White Paper

What Virtual Reality (VR) means for Ground Operations

Executive Summary

Imagine being able to reduce the duration of your training by 25% while simultaneously improving the knowledge retention of your trainees by 4 times. This is precisely what VR can bring to your organization when implemented effectively in your training. This whitepaper describes the successful implementation of VR technology in Ground Operations Training, through the RampVR platform and studies how Fraport Ground Services integrated VR training in training for new and existing ramp and ground services employees.

This whitepaper aims to:

- Lay out the challenges to the adoption of VR in training;
- Explain the benefits of VR training through a case study with tangible results;
- Trigger interest and stimulate exchange on the topic within the air transport innovation community.

Introduction

Virtual reality (VR) is here to stay! Although VR has been extensively used in the gaming industry, it has only become mainstream in business applications with the recent advancements in the technology. VR software and hardware have developed tremendously which allow organizations to comfortably and securely utilize it in their operations. Besides VR is now readily available in many countries and the availability of various formats has significantly reduced the cost of implementing the technology. Moreover, the installation is simpler with a lot more "plug and play" components similar to consumer electronics.

A couple of early adopters of the VR technology have seen the benefits of VR. American Airlines used virtual reality to train their cabin crew which reduced training time and increase training effectiveness leading to cost savings and improved staff retention. Qatar Airways rolled out VR training globally to their stations and are exploring collaborative VR training platforms to make VR more pervasive within their organization. At Basel Airport, new marshallers use VR to prepare for their marshalling examination and existing staff must undergo a VR training session every six months to ascertain that they use the industry accepted standard gestures. On the customer experience front, Iberia is currently trialing virtual reality in inflight entertainment onboard selected flights.

The area in organizations which benefits tremendously from VR is training. The main driver for investing in VR training is that it makes training safer, cheaper and more effective. The immersive experience of a carefully created training solution provides the access to situations, locations and equipment that are customarily challenging to experience or reach. The realistic audio and visual environments provided through VR give trainees a sensory feeling of 'being physically there'.

IATA embarked on our VR journey in 2016. A key objective of our VR endeavor was to build a strong case to use VR more extensively in training individuals; more specifically on understanding and applying operational standards in the air transport industry.

We see the digital transformation as imperative and omnipresent. We see VR as an enabler to meet the future needs of the air transport industry. IATA is invested in helping airlines develop a VR roadmap to achieve their digital transformation goals.

Training Challenges

Current operational training is able to impart knowledge to trainees through instructor presentations and occasional demonstrations. Traditional instructional methods lack certain aspects which promote the retention of knowledge. Moreover, conventional training is typically unidirectional without the interactivity that a practical and on-the-job training provides.

Passive theory

Common feedback from training programs in workplace is the passiveness of learning experience. The standard method of instructor led training is still considered an effective method of learning, however

the inability of participants to actively participate creates less positive learning experiences. Especially for operational and technical topics the effectiveness of classroom-based training program becomes heavily dependent on the ability of the instructor to engage the trainees and maintain their attention at a satisfactory level.

Poor knowledge retention

It is proven that approximately 70% of memory from training is lost within the first 24 hours if there is no attempt to retain it ('Forgetting Curve', Herman Ebbinghaus). In training, an effective method of retention is the immediate application and repetition.

Logistical and administrative hurdles

Training in a live, operational environment is a complex process logistically. There are several constraints before trainees can have access to an aircraft. The aircraft has to operate on-schedule with ample ground time. Weather conditions have to be optimal to allow proper training to occur. For training to be conducive, it would be performed during the day to make it easier for the instructor to monitor the trainees. As a result, trainees usually experience poor lighting or low visibility conditions for the first time only when they are operational. Furthermore, applying for and receiving airside security passes can be a lengthy and tightly controlled process which could be burdensome.

