University of Twente

# WORKER

Train together. Save together

Business Development Lab

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# Contents

# Introduction

WorkER is a venture concept developed in the course “Business Development Lab” over the course of half a year. The process included working with the Lean Canvas, carrying out market research, developing a prototype, and analysing monetary and societal aspects.

This report aims to give an overview of the whole business development process and to describe the product in detail. First, the initial customer needs, validation research and validated customer needs are discussed. In the second chapter, the proposed solution is presented. Here, the solution validation research methods and results are outlined, as well as an updated solution. The next chapter introduces the lean canvas, followed by an in-depth discussion on some of its parts including intellectual property strategies, ethics and sustainability. Chapter four explains the financial aspects of the venture concept, drawing up strategies and forecasts regarding the cost and revenue model. Finally, chapter 5 reflects on the relation between business and technology.

## WorkER Lean Canvas

| **Problem** | **Solution** | **Unique Value Proposition** | **Unfair Advantage** | **Customer Segments** |
|---|---|---|---|---|
| Applying theoretical knowledge to a real life situation needs constant practice to come naturally<br><br>Lack of immediate feedback on performance<br><br>Lack of interdisciplinary[1] cooperation training between units<br><br>Interdisciplinary training sessions are expensive to organise and time-consuming to partake in<br><br>***Existing Alternatives***<br><br>Collaborative training | A VR-powered application simulating emergency situations for emergency workers[7], including medical accidents, fire, car accidents, accidents at sea<br><br>VR-application for a mobile device in a cardboard/head mount + handheld bluetooth remote controls<br><br>Individual or multiplayer training of collaboration situations between different units<br><br>Timing of tasks for testing and examining<br><br>Possibility of immediate feedback and notifications when incorrect behaviour is encountered<br><br>Summary at the end of the | Make training as accurate as possible, while still being just a simulation<br><br>Teamwork and cooperation practice without the need for having real teams present<br><br>More convenient alternative to existing training centers, no need to leave the workplace<br><br>Simulated, more realistic practice environment will improve routine, applicability in real-life situations | First to market – a novel idea with limited to no direct competition<br><br>Governmental support<br><br>Multi-disciplinary development team<br><br>Solution worked out with professionals<br><br>Network effect | Police, Rescue, and Health Care Colleges<br><br>Estonian rescue workers including Estonian Rescue Board (firefighting, chemical accidents, explosives, accidents at sea), the police, and ambulance<br><br>Both professional and voluntary units<br><br>Estonian Rescue Board[8]:<br>72 national brigades +<br>4 bombing squads +<br>119 volunteer brigades<br><br>Estonian ambulance[9]:<br>62 ambulance bases,<br>102 ambulance brigades (3 members each) out of which:<br>14 with doctors,<br>82 with nurses, |

[1] Happening between different types of emergency rescue units from different disciplinary areas, i.e. firemen and paramedics

| | | | | |
|---|---|---|---|---|
| centers[2]<br><br>Theoretical training materials (written texts, videos)<br><br>Virtual training[3] [4] [5]<br><br>Elite VR training[6] | simulation exercise<br><br>Guidelines, walkthroughs and tutorials<br><br>Reminders to practice<br><br>Statistics for self and supervisors<br><br>Scoreboards and comparisons between players | Available whenever one wishes to brush up on their teamwork skills<br><br>Better overview of hours spent on practice and skill levels of the workers for their supervisors<br><br>***High-Level Concept***<br><br>*WorkER* - Emergency teamwork simulator for rescue workers | | 6 reanimobile brigades,<br>+ bicycle brigade in summer,<br>+ need-based telemedical consultation<br><br>Interested in staying sharp in their emergency and teamwork skills<br><br>***Early Adopters***<br><br>Students in Health Care Colleges<br><br>Technologically forward thinking jurisdictions<br><br>(Volunteer brigades) |
| | **Key Metrics**<br><br>Number of subscriptions<br><br>Frequency of use<br><br>User rating & feedback | | **Channels**<br><br>Existing training providers (the Estonian government)<br><br>Direct sales and communication<br><br>Online support (a.o. website) | |
| **Cost Structure**<br><br>App development including product testing<br>Integration and customization<br>Market and customer research<br>Marketing & advertising<br>App maintenance<br>Customer support<br>Hosting costs<br>Human resources<br>Content creation | | | **Revenue Streams**<br><br>Monthly subscriptions (multiple levels) to training suites<br>VR equipment brokerage | |

[7] Such as paramedics, firefighters, the police
[8] https://www.rescue.ee/et/paeaesteameti-struktuur
[9] https://www.terviseamet.ee/et/tervishoid/inimesele/kiirabi
[2] https://www.jems.com/articles/print/volume-36/issue-6/training/chicago-fire-department-builds.html
[3] http://www.ludus-vr.com/en/areas/emergency/
[4] https://www.vreta.co/
[5] https://safetymanagement.eku.edu/blog/how-the-department-of-homeland-security-can-use-virtual-reality-for-disaster-response-training/
[6] https://elitevrtraining.com/fire-safety/

# 1. The Needs

## Initial Customer Need Hypotheses

Before conducting the market research and talking to any potential customer groups, we decided upon **knowledge of first aid amongst the general public** as our field of interest and formulated some initial hypotheses about which needs the customers may have:

- **The level of knowledge about giving first aid is low** amongst the general public: 70% of the population between ages 20-40 has not had any first aid courses.
- **The level of long term retention of first aid procedures is low** amongst the general public: 80% of people who have had first aid training of any kind do not remember how to perform first aid procedures correctly despite having practiced the procedures during a first aid course.
- People participating in a first aid course **would like to see more realistic visuals of the injuries** to help them understand and learn better.
- People participating in a first aid course **would like to have a hands-on experience with the injuries** to help them understand and learn better.
- **The cost of first aid training instruments**, such as CPR mannequins, **is too high** for most first aid course providers to be able to allow using them in first aid trainings meant for the members of the general public.
- **Preparing fake injuries with makeup and body paint requires additional acting personnel and is too time-consuming** for first aid course providers to use it in trainings meant for the general public.
- **First aid training sessions offer less intensive training** due to a large number of participants in each class which reduces the efficiency and effectiveness of the training.
- 80% of the members of the general public are **not willing to pay more than 5 euros a month for a augmented reality based first aid simulation**.

Therefore, the main problem can be formulated as the general public lacking a cheap and efficient way to practice first aid in a more realistic way both during and after first aid courses.

### Secondary Data to Support Initial Need Hypotheses

To begin with, the initial domain choice and customer need hypotheses were based on the experiences of the team members with different international backgrounds. During a discussion, it was discovered that while in Estonia and Germany first aid courses are a mandatory part of

the process of obtaining one's driver's licence (Riigi Teataja, Traffic Act, §100 section 3), this is not the case in the Netherlands, nor the United States.

Furthermore, when looking back at our own experience and discussing the ability to give first aid both amongst ourselves and with some of our peers, we concluded that those, who have participated in a first aid training course have forgotten most of the material due to not having re-read the theory and practiced the skills for a relatively long period of time. This is also supported by a variety of online articles and statistics. For example, in the UK, only 1 in 13 people feel confident that they are capable of performing first aid on an injured person (BBC News, 2009) and only 9% of parents correctly solved three emergency scenarios (Christian News).

In addition, there are currently several obstacles concerning first aid training. First, existing training mannequins and injury sets cost several hundreds or thousands of euros depending on their features[10]. This is a huge problem for schools which often do not have sufficient funds to buy these mannequins for classes. The lack of mannequins, as well as a lack of training are two of the main factors limiting the quality and frequency of first aid courses in schools (Bakke, Bakke, & Schwebs, 2017).

Second, long-term retention of first aid skills can be difficult. Banfai, Pek, Pandur, Csonka, and Betlehem (2017) noted a decline of 5-30% in the performance of children age 7-14 four months after learning practical first aid skills. However, training methods involving hands-on practice on mannequins lead to better long-term retention and overall performance improvements (Herrmann-Werner et al., 2013).

# Research

To confirm or disprove our initial customer need hypotheses, a minor-scale market research was conducted. Due to our first need hypotheses being disproved, the research process can be separated into two rounds that smoothly evolved from the first one to the second. What follows is an overview of the whole process.

## Participants

We started with members of the **general public** (e.g. university students) and **professionals** working in the fields that are related to medicine or in which first aid trainings are mandatory (e.g. general practitioners, Red Cross workers, school teachers). In round 2, we focused on professional emergency workers, such as paramedics, firefighters, and the police.

The participants were recruited either by **random selection** in the street (in case of the general public) or by **word of mouth** with help from friends working in the rescue field (in case of professionals). The participants were from the Netherlands, Estonia, Germany, Indonesia,

[10] https://www.laerdal.com/gb/doc/785/BTLS-Victim-Injury-Set

Portugal, and the USA. Overall, 17 people were included in the study, 11 in the first round and 6 in the second round.

The participants were not offered any incentives to join the research and helped out purely of their own will to do so.

## Method

The market research was conducted in the form of **semi-structured interviews**. This means that although questions for the interview were prepared in advance, the participant was asked to elaborate on other relevant and interesting aspects that arose during the interview.

If possible, the interviews were conducted face-to-face. In cases where the interviewee was located further away (in Estonia, for example), the interviews were conducted via a video or a voice call.

At the beginning of the interviews, the interviewees were reminded that they may refrain from answering any questions they wish and can stop the interview completely at any time. The interviews were not recorded, but notes were taken during the process.

## Questions

Following are some of the questions that were either asked in the original or a slightly modified format during the interview. Between the first and second round, the questions and research goal was slightly modified based on new insights from the first round. This new approach was intended to support the modified research direction and find out more about the training routines for professional rescue workers.

**From members of the general public**:

- Have you had any first aid training?
- Do you see being able to give first aid as a necessary skill?
- Why would you like to have first aid training?

**Professionals Round 1**:

- When was the last time you participated in a medical training?
- Which first aid trainings have you participated in?
- Which first aid methods have you been taught?
    - What should you do in case of an open wound / someone fainting / epilepsy / etc?

- Which devices / study materials were present in your first-aid training?
- Are you expected to know first aid by your employer?
    - How often do you give first aid in your work?
- When was the last time you were in a situation that required someone to give first aid? What happened?
- How much should others know about giving first aid?

**For exploring and identifying the problems professionals might have:**

- What does your typical workday look like?

