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USE OF VIRTUAL REALITY SIMULATION TECHNIQUES FOR TRAINING AIRPORT FIRE OFFICERS

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Contents

The Report

The introduction, section 1, gives a background to the study and introduces a simulator and a desktop trainer together with an overview of training in command and control procedures. Section 2 of this report identifies the methodology adopted in completing the study, essentially this involved subjecting a number of experienced airport fire officers to an exercise on the simulator and by questionnaire, observation of their performance and de-briefing, sufficient data was obtained to make positive conclusions in respect of the simulator. In section 3 a full description and narrative of the two scenarios employed in the evaluation is documented. Section 4 details the analysis of the questionnaire in terms of realism, command and control skills, pressure, stress, potential in training, and strengths & weaknesses. In section 5 there is an analysis of the officer's performance on the simulator by direct observation and retrospective examination of the individual video recordings. Salient points derived from the individual de-briefing and open forum sessions are collated in section 6. During the live running of the exercise it was possible for the technical staff of the University, the consultant fire officer and the University's project manager to critically assess the main features of the training facility. The results are discussed in section 7 of the report. In section 8 of the report there is an assessment of the desktop training facility (DTT). An analysis of the training benefits of the simulator is given in section 9. Section 10 lists the main conclusions to be drawn from the report. In the appendices section 11.2 records the actual data collated via the questionnaire. All Trade Marks are acknowledged.

Executive Summary

Results of the evaluation indicate that there remains a need to enhance both training in the skills of command and control and facilities which allow airport fire officers to practise and further develop their skills. The simulator is an interactive facility which may provide an initial enhancement of the command and control elements of an airport fire officer's current training. With appropriate development of the software the facility would appear to be capable of providing a method for the training and development of command and control skills.

With further research and experience it is likely that the facility could also provide a means of assessing the skills of personnel prior to appointment to positions that may require them to become incident commanders.

The Authors

Bernard Brown has more than 25 years extensive experience associated with the fire and rescue services, he spent 13 years with local authority fire services including five years in training at Brigade level. He has undertaken the evaluation and inspection of rescue and fire fighting resources at both United Kingdom Licensed Aerodromes and a number of overseas International airports. He was for three years the Officer in Charge of the CAA's International Training Centre at Teesside before being appointed as the Chief Fire Officer of the UK CAA. Bernard Brown currently provides Rescue and Fire Fighting consultancy services to the aviation industry.

Ray Brunskill is the Projects Manager in the Virtual Reality Centre at the University of Teesside. He has more than thirty years experience in the design, presentation and evaluation of computer based training programmes for use in industry and higher education. In the recent past he has undertaken assignments to accredit courses on behalf of the British Computer Society, the British Council, UNESCO, the Institute of Electrical and Electronic Incorporated Engineers and the Higher Education Funding Council for England.

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Section 1 Introduction

The task of the airport fire officer in the event of a serious aircraft accident occurring is to take immediate command of resources on arrival at the scene and ensure that these are used to maximum effectiveness and efficiency.

The priority is to make an instantaneous attack on any fire and to take every possible course of action in order to maximise the opportunities for the saving of life.

In the course of a fire officer's career which may span up to 40 years he/she may never be confronted with a serious aircraft accident in which large numbers of lives are at risk. With this fact in mind it is apparent that an officer who may one day be called upon to command and control a serious accident will have had little if any opportunity to gain essential operational experience.

Whilst the competencies required of an airport fire officer are currently the subject of a national review being undertaken by the Training Standards Consultative Group, there is a well recognised list of competencies expected. These are as follows:

- To quickly and calmly assess the incident situation and prioritise actions in order to ensure that maximum opportunities are afforded for the saving of life.
- To deploy all available resources in an effective and efficient manner.
- To identify other resources required at the scene and request their attendance.
- To give required orders at the scene clearly and concisely.
- To delegate command roles and other responsibilities in the appropriate manner.
- To constantly monitor the situation for the duration of the incident and adapt the strategy to suit the changing circumstances.
- To ensure that resources are being continually deployed in an effective and efficient manner and where this is not the case to order their redeployment.
- To ensure that appropriate safety procedures are enforced and monitored throughout the accident.
- To ensure that a calm, orderly and authoritative atmosphere is created and maintained throughout the accident.
- To ensure that other required resources are identified and requested within optimum time scales.
- To co operate with senior officers from other key agencies on their arrival at the scene.

Investigations following major aircraft accidents in which loss of life has occurred have on occasions commented on the lack of command and control exercised by the fire officer during the accident. Since 1985 the UK Civil Aviation Authority have sought to improve the level of training in command and control skills. It is possible that there are reassessments to be made in the current levels of training of fire officers.

Whilst there are opportunities for fire officers to undergo regular training, it was considered that there might be a need to further improve the training and assessment of the competencies of airport fire officers in respect of command and control skills.

A broad description of current airport fire officer training is given in section 1.3.

Environmental Tectonics Corporation (ETC) developed a virtual reality fire training simulator for the UK Defence Fire Service. This new training system for airport fire officers was installed and accepted by the Defence Fire Service College at RAF Manston in November 1996.

The Civil Aviation Authority commissioned a study to evaluate the Tactical Command Simulator (TCS™) as a training system to develop and measure the competency of the incident commanders and crew commanders in command and control procedures. This report has been produced as a result of the study.

Part of the study was to assess the training benefits to be gained from the use of small screen desk top trainers as these are an integral part of the Tactical Command Simulator (TCS™) training concept.

The independent study and evaluation work was contracted to the University of Teesside for the trials to be carried out in the Virtual Reality Centre. (See section 1.1).

1.1 THE TACTICAL COMMAND SIMULATOR (TCS™)

The ETC Tactical Command Simulator is a real time, interactive, immersive training simulator which provides realistic simulation of serious aircraft accidents. The simulation is projected in a Virtual Reality Centre as shown in Diagram 3.1 of this report. It provides a 140° horizontal wrap-around view for the trainee who is seated at the centre of the projector screen. A sound system synchronised to the visual images is provided to ensure a realistic simulation. The presentation of the simulation produces effective stress conditions for the trainee. The trainee controls his visual perspective of the scenario by means of a joystick.

The real-time textured software model developed by ETC runs on a Silicon Graphics Infinite Reality Onyx system running under the IRIX 6.2 operating system and produces images of aircraft, fire vehicles, people, fire, smoke, foam and weather etc. Photo-textured images along with multiple intelligent models are used to allow for correct behaviour and realistic representation of real world accident situations.

The control section of the simulator software provides drop-down menus for ease of set-up and control during a training exercise.

Training exercises for the simulator are scripted then turned into a computer model using the drop-down menus which provide individual selections for all variables required to generate a realistic real-time scenario.

The simulator software was installed in the Virtual Reality Centre at the University of Teesside on Silicon Graphics Onyx computers to set up the Tactical Command Simulator (TCS™) needed for the trials as part of the CAA study.

The study was conducted by the staff of the University of Teesside in the Virtual Reality Centre as described in this report.

1.2 DESK TOP TRAINER (DTT)

The desk top trainer (DTT) is specifically designed for use in an airport fire station to provide a training facility which is available to fire officers 24 hours a day.

The DTT consists of a Silicon Graphics O2 workstation which is a state of the art graphic computer with large screen, keypad and mouse. The computer does all the set-up menu processing in addition to providing the visual display. The DTT runs the same software as the simulator with the same flexible exercises. The scenario is computed and displayed in real-time.

The trainee can develop new training scenarios for himself or these can be produced by either an instructor or ETC.

The DTT can be provided with a projector and screen so that the student using a joystick on a pedestal in front of the screen can control his/her visual perspective of the scenario. The arrangement provides all of the training features of the virtual reality simulator but without the wrap-around vision effect. In this mode a second student operates the DTT computer and acts as the instructor.

The DTT is provided with a basic set of training exercises as part of a structured training programme for fire officers. The DTT enables the trainees to learn new command and control skills, to carry out training exercises relating to serious aircraft accidents and to experiment in a free play mode. The variable selection options available for set-up enable a portfolio of training exercises to be built up and recorded. Realistic sound is also provided by the DTT to synchronise with the progress of the exercise.

The same detailed textured presentation of aircraft fire vehicles, people, fire, smoke, foam and weather etc is provided in the DTT as in the TCS™.

The DTT is capable of providing most of the training benefits available with the TCS™. One reduction in benefit is that the DTT does not incorporate the wrap-round vision effect, this means that the high levels of stress which full immersion in the Virtual Reality Centre achieves are somewhat reduced. However, with the use of a larger screen facility and the full wrap round sound system, a standard feature with the DTT, a sense of urgency to respond to the various audible and visual cues is provided. Whilst stress under training conditions appears to be related to an individual's confidence, technical knowledge and practical ability, the features provided by the DTT are intended to introduce an appropriate degree of stress for students using the system.

1.3 OVERVIEW OF TRAINING IN COMMAND AND CONTROL PROCEDURES.

There is currently an acknowledged need for enhanced training in fire ground command and control skills (see section 4).

To date much of the training carried out by airport fire officers in relation to developing command and control skills has been achieved by:

- Live fire exercises
- Table top exercises

- Attendance at mainly, but not exclusively, relatively minor aircraft accidents and domestic calls, this last method is very much a case of learning 'on the hoof' and is not the recommended route for training officers to deal with major accidents in which a considerable number of lives may be at risk.

Probably the best available method at the present time is to train airport fire officers on the fire ground under conditions which represent, as far as is achievable, those likely to be encountered at a real accident. There will always be a need for officers and fire fighters to receive training under conditions of real smoke and heat.

Exposure to, and experience under fire, heat and smoke is a fundamental requirement of the job and it is not considered that the simulator could ever replace that particular aspect of training in its entirety, but rather to complement it.

The present level of training has a number of drawbacks. The reasons are many and varied but include the following;

1.3.1 It is impossible to set up an exercise involving a serious aircraft structure fire using time expired aircraft and then to repeat it in precisely the same way in order to allow an individual to have a further try in order to correct any mistakes made and develop command and control skills. For example:

- The development of the fire may not be the same
- Some of the aircraft structure may be destroyed during the first exercise.
- The temperature of a subsequent fire may not be the same
- The ambient temperature may have changed
- The wind strength and direction may have changed
- Old airframes can be difficult to acquire and are expensive when available. The fabricated structures that many airports have invested in whilst providing interesting and in some cases quite gruelling fire scenarios do not, and were never intended to, provide anything resembling a real aircraft on fire.
- Environmentally, the burning of aircraft hulks with all the attendant release of toxic materials into the atmosphere is now regarded as unacceptable in all but a few exceptional locations. At a busy airport such a release would almost certainly be considered unacceptable.
- In addition to the above factors it is extremely difficult for airport Rescue and Fire Fighting Service (RFFS) appliances, equipment and personnel to be tied up on training exercises of such a complex nature while aircraft movements are taking place.
- There is also a requirement for on going training in command and control skills and the need to provide an opportunity for an individual to regularly practise their command and control skills so that these become second nature.
- Finally there is probably a need to assess the capability of fire officers prior to appointing them to a position in which they could be called upon to act as an incident commander.

1.3.2 It is not normally possible at a licensed aerodrome for all of the RFFS resources to be engaged simultaneously in major training exercises whilst aircraft movements are taking place.

1.3.3 Resources and procedures are currently not available at airports which enable the training, development and assessment of airport fire officers in the competencies of command and control to the level detailed in this report. This is clearly expressed by the 30 airport fire officers who attended the trials at the University of Teesside (see section 4).

Section 2 Methodology for Conducting the Evaluation

In order to evaluate the Tactical Command Simulator (TCS™) the following aspects of the simulator were investigated.

- Realism
- The ability to develop command and control skills
- Issues relating to pressure and stress
- Relationship to existing training facilities
- Simulator software structures
- Potential benefits
- Other aspects of the simulator

Initial work on the study started in March 1997 and was completed in September 1997. The evaluation included the following tasks:

Task 1 Preparation and set up

1.1 Confirm the project plan
1.2 Set up hardware
1.3 Install the software
1.4 Establish the interface between the software and the Virtual Reality Centre
1.5 Check out the overall system (integration of hardware and software)
1.6 Develop the training exercises
1.7 Test run and evaluate these training exercises
1.8 Identify the population of users by size and role
1.9 Establish a sample
1.10 Agree video recording procedures for the assessors
1.11 Construct the questionnaire for candidates
1.12 Validate the questionnaire

Task 2 Conduct the test and evaluation

Task 3 Carry out the analyses

Establish the results
Analyse the results

Task 4 Production of the draft report

Task 5 Submission of final report

It was agreed that the University of Teesside would appoint an experienced fire officer as a consultant to assist with the programme. At the project meeting on 20 May 1997 attended by the University's project manager, the consultant fire officer, representatives of ETC and CAA, it was agreed that 32 fire officers from UK airports would be invited to assist with the evaluation. It was further agreed that the questionnaire (see appendix 11.1) would be used in the evaluation.

Four officers per day were invited to attend the Virtual Reality Centre at the University of Teesside on eight days between 21st May and 30th June 1997. In the event two officers were indisposed. The 30 officers who attended were considered to be a sufficient sample on which to complete the evaluation. Eleven senior officers, 17 watch officers and 2 vehicle commanders drawn from the following airports attended:

Heathrow	Manchester
Stanstead	Bristol
Gatwick	Highlands & Islands
Blackpool	East Midlands
Teesside	Newcastle

The programme for each group of 4 officers included

9.30–10.15	Presentation and demonstration of tactical command simulator	
10.30–11.15	Demonstration of desk top trainer.	
11.15–13.30	Individual experience on the simulator	30 minutes
	Completion of questionnaire	40 minutes
	Individual de-briefing	20 minutes
14.00–15.00	Open forum	

N.B. During the individual experience a video recording was made to assist with the evaluation

The analysis of the results of the questionnaires was undertaken by the project manager, observation of the individual officers' performance on the simulator was undertaken by the project manager and the consultant. The evaluation of the software was undertaken by the University's project manager, the consultant fire officer and the technical staff of the Virtual Reality Centre at the University of Teesside.

Section 3 Development of Training Scenarios

The Tactical Command Simulator (TCS™) includes a facility which allows different scenarios to be constructed from a menu of graphics and sound files. The consultant designed two scenarios for use in the evaluation of the simulator. The two scenarios were considered to represent an appropriate level of complexity so as to provide the officers with a meaningful exercise.

The objective was to use aircraft accident scenarios which demonstrate to the officer taking part in the evaluation the type and complexity of accidents which can be designed to work on both the DTT and the (TCS™). The prime function of the facility is to train rescue and fire fighting personnel in the skills of command and control.

Whilst the simulation programme has been set in order to provide a number of specific problems for the officer in charge on arrival, the accident is fully reactive to actions taken by the officer in charge. A series of visual, verbal and other audible cues (only some of which are indicated in this document) are provided throughout the simulation. By making the appropriate operational decisions, the officer in charge has a real opportunity to influence the outcome of the incident.

The officer in charge is expected to continually monitor and assess the accident as it progresses and ensure that the airport fire and rescue service (RFFS) operates to maximum effectiveness and efficiency. Where action needs to be taken in order to command and control resources at the scene, the officer in charge is expected to respond in the appropriate manner in order to address the situation.

The officer in charge is expected to respond to a variety of visual, verbal and other audible cues throughout the incident.

It should be noted that some radio messages responding to requests etc. from the officer in charge will, depending upon the request, need to be generated during the simulation.

The evaluation of the simulator was undertaken in the Virtual Reality Centre at the University of Teesside. The general arrangement of the facility is shown in the plan view of the auditorium (see Diagram 3.1). Diagram 3.2 shows a representative view of the scene.

The officer in charge was able to control his position in relation to the scene by using a joystick. Communication between the officer in charge and other agencies was achieved by a desk mounted microphone. Verbal responses and other information relative to the progression of the accident was provided by the fire consultant. The instructions of the fire officer in charge were interpreted by one of the technical staff of the Virtual Reality Centre.

3.1 SCENARIO 1

The incident for scenario 1 is designed to represent an actual major aircraft accident.

The simulation includes the following detail.

- Positioning of all vehicles upon their initial arrival at the scene.

- The fire will be hampering evacuation of the aircraft with only three doors available for use by the passengers. These are Right 1, Left 1 (Slides deployed are shown on graphic 1) Right 2 is available but has failed to deploy.

- There is a serious fuel leak from the No 1 engine. (Port Engine) The heat from the engine has ignited the fuel and this in turn has caused fire to enter the aircraft via the fuselage adjacent to the engine. There is therefore both an internal and external fire occurring simultaneously.

- Three major foam tenders will be represented by Crash 2, Crash 3 and Crash 4. These vehicles carry 9000 litres of water (2000 gallons) with a monitor discharge rate of 4500 litres per minute (1000 GPM)

- In addition to the primary agent i.e. water / foam, 100 kilograms of halon (BCF) will be available for selection by the officer in charge. The discharge rate for this agent is to be 2 kgs per second.

- 70 passengers and crew are on the aircraft. 15 will either escape under their own efforts via the two front exits or be rescued by the RFFS. The simulation will cause 55 persons to perish during the ensuing fire although appropriate action by the officer in charge can reduce the total number of fatalities by 10.

- The officer in charge is able to request a media status at any time during the simulation.

Configuration of current software

Due to the current configuration of the simulation software some limitations were experienced, for example:–

- A TAC R vehicle simulated the vehicle used by the officer in charge. No fire fighters were available from this vehicle although two were clearly visible.

- Whilst each of the major vehicles were manned by 3 fire fighters, one fire fighter from each vehicle was not available other than to operate the monitor or pump.

- Only halon could be selected as a complementary agent.

- A maximum number of 70 casualties could be provided.

