OVA's Virtual Reality Crisis Skills Training Achieves Readiness Objectives

OVA
Best Advance in Unique Learning Technology
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Company Background

Company At-a-Glance	
Headquarters	Quebec, QC, Canada
Year Founded	2014
Global Scale	Canada
Customers/Output, etc.	Ville de Québec – City of Quebec (Public security: police, firefighters, paramedics and civil security).
Industry	Virtual Reality
Website	www.ova.ai www.stellarx.io http://www.co-dot.ulaval.ca/en

Value Proposition

Crisis situations are complex, dynamic and unpredictable, placing great demands on the human information processing system which, in turn, may leave responders vulnerable to human error.

These situations can be regarded as rare and uncertain events with potentially high and broad consequences. Each situation is different and crises, as well as the resources to deal with them, can change continuously over time.

Responding to them often requires multiple decision makers who must reason, communicate and make choices about complex systems such as interrelated networks of personnel and material resources.

This collaboration involves individuals, groups and organizations with dissimilar backgrounds and levels of experience working together. The characteristics of crisis response are impossible to predict.

In fact, the main problem that organizations responsible for crisis management face is how to prepare for these "state-of-the-world" uncertainties through training and preparing to handle crises. One way to deal with these uncertainties is to provide effective training in a realistic environment to ensure responders are ready to face these situations and possess the non-technical skills central in determining the effectiveness of emergency response.

Emergency service personnel — police, firefighters, paramedics and the military — must be prepared for various operations, and continuous training is essential for their success and security. Indeed, training professionals to face emergencies requires the mastery of several skills and abilities that need practice.

The objectives of a response to an emergency are preventing or at least minimizing negative consequences (e.g., human and economic losses) and ensuring the emergency will not escalate into disaster. Events that trigger emergencies and the possibility of disaster are difficult to anticipate yet they may have extremely high consequences to individuals and social systems.

Crisis management training aims at facilitating the transposition of learned skills from theory to practice. Learners can share their experiences, knowledge and points of view in order to experience new ways of thinking. In addition, skills like decision-making, communication, mental model sharing, leadership, coordination and interoperability (Lagadec, 2012) are necessary for effective emergency management.

While training in real-life simulations is considered by many to be the gold-standard in training environments, it is costly, includes many logistical challenges and may not address individual learning needs. Moreover, it can take up to six months to plan a live exercise for crisis management training to ensure all elements are in place to meet the objectives of the different organizations taking part (Field, Rankin, Lemmers, & Morin, 2012). The training objectives for each organization need to be included and the various abilities of trainees must be taken into account.

On the other hand, exercising through simulation provides opportunities to test the knowledge, skills and abilities of first responders, assess participant perceptions of

teamwork, training adequacy, response network effectiveness, job risk and equipment adequacy.

Comprehensive training and exercising programs show many more benefits, including the development of shared mental models across team members and an increased understanding of each other's knowledge, skills, roles, anticipated behavior and needs.

They can also be used to develop stress resilience and competency in new decision procedures and in distributed decision making (Sinclair, Doyle, Johnston, & Paton, 2012). Virtual reality (VR) technology is an effective means to meet a wide variety of training requirements and well suited for developing the necessary cognitive skills to turn a team of experts into an expert team (Roman & Brown, 2008).

Virtual reality-based training systems offer numerous advantages over traditional methods (immersive, controlled environment, cost-effective, engaging). By invoking a combination of arousal, time pressure and anxiety, VR can prepare responders to develop the necessary skills for dealing effectively and efficiently with whole-task decision-making while experiencing the overload and anxiety associated with real-life crises (Sniezek et. al., 2002).

Such a virtual experience avoids the risk of costly error inherent in trial and error learning, while providing some of the benefits of actual experience, such as facing psychological pressure, engaging in sense-making and recognizing when constraints such as rules are helpful or not (Moynihan, 2009).

Moreover, using VR, training can be provided in a repeatable and controlled setting. Repetition time and the feeling of presence, which is provided in VR, both have positive effects on task performance, enabling the learning situation to be experienced in as close to a real context as possible. This helps to promote experiential learning as well as the development of operational and formal thinking by facilitating the exploration of different possibilities.

Through its programs, "Vitrine Technologique" and "Faire Face," OVA partnered with Quebec City to develop and create a VR simulation for emergency service personnel such as police officers, fire fighters, paramedics and civil security officers.

Combining OVA's experience in virtual reality and consumer-gaming hardware performance, a simulation was created and developed for training emergency responders in a repeatable and controlled setting to mimic real-life situations as closely as possible, without putting the users at risk for motion sickness.