**Professionals Round 2**:

- Which (work-related) trainings do you have?
- How often do you have work-related trainings?
- How well can the skills obtained from the training be transferred to your daily life / working situations / environments?
- What is lacking from the trainings?
- How could the trainings be improved?

By using a semi-structured interview format, it was possible to gain additional information with tailored follow-up questions.

## Results

The initial research hypotheses were **disproved**.

The first round of interviews unveiled that neither hobbyists, nor inexperienced members from the general public and professional medical workers consider the **lack of higher visualisation of the injuries** in first-aid trainings as a pressing problem. Although interviewees without medical training stated that knowing how to give first aid is an important skill to have, they were not highly interested in participating in any training to begin with.

All of the professional rescue workers (6 of the 11 interviewees) thought **enhancing generic first aid training courses by using augmented reality solutions would not be viable**. Due to seeing the will to learn first aid as connected to a deeper, moral responsibility of an individual, they failed to see how an AR application would help solve that problem.

Medical professionals (4 out of 6) thought that **simpler trainings**, which can be completed more often, **make learning more fun and engaging**, and, as a result, **increase the amount of**

**information retained**. Classroom trainings, as opposed to more hands-on in-the-field trainings, can only provide limited practice for real life according to 9 out of 10 interviewees, and are hard to translate into real world emergency situations.

This was also confirmed by the fact that 8 out of 11 interviewees also found it **difficult to transfer skills from artificial and largely theoretical practice scenarios to real life situations**. Because of this, emergency workers and especially volunteers, who have less practice in general, may fail to recognise certain (medical) conditions or struggle with dealing with them in real life despite having received thorough training beforehand.

Many other problems besides the lack of first-aid skills were identified from the conducted interviews (e.g. communication, psychological endurance, applying training that was done elsewhere to a specific physical real world location), but a common one among the different categories of rescue workers (paramedics, firefighters) was **how teamwork practice is currently executed**. The interviewees regularly practise emergency situations on their own and together with their disciplinary team/unit (e.g. a team of paramedics) both theoretically and practically on either a higher or lower level in regard to detail and realism.

On the other hand, interviewed emergency workers often **lack practice with their more distant colleagues from other disciplinary units** due to time, location, and financial issues. Organising a major-scale on-location training costs money, demands the workers to allocate time (often a whole day or more), and forces them to travel to a specific training location. This process needs to be coordinated between multiple disciplinary units from various rescue fields. As a result, such cooperative trainings with all different units is only carried out about 3-4 times a year.

The problem is even more pressing for **volunteer rescue workers** who may participate in fewer calls and thus have fewer opportunities to gain experience or retain their knowledge and skills. The web page of the Estonian Rescue Board implies that some volunteer rescue workers do not even have a nearby brigade to join and practice with.

Knowing how to work together, however, is an important skill for any rescue worker. Especially during accidents, several interdisciplinary emergency units (most often the medics, the firefighters, and the police) have to **work simultaneously** and **in collaboration** with each other. Practicing this kind of teamwork beforehand might increase the efficiency of interdisciplinary units working together in an actual emergency situation and give the rescue workers an advantage in resolving the problem better and faster, thus improving the safety of both the rescue workers themselves and the members of the general public.

## Validated Customer Needs

After iterating on the customer research process, disproving the initial customer need hypotheses, and exploring the market domain of emergency services further, the following customer needs were identified and confirmed:

- **Emergency workers need constant practice in order to be able to apply theoretical knowledge to real life situations in a natural and effortless way;**
- **Emergency workers lack immediate feedback on their actions and performance which would enable them to become more professional and efficient in their job;**
- **There exists a lack of interdisciplinary cooperation training between different emergency response units;**
- **Interdisciplinary training sessions are expensive to organise and time-consuming to partake in.**

Based on these validated customer needs, we propose WorkER, a virtual reality powered emergency teamwork simulator for rescue workers.

# 2. The Solution

## Features

WorkER is an emergency simulator for professionals. The prototypes of the concept can be seen in sections Storyboard and Point-of-View Video.

WorkER is a virtual reality powered mobile application designed to **simulate emergency situations** (such as medical accidents, fire and car accidents, or accidents at sea) and can be used for **training** purposes by emergency workers from various different disciplinary fields, for example, paramedics, firefighters, and the police. By removing the monetary and location-induced constraints from the training process, WorkER enables rescue workers to **train more often**, thus constantly improving their skills, effectiveness, and efficiency, and allowing them to retain their level of professionalism.

The WorkER suite can be split in two. The **training** sessions are supported by guidelines, walkthroughs, and tutorials intended to help the users assimilate new knowledge. The **testing** (examination) sessions provide an uninterrupted workflow designed to simulate real-life emergency situations as close as possible. Periodical **reminders** notify the users to practice.

WorkER supports the improvement of emergency personnel by providing the users with **feedback** on their performance. The simulation sessions are timed and feedback can be both immediate following incorrect behaviour (training session) and summative at the end (testing session). In addition to the user themselves, the performance statistics are also shared with their immediate **supervisor**. This gives the supervisors an overview of their team's overall performance and enables them to focus on both individual improvements and the skill level of the whole unit.

WorkER enables both **individual** and **multiplayer** training sessions. This way, the users can practice various emergency situations that demand collaboration either between the members of their own disciplinary unit or between multiple interdisciplinary units.

The WorkER application is **low-cost** for the customer. It works on any smartphone with VR support which means that the customer does not additionally need to buy expensive equipment, such as HTC Vive, to use WorkER. The customer only has to invest in a head mount for their mobile phone and a pair of handheld Bluetooth remotes which enable them to further control the simulation and the virtual environment, while the application reacts to the user's head movements and focused gaze points. The headmount can even be made out of cardboard (e.g.

Google Cardboard). This makes the WorkER **cheaper** to use than other high-end VR solutions (e.g. FLAIM Systems[11]) or actual field trainings.

## Competitive Advantage

There are currently some virtual reality training systems in the marketplace, but none directly address all of the problems we have solved with WorkER. The crux of this is the focus of our virtual training exercises on interdisciplinary cooperation and teamwork. While current solutions address trainings for **individual teams** (e.g. firefighters[12]), they do not enable the practice of working with the other units who will inevitably be at the scene of an emergency as well. An especially unique advantage that WorkER offers in this domain is the ability to **train with virtual workers from other domains and teams**. In this form, this does not presently exist anywhere on the market.

Unlike current competitors in virtual reality training, physical training centers do involve the same **teamwork aspects** as WorkER . However, here our powerful difference comes from the fact that WorkER offers **more convenient** training, while maintaining a **high level of effectiveness**. Through **partnerships with clients to develop content**, we will have uniquely accurate training simulations, based on real events and the experience of veteran emergency workers. While we retain the advantages of offering these trainings through **simulated environments**, we will be able to make the trainings as **accurate** as possible. Additionally, though the ease with which virtual simulations can be accessed, both in terms of financial and location resources, our solution will be far superior to existing physical training centers. On the one hand this means that trainings will be able to be run far **more often and cheaply** because all that is required is a virtual reality headset as opposed to a large training facility. In addition, **time and money saved** in transportation to those facilities for the trainees will encourage more trainings as well. Both of these factors mean that trainings will occur **more regularly** leading to improved routine and applicability to real-life situations.

A further benefit to the WorkER training system is its **simplicity**. While this is inherent in the cost and location benefits, it also offers the unique advantage to enable **spontaneous training**. Any operative of an emergency service can train at any time to keep themselves confident and up to date. In tandem with this comes another key advantage, namely a **support system** to track hours spent training, levels of training, and other metrics. This is important to encourage and value trainings from both the perspective of the trainees and the supervisors.

[11] https://www.flaimsystems.com/
[12] https://www.re-lion.com/redsuit.html

# Initial Solution Hypotheses

The solution hypotheses can be formulated as follows:

- **We expect 80% of the interviewees to agree with the central premise of a virtuality training to solve issues related to colocated training exercises.**
- **A majority of the interviewees will imagine the solution to increase the value of their own training exercises:**
    - Through better retainment of theoretical knowledge,
    - Better support of interdisciplinary training sessions,
    - More updated content to reflect the newest and best practices, and
    - Improved feedback on performance through real-time metrics.
- **Providers and organizers of interdisciplinary emergency training will see the solution as an improvement over costly existing alternatives.**
- **We expect interviewees to be willing to consult with our team on the content of the application, specifically the content of trainings.**
- **We expect potential customers to be open to investing in the (one-off) startup costs of the product, namely a virtual reality headset docking and controllers.**

These hypotheses will form the basis for the solution research.

# Research

To confirm or disprove the solution hypotheses and see how the customer group feels about the proposed concept, a market research was conducted.

## Participants

Participants were recruited via word-of-mouth or by directly reaching out to the workers of the targeted emergency units (e.g. fire stations) using either the connections made in the first round of interviews (see The Needs - Participants) or contact information found online, or by visiting their work stations. The participants were either members of an emergency response unit (paramedics, firefighters, the police, including the volunteers) or closely tied to the field of rescue services (lecturers in training facilities). Their ages ranged from 22 to 54. In total, 11 people participated in this part of the study.

The participants were not offered any incentives to join the research and helped out purely of their own will to do so.

## Methods

Multiple methods were used either on their own or in combination with each other. All the different methods used to elicit responses from the participants were as follows.

