand the sensitive nature related to data from police personnel. In some cases, (parts of the) data might also be stored on servers from the VR-provider itself. It should be clear to all parties where the data will be stored. If stored locally at the end user's premises, the end user should take the necessary measures to sufficiently encrypt and protect the data. It might be advisable to discuss with the VR-provider which measures the end user could take to maximally protect the data. Sometimes, VR-providers offer additional security measures as well. When data is stored with the VR-provider, it should also be clear to the end user how the VR-provider will secure these data and prevent unauthorized access or misuse of the data.

- **Who has access? (Provider site and on organisational site)**
  Especially when data from trainees is stored over a longer period in time (for example, for trainers to keep track of trainee performance across trainings or when trainees have their own 'training page'), thorough reflection on access is needed. Security measures need to be put in place to make sure only authorized people can access. In this regard, it is also recommended to check with the VR-provider whether certain data is transferred to third parties. For example, some of the applications/features (software or hardware) used in a VR-system are third-party applications that collect data from the use of the device or software (e.g., the Oculus Quest), to analyse, for example, the performance or type of use of the device. For security reasons, it might be good to check the data privacy policy of that third-party and, if necessary, to elaborate together with the VR-provider for possible alternatives for that application.

☐ **How long is the data stored?**

Make sure the data is only stored the time that is actually needed. Often all data types are all stored the amount of the one longest stored data type. This of the has practical and resource reasons. But a distinction of storage duration per data type is necessary to minimise the risk.

☐ **What will the data be used for?**

An important ethical issue relates to what the data will be used for. VR-providers might want to collect data to be able analyse the functioning of their system based on large (anonymous) datasets, or to detect malfunctions or to make improvements to the system. In essence, this does not have to be a problem and will also benefit the end user in the longer run (I.e., a better system). However, it should be clear beforehand what data will be further analysed by the VR-provider and for which purpose. Similarly, and equally important, the end user will also have to reflect upon the use of the collected data from the trainees. For example, will the data only serve for training purposes and to improve the performance of the trainees through training? Or will the data also be used by trainers for evaluations or grading of trainees, or serve as input for employee performance reviews? This needs to be decided beforehand and needs to be communicated to all trainees before they start training with the VR system. Furthermore, the data collected in the VR training might also be interesting for the LEA to analyse overall performance or to identify overall strengths and weaknesses of their officers that might require additional attention or training. Again, this should be clearly communicated to the trainees.

☐ **Can data be deleted on request and what is the process?**

In some cases, during the use of the system, it may be necessary to delete certain data of trainees despite all defined guidelines (e.g. also if a user is leaving the organisation). This process needs to be defined in advance and not only et the time needed.

☐ **What is the data privacy policy of the provider?**

An overall guideline concerning the issue of protection of user data is to check whether the VR-provider has a Data Privacy Policy in place. In such a Data Privacy Policy, many of the above-mentioned questions will be answered. If they don't have a Data Privacy Policy, it is especially important to have the above discussion with them

We recommend drawing up a **Data Processing Agreement** that is signed by all parties. In such an agreement, the parties can clarify which technical and organisation security measures will be taken by whom, where the data will be stored and for how long, and (importantly) what will happen with the data when the contract is terminated, who is responsible in case of loss of data or data breach, etc. An example template of a Data Processing Agreement can for example be found at https://gdpr.eu/data-processing-agreement/

As soon as there is an agreement and a defined process between the organisation and the provider, it should be made sure that training participants are informed transparently on the data topic. This could be done by a letter of content or as part of the local employment contracts or as part of an agreement with the works councils etc. This should be defined together with the IT and the law department of your organisation. Consider the principle of data minimisation in this agreement (store relevant data only), as the less data is stored, the less can be misused.

8.1.5.1.2 Well-being

In general, the goals of VR training are to bring trainees into situations that feel like real-life. We consider simulation-based training as a good way to prepare/train officers for what they will encounter in real life and consequently a high immersion and presence are targeted. VR training aims to make them feel like they are physically and mentally in this situation as if it were a real situation and wants them to be exposed to all the perceptual, motor, emotional and cognitive deficits that are associated with the high levels of stress they can also experience in real interventions. As this can be achieved by VR training quite well, this also brings up additional ethical issues regarding the well-being and the physical and psychological health of trainees as the risk of having longer-term psychological consequences increases.

Regarding **physical health,** general measurements should be foreseen like having **medical first-aid kits** available for injuries that occur when running/moving in the scenario as well as in case of collisions. The conditions for locations and facilities valid for safe execution of training with VR technology should also be defined in advance. Regarding general well-being, hygiene when using the equipment should also be defined in advance to make sure, the body-worn parts of the VR system are disinfected well.