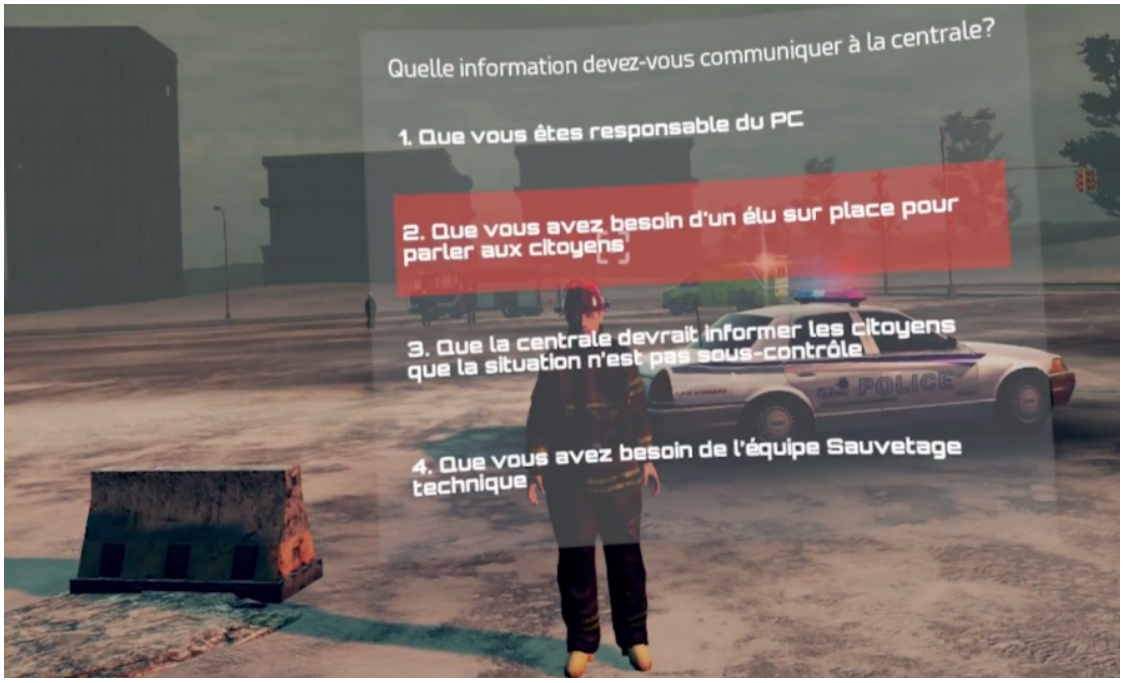
The simulation was designed using StellarX, an immersive virtual and augmented reality platform created by OVA that is a launching pad for diverse situations, including emergencies, through a safe and interactive approach. Its dynamic, intuitive and immersive learning environment fosters critical thinking and facilitates content retention.

In order to develop a unique, valid and adequate simulation, OVA partnered with the COgnition: Distribution, Organization and Technology (Co-DOT) research laboratory from Laval University. The Co-DOT team provided their expertise in cognitive sciences, human factors, advanced usability testing and neuroergonomics.

OVA's simulation scenario places four chiefs (police, firefighter, paramedic and civil security officer) in the middle of a crisis management situation in which a criminal act resulted in an ammonia leak threatening citizens in an arena. As a real crisis-management situation, the plot evolves as a consequence of the decisions of the four chiefs.

To construct the simulation scenario, OVA started by explicitly describing the learning objectives, and the team and individual behaviors indicating these competencies. Based on the learning objectives, the scenario was developed in concert with members from the specific functions we wanted to train (police officers, firefighters, paramedics and civil security).

Figure 1: Example of a Decision to be Made by the Chief of Firefighters[1]



Source: OVA 2018

Product or Program Innovation

The basic assumption is that training should provide opportunities for practice, enabling a team to develop critical competencies to conduct their mission or to manage an emergency.

This immersive Virtual Reality simulation is cost effective, especially in the long run. Running an IRL (in real life) simulation means complex logistics and requires many resources, notably man hours and expensive assets like vehicles and buildings. Once completely virtualized, running a basic four-user simulation requires only a trainer, who

[1] Translation from French: *"Which information do you communicate to the PC (Command Center)?"*
1. *That you are responsible of the PC.*
2. *That you need an elect on site to speak to the citizens.*
3. *That the central should inform citizen that the situation is out of control.*
4. *That you need the technical evacuation team.*

runs the simulation. Other features are interesting, on a case-by-case basis, but not necessary: a 911 call center actor[2], a personal chaperon[3].