Whilst these limitations are listed it is not considered that that these had any adverse effect on the evaluation programme.

Narrative

Following receipt of the call the appliances respond. For the purpose of this exercise the simulation will commence on arrival of the officer in charge at the scene, all times quoted below are referenced to his arrival. The situation will be as per Graphic No.1. Visual cues provided by the simulation include the following:–

- A serious fire will be visible to the officer in charge. The fire involves;

  (a) the left hand engine with fuel running from the engine and

(b) the fuselage adjacent to the engine

- Dense smoke is blowing across the top of and underneath the aircraft from the mid section to the rear. The left No's 2 and 3 exits are not open due to the intensity of the fire. The rear left and right exits are not available due to the fire. Five passengers have evacuated via each of the two front doors and remain in that area unless ordered to move to a place of safety by the officer in charge.

- Foam falling short of the aircraft nose can be observed. The officer in charge will need to order Crash 2 to be repositioned in order for this to be effective, during the interim period the vehicle is discharging its water via the monitor at a rate of 4500 litres per minute.

- Crash 3 is the second vehicle to arrive and positioned as indicated on Graphic 1 and commences immediately to produce foam onto the smoke on the right side of the aircraft at a rate of 2250 litres (500 GPM) per minute.

- Four minutes into the incident five passengers will appear at the Right No 2 exit, the slide has failed to inflate at this exit. The officer in charge will have the ability to order a ladder to be pitched against this exit in order to assist the escaping passengers.

If the officer in charge fails to spot the running fuel fire at 1 minute 30 seconds following its arrival Crash 2 will inform the officer in charge via radio **'Crash 2 to OIC there is fuel leaking from the port wing and a running fuel fire is taking place'**

The officer in charge will need to get the monitor from Crash 2 'knocked off' and hose lines from this vehicle got to work if he is to avoid this vehicle running out of water at 4 minutes.

At 4 minutes into the accident if the officer in charge has failed to order the repositioning of Crash 2, the deployment of a side line and complementary agent from that vehicle in order to deal with the running fuel fire he will receive a message from Crash 2 saying that **'Our water supply is depleted and we need to replenish'** . The response of the officer in charge will be recorded.

Crash 4 is the third vehicle to arrive and will position to the rear right of the aircraft in order to tackle the intense fire involving the port side fuselage. The appliance will initially use the monitor at low output i.e. 2250 litres per minute (500 GPM).

Once again the officer in charge will need to give orders within two minutes for the monitor to be 'knocked off' and a hose line from this vehicle got to work if he is to avoid the vehicle discharging all the agent by 2 min 15 secs into the incident.

In the case of the latter situation a verbal message at four minutes will be given **'Officer in charge from Crash 3 we have run out of water and need to replenish the tank'**

At five minutes the officer in charge will receive a message from ATC via the radio, **'ATC to Fire Service OIC, there is reported to be 132 passengers and crew on board the aircraft'** ATC will also ask the officer in charge **'Do you require the Local Authority Fire Brigade to be escorted from the rendezvous point to the accident scene?'**

The response of the officer in charge will be recorded though there will be no facility for the purposes of this exercise for interaction with the LAFB.

At seven minutes a voice will be heard reporting to the officer in charge. **'I'm Inspector Bagshaw from the local police with four officers, what assistance do you want from me?'** The response of the officer in charge will be recorded.

If the officer in charge requests help with the removal of passengers to be removed from the scene there should be the facility for this to take place.

If the officer in charge orders breathing apparatus crews into the aircraft at any time during the accident they will report that **'There appears to be a large number of fatalities on board the aircraft'.**

At 12 minutes into the accident the officer in charge will receive a verbal message, **'I'm Station Officer Graham from the Local Authority Fire Brigade, I've got three pumps and 11 crew members what do you want us to do?'**

At this point the response of the officer in charge will be particularly noted as the priorities at this time could be to:

- maintain a water supply to at least one of the major foam tenders.
- release one of the vehicles to either replenish back at the fire station or to ask the LAFB to set into one or more of the airports fire hydrants and supply the foam tender.
- provide one or more breathing apparatus teams equipped with a hose line to make entry into the aircraft and carry out any necessary rescues and to confirm the position on board the aircraft.
- to take over control for breathing apparatus teams
- to attempt to make available all unopened fire exits and attempt to effect an entry into the aircraft.
- to summon further assistance from the LAFB for what should now be obvious to the officer in charge is a major accident.

The scenario was designed to run for 15 minutes minimum and 20 minutes maximum.

3.2 SCENARIO NUMBER 2

Introduction

Scenario number 2 is again based on a previous accident. In addition it incorporates low visibility conditions and in order to make the accident relevant and to fit with the simulation package currently available, some of the detail has been changed.

The same objectives stated for scenario 1 apply to this scenario. The same vehicles, fire fighting agents, equipment and manpower provisions stated for scenario 1 will apply. Following receipt of the call the appliances respond. For the purpose of this exercise the

simulation will commence on arrival of the officer in charge at the scene, the situation will be as per Graphic No.2. The aircraft will be carrying the maximum complement of passengers and crew. A Total of 43 passengers will either be rescued by the RFFS or perish in the fire. The remainder (limited to 27) will escape uninjured. Visual cues provided by the simulation are indicated by a bullet point and include the following:

- The aircraft has suffered a major engine problem in flight and during the emergency landing the port engine has detached itself from the aircraft. The engine can be seen burning some distance from the aircraft and provides a possible distraction for the officer in charge.

- Officer in charge will observe the aircraft landing having developed a serious fire on the No 1 engine (Port wing).

- The officer in charge will be the first to arrive at the scene in Crash 1 (no fire fighters are available from this vehicle).

- Passengers can be observed commencing evacuation via the Right 1 and Right 3 exits.

- On arrival at the scene appliances position (as per Graphic No. 2.)

- Crash 3 is the first foam tender to arrive and is positioned incorrectly and too far away from the aircraft for the monitor to be effective. (A visual cue showing the foam falling short of the aircraft is provided). It can only be repositioned if crews are detailed to move bodies from in front of the vehicles path. (Visual of this to be provided) Without such an order from the officer in charge, crews from Crash 3 will commence of their own accord to deploy two side lines from the vehicle in order to apply foam at 2250 lpm (200 gallons) per minute through each of the two branches. At four minutes into the accident one of the hose lines will burst and require to be replaced. The officer in charge will receive a **message 'Crash 3 to OIC we have a burst hose on one of our lines and are knocking off the line in order to replace the hose'** For the purposes of this exercise this vehicle will run out of water at eight minutes. At 8 minutes the officer in charge will receive a message **'OIC from Crash 3 we have now run out of water and need to leave the site in order to replenish'**.

  The response of the officer in charge will be recorded.

- As passengers are vacating the aircraft, some, who are overcome with smoke and heat, collapse in front of Crash 3 making it difficult, if not impossible, for the appliance to be repositioned.

- The port side slides are not available due to the intensity of the fire.

- At three minutes into the accident, due to the spread of fire under the aircraft and following an explosion, (loud audible cue) the rear port slide bursts. Following the explosion the officer in charge should investigate and see that the rear port exit is not available unless the RFFS fight the fire and pitch a ladder into the exit.

- Escaping passengers will hamper RFFS actions if they are not directed to a place of safety.

- On arrival at the scene Crash 2 positions to the rear of the aircraft in the correct line but too far away for the monitor to reach. (Foam falling short of the aircraft is shown as a visual cue for the officer in charge).

- On arrival at the scene Crash 4 positions to the right of the aircraft and immediately deploys two sidelines. One aft and one forward of the right wing in order to protect the two exits being used by the escaping passengers.

If the officer in charge orders breathing apparatus crews into the aircraft at any time during the accident they will report **'BA team to OIC, there appears to be a number of passengers requiring urgent assistance. Also believed to be a number of fatalities on board'.**

At four minutes into the accident, if he/she has not noticed the situation, the officer in charge will receive the following verbal **cue 'The explosion has damaged the rear port slide'** (the responses of the officer in charge throughout the accident will be recorded).

The officer in charge should order the repositioning of Crash 2 and hose lines to be deployed within the first three minutes. If he fails to do this the vehicle will run out of water. If this is the situation at three minutes the officer in charge will receive a message from Crash 2 saying **'Crash 2 is out of water we need to return to station to replenish'.**

The response of the officer in charge will be recorded, however he/she will need to decide:

- whether the appliance returns to the fire station

- can the personnel be used to run a hose line from any nearby hydrants to the vehicles at the accident

- should the personnel be deployed on other duties at the scene

- should a hose line be got to work from one of the other vehicles at the scene

At 3 minutes from deploying any hose lines from Crash 2 the officer in charge will receive the alternative message **'Crash 2 to OIC we have a burst hose line and are knocking off in order to change the length'**.

At five minutes into the incident the officer in charge will receive the message **'I'm Station Officer Jackson from the Local Authority Fire Brigade I've got three pumps and 10 fire fighters what assistance do you need?'**

Whilst for the purpose of this exercise there will be no facility for actual interaction with the LAFB the range of verbal options open to the officer in charge include:

- please provide a supply of water to the foam tenders at the scene from the LAFB

- arrange for breathing apparatus teams to enter the aircraft with charged hose lines to ascertain the status and commence any rescues

- assist with providing a water relay to the scene

At seven minutes a voice will be heard reporting to the officer in charge. **'I'm Inspector Bagshaw from the local police with four officers, what assistance do you want from me'** The response of the officer in charge will be recorded.

Unless he has given orders to the Local Authority Fire Brigade concerning the provision of a water supply to Crash 4 at 10 minutes into the accident the officer in charge will receive a radio message **'Crash 4 to OIC we have almost run out of water and need to return to station in order to replenish'.**

The response of the officer in charge will be recorded, however he/she will need to decide:

- whether the appliance returns to the fire station
- can the personnel be used to run a hose line from any nearby hydrants to the vehicles at the accident
- should the personnel be deployed on other duties at the scene.
- should a hose line be got to work from one of the LAFB vehicles now at the scene.

The scenario was designed to run for 15 minutes minimum and 20 minutes maximum.

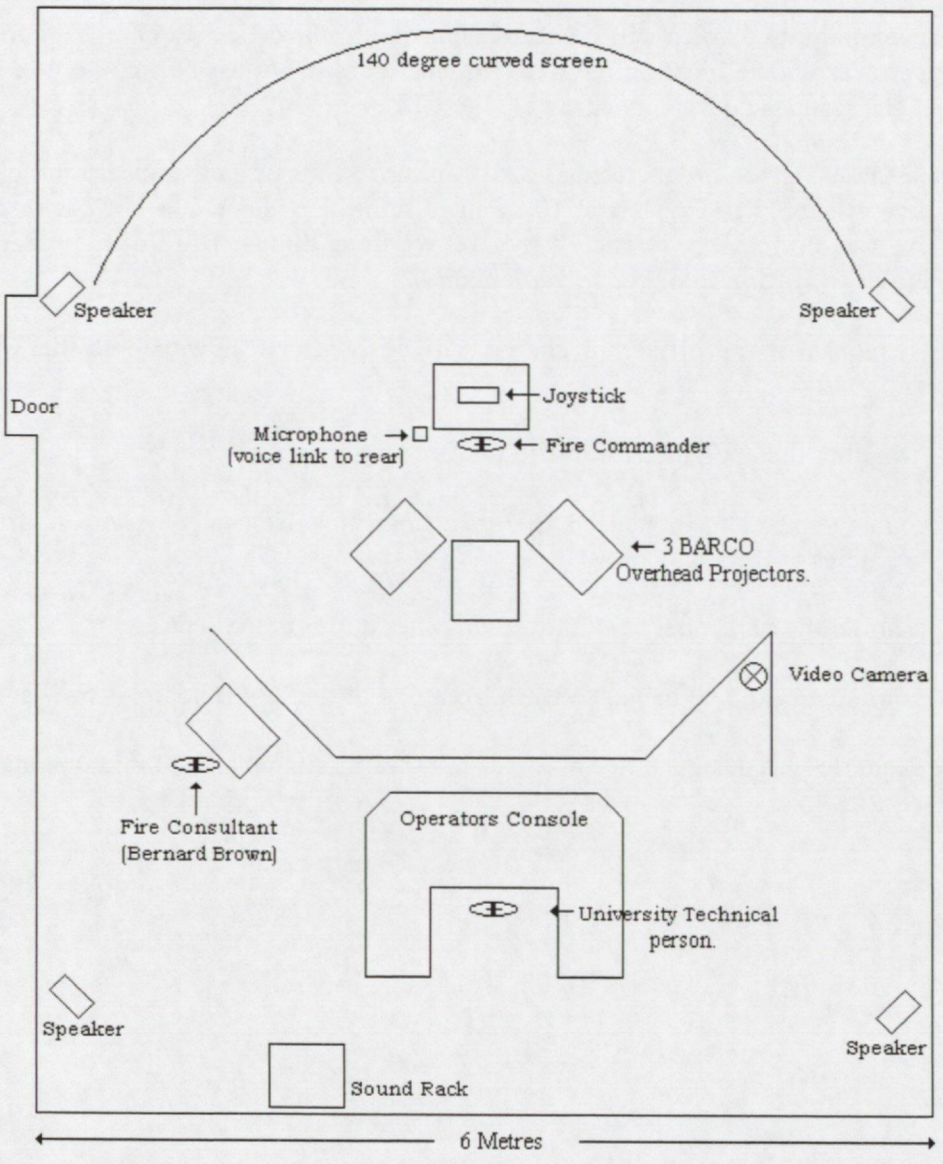
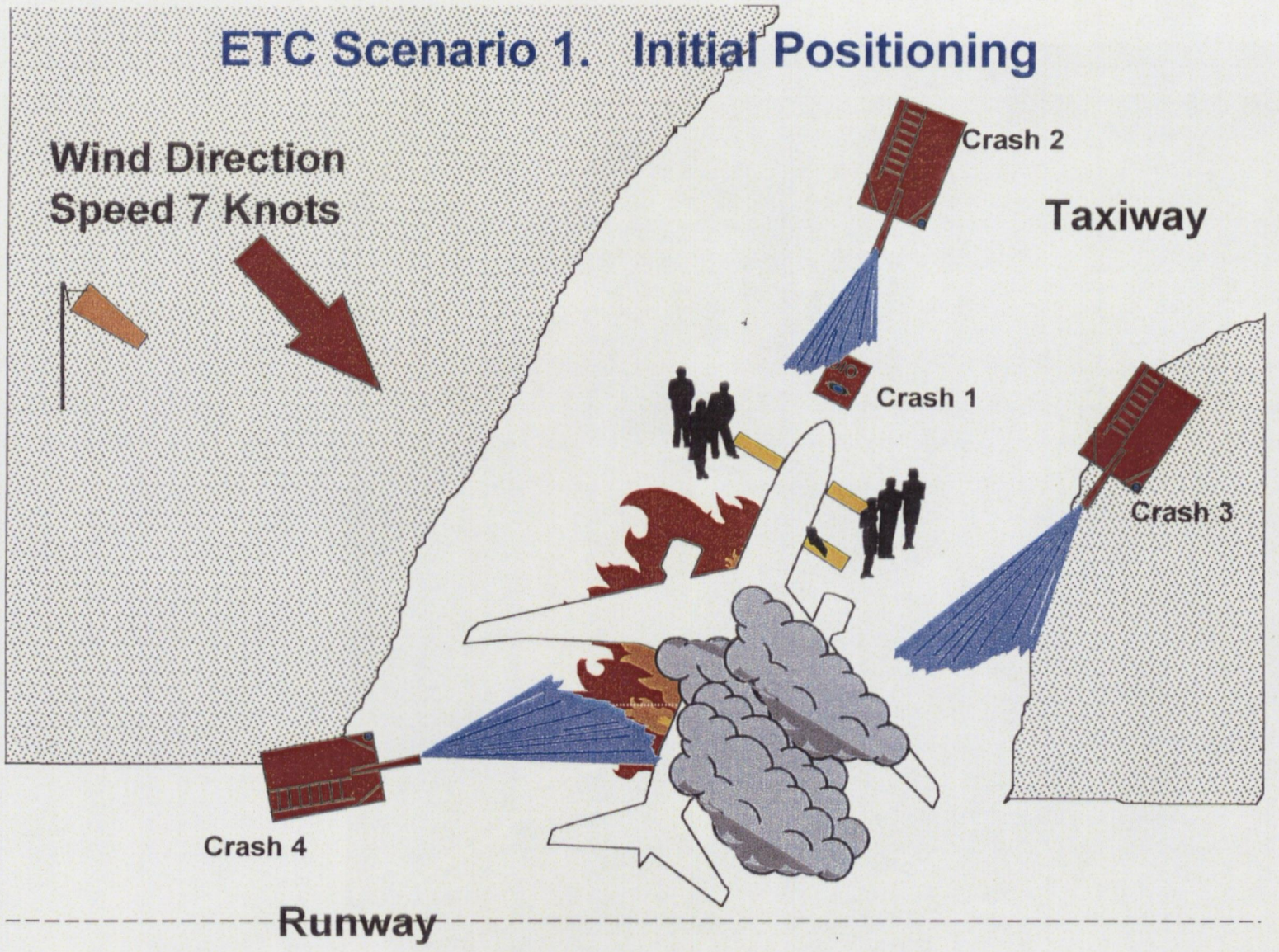
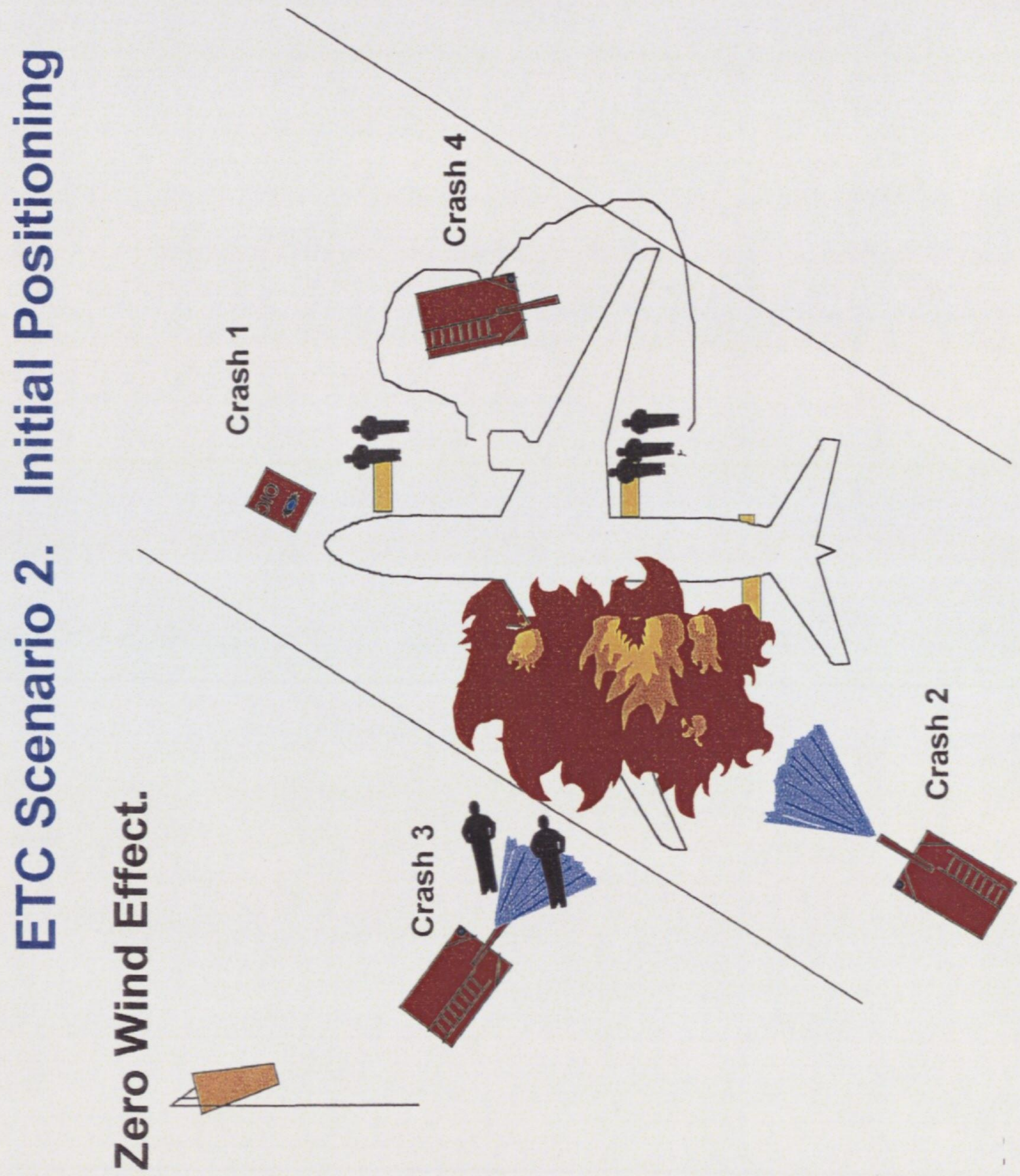