Infrequent exposure to irregularities

Fortunately, irregularities like aircraft damage and equipment malfunctions are rare and they are practically impossible to show trainees in reality. Hence it is challenging for trainers to be able to demonstrate abnormal situations and expose trainees to these situations in order to develop the critical awareness and responses.

VR is here to stay

We have integrated VR into Ground Operations training through extensive research and thoughtful implementation. We have discovered that our RampVR tool augments current operational training and introduces unique capabilities to instructors by permitting access to airport and aircraft "on demand".

The design of any VR training tool needs to comprehend the objective of the training but also be convenient, easy and simple to use. We designed RampVR with the following qualities which we encourage organizations to be cognizant when implementing VR in their training offering:

- Accessibility anytime and anywhere;
- Easy and quick setup preferably plug-and-play;
- Intuitive user interface and experience;
- Simple setup in a standard office environment without significant space requirements;
- Ability to easily update and introduce new modules.

RampVR has all these features and we have made it the "flight simulator" for ground operations. It provides an immersive, interactive, realistic 3D environment for training and is fully compliant with global industry standards.

We considered the following aspects in the design, development and implementation of RampVR in our training programs.

- **Comfort**: The ramp environment is noisy and full of frequent obstacles which can disrupt training. We wanted VR to increase the comfort of the training environment. Replicating the ramp environment, with the added ability to pause, review and restart functions improved the learning experience significantly. A small point to note is that there exists a small percentage of trainees who report discomfort when using VR equipment. The term "VR sickness" inflicts around 5% of users based on our extensive use of VR in training. Research on this ailment remains limited since more VR applications became available to training after 2016. The sensitivity arises due to the design of applications where the user's balance is impacted by the perception of motion in the visuals of the VR application.

- **Safety**: The hazards and risks associated with training on the ramp can be reduced in a VR environment where the trainees remain in a controlled office environment.

- **Realism**: As technology develops, the processing power and graphics hardware improves resulting in an ever-increasing ability in VR systems to render objects and visual effects even more realistically and in higher resolution in 3D. The level of complexity influences the specification of hardware hence a visually intensive application would require more processing power. We weighed the cost versus the quality of image resolution and opted for a balanced solution with RampVR which provided a high level of realism without compromising image quality so that trainees receive a more immersive experience. We focused on 2 aspects of realism which we regarded as highly essential in order to make the virtual environment as real as possible.

  - Sound

    - Spatial sound: Making the experience more realistic by eliminating logical distractions but including typical spatial sounds to enable the training to be more focused.
    - Ambient context: Setting the scene is not based exclusively on detailed visual designs but also on realistic sounds of the environment.

  - Replicating unattainable reality

    - Uncommon: VR enables trainees to experience situations which may otherwise occur infrequently. For example, operations of a wide-body aircraft in a small regional airport. Staff can be trained on a specific aircraft types which do not typically operate at their location.
    - Impractical: It is practically impossible to stop and restart the aircraft during marshalling. No operating airline would permit the use of their aircraft. Additionally, companies would hope that trainees would be familiarized with various damages on aircraft without inflicting or seeing actual damage on aircraft.
    - Dangerous: Exposing trainees to a potentially hazardous scenario is better controlled in VR than to try to replicate the actual scenario in operations where safety is crucial.

Realizing benefits

What is VR for (... and what it is not)

It is important to understand the benefits that VR can bring and its limitations so that its implementation to training can be maximized. We discovered these benefits with our RampVR tool:

- Complements theoretical training with practical experience;
- Creates a multitude of scenarios and operational issues;
- Allows trainees to familiarize with different aircraft types;
- Simulates day and night operations with and varying levels of visibility;
- Scores students and provides instant feedback;
- Mirrors reality operational environment and follows IATA Standards: Airport Handling Manual (AHM) and IATA Ground Ops Manual (IGOM);
- Provides a memorable albeit short experience. With the average trainee using the VR tool for a duration of 12 minutes, we managed to improve the learning journey and reinforced critical knowledge points.