Figure 2: Virtual Vehicles

Source: OVA 2018

Also, compared to IRL simulations, VR means much simpler logistics. Only the users (up to four) and the trainer needs to be scheduled together.

IRL for the same scenario, some of the assets needed (and mobilized) are: an arena, its parking lot, police cars, firetrucks, ambulances and gas detectors.

Additionally, a large number of personnel are required to control the scenario and keep the distractions away.

[2]Having a 911 call center actor that responds to the users' communications via radio makes it easier for the trainer instead of doing that himself.

[3]Having a personal chaperone has proven to be effective when the chaperone wants to focus on a specific skill to measure on a specific user.

Figure 3: Logisitics of a Virtual Simulation and IRL Simulation

Source: OVA 2018

From a safety perspective, training often needs to demonstrate risks to show trainees how to avoid them. In training with potentially dangerous equipment (like vehicles or chemicals), it's not likely an accident will occur, but if one does, its severity can be high. VR simulations almost eliminate the severity of training accidents.

OVA's simulation allows multiple users from different services (e.g., police, fire, medical) to share the environment, communicate and coordinate for efficient emergency response. It possesses all the key features to be a training tool for emergency managers' training.

This platform is very flexible and allows for precise manipulation, as most of the functions implemented into the system can be easily switched on or off for testing or training purposes.

All critical events can be simulated within the platform (e.g., residential fire, vehicle accident, bomb threat) and each can be characterized by a list of parameters that specify required actions by the emergency manager.

Another key feature of this platform, as a training environment, is the automatic calculation of cognitive and teamwork-related metrics for the assessment of performance and team during the execution of the task.

In this context, simulation can help bridge the gap between tabletop exercises and real-world simulation exercises, providing an affordable, high-fidelity training environment for learning activities in crisis scenarios.

The platform can become a useful environment for measuring the performance of a crisis manager against the management of a crisis in a realistic and complete simulation, a simulation reproducing a realistic emotional status, and a simulation which might include different crisis managers from different sectors.

Using the platform as a crisis management training system benefits trainees in many ways:

- By training on actual procedures, functions and technologies of crisis management while operating in the real world.
- By learning general competencies required to perform in complex, dynamic problem spaces where:
  - Information is incomplete and changing
  - Multiple participants are involved and have concurrent and conflicting goals
  - Interactions between events and participants may give rise to unexpected complications and aggravations in the crisis management process.

Figure 4: Paramedic, Firefighter and Police Badges

Source: OVA 2018

For training purposes, a simulation is realistic if it induces the same psychological processes in the training context as in an actual crisis. Perhaps the greatest challenge in training for crisis management is inducing the psychological processes associated with the acute stress experienced in actual crises (Sniezek et al., 2002).

Using VR technology, training is provided in a repeatable and controlled setting that mimics real-life situations as closely as possible. Repetition time and the feeling of presence, which is provided in VR, have positive effects on task performance, enabling the learning situation to be experienced as close to a real context as possible (Bertram et al., 2015).

The degree of realism in the simulation is important in maintaining participants' interest and enhancing the educational benefits. The simulation engages participants and keeps them motivated as they make multiple decisions throughout the scenario.

Recent research indicates that simulation-based instructional programs motivate trainees by providing them with authentic, interesting tasks and contexts (Adams et al, 2008; Cognition and Technology Group at Vanderbilt, 1990; Edelson, Gordin, & Pea, 1999; National Research Council, 2011).

Effective training must identify key human performance measures as well as end users' specific training needs. Responding to emergencies requires a range of response tasks, varying in scope, complexity and means of execution that usually involve multiple decision makers.

The process by which members of responding organizations think, work and communicate to achieve common objectives, i.e., collaboration, has a central role in determining the effectiveness of emergency response (Mendonça et al., 2007). Besides collaboration, Schraager and Van de Ven (2011) identified other macrocognitive functions that deserve special attention in supporting humans in the crisis loop:

- Communication
- Coordination
- Critical thinking
- Adaptability
- Shared situation awareness

While the simulation scenario was created, these critical non-technical skills were taken into consideration, so cognitive and teamwork-related metrics were developed to be extracted directly from the platform that best reflects each of these skills.

For instance, coordination and communication can be measured by recording all verbal interactions between participants during the simulation scenario.