Checklist for **locations** to ensure **physical safety** and execution during VR training:

- ☐ Burglary risks
- ☐ Ensuring stability/surefootedness
- ☐ Checking and ensuring escape and rescue routes (the second escape route)
- ☐ Marking of the training area (to ensure execution and weapon handling only in the dedicated area)

- ☐ Technical support lines (power plugs, lighting, water etc.)
- ☐ Air conditioning
- ☐ Room size and floor conditions
- ☐ Fire Prevention
- ☐ First aid material on site sufficient for all participants (recognizable storage location, basic first aid kit and suitable medical coolants)
- ☐ Privacy options when dressing or undressing VR parts like body-worn sensors like chest bands (e.g. mobile walls)

Furthermore, it is important to make sure the physical state that is measured and calculated into different **stress scores** is observed by the trainers. The stress measurement is individual, but the baseline is always measured at the beginning – so differentiations to that level over a certain percentage (red marker in the software) should be **observed** very intensively and **not overstretched**.

Regarding stress, also the psychological aspect of well-being during VR training needs to be considered. As VR training are much more immersive than real-life training where the perpetrator is either a card-board opponent or one colleague, VR is very different. An avatar representing a child or an old man could cause much more stress than in real-life training. Moreover, the non-achievement of the goal to save them might cause traumatic situations and should always be taken into account during the debriefing sessions after the scenario. The role of the trainer regarding these aspects is much more demanding than in other training types and they need to make sure that the experiences are mostly positive and that the stress does not cause real-life emotional damage. Try to define scenarios that are not overwhelming for the training groups planned to execute them. Additionally adapt the scenarios on the fly considering individual needs. Always keep in mind: Only because the VR can create the situation it's not necessary to do it (e.g. extremely dangerous situations). Always consider the experience status of the trainees and create scenarios and learning goals that are achievable by the trainee. Have group or individual follow-up options available for the trainees to discuss the experiences also from the psychological aspect and provide from the beginning internal guidelines or code of conduct for appropriate behaviour in the VR (also consider bullying, racism, sexism etc.).

One other physical topic might be motion sickness and the consequences of a possible impairment of the perception of the real world after the training ends. On the one hand, it might occur that some trainees might be affected by diverse intensities of motion sickness. Depending on the intensity, safety measurements should be foreseen. Cold water, an area to rest and also the trainer should be trained to observe the trainees for possible effects and also not let them "overact" just because they do not want to show that they are capable. If motion

sickness to a harder degree occurs, these trainees should take on other tasks, e.g. assisting the trainer or the operator in the procedures and the scenario adaptions, self-select sequences to be discussed in the after-action review sessions or give feedback themselves to the other trainees. By this, model learning is still applicable, the trainee is not only sitting on a bench waiting and the others can also benefit from additional feedback. Although it does not occur often, it can happen and a trainee should not feel ashamed.

Example of a Participation Declaration

I hereby declare that I have been familiarised with the safety regulations for VR training. Essential components of the safety aspects were:

- Live weapons and ammunition must not be brought into the training area (obligation to store safely).
- The instructions of the supervisor must be followed.
- In case of an accident or other unforeseeable events, a cue is to be established. This could be: "Stop for all!". The exercise must then be interrupted immediately.

8.1.5.1.3   Ethics in VR design

The third aspect of ethics and VR is the ethics in the software and the development itself. When virtual worlds are designed, there is a high risk of ethnic profiling, which means stereotyping and stigmatising certain groups by design based on their ethnicity, culture, religion, gender or appearance. A known risk of VR applications is the risk of inducing implicit bias (e.g., racial bias) in its users, by having them systematically experience negative situations with a specific person/group. VR can contribute to training and reduce implicit biases of officers and raising awareness of ethnic profiling by rapid variation of environment, cultural perception, and changing appearances of bystanders.

Therefore, it should be randomised, for example, to which ethnic group, skin colour, sex and other groups a perpetrator and also the bystanders are being associated with visually. Also, a lack of diversity in 'skins' of the avatars that trainees can choose from (e.g., only white characters, slim/busty characters, young people, etc.) can lead to feelings of exclusion, of not fitting the norm. Furthermore, the behaviour and even the visual social role should be randomised within the characters.

Another aspect to be mentioned here is the challenge of associating VR training with gaming, especially ego-shooters. Again, here it is important to have a code of conduct available that includes the behaviour. VR training is not a game! Making mistakes (shooting etc.) as part of the learning process is fine and part of the training, but intentional unethical, illegal or

disrespectful behaviour (e.g., randomly shooting down passers-by or shooting at each other) is not acceptable in VR training and needs to be stopped by the trainers.