### Storyboard

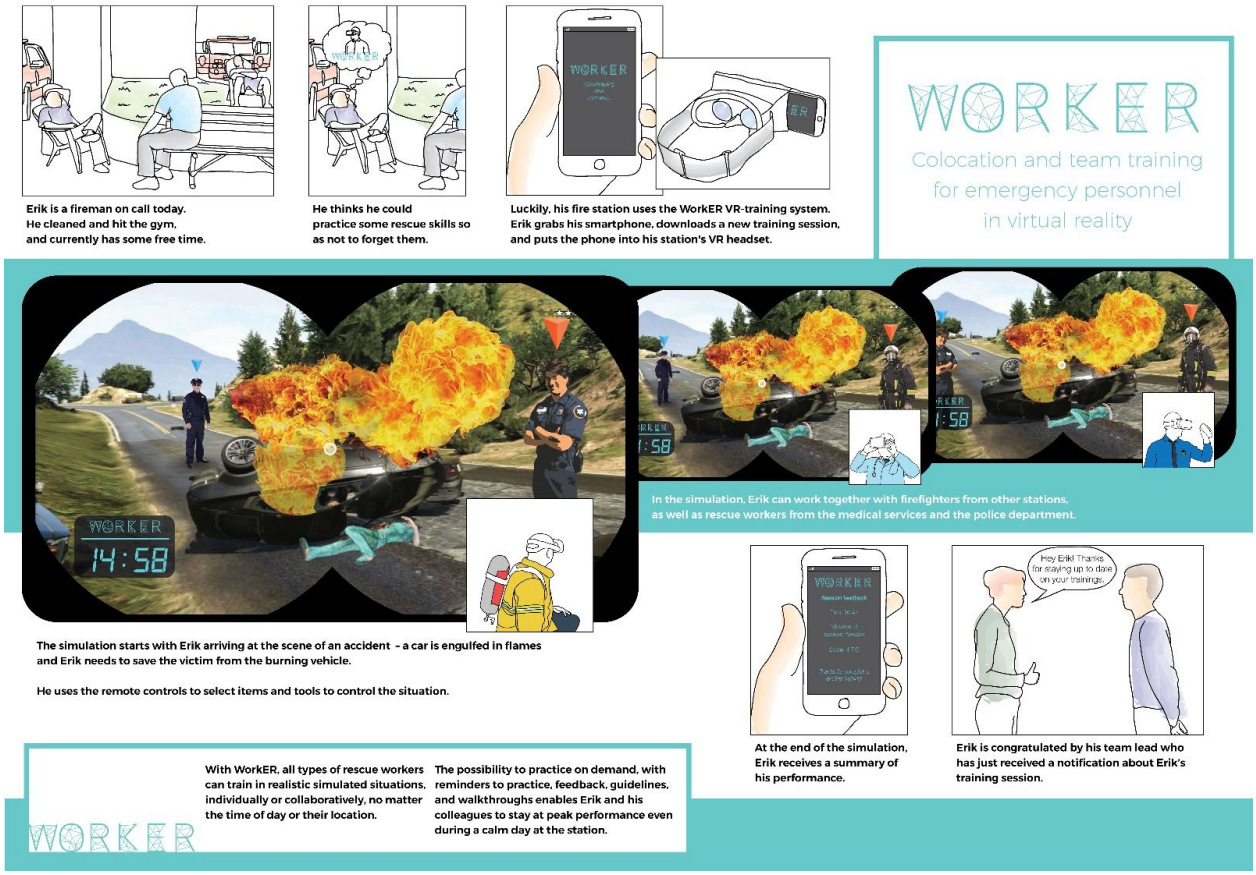


*Figure 1: Storyboard used for solution interviews*

The storyboard visually illustrates a typical usage scenario of the WorkER application from a firefighter's perspective. The goal of the storyboard is to make it easier for the participants to imagine how WorkER is intended to be used and to enable them to envision using the application themselves. The point-of-view images from the perspectives of representatives of different emergency units represent the interdisciplinarity of the system.

### Descriptive Text Scenario

Sometimes, the scenario shown in the storyboard was also explained orally. In these cases, the following text was used:

"*Erik is a 40-year-old fireman from Estonia. He is on call today at his local fire department. In the morning, he and his team checked and cleaned the firefighting gear. After lunch, he hit the gym. Now, Erik has some free time. He wants to practice some firefighting skills to keep himself from becoming rusty. Most of his colleagues are taking an afternoon nap, so he has no one to practice with.*

*Fortunately, Erik's fire station is subscribed to WorkER - a simulator for emergency situations. Erik grabs his smartphone and two remote controllers. He goes to the common room where there is more empty space to move around. Erik connects the remote controls to his phone, turns on the WorkER virtual reality application, inserts the phone in the head mount, and puts it on his head.*
*Immediately, Erik is standing inside a fire station, but not in the one he was just in - he sees himself in a virtual environment instead! Today, Erik feels like practicing a more rare and serious scenario, so from the list of possible exercises and missions he chooses "Severe car crash".*

*The simulation starts with Erik arriving at the accident scene. The car is engulfed in flames and Erik notices a figure in the burning vehicle. "The driver is still inside," Erik's team lead yells. Without wasting any time, Erik grabs the cutter tool and heads to the car, while his teammates work to extinguish the flames.*

*In the simulation, Erik has to work together with his own team members and firefighters from other stations, but also other rescue workers from the police and the medical services. He uses the remote controls to select items and tools to control the situation. Soon, the driver is out of the vehicle and in the ambulance, the flames are extinguished, and the situation is under control.*
*At the end of the simulation, Erik is presented with a summary of his performance. He sees the time it took to tackle the accident, the mistakes he made, and other relevant statistics about the session. Another collaborative emergency simulator successfully completed, Erik takes off the virtual reality set and heads to the kitchen.*

*"Good job, thanks for keeping up on your safety trainings," says his team lead who has just received a notification about Erik's training session on his mobile device. With WorkER, all types of rescue workers can train in realistic simulated situations, either individually or in collaboration with each other, no matter the time of day and their physical location. The possibility to practice on demand, reminders to practice, feedback, guidelines, and walkthroughs have enabled Erik and his colleagues to stay at peak performance even when it is a calm day at the fire station.*"

### Point-of-View Video

To further immerse the participants in the possibilities of WorkER and to let them experience what WorkER has to offer, a point-of view video was shown. In the video, a man puts on a virtual reality headset after which he can choose a training mission. Then, a short clip of said

training mission is shown from a firefighter's perspective. Unfortunately, the video cannot be controlled by the viewer as it would in case of an actual VR system. After "completing" the mission, a feedback screen with assessment scores is presented, and the VR headset is removed.

The video can be found here:
https://drive.google.com/file/d/13lIYK83p4zbewGpDWyDIsdITfSFX_5LD/view?usp=sharing

### Sony Playstation VR

In case of some Estonian participants, Sony Playstation VR[13] was used to enable participants experience using a virtual reality environment. Two different subgames from the Playstation VR Worlds suite were offered. The virtual reality set consisted of a PS4 console, a headset with built-in headphones and microphone, a PlayStation camera and a Playstation remote control.

In **Ocean Descent**, the participants could experience viewing a 360-degree video. In this game, the actions and scenario could not be controlled. This experience was passive and designed to observe how well participants handle a situation in which they can look around in a virtual environment.

In **London Heist**, the participants could experience an interactive action story. In this game, the scenario could not be controlled, but a variety of objects could be handled using the remote controls. For example, the participants could light up a cigarette or shoot with a gun. This experience was active and designed to observe how well participants use the remote controls to carry out the possible actions in a virtual reality environment.

### Semi-structured Interview

All of the previous methods were supported by a **semi-structured interview** designed to elicit opinionated responses and feedback from the participants. Some of the questions asked during the interviews were:

- What kind of a phone do you own? If you own a smartphone with VR support, would you use the WorkER application on your own phone or would you prefer to use it on a company phone shared with other people in your emergency unit?
- How often would you use the WorkER application?
- During which moments would you use the WorkER application?
- Which additional feedback or performance statistics would you want to see?

[13] https://www.playstation.com/en-ae/explore/playstation-vr/

- How would it make you feel if your performance statistics were shared with your supervisors or colleagues?
- Which training scenarios would you wish to see in the final application?
- Would you be willing to collaborate with us on the content side?

## Results

Overall, the participants saw **enormous potential** in using the WorkER virtual reality emergency simulator in the field of rescue. Some of the advantages the participants themselves mentioned were **time-saving**, **cost-saving**, and better **preparation** for real-life emergency situations.

In both Estonia and the Netherlands, the possibility for emergency team members to **train remotely and independently of the time and physical location** was highly valued. While the benefits for virtual reality training in general were recognised, it was pointed out that our focus on enabling **multidisciplinary** teams to train together with each other is a strong advantage compared to the current training methods of emergency response units. The interdisciplinary training was especially valued by the fire department in Twente who already use VR for regular training (with their own team only).

While the **younger generation** usually had no difficulties handling the virtual reality equipment and responded more positively towards the PlayStation VR experiences in general, the representatives of the **older generation** stated that they may probably need more time to adjust to this kind of a learning method than their younger colleagues. However, they did not fail to see the potential in the VR training and were excited to try it out.

As a rule, the interviewees positively welcomed the **statistics and performance review** presented to them after the emergency simulation had been completed. They pointed out that this kind of a feedback would definitely contribute to their **personal development** and provides a way to **track their improvement** over time. Generally, the interviewees were not opposed to **sharing the statistics** with their supervisors and/or co-workers and thought that seeing an overview of the strengths, weaknesses, and the general proficiency level of the team would even prove to be useful when putting together a nation-wide action plan for responding to emergencies. Not to mention the **tailored trainings** focused on their weaknesses that the team could have.

Regarding the statistics, a **gamification** element also became apparent. Various emergency workers said that being able to compare their results to the results of their colleagues via a scoreboard, for example, would introduce a competitive element which would, in turn, motivate them to use the WorkER application more often so as to become more effective and efficient in their job.

Furthermore, the importance of **imperfect situations** and the influence of **bystander actions** was pointed out. The participants were concerned about the simulation being too realistic when the computer-generated colleague-bots behave perfectly all the time and do not make any mistakes. In real-life situations, other workers may make mistakes themselves. Being able to deal with those moments is crucial. This also applies to bystanders and victims, who are, according to interviewed paramedics and firefighters, an important source of disturbance and one of the most volatile parameters in the equation of an emergency situation.

## Updated Solution

Overall, the solution interviews confirmed that the VR environment needs to match real-life conditions as closely as possible. This will make the training more effective and ensure that rescue workers will be able to easily transfer the skills and knowledge acquired in VR simulations to actual, real-life situations.

From the interviews it became apparent that people are keen on the potential **gamification** aspect of WorkER. Therefore, we have decided to incorporate further gamification elements, such as statistics, scoreboards and comparisons between different units and members of those units. These features also help strengthen the **network effect** (see Intellectual Property). However, it needs to be noted that participating in these kinds of comparisons needs to remain **voluntary** and, if asked for by the user, **anonymous** to at least a certain degree (e.g. only supervisors see individual results of their unit).

Another important aspect to pay attention to is the **in-game communication**. Interactions with other users' avatars (in-game representation of the user) and non-playable characters (NPCs, bots) needs to be done as naturally as possible. For avatars, the most effective method for this would incorporate audiovisual cues, such as speech input using a microphone and physical movements. For NPCs, the possibilities range from less sophisticated methods, such as choosing from a list of available options (multiple choice), to more advanced technology involving speech recognition and production. The latter comes much more naturally for humans and, therefore, we have decided to incorporate natural speech processing in WorkER.