140 degree curved screen
Speaker
Speaker
Door
Joystick
Microphone
(voice link to rear)
Fire Commander
3 BARCO
Overhead Projectors.
Video Camera
Fire Consultant
(Bernard Brown)
Operators Console
University Technical
person.
Speaker
Speaker
Sound Rack
6 Metres

Diagram 3.1

Diagram 3.2

Graphic 1


ETC Scenario 1. Initial Positioning
Wind Direction
Speed 7 Knots
Crash 2
Taxiway
Crash 1
Crash 3
Crash 4
Runway


ETC Scenario 2. Initial Positioning
Zero Wind Effect.
Crash 1
Crash 2
Crash 3
Crash 4

Graphic 2

Section 4 Analysis of Questionnaire

Eleven senior airport fire officers, seventeen watch officers and two vehicle commanders each undertook one of the two exercises on the Tactical Command Simulator (TCS™). After completion of the exercise, each officer, without reference to any other officer, completed the questionnaire (see appendix 11.1). Each officer spent approximately 40 minutes replying to the 25 questions on section 1 and the four questions on section 2. The analysis of the results of the questionnaire is presented here.

Section 1 of the questionnaire deals with the Tactical Command Simulator, the questions were designed to obtain data in respect of the following aspects of the simulator:–

4.1 Realism, questions 1, 2 and 3.

4.2 Use of command and control skills, questions 4 and 5.

4.3 Issues relating to pressure or stress, questions 6, 7, 8 and 9.

4.4 Use of simulator in training, questions 10, 11, 12, 13, 14, 15 and 16

4.5 Other aspects of the simulator, questions 17, 18, 19 and 20.

4.6 Strengths, weaknesses and potential of the TCS, questions 21, 22, 23, 24 and 25

Section 2 of the questionnaire deals with aspects of the Airport Fire Station Training Facility:–

4.7 Desk Top Trainer

4.1 REALISM

All of the responses indicate that the officers' perception of the realism associated with the exercise was representative of an aircraft incident. Of the 30 responses, 13 were very realistic, 14 realistic and 3 almost realistic. The responses gave no correlation between the class of officer. Those aspects of the simulator reported on being least realistic were as follows:–

- Flexibility in use of crew 11
- Lack of busyness and crew movement 8
- System response time between command and action 8
- Absence of other vehicles 2
- Communication between OIC and rest of crew 2
- Initial turnout 2
- Different procedures 2
- Non applicable replies 1

It is apparent that the least realistic aspects are associated with the officer in charge feeling unable to communicate with crew members and other agencies. A lack of busyness is also cited as being less than realistic. Procedures implicit in the exercise were considered different e.g. activities undertaken following initial turnout and the donning of breathing apparatus. These aspects were considered by the fire officers to be relatively minor when compared to the overall experience afforded by the simulator. Those aspects considered to be most realistic were:–

- Development of the fire and the incident 12
- Decision making 8
- Graphics and sound 8
- Initial turnout 2

Since only two respondents commented on the real time nature of the simulation, it was apparent that officers quickly became involved in the incident confirming that the real time development of the incident was realistic. The interaction between the officer in charge and the simulator in the deployment of resources, provides an extremely effective and realistic training experience.

4.2 USE OF COMMAND AND CONTROL SKILLS

All responses indicated that officers felt that the visual realism was adequate and that they were able to influence the outcome of the incident using their command and control skills. All responses indicated a feeling of involvement in the incident with 57% being totally involved and 43% very involved. 64% of the senior airport fire officers reported total involvement as against 50% for watch officers.

These responses indicate that the exercises were constructed in an effective way reflecting the likely events which occur at real accidents. It is important to realise that the effectiveness of the simulator in ensuring that the officer becomes involved in the exercise, is directly related to the skill of the author of the exercise in judging the level of difficulty to be introduced into the exercise. Both of the exercises provided the officers with an experience which is unique in developing command and control skills. The comments in relation to command and control skills were all positive but also provided some useful information in respect of further development of the simulator. These related mainly to the way in which whilst using the simulator, the officer in charge has to take all the decisions to control the incident.

4.3 ISSUES RELATING TO PRESSURE AND STRESS

One aspect of the evaluation was to determine the extent to which the officer in charge was subjected to simulator induced stress. It is worth noting that senior officers who have the actual ongoing responsibility for potentially commanding and controlling an incident reported higher stress levels than the watch officers. The table 4.3.1 shows the distribution of responses to question 6:–

Table 4.3.1 Distribution of responses to question 6

	SAFO	*WO*	*VC*	*TOTAL*
Totally stressed	0	1	0	1
Very stressed	6	4	2	12
Moderately stressed	4	12	0	16
Not at all stressed	1	0	0	1

The additional comments indicate that the level of pressure or stress experienced by the officer in charge is appropriate and consistent with that experienced on a training exercise. The exercises were especially designed so that the level of difficulty associated with the control of the simulated incident matched that usually found on training exercises. The results indicate that the stress levels induced by the simulator were similar to those found on a training exercise. Officers were asked to indicate whether or not the stress levels induced by the simulator were greater or less than those associated with operational incidents at their own airports. The table 4.3.2 shows the distribution of responses to question 9:–

Table 4.3.2 Distribution of responses to question 9

	SAFO	*WO*	*VC*	*TOTAL*
Greater	6	5	1	12
Same	3	5	0	8
Less	2	7	1	10

Detailed reference to the individual comments suggest that the stress levels induced by the simulator are broadly the same as those associated with real accidents. Those reporting higher levels of stress on the simulator made reference to unfamiliarity with surroundings, equipment and the fact that on the simulator crew members were not acting on their own initiative.

4.4 USE OF THE SIMULATOR IN TRAINING

During the debriefing sessions and in the group discussions, officers confirmed that the level of formal training for serving officers in relation to command and control was minimal. The formal training is limited to fairly infrequent attendance at courses in central training establishments. A point made by several officers was that not everyone attending these courses were given the opportunity to act as the officer in charge during the training exercise. Training is undertaken at airports on a more frequent basis but is considered inappropriate for senior officers since in many cases, they themselves have designed the exercise mainly for the benefit of the more junior officers and not specifically for command and control training. In the questionnaire, officers were asked to assess the realism of the experience on the simulator compared to that provided at central training establishments. The responses to question 10 (see appendix 11.2.10) indicate clearly that the simulator was more realistic than the fire ground training at

central training establishments. None of the senior airport fire officers thought it less realistic.

Those officers who assessed it as less realistic qualified their responses with remarks relating to heat, smells, noise etc. There is a strong feeling that the simulator should supplement fire ground training and in no way can be used to replace it.

In relation to facilities available at their own airports, officers overwhelmingly indicated that the use of the simulator for command and control training would be more realistic than existing methods. A comment from a senior airport fire officer illustrates the impact the simulator could have on training:–

'From command and control view it is beyond comparison. Because it is run under strict conditions it makes analysis of performance simple and easy to see where things went awry. It will also allow pre-planned tactics to be tested and developed with all officers deriving benefit and development of an essential skill because debriefs can be targeted to events that went wrong and how individuals could influence the outcome if they had recognised and deployed their team effectively'

The qualifying comments associated with questions 10 and 11 clearly indicate the potential that the simulator would have in command and control training, both at central training establishments and at airports.

Tables 4.4.1 and 4.4.2 indicate the distribution of responses in relation to the realism of the simulator vis a vis centralised training establishments and training provided at airports respectively.

Table 4.4.1 Realism of the simulator vis-à-vis training establishments

	SAFO	*WO*	*VC*	*TOTAL*
More realistic	9	10	0	19
Less realistic	0	6	1	7
Same	0	0	1	1
Indecisive	2	1	0	3

Table 4.4.2 Realism of the simulator vis-à-vis training at airports

	SAFO	*WO*	*VC*	*TOTAL*
More realistic	11	14	2	27
Less realistic	0	3	0	3
Same	0	0	0	0
Indecisive	0	0	0	0

In an effort to gain some feedback which could be used in the further development of the simulator for use in civilian airports, officers were invited to list those aspects of the

simulator they believed to be less realistic than those provided by existing training methods. The individual responses are listed in appendix 11.2.12. The following aspects were identified by the officers as being less realistic than those currently provided by existing training methods.

- Response times
- Communication with crew and other agencies
- Heat, smoke, rough terrain
- Variability of resources
- Airport specific procedures
- Secondary media

Officers were invited to comment on the duration of the simulation since this would influence both the design of the exercises and the stress levels induced by the simulator. Fourteen officers (47%) indicated that the duration was adequate, 13 (43%) expressed the view that it was too short. There were three other responses which did not address the question. There is no relationship between the duration of the exercises and the levels of stress experienced by the officers. Of the fourteen officers indicating the time duration was adequate, 50% had indicated that they had been moderately stressed. There was a more or less identical situation for the thirteen officers who indicated that the duration was too short. The implication is that exercises should be designed to last between 20 and 30 minutes.

In order to assess the perceived level of difficulty associated with the simulator, officers were invited to comment on the level of difficulty compared to that associated with other training exercises. The individual responses are listed in appendix 11.2.14. of the 29 definite responses, 22 (76%) indicated that the simulator exercise was more difficult to control than other exercises they had experienced. Table 4.4.3 gives the distribution of responses to question 14.

Table 4.4.3 Level of difficulty vis-à-vis training exercises

	SAFO	*WO*	*VC*	*TOTAL*
More Difficult	8	12	2	22
Less Difficult	2	2		4
Same	0	3		3
Other responses	1	0		1

The qualifying comments accompanying the responses to this question indicate that much of the difficulty is due to the unfamiliarity with the simulator and a feeling of isolation on the part of the officer in command. there was no appreciable difference in the distribution of the responses between senior officers and watch officers.

Officers were asked to comment on the adequacy of the audible and visible cues provided during the simulation. All of the responses were positive with one or two qualifying comments relating to the audio communication. The individual responses listed in appendix 11.2.15 provide some interesting comments which should be of assistance in developing further exercises. The feature most often referred to related to the method of audio communication used by the officer in charge in the auditorium.

All of the officers considered that the simulator would be either extremely useful or very useful in terms of training and developing the command and control skills of airport fire officers. Table 4.4.4 indicates the distribution of responses to question 16, other comments relating to this issue are listed in appendix 11.2.16.

Table 4.4.4 Distribution of responses to question 16

	SAFO	*WO*	*VC*	*TOTAL*
Extremely Useful	8	12	1	21
Very Useful	3	5	1	9
Moderately Useful	0	0	0	0
Not at all Useful	0	0	0	0

4.5 OTHER ASPECTS OF THE SIMULATOR

Communication skills are undoubtedly an important aspect in responding to incidents. Officers were asked about the role of the simulator in developing communication skills. Twenty nine of the officers indicated that it would be useful. The qualifying remarks listed in appendix 10.2.17 show that officers are very much aware of this aspect of their work and also gave the impression that it would be useful to extend the opportunity of being involved in the simulation to other agencies, particularly air traffic controllers and off airport emergency services. This would enable a total aircraft accident scenario to be simulated and would provide training in the interaction between the different services, particularly in the improvement of communication skills and use of mobile handsets.

The fact that the incident was sited at an airport with which the officers were unfamiliar does not present any difficulty in respect of command and control training only 8 (27%) of the responses indicated that the fact that the scenario was set in an airport, other than their own had affected the training experience. Qualifying statements listed in appendix 11.2.18 suggest that a scenario set in their own airport would be desirable but not essential. Table 4.5.1 gives the distribution of the responses to question 18.

Table 4.5.1 Distribution of responses to question 18

Did not affect training	17	57%
Did affect training	8	27%
Marginally affected training	4	13%
Other	1	3%

An important aspect of this study was to ascertain whether or not the simulator would provide a realistic opportunity to evaluate a fire officer's potential and skills to command and control a real accident. In order to assist with this aspect of the evaluation, officers were asked to consider whether or not the simulator provided a realistic opportunity for evaluating an officer's potential to command and control a real accident. All of the senior airport fire officers considered that it would. There were some qualifying remarks mainly to indicate that the simulator should be part of the evaluation procedure. Fourteen of the other officers made very positive responses, four expressed some doubt and there was one other comment not directed at the question. The table 4.5.2 gives the distribution of the responses to question 19, appendix 11.2.19 lists the officers' individual responses to the question.

Table 4.5.2 Distribution of responses to question 19

	SAFO	*WO*	*VC*	*TOTAL*
Yes	11	12	2	25
Some doubt	0	4	0	4
No	0	0	0	0
Other	0	1	0	1

This aspect of the study was closely monitored after discussion with the officers at the debriefing session and at the group discussions. In addition, observation of the video recordings provided additional information. It was generally agreed that the simulator is likely to be the best tool available for assisting in the assessment of command and control skills. Regular exposure to the simulator would also be useful as a self assessment tool. Before the simulator could be used as a reliable indicator, it would be necessary to conduct a large number of tests so as to provide benchmarks for the various competencies which are being assessed. An additional factor which must be addressed is the role of the operator in interpreting the commands of the officer in charge and the response time associated with those commands. Any variation would question the reliability of the results.

In order to provide information to assist in the further development of the simulator, officers were asked to suggest enhancements. Their suggestions are listed in appendix 11.2.20. In the main their suggestions fall into the following areas:–

- Involvement of other agencies
- Scenarios linked to individual airports

- Communication with crew members.
- Pre-deployment of resources en route.
- For the two scenarios used during the evaluation appliances and personnel were pre-positioned although this was not a requirement of the facility.

4.6 STRENGTHS, WEAKNESSES AND POTENTIAL OF THE TACTICAL COMMAND SIMULATOR

The officers' responses in respect of the main strengths are listed in appendix 11.2.22. All of the responses are positive in that they identify closely with the need for training in command and control. In particular, they recognise the value of the simulator in enabling full immersion in a real time environment where there is the opportunity to demonstrate command and control skills under stress.

The responses to the question 23, listed in appendix 11.2.23 indicate issues relating to response times, communication with crew and the interaction with the scene via the joystick and microphone. During the subsequent de briefing sessions these issues were considered to be of a fairly minor nature compared to the benefits provided by the simulator.

Other comments listed in appendix 11.2.24 should assist in developing more realistic scenarios. Many of these comments confirm the responses to scenarios addressed in section 4.1.