You can also discuss with the technology vendor whether there are possibilities to provide certain automatic warnings for critical mistakes (i.e., behaviour that is immediately flagged, e.g., by pausing the training or by seeing a red screen). These can serve as warning signs and can prohibit the trainees from further behaving like that. It allows the trainer to intervene immediately, assess whether it's an honest mistake or intentional disrespectful behaviour), and take the appropriate next steps.

To summarise, for the execution of scenarios in a virtual environment, ethical aspects need to be considered before, during and after training.

8.1.5.1.4   Dimension Gender & Diversity

During the SHOTPROS project, the dimension of gender and diversity was considered at different levels. This included gender and diversity consideration definitions of requirements, but also to include this aspect as part of the ethical consideration when setting up a VR training curriculum.

This aspect is partly related to the aspect of ethics, but has to be considered separately in the XR context because of the creation of additional realities and the corresponding effect on the users:

- **Design aspects** (environments, visualisations, country specifics) and **representation** of avatars (visualisation and reactions) according to or contradicting social norms and images. When creating virtual realities, it needs to be considered very well that the representation of gender and diversity follows the internal rules of the organisation. There is a clear role model function of environments, avatars and courses of action in use throughout a scenario for the trainees. Trainees should find a gender and diversity accepting environment. Avatar should not follow prejudiced stereotypes but offer a wide range of selectable appearance and behaviour. This is very important for the visualisation of the perpetrator and the victims.

  But there is another aspect on that: The selection of appearances (typically called "skins" in the IT language) for the avatars representing the trainees during the training should also be diverse. A smaller female trainee with blonde hair and dark skin colour should not be "forced" to select a dark-haired character with a certain body-type and light skin colour and vice-versa.

- **Gender and Diversity related requirements towards the training solution.**
  To be able to consider all relevant needs of the future end users, it is also important to specifically consider the gender and diversity aspects during the requirements phase. It makes sense to involve representatives from all user-groups, define their certain needs and consider them during the selection/contracting phase. If available at your organisation, involve the relevant unit for this or select suitable representatives, in exchange with your human resources and legal department, yourself.   The aspects to be discussed are ergonomics and cyber-sickness considerations. During SHOTPROS a few requirements were identified following this aspects:

  Hardware - VR suit
  The experience of smaller female officers was that the VR suit sits a **bit loose on the body**. Workshop participants stated that consequently immersion is sometimes lowered by the loose fit, as on the one hand the tracking is not exact enough if the **tracking** sensors are too loose and, on the other hand, even if the tracking is ok, the loose parts feel **distracting**. Furthermore, the **immersion** is also **limited** since trainees do not feel the haptic feedback clear and/or intensive enough if the sensors are not fitted correctly. The fitting of the VR suit also influences the acceptance by users and therefore might influence the acceptance within female trainees. This is not only a purely gender-related recognition, as it refers to the physical characteristics - but often occurs in female VR participants due to the anatomical characteristics. Therefore, either more variable suits are necessary or, which is a go-for solution within SHOTPROS, provide a video how to pull and tighten all ends of the suit to get an exact fit and mention the relevance of the fit as well. Furthermore, the relevance should be known and considered by the trainers.

  Hardware - tactical belt
  In real life, if the **waist-size** of an officer is often **smaller**, and officers should not, for safety reasons, put gear on the back of their waist (as there is not enough space on the front), they tend to attach gear to their tactical vest. Individual positioning of police gear needs to be able in the VR as well.

  Motion sickness
  Most of the research says that female users tend to be **more likely** to be **affected** by motion sickness in VR trainings than male users. But there are **newer findings** that show that **interpupillary distance non-fit** was found to be the primary driver of

gender differences in cybersickness[7]. If interpupillary distance of the VR glasses can be adapted to a certain (smaller) range, the probability of motion sickness may decrease. Not all HMDs have this opportunity and due to the average physical size, female participants are more often affected by this limitation.

Field of view

There was an input raised regarding the **field of view** as this is typically limited by the VR but according to the workshop participants in real-life female persons tend to have a broader field of view (and therefore tend to be more attentive). With VR training and the fact that VR limits the field of view this might be limiting the natural tactics of female officers. This should be considered when **selecting HMDs**. HMDs with a broad field of view should be preferred to prevent this possible gender limitation.

8.1.5.2 Scientific model of human factors influencing DMA-SR

To provide a fundamental and scientifically validated training framework for SHOTPROS VR training, a conceptual human factors model of decision-making and acting under stress and at high risk (DMA-SR) was set up and builds the base of all VR developments within the project.

