

# Virtual Reality Based Disaster Resilience Training

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**Project name:** VR-based disaster resilience training simulations

**Project owner:** Asia Pacific Disaster Resilience Centre, Republic of Korea National Red Cross

**Release date:** 2018

**Locale:** Philippines, Nepal, Republic of Korea, Mongolia, Singapore, Thailand, Vietnam and Indonesia

**Languages:** Korean, English

**URL:** <https://www.apdisasterresilience.org/vr-safety-training.html>

**XR medium:** Full VR

**Hazards:** Fire, Sinking Ship, Earthquake

**Activity:** Disaster drills and evacuations

**Age group:** 13+

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# Table of Contents

<b>#1 PROJECT BACKGROUND</b>	P3
<b>#2 AIMS &amp; RATIONALE</b>	P4
<b>#3 AUDIENCE</b>	P5
<b>#4 EXPERIENCE</b>	P5
Key design considerations	
Content	
Integration into school disaster training curriculum	
<b>#5 TECHNOLOGY</b>	P7
<b>#6 PRODUCTION &amp; DISTRIBUTION</b>	P8
Production	
Integration, dissemination and distribution	
Licencing	
Challenges	
<b>#7 OUTCOMES AND FUTURE PLANNING</b>	P12
Future planning	
<b>#8 INTERNAL EVALUATION AND LEARNINGS</b>	P13
Process	
Design and content	
Scalability	
Effectiveness	
Key Learnings	

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# #1

## Project Background

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The Asia Pacific Disaster Resilience Centre (APDRC) hosted by the Republic of Korea National Red Cross (KNRC) embarked on a [virtual reality journey](#) in 2018 because of the need for more realistic and participatory training in Asia Pacific, the most disaster prone region of the world. VR is one of various experimental disaster safety training tools used by ADPRC.<sup>1</sup>

Working with South Korean education company [Tekville Education](#), and funded by the Red Cross Honors Club<sup>2</sup>, ADPRC disseminated two virtual reality (VR) pilot disaster simulations of 1) a fire in a theatre and 2) a sinking cruise ship. These were then rolled out across five National Societies: Philippines, Nepal, Republic of Korea, Mongolia and Indonesia<sup>3</sup>. To date over 4,200 young people, Red Cross staff and volunteers have tried the simulations that are delivered as one-off experiences either with a leaflet at events and conferences, or as part of a disaster preparedness one hour training session. As of 2019 this training package is being rolled out in schools in

seven countries: Republic of Korea, Mongolia, Nepal, the Philippines, Singapore, Thailand and Viet Nam. The APDRC is now working with the ICRC on a fully immersive urban earthquake evacuation simulation, following user feedback on simulation topics most in demand as part of an evaluation of the first two VR experiences.

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<sup>1</sup> Others include a fire extinguisher simulator, serious games and actual simulation exercises

<sup>2</sup> A donors' club of the Korean Red Cross, consisting of donors who donate more than USD 100k per year

<sup>3</sup> All countries were provided with the fire simulation. The Philippines and South Korea received the cruise ship simulation as well.

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# #2

## Aims & Rationale

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The aim of the VR-based disaster resilience training simulations according to APDRC is to:

*“train people and raise general public awareness on disaster risks and make them learn, through disaster simulations, what are the proper emergency reactions and the step by step guidelines in each situation.”*

ADPRC decided to focus on VR because they wanted to improve learning outcomes around disasters and identified VR as an effective way to achieve this, stating that.

*“This method (VR) has completely modernized theoretical learning and provides, in addition, a practical dimension and realistic scenarios that make the understanding and learning easier and more efficient.”*

Additional reasons cited by APDRC for this choice include:

- ▶ More realistic disaster scenarios give people a better chance to test how they would really react in a disaster and give greater awareness of how dangerous disasters can be, leading to people being better prepared for disasters when they happen and be more likely to take life-saving actions
- ▶ Action-based learning has been proven to increase learning outcomes: Combining traditional training with VR helps to retain learning. Physical “learning by doing” is more effective than showing films.
- ▶ VR makes the learning process more visual by immersing the user in the visual experience and allows them to learn how to handle a disaster situation while in a safe environment.

KNRC’s PR team had previously developed a 360 video VR experience some years ago but APDRC found that although this as useful for building empathy and fundraising, it was not as useful for training as a fully immersive experience.