Officers were asked to comment on the potential of the simulator in the development of new tactics and techniques for handling various fire situations. The responses listed in appendix 11.2.25 were all positive. The qualifying remarks indicate the potential they envisage for the simulator. In particular, there was the opportunity for variety in the exercises, use of the simulator for re-runs and critical examination of the exercise, during de-briefing sessions.

4.7 AIRPORT FIRE STATION TRAINING FACILITY (DESK TOP TRAINER)

During their attendance at the University, all officers participating in the study were given a short demonstration of the desk top trainer intended for use at individual airports. The responses to section 2 of the questionnaire are based on a simple demonstration of the facility which did not involve the officers in its actual use. Any consideration of the responses should bear this in mind. Officers were asked to consider the potential of the desk top trainer in training and in the development of command and control skills. The responses clearly indicate that such a system available at individual airports could provide a realistic method of training. The distribution of responses is given in table 4.7.1

Table 4.7.1 Distribution of responses to question 1 section 2

	SAFO	*WO*	*VC*	*TOTAL*
Yes	10	12	2	24
No	0	3	0	3
Possibly	0	2	0	2
Other	1	0	0	1

The qualifying remarks recognise the following benefits:–

(1) Useful in training at all levels

(2) Good introduction to command and control

(3) Should be part of a formal training package

(4) Development of communication skills

Twenty eight of the officers indicated that the desk top trainer provides a level of training not currently possible within an airport's operational environment. The qualifying comments confirm that the desk top trainer would eleviate some of the problems of having to organise training within the constraints of the normal airport operation. Appendix 11.2.27 lists the individual responses to question 2 of section 2.

Other aspects which officers felt need to be considered to develop the desk top trainer are listed in appendix 11.2.28. Those that relate only to the desk top trainer include:–

(1) Customise to individual airports

(2) Pre-determined resource deployment

(3) Incidents involving dangerous cargo

(4) Domestic situations

Officers were asked to consider the advantages and disadvantages of the simulator vis-a-vis the desk top trainer. The individual responses are listed in appendix 11.2.29. The main thrust of the responses refer to the realism associated with the simulator which is not available on the desk top facility. There is a recognition that the desk top facility is capable of providing group training. A number of responses identified the relative difference in costs and the likelihood that a simulator would be centrally sited whereas desk top trainers would be most useful if available at individual airports.

Section 5 Observations of Fire Officers Participating in Evaluation Programme

As part of the evaluation of the Tactical Command Simulator (TCS™) a video recording was made of all officers participating in the programme. In addition to the video a personal observation was made during the exercise. A subjective assessment of the video recording was carried out. The purpose of these observations was to asses three specific aspects as set out below.

5.1 THE REACTION BY THE OFFICER TO THE VIRTUAL REALITY ENVIRONMENT

It was clearly observed that within just two or three minutes the officers became unaware of their natural surroundings and took on the role of incident commander at the exercise they were witnessing under virtual reality conditions.

Almost all officers appeared to be impressed by the high quality of realism of the aircraft and fire situation which resulted in them becoming quickly immersed in the incident.

A number of system malfunctions occurred, some of which were caused by operator error, this resulted in unnatural occurrences on the screen. This phenomena appears to be caused by the software preventing the operator from issuing a series of commands to an appliance crew at one time. The software requires that one instruction is completed before another instruction is entered (see section 7).

5.2 OBSERVATION OF THE HUMAN/COMPUTER INTERFACE

The extent to which the required interface to the system, achieved by means of a joystick and verbal communication, was a distraction to the officer in tackling the simulated incident, was considered to be an important factor in the evaluation.

All officers were given a pre-exercise practice using the joystick interface. In spite of this a number of officers had some difficulty manoeuvring around the incident using the joystick, one or two commented that they had never used a joystick before. Problems witnessed during the exercises included officers moving too fast around the scene, a minority of officers used the joystick facility to back off from the incident site which meant that the visual cues faded and the background sounds diminished, this gave the officer the comfort of making decisions under quiet and unresponsive conditions. On two occasions the officers concerned backed off to such a distance that they were unable to identify appliances to which they wished to give orders. This and other issues relating to the interface are addressed in Section 7.

During the simulation two officers claimed that they were suffering from nausea, during the subsequent debrief four officers mentioned feeling nauseous and three officers mentioned the subject in the questionnaires. This is not a straight forward subject and the reason behind these reports by the officers are explained in section 6.1.1.

Verbal communication was achieved by means of a static microphone placed adjacent to the fire officer. Via the microphone the officer was able to communicate with other appliances at the scene, the aircraft flight deck, ATC, LAFB and other airport local services via a single operator who took on the roles of those contacted. Whilst this appeared to work well the incident commander was not subjected to the high levels of radio traffic normally experienced at major incidents.

5.3 OBSERVATION OF COMMAND AND CONTROL TECHNIQUES

An important aspect of the evaluation was to determine the success or otherwise of handling the exercise in terms of command and control techniques. The following comments are drawn from direct observation during the exercises and of the video recordings.

Whilst air traffic controllers and aircraft pilots have for many years used simulators within their respective structured training and assessment programmes, such facilities are a fairly recent innovation within the airport fire and rescue service. In fact exposure to a virtual reality simulated environment was outside the experience of all of the fire officers who participated in the evaluation programme. It is important to recognise that comments made regarding the performance of participants are in the context of the individual officers working within such an environment.

Years of experience of training air traffic controllers and pilots, have proven that the simulators used in the respective courses are so representative of the real environment that in some cases simulators have become the sole source of exposure prior to the student operating the 'real thing'.

The environment within which a fire officer must work at the scene of an aircraft accident is not one that is easily replicated particularly in terms of smoke, heat and trauma. The opinion of the majority of the airport fire officers was that the simulator provided a more real simulation than that available on fire training grounds (see section 11.2.10). It is believed that the virtual reality facility used during this evaluation does provide a means of training and assessing an individual's competencies in respect of command and control. However, it is recommended that a more extensive evaluation programme followed by careful analysis of performance at actual aircraft accidents, would need to be carried out in order to discover whether the simulator used during this evaluation has the same level of authenticity as other simulators used in other aviation applications.

It should be noted that without exception all officers who participated in this evaluation considered that the virtual reality training facility used during the evaluation had much to offer and filled an urgent training need at this time (see section 11.2.16).

Whilst a minority of officers handled their exercise relatively well the general picture which reveals itself is one which emphasises the need for improved training and the further development of command and control skills.

5.4 SECOND ATTEMPTS

In order to check whether or not repeating the exercises would improve the performance of an officer in controlling an incident under simulated conditions, four officers were invited to attend the Virtual Reality Centre for a second time.

On 9th July 1997 each of the four officers undertook a second but different exercise.

All of the officers on this occasion confirmed their earlier views that the simulator was an excellent training aid. Each confirmed that the scenario attempted appeared just as realistic as on the first occasion.

In observing the officers' performance three of the four made fewer errors, one of whom managed to control the incident very effectively and during the debriefing session indicated that he felt he had *'really been in control of the incident'*. He was obviously elated and confident and expressed the view that the second attempt had clearly been of benefit to him. One officer who had experienced symptoms of nausea on the first occasion, experienced the same symptoms on the second attempt.

The fourth officer who performed less well than on the first occasion considered that he had perhaps been over confident and as a result of losing control of the incident felt frustrated and deflated.

It appears clear, even from the very limited number of second attempts, that training under simulated conditions such as those experienced by fire officers during the Teesside trials can do much to improve an officer's performance and confidence in terms of command and control competencies. It is considered that regular training on the simulator using different scenarios will further improve the competency of fire officers in respect of command and control skills.

Section 6 Analysis of Feedback

6.1 INDIVIDUAL DE-BRIEFING

Each officer after having completed the questionnaire, attended a de-briefing session with the project manager. In each case the discussion covered five areas.

6.1.1 The simulation environment

6.1.2 Existing training in command & control

6.1.3 Desk top training

6.1.4 Potential use for assessment

6.1.5 Educational value

6.1.1 The Simulation Environment

All of the officers confirmed that their experience on the simulator was extremely beneficial. Most officers believed that the experience they had on the simulator had improved their skills even though they had had only a brief introduction. The majority, over 80% indicated that they had been completely involved in the incident and had been greatly impressed by the graphics associated with the exercise. Issues relating to the communications between the officer in charge, the computer operator and the other agencies were discussed in some detail. Most officers agreed that the verbal communication was acceptable and did not detract from the exercise. Officers agreed that response times were fairly accurate, but since there was an apparent lack of busyness on the screen, response times appeared to be long. Those officers who had noticed the inability of the simulator to accept multiple commands indicated that this was only a minor distraction in relation to the benefits afforded by the simulator. The ability to move around the scene was a great advantage.

The majority of the officers quickly became accustomed to using the joystick, although there was a significant number who indicated that the speed of movement around the scene was too fast. Each of the officers were asked if they had experienced any symptoms of nausea. One officer had been seriously affected, one moderately affected and two only mildly affected.

Out of the 30 officers who undertook the virtual reality exercise, four commented verbally and three referred in their completed questionnaire to feeling nauseous. Due to the anonymity of the questionnaire it is not known whether or not the responses refer to the same individuals. During the exercises two officers claimed to be feeling nauseous, however, it is interesting to note that both of these officers had appeared to lose control over the exercise some moments before the claim. From observations made during the trials and from the subsequent verbal and written comments made there would appear to be two possible causes for any nausea experienced. Firstly, the sensation may have been due to the individual moving around the scene too fast, this being caused by an excessive movement of the joystick. If this is the case then a simple adjustment to the software limiting the speed of movement to theat equating to a fast walking pace could remove the cause. Secondly, there is the possibility that an individual feels so stressed

at losing control of the exercise situation that he/she either genuinely experiences nausea as a side effect of feeling stressed, or gives this as a reason to justify their perceived failure. Adjustments to the joystick software together with further experience will provide the necessary additional data for a full understanding of the causes of this experience to be revealed.

6.1.2 Existing Training in Command and Control

Each of the officers confirmed that training in command and control was limited to attendance at central training establishments, and in house training at airports. All officers indicated that there was a need for more training to be made available for command and control, though this should not be at the expense of actual fire ground training which was considered to be an essential part of an officer's training.

6.1.3 Desk Top Training

Officers believed that if the desk top trainer was made available in their own airports it would enhance the quality of training. Benefits mentioned were:

- Involvement with other agencies.
- Use for theoretical aspects of training.
- Minimal disruption to airport operation.
- Exercises could be airport specific.
- Involvement of crew members.
- Training on demand.

6.1.4 Potential use as an Assessment Tool

In the de-briefing sessions the project manager discussed the use of the simulator to assess the capability of an officer to undertake command and control duties. In answer to a similar question on the questionnaire, 25 of the officers believed it would be a useful part of the assessment. During the de-briefing sessions it was noted that officers had not been aware of the importance of the interaction between the officer in charge, the operator and the simulated verbal responses from other agencies. It was confirmed that if the simulator was to be used for assessment, then careful attention must be paid to this three way interaction to ensure some standardisation in the response times and quality of the audible responses. All of the officers expressed the view that the simulator had potential as a tool for some part of the assessment process (see 10.2.5).

6.1.5 Educational Value

During the discussion with officers there was a general recognition of the potential of the simulator to be used in an educational environment to explain tactics, to illustrate the effect of certain actions, to repeat exercises to identify good practice and of course to highlight inappropriate courses of action. There was a general consensus that the use of the simulator could be integrated into courses especially designed to improve command and control training. Officers were extremely enthusiastic about the prospect of this type of training being made available.

6.2 GROUP FEEDBACK

As part of the evaluation process a group discussion took place involving the project manager, the consultant, the computer operator and the officers attending on each of the

days. The purpose was to derive some feedback which would be useful in the further development of the system. All of the officers confirmed that the experience had exceeded their expectations of a simulator. Substantial benefits were identified as follows:

- Useful as a supplement to current training and assessment
- Virtual reality can offer scenarios not available using other methods
- All fire fighters can appreciate the tasks undertaken by the officer in charge
- Can give fire fighters training without real fires
- Environmental benefits
- Development of tactics and techniques
- Simulation of other incidents, e.g. terminals, other types of aircraft, off site accidents

Officers identified aspects which would enhance the realism associated with the simulator. The most frequently quoted were:

- Airport specific scenarios
- Elevation control of monitors and sidelines
- Scenario to include other agencies
- Provision of fire hydrants, open water reservoirs
- Adjust joystick sensitivity
- Use terminology more appropriate to civilian airports
- Increased communication with crew members
- Relative inaction en route to incident
- More involvement with passengers

There were some comments related to the operation of the software, this is dealt with in section 7.

Section 7 Assessment of Tactical Command Simulator Software

In order to present the training exercise it is necessary for a computer operator to interpret the commands given by the officer in charge. The operators were drawn from the technical staff in the Virtual Reality Centre of the University of Teesside. None of these staff have any previous experience of airport fire and rescue procedures. They do have extensive experience in the design and use of graphics based software.

Each of the operators spent 4 days gaining familiarity with the operating procedures embedded in the software. This was done with the consultant in attendance to explain how the instructions of the officer in charge should be interpreted. The computer operators had six or seven practice sessions before the airport fire officers attended the university for the purposes of evaluating the simulator. The consultant was satisfied that the operators were sufficiently familiar with the procedures to enable the evaluation exercises to proceed. The operators were well aware of their importance in the simulation and reported feeling stressed during the actual exercise.

The computer operators reported that the menu system is logically organised with access to the most frequently used items available either by the title bar pull down menus or the vehicle and crew pop up menus. The screen in the control desk shows a diagram of the aircraft and a plan view of the airport which assists the point and click interface.

7.1 INTERFACE BETWEEN OFFICER IN CHARGE AND THE COMPUTER OPERATOR

The interactive nature of the simulator is considered to be adequate for this application. It is difficult to interface voice signals directly to the software. The current arrangements available on the simulator are considered to be very effective indeed. The computer operators have identified a number of issues associated with the software which may affect the operation of an exercise, and which should be addressed in the civilianisation of the software.

7.2 CIVILIANISATION OF THE SOFTWARE

A number of additional and varied scenarios would need to be developed which require fire officers to use their technical knowledge, practical experience, cognitive and command and control skills.

The provision of additional exercises should be such that it allows scenarios to be selected according to the needs of the student undergoing training and the level of airport at which the individual is employed.

7.2.1 Three phases should be considered in detail for each scenario provided:

- En route to the accident
- Initial arrival at the accident
- The fire fighting and rescue phase

7.2.2 A range of aircraft types should be available for selection and should include:

- Four engined, wide bodied, multi-deck aircraft

- Three engined, wide bodied aircraft
- Twin engined, narrow bodied aircraft

7.2.3 Accident scenarios available for selection should each include the option for:

- Accident with fire internal
- Accident with fire external
- Accident with fire both internal and external simultaneously
- Running fuel fire
- Accident with no fire but which requires specific operational action e.g. overheated undercarriage
- The option of including a hazardous cargo should be provided

7.2.4 The accident site locations available for selection should include:

- Airport taxiways
- Airport runways
- Runway undershoot/overshoot areas into water
- Airport areas unpaved (soft terrain)

7.2.5 Appliances and equipment available for selection should accommodate the following:

- Appliances should be to a general and civil airport standard in terms of appearance and performance. Appliances selectable for any given scenario should be between two to six dependant upon the airport of the individual(s) undergoing training/assessment.

- In order to cater for the variance in capacity of vehicles at UK airports at least two different capacities should be available. The capacities should include 9000 litres and 4500 litres. Both roof mounted and bumper mounted monitors should be available for use.

- The use, quantity and destination of the fire fighting media should be under the control of the fire officer. A separate vehicle with no fire fighting capability or additional personnel resource should be available as transportation for the officer in charge.

- A selection of complementary fire fighting agents including dry-powder, halon 1211 (BCF) and carbon dioxide should be available.

- Manpower resources should be selectable from two to four persons per appliance

- Operational procedures and terminology should conform to current civil airport practise

- In order to accommodate the larger UK airports, a facility to select a two fire station capability should be provided. In this case, the resources responding to the accident should be divided between the two and appropriate time lapses built into the responses.

- A range of audible sounds including substantial radio traffic should be provided throughout the exercise.

- The joystick interface should be modified to restrict the pace at which the officer can move around the incident to a fast walking pace. A limiter which prevents the officer from moving more than 100 metres away from the aircraft at any point should be considered to ensure meaningful operations.

7.2.6 During the study there has on occasions been an unacceptable delay between an order/request being made by the officer and the order/request being acted upon by the operator. In order to address this particular problem it is recommended that additional displays and facilities are provided for the simulator software operator. These should include the following:

- Constant display showing status and location of personnel particularly breathing apparatus teams

- Constant display of agent status for each vehicle with the provision of an indication that water supply is depleted as this occurs.

Section 8 Assessment of the Desk Top Trainer (DTT) which is part of the ETC Airport Fire Station Training Facility (AFSTF)

8.1 INTRODUCTION

With modern computer technology, an aircraft accident can be simulated by a desk top computer and displayed in real time for the student to make decisions based on what is seen and/or heard. A scenario can be set up and the computer can play specified roles, leaving the student to perform the duties of an incident commander.

Arriving at the accident, he/she deploys the vehicle, orders evacuations, sets up holding areas, and orders the repositioning of his appliances. The outcome of the exercise is totally dependant on the decisions made by the officer in charge. A bad decision can lead to loss of life, equipment and fire fighters. The exercise can be tailored, starting with simple basic command and control decisions, and then increasing to a full simulation of a major aircraft accident. The basic exercises can be created to give the officer in charge hints on things he should consider, or can free play, leaving all decisions entirely to the student officer in charge. Equipment malfunctions can be simulated, to place additional real-time decisions on the student. In one hour of training the student can gain the experience a number of different accidents. Different types of fires and accidents can be presented including those involving the undercarriage assembly, engines, fuel and fuel spillages and interior fires. Different types of cargo can be presented, such as hazardous cargo. The number of passengers on board can be up to 70. Passengers can be injured, requiring the officer in charge to use resources to help in evacuation. The aircrew can automatically evacuate the aircraft, and can then evacuate on the wrong side of the aircraft. Multiple fires can be simulated, requiring attention, while other fires can wait.