A very compressed overview of that model is summarised here:

In general, it can be said that people perceive a situation as stressful if the perceived *demands* and the perceived *capabilities* to cope with the situation are ***imbalanced.*** Stress occurs when the perceived demands outweigh the perceived capabilities and the individual feels that the situation is threatening to their well-being. How you perceive the situation is influenced by various **human factors**. Human factors can be **personal**, **contextual**, **organisational**, or **societal**. When an imbalance between perceived demand and capabilities and the police officer cannot mitigate the stress response (for instance, by investing extra mental effort), he/she starts perceiving **task-irrelevant input** (such as threat-related information) instead of the task-relevant input (such as goal-driven information). This represents a change in **attentional processes** and leads to suboptimal DMA.

For SHOTPROS, this model forms the basis of **VR training** – the human factors help to create realistic VR training where different situations and variations are provided for the trainees.

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[7] https://pubmed.ncbi.nlm.nih.gov/33501173/

By this, police officers can train to **restore or retain their attentional processes** in any stressful situation and learn to remain focused on the task-relevant inputs and stay in control.

In VR you can **manipulate** the **sensory** (e.g.: noise) and the **cognitive** (e.g.: dispatcher information) **input** with just a few clicks. If VR training is individualised for each trainee, DMA training will be enhanced, which will lead to **better DMA performance** in real life. Consequently, this training does not necessarily make police officers less stressed or prepare them for all possibly occurring situations**, but it enables them to train their attentional processes to focus on task-relevant input in stressful situations,** instead of being distracted by task-irrelevant matters.

8.1.5.3   Training Framework

Based on the above-described model, implications of how to set up a solution-oriented VR training framework were drawn as a result of research, technology and end-user input. The following 7 criteria are well described via the links including video descriptions:

- ☐   Is there a clear assignment? PDF click here
- ☐   Is there high-quality instruction? PDF click here
- ☐   Is there a well-designed practice situation? PDF click here
- ☐   Is model learning used? PDF click here
- ☐   Is there variation and differentiation? PDF click here
- ☐   Is there a possibility of self-regulating learning? PDF click here
- ☐   Is there constructive, motivating feedback? PDF click here

More details can be found in the download section of www.shotpros.eu in deliverable D7.5.

8.1.5.4   Train the trainer Curriculum

Caused by the fact that VR training includes new aspects to be considered, also the trainers need to be prepared for their new role. A specific train-the-trainer course needs to be included in the trainer education curriculum and should cover the following aspects:

- **Basic Technology Know-How**
  Basic user know-how including handling of a PC, mouse, steering options etc. should be an entry barrier for trainers.

- **VR Know How (tools and background)**

The knowledge of the VR on tools to adapt the scenario during the training (by yourself at the trainer station) and knowledge of what an operator can adapt needs to be trained. Furthermore, the knowledge of how to start an after-action review needs to be repeated until settled. Changing perspectives, and selecting KPIs or other information during AAR, need to work efficiently. But also in the preparation phase of a training, how to get dressed and where the important sensors should be paced need to be part of the train-the-trainer courses including the background knowledge of what these parts are triggering/executing in the system. Furthermore, to cover the data aspects of VR, the knowledge of "where which data is stored for how long and accessible by whom" should be part of the VR knowledge of a VR trainer. Know How Factsheets should be adapted agilely after training sessions are executed – this is especially important in the first few months of a VR introduction to an organisation.

- **Handling the new risks in VR training - ethics and well-being**
  Motion sickness can occur and is no sign of weakness, a protocol needs to be in place to give affected trainees other roles (co-trainer, model learning, NPC control, etc.). Ethics needs to be considered during scenario definitions and in all variations.

- **Training Framework**
  The above-described training framework with clear guidelines on how to execute VR training in the organisation needs to be trained. This includes a large focus on selecting proper training objectives that can be achieved using VR training, ethics as well as feedback and monitoring. Dealing with motion sickness or the psychological well-being of the trainees is a new dimension for the VR trainers.

- **Monitoring & feedback options**
  A trainer in general always needs to monitor the state of the trainees he/she is responsible for. But with VR this also offers the option to interrupt and use the pause for adaptions, variations, repetitions or feedback without the risk of needing to re-build the scene or other typical real-life restrictions. You can start again anytime, and this offers additional options for a trainer. But this also means a trainer needs to be very flexible, open-minded and needs to have the didactic know-how on what adaptions are suitable in which situations to actually meet the needs of the trainees.

- **Feedback based on infinite evidence**
  With VR technology, the trainer has almost infinite options – all views are recorded, hundreds of KPIs are possible to be tracked. But providing a trainee with this unfiltered

information is not an option. The trainer now has the task to filter the appropriate feedback and release the trainee with a positive feeling towards the training and the situation. Partial sequences can be failed by the trainee, but the overall results should be positive. (Adaptions in the scenarios during training - if necessary).