EASY access to assets any time!

With the immersive experience and the careful design of 3D assets we have managed to provide our instructors with a tool that allows them to customize the experience for every participant. The customizable variations are linked to:

- Aircraft types (wide-body versus narrow-body, jet versus turboprop);
- Day or night operations;
- High or low visibility conditions.

High retention – Muscle memory

Allowing participants to experience and repeatedly use VR training tool improves the retention of key knowledge items. Repeating the correct procedures allows trainees to develop patterns and generate 'muscle memory'. With VR, a marshalling trainee can perform at least three marshalling sessions within 10 minutes where each session has a different aircraft type and a different lighting condition.

Makes training interesting

Introduction of new technology appeals to younger trainees and motivates them to participate more actively. Showing that the company embraces innovation and invests in modern methods of learning creates positive ambiance among employees. Furthermore, motivating experienced trainees in recurrent training on topics that they are very familiar with is crucial in a higher level of engagement and participation. Introducing and 'simulator' type training tools in the traditional classroom training reduces the total time spent in the class while increasing the level of active participation of all trainees. At the same time VR works as a knowledge verification tool where the instructor can identify a trainee's knowledge gaps during a VR training session. This helps an instructor customize the training to the needs of the trainee which effectively makes training more useful and more personalized.

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One tool for fresh and recurrent training

There have been several approaches to the implementation of VR in our training programs and in partner organizations that chose to use RampVR. While we have chosen to fully the integrate the tool in practice and assessment phases of training, other instructors have introduced in various phases in order to increase trainee familiarization.

Case Study: Fraport Ground Services

Fraport Ground Services forms part of the integrated business model of Fraport AG, the owner and operator of Frankfurt Airport. As one of the leading international providers of ground services in accordance with IATA Airport Handling Manual AHM 810, Fraport Ground Services offers the full range of handling activities.

With over seventy years of experience in ground handling, Fraport Ground Services is currently catering to the individual needs of more than 100 airlines operating to/from Germany's largest aviation hub. In 2018, our workforce of 7,500 employees was responsible for almost 416,000 aircraft handlings and processed 2,2m tons of airfreight. In addition to the provision of one-stop, trouble-free passenger, ramp, transport, baggage and cargo services on a year-round 24/7 basis, the largest segment of Fraport is also involved in activities related to the central infrastructure as well as responding to worldwide consultancy and training opportunities.

Frankfurt Airport's renowned reputation is largely dependent on speedy, reliable and efficient processes and thus these indicators represent key components for smooth operations. This becomes particularly important to a hub, which is characterized with more than 60% transfer passengers. Very often, dedicated processes are developed in-house,

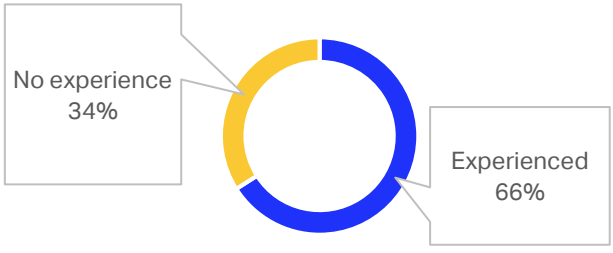
constantly monitored, reviewed and fine-tuned in order to meet the ever-increasing expectations of a demanding clientele.

On the other hand, well-trained employees are a prerequisite to execute these process-driven activities in a safe, proper and quality-oriented manner. In view of a soaring complexity, training therefore becomes more and more challenging. To ensure a constantly high level in Fraport's employee's motivation and expertise, Fraport's Ground Handling department started to look for more innovative approaches in training and identified VR technology to be a promising tool for achieving this goal.

Within the scope of Fraport's very successful and long-lasting partnership with IATA, a cooperation in the area of VR-based training was established in 2018. The main objective of this joint project was to gain insight into the specific utilization of VR-applications as part of the training for operational staff and to determine the suitability of VR training for the needs of the company.