All of this training capability is packaged into what ETC call a desk top trainer (DTT). The DTT provides a training facility in the airport fire station for use as an integral part of a structured training course.

The ETC desk top trainer uses the same interactive software as the Tactical Command Simulator (TCS™).

8.2 SYSTEM EQUIPMENT

8.2.1 General

The DTT provides the fire service with a command and control training system for incident commanders using object-orientated software, modern graphic displays, digital video record/playback, and an automated courseware system capability. The DTT is located in the fire station making available a simulator terminal for use as part of a structured training.

8.2.2 Computers

The system includes a state of the art graphic computer. The computer serves as a user interface doing all of the menu processing as well as the image processing.

8.2.3 Displays

In the DTT configuration, the computer drives graphics displayed in a window on the monitor of the DTT trainee station. Images for each DTT station are processed and displayed in real time. An optional projector can be used to display a full screen image.

With the projector screen, a joystick on a pedestal can be used to allow the student to control his/her viewpoint around the scenario providing the full command and control training as found in the virtual reality simulator but without the wrap around vision effect. In this training mode, a second student operates the DTT computer and plays the role of instructor.

8.2.4 Sound System

The DTT includes a sound system controlled from the computer. Sound representative of real-world sources appear to emanate from their appropriate directions as well as travel within the field of view and include:

- Bell/siren
- Air traffic controller/operator messages
- People (general background shouting)
- Distracting voices (instructor)
- Traffic
- Explosion

8.3 COURSEWARE

8.3.1 General

The software used in the DTT is the same as that used in the TCS. The set up menus are also the same.

The courseware allows the trainer to present a scenario with a consistent condition. These exercises standardise the simulation so that results or score of one trainee can be directly compared with another. Exercises are constructed in stages as follows:

- Initial condition
- Alarm stage
- Travel to the accident
- Arrival and deployment
- Fighting the fire
- Debrief and scoring

8.3.1.1 *Initial Conditions*

The initial condition stage sets up the exercise. During this stage, the system creates the crash site with the location of the aircraft, vehicle(s), weather and wind conditions. When this stage is completed, the visual system displays (on the computer monitors or video projection screen) a view from within the fire station. An exercise allowing the officer in charge to inspect all equipment is available.

8.3.1.2 *Alarm Stage*

When the instructor or trainee starts the exercise, the initial command is the alarm. The alarm is broadcast over the sound system. Verbal messages giving brief information regarding the call can also be provided.

8.3.1.3 *Travel to the Accident*

Travel to the accident occurs after the crew members are in their vehicles and after a small delay from the initial alarm. Each crash vehicle travels to the accident site or a holding point based on a pre-programmed path. The exercise defines the initial travel point. Each vehicle model computes the speed based on the vehicle type. During transit to the accident, the vehicles travel straight ahead until they reach a decision point. The vehicle model then computes the direction, distance, and speed to the vehicle between decision points. When the vehicles reach the last decision point, they proceed directly to their deployment position. Deployment positions are either defined in the exercise or redefined by the trainee before reaching the final decision point.

8.3.1.4 *Arrival and Deployment*

After arriving at the last decision point, the exercise is placed into the arrival and deployment stage. Each vehicle goes to the position specified by either the trainee or the exercise. Sideline deployment is also either defined by the exercise or by the trainee. Laying foam down to provide a safe path for evacuation can be commanded either by the exercise or by the trainee using the redirect command.

8.3.1.5 *Fighting the Fire*

The vehicle crew will automatically point to the hot part of the fire within reach from their command position. The fire crew continues fighting the fire until all the fire in their area is out. Fire crews can be assigned different skill levels (A level-elite, B level-intermediate, C level-newly trained).

A level crews continue fighting the fire until all crib heat releases are zero for water, all oxygen is zero for foam, and then automatically extend their sidelines to reach other areas where fire is remaining.

B level crews continue fighting the fire the same way as an A level crew, but do not automatically extend their sidelines.

C level crews stop using foam when oxygen is close to zero. A command from the trainee is needed for the C level crew to continue fighting the fire until it is completely out.

The exercise assigns crew capability to each crash vehicle. Any combination of crew can be re-assigned to different crash vehicles in the same scenario.

8.3.1.6 *Debrief and Scoring*

When the exercise is completed, the trainees' score is displayed on the trainee screen. Scoring is based on specific values such as the fire model tracking maximum heat release values attained during the fire fighting stage. Heat release values give a good indication of fire intensity. The fire model increments a counter for each crib on fire.

The number of cribs on fire is a good indication of damage caused by the fire, the amount of foam used, the amount of water used and the number of people injured by smoke or fire.

The Exercise Scoring Software (ESS) scores the trainee based on a standard scoring algorithm. This algorithm scores on the same variables for every scenario. The ESS Score command produces individual scores at the end of the exercise using objective event based data (gathered and stored during the exercises) and subjective Instructor input based prompts. A single final score composed of all the individual scores combined using weighting is then produced. All scores (individual and final) can be saved to disk, displayed on screen, and printed out on a Student Lesson Log.

8.3.1.7 *Exercises*

Standard training exercises are included in the DTT. The Instructor or Student or ETC professional staff can create additional exercises by using the 'pop up' menus which are built into the simple software set up screens. These are easy to understand and simple to operate enabling the wide range of set up parameters to be selected according to the exercise script.

Section 9 Training Benefits Analysis

9.1 TRAINING BENEFITS TO BE GAINED FROM THE TCS™.

Section 1.3 sets out current methods employed in order to train incident commanders and goes on to explain why these methods are unable to achieve the objectives.

The evaluation of the Tactical Command Simulator (TCS™) indicates that there are numerous advantages in using virtual reality training over current methods employed. These specifically include the following:

9.1.1 Current training usually requires that the officer in charge of the watch/fire station (who is likely to be the incident commander) actually arranges, manages and supervises the ongoing training programme. This results in few if any opportunities for the officer in charge to undergo training and to develop command and control skills. The simulator provides virtually unlimited opportunities for officers to undergo training and development in respect to these skills.

9.1.2 Exercises can be carefully constructed to include such detail as aircraft type, incident location, ambient temperature, wind direction and strength, type of fire, development of the fire, casualties, time planned events and event based actions. This cannot be achieved by any other method.

Exercises can be repeated precisely. This allows incident commanders to consider their actions following an initial exercise and then to re-run the exercise taking different decisions in an effort to improve their performance. There is no limit to the number of repeat exercises which can be run thereby allowing officers to perfect individual skills and to develop confidence in their own abilities.

It has been demonstrated that in addition to individual training and development it can be used for the training of groups. This aspect is considered important in relation to developing a number of individuals who from time to time are required to work closely as a team.

The potential exists for the development of tactics and techniques. This is possible by means of the ability to input specific commands into the simulator, to then evaluate the result of those particular commands, if required to re-run the sequence entering alternative commands and by making an assessment of the results determine the most beneficial tactics and techniques.

Unlike live fire training realistic exercises can be run for extended periods with no damage to the environment.

As exercises using the simulator do not utilise the actual airport resources these can be maintained at immediate readiness for response throughout these training sessions.

The operational life span of RFFS resources including major appliances may be extended by a reduction in the actual use of the resources and an introduction of training using the virtual reality simulation.

Ongoing training can be provided thereby enabling fire officers to develop command and control skills and through regular training and practise develop and maintain an adequate level of competency.

9.2 TRAINING BENEFITS TO BE GAINED FROM THE DTT.

The initial study undertaken at Teesside University focused on the TCS™. Whilst the DTT was not subjected to a detailed evaluation some consideration has been given to its potential and the following is a summary of the perceived benefits.

- Opportunity for officers to study the basic principles of command and control at any time when local circumstances permit. Interrupted training sessions can be recommenced at a later time at precisely the point at which the interruption occurred.

- Complex aircraft accidents can be simulated for training without any involvement of the actual RFFS resources thereby allowing these to maintain an instantaneous response.

- Opportunity for officers to practice in private command and control tactics and techniques, working in such an environment allows mistakes to be made without any loss of face in front of subordinates.

- Within an operational airport environment it is extremely difficult for the RFFS to develop and practise tactics and techniques using actual aircraft and RFFS resources. The DTT provides excellent opportunities for developing and testing various tactics and techniques on a range of aircraft accident situations in order to study their effectiveness and efficiency.

- Due to the pressure on the time of an officer whilst on duty there is little time for personal involvement in practical exercises, this, coupled with the fact that it is rarely possible to conduct major RFFS exercises whilst maintaining an adequate response capability, there is a real need for the officer to participate in ongoing training programmes. Again the DTT provides the resource for officers to continually practise their command and control skills and maintain an acceptable level of competency at a time and pace to suit the individual and operational circumstances.

The DTT also provides opportunities for junior officers, vehicle commanders and even basic firefighters who either need to, or desire to, learn the requirements of command and control. Specific opportunities include:

- An individual can work through one or more pre-set exercises as part of a structured course of training. A wide selection of training exercises is available and additional ones can be created by the airport fire officers themselves.

- A group of RFFS personnel can be given instruction on both tactics and techniques and the issues affecting command and control. As part of a structured training session they can see and discuss various options being considered and then implemented and by so doing understand the most effective and efficient way of dealing with a particular aspect of an aircraft accident situation.

A further feature of the DTT is that it can be set up in a similar way to the Virtual Reality Centre with one student operating a joystick to manoeuvre around the accident scene and an instructor operating the computer functions.

There is little doubt that the DTT offers a highly technical training capability at relatively low cost compared to using a Virtual Reality Centre. However, the DTT does not provide the same level of immersion and should be seen as complementary to the full facility rather than as an alternative.

Section 10 Conclusions

The following conclusions derived from the study indicate the effectiveness of the ETC Tactical Command Simulator (TCS™) as a training system to develop and measure the competency of incident and crew commanders in command and control procedures.

10.1 SUMMARY

Results of the evaluation indicate that there remains a need to provide both training in the skills of command and control and facilities that will allow airport fire officers to practise and further develop their skills. The ETC simulator is an interactive facility which could provide an initial enhancement for the command and control elements of an airport fire officer's current training. With appropriate development of the software the facility would appear capable of providing a method for the training and development of command and control skills.

With further research and experience it is likely that the facility could also provide a means of assessing the skills of airport fire officers prior to appointment to positions that may require them to be incident commanders.

10.2 CONCLUSIONS

10.2.1 A subjective assessment made during the trials indicates that a number of the participating airport fire officers would benefit from an improved level of training in the skills of command and control.

10.2.2 The Tactical Command Simulator is an interactive, responsive, real time facility which provides new methods of training in command and control skills for airport fire officers at a level not possible with existing methods.

10.2.3 The simulator is not intended to be a replacement for essential elements of training which involve the exposure to live fire and smoke conditions.

10.2.4 Even with the present limited scope of public transport aircraft types and mainly military based design it is considered that this simulator provides training opportunities which are otherwise currently unavailable. The high level of virtual reality simulation permits interactive real time training opportunities, the results of which are fully dependent upon the actions taken by the participating student. In addition the simulator has the ability to provide opportunities to:

- Practise the skills of command and control against a variety of graded scenarios that realistically simulate conditions likely to be encountered at the scene of a real aircraft accident.

- Assist in the development and testing of operational procedures, tactics and techniques.

- Practise under realistic conditions the skills of communicating and working within the structure of local operational procedures.

- Train both individuals and teams with the potential to extend the scenarios to include other on and off airport emergency response teams.

- Precisely record each and every action taken by the trainee during the exercise thereby enabling both objective and subjective assessments to be subsequently made.

- Permit trainees to make their own decisions in respect to command and control issues thereby providing them with the ability to successfully complete the exercise. The impact of each decision taken by the trainee will have some impact on the final outcome.

10.2.5 The simulator includes a facility to assess an individual's competency in terms of command and control skills. It is considered however that at the present time there is insufficient experience and previous scores to establish bench marks with respect to identifying a formal acceptable level of competency. It may be possible to use the simulator as an aid to establishing a bench mark with respect to an acceptable level of competency in command and control skills.

10.2.6 There are considerable benefits to be accrued in using the simulator in dedicated command and control training programmes. They include:

- The ability to exactly replicate previous accidents and exercises which under real life conditions would be prohibitively expensive and almost impossible to achieve.

- The ability to run large scale simulated exercises involving all of an airport's rescue and fire fighting resources without compromising required response times.

- A substantial reduction in adverse affects on the environment over current training methods.

- The ability to create scenarios and run exercises of a scale of complexity, magnitude and nature which are otherwise impossible to achieve, for example large scale fires involving the evacuation of aircraft, fatalities and casualties relevant to the operation of an airport.

10.2.7 Based on the responses from the airport fire officers (see appendix 11.2) the evaluation has confirmed that the use of the simulator enhances the ability of an incident commander to:

- Quickly and calmly assess the accident situation
- Prioritise actions
- Deploy resources effectively and efficiently
- Issue commands clearly and concisely
- Monitor the situation for the duration of the accident
- Adapt the strategy to suit changing circumstances
- Enforce safety procedures
- Liaise with other agencies
- Communicate

10.2.8 Based on the responses from the airport fire officers, the simulator is able to produce safely a level of stress similar to that experienced on the fire ground.

10.2.9 Taking into account the experience gained during the evaluation at the University of Teesside a single intensive one day training course utilising the simulator with its current software may be worthy of consideration. Appendix 11.3 identifies a proposed outline which could be considered for such a course.

10.2.10 Whilst the desk top trainer (DTT) was not subjected to a detailed evaluation it is considered that this resource offers a highly effective training capability at relatively low cost compared to using a Virtual Reality Centre. However, the DTT does not provide the same level of immersion and should be seen as complementary to the full facility rather than as an alternative.

Section 11 Appendices

Appendix 11.1 Questionnaire

SECTION ONE – VIRTUAL REALITY SIMULATOR

1. Did you consider that the simulation was representative of realistic aircraft incident?

2. Which aspects of the experience did you find least realistic?

3. Which aspects of the simulation did you find most realistic?

4. Did you feel that you were actually at the scene and able to influence the outcome of the incident by using your command and control skills?

5. To what extent did you feel involved in the incident?
   Totally involved?
   Very involved?
   Moderately involved?
   Not at all involved?

6. During the simulation did you at any time feel under pressure or stress? Please indicate the level of pressure experienced
   Totally stressed?
   Very stressed?
   Moderately stressed?
   Not at all stressed?

7. If you answered yes to the above question which aspects of the simulation caused you to feel under most pressure?

8. What is the largest aircraft related incident which you have taken command of?
   a) in real life?
   b) in training?
   Please give brief details

9. Do you consider that any pressure & stress you experienced during the simulation was greater or less than that which you experience when attending operational incidents at your airport?

10. Do you consider that the simulation experience was more realistic than the type of fire ground training currently provided at central training establishments?

11. Do you consider that the simulation experience was more realistic than the type of fire ground training currently provided at your own airport?

12. Please list those aspects which you considered to be less realistic than those currently provided by existing training methods?

13. Did you feel that the duration of the simulation was adequate, too long or too short?

14. Do you consider that the simulated training exercise was more difficult to take control of than other training exercises which you have experienced?

15. Were the visual and audible cues provided during the simulation sufficient to allow you to make operational judgements and decisions?

16. How useful do you consider the Virtual Reality Simulator could be in terms of training and developing the command and control skills of airport officers?
    Extremely useful? Very useful? Moderately useful? Not at all useful?

17. Do you consider that the simulation could assist personnel in developing communication skills?

18. Did the fact that the simulation took place at an airport other than your own affect the training experience in any way?

19. Do you consider that the simulation experience would provide a realistic opportunity to evaluate a fire officer's potential and skills to command and control a real incident situation?

20. Accepting the fact that further scenarios are currently being developed for use by Civil Airport RFFS personnel, what other aspects do you feel need to be considered in order to develop the Virtual Reality Simulator?

21. Are there any ways in which the structure and sequence of the scenarios have affected your views on the use of the Tactical Command Simulator?

22. What was the major strength of the Tactical Command Simulator?

23. What was the major weakness?

24. Do you have any other comments about the programme which could make it a more satisfactory training experience?

25. Do you consider that the simulator could be used for developing and practising new tactics and techniques for handling various fire situations?

SECTION TWO – AIRPORT FIRE STATION TRAINING FACILITY (DESK TOP TRAINER)

1. Do you consider that the Airport Fire Station Training Facility (Desk Top Trainer) is able to provide a realistic method of training in developing the Command and Control skills of fire service personnel?

2. Do you consider that the Airport Fire Service Training Facility provides a level of training which is not currently possible within the airports operational environment?

3. Accepting the fact that further scenarios are currently being developed for use by Civil Airport RFFS personnel what other aspects do you feel need to be considered in order to develop the Airport Fire Station Training Facility?