- **Increase of mental load on the trainer**
  With all these option in mind and being a filter of them to the trainees (to not overwhelming them) at the same time causes an enormous increase in the mental load of the trainer in even shorter time. This should be discussed in the train-the trainer sessions and be monitored by the organisation (including mitigation measures as additional trainers, other entry barriers for trainers etc.).

8.1.5.5 Scenario Design Checklist

When creating a scenario suitable to train DMA-SR in the VR, the following should be considered:

SCENARIO DESIGN CHECKLIST

- ✓ Choose the right training type
- ✓ Consider the 4 human factors influencing DMA-SR
  - ✓ Personal (child, level of threat etc.)
  - ✓ Contextual (unexpected weapon, blood traces)
  - ✓ Organisational (distance to perpetrator, use of forces)
  - ✓ Societal (filming bystander asking sensitive questions)
- ✓ Consider the status of each trainee team
- ✓ Include sensory and cognitive information as naturally as possible
- ✓ Avoid stairs, closed doors, touching too many virtual objects
- ✓ Include raising stress-provoking elements (task relevant and irrelevant)
- ✓ Include external input
- ✓ Include clear decision-making points
- ✓ Include variation (context)
- ✓ Include differentiation (level of complexity)
- ✓ Avoid familiarisation with the scenario (use new environments)
- ✓ Include team tasks
- ✓ Try to reproduce real-life operations
- ✓ Use tasks for the number of trainees available (realistic group sizes)
- ✓ Use the SHOTPROS template for description

Table 8: VR scenario design checklist

8.1.6 STEP 6 - Assessment & Implementation

A huge part of the introduction is done with the first 5 steps. Now, the actual implementation together with the provider and the internal IT department can start. This phase includes defining final requirements with the provider to be implemented before roll-out, project planning with the internal IT department and the provider as well as education on the system (by the provider for your internal super-user team). If you have resources for external support, this is also a suitable time to include this.

Additionally, this phase also means you can start defining first training environments and scenarios. Depending on the scenario editing options of your provider, this also involves external creation of environments (buildings, streets) and inventory (cars, walls, furniture, objects) and avatars (persons and animals and their behaviour) as well as the definition of a scenario script (what happens after which event etc. These scripts should be available in written form so that the provider, but also future trainers have access to the definitions.

Regarding feature of the SHOTPROS solution, please consultant deliverable D7.6, the final VR guidelines of the SHOTPROS VR solution in the download section of www.shotpros.eu.

8.1.7 STEP 7 - Roll-out

The las step before the first training can be executed, is the internal roll-out. This is a more technical wording for making the software available in the internal systems. But this step is not referring to the technology only. This also includes a lot of internal (probably also external) communication. To make sure the message about the goals of the new training approach is clear, don't skip this step.

In this phase it is useful to have internal supporters identified that can spread the word and emphasize the positive expectations on the introduction. Make sure you are also able to answer the negative comments that will automatically be raised by some doubters. Prepare short factsheets for the internal mass but also prepare background information for more interested persons. Make sure relevant persons are informed on time and before the official roll out, so no one has the feeling to be left out. If sceptics are in positions that are relevant for the roll-out, make sure you contacted them individually before.

This phase should be prepared in advance to ensure that no internal regulations or bureaucratic issues hinder the successful introduction. If you decided for external consulting during the introduction process, this is again a part that can be partly taken over or guided by

externals as sometimes externals are rather heard or accepted than internals and might approach sceptics by other means.

As this phase is a large technology step as well, make sure the IT department is on time and also available as soon as the first trainings are executed. Furthermore, as soon as the first trainings are planned to be executed, it needs to be clarified who can be contacted if there are any technical problems during set up and execution (E.g.: internal IT department first, they contact the provider; provider is available during first trainings to be able to react directly etc.). This should be done in line with the contracted service arrangements, but enhanced during the roll-out phase with additional support by the provider (which should be also part of the contract).

8.1.8 STEP 8 - Usage & Feedback

Now, as the VR training solution is finally ready for use, it is important to make sure it is actually used. Supervise all training plans and attend the initial trainings yourself (accompanied by internal IT and the provider in second or even first line) to let them be executed excellently and, if any challenges arise, that they can be dealt with immediately.

Provide resources to gather feedback during (especially the first) trainings and share it with the relevant internal department and the VR provider. Work on release plans with the VR provider to make sure relevant identified features are implemented and made available as soon as possible. Communicate these time plans internally if this helps to manage expectations but don't promise too much. Still invest in internal communication (on successful trainings, good feedback etc) and provide testimonials with quotes on the success and probably also on already tackled challenges ("We know x is not ideal, but it will be replaced by y in time z."). At the same time be transparent with challenges but do not focus on them in mass communication.

