

XR Technology assisted simulation training and the role of collaborative human-to-human interaction

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Within this paper the authors describe their background as practitioners in first responder XR trainings as well as as technology provider for such trainings. Further, they describe the experiences they made in applied research projects in the context of XR technology assisted first responder simulation trainings within the last years. Among these experiences are large scale trainings such as the Ironore 2019 exercise, as well as full process based simulation trainings within the SIM Campus Eisenerz. In addition, the authors will contribute their personal experiences as lecturers and paramedics for medical first responder organizations.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**; • **Applied computing** → *Interactive learning environments*; **Collaborative learning**.

Additional Key Words and Phrases: eXtended Reality training, practitioners view, collaboration, strategic training, tactical training

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1 INTRODUCTION

With respect to the outlined topics for the CHI '22 WORKSHOP - VR [WE ARE] TRAINING we are detailing in this motivation statement the background the authors are coming from as well as their organizations, the work and research experience they have gathered within the last years with respect to eXtended Reality (XR) Training as well as the contributions they intend to bring to the workshop upon approval of participation by the reviewers. Regarding the two main topics of the workshop the authors will report their experiences on *Collaboration between trainers, trainers and trainee(s), and trainees in VTE* with respect to: a) Innovative interaction concepts between trainer and trainee in VR → practical experiences in the communication actions witnessed in large scale first responder exercises, b) Real-time performance measurements in VR and dashboards to visualize those measurements → experiences on existing dashboards for tactical and strategic communication as well as initial findings on KPI development for trainer information systems as well as the connection to APIs of learning management systems (LMS), Furthermore, the effect of (simulated) media coverage on rescue operations, especially the pressure exerted on the commanders in charge c) Didactic concepts for training in VR → the utilization of phenomenological as well as experiential pedagogical learning theory in real use cases and d) integrate and combine traditional with virtual training → initial steps towards blended learning concepts in the context of safety procedures on the shop floor and for apprenticeship. Regarding the second core topic of the workshop *Novel collaborative interfaces for VTE* the authors will contribute with their hands-on experiences towards a) Prevention of problems and errors (e.g. motion sickness, not taking training seriously etc.)

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→ challenges for large scale training systems and their operation for different stakeholder groups as well as on the opportunities and (unexpected) challenges gamification might impose in this context. The remainder of this paper is structured as follows: In section 2 the authors will describe the setting of a full scale first responder exercise that took place in Eisenerz, Austria in September 2019 and the evaluation results derived from this exercise with respect to the utilization of XR technologies as a training tool. Section 3 will describe full process simulation (FPS) in a simulation hospital and the inclusion of XR technologies in this FPS. Section 3.1 will shortly describe the background of the authors and section 3.1 will list the contributions the authors are intending to bring to the workshop based on the two main topics.

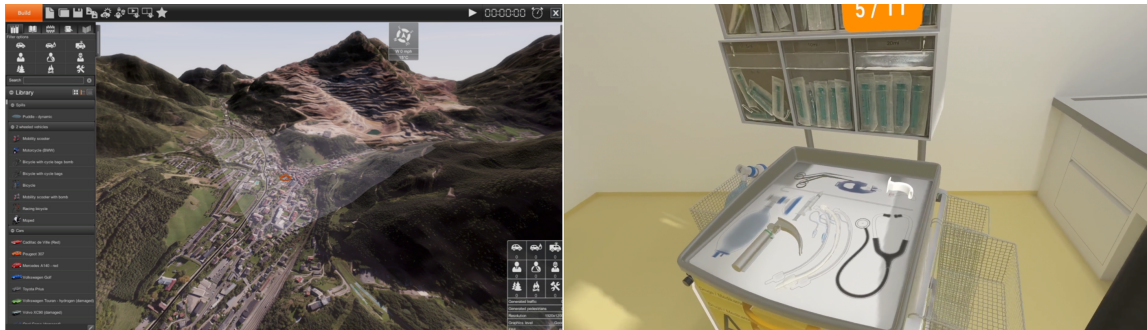


Fig. 1. IRONORE 2019 (left), preparation of equipment for a medical emergency process as part of full process simulation @SIM Campus GmbH (right)

2 IRONORE 2019

The IRONORE2019 project has been deployed within the UCPM-2018-EX-AG framework of the European commission. The given context for this large field exercise was the fact that around 40 minor earthquakes occur in Austria per year. Looking back into the historic data also heavy shakes with a magnitude 7+ on Richter scale are possible. Under such circumstances, a request for international assistance via the European Civil Protection Mechanism is very likely.