# #3

## Audience

The primary audience is the general public, as well as young people and RCRC staff and volunteers. As such, the simulations have been used with a large age range, from 13 to 60. There is no official age limitation imposed by the APDRC, although


they follow what the headsets recommend (13+). They have tried using the simulations with elementary school children (6 - 13) who did not experience motion sickness.

# #4

## Experience


### Content

APDRC have developed three disaster simulations, two that have already been rolled out and one that will be available by August 2019.



3 Contents

2 more languages

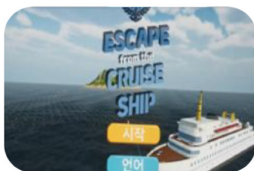


극장 화재 치

시작

종료

Fire in a Theatre  
(KR, EN)




ESCAPE from the CRUISE SHIP

시작

종료

Escaping from ship  
(KR, EN)



Earthquake

Earthquake  
(KR, EN)

\* Coming soon

Videos of the simulations are available on the APDRC website: <https://www.apdisasterresilience.org/vr-safety-training.html> [\*include YouTube videos in multimedia case study].

The topics were chosen because:

- ▶ Fire disaster preparedness is an obligatory subject in South Korea's school curriculum and is the most common disaster across Asia Pacific
- ▶ A major cruise ship disaster where 300+ highschool students died took place in 2014 and hence was a priority for the Korean public
- ▶ Evaluations of the first two simulations highlighted the need for an earthquake evacuation simulation

Both scenarios currently in use immerse users into the emergency situation and require them to escape safely from the burning building or sinking cruise ship.

The simulations contain a health and safety warning at the start: "Use only in a safe environment. Stop if you have dizziness, severe motion sickness, or discomfort." They are available in Korean and English.

### Escape from the Cruise Ship

*Duration: Seven - ten minutes*

*Storyline: "Imagine being on a cruise trip and suddenly hearing the emergency alarm saying that the ship is sinking. What are you going to do? How are you going to escape safely?"*

The simulation begins The simulation contains a warning at the start that this is "experience oriented content" and that in the event of a real accident on a ship it is safest to follow the instructions of the crew. The passenger (the user) receives the normal safety instructions that would be delivered onboard to passengers, taking advantage to educate users on general safety information for disaster risk reduction. The ship then encounters a collision, and from then on the safety advice is focussed on how to respond to the ship sinking (e.g. get a life jacket, get on deck, avoid fires, activate lifeboats and use of emergency kit items). The user is asked to make decisions along the way.

The experience captures the adrenaline of a real event, even from simply watching a video of the experience. The simulation contains realistic graphics and uses small snippets of real videos to illustrate some actions, such as the lifeboat inflating once activated. The cruise ship has a generic look so is more broadly applicable than only to Korean cruise ships. There are no other people visible in the simulation and multiple-user interaction is not possible.

### Fire Theatre

*Duration: Five minutes.*

*Storyline: "A sudden fire starts while you're comfortably sitting on your seat in the theater. Do you know how to protect yourself from the smoke? What actions to take?"*

The simulation starts when a fire breaks out in a theatre where the user is a spectator. The setting is a generic cinema or theatre view with a red curtain and seats that could represent an

urban theatre in multiple countries. When the fire breaks out, the user must carry out various safety checks as they try and escape from the burning theatre. For example, testing if the door handle is hot before opening; staying low on the floor as evacuating a smoke filled corridor, and using a fire extinguisher. The user is asked to make decisions along the way.

The developers deliberately kept the scenario simple with one theatre scene, because they wanted to focus on the safety messages communicated to the user and have simple and easy actions to memorise (for example, not to use an elevator in time of fire, check exit and temperature of door knob before opening, and use a fire extinguisher). At the end of the experience a list of safety tips are provided.

The experiences are not currently integrated into broader training sessions, though they are distributed as part of a one hour disaster preparedness training package (see Production and Distribution section) including in schools in some of the target countries.

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## #5 Technology

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The fully interactive simulation was built by the education company in Unity, and both HTC Vive, Oculus and Samsung Odyssey headsets were used during the initial roll out, alongside gaming laptops. These headsets require room controller installation, which can be complicated as they require specific technical training. Instruction manuals and training of trainers was offered to be able to train team members to deliver the experiences.

With the new phase in development with ICRC, the recommended headsets are Samsung Odyssey, which include camera tracking in the headset, so they are easier to set up and require basic technical skills. However these headsets also work along with gaming laptops, which inflate the cost per kit, though the new headsets can be used with the same gaming laptops. A side monitor was also recommended to be

able to broadcast the experience inside the headset to other users around.