Now it's also time to invest in external communication. Contact your internal communication department, be available for press interviews for internal (internal magazines, intranet etc.) or external purposes (social media, TV. print) and share your knowledge in networks or groups with other law enforcement agencies. Also support your provider in communication measures to make sure your features are prioritised, because one good turn deserves another.

And now, as you finally introduced VR successfully into your organisation speak about this success also internally. If management trusts in this success, they are more willing to invest in the continuation of the trainings and also into other promising (digitalisation) projects.

Don't forget to provide information on project controlling, the comparison with the original goals defined in step 1. Furthermore, based on that and all the feedback gathered, define a

plan for the next steps (other features, more trainings, wider target group within the organisation etc.) and last but not least – be proud of this huge success!

9 Policy-maker impacts for policy issuers on national or European level

Throughout the 3,5 years of the SHOTPROS project, policy-makers on all levels were integrated, involved, and considered. Many contact points like national deciders on various levels (police academy leaders, regional police presidents, representatives from the Ministry of Internal Affairs or even the Minister of Internal Affairs (e.g. Belgium, Romania, NRW), organisations like CEPOL, Europol or OECD and many others, all well-received the SHOTPROS project results and impacts (details on this can be found in D8.9, the SHOTPROS Dissemination Report.). But this awareness needs to be taken as a chance to further develop and establish two topics on regional, national and European level: First, the **relevance of DMA-SR training** for police officers itself and second, **VR technology as an enabler** for this type of training but also as a future training tool to consequently **enhance the performance of European police officers**:

- **DMA-SR training** (training of decision-making and acting under stress and at high risk) This includes the set-up of guidelines how to train DMA-SR, the establishment of tactical and scenario-based training as a suitable tool for better performance of European police officers and focusing with the scarce resources on tactical and strategic decision-making training instead of physical or skill training.
- **VR technology for DMA-SR training** and (in the future) for other training types This aspect covers the tool how tactical and scenario-based training (that is provided too rare to European officers) can be provided more often and at lower resources but also includes the enabling of the introduction of these tools.

To support this, based on all SHOTPROS results, the policy-maker toolkit was developed and will be made available to LEAs in Europe by supporting two strategies:

- **Bottom up**
  Enabling police (middle) management and tactical trainers to gain knowledge and to be able to foster an environment within their organisations to introduce new training types and tools.
- **Top-down**
  Providing policy-makers on European and national level as well as top-management

within law enforcement with the knowledge on the training type and the technology to enable technological change and digitalisation.

Although the information within the policy-maker deliverable at hand is consequently highly relevant for policy-makers outside a certain law enforcement organisation, and the aspects for policies to be issued on European and national level can be derived from this provided information easily, we summarised the relevant aspect for national and European deciders in particular in this chapter of the document and enhanced it with topics more relevant for the national and European policy-makers to subsequently enhance the sustainability of the project.

Introducing **DMA-SR training and VR technology** to a law enforcement organisation also means a lot of (re)-definition of processes and guidelines. If there are national or European guidelines and **regulations** on this topic **already available** or even in use, this saves time, resources and discussion for single organisations and fosters the processes avoiding the risk to rout into a dead-end due to missing knowledge or regulations. Rejections and risks might be lowered if regulations are already in place and adaptable to the organisation. Currently most of these regulations and guidelines are missed and the introduction of VR as a training tool needs much more internal resources to be realised and therefore sometimes is not successful. To avoid this, governance is needed. All of the following aspects need to be evaluated and elaborated on a European and following also on a national level to be able to successfully introduce VR as training tool in police organisations.

Table 9: Top 3 enabler for Policy-maker

The following **environments** and/or sustainable **regulations**, **guidelines** and/or **standards** should be provided by national and/or European policy-makers:

- **DMA-SR training Guidelines** (see D7.5) on national or European level to foster the relevance of tactical DMA-SR training as methodology to enhance the performance of European law enforcement.

- **Resources for DMA-SR training**
  Time, money and human resources need to be made available for this training types within the different organisations

- Positioning of **VR technology** as law enforcement training tool. A positive stimulus on different levels (regulations, know-how, acceptance, resources, hierarchies, suitable definitions of responsibilities etc.) for the adoption of VR training within LEAs.

- General **e-learning** establishment at law enforcement organisations
  VR is one aspect, but often it lacks a general framework for digital learning in organisations. If there are more general guidelines available, the addition of similar training methods is facilitated.

- Introduction of **data security** regulations for VR training
  National/European regulations for user protection of digital training data (incl. health data) and performance measuring and long-term comparison (i.e. storage of data) from users.