Physiological and behavioral measures of these aspects of the users' functional state are integrated into StellarX:

- Workload, manipulated by altering the number of concurrent tasks the trainees must perform
- Information-seeking patterns, based on the comparison of different amounts of content displayed
- Engagement, manipulated by altering the pace of the scenario
- Mental fatigue, based on the comparison, before and after the task

Some organizations have a natural tendency to work independently or in silo. In the event of a critical emergency response, they must work together. This simulation enables and even forces its cross-organizational players to collaborate to resolve the crisis.

Another advantage of a virtual simulation is that many current tools that are used infrequently in crisis situations can be virtualized and used. This provides a good refresher for users and often reminds them of the necessity to use such tools in the field.

Figure 5: Example of the Client's Tools Virtualized

Source: OVA 2018

Ova's simulation software also gathers analytics data like choices made or delay to pick choice automatically. This enables the trainer to objectively measure trainees' performance and/or acquired skills.

The simulations provide users with what is playfully called the "post immersion creativity boost." Participants clearly remember every moment of it and have a lot of feedback to offer.

OVA is positioned as developer of the container, while its clients are SMEs (Subject Matter Experts) of the content. Mutual collaboration with clients is critical to ensure good content in a container that tightly fits their needs. The company manages each project with great attention to detail and with clients' needs in mind.

A mix of lean and agile methodology is used to execute development sprints as soon as the scenarios and all the details are understood and laid out visually. The company delivers a pre-alpha version to enable client feedback.

Unique Differentiators

One of OVA's key specialties is the quality of the developed immersions. Virtual Reality is an industry in its infancy. Recently, consumer hardware performance specifications reached the levels needed to avoid motion sickness and other negative side effects. The industry's leading practices have not been established, including:

- Minimum frame rate
- Maximum scene luminosity
- Reading distance ranges, relation between the six degrees of freedom and motion, and more

Figure 6: Text Interface that Respects the Reading Distance Leading Practices

Source: OVA 2018

OVA's developer team consists of bright minds with engineering or gaming backgrounds, and the expertise for choosing the right hardware and software architecture for the best possible immersion. Having such a strong technical team enables OVA to quickly respond to clients' feedback and add powerful tools during development.

A good example of such a tool is the real-time suggested communication script. As the crisis management scenario unfolds, scripted communications are pushed to the trainer via a live web page accessible by desktop or mobile device. This provides the trainer's control over the cognitive charge (i.e., distraction, stressful events) throughout the simulation.

Figure 7: Script Pushed and Trainees Responding

Source: OVA 2018

Ova was selected, invested in and graduated from ViveX[4], where only about 3% of applicants are chosen. ViveX is the most important Global VR/AR Accelerator. Also, it is the investment arm of HTC[5].

Measurable Results

One major limiting factor in the use of simulated exercises for crisis management training is the lack of effective measures and associated methods for capturing performance data during the execution of a training scenario (Hussain & Feurzeig, 2008).

[4] Second Batch of Companies Joining Vive X Accelerator Program: https://blog.vive.com/us/2017/03/27/vive-x-batch-2/

[5] Vive X Accelerator crunchbase profile: https://www.crunchbase.com/organization/vivex#/entity

However, the simulation possesses the capability for automatic computing of cognitive and teamwork metrics in the assessment of performance and team functioning. StellarX automatically records every action by participants and synthesizes the results, drawing on cognitive-based metrics.

When combined with eye-tracking, it allows the extraction of a range of critical cognitive measures such as coordination efficiency, monitoring and adaptability. This process is completely automatic and as a consequence, does not interrupt participants' decision-making and task accomplishment. These measures target functions of cognitive work, from individual task performance to the quality of teamwork.

Based on measurements included in the platform, the training staff can make valid diagnoses of each participant's performance and assess to what extent learning objectives have been achieved.

During the debrief after the simulation, feedback is provided, and lessons learned are formulated. It has been shown that people learn best from their experience if they receive immediate feedback, allowing for better recognition and assessment of errors (Sniezek et al., 2002).

The results of this project define the guidelines and recommendations for designing virtual reality training platforms. The introduction of human factors, and affective and cognitive sciences in the development of entertainment application s will benefit national competitiveness.

The outcomes associated with this project will significantly impact several key areas of Canadian interest with the potential for significant technological, economic and societal benefits to Canada.

Increasingly, training systems are being used as effective learning tools across a wide range of domains, from schools, healthcare and the military. Incorporation of a virtual reality environment for training will improving learning by maximizing trainees' engagement, and measuring cognitive and affective states.

Such training methods can be applied in a variety of safety critical work domains including transportation and public security, where large quantities of data must be processed by users while maintaining acceptable response times and systematic decisions. As such, the impact in the Canadian public safety sector will be significant.

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