- ▶ Pros of the equipment: high-end experiences, quality viewing, interaction through controllers
- ▶ Cons of the equipment: expensive, tied to a gaming computer

In 2018, KNRC distributed one device kit each to the Philippines, Indonesia, Nepal and Mongolia and six to different KNRC chapters. In 2019, KNRC distributed two devices to each of the six NSs and an additional 9 to KNRC chapters, bringing the total devices distributed in Korea to 15 and other NS to 12. The simulations are implemented in National Societies by focal points trained by APDRC in three trainings of trainers held in 2018 and 2019, and NS staff and volunteers who they subsequently trained.



# #6

## Production & Distribution

### Production

Production took place between 2016 to 2018. APDRC worked with an educational training company from South Korea, Tekville Education, who they had already worked with in the past to develop e-learning programmes. Tekville produced and continue to provide maintenance for the

simulations. The production was done with occasional consultation with APDRC, although the bulk was done directly by Tekville. There were pros and cons to outsourcing the development, highlighted in challenges below.

### Integration, dissemination and distribution

APDRC has rolled out the fire and ship simulations across five National Societies: Philippines, Nepal, Republic of Korea, Mongolia and Indonesia<sup>4</sup>. They developed an

operations manual and invited focal points (HQ programme managers) from the Na-

<sup>4</sup> All countries were provided with the fire

simulation. The Philippines and South Korean received the cruise ship simulation as well.

#### 1 (3) Hour

- lecture + VR experience + leaflet
- lecture (incl. serious game) + VR + Discussion



#### 5 Minutes

VR experience + leaflet





tional Societies to a Training of Trainers to learn how to use the devices and simulation. The focal points have then passed on this training to other staff and volunteers as some NSs provide this services at the chapter level.

The simulation is disseminated in two ways:

- ▶ **At exhibitions or conferences**, in booths, as a one-off experience complemented by a leaflet with more information
- ▶ **As part of a one-hour disaster preparedness training package.** Before the simulation is used, the audience is provided with disaster knowledge and concepts and after the simulation they

share their reactions and feedback and have a discussion. Video clips are also shown. Sometimes this is combined with training in CPR and/or the disaster prevention serious game [Riskland](#) developed by UNDRR and UNICEF.

This approach is being used already in schools in South Korea and the Philippines. The training package was shared in the training of trainers session with the other NS this year and they will be rolling this out across schools in the other countries from April - December 2019.

Total distribution figures:

Country	Devices	Targets	Participants	Events	Duration
Rep. of Korea	6	2,520	2,977	51	June 2018 ~ March 2019
Philippines	1	100	512	15	April/May ~ November 2018
Mongolia	1	150	234	9	
Nepal	1	100	527	21	
Indonesia	1	100	27	2	
<b>Total</b>	<b>10</b>	<b>2,970</b>	<b>4,277</b>	<b>98</b>	

The simulations have been promoted through IFRC internal channels such as newsletters and APDRC has shared information with the other Red Cross Red Crescent Disaster Preparedness Reference Centres globally. The VR simulations have also been disseminated at events across the AP region, including:



AP FbF Workshop, KL



AMCDRR, Mongolia



Youth Exchange Program, Korea



National Youth Camp



Korea Baseball All Star Game



AP Regional Conference

## Licencing

Tekville is a private company that also receives some public funding. APDRC were originally required to pay a licensing fee per month per user, which limited their ability to roll the simulations out more

widely. They renegotiated to a flat fee per download, abolishing the monthly rental. This is per install per device and has no associated time restrictions. The copyright for the simulations remains with Tekville.

## Challenges

The major challenge faced by APDRC in the production and distribution of the VR simulations was the restrictive licencing arrangement with the developer Tekville Education. The consequences of the arrangement have meant that it is too costly to roll out at a wider scale, in addition to the expense of the equipment. This also limits the experience to a one off.

Based on these challenges of cost and copyrights, the next simulation APDRC is working on (earthquake evacuation) is being produced in house<sup>5</sup> by ICRC (see future plans). APDRC felt that working with ICRC was more financially viable, as ICRC are able to absorb most of the development costs, excluding the script-

<sup>5</sup>To the RCRC Movement

writing and voiceover. This is not however a model that would always be replicable in the future, given the expense for ICRC.

Other challenges included:

- ▶ Content development was led by Tekville, who have their own training expertise. It was not developed in partnership with KNRC or tailored to the

DRR behaviour change communication campaigns of the NS it was rolled out to.