- Regulations on **well-being of the VR users**
  Provisioning of concepts and regulations on well-being in a digital training context (physical and psychological health of the users, roles and responsibilities of the trainer in the new context, labour laws, etc.)

- Guidelines for **ethical aspects of VR design** for technology providers, education (design and technology) as well as for the users of the technology (LEA management and trainer)

- Adaption and regulation of **labour laws** considering VR training (see data protection, physical and psychological risks etc.)

- **Knowledge Hubs & Networks**
  Provisioning of knowledge on all levels for example:
  - Provisioning of top-management knowledge (e.g. CEPOL webinars etc.) raises the awareness for VR technology and openness towards new technology to foster top-down introduction.
  - Provisioning and dedication of resources within organisations enables the processes.

- o Fostering of education in VR technology at law enforcement schools and universities enables bottom-up processes on new technology.
  - o Fostering of VR development skills in education to provide enough European human resources for VR providers
  - o Etc.

- **Strengthening of European technology providers**.
  The creation of environments for technology providers to introduce the technology and the scenario design assets to European LEAs

- Establishment of **certifications for VR training** in the police context for providers. Standardisation of technology will probably not work, but certification and approval of "capabilities" might be a solution. Similar to for example FAA approved flight simulators.

- Creation of a **European marketplace and technological exchange standard for scenarios and/or scenario assets** for VR training.
  The police of one country should be able to "buy" scenarios used in other countries and to share for example assets (like the 1:1 3D replica of a certain public building) via a marketplace. This mainly needs the establishment of a European standard interface of VR asset exchange as well as supporting regulations and guidelines for providers to use these standards (e.g. a "Open VR Standard")

- **Provide material and step-by step introductions for internal processes** (e.g. the 8 steps introduced in this document) on European and national level. Enhance the guidelines with clear internal hierarchy/processes & references to existing regulations)

These are the main aspects to be considered and will need more detailed analysis and definitions on national and European levels. Nevertheless SHOTPROS was able to tackle some of these already within the project and participating partners will consider some of these aspects also within their exploitation work after the end of the project, first and foremost the continuation of the VR and police network (www.vrandpolice.eu) established during the duration of the project.

The above aspects need to be considered for solutions such as the SHOTPROS VR solution (large scenario-based training to conduct DMA-SR training with more intensive trainer supervision), but it is also necessary to focus on VR as technology in a broader context. Within the training context for example also for future concepts enabled by VR technology when

trainers are not in place as real persons but only available virtually (e.g. for de-centralised trainings) and for "other" training aspects where trainees and trainers do not need to be in the same place (compact product version what can be used at police stations as training preparations or for detailing gained knowledge or for law and regulations training). But also, as a tool for operation planning within special units or augmented and mixed reality for usage during operations, etc. It is obvious that XR will bring further aspects and options of usage into law enforcement organisations that need to be considered now, as they will soon be part of the future.

10 Appendix

10.1 SUMMARY - checklists combined

How to sucessfully introduce VR training to my law enforcement agency?

A step-by step introduction on digital transformation

STEP 1. VISION & BENEFIT
Define what you relly **want** to achieve
Define what you **don't** want to achieve
Identify fans and refusers

STEP 5. INTERNAL PROCESSES & REGULATIONS
Clarify data protection and ethics
Implement a VR training framework
and train-the trainer courses

STEP 2. SKILLS & COMPETENCIES
Define project team & authorities
(IT, legal, deciders, externals etc.)
Gain as much knowledge as possible

STEP 6. ASSESMENT & IMPLEMENTATION
Clarify final requirments with provider
Receive trainings for software
Design scenarios

STEP 3. CALL FOR TENDER
Identify criteria and start the
process (regulations)
Try out providers & challenge them

STEP 7. ROLL-OUT
Invest in internal communication
Identify supporters
Prepare first training excellently

STEP 4. SELECTION & CONTRACTING
Clarify your needs in written form
Define involvement & responsibilities
Involve legal dep. &working council

STEP 8. USAGE & FEEDBACK
Make sure it is used (training plans)
Gather feedback & share with provider
Show the success & Raise money

SUCCESSFUL INTRODUCTION
ongoing process

Table 10: Steps to implement VR training in a LEA

To Do's Step 1 – Vision & Benefits

- ☐ Describe a vision of the project
  (including a short version in 5 sentences)
- ☐ Define the objectives of the project
- ☐ Describe current problems and challenges in real-life training
- ☐ Identify supporters
- ☐ Be an evangelist on the topic throughout the organisation