4. What do you consider the advantages and disadvantages of the wide screen trainer vis a vis the Desk Top Trainer?

5. Please circle your current responsibility:

   SAFO Watch Supervisor Vehicle Commander

Appendix 11.2 Summary Of Individual Responses

SECTION ONE – VIRTUAL REALITY SIMULATOR

1. Did you consider that the simulation was representative of realistic aircraft incident?

S	01.	Very realistic with good progression of fire spread.
W	02.	Yes, it did contain most of the component parts i.e. pass interfering, time scales etc.
S	03.	Generally yes – but the area would have been more 'busy'.
W	04.	I do consider the simulation to be very realistic of an aircraft incident, especially as the situation becomes increasingly involved.
W	05.	Almost, lack of passenger(s) evacuating.
S	06.	Yes.
S	07.	Yes.
W	08.	Very realistic to command and control for the officer in charge.
W	09.	It is the most realistic training scenario that I have attended without getting wet or dirty.
W	10.	Yes, when you start to deploy the men at the incident, you have to concentrate quite hard and the results of my commands were there to see, as would be at a real incident.
W	11.	Yes, the simulation was very good, aircraft and appliances are very realistic, fires also first class.
W	12.	Very realistic indeed.
W	13.	As realistic as possible without actually attending the incident. Apart from manpower duties, which you would expect to occur without orders i.e. applying foam to fire situation.
W	14.	Yes, the aircraft type and appliances were good.
W	15.	Yes.
S	16.	Yes, very uncomfortably so.
W	17.	Yes, deployment not realistic.
W	18.	Yes.

S	19.	The simulation was excellent and during the 'incident' I treated the whole scenario as 'reality'.You become so involved that everything else appears unreal!
W	20.	Yes, the scenario was very realistic and followed a logical progression.
S	21.	Yes.
S	22.	Yes, actions or lack of actions resulted in realistic scenarios.
S	23.	Yes.
W	24.	To a degree, overall scene was very good, because the airfield is unknown, it was difficult to gain bearings, but the size and overall aspect was very good.
S	25.	Yes, the simulation was representative and very quickly I was aware that I had to grasp hold of the situation. It certainly increased the stress levels.
W	26.	Yes, realism to the situation.
W	27.	Yes.
S	28.	Very realistic, you are immersed in the incident from the word go, the noise really adding to the reality, on the whole representative of an actual incident.
V	29.	Yes.
V	30.	Yes.

2. Which aspects of the experience did you find least realistic?

S	01.	Some crew movements and monitor target areas.
W	02.	I was unable to directly contact individuals on the fire ground i.e. without using the radio.
S	03.	I would like to have seen some more non-fire service vehicles in addition to local authority services.
W	04.	The simulator is made towards the MOD and our training in somewhat different.
W	05.	a) The time it took crews to don breathing apparatus. b) I had to remind crews to apply media onto fire as they were intermittent in their actions.
S	06.	Personnel – branches too same – not 'alive'.
S	07.	Perhaps evacuating pax walking towards danger at times when the majority would hopefully walk away from the scene.
W	08.	Not least realistic, but all realistic from the moment you sat down (taking charge).
W	09	I feel that the joystick could be replaced by some form of body reactive device? As the operation of the joystick is something that needs to be thought about.
W	10.	The overall view, and not knowing or seeing your manning levels being used.
W	11.	RAF fire-fighters appear 'faceless' though to an RAF officer probably would be realistic, ladder against aircraft fuselage looked unreal (stood on its own).
W	12.	Movement of the fire fighters.
W	13.	Gaining entry into A/L, fire men walking through fire to get to A/L to make entry, significant delays in carrying out instructions.
W	14.	The waiting times between commands and actions especially.
W	15.	Movement of people.
S	16.	Initial turnout. Perhaps the ability to deploy appliances en route may be an advantage, if the trainee wanted that option.
W	17.	I would have pre-deployed – 2 out of 3 appliances O.O.C.
W	18.	I would expect appliance commanders to have more autonomy i.e. produce foam if there is a fire, knock it off if there were not.
S	19.	Once the incident had started I didn't find any aspects unrealistic.

W	20.	From the moment you take control of simulation, you do realise that this is a computer generated scene, however, pressure to succeed soon overcomes this and you are lost in the realism of the scenario and you become a major player.
S	21.	When a vehicle is asked to reposition it reverses before moving forward. Unable to use hatch on undercarriage, time scale for BA to come into use. Getting individual fire fighters in close proximity to react.
S	22.	Inability to pass messages on progress to incident. Time delay on some actions. No allowance for experience of personnel.
S	23.	Response to commands were delayed or put on hold until an earlier command had been completed.
W	24.	Positioning of appliances and their distance from a/c it felt unusual sitting during the exercise, not having control over individual fire fighters. Also the application of media did not seem real.
S	25.	Local authority fire service – no visual input. Being unable to order individual fire fighters, only appliance crews. Being unable to reply on appliance crews performing without direct instruction.
W	26.	None.
W	27.	The delay in commands being acted upon.
S	28.	Lack of flexibility to use crews from other appliances i.e. change hose lines from one appliance to another to alleviate water shortage, lack of ability to instruct crews en route to the incident. Lack of passenger panic situation (screaming, shouting etc.).
V	29.	Movement of people. Unable to task crew members individually or task them with equipment from another appliance.
V	30.	The inability to control individual crew members or to deploy crew from one vehicle to work from another. Initial deployment of vehicles is far removed from current civil airport practices.

3. Which aspects of the simulation did you find most realistic?

S	01	Movement of Fire 1 and the actual visual contact with the aircraft.
W	02.	The decision making process i.e. having to make several decisions at the same time.
S	03.	The internal fire situation and the time scale.
W	04.	The progressive worsening of the situation. The fact that despite your commands the crews interpretation was not always the same. The problem with evacuating passengers and controlling them.
W	05.	The appliance and aircraft graphics.
S	06.	Fire – size of aircraft.
S	07.	The escalation of the incident. The problems associated with maintaining control of the crew and the deployment of equipment: the problems associated with conservation of media.
W	08.	From the initial call, to turning out arriving and taking charge.
W	09.	The progress of the incident and the development of the fire; the way in which the passengers were using any and every exit.
W	10.	The actual fire and fire fighting developing into a major incident.
W	11.	Aircraft type, airfield runway layout, fire appliances, sidelines and foam.
W	12.	The sound and the aircraft graphics.
W	13.	A/L fires, and extinguishment when media applied.
W	14.	The approach to the scene.
W	15.	Ability to move around incident and how incident can escalate.
S	16.	Fire spread – smoke travel. Situation development/deterioration. Time scales/vehicle manpower – equipment deployment.
W	17.	Fire situation – survivors – real time.
W	18.	Graphics and sound score were very good, very realistic.
S	19.	The 'time factor' as decisions were made and acted upon the situation developed in real time. A very realistic simulation.
W	20.	Sound and vision allied to verbal commands between player and controller which resulted in an action on screen.
S	21.	The fire scenario, the passengers milling about.

S	22.	The requirement to pass numerous radio messages and the need to be totally aware of whole incident site including personnel.
S	23.	The ability to move around the incident was excellent, the graphics were also very good but the sound that accompanied the scenario really added to the stress levels.
W	24.	The overall size of the exercise, speed and time felt very real, you became involved very quickly.
S	25.	The actual fire scenario development. The workload (mental) on myself as the OIC. The visual and audio impact – very realistic.
W	26.	Real time delays and realistic conditions.
W	27.	The effects fire fighting had upon the fire (suppression or lack of effectiveness).
S	28.	Fire scenario, ability to move around in virtual reality, ability to control events and re-position crews and resources. The response of the incident to the commands you give.
V	29.	The aircraft itself and the fire evolving as it would in real life. Also the fire-fighting actions and their effect on the fire.
V	30.	Noises and graphics very realistic, also time scales.

4. Did you feel that you were actually at the scene and able to influence the outcome of the incident by using your command and control skills?

S	01.	Yes, so much so that I became engrossed and did not compensate for real time.
W	02.	To a great extent yes. However there were problems regarding individual crews not working on their own initiative. I felt that I was having to make major changes in their deployment, instead of co-ordinating the whole incident.
S	03.	Yes I did, but would have like more feedback from the vehicle commander.
W	04.	I definitely felt I was at the scene and in command, and used the skills throughout the exercise.
W	05.	I do feel I had some bearing on the outcome.
S	06.	To some extent.
S	07.	Yes – quicker more decisive action in regard to rescue would have helped the incident.
W	08.	Very true, it felt you were surrounded actually looking ahead and what's going on around you and making the decisions necessary to achieve your goal of saving life.
W	09.	I did have the feeling of being there; however, I would like to attend another incident when it (simulation) has been adapted for civil aircraft.
W	10.	Yes, but not fully in control because of my answer to question 2.
W	11.	Yes, I was at the scene, initially unable to influence the built in software programme but the more into incident the more influence.
W	12.	Yes.
W	13.	At certain times during the exercise, I felt my directions to personnel were influencing the outcome, at other times it felt unnatural.
W	14.	Yes, but would have been better served by control of the appliances initial positioning. The deployment of sidelines was not initially under my control.
W	15.	Yes.
S	16.	Yes, for better or for worse.
W	17.	As the situation progressed I became more convinced – frustrated that some call signs failed to act as ordered.
W	18.	Yes, to both parts of this question.
S	19.	Yes, most definitely – it was by far the most challenging experience I have ever encountered in testing command and control skills.

W	20.	Not only was I there, but I attended the funerals as well afterwards, (if only I had done better!!).
S	21.	Yes, but found it difficult to keep track of what was happening. The fact that no-one did anything without instruction was a culture shock, we are used to pre-planning and correcting if it is going wrong.
S	22.	Yes, I felt that my commands influenced the incident, however, more scenarios could be added that would make the incident un-solvable.
S	23.	In the most part I found it frustrating at times that you could not request multi-functional tasks to be carried out.
W	24.	At no time did I feel it was a game, I became part of the incident very quickly.
S	25.	It did feel as if I was actually present and able to control.
W	26.	Yes – ability to control resources at a major aircraft incident.
W	27.	Yes.
S	28.	Certainly, a real eye opener, will prove an invaluable aid to command and control training, excellent potential.
V	29.	I did feel actually at the scene, but felt restricted in carrying out orders which I think had an effect on the outcome of the incident.
V	30.	Yes.

5. To what extent did you feel involved in the incident?

Totally involved? **17**

Very involved? **13**

Moderately involved?

Not at all involved?

Other Comments:

S	01.	Became frustrated at time when things did not go as fast as I wanted.
W	02.	It certainly gave you the impression that if you didn't do something, no-one would do anything. Although in real terms that would not be the case.
S	03.	Totally involved and waiting for more problems to manifest themselves.
W	04.	I really felt that the whole incident was in my hands throughout.
W	05.	With VR you become totally involved.
S	06.	–
S	07.	Total involvement in that many facets of the incident were continually going through my thoughts giving the correct ones priority was the problem.
W	08.	–
W	09.	It gave me the feeling that I must carry out my duties and constantly assess the situation as peoples lives depended on my decisions.
W	10.	–
W	11.	Total thinking on your feet scenario, but felt my crew did not show initiative or help in any way.
W	12.	The time just flew by.
W	13.	With further training I feel that I would become involved and gain from the experience.
W	14.	–
W	15.	–
S	16.	The longer the incident progressed the more complicated the scenario developed and the more engrossed I became with the incident.

W	17.	Progressive – now knowing what to expect – total commitment would take place earlier on subsequent incidents.
W	18.	–
S	19.	Complete total involvement, so much so I was totally unaware of anybody else being present in the room.
W	20.	As question 4.
S	21.	Only the heat was missing and people grabbing you are dragging you away (or trying to) to help elsewhere.
S	22.	Very impressed with the ability to move and view all areas of the incident.
S	23.	The delay in some commands being carried out allowed situations to develop that might otherwise have been averted.
W	24.	To be totally involved, equipment and personal need to react in expected fashions.
S	25.	Very quickly you feel that you are the only person in the room and everything is reliant on your actions.
W	26.	–
W	27.	–
S	28.	Very much involved, total concentration, time passed in a flash.
V	29.	–
V	30.	When the exercise was stopped and I was informed that I had been working for 14 minutes I was amazed as it didn't seem so long.

6. During the simulation did you at any time feel under pressure or stress? Please indicate the level of pressure experienced:

Totally stressed?	**1**
Very stressed ?	**12**
Moderately stressed?	**16**
Not at all stressed?	**1**

Other Comments:

S 01. The visual impact of an aircraft in distress was probably the cause of being moderately stressed.

W 02. I did feel some frustration in that supporting agencies did not turn up and that I could not speak with individuals at the scene.

S 03. Initially, a little pressure due to the unknown, once into the exercise not as much as I expected.

W 04. It definitely caused some stress, but being a simulator and not under exam conditions I was not totally stressed.

W 05. The very first VR incident I was very stressed although my second attempt, and probably others, would be moderately.

S 06. For three quarters of the exercise I felt so nauseous that it affected my concentration – I assumed this to be mainly due to joystick movement.

S 07. During the incident I could see the fire escalating and at one point was at a loss to think of how I could improve the situation. A walk around the aircraft provided another option I could have used.

W 08. As a fire officer at a senior level the job sometimes is as pressured and maybe stressful from the time of call and throughout the scene of an incident till all persons are accounted for.

W 09. I was very much interactive, I really did feel stress (though not unhealthy) this sort of training is definitely the future I feel.

W 10. It was hard not to think that if you made a mistake all would be lost.

W 11 Initial stress caused by inability to set the scene prior to crews getting to work, as would normally occur, unable to physically touch someone to attract their attention.

W 12. Manageable stress (enjoyable).

W 13. Due to lack of action from personnel when requested.

W	14.	Waiting times for actions – not being able to see the activity happening.
W	15.	–
S	16.	Following 5, as the situation deteriorated the more pressured I felt.
W	17.	By the end of the exercise, I was enjoying myself.
W	18.	Only very slightly stressed if at all because I knew I was not being tested, but only looking at the concept. If adapted and I was told it was assessable I am sure stress would be high.
S	19.	I can only imagine that the level of stress/pressure would be the same or more in a real incident.
W	20.	The stress levels would be considerable if the scenario was fully played out to a conclusion.
S	21.	At one point I was becoming irate at crew as they were failing to use initiative. The workload was pushing things to the limit.
S	22.	It was hard not to think that if you made a mistake all would be lost.
S	23.	As one problem was overcome another problem confronted you.
W	24.	It became frustrating because I had not got full control i.e. of individual personnel. Also, I feel that because I had no radio I was losing messages because they were coming from behind.
S	25.	I feel that the simulation produced as much stress as, for example, a full scale emergency exercise, or a real emergency situation in my experience.
W	26.	–
W	27.	Usually through frustration when commands were not acted upon.
S	28.	Strange, at the time didn't have time to feel stressed – to busy, but at conclusion when it was over I could feel the sweat trickling down my armpits.
V	29.	–
V	30.	–

7. If you answered yes to the above question which aspects of the simulation caused you to feel under most pressure?

S	01.	–
W	02.	Being the first time I have experienced this kind of system, I unfortunately suffered from motion sickness. I think it was due to me moving around the incident too fast.
S	03.	Lack of positive feedback from crews.
W	04.	When I realised I had a major internal fire situation.
W	05.	That under your control the teams were slow in their actions
S	06.	Commands not being responded to.
S	07.	Not ensuring casualty evacuation took place promptly. The initial small fire caused me to have 'tunnel vision' in regard to the incident.
W	08.	Positioning wrong, running out of media.
W	09.	Remembering where and what crew you had deployed and keeping tabs on the media situation.
W	10.	None.
W	11.	Speed at which my commands were carried out, especially stressed when crew seemed to 'do their own things'.
W	12.	The initial turn out – probably the sound of the sirens and bells.
W	13.	As above.
W	14.	As question 6 comment.
W	15.	The time delay in commands being carried out.
S	16.	Inability with resources and deployment to prevent internal fire spread. Frustration with realistic time scales.
W	17.	Frustration over appliances and manpower not responding as directed.
W	18.	–
S	19.	The need to prevent the situation from getting worse or out of hand with the resources available.
W	20.	After initial deployment and getting to work the pressure was slight, but when other events occur which causes you to react and make decisions which will influence the outcome, then the pressure starts to build.

S 21. The persistence of the running fuel fire, it was draining the media resource, the fact that I was struggling to cope with having to constantly tell crew what to do created a high level of stress.

S 22. The slowness of actions after commands, knowledge of no back-up – and no visual signs of back-up.

S 23. As a mistake was made then you could gradually get drawn into a series of mistakes. It was also very hard to try and remember which crew had carried out what instruction.

W 24. Because it was an unknown airfield it was difficult to get my bearings. It was difficult to hear radio messages because they were coming from the wrong direction. It became frustrating early on because appliances were in the wrong positions and I was bringing more pressure on myself to rectify this and contain the incident.

S 25. Being unable to identify with my crew and understand their reactions. Being unable to visually identify with local authority actions.

W 26. Real time delays and realism to the situation.

W 27. Delays in commands being executed (or not at all).

S 28. Waiting for things to happen after giving commands. Unexpected explosion once, I thought I had the external fire under control.

V 29. The utilisation of crews to deal with the internal fire and large numbers of casualties.

V 30. Trying to communicate without ambiguity.

8. What is the largest aircraft related incident which you have taken command of:

a) in real life?
b) in training?

Please give brief details:

S 01. Boeing 767, Boeing 747

W 02. Engine fire and hot brakes.
Major external fire on A/C

S 03. a) Nose wheel collapse on 707. Engine and wing fire 707.
b) Numerous annual exercises – aircraft accident.

W 04. a) Boeing 737 – 400, I was Acting Fire Station Officer for Aircraft Accident Imminent, burst tyres on take off and returned believing he had lost part of the undercarriage.
b) Trident size – all types of training.

W 05. I have been involved with engine fires, under carriage and full evacuations of passenger aircraft.

S 06. a) Only relatively routine.

S 07. a) Swats 360, smoke in cabin, oil leak in engine. I was a Police Officer first in attendance at a USAF F1-11 fatal accident.
b) Various exercises C130 Hercules simulated engine fire, Chinook helicopter gearbox warning lights – minor.