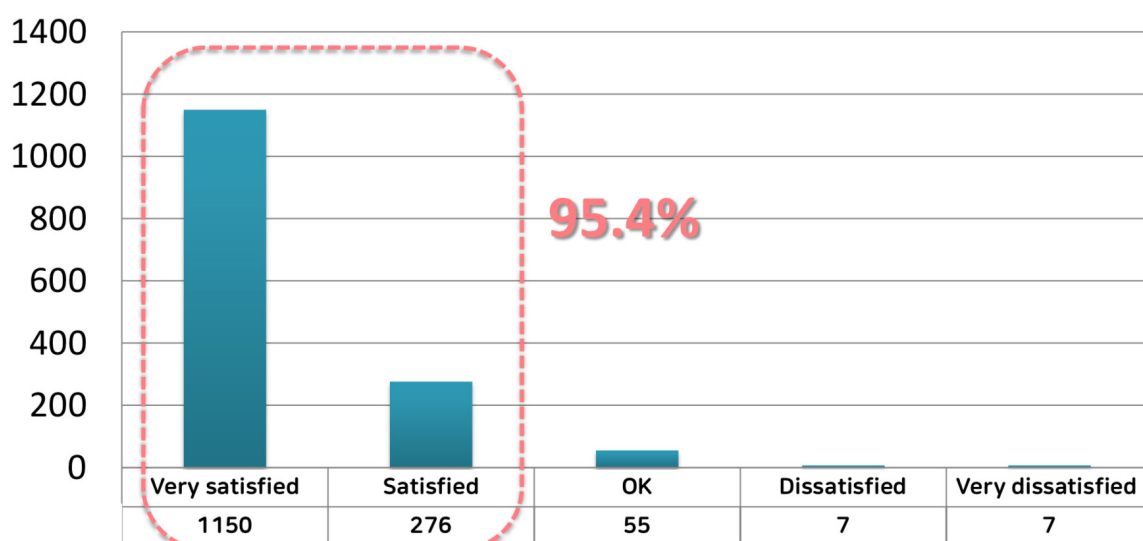
- ▶ Lack of qualified software operators in schools to be able to increase roll out
- ▶ HR constraints: APDRC has only two full time staff, and therefore they worked with other departments and chapters of KNRC and university student volunteers to provide training.

## #7

# Outcomes and Future Planning

A 2018 satisfaction survey of over 1500 users found that 95.4% were either satisfied or very satisfied with the experience. The surveys were carried out after several VR trainings in 2018 both at conference and events and as part of training packages

delivered in schools. Occasionally APDRC conduct a pre and post test, although this is not formally built into the training package experience.



[Feedback from National Societies](#) included::

#### Positive:

- ▶ Interesting
- ▶ Very practical
- ▶ Interactive
- ▶ Realistic
- ▶ Fun and easy way to learn
- ▶ Nice graphic designs
- ▶ Perfect for emergency practice
- ▶ Effective

#### Difficulties:

- ▶ Understanding the English content
- ▶ Setting up VR tools
- ▶ Confusing controls (difficult to control the thumb stick)
- ▶ Some people felt dizzy afterwards, including elderly people