Additionally, users should not be limited in the choices they can make in the simulation. This requires the system to be very flexible, and to recognise and respond to a large variety of speech commands and actions. For example, users should be able to practice giving commands to other avatars, making strategic decisions and responding to unexpected events.

On the other hand, the system may misunderstand or misinterpret the user's speech and, thus, choose an inappropriate response for the NPC. Since humans also tend to make mistakes in real-life scenarios (especially in intense and highly demanding ones where lives and wellbeing of others are in danger) and their reactions can be difficult to predict, we do not assess this problem of misinterpretation as too serious, especially when taking into account the current technological possibilities for speech recognition.

Furthermore, after talking to the customers, we also decided that WorkER will offer the users the option to choose **how often NPCs should make mistakes**, if ever. This lets them practice situations in which other rescue workers make the wrong decision or in which bystanders complicate the rescue mission with obstructive behaviour.

Regarding the **behaviour of bystanders**, such as the civilians, however, additional research is needed to enable modelling the natural and more true-to-life behaviour for those NPCs. This can be done by relying on information gathered from previous rounds of interviews, and by conducting additional interviews and observations.

# 3. Lean Canvas

| **Problem** | **Solution** | **Unique Value Proposition** | **Unfair Advantage** | **Customer Segments** |
|---|---|---|---|---|
| Applying theoretical knowledge to a real life situation needs constant practice to come naturally<br><br>Lack of immediate feedback on performance<br><br>Lack of interdisciplinary[14] cooperation training between units<br><br>Interdisciplinary training sessions are expensive to organise and time-consuming to partake in<br><br>***Existing Alternatives***<br><br>Collaborative training centers[15]<br><br>Theoretical training materials (written texts, videos)<br><br>Virtual training[16] [17] [18]<br><br>Elite VR training[19] | A VR-powered application simulating emergency situations for emergency workers[20], including medical accidents, fire, car accidents, accidents at sea<br><br>VR-application for a mobile device in a cardboard/head mount + handheld bluetooth remote controls<br><br>Individual or multiplayer training of collaboration situations between different units<br><br>Timing of tasks for testing and examining<br><br>Possibility of immediate feedback and notifications when incorrect behaviour is encountered<br><br>Summary at the end of the simulation exercise<br><br>Guidelines, walkthroughs and tutorials<br><br>Reminders to practice<br><br>Statistics for self and supervisors<br><br>Scoreboards and comparisons between players | Make training as accurate as possible, while still being just a simulation<br><br>Teamwork and cooperation practice without the need for having real teams present<br><br>More convenient alternative to existing training centers, no need to leave the workplace<br><br>Simulated, more realistic practice environment will improve routine, applicability in real-life situations<br><br>Available whenever one wishes to brush up on their teamwork skills<br><br>Better overview of hours spent on practice and skill levels of the workers for their supervisors<br><br>***High-Level Concept***<br><br>*WorkER* - Emergency teamwork simulator for rescue workers | First to market – a novel idea with limited to no direct competition<br><br>Governmental support<br><br>Multi-disciplinary development team<br><br>Solution worked out with professionals<br><br>Network effect | Police, Rescue, and Health Care Colleges<br><br>Estonian rescue workers including Estonian Rescue Board (firefighting, chemical accidents, explosives, accidents at sea), the police, and ambulance<br><br>Both professional and voluntary units<br><br>Estonian Rescue Board[21]:<br>72 national brigades +<br>4 bombing squads +<br>119 volunteer brigades<br><br>Estonian ambulance[22]:<br>62 ambulance bases,<br>102 ambulance brigades (3 members each) out of which:<br>14 with doctors,<br>82 with nurses,<br>6 reanimobile brigades,<br>+ bicycle brigade in summer,<br>+ need-based telemedical consultation<br><br>Interested in staying sharp in their emergency and teamwork skills |

[14] Happening between different types of emergency rescue units from different disciplinary areas, i.e. firemen and paramedics
[15] https://www.jems.com/articles/print/volume-36/issue-6/training/chicago-fire-department-builds.html
[16] http://www.ludus-vr.com/en/areas/emergency/
[17] https://www.vreta.co/
[18] https://safetymanagement.eku.edu/blog/how-the-department-of-homeland-security-can-use-virtual-reality-for-disaster-response-training/
[19] https://elitevrtraining.com/fire-safety/
[20] Such as paramedics, firefighters, the police
[21] https://www.rescue.ee/et/paeaesteameti-struktuur
[22] https://www.terviseamet.ee/et/tervishoid/inimesele/kiirabi

| | | | | |
|---|---|---|---|---|
| | **Key Metrics**<br><br>Number of subscriptions<br><br>Frequency of use<br><br>User rating & feedback | | **Channels**<br><br>Existing training providers (the Estonian government)<br><br>Direct sales and communication<br><br>Online support (a.o. website) | ***Early Adopters***<br><br>Students in Health Care Colleges<br><br>Technologically forward thinking jurisdictions<br><br>(Volunteer brigades) |
| **Cost Structure**<br><br>App development including product testing<br>Integration and customization<br>Market and customer research<br>Marketing & advertising<br>App maintenance<br>Customer support<br>Hosting costs<br>Human resources<br>Content creation | | **Revenue Streams**<br><br>Monthly subscriptions (multiple levels) to training suites<br>VR equipment brokerage | | |

# Problem

The problem definitions are the result of an in-depth customer need research. This is described in Chapter 1.

# Solution

Key properties of the solution are presented in this section of the lean canvas. The solutions map directly to the validated customer needs (problems), and are explained in Chapter 2.

**Key Metrics**

Our solution is a VR training platform which can be run on any state-of-the-art smartphone. To measure both performance (data which we can use to improve the product) and usage details (to base the customer costs on), we have defined three key metrics for the application. The number of subscriptions, per brigade, branch, department, region or even country, are used to investigate the market. This is supplemented with the frequency of use. Additionally, users are prompted to rate the application after use and even give us direct written feedback. This helps us improving the product and solving any potential flaws as quickly as possible.

# Unique Value Proposition

Our validated solution to the validated problems comes with unique value propositions, which give us competitive advantage.

## Channels

WorkER is currently in the new product creation phase. In this phase, it is important to **attract initial customers** to be able to successfully launch the product. For this purpose, we want to focus on using **direct sales channels** and approaching potential customers directly. This mainly involves contacting local rescue worker units and organisations. Since the VR technology we are using is still in its early stages of maturity, we need to make our product as simple as possible to facilitate its adoption for users. We are doing this by making our system compatible with smartphones to reduce the equipment that customers need to buy. We also offer the option to sell VR equipment in addition to the training system.

With regards to **marketing**, we need to convince customers of the feasibility and effectiveness of our product. Our goal is to **partner with large international organisations** like the Red Cross, as well as **national rescue worker organisations** like the Estonian Rescue Board or Brandweer Nederland. They can help us gain customers by promoting our product to smaller organisations and individual units they are working with, and also assist with expanding our operations internationally by putting us in touch with contact partners in other countries. In this way, we can also adopt additional channels and indirect sales later on. Since VR is not yet widely used, partnering with large organisations will help us establish a **brand image of quality and reliability** in the eyes of customers and make them more willing to try out the new technology.

We use traditional ways to reach our first customers. This can go by **mouth-to-mouth advertisement** and presenting our concept at a lot of rescue worker associations (**direct sales**). When a customer is interested in our product, or has bought a subscription, we can switch to more novel communication ways. Since our key point of the product is remote training, the communication will also happen as remote as possible. This means we will set up an **advanced communication model** to offer the best **customer service** as possible. It is important to maintain good contact with our customers, since we want them to keep subscribed for as long as possible.

As our business and the technology start maturing, we will need to switch our focus to making our product **distinct from the competition** and **expanding our customer segments**. For example, this could mean developing new versions of the VR system targeted towards educational institutions or the general public. With increasing maturity and a stronger customer base, we can also start to benefit from **network effects**. The more people use our product, the more information we have about their training behaviour which we can use to improve the system. Wit more users, the elements of gamification, such as scoreboards, competitions and in-game communication, also become more effective. It is likely that VR technology will go through major developments in the future since it is still in its early stages, and we will have to adapt and embrace these changes to keep our product relevant.

# Unfair Advantage

Next to the unique value propositions, we researched which unfair advantages our solution has in comparison with existing alternatives. Our main unfair advantage is that we are the **first of our kind on the market**. If market entry and selling goes as expected, we will eventually obtain advantages from the **network effect** to create a market **lock-in**. We come to this because we offer a product which is created and constantly updated in collaboration with emergency case professionals and with governmental support (financial support and brand awareness).

# Customer Segments

Our initial customers are **rescue departments in Estonia**. As our customer hypothesis is mainly confirmed by interviews with Estonian rescue workers, this is also chosen as our first target group. Another reason is that **government support** for rescue teams seems stronger in Estonia than in the Netherlands, which was our previous market focus. The identified new problems of rescue training include unrealistic training settings, a lack of feedback, severely limited multidisciplinary collaboration, and expensive trainings. The existing attempts to solve these problems in Estonia are practice sessions within individual teams, rather infrequent multidisciplinary trainings, one larger-scale fire training centre, and theoretical training materials; therefore, we propose to adopt some contemporary VR-based alternative solutions from other parts of the world. *WorkER* is our proposed VR-based solution concept that simulates emergency situations faced by various professional and voluntary emergency workers (firefighters, ambulance workers, and police). In the Estonian market, we expect *WorkER* to be a novel contribution to the market that will gain governmental support.

Early adopters are (Estonian) students and technologically forward thinking rescue teams. We will also collaborate with those parties to develop a high-fidelity prototype and iterate to a final product.

## Customer segmentation

In the development process, we have considered targeting a number of potential customer segments including educational institutions, the military or the general public for both educational and entertainment purposes, but we decided to zone in on rescue workers as our strategic customer focus. It is important to keep a narrow focus especially when starting out since **different groups of customers also have different requirements and requests**. Trying to fulfil all of these at once can easily get out of hand. To navigate this issue, need-based segmentation was quite relevant for us since all of the potential customer groups mentioned above have different needs. For example, rescue workers need to maintain their already existing knowledge and skills while also gaining experience with less common situations such as train accidents; systems targeted towards educational institutions should focus on building a solid foundation of skills and increasing the self-efficacy of students in emergency situations;

and systems targeted towards the general public should focus on teaching them how to behave in emergency situations to accommodate rescue workers as well as some basic first aid skills.