W 08. Training exercises at the fire school.

W 09. a) Smoke in cockpit of an airbus A320, evacuated pax and turned out to be an electrical fault.
b) A/C mid air collision multiple casualties.

W 10. a) Tornado aircraft dropping fuel tank onto the runway on take off.
b) At CAA Training School.

W 11. a) None on this scale, usually minor engine fires, APU's undercarriage. Dozens of full emergencies up to 1-11, 146 size.
b) Fire School Tridents etc, annual exercises on Cat 5 airfields.

W 12. a) Tristar with hot wheels (240 pax)
b) Incidents of FSTC

W 13. a) F100 with engine fire warning, smoke issuing.
b) B737 training rig exercises.

W 14. a) Tristar – engine fire and A/C collision while ferrying 2 x short 360 to hangar.
b) Full scale exercise at Newcastle numerous times.

W	15.	a)	B757 major fuel leak in P engine on take off. Returned to airport full fuel load and pax.
		b)	Trident A/L accident IFTC.
S	16.	a)	B734-400 post rescue and recovery/vanguard. Kegworth incident from 0600 morning Tornado aircraft dropping fuel tank onto the runway on take off.
		b)	Destruction by fire of two Vanguards on fire ground.
W	17.	a)	Vehicle commander – first in attendance B737 at Kegworth.
		b)	Annual exercises 3 x RFFS, approximately 10 x LAFB pumps, 3X LAS and Police – at least 4 times.
W	18.	a)	B747 aborted take off, burst tyres OIC for first 2 mins only.
		b)	737 simulator rig.
S	19.	a)	Real life – collapsed undercarriages on small a/c and helicopter running faults needing evacuation of a/c.
		b)	Several incidents on 747/737 simulations at IFTC where I was an instructor for 15 months.
W	20.	a)	BAC 146 – engine fire, Hawk (MIL) – engine fire.
S	21.	a)	C150 taxing in high wind blown onto back, pilot suspected spinal injury.
		b)	B737 fire training rig, external/internal fire with casualties to be cut out.
S	22.	a)	Engine fire A320
		b)	CAA Fire School training scenarios.
S	23.	a)	757 overshooting the runway, which became an aircraft recovery operation once all pax had evacuated. A number of light aircraft accidents.
		b)	Trident
W	24.	a)	A Viscount a/c arriving with smoke in the passenger cabin, 50 pax and crew.
		b)	Incident involving 737 + 12 seater helicopter and a passenger train, the scenario also included the 737 breaking in three, one of which fell on a holiday camp.
S	25.	a)	Overheated undercarriages.
		b)	Full scale licensing exercises.
			The major exercises involving attendance from all external services and agencies held for licensing purposes.
W	26.	a)	B737 A/C full evacuation.
W	27.		2 Tornado aircraft involved in mid air collision both a/c damaged but extent not known. On landing 1 a/c had belly fuel tank rupture resulting in major fuel leak on stand.

S 28. Later series of Boeing 737 incident Aug 85, Boeing 747 undercarriage fire, several other undercarriage and engine fires over the years.

V 29. a) As a number 2 (sub officer) 767 smoke in cabin, caused by air-conditioning fan bearing overheating.
b) A/C accident at IFTC Teesside.

V 30. a) Tomahawk nose wheel collapse.
b) Major aircraft fire.

The Tomahawk suffered a collapsed nose wheel on landing no fire no injuries. Major aircraft fires on training school fire ground various scenarios.

9. Do you consider that any pressure & stress you experienced during the simulation was greater or less than that which you experience when attending operational incidents at your airport?

S	01.	No greater or less as I went into the simulation with an open mind and treated it realistically.
W	02	I think the stress level today may be higher, due to not seeing the system before. However, in real terms the simulation could be the same.
S	03.	Probably less.
W	04.	I feel that if the simulator was under examination procedures then there would be a lot of stress. Otherwise stress at a real incident is greater, but training under stress can only benefit the fire commander.
W	05.	Slightly less. However, more time spent on the VR will decrease the stress factor.
S	06.	Greater – isolated – lack of support.
S	07.	I have to say greater stress due to the location of the incident and the feeling that I did lose control of a manageable situation.
W	08.	I would say they are on a parallel.
W	09.	I would say that this simulator is the nearest thing that will and can put you under the sort of pressure that you are likely to face in a real incident of this type.
W	10.	Less.
W	11.	Exactly the same as a true simulation. Still felt as if on a fire school course and needed to pass!
W	12.	About the same.
W	13.	As great due to not being 100% familiar with equipment.
W	14.	Greater, because of the lack of actual contact with fire fighters – reporting back with problems.
W	15.	Slightly less, as you know its only a simulation.
S	16.	Initially less as anything could happen, but due to minor nature of most airport incidents pressure was greater during simulation.
W	17.	Stress created was by the surroundings – the incident caused less stress than an operational incident.
W	18.	On this occasion pressure/stress was much less than on operational incidents for the reason given in answer 6.

S	19.	The simulation pressure was higher – probably due to aircraft size and life threatening scenario.
W	20.	Greater, operational incidents do not allow for others i.e. fire fighters and subordinates to take some of the decision making away from you as their level of competency allows.
S	21.	Perhaps it was slightly higher than I would expect on my own airport. Whatever it was because of the simulator or fact that it was a major incident which was proving difficult to exert control over under observation.
S	22.	Less stress with simulator – due to 'real life' with 'real' people and obvious 'real' outcome of actions at operational incidents.
S	23.	Yes I do, because at an operational incident there are always going to be decisions undertaken by the officers below you would/should assist the situation. With the simulation everyone needs instruction for all tasks.
W	24.	Some aspects were greater because of not having full control, sitting down during the exercise gave you a false sense of security.
S	25.	The pressure and stress experienced was certainly as much as I have felt during operational incidents and major training exercises.
W	26.	No – command and control trainer is less stressful.
W	27.	Probably less – but not much less.
S	28.	In fact it was broadly similar.
V	29.	I felt that the stress was slightly less due to the fact that in my mind I knew it was not real.
V	30.	Greater – though probably because it was a larger incident than any I had previously met.

10. Do you consider that the simulation experience was more realistic than the type of fire ground training currently provided at central training establishments?

S	01.	You do not get the feeling of heat, people panic and the actual hand on obviously, but the simulation is the first I have seen.
W	02.	Yes, if only because the same situation can be re-played exactly the same as before. It would not completely eliminate the need for hot fire exercises.
S	03.	I think there is a need for both types of training, each having its own merits.
W	04.	Definitely, for command and control scenarios. However, practical hot fires are still a very important training feature. We need both.
W	05.	For command and control I don't think we have an alternative.
S	06.	Yes – size of aircraft – kind of fire.
S	07.	Yes. Although practical training is good. There is no possibility of repeating scenarios identically.The benefit here is that may be possible. Again, the exclamation of an incident is hard to simulate practically.
W	08.	It is good for airport fire fighters to train. Practical and with the real thing. But this is another dimension.
W	09.	From an officer in charge's point of view, I would say that this is definitely more realistic, although we still need to train with hoses etc, so a balance of both has got to be a winning combination.
W	10.	To be able to control and command an incident without actually being able to lose an aircraft enabled me to make better decisions.
W	11.	No, nothing can beat hands on, but is once or twice in five years enough, (I doubt it).
W	12.	They both have their own realistic values.
W	13.	No, but could further enhance training.
W	14.	Not as realistic, but more benefit because of the repeatable situation where you can actually make improvements.
W	15.	Yes, very much so.
S	16.	For command and control very definitely.
W	17.	Yes, because it is visual, a greater understanding is gained, on the table tops most people see a slightly different incident.
W	18.	No, (probably only because I felt no heat from the flames).
S	19.	For command and control purposes – categorically yes.

W	20.	No, nothing can take the realism of fire ground training away – the smells, the noise, the excitement.
S	21.	Yes. Whilst putting me under pressure the scenario was run under strict control, the success of the operation depends on individuals not efforts of others.
S	22	The ability to progress incidents has more benefit for command and control training than at present. The need to combine both situations would be ideal.
S	23.	Yes, because the simulation can be taken to whatever lengths so as to put the OIC under pressure and this can be done as many times as required.
W	24.	It gave you a better overall aspect, programme more specificity, it gives the officer experience in making the situation longer than can be achieved on a fire ground and a greater possibility of using outside agencies.
S	25.	Yes, it encompassed all the requirements of dealing with command and control and prioritising under a fairly high level of stress.
W	26.	No substitute for realistic fire ground training – best used as tactical trainer.
W	27.	From the point of command and control at a major a/c incident – yes.
S	28.	For command and control purposes yes, but it is not a substitute for realistic hands on practical training using hot fire training aids.
V	29.	I would put it as an equal.
V	30.	No – probably good for a range of scenarios and possibly more frequent use, but fire ground training takes place in all weather conditions and each incident is different.

11. Do you consider that the simulation experience was more realistic than the type of fire ground training currently provided at your own airport?

S	01.	In terms of real A/C – yes, in terms of actual work and hands on – no.
W	02.	Not really, we have a very comprehensive fire ground. It would be an advantage when first training regarding command and control.
S	03.	For command and control yes, at this time.
W	04.	Once again, for command and control it is along way ahead of station training. As an officer there is a lot of emphasis on stations to set up practical training but it is very hard for ourselves to practice command and control. With safety having such a high priority on fire training grounds, the simulator is far more realistic for incidents.
W	05.	For command and control I don't think we have an alternative.
S	06.	Far more.
S	07.	Again yes, with the same reasons as 10.
W	08.	With being stationed at a small airport, money is a shortage and can cause a problem in training, but it would be an advantage for this simulation experience realistically.
W	09.	Definitely, with resources being restricted, and commitment of crew in exercises also being restricted this type of training is unavailable.
W	10.	Yes.
W	11.	Yes, although we have good aids, we are limited to set scenarios, and operational requirements.
W	12.	Yes, because I have some control over my own training.
W	13.	No, but could be used to train JOs in tactics and techniques, and if multi-screen, all fire fighters with positioning drills.
W	14.	More realistic in scenario terms.
W	15.	Yes, very much so.
S	16.	Except for large aircraft fires, which are few and far between, yes.
W	17.	Yes*, but regular command and control 'physical' exercises must take place to enable all crews to appreciate deployment, tasks, problems etc. (*Good for OIC training).
W	18.	No, (as an extra aid to training this would be excellent).
S	19.	Once again for incident command and control yes.

W 20. Yes, it offers the opportunity for others to play the same role in the same way, but with different decisions and outcomes. This would allow for tactics and techniques to be honed at the airport.

S 21. From command and control view it is beyond comparison. Because it is run under strict conditions it makes analysis of performance simple and easy to see. Where things went awry. It will also allow preplanned tactics to be tested and developed with all officers deriving benefit and development of an essential skill because debriefs can be targetted to events that went wrong and how individuals could have influence the outcome if they had recognised and deployed their team more effectively.

S 22. For command and control training – definitely.

S 23. Yes, with the exception of heat and smoke transfer.

W 24. From a purely command and control situation I have to say yes, but the programme would need to be more specific, but it could be useful for communication exercises as well as fire situations.

S 25. Definitely yes. As a senior fire officer command and control capabilities are not evaluated realistically at my own airport.

W 26. Yes – realistic conditions.

W 27. Yes – training is controlled so as to be realistic but safe. Scenario's on station are limited. Other restrictions influence training (smoke travel etc).

S 28. Basically, as above, excellent command and control training which is not available at airports because of maintaining mandatory fire cover.

V 29. Far more realistic.

V 30. Yes.

12. Please list those aspects which you considered to be less realistic than those currently provided by existing training methods?

S 01. The virtual reality will never take the place of hands on practical training but I believe it has a place in AFSTS.

W 02. Response time of individuals (you have to use the radio at all times at present). Also, there would be more messages/requests coming from your crew.

S 03. This simulation is not like any other current training methods so is difficult to compare.

W 04. For command and control none! For fire fighting it still needs to be practical training.

W 05. Fire ground communication on VR is always 100%

S 06. Heat, presence of smoke.

S 07. I believe it may be hard to simulate the practical drain on resources. Each individual airport has its own queries/procedures which would need to be taken into consideration.

W 08. We are always looking to the future to make it as realistic as possible for fire fighters with training.

W 09.
1. The feeling of heat.
2. The feeling of rough terrain and foam blankets.
3. The human factor of some crew members going off on a tangent.

W 10. Not being able to see wind directions or feel the heat.

W 11. Existing training interfaces with people on the ground, team building and team working cannot be simulated neither can heat, smoke, water, foam.

W 12. Personal contact.

W 13.
1. OIC of appliance making own decision in initial stages.
2. No heat.
3. Human ingenuity.

W 14. As far as command and control goes there are none.

W 15. No heat, time delay to commands.

S 16. Only those that are airport specific in call signs, airport topography, local authority response times, water supplies etc. These are fairly minor points.

W 17.
1. The option of pre-deployment is not offered.
2. Appliances waster media.
3. Initial vehicle positioning was poor/bad.
4. BA teams failed to deploy.

W 18. Fire, smoke, flame, water, foam, BA appliances, BCF.

S 19. For officer level command and control there are no aspects which are less realistic.

W 20. Heat/smoke.
Human sounds (other than radio voices).

S 21.
1. Appliance positioning – although commander can influence this.
2. The delay in donning BA.
3. Secondary media need dry powder.
4. Dual accent attack on undercarriage.

S 22. Heat and smoke. Reaction to and from passengers, adrenaline.

S 23. The physical hands on of an incident i.e. heat, smoke, hazards etc, speed of reaction to commands.

W 24. The way media is applied, the officer needs to stand not sit, communication needs improving. Some aspects of movement.

S 25. Existing training methods utilise real manpower and communication, however the present training is repetitive and not interactive from the fire development point of view.

W 26. –

W 27. Delays in commands being executed. Fire fighters initiative, fire fighters training.

S 28. Only the hot fire realism which can only be gained from hot fire training.

V 29. The fact that no one person is real. In practical training there may be dummies acting as casualties, but the crew is real.

V 30. –

13. Did you feel that the duration of the simulation was adequate, too long or too short?

S	01.	Adequate.
W	02.	For me it seemed very short. However, I think 30 – 45 is about right. If it is going right, fine, but if not 30 mins is long enough.
S	03.	Time went extremely fast – suggest duration was too short.
W	04.	Adequate. I could not believe how long I had been on the simulator, the time went by so quick.
W	05.	The simulation could be longer.
S	06.	For three quarters of the exercise I felt so nauseous that it affected my concentration – I assumed this to be mainly due to my ..... movement.
S	07.	Too short, I would have liked to continue to see if I could have achieved more than it looked like I was going to achieve.
W	08.	Adequate.
W	09	For an introduction the simulation time was adequate, although I would like to be able to use this type of facility on a regular basis.
W	10.	The time flew by, it was probably 30 mins.
W	11.	Too short, I wanted to fully test my emergency plan through to a stop message, incident closed, I feel cheated!!
W	12.	About right.
W	13.	Too short.
W	14.	Adequate – working to a conclusion would have to be in real time – hence too long.
W	15.	Adequate.
S	16.	Duration needs to be incident related/specific. Benefit could be gained either by stopping a cockup once the point has been realised (and maybe restarting) or allowing to run through to conclusion depending on the aim of the training detail.
W	17.	Too short.
W	18.	About right.
S	19.	Too short – only because I wanted to see the incident through to its conclusion.
W	20.	Short – I would have liked to have played it to a full conclusion.

S	21.	As the incident command influences the duration of time scale is governed by the events leading to conclusion.
S	22.	Too short – debrief would be advantageous.
S	23.	Adequate.
W	24.	The exercise I dealt with seemed to short.
S	25.	The time was adequate to give an impression of the scope that VR has within the command and control training environment.
W	26.	Time was about right.
W	27.	Adequate – perhaps it should be allowed to run until the a/c fire is extinguished or the a/c is totally lost.
S	28.	Adequate, time was compressed, I could not tell you how long the exercise lasted.
V	29.	I felt the duration was adequate.
V	30.	Too short.

14. Do you consider that the simulated exercise was more difficult to take control of than other training exercises which you have experienced?

S	01.	The activity to instructions were slow, whereas direct orders on the fire ground are carried out and confirmed speedily and effectively.
W	02.	Yes. However, it was the first occasion that I have done it, with practice I think the benefits are numerous comparing costs, time, repetition of exercises.
S	03.	The contents of the exercise was no more difficult but controlling it was.
W	04.	Most definitely, because the exercise was progressive, whereas other exercises are set out and cannot be progressed.
W	05.	Depending on the incident and how complicated it can be I believe it was as difficult as a major training exercise.
S	03.	More – but see 6 and the fact that the responding actions lacked some detail.
S	07.	Yes, on other exercises my colleagues will think for themselves. A feature of the AFS. As an OIC it was difficult to get everything done when I wanted although I may have been thinking about it.
W	08.	This is the first time for me to take charge of a simulator, it was difficult but with training it will be achieved.
W	09.	In some respects it is on a par with other training exercises, although you do not have the human element of crew members doing their own thing, as it were.
W	10.	It was more difficult because you don't see the full picture of the incident developing.
W	11.	Yes, because the simulator cannot let you obtain peoples comments and ideas (helpful or otherwise) as a real exercise would.
W	12.	Yes, because you are by yourself.
W	13.	Yes, because many decisions are made and relayed before arrival at incident, from things observed en-route.
W	14.	No – less stressful prior to the training.
W	15.	It was more difficult because you don't see the full picture of the incident developing.
S	16.	No, except need to have more experience at ordering around VR figures. Is quite a strange feeling.
W	17.	No, easier, would be good facility to use on night skills.
W	18.	Yes.