To Do's Step 2 – Skills & Competencies

- ☐ Set up a project team (active and supporter roles):
  - ☐ Owner of the project & evangelist
  - ☐ Project manager
  - ☐ Implementing team members
  - ☐ Psychologists and trainer
  - ☐ IT department
  - ☐ Supportive End Users (Trainer)
  - ☐ Legal support
  - ☐ (Internal) Communication
  - ☐ External consultants
  - ☐ Sponsors
- ☐ Define a kick-off meeting
- ☐ Start gaining knowledge and competencies
- ☐ Register for certain online and offline networks
- ☐ Attend conferences, fair and exhibitions
- ☐ Meet the market and the providers

To Do's Step 3 – Call for tender

- ☐ Define your needs as an organisation towards a VR solution (not technical, but from your point of view)
- ☐ Together with the legal department: create a call for tender document suitable for your organisation (according to the identified needs – re-check with your vision and objectives)
- ☐ Test out systems on market

To Do's Step 4 – Selection & Contracting

- ☐ Do final try-outs (in a realistic context of your organisation)
- ☐ Select a potential provider
- ☐ Define requirements of the contract
  (with internal legal department and IT)

To Do's Step 5 – Internal Processes & Regulations

- ☐ Define all (internal) processes that need to be adapted
- ☐ Consider ethics (health, safety, data security etc.)
  & define all ethical requirements and regulations:

Data privacy/security/transparency:

- ☐ What data is collected and which of them is stored?

  (Haptic data, biophysiological data (e.g., heart rate), audio-visual data, eye-tracking data, personal data, performance data, timestamps, etc.) – For example, personal data can be stored on an extra hard drive and only the organisation can use this data – the provider has no access etc.

- ☐ Who has access? (Provider site and security steps on organisational site)
- ☐ Where is the data stored?
- ☐ What will the data be used for?
- ☐ How long is the data stored?
- ☐ How is the data secured?
- ☐ Can it be deleted and what is the process?
- ☐ What is the data privacy policy of the provider?

Locations to ensure **physical safety** and execution during VR training:

- ☐ Burglary risks
- ☐ Ensuring stability/surefootedness
- ☐ Checking and ensuring escape and rescue routes (the second escape route)
- ☐ Marking of the training area (to ensure execution and weapon handling only in the dedicated area)
- ☐ Technical support lines (power plugs, lighting, water etc.)
- ☐ Air conditioning
- ☐ Room size and floor conditions
- ☐ Fire Prevention
- ☐ First aid material on site sufficient for all participants (recognizable storage location, basic first aid kit and suitable medical coolants)
- ☐ Privacy options when dressing or undressing VR parts like body-worn sensors like chest bands (e.g. mobile walls)

Psychological safety:

- ☐ Include the topic in the train-the-trainer program
- ☐ Provide after-training options to discuss the experienced situations as VR training is more realistic and can cause emotional damage

VR Design:

□ Make sure the provided avatars are diverse and reduce stigmatisation. Include this topic in the scenario design part of the train-the-trainer program

□ Create a participation declaration for the trainees (considering ethics)

□ Define an adapted training framework for digital learning and the usage of VR training and include it in the current curriculum – consider the following criteria:

 □ Is model learning used?

 □ is there a well-designed practice situation?

 □ Is there a clear assignment?

 □ Is there constructive, motivating feedback?

 □ Is there high-quality instruction?

 □ Is there a possibility of self-regulating learning?

 □ Is there variation and differentiation?

□ Create and provide guidelines for the future VR trainer

□ Set up an internal train-the-trainer program and include them in the current curriculum

□ Adapt the internal curriculum for trainees

To Do's Step 6 – Assessment & Implementation

□ Define the final requirements towards the provider

□ Be involved in the (final) development of the provider and your internal IT department

□ Plan the roll-out (including communication efforts)

□ Involve end users

□ Define environments, scenarios etc. on a general level

To Do's Step 7 – Roll-out

□ Start the roll-out process

□ Test all implementations before first official usage

□ Communicate internal

To Do's Step 8 – Usage & Feedback

□ Be involved in the first trainings

□ Make sure the feedback is transported to the provider

□ Create release plans for further developments together with the provider

□ Communicate external

Final advises for the project owner

- ☐ Set objectives for the projects before the beginning not shortly before the technology is rolled-out

- ☐ Try to find out who decides about what in your organisation and involve them from the beginning

- ☐ Involve end-users from the beginning

- ☐ Detect fans and refusers of the new technology and make them your multiplicators

- ☐ Involve yourself in independent networks on the topic to gain as much knowledge as possible

- ☐ Find employees that want to be the "best" in this topic

- ☐ Involve external consultants that have the experience and the external view

- ☐ Do not overload the meetings or receivers of information with too many people as a high number of participants might slow the progress – but at the same time include as much as needed – This balance (giving everyone a voice but at the same time finding the right solution) is hard to find but has a huge impact on the progress