Most other approaches to customer segmentation do not make sense for us at this stage since we are still developing our product and do not have any customers yet. Therefore, we did not consider segmentation of existing customers and segmentation based on sales channels. Buying based segmentation can also be disregarded since different types of rescue workers have similar training and organisations, and segmenting them further would not create any additional value. As of now, brand-based segmentation is also not that important. However, it could be used later on to start marketing our product towards the general public: We could have two versions of the training system, one with more elaborate scenarios, functionalities and statistics for rescue workers and a more basic one with common scenarios to teach members of the general public how they should behave in emergency situations.

## Cost Structure and Revenue Streams

*WorkER* adopts a **subscription-based business model** to offer training suites to state and local governments, and will be marketed through direct sales and communication. The product is subscription-based, to offer **continuous support** to users and offer **regular updates** of training environments and situations. Without this, it would be a one-buy product without support and improvements, which is the opposite of what we want to reach, namely as realistic and novel training situations as possible. Subscriptions will be offered on multiple (entry and premium) levels. An additional income will be generated by selling '**starter packages**', consisting of the equipment (VR glasses, controllers etc) required for the simulations.

Costs and revenue models are further discussed in Chapter 4.

## Intellectual Property

Utilising different forms of intellectual property will be important to optimise our profits and protect our business from being copied by other parties. Before developing our product further, we will conduct additional screening to make sure that we are not infringing on any existing intellectual property which could be detrimental to our business.

While we are also considering using more traditional methods of protecting our intellectual property, such as copyrights or patents, we mainly focus on the benefit of **lock-in** and **network effects**. Since the idea of our product is to enable rescue workers from different specialities and locations to practice together, they all have to acquire a WorkER system. The more users we have, the easier it is for them to find training partners at a given time.

Furthermore, we have decided to add elements of **gamification**, such as scoreboards and statistics over time as well as in relation to other rescue worker units. These provide additional

value to users since they allow them to compare their performance to each other, and keep them from switching to other platforms.

The more users we have, the more data we can analyse to **improve the content** of our system and adapt its behaviour, e.g. the reactions of NPCs in training simulations, to user requirements and wishes. With a strong customer base, WorkER will be able to offer **more realistic multiplayer training** and thus be **hard to copy** for competitors.

We have designed the technology for our product to be as **accessible** as possible to make it more attractive to new users. The system is compatible with smartphones and only requires a VR headmount and Bluetooth controllers. This reduces the need for expensive equipment and shortens the learning period before being able to use the system. We are also **partnering** with large organisations like the **Red Cross** and the **Estonian Rescue Board** to gain more traction. They can promote WorkER to their members and partners, which improves our **credibility** in potential customers' eyes and helps us enlarge our customer base.

Being first to the market will also be important to help us establish a **strong network of users**. While there are already a few VR solutions for rescue trainings on the market, they are mostly focused on North America. Additionally, no other company has addressed the need for interdisciplinary training independent of time and location. Therefore, we believe that by focusing on **European markets** at first, we can fill the current gap in training solutions for rescue workers.

To protect our product before its release, we will need to keep any information and negotiations strictly **confidential**. Patents can be useful safeguards during the product development phase. To our knowledge, no other training system has so far combined VR technology with a focus on interdisciplinary training. Therefore, applying for a patent could be an option to prevent copying before we can release our product.

However, the patent application process takes a long time and requires expensive fees, which might not make it a good option in combination with a **first-mover** and **network strategy**. Therefore, we have decided to opt to using **copyrights** and **trademarks**. The former will stop others from producing the exact same simulations and protect our software, while the latter will help us to protect and promote our brand. While copyright applies automatically, trademarks need to be registered.

After releasing our product, we are planning to utilise **licensing** to allow similar platform developers and emergency training providers to use our intellectual property legally, while paying a licensing fee and adhering to certain **terms and conditions**. These will cover binding non-disclosure agreements, mandatory minimum royalties, licensed territory and time as well as penalties in case of IP violations. Licensing will increase our income while helping us to establish and strengthen our network effects. By providing more options for training simulations,

we can broaden our user base, allowing us to develop more interesting multiplayer systems and cementing our position in the market.

## Ethics and Sustainability

WorkER can help solve several global societal challenges[23] and strive to reach global goals for sustainable development[24].

First, we are contributing to **fortifying secure societies**. Our solution ensures that rescue workers are better trained to deal with a variety of emergency situations. As climate change shows more effects, previously rare events like floods, earthquakes, storms and other extreme weather conditions will become more frequent and require rescue workers to be trained in handling these urgent, but comparatively **rare situations**. Since they are hard to practice in real life, VR simulations are a valuable alternative. Furthermore, rescue workers **will not have to expose themselves to harmful situations** for the purpose of training in realistic situations, like they would if the training situations were acted out in real life (e.g. actual chemicals released for training purposes).

This will not only help them work together more efficiently and keep themselves safe, but also **improve the security of the general public**. This is also in alignment with the third goal for sustainable development, which addresses **good health and well-being of the society**.

Furthermore, the public use of WorkER itself will significantly **improve the education quality** of respective emergency teams. As we should ensure **inclusive and equitable education** and promote **lifelong learning opportunities** for all, the application of virtual reality enables every user to train and experience realistic emergency situations with always-updated simulation through open innovation. Rescue workers will be able to practice at any time across multiple locations, and benefit from the data collected from a multitude of rescue units to improve the training.

Additionally, our solution helps tackle the climate warming by **reducing CO2 emissions** in two ways. First, all the emergency departments will have to **travel less** to meet other teams to train. This will directly reduce the emissions caused by transport, both of civilian cars but also the larger operational vehicles (large fire trucks, etc.). Second, no (or significantly less) CO2 will be emitted from **simulating an emergency situation** (for example, a fire) rather than creating a real situation for practise purposes. This also fits in the global sustainable development goal 13 regarding climate change action.

Using VR applications will also allow rescue workers to digitize and upgrade their technology. Our system provides more effective and accessible resources for training while reducing the

[23] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges
[24] https://www.un.org/development/desa/disabilities/envision2030.html

need for travel, which enables them to use their time and resources more efficiently. These innovative training methods will help rescue workers to increase their productivity and the value they are contributing to our society, promoting **decent work and economic growth** for everyone.

Finally, one opportunity for our company to strengthen its **corporate social responsibility** in the future is to expand our operations beyond the EU and into **developing countries**. This would work on several fronts. In the most straightforward manner, we could offer new or expanded trainings targeted at individuals in areas without emergency services and bring them up to the same standards as trainings in the EU. Additionally, because it is not uncommon for aid workers from Europe to go to these areas, trainings could be developed for Europeans to practice scenarios to prepare them for emergency situations in these developing countries or any other locations with unfamiliar emergency procedures.

## Strategic alliances

We will pursue a number of strategic alliances to improve our operations and be able to reach a wider audience. One very important alliance partner is the **Red Cross** due to its **global network and operations**, as well as its image as a very respectable **humanitarian** movement. It is one of the largest and most well-known organisations of its kind and, thus, an important starting point for developing and commercialising our product. Through the alliance, we will be able to receive advice on **content creation**, **market our product** to rescue workers collaborating with the Red Cross and make connections with other **potential partners** all over the world. Especially at the start, this can help us find our first customers, improve our product, increase our revenues and grow faster. Having an alliance with a large global organisation, such as the Red Cross, also gives us a **competitive advantage**, since it suggests to customers that we have the necessary capabilities and resources to develop an excellent product, thus giving us more credibility and making them more likely to want to use our product.

Secondly, **national and regional associations** for rescue workers will be another group of useful alliance partners. They can especially help us with **content creation** and make our product available for their members. This will help us to establish a customer base and make profits, as well as serving as a reference for quality.

Collaborating with **governments**, specifically in Estonia and the Netherlands as our first locations of market entry, will also help us to establish credibility; not just in the eyes of customers, but also for other potential alliance partners. Additionally, governments can provide financial funding, working spaces and other support for new start-ups.

Another potential strategic alliance partners are **educational institutions**, for example, the Estonian Health Care College. We see them as potential **early adopters** of our product, since they tend to be keen on using new technologies, such as virtual reality, and can help us

establish a customer base and provide access to **informational material** for the content creation of our system.

Most importantly, we will need to collaborate with teams of **developers** to actually create the VR system for our product. For this, we might be able to use other connections, for example an educational institution, such as the University of Twente. Another option would be to collaborate with another startup who can provide the necessary skills, or to hire new people for our team.

For the additional accessory items (headmount and Bluetooth controllers) we will need to partner up or make contracts with **suppliers**. Initially, we will explore two advancedness levels of equipment. For low cost headmounts, Google has designed a Cardboard Headmount[25]. Low-cost Bluetooth controllers are manufactured by for example Samsung[26]. For an accessible more advanced, stand-alone head mount, for example Oculus Rift Go could be purchased via us[27].

## Market entry strategy

Our market entry strategy will be focused on **collaboration**. We believe collaboration with our target group, as well as stakeholders, will result in the most efficient product development and market entry. Rescue teams will provide substantive knowledge and requirements on the actual simulations. When the product is developed in collaboration with multiple rescue teams in Estonia, these rescue teams will also be our first customers. Staying in close contact with other stakeholders, most likely the Estonian government and other rescue team suppliers, will give us a broad network of potential new customers. Although our market entry focus is in Estonia, markets in other high-developed and technology-progressive countries should be researched after market entry in Estonia. We have chosen Estonia specifically because of its advanced start-up culture and highly techno-progressive government that is open to innovation.

[25] https://vr.google.com/cardboard/
[26] https://www.samsung.com/us/mobile/virtual-reality/gear-vr/vr-controller-et-yo324bbegus/
[27] https://www.oculus.com/go/

# 4. Finances

## Cost model

The initial costs for product development will mostly come from **market and customer research**, hiring developers to create the **software** for the training system, collaborating with rescue workers to create the **content** for the trainings and **marketing** to attract initial customers. Once we have a minimal viable product available, there will be ongoing costs for **hosting** (website and app stores), **customer support**, **human resources**, **application maintenance** and **improvement**.