#### What can be improved or added:

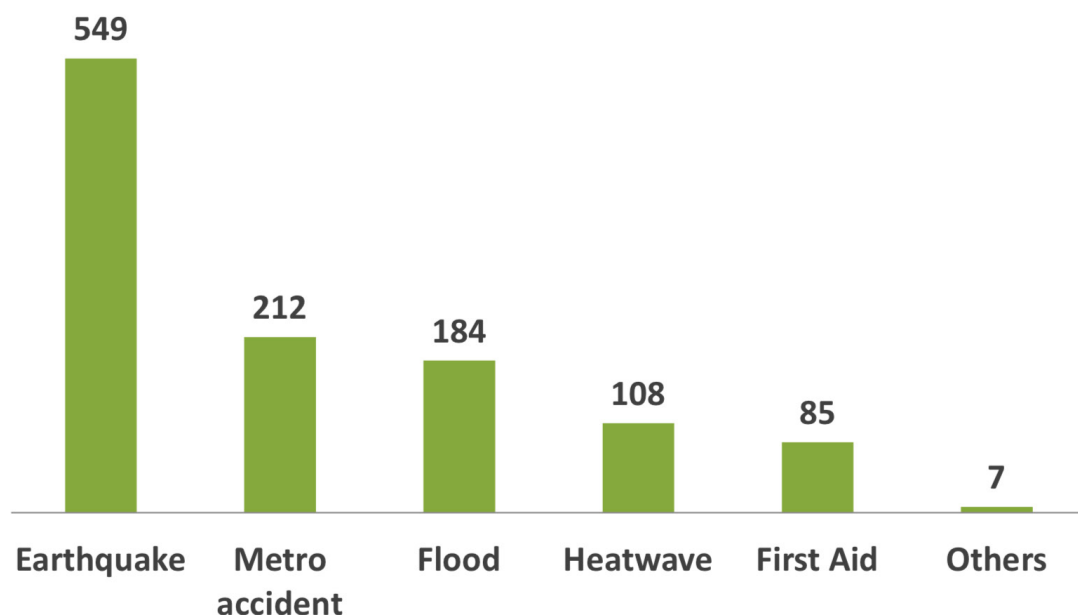
- ▶ Need a Nepali version of the games
- ▶ Need to add more scenarios (earthquake, flood, first aid)
- ▶ The fire scenario is too short<sup>6</sup>
- ▶ Add difficulty levels
- ▶ Make audio instructions
- ▶ Add more players
- ▶ Add more decision making elements
- ▶ Add motivational incentives
- ▶ Improve controls

<sup>6</sup> Though it is the recommended length for a VR simulation



One of the most common suggestions was to have more types of content, particularly around earthquakes. A specific survey of over 1,400 people on new content development also confirmed this.

There have also been requests for a simulation of a fire in a rural setting, however APDRC feels that urban populations are better equipped to use the technology and are not planning to act on this feedback.



(No. of Respondent: 1,145)

## Future planning

In 2019, APDRC started to roll out the simulations out to an additional three National Societies (Singapore, Thailand and Vietnam) and 15 KRCS chapters bringing the total number of users to 14,060.

As of 2019 the simulations are only available in Korean and English but APDRC would like to translate them into the local languages of the NS they are working with, particularly in places like Mongolia, Nepal, Thailand and Viet Nam. As soon as they secure funds, APDRC plans to translate both the cruise and fire simulations into two more languages.

Building on user feedback, the APDRC

team is working with the ICRC to build an earthquake evacuation simulation with a substantially different mode of production and delivery. It is planned to be ready for testing in the second half of 2019. In contrast to the fire and ship simulations where the training company led on content development, for this iteration APDRC put together an internal task force to come up





with detailed storyboards for the simulation that were provided to the ICRC. They are aiming to improve on the first two VR experiences and make the new one more interactive, for example by integrating a scoring system to motivate users. As the director of APDRC says,

*“Interactivity is key, people need to learn by doing.”*



*Caption: ICRC / APDRC earthquake preparedness simulator in the design process: evacuation from a typical urban apartment during an earthquake, that also includes how to make the apartment safe before an emergency.*

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## #8

# Internal Evaluation and Learnings

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### Process

The design process was entirely handled by Tekville Education, who consulted experts and academics on the content, with little input from KNRC. Although this alleviated the workload from an already stretched and small team, it meant that the National Society had very little say over the quality of content of the simulations. This led to some inaccuracies in the content, for example the fire simulation appears to allow users to get too close to the fire that would be advisable or possible to do in real life. Although no NS have reported issues with the safety advice provided in the simulations, it is a missed opportunity not to have worked with disaster management professionals to tailor the content to the first aid

and disaster management messaging of the NS involved, particularly as the simulations are rolled out in schools.

The overall cost to APDRC was kept low despite the expensive equipment because of public funding received by Tekville. However the restrictive licensing features was a hidden cost not anticipated by the NS and has prevented wider roll out of the experiences, as has the expense of the equipment.

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## Design and content<sup>7</sup>

The content design integrates a basic level of decision making but without the complexity of branching scenarios. Tekville aimed to keep the messaging simple and focussed on a few key safety activities. The simulation is therefore simplistic, but given that it is not recommended for more than five minutes, and that it is currently used as a one off, the simplistic approach is effective. Complex content is more suited to a repeated experience, or one that is part of a more extensive educational package.

Tekville incorporated user feedback into the design, but they managed this process themselves and it is not clear how extensive the testing was, who provided feedback, or how many changes were made based on user feedback. ADPRC was not at all involved in this process. It is not clear if young people were involved in the design or pilot. Several experts and academics were consulted on the detail of the content. The lack of a clear strategy to involve of school teachers or disaster management officials was a missed opportunity by Tekville to produce content more suitable for integration in curriculums and for wider roll out in schools.