Initially, two modules: "Aircraft Marshalling" and "Turnaround Inspections", were imbedded into basic and refresher training sessions over a period of three months. Fraport's own experienced operational instructors delivered these VR training. All instructors have a proven record of delivering courses to both newly recruited staff as well as experienced employees who have been with the company for many years. During VR-based sessions, trainees were asked to complete specially designed feedback forms, the results of which are presented in this whitepaper.

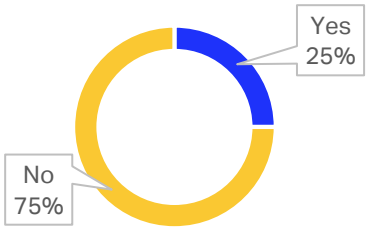
Level of experience of trainees who used RampVR modules (fig. 1)



In the study, 34% of trainees used RampVR as part of their basic training, whereas the remaining 66% considered skilled staff experienced RampVR as part of their refresher course.

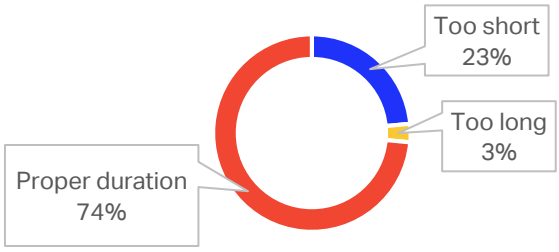
For 75% of the trainees it was the first time that they experienced VR.

Percentage of pre-existing experience of VR technology (fig. 2)



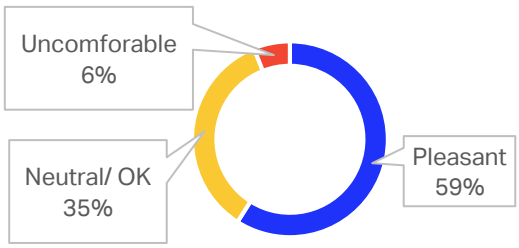
"So far, the attendance of refreshers was mandatory but rather considered sort of annoying sessions because we got explanations for duties we've been doing for many years already. Now that we are using RampVR, we became much more interested in these refresher courses and do retain more knowledge." (Fraport trainee)

Duration of session using VR (fig. 3)

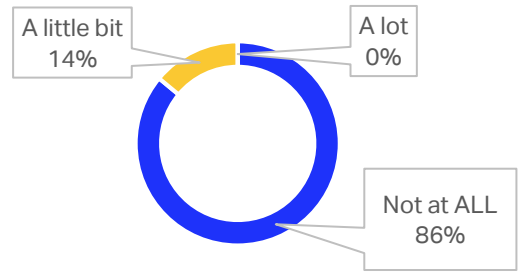


On average each trainee spent 12 minutes using RampVR and in most cases it was perceived as being just right. A module should not take longer than 15 minutes, so instructors could manage the training time well.

Was it comfortable wearing VR set? (fig. 4)

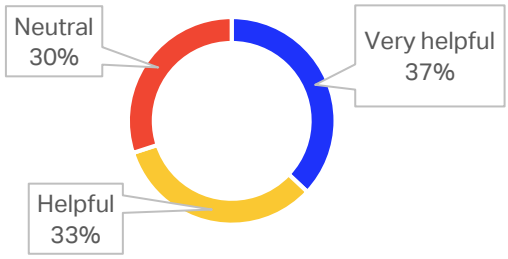


Percentage of negative reactions (Note: none of trainees experienced considerably unpleasant sensation) (fig. 5)



There were no complaints about cybersickness ("VR sickness") and wearing goggles was a positive experience for most of them. Even users with classes did not experience any problems when using VR-goggles and continued to wear their glasses.