Consequently, the majority of the costs will be incurred before we can collect the first revenues, which is typical for startups in the technology sector. But once the application is launched, we will have significantly lower costs and be able to earn them back quickly.

## Revenue model

In terms of revenue, the cost structure for customers of WorkER is based on a **tiered subscription** service. As mentioned in previous sections, the training suites our company offers are accessed through a subscription to the service. This subscription has several tiers, from an entry level that simply accesses the training material, to more advanced levels that unlock additional features for the trainings as well as more advanced tracking support and metrics. This will allow us to offer continuous support to users as well as regular updates to the training environments and situations to make them as realistic and relevant for rescue workers as possible.

Additionally, we will generate revenue by selling '**VR starter packages**' for rescue worker units, based on a **brokerage** model. These consist of the equipment required for the simulations, namely VR glasses and controllers.

To cover the initial product development costs, we will rely on **Family, Friends & Fools** as well as search for opportunities of **subsidies** and other **funds** from the government and EU.

## Venture viability

We see the proposed venture as a viable and promising startup to improve rescue worker trainings. We have conducted extensive market and customer research on their willingness to adopt VR-based training systems and their available financial resources. Our customer interviews (see The Needs), especially those with Twente firefighters, provided ample evidence that fire departments are open to investing in VR technology, even beyond what would be

needed for our product. Estonian interviewees as well felt that the initial investments would be balanced out by cost savings and increased training efficiency.

We are planning to **partner with large established organisations** to help us convince customers of the feasibility and effectiveness of our product. This will be necessary since VR technology is not quite established in the market yet. To make customers more willing to try out the new technology, we provide our partners with a few **trial versions**, so that individual units can see for themselves how a VR training system adds value to their trainings and operations.

Furthermore, we have designed our product to be very **cost-effective**. Rescue workers do not require a fully equipped VR headset, but can instead use a smartphone in combination with a viewer set. This enables customers to choose how professional and advanced they want the product and its features to be. If a training team does not want to invest a lot of money, they can merely get a subscription to our training system and work with a smartphone with sufficient graphical and computational quality, and buy a cheap, low-quality viewer like the Google Cardboard themselves. Additionally, they can also acquire VR headsets, including more sophisticated ones, and controllers from us.

To increase our revenue over time, we rely on **network and lock-in effects** as described above. Once our product is developed and launched, any new customers we gain generate little additional costs since the number of training situations does not depend on the number of customers. There will be some increases from customer support, but new customers will mainly generate extra revenue and allow us to invest more into developing and refining the training simulation further. Overall, this shows that our solution is cost-effective for both our company and our customers.

Additionally, our solution is believed to be more cost-effective for our customers than existing methods. As mentioned before, there are few opportunities for large-scale training, and even those require high travel costs and time investments. Furthermore, there is currently not a lot of practice for how to handle complex emergency situations where interdisciplinary teamwork is required. This is a problem that we can solve via our VR-based solution. It also will not require the presence of a professional instructor since users will be guided and provided with feedback in the emergency simulations, saving rescue teams money and time.

**Cost benefit**

Virtual Reality headsets of sufficient quality do not have to be expensive these days. A fully equipped VR headset is not required, a smartphone can be used in combination with a viewer set. The advantage of our proposed solution is that customers can choose how professional they want the product to be for them. If a training team wants to practice teamwork in interdisciplinary emergency situations, but does not want to invest a lot of money, they can choose to merely get a subscription on our application. The application will work on smartphones with sufficient graphical (computational and visual) quality. These customers can then choose to buy a cheap, low-quality viewer, like Google Cardboard (or equivalents), and

controllers themselves. Offering only the subscription on the application will also come in handy in case the rescue group is already equipped with a virtual reality headset and controllers.

From our experience we know that customers often appreciate the offer of a complete package. Especially non-technical disciplines usually do not want to invest too much time into acquiring new and innovative technical solutions, but instead want to buy a complete solution. To cover this target group, we will offer the possibility to buy a complete ‘starters’ package. This will include a comfortable, robust and sustainable virtual reality headset mount, the controllers, and the first payment of the subscription on the application. To keep initial costs for customers as low as possible, the headset and controllers will be low-cost but of sufficient quality. Cardboard or plastic VR headsets are available from €10 (offered on various platforms), so this is still very cheap. Additional controllers, two per set, do not have to be expensive either (starting from €30). These controllers need to be compatible with the operating system the application will run on, preferably both Android and iOS.

The purchase of the hardware is a one-off cost. Because these costs are still relatively low, we do not expect that this will be a holdback for rescue teams to get a subscription. This will be evaluated in the next round of potential customer interviews. In addition, there are few costs involved for us in selling the hardware. We will add a margin on these products, which will allows us to make a small additional profit.

# 5. Business and Technology

While designing the technology that WorkER adopts, the business side has played an important role. Simply put, innovation consists of invention times commercialization. While the success of commercialization itself strongly depends on the willingness of the market to purchase our solutions, each of the lean canvas elements has to be designed in order to fit potential customers' needs.

Thus, these following features of our final design manifest what the business side expects in an emergency training simulation solution:

1. **Virtual reality based technology**
   The rise of virtual reality is strongly associated with the increasing performance of ubiquitous computing in smartphones. Equipped with qualified computation power and built-in accelerometers and gyrometer sensors, mainstream smartphones are sufficient gadgets to deliver VR-experiences everywhere at any time. Thus, considering this phenomenon, VR comes as our primary choice to tackle current problems encountered by emergency teams, for example less practical trainings, lack of interdisciplinary involvement, and expensive systems. By using VR as the fundamental technology for our system, WorkER will require little financial and physical effort from the perspective of potential customers.

2. **Scoreboard features**
   The scoreboard makes use of the gamification concept and includes the network effect in our commercialization process. Simply put, a network effect is defined as a positive impact when more users add more value to WorkER itself. Scoreboards enable users to compete and compare their achievements. This feature aims to motivate users to complete more simulations, improve their performance, and support reward systems. Network effects, instead of more conventional methods of intellectual property protection, can also be an easy solution to introduce WorkER to our target users and to avoid competition from other similar emergency-training applications at the same time. While future applications could duplicate the idea of a VR-based simulation, a strongly established customer base of WorkER would be hard to copy and will keep WorkER superior to the competitors.

On the other hand, the adopted technology interferes with the business side of WorkER. As a VR-based simulation developer, these following parts of our lean canvas consider technology as main factors:

1. **Cost structure**
   The initial costs for the product, thus before a product launch, are application development, integration, and customization of the application and market, and

customer research. When the minimal viable product is finished, there will be ongoing costs for hosting (website and app stores), costs regarding customer support, application maintenance and improvement development and HR. Consequently, most costs will be made before first revenue is realized, which is typical for start-ups in the technology sector. But once the application is launched and paid for by the first customers, costs will be earned back quickly since the costs from that moment on will be significantly lower.

2. **Revenue stream**

   WorkER generates income from subscription fees and a brokerage model for supporting accessories, such as VR-headsets and controllers. From our experience we know that customers often appreciate the offer of a complete package. Especially non-technical disciplines usually do not want to invest too much time into acquiring new and innovative technical solutions, but instead want to buy a complete solution. To cover this target group, we will offer the possibility to buy a complete 'starters' package. This will include a comfortable, robust and sustainable virtual reality headset mount, the controllers, and the first payment of the subscription on the application. To keep initial costs for customers as low as possible, the headset and controllers will be low-cost but of sufficient quality. Plastic VR viewers are available from €15.00 (offered on various platforms[28]), so this is still very affordable.

[28] https://www.tomsguide.com/us/pictures-story/1044-best-cheap-vr-headsets.html#s9

# 6. Conclusion

WorkER tackles some of the most important problems emergency workers currently have by providing cost-effective and flexible VR-based interdisciplinary training. This report has presented a detailed overview of the customer research process, our proposed solution, its financial feasibility, and additional aspects regarding business processes and technology. We hope this analysis provides a thorough basis for our additional endeavours while developing WorkER further.

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# Appendix 1 - Customer Need Interviews

## First round of interviews

**1. Estonian Firefighter (Rescue Worker)**

Estonian firefighters used to have a lot of training programs (i.e. medical training, car accidents), but not anymore. They mostly practice on their own in their free time. There are certain norms they have to fulfil for the control exercises, i.e. cutting up a car in a limited amount of time.

It is especially difficult to remember the medical training which used to take place once a month. A medical worker would come to the fire station and carry out the training which consisted of both theory and practice using mannequins. Exercises included bandaging wounds, resuscitation (CPR). Interviewee does not remember how to do CPR.

In Estonia, there is just one training centre where firefighting skills (especially smoke diving) can and have to be practiced properly once a year. The commando usually sends a group of five firefighters at once. Travelling so far for this is bothersome.

Estonian firefighters are quite well off regarding the equipment as opposed to some other countries thanks to governmental support. When on call, team relies on audio-based radio connection that is always open in case of smoke diving. Without thermographic (heat) cameras, the visibility in a smoke-filled house is absolutely zero.

**2. Estonian General Practitioner (GP)**

Lack of immediate one-on-one contact in most online training courses stops from asking questions. It is impossible to get a hands-on experience in online courses. Trainings have to be practical (applicable to her job as a treatment method or a new medical device), not highly academic and theory-based speculations/research.

Patients are assessed using external observations (gait, weight, breathing, etc), and internal analysis (blood tests, blood pressure). Some people exaggerate the seriousness of their condition.

Small medical practices do not have expensive and advanced medical devices. If needed, patients are referred to a hospital that has those devices. Centralised medical practices make it hard for countryside people with lack of transportation and ability to move to visit their GPs.

GPs do not get a notification anymore if their patient visits an emergency room or calls an ambulance.

Estonian medical system is highly digitalised. Entering appointment and patient's medical information into a digital system takes time (sometimes up to 3 h a day).

There is a lack of medical professionals in Estonia. It is difficult to find replacements for holidays.

Anti-vaccination movement is a problem. Unvaccinated immigrants bring new diseases to Europe. Although there are few people who are against vaccinating, their fabricated information spreads throughout the Internet easily.

**3. Estonian Emergency Medical Technician (EMT)**

60 hours worth of additional medical training has to be completed every year (category chosen by himself). He trains on both mannequins, co-workers and himself.

Group practice consists of theory, discussion of the theory, practice, discussion of mistakes, repeated practice, and asking questions. Group training is fun and feels like a game.