The main purpose of the IRONORE 2019 exercise was to test the understanding and response in the framework of the European Civil Protection Mechanism in an alpine region using a Discussion-based Exercise (DBX) and a Full-Scale civil protection exercise. The focus of these exercises has been placed on development of response starting with local response, request of assistance using CECIS via the Austrian Ministry of interior and opening the European Civil Protection Mechanisms, receiving international assistance (EU modules, other response capacities and a UCP team), train host nation support and embed incoming assistance into the Austrian response system. Especially for the Discussion-based Exercise (DBX), innovative virtual reality technologies were used to simulate assessments of the different emergency sites for decision making during and to use these technologies in order to introduce new methodologies into preliminary assessment including vulnerability and capacity assessment.

2.1 Discussion-based-Exercise (DBX)

Because of the earthquake remote areas of the region have been cut off from the environment. The inhabitants left their houses or have been evacuated due to the danger of further aftershocks and collapses of buildings. The main distribution of electricity, the mobile phone network and parts of the water supply have been severely damaged and failed. In the region a number of companies is active. These companies work with gas, oil, chemical substances and industrial

explosives. In the exercise context, almost all of these companies temporarily stopped their production, because of damages and for safety reasons. Thousands of people have to spend the next few days outdoors because there are not enough temporary shelters available and the access roads could not be opened yet. Based on this given facts the DBX simulated the different procedures during a Union Civil Protection Mechanism (UCPM) response operation. The aim of such a simulation exercise is to implement and test standard operation procedures (SOPs) and activities related to on site assessment and humanitarian needs assessment, to improve knowledge and skills of participants related to on site assessments and humanitarian assessments. Within the described DBX an additional focus was put on the introduction of new methodologies into preliminary assessment including vulnerability and capacity assessment as well as the utilisation of virtual reality technologies in order to simulate assessments of the different emergency sites for decision making during and to use these technologies in order to introduce new methodologies into preliminary assessment including vulnerability and capacity assessment.

2.2 Utilization of virtual reality simulation within the DBX

The utilization of virtual reality reached beyond commonly used headsets and included also the simulation of social media messages and news reports to foster the immersion effects of crisis media and train commanders in charge on collaboration with media. In terms of emergency site representation, headset based evaluation of emergency sites as well as screen based virtualization in the situation and control room were used for wide area assessments and field assessments by the teams during the different DBX phases.

Participating team commanders virtually flew in the affected area with a helicopter through VR headsets. This simulation made it possible for them to get an awareness of the actual situation in the town of Eisenerz, identify hot zones and possible urgent needs and to communicate all these appropriately with the control centre. Thereby, they were able to see the damage of the transportation infrastructure, the blocked roads, possible water sources etc. and had to note this down and report it accordingly via radio. In addition, on-site visits for field assessments at different emergency site for different responder teams had been realized in headset and screen based virtual representations.

2.3 Evaluation of XR tools used in the DBX

A detailed description of the evaluation team and the used evaluation methodology can be found in [1]. Overall the virtualization tools were generally appreciated very much by the participants and enhanced the situational awareness of the team commanders through the opportunity to conduct a virtual aerial overfly in a helicopter. Also for the different team leaders and members the technology was interesting to use, helpful and provided an added value. In particular, the (virtual) aerial assessment via the VR headsets created a better connection to the scenario. Mentioned shortcomings were mainly targeted towards communication and information sharing for joint awareness of situations. Among these collaboration topics the ones most mentioned were a) ability to visually share what is seen with the command control centre, b) the ability to take screen shots / pictures of what's seen in the headset / screen in order to include that into the assessment report, c) the option to indicate areas of interest from the command control center through remote assistance in the field of view for the person conducting the (virtual) field assessment, d) digital tools for taking notes in the virtual reality, e) ability to assess emergency sites as a team with each team member wearing a headset and thereby having the option to divide the emergency site inspection among the team for a more rapid assessment.

2.4 Lessons learned

With respect to the utilization of eXtended Reality technologies the following challenges and respective needs for additional features have arisen in the context of the DBX, which are worth to be tackled in future implementations:

- Establishment of situation awareness by having shared views between the field examiner and the command and control. Furthermore, visual guidance and assistance opportunities in the shared views
- Multiplayer option for joint field assessments of disaster (virtual) sites