The experiences come with a health and safety warning and is always accompanied by someone from the Red Cross. The simulation contains a warning at the start that this is “experience oriented content” and for the ship evacuation simulation - that in the event of a real accident on a ship it is safest to follow the instructions of the crew. There does not seem to be strict adherence to the 13+ age restriction

suggested by the headset developer as the experienced has been trialed with elementary school children. Stricter guidance on age restrictions is suggested to be added to the roll out package, particularly for the ship evacuation that is more realistic and could be intimidating for smaller children who are not able to separate simulation from reality.

The training package mode of delivery is one hour long and incorporates some feedback to users and discussion on their experiences. However when the simulation is tried at conferences and events no feedback is given. Within the experience, given the low level of decision making, there is consequently a low level of feedback incorporated into the simulation. For example, if you test the door handle and it is hot, indicating fire on the other side of the door, but you decide to open it anyway, you are given a warning sign and told to use another exit.

There is no player interaction or other people visible in the simulation which detracts from the reality of the immersive scenario. Conversely, this makes it more accessible to a wider age range as the increased reality of other players or simulated people in distress could be disturbing for younger audiences.

The content is currently available in Korean and English. User feedback from NS requested translation into their local languages, which has not been possible given the restrictions for working with Tekville but should become possible with the ICRC earthquake simulator.

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<sup>7</sup> The licensing restrictions prevented a detailed testing of the experience and this review is based on videos of the simulation.



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## Scalability

APDRC have only been able to scale up the distribution of the kits to NS to a certain level because of the cost of the equipment, the licensing restrictions, and technical user requirements necessitating training. It is not clear how the NS are rolling this out, but with the technical skills needed to set up and use the simulations there could be some blockages to roll out at the NS level. This is not predicted to change as APDRC work with ICRC going forward, given that APDRC have purchased new Samsung headsets that have similar restrictions. Recent technological developments have been made in the field of standalone VR

headsets that can perform without a laptop to a high standard, such as Oculus Quest. These headsets cost approximately 400 USD and are now available on the market and that would provide a more scalable option for National Societies.

ADPRC are only rolling out the simulations in urban areas as they feel it is more appropriate for urban contexts, but given the fast development across the Asia Pacific region, where the content is relevant, it could be beneficial to broaden out to rural or peri urban settings where many of the most disaster prone still live.

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## Effectiveness

The aim of the simulations is to improve learning around how to react in disasters through a “learning by doing” approach. As evaluation reports are not available in English it is difficult to tell if this has been successful. User feedback is very positive, but was gathered focused on satisfaction levels rather than impacts on learning. Pre and post simulation test results suggest an increase in learning but this has not been systematically integrated into how the experience is rolled out.

There are some limitations in effectiveness from the one off nature of how the simulation is used. VR is best used as part of a training package and not as a standalone tool, and so when the simulations are used at conferences they attract people with the wow factor, and act as a door opener to get people further engaged, but this is then not capitalised on in the same way as when VR is integrated into a broader training experience and complemented by other methods.

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## Key Learnings

The simulations deliver a set of key messages and safety advice for two emergency settings in a simple but effective way. The main learnings or relevance centre around, but are not limited to, the production process and barriers from working with an external agency with restrictive licensing and a non-participatory content development approach.

- ▶ Strong example of roll out of XR to multiple National Societies. The process of engagement with NS is effective and thorough, for example in training focal points and not just providing the equipment.
- ▶ Example of a NS not only rolling the technology out to their own organisa-

- ▶ tion (KNRC) but also focussing on NS that they support in the region.
- ▶ Lack of participatory design process can lead to lack of alignment with RC messaging and lack of ownership of content
- ▶ Limitations to scalability coming from working with a commercial company that issues licencing fees and retains the copyright
- ▶ Limitations of scalability using expensive and more technically challenging equipment, despite multiple country roll out
- ▶ There is an opportunity for GDPC to act as or create a hub to share and showcase ongoing XR initiatives across the Movement. APDRC was not aware of some of the other RCRC initiatives that could have provided useful insights and learning and informed their decisions on next steps.

Many of these learnings are being taken on board in the approach with ICRC, for example through the detailed establishment of a task team to develop the content and story boards in-house. However, scalability issues with National Societies are still predicted to be a barrier given the cost of the gear that is planned to be used.



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