Certification exam has to be taken once a year. Most mistakes during exams are caused by a lack of experience with the situations that occur rarely in their everyday job.

Ambulance collaborates with firefighters and other rescue workers a lot.

Everyone should know two basic first-aid principles: if one is dead, pump their chest; if something is leaking, apply pressure to the wound. Often people give first aid wrong. Depending on the situation, it can be both worse and better than doing nothing at all. Case: a professional nurse called the ambulance instead of doing CPR and because of that the patient is now in a vegetative state.

People should only call the ambulance if the problem is indeed that serious. With other cases, they should go to the ER themselves or consult with their general practitioner.

Cases with children are more difficult than those with elderly both psychologically and because veins are smaller and harder to hit.

In an AR training app, he would like to see and practice extreme (gory) cases.

**4. German Red Cross Youth Volunteer**

The Red Cross has at least one chapter in every municipality in Germany, with bigger towns having additional chapters. They each hold weekly meetings for volunteers, during which they practice common medical tasks like measuring blood pressure or putting on bandages with expired materials, but also more elaborate scenarios like car accidents or fires. These are presented with the help of experienced actors wearing makeup, but in this way it is hardly possible to realistically depict conditions like strokes or heart attacks. Another problem is that

the scenarios require lengthy explanations, whereas volunteers should be able to recognise these on their own and to practice this in the weekly meetings.

While simple AR would not be that helpful, putting people in VR simulations would be great to practice these scenarios more realistically and effectively. It could allow volunteers to figure out what they need to do on their own or work with others and divide tasks. More realistic practice conditions will increase their routine and self-efficacy, making it more likely that they will be able to apply their skills in real life.

However, this kind of training would be more useful for advanced classes like Red Cross meetings or paramedic training, rather than for first aid courses in schools or driver's license courses.

**5. German Nurse**

During their education, students switch between school and practical training in a hospital. At school, they mostly have theoretical classes in the traditional lecture format and only few practical classes during which they learn simple tasks like measuring blood sugar, but not the more complex tasks.

For their practical training, students are stationed in every hospital ward for a few weeks and switch regularly. They mostly perform routine tasks like washing patients and preparing them for surgery. While they are also supposed to learn complex tasks like placing catheters or inserting probes, in practice doctors and nurses are often too busy to teach them. Before exams, doctors who are off rotation have to take time to show the students what they should have learned months ago.

Hospitals also have problems with bad communication: It is often not clear who is responsible for certain patients, and when they are expected at surgery. Additionally, many doctors and nurses do not know basic first aid or follow outdated procedures they learned during their education. There are no regular courses to refresh their knowledge. Some newer regulations, e.g. for hygiene, are also excessively strict and are not always followed precisely.

**6. Dutch Preschool Teacher**

The interviewee is a 19 year old kindergarten teacher with a temporary contract. Because she is working as a substitute, she did not have any emergency training in the child care center. She knows how to handle small things herself, like wounds. Although she is an interim employee without medical aid certificate, she has full responsibility over the children and her presence counts towards the teacher regulations. She knows where to go if something she doesn't know how to handle happens (e.g. epileptic seizure, fire), then the other person leading the group for that day knows what to do.

She says medical aid training with AR at schools would be fun, but probably won't add any value because they practised with dolls and says to remember quite a lot (it is one year ago).

However, it was only the basics and not a full first aid course and does not recall how to perform CPR.

On the other hand, she thinks AR emergency group training would be a good idea. To practice in the actual child care center in the classrooms with situations which can simulate fire/medical/raid etc and which lets employees collaborate with their colleagues in more realistic cases in their own environment.

**7. Indonesian Outdoor Enthusiast**

In outdoor activities, medical training does not only study first aid, but also focuses on what surrounding people in the remote area can do before calling for medical help and how to keep patient safe before professional handling. However, since there is no compulsory requirement to attend a medical training before doing outdoor activities in Indonesia, most independent outdoor enthusiasts (that do not belong to any association) usually have no awareness of importance of medical training.

As member of outdoor-enthusiast association during 2014 to 2017, our subject attended 5 medical trainings as both trainer and participant. During practical situation, he realized there are several significant problems that remain unsolved, such as:

- No adequate medical kit during real outdoor activities
- Panic attack
- Difficult to determine level of burning
- Difficult to determine problem of unconscious patient
- Difficult to determine whether patients are able to continue their activities without further risks.

**8. Portuguese Biomedical Engineering Students**

Subject attended one medical training as a mandatory Safety Drill in his previous company in Portugal. As it took place in office setting, medical training focused on examining only three problems: fainted, choked, and bleeding. Subject was able to recall complete chronological steps of examining and curing each problems. Unfortunately, he remarked that he cannot picture realistic situation since he got no in-hand experience during the training and no accidents that require him to apply those techniques. He personally considers first-aid skills to be important, but not urgently needed.

In biomedical engineering, designing a massive solution with affordable price is a technology trend. The main issue that designer encounters are bureaucratic proposal and fulfilling strict CE Marking license certification criteria (in European Economic Area region). Based on CE Guideline for classification of medical devices, bleedAR belongs to Non-invasive Level 1 (only skin contact is enabled). This is the lowest class of CE Guideline with least strict conditions compared to other level.

**9. American Nurse**

One of our first interviewees, they work in a general hospital, and as such are trained by the Red Cross semi-annually in first aid. In addition to their regular duties at the hospital it is expected that all nurses know CPR, and how to identify and treat stroke victims. This provided an interesting opportunity to talk with someone who must be trained regularly for their work. They offered several interesting insights. For one, the main problem they see with training is a discrepancy between the environment where you train and where you would put that training to use. Additionally, they had noticed that the Red Cross is constantly updating their training methods to use better and better technology, yet this still lags far behind what is state of the art at any given time.

**10. Dutch Party Manager**

The managers of the restaurant get 'robbery training'. In these trainings the participants are taught how to deal with a raid or aggressive persons, how to prevent this. They first get theoretical training, but this is followed by a practical training. In this practical training actors act aggressively or they role play a robbery. According to the interviewee the actors are trained really well, and the play and their reaction are impressive. They discover what their individual reaction is to aggressive behaviour, i.e. fight-or-flight (or freeze).

He mentioned that the trainings are really professional and helpful. But also that his colleagues either receive a different or no training, which makes him insecure in knowing what happens in a real situation. He would like to practice situations with his own colleagues in the usual environment, to get to know how to work together on their own floor.

**11. Dutch University Students**

First-aid courses are not mandatory in the Netherlands as they are in Estonia and Germany, for example, when you are getting a driver's licence. The two interviewees with Dutch origin from the University of Twente had not had any first-aid courses and did not perceive this skill as necessary. They stated that they would not be interested in taking part of any kind of medical training at the moment either.

## Second round of interviews

**12. Dutch firefighter (volunteer) in Kamerik**

In Kamerik, the team consists of only volunteers, like in many small villages in the Netherlands. They practice every Thursday night with as many volunteers as possible. Usually, they practice with only their own team, but a few times a year they team up with other fire brigades in nearby towns. This is important, because when they are called for a real fire then usually multiple teams from multiple brigades are present. In addition, every fire brigade has their own speciality. This team is specialized in extinguishing thatched roofs, they are called to a fire even if it is 50 km away.

Secondly, they also team up with the local first aid volunteering association (EHBO) in order to practise severe emergencies. They, for example, set an old car on fire, where the medics and the firefighters have to work closely together to get dolls out safely and extinguish the fire as

soon as possible. But this happens only twice a year, while in real emergencies the firefighters have to work more together with medic teams, or even have to operate without any medic team near. The last happens because the firefighters usually arrive earlier at the emergency location.

They also rarely team up with local restaurants etc to practice with new situations together.

They have a lot of testing equipment which they share with other brigades, for example a smoke machine. This way, all fire brigades are able to practice. It is important to note that all practises and collaborations happen on own initiative.

**13. Estonian Volunteer Firefighter (Rescue Worker)**

Due to being occupied by work, the interviewee has stayed away from volunteer rescue work recently. In his work, he mostly relies on previous knowledge and has not attended additional trainings for a long time. The last one he had was Pääste2 where they go over what happens on call, how communication is organised, who does what and who is in charge.

He said his younger colleagues often go to additional trainings (i.e. car accidents), but his daily job poses an obstacle for him. His last call was to a burning sauna. The victim had called them too late and by the time the rescue workers arrived, the building was in flames. They had to extinguish from the outside and contain the flames so they would not spread to nearby buildings.

He said that rescue workers support the medical workers and are often discouraged from doing medical work themselves due to not knowing the proper way to do it. His volunteer fire fighting brigade differs from other volunteer brigades because they also have the equipment needed for dealing with car accidents. They are not allowed to enter a smoke-filled house due to not having the equipment and knowledge. Collaborative trainings with other emergency workers (i.e. the medics) happen rarely, only 3-4 times a year, but when on call, both firefighters and ambulance workers need close co-operation.

**14. Estonian Firefighting (Rescue) Team Lead**

The fire brigades have special commandos (specialisations) for different types of accidents, i.e. car accidents, fire, natural disasters, chemical accidents, accidents at sea.

The team lead is responsible for the actions of others. Without team lead who supervises the actions and makes important decisions the team would be uncoordinated and all over the place. He tells others what to do, where to go. Team lead uses audio-based radio connection to communicate with both his team and a higher supervising unit. He needs to get a general picture of the situation on arrival and to keep himself constantly updated through the information he gets from his team.

The rescue workers must let him know where they move at all times and what they encounter. Based on that, the team lead constructs a mental map of the building in his head. In more

complex cases, the information and times of entering the building per worker are written down using a whiteboard and a marker.

The brigade also carries out regular evacuation training for schools, shops, and other institutions/buildings. During these trainings, they do not normally enter the building. They just arrive in front of the building, sound the alarm and observe how people exit the building (how teachers guide the children out). They do not create any realistic-looking situations, such as fake fire or smoke.

The cooperation with medical workers remains on the level of getting the person out of the dangerous situation. Normally, fire brigades are discouraged from providing medical help due to the fear of doing it wrong.

**16. Follow-Up With Estonian Emergency Medical Technician**

Paramedics mostly organise trainings for other rescue workers. Large cooperative trainings with interdisciplinary teams happen once or twice a year and training centres are responsible for those.