Did the VR support your after training operational assignment? (fig. 6)

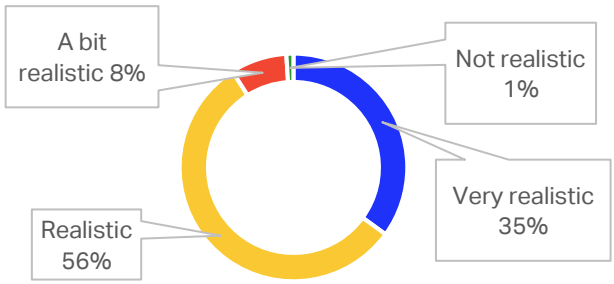


One of the key benefits for trainees is that confidence gained before going to the live operational environment. We believe that the most positive effect of RampVR, related to the employee's well-being. For marshalling trainees– especially at the beginning of a career – their task tends to be very stressful and difficult. With RampVR, trainees can develop a certain routine, which makes their entry into the live working environment a lot easier. They perform their first live task with much more confidence and reveal an increased safety awareness.

The level of realism has met the expectations of the trainees. Both, graphics and the "gaming-experience" were described as being "very close to reality". The visualization is perfect to demonstrate some of those aspects, which are not frequently experienced on the ramp such as aircraft damages, FODs, foggy weather conditions etc.

"The "muscle" memory can be trained extremely well with the marshalling module. We are able to show and train the right movements with the trainees until these movements are internalized and our guys are ready for action at the real aircraft." (Trainer)

How realistic was the VR session? (fig. 7)



To conclude, feedback received from all our staff involved in the project was extremely positive and an ongoing use of the VR tool is very much favored in the future.

"RampVR is an excellent tool to store theoretically gained knowledge in a sustainable way. Trainees did remember the procedures far better and retained them for a longer period, which at the end translated into an everlasting improved performance quality. They just got a better understanding of what we – as trainers – are expecting from them on the real ramp environment." (Fraport Ground Services, Ramp Training Department)

Fraport Ground Handling Services took the decision to integrate the two IATA RampVR modules as a permanent part of operational training and to further develop and expand VR trainings in additional areas.

Further steps to achieve success

The case study of Fraport's use of VR in training has demonstrated the usefulness and versatility of the technology. In implementing VR in training, we recommend that that a clear objective is identified and the following points are considered.

- VR should be considered as a tool for knowledge transfer and knowledge retention. However, it is very important to understand how its application in knowledge consolidation and trainee sensitization.
- Any development of training modules needs to be integrated into an organization's overall training strategy in order to achieve its full potential and desired outcomes.
- VR should not be considered a replacement for real situational training. It can simulate many more scenarios and situations and be used to augment training which otherwise can be theoretical and less contextual.
- VR technology is pervasive, however pay heed to the plethora of solutions. Weigh the costs versus quality argument and decide on the type of implementation which would address the needs of your organization and your trainees.
- It is of utmost importance to actively involve your instructors in the conception, design and implementation of VR in your training programs so that you will realize the benefits of the technology.

About IATA

The International Air Transport Association (IATA) is the trade association for the world's airlines, representing some 290 airlines or 82% of total air traffic. We support many areas of aviation activity and help formulate industry policy on critical aviation issues.

Thousands of aviation professionals and businesses are trained by IATA each year with a commitment to developing careers and a workforce that makes our industry safe, secure, and sustainable. IATA's understanding of best practice, international standards, and industry regulations ensures courses address real workplace challenges.

IATA Training offers flexible training solutions in a classroom, distance learning, virtual or in-house format to meet all budgets and needs.

RampVR is IATA's award-winning "plug-and-play" virtual reality training solution for ground operations. It is a fully IATA and industry compliant virtual reality training tool for ground operations professionals. It complements theoretical knowledge with effective practical training in a visually realistic environment, covering major turnaround activities in Aircraft Turnaround Inspection, Aircraft Marshalling, Passenger Boarding Bridge Operations and Aircraft Pushback.

More information: iata.org/RampVR

iata.org/Groundops

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