3 FULL (VIRTUAL) PROCESS SIMULATION IN A HOSPITAL

The interaction between trainers and trainees in medical simulation is a comprehensive field of research. In this respect SIM CAMPUS GmbH conducts research regarding interaction and collaboration at different levels and modalities. This is done from the perspective of a) skills training, in which direct trainer-trainee teaching interaction is very intensive, b) from the perspective of scenario training, where the direct teaching interaction between trainers and trainees is already decreasing, and finally c) from the perspective of full process simulation (FPS), in which the training interaction disappears completely and trainers interact and collaborate with the trainees in the form of role players without them "knowing" that they are trainers. This allows collaboration and interaction in a new, very little researched area, the interaction between the trainer in the role of a co-worker, a superior or a patient and the trainee fits like a mosaic into the situation that is exactly based on reality. For this FPS SIM Campus GmbH is teaming up with Mindconsole GmbH in order to include XR technology into this full process simulation in order to enable repetitive training on certain processes that would be very time consuming when being trained multiple times in the real world settings. In the initial phase this partnership has teamed up together with AIT Austrian Institute of Technology GmbH in the XRTrain project (funded by the project fund Work 4.0 of the styrian chamber of labour) where they implemented the two use cases: a) an emergency evacuation of a hospital and b) the preparation of intubation equipment for an emergency procedure to be carried out. In both of these use cases the interference through ostensibly not involved (human) characters might serve as a willing (anti) collaboration acts in order to better train persistence and resilience in following process rules. However, also the positive utilization of in itself not intended collaborators can be a training goal in this context. For such kind of a training, recording of interaction and collaboration actions for the sake of debriefing sessions with trainers is of utmost importance in order to enable a novel form of learning experience and better retention of correct procedure execution in FPS. Hence, the option of having such digital recordings of trainee collaboration and interaction behavior constitutes a novel form of after-action-review possibility, which the authors are currently exploring.

3.1 Lessons learned

- Complete virtualisation of full process simulation that considers collaborative acts demands the systems ability to be either multiplayer or (better) to have to opportunity of role playing characters that are controlled by trainers
- For such multi actor settings after-action-reviews via recorded training session of the virtual interactions is absolutely necessary.
- Straightforward procedural training can be improved by incorporating (anti) collaborative acts (e.g. through avatars, ringing phones etc.) in the form of distraction for training resilience and procedure persistence.

REFERENCES

- [1] Helmut Aschbacher and Josef Riener. 2020. *IRONORE 2019:Project Review, Findings and Way Forward*. Technical Report. Austrian Red Cross, Vienna, Laubegg.

ANNEX I: CONTRIBUTIONS TO THE WORKSHOP

Within this sections the authors describe their intended contributions towards the workshop main and subtopics.

Collaboration between trainers, trainers and trainee(s), and trainees in VTE:

- *Innovative interaction concepts between trainer and trainee in VR:* practical experiences regarding communication actions in first responder exercises and daily routines
- *Real-time performance measurements in VR and dashboards :* experiences on existing dashboards for tactical and strategic communication as well as initial findings on KPI development for traininer information systems as well as the connection to APIs of learning management systems (LMS)
- *Didactic concepts for training in VR:* the utilization of phenomenological as well as experiential pedagogical learning theory in real use cases
- *How to best integrate and combine traditional with virtual training:* initial steps towards blended learning concepts in the context of safety procedures on the shop floor and for apprenticeship

Novel collaborative interfaces for VTE

- *Prevention of problems and errors (e.g. motion sickness, not taking training seriously etc.):* We describe challenges for large scale training systems and their operation for different stakeholder groups. Furthermore, the effect of (simulated) media coverage on rescue operations, especially the pressure exerted on the commanders in charge

ANNEX II: AUTHOR BACKGROUNDS

DI (FH) Markus Karlseder, MA, Global Creative Lead: He holds a master degree in „Information- and Exhibition Design“ from university of applied sciences Joanneum Graz. In his role as creative und XR lead of Mindconsole GmbH he focuses on media interaction design. Furthermore, he has been leading Mindconsole's involvement in international research and business projects in the conception phase as well as in the implmentation. Having volunteered in emergency services for 20 years as an emergency medical technician, operations officer, and operations tactics instructor, he represents the perfect hybrid of conceptual as well as user perspectives in medical first responder settings

Benjamin Roszipal, BSc, RN, Head of the Institute for Emergency-, Crisis and Disaster Simulation (SIM Campus GmbH) and lecturer for nursing at university of applied sciences St.Pölten. In addition, Benjamin is a registered nurse and working as a paramedic and also acting as lecturer for emergency services and first aid for the Austrian Red Cross organization. He has therefore a strong background as practitioner in medical first responder contexts. At SIM Campus GmbH he is responsible for the development and implementation of different curricula in the context of medical full process simulation and related communication and collaboration skills for the trainees.

Mag., Dipl. Ing., Dr. techn. Sebastian Egger-Lampl is head of research at Mindconsole GmbH, working on XR technologies for professional training and education. He holds a Dipl.-Ing. in electrical engineering and a PhD degree in Information and Communications Engineering from Graz University of Technology as well as a Mag.phil. in Sociology from University of Graz. He is author of numerous conference and journal papers and acts as reviewer and TPC member for international conferences and journals and serves as Editor in chief for Springer's Quality and User Experience Journal. His main research interests are the intersection and utilization of pedagogical concepts in XR training and education as well as the assessment and analysis of related communication and collaboration processes between system users (trainers, trainees, examiners etc.)