The police does not organise any trainings for paramedics, but they often need to work together when paramedics have a drunk or aggressive patient, or when someone is injured during a scuffle with the police. The closest collaboration for paramedics on call is often with rescue workers from fire brigades, i.e. during “rope saving” (accidents regarding cliffs/wells) or car accidents.

# Appendix 2 - Solution Interviews

**1. Estonian Firefighter (Rescue Worker), older generation**

The interviewee expresses concern about having to use the system during their break time and is worried about increased workload if using the system is made mandatory. Instead, there could be allocated time slots for doing these simulation exercises, similar to the way training days are currently organised. However, if the simulation could replace the current training days and the obligation of travelling to another part of the country even partly, if not fully, the interviewee sees huge potential in it. Training without having to leave the fire department would be less time-consuming.

Concern is expressed regarding the statistics. The interviewee said they would feel observed and controlled knowing that all their mistakes are pointed out to their supervisors. On the other hand, they state that perhaps it would help them improve further. It would be good to compare themselves to their co-workers, but it might help if this comparison was anonymous.

The interviewee owns a smartphone themselves, but the virtual reality environment is new and unusual to them - they have not used anything like this before. Seeing the simulation environment move, but not physically moving themselves in real life causes some motion sickness. Interestingly, the interviewee learns fast and is able to use the PlayStation controller to pick up items in the virtual environment after some practice.

**2. Estonian Firefighting (Rescue) Team Lead, older generation**

As a team lead, the interviewee is especially fascinated by the possibility to view the team members' statistics about their training sessions. This provides a good overview of the training level of both the team in general and individual team members. When confronted about the anonymity issue, the interviewee states that seeing the statistics per team member would be more valuable for them, but even a summative analysis can already provide a lot of insight.

Statistics also alert the team lead of the need for any additional planning and the categories, situations, or exercises that require closer attention. As a result, large-scale cooperative trainings can be designed to include the scenarios rescue workers have difficulties with. By focusing mainly on the concerning areas that need development, the trainings become more efficient.

The interviewee is fascinated by the possibility to practice remotely with people from other disciplines (the police, medics) and does not care if the session is conducted with simulated bots or actual users. The interviewee does not have a smartphone suitable for running VR themselves, and has some trouble feeling comfortable in a VR environment, especially with using the PlayStation controller to pick up items in a game.

**3. Estonian Emergency Medical Technician, younger generation**

The interviewee sees real potential in this solution and says that right now is the best time to make this a reality because a lot of medical workers from the older generation are retiring and this could attract the younger generation to join the medics. In their opinion, the younger generation is more prone to using such technologically advanced solutions. The interviewee has no problems using the VR environment despite a lack of previous exposure to VR.

Regarding the content, the interviewee would like to see scenarios about bigger accidents (e.g., train crash, chemical disaster) and extreme situations (e.g., accidents at sea) where several inter- and multidisciplinary units need to work together as one. The interviewee already offers to work with us on the content part.

In accident locations, the first medical team to arrive organises the work of every following team of medics. This can easily be practiced in a simulation to improve the workflow in actual situations.

The interviewee expresses concern about simulation bots never making mistakes. If the simulation is always perfect, it is not close to real life where people make mistakes that (in)directly affect others around them. It would be cool to be able to point out and deal with the mistakes bots make.

**4. Lecturer in Tallinn Health Care College**

Virtual reality simulations could be used in the training process of new medical workers. Currently, there are some simulations, but these are mostly in 2D. They use a map of Tallinn and test the logistical thinking of the students: how to organise units that arrive at the scene of an accident, how to decide which units are needed. These simulations have less focus on interdisciplinary cooperation training, and are designed to train the logistical aspect of emergency situations.

The colleges could use a VR-simulation to make the situation more realistic. There are many students in the College which means that they can play the game with each other, eliminating the need for “perfect” bots. Using real persons in the simulation can trigger more mistakes that can be discussed in class afterwards, letting the students identify with the learning material more. The simulation could also be used for examining the students if the feedback was shared with the lecturer - perhaps via a separate testing interface?

The younger generation coming to colleges now is probably more prone to using such new technological solutions anyway. There is also some pressure from the government and the general public to advance the education using technology.

**5. Volunteer Police Officer, younger generation**

There are occasional trainings for the police, but rarely with units from other disciplines. Using a simulation for that could improve the behaviour in actual situations. Volunteer police officers can join the force irregularly at their preferred time to help guard bigger events or ride along with the

patrol occasionally. This means that they have less experience with extreme situations that may occur. Training for these situations using simulations would be highly welcome. The interviewee would gladly do this in their free time to improve themselves.

They would not mind sharing the statistics with the supervisor either, although they see it more as important feedback to themselves: “I am not doing this for the salary!”. They even suggested having a scoreboard where users could compare their performance with others across the country or even from other countries.

The interviewee has no trouble with picking up objects and shooting a gun in a PlayStation VR environment and is highly captured by it. It would have been nice to have this kind of a simulation at school when training to become a volunteer police officer.

**6. Estonian Emergency Medical Technician, older generation**

Interdisciplinary training is definitely needed on a larger scale than it is done now. Units from different disciplines tend to make mistakes when working together without previous thorough practice.

Often, police officers tend to “forget” about securing the accident scene before starting to deal with insurance issues. The interviewee has been in a situation in which medics got angry with police officers responsible for securing the accident scene because they had not stopped the traffic. As a result, the medics had to risk the lives of themselves and people driving by the scene to help the injured person, and basically performed resuscitation (unsuccessfully) knee-deep in snow in a ditch next to the road. Getting feedback in training could avoid this kind of a situation occurring in real life and save actual lives.

Based on this, it would be nice to play against actual people in the simulation and give feedback to their performance afterwards. This way, the feedback would not only rely on a computer algorithm, but scenarios could also be discussed with people who participated.

The simulation would not even have to be interdisciplinary because several medical units often need to work a scene together as well. There are different tasks, and it takes practice to know how to organise the units into completing all of them, especially for operative managers (*“välijuht” in Estonian*) who have fewer trainings and mostly learn by doing right now.

**7. Ambulance driver (experienced)**

Ambulance drivers are actually not allowed to perform any medical task. In serious emergency situations however, they help the medic team or even other teams if the situation allows it. They never practise this beforehand, so any form of interdisciplinary team practise would help them and their colleagues.

They would like the simulation to cover the scenario from beginning to end. Their most important job is to bring the car as soon and safely as possible to the emergency location, and to identify the best position there. Then, they need to transport the patient to the hospital, also

as soon and safely as possible. Before arriving to the emergency location, it is usually unknown which other parties are already at the location, so it is important for ambulance drivers to practise the arrival at the location.

In less critic situations, they are usually the only ‘professional’ person who does not have to perform a highly demanding task during the operation. They are usually assisting the medic. This means that they often have to deal with bystanders, like witnesses or family members. The interviewee knows how to deal with this now due to their experience, but they think it would be good practise for the younger generation.

**8. Ambulance nurse (experienced)**
They are already doing this job for a really long time, so they have quite some experience. In addition, they usually work together with the same ambulance driver (also interviewed). They remember that during their training, they usually focused on how to best help the patient in every situation. This mainly involved medical training, and less attention was paid to interaction between different emergency teams. For starters, VR training would be ideal to practise this.

Because their shifts can take up to 24 hours, they are assigned to do tasks in the hospital while waiting for a call. This can take long, since they are operating in a relatively quiet rural area. Both the ambulance nurse and the driver sometimes feel bored by doing these tasks, because they have to be ‘easy’ so that they can leave at any moment. The interviewee would like to see some training to fill the boring hours instead.

There are currently three parties in the proposed scenario for WorkER, but they would like to see even more parties involved in the collaboration, to practice an even wider variety of scenarios. Examples include lifeguards, military police and company first aid workers.

**9. Firefighter (experienced)**
They only practise once or twice with the first aid workers, and almost never with other emergency disciplines. In the real world however, they often encounter ambulance workers as well. Collaboration usually goes well, but just because they know each other quite well.

The simulation training could even be useful for normal people, as it can be hard for them to understand firefighters’ instructions in emergencies. They are not used to emergency situations and don’t know what to do. In addition, they are often very emotional, so firefighters need to learn how to deal with this.
The interviewee thinks it would be valuable to include ‘disturbing’ characters in the simulation, in addition to collaborative work. This could be a very emotional woman whose cat is stuck in a burning house or a very aggressive man who does not want to listen to medics’ instructions. Firefighters are usually the biggest team at the location, so one of them usually has to deal with these difficult situations. Luckily there is always have at least one firefighter with psychological expertise who can support the victims.

The videos presented as VR from the point of view of a firefighter made the subject feel a bit nauseous and uncomfortable. But as he said, this is probably due to not being in control of the situation and camera movements, and not being used to VR applications.

**10. Firefighter (Brandweer Twente)**

The training regiments of the firefighters in the Twente fire department currently use a virtual reality system. At the Troned training facility, the fire department has a Elite VR RedSuit training system involving a smart suit, goggles, and controllers for firefighter training (simulated fires the firefighters must navigate). After a VR training session, the workers involved debrief with a moderator and explain decisions and talk about mistakes. Currently the Twente fire department trains about 80% in real world trainings and 20% in this VR system, though they are aiming to reach an even 50/50 between the two methods. At a different training facility in Arnhem, the Twente area has a multidisciplinary version of the system where firefighters can work with police and medical personnel. This system employs an array of around 15 screens with joystick controllers that allow several individual from each team to interact in the scenario. Both these systems are quite large and complex and thus don't allow any spontaneous training, nor training in the VR environments outside of the two physical centers. While improvements to practical skills do not feel noticeable from these trainings, they are greatly beneficial for scenario-based skills such as team work and/or standard operating procedures. Another benefit that VR training provides is the ability to simulate extreme scenarios that are not feasible at real training centers (such as plane crashes).

**11. German Nurse**

During an accident, nurses would not be directly involved. The paramedic is the main provider of pre-hospital emergency care that has a role to handle this situation. In a medical context, the concept of VR training is fascinating to build paramedics' habitual instinct to emergency. The solution can save a lot of time and money compared to existing simulations which require a training center and other physical training manikins. However, in real-life threatening situations, not only their decision making but also how executing the practice in the right way will matter. This solution will be complete if it can address both points. Including a tutorial also plays an important role since some users may not be familiar with how to operate within the application. To optimize envisioning real-life situations, interaction between users or with other non-player characters must be done orally. This should also enable oral instructions to non-player characters.