S	19.	Yes – but mainly because I was unfamiliar with the resources at my disposal. Whereas normally I am controlling my own team/resources.
W	20.	No, possibly easier as communication was immediate and direct.
S	21.	Yes, much training time is devoted to practising pre-planned scenarios. As the team is currently trained to work either on their own or as a team with an incident commander fine tuning actions, we will have to alter current working practices.
S	22.	No, but the visual results of commands were impressive.
S	23.	In many ways. The main difference was that you did have a fire situation – internal and external, or there would be an explosion or that the running fuel fire could only be controlled and not fully extinguished.
W	24.	Yes, but this maybe unfamiliarity of the equipment or the type of programme.
S	25.	Yes, this was partially due to the unfamiliarity of the operation.
W	26.	Yes, first chance to test skills under such realistic conditions.
W	27.	Yes.
S	28.	Yes, the virtual reality aspect really made you work, the situation reacts to your command and control techniques.
V	29.	Yes, due to not being able to task single crew numbers.
V	30.	Yes.

15. Were the visual and audible cues provided during the simulation sufficient to allow you to make operational judgements and decisions?

S	01.	Yes.
W	02.	Not really, but this may be due to not being used to the system. I think it will be improved in time when a broader case of people have used the system.
S	03.	Generally yes.
W	04.	Yes, they were adequate.
W	05.	Yes.
S	06.	Some visual ones I found hard to interpret.
S	07.	Yes, the visual cues in particular were very relevant especially in regard to the deployment of the incident. Audio communication was a little difficult.
W	08.	Realistic and sufficient.
W	09.	Yes, it was extremely realistic.
W	10.	I probably didn't take any notice of the cues you tend to deal with what you see.
W	11.	Yes, once we had got into the rhythm and feel of the simulation. This would have improved if we had initial control.
W	12.	Yes.
W	13.	Some were sufficient, in fact most were probably, in time these will be improved upon.
W	14.	Yes, however I feel a headset would be of benefit – the purpose of the simulator would not be affected.
W	15.	Yes, but radio TX from tower very quiet.
S	16.	Yes, showed the need to ask questions of 'players' more frequently and emphasised the need to back-off, re-assess on a regular basis. Time, as in real life, lost its meaning.
W	17.	Yes, ATC tend to apply pressure to speed up, for commercial reasons.
W	18.	Yes.
S	19.	I believe so, but only assessment of those decisions would show if that is a true view.
W	20.	Yes.

S 21. Visual cues were sufficient. Audible cues at times were difficult to hear, I would prefer handset to microphone stand as this annoyed me during the simulation.

S 22. Yes.

S 23. Yes.

W 24. Visual cues were very good, but it took a little while to gain all round vision. Audible cues were a little more difficult, they were coming from the wrong direction for me, this made me ask for repeat messages.

S 25. Visually the simulation was clear. The audible cues provided were at times difficult to hear, but this is representative of real R/T messages on the fire ground.

W 26. Yes

W 27. Yes.

S 28. In the main yes, slight criticism of apparent lack of action once command given.

V 29. Yes.

V 30. Yes.

16. How useful do you consider the Virtual reality Simulator could be in terms of training and developing the command and control skills of airport officers?

Extremely useful?	**21**
Very useful?	**9**
Moderately useful?	
Not at all useful?	

Other comments:

S	01.	–
W	02.	–
S	03.	–
W	04.	It is training at a level that at present we do not have.
W	05.	–
S	06.	–
S	07.	–
W	08.	–
W	09.	–
W	10.	–
W	11.	The simulation could also be extended to train and monitor men/pump operators and drivers etc. All areas of RFFS could be tested.
W	12.	–
W	13.	I would suggest that any training in command and control is welcome.
W	14.	–
W	15.	Needs to be structured to airports, equipment and procedures.
S	16.	This is undoubtedly the best tool I have experienced for this type of training.
W	17.	Would need to be used as part of a training scheme – in addition to and not in place of.
W	18.	This will not replace the need to do realistic training, but what an excellent aid!

S	19.	It is a much needed development within the Aviation World and by combining with traditional practical training it will be a huge asset.
W	20.	–
S	21.	This simulator in conjunction with a course should be used from an early stage in the training of an officer, in fact as part of a potential officer assessment with increasing levels of difficulty.
S	22.	Would be of great benefit to all officers.
S	23.	There has never been a command and control course available so to have this module on such a high standard is excellent.
W	24.	To assess it fully it maybe necessary to have an officer in the background watching and listening.
S	25.	Personally speaking, I think that this is definitely what is required to fill this particular void in fire officer training and evaluation.
W	26.	Good trainer to develop fire officers skill in command and control under realistic conditions.
W	27.	–
S	28.	Extremely good potential for command and control training.
V	29.	–
V	30.	–

17. Do you consider that the simulation could assist personnel in developing communication skills?

S	01.	Most definitely.
W	02.	Yes, it will need to cover both radio and direct liaison.
S	03.	Yes – this was a useful aspect of the simulation.
W	04.	Yes, because it showed clearly that communication between crews is vital.
W	05.	Correct communication on the fire ground will be enhanced by this system.
S	06.	Yes – but it needs a response back.
S	07.	Yes, it is something we need to work on. Doing it annually at an exercise on airports is not the way to become proficient.
W	08.	In a fire situation communications can be a problem from the officer in charge and communication with other emergency services. Yes, it can assist.
W	09.	I believe that this form of training will allow all skills to be honed and fine tuned, and very developing to an OIC
W	10.	Not sure.
W	11.	Yes, very much so.
W	12.	Yes – (inter-department/emergency services).
W	13.	With different scenario, yes.
W	14.	Yes, but call signs etc, as not standard and would have to be targeted at the individual.
W	15.	Yes.
S	16.	Fire ground communication skills – definitely.
W	17.	Yes, but standards would be dictated by the standard of the responding voice – ATC controller training?
W	18.	Yes.
S	19.	Yes as far as directional communication goes i.e. incident command and control.
W	20.	Yes, communications are the key to successful operations.
S	21.	Yes, however, this will only be beneficial if personal radios can be issued, on many locations resources are limited and accessories which will be required add to cost.

S	22.	Yes.
S	23.	Without a doubt.
W	24.	Yes, but it maybe better with a personal radio.
S	25.	Yes, because the progression of the situation is governed by the fire officer being able to communicate his requirements. Extremely important.
W	26.	Yes – by using ATC and security in R/T would help in realism to the situation.
W	27.	Yes – being specific in your instructions will prevent the request to repeat.
S	28.	Yes, passing and receiving messages in a highly realistic environment.
V	29.	Yes.
V	30.	Yes.

18. Did the fact that the simulation took place at an airport other than your own affect the training experience in any way?

S	01.	Perhaps slightly, but the tactics and techniques are the same.
W	02.	Yes, you tend to do things the way they are done at your own place. It is important to put that into this programme.
S	03.	No, although I think the simulation should depict your airport.
W	04.	For command and control no. However for things like ATC, LAFS and Police we need them using procedures we are familiar with.
W	05.	Not much.
S	06.	No.
S	07.	Yes. In particular in regard to initial appliance positioning. However, I felt I had the appliances positioned correctly eventually, its how I use them after that.
W	08.	It can be a problem from the layout point of view – taxiways, runways, terrain.
W	09.	To some degree, although coming from a career of working both military/civil airports it did not affect the training significantly.
W	10.	No, you deal with the incident as you see it.
W	11.	No, though an individual programme for each airfield would be the ideal.
W	12.	Local knowledge probably would have helped in location of emergency water supplies – crashgates etc.
W	13.	Not really. Just familiarity with system required.
W	14.	No.
W	15.	Yes, each airport has differing equipment and procedures, each crew is used to working with each other and can re-act as required.
S	16.	Not substantially. I think having own airport specific detail would help remove some of the necessary extra thought processes that would be automatic on own ground.
W	17.	Yes, would feel more comfortable in familiar surroundings.
W	18.	No.
S	19.	Yes, but only as previously stated because I was unfamiliar with the airport/resources available.
W	20.	No, an a/c on the runway is an a/c on the runway.

S	21.	Only marginally. Becoming used to resources available would take a short time. One concern I have is whether incident commander will be able to make impact on appliance positions. The workload en route in passing messages and donning kit will have a major effect on ability to function.
S	22.	Yes, no allowance for local operating, procedures or knowledge that would have aided decision making.
S	23.	It would in as much as there could be a lot learned from the differing conclusions both actual and simulated.
W	24.	Yes it did, I found it difficult to get my bearings also there's a feel to an incident. If the scenery had been more familiar I think I could have gained the feeling back.
S	25.	Yes. This made the experience unrealistic as local airport topography and aircraft/appliance familiarisation are fundamental to fire officers.
W	26.	Not really – but simulation of own airfield and user A/C would be better.
W	27.	No.
S	28.	No.
V	29.	No, I feel that the topography of the area was unfamiliar to me but the accident scene could have been at my airport.
V	30.	No.

19. Do you consider that the simulation experience would provide a realistic opportunity to evaluate a fire officer's potential and skills to command and control a real incident situation?

S	01.	I believe it would enhance his skills yes.
W	02.	Yes, it would give a broad outline of how he saw things, in comparison to other offices.
S	03.	Yes, without a doubt.
W	04.	As part of an overall assessment on many aspects of being a fire officer.
W	05.	It is a good training aid.
S	06.	Yes.
S	07.	Yes, but in conjunction with practical training.
W	08.	It certainly would.
W	09.	Up until now there has not really been a medium to assess officer potential, I believe this is the answer.
W	10.	Without doubt it would help make decisions of control at an incident.
W	11.	Possibly, it also has potential to debrief situations that have occurred.
W	12.	I think after a few exercises that I would be more effective at command and control.
W	13.	Without a doubt, it would help make decisions of control at an incident.
W	14.	I feel the purpose is to train command and control and evaluation would be difficult – de-briefs would have to be simulator driven – re: the correct method.
W	15.	Yes.
S	16.	I believe that it would form a very useful part perhaps the largest part of the jigsaw.
W	17.	Yes, but alongside other evaluations of the officers competence.
W	18.	I would not accept this simulation alone, but again it would work really well with practical applications.
S	19.	Yes, and it will also allow self assessment with experience offering a better learning curve.
W	20.	Yes.
S	21.	Yes.

S 22. Yes.

S 23. Yes.

W 24. It could, but to be fair, the officer would need a little experience on the simulator, perhaps at a fire ground as opposed to an incident to be able to get the feel of things.

S 25. Definitely yes. By structuring the experience to local airports, this type of simulation has to be a major step forward in fire officer command and control training.

W 26. Yes, but best used as a tactical trainer and not used for assessment of officer competence.

W 27. Yes.

S 28. Yes, at the moment we do not have reliable indicators such as this, we rely on training, intelligence, table tops and real incident experience.

V 29. Yes, however I think that an officer has to be able to task individuals as well as crews at an incident and think this would provide a more realistic atmosphere.

V 30. Yes.

20. Accepting the fact that further scenarios are currently being developed for use by Civil Airport RFFS personnel, what other aspects do you feel need to be considered in order to develop the Virtual Reality Simulator?

S 01.
1. Pre-prepared messages responding crews.
2. Feed back from crews as to their contents.
3. Runway hydrants considered.
4. Open water.
5. Aircraft down in water.
6. Aircraft broken up.
7. Cargo aircraft.
8. Two aircraft colliding on ground.
9. Helicopter incident.

W 02.
1. Local authority liaison.
2. Other agencies role.
3. Local procedure.

S 03. Inclusion of other airport problems, i.e. motorways, rivers etc.

W 04. Tactics and techniques as for civil RFFS.
Other airport agencies.
Hazardous cargo, terrain.

W 05. Back up personnel i.e. local authority fire service, engineers, operations dept etc.

S 07. The obvious variations in aircraft, but in practical crew size. Most airports have minimum crews and the lack of manpower immediately available is always a concern. Assistance from the LAPB is very important.

W 08. It could be made harder, local authority arriving at the scene, casualty clearance areas.

W 09.
1. BA wear time.
2. Arrival of back up services.
3. Crews automatically deployed with subs/L/Fs in charge until re-deployed by officer in charge.

W 10. –

W 11. Background noise, i.e. other aircraft, appliance engines, fire ground noise, casualty voices.

W 12. Use of other services i.e. police, fire, ambulance or other equipment i.e. cutting gear, or post accident simulation.

W 13. Cost to be kept down otherwise smaller aerodromes will not benefit. Maybe a simplified version if possible.

W 14. The simulator is OK – communications from appliances would be good. Involvement of other services at organised simulator exercises would be of benefit.

W 15. Needs if possible, to be structured to individual airports – if not possible a short intro. period to familiarise with rescue appliances and equipment and reactions to simulated crews. Also to communications to be used to call signs.

S 16. To continue a scenario into the deployment by local authority emergency services as this would happen in most cases within the 'active' phases of even a fairly minor incident. This could include proper hand over procedures inter-service liaison and perhaps a separate issue based on the outcome of the scenario separate add-ons for the tactical and strategic commands.

W 17. 1. Domestic incidents.
2. Chemical/hazardous cargo incidents.
3. Interview techniques.

W 18. None specific.

S 19. Possibly response to a domestic incident within the airport i.e. terminal fire like Dusseldorf!

W 20. a) Military aircraft.
b) The fire fighters role.

S 21. Aircraft on stand surrounded by servicing and fuelling equipment etc.
Helicopter, tower fire, major terminal building fire, whilst a/c are landing/taking off.
Inclusion of ATLC and ..... for major incident as table top exercise.
Inclusion of fast rescue draft for offshore rescue.

S 22. Ability to communicate with appliances on progress.
Ability to communicate with individuals.
Speed of actions.
Ability to call other services and see deployment and results.
Interaction between responding OICs of local authorities police, fire, ambulance.

S 23. The ability to position vehicles prior to the aircraft landing and the ability to instruct crews to perform tasks whilst responding i.e. donning BA sets.

W 24. An officer would need to get used to simulator so a programme needs to be developed at a fire training ground before being given an incident this will help to gain a feeling for this type of equipment.

S 25. The ability to command individuals. The ability to instruct OICs of appliances to control certain areas. The simulation has to be geared towards your own airport and resources.

W 26. Terminal buildings (domestic fire). LPG and fuel farms.

W 27. Fire fighters previous training and initiative.

S 28. Concentrate on developing civil applications, modify programme to allow preparation for incident en route. Market desk top facilities.

V 29. As mentioned before, the capability of tasking individuals and tasking one crew to use equipment from another appliance.

V 30. The inclusion of other agencies including airport staff who would normally be part of any emergency plan.

21. Are there any ways in which the structure and sequence of the scenarios have affected your views on the use of the Tactical Command Simulator?

S	01.	I would most definitely be aware of real time in future.
W	02.	No, I have come with an open mind and it has confirmed that it has a role to play.
S	03.	I found it beneficial to stay in one place and concentrate on the incident rather than moving around.
W	04.	–
W	05.	–
S	06.	–
S	07.	I didn't have a preconceived view. I believe it will be a very beneficial addition to OIC training in command and control.
W	08.	A more positive approach to deal with incidents from table top exercises to the larger scenario.
W	09.	I came here with an open mind not really knowing what to expect and I think at least there is a way I can develop as an officer in charge of incident, without having to worry about causalities etc.
W	10.	No.
W	11.	No.
W	12.	No.
W	13.	As this is my first attempt, I found that the simulator was the best alternative to a real incident.
W	14.	It appears logical.
W	15.	Yes, can only be a good learning tool.
S	16.	This is my first experience.
W	17.	The quality of the graphics was far superior to other systems, which made it more realistic – the 'voice' was a realistic response.
W	18.	This experience has changed my mind about TCS. Before I would have said there was no place for it, now I am sure there is.
S	19.	The structure and sequence appeared logical and progressive which aided the scenario.
W	20.	No.

S	21.	Re-inforced my view that this should be an integral part of officer training.
S	22.	Very impressed obvious use for fire officer training.
S	23.	Yes, it opens up your eyes to a whole new set of problems which can only be imagined on the fire ground unless you have had a real aircraft accident.
W	24.	I think the simulator is the way forward, but a few more specifics need to be added to the programme. The officer being trained needs to attain a better feeling.
S	25.	I was fairly confident that this training would bridge the present gap in command and control training. Having experienced the scenario, I am now convinced.
W	26.	No.
W	27.	No, I have always considered it to be a useful and realistic training aid.
S	28.	Very impressed, I would suggest this is the command and control training for the future.
V	29.	I came with an open mind to this session, but now feel this is the way forward for developing command and control skills along with existing methods.
V	30.	No.

22. What was the major strength of the Tactical Command Simulator?

S	01.	Visual and sound effect.
W	02.	Variety of situations, the ability to stop, change items, then resume.
S	03.	The build up and increasing scenario development. .
W	04.	N/A
W	05.	N/A
S	06.	Use as a training tool.
S	07.	The reality of the incident the fact that all the factors are happening, aircraft incident, PAX evacuation, manpower deployment and tactics and techniques. The fact that the incident is changing continually makes it very difficult but realistic.
W	08.	Actually being in control for all it was a simulator.
W	09.	Allowing us to hone our command and control skills to an unlimited degree affording us a more professional approach to our careers.
W	10.	Being able to command an incident without depleting the fire cover and the cost.
W	11.	To test command and control and officer 'real-time' reactions and ability to control situations.
W	12.	Realistic scenarios that engrossed.
W	13.	Recreating actual incidents and being able to develop an incident or deduce as correct action/or not is taken.
W	14.	The tactical benefit derived.
W	15.	Allows tactical commands and decisions to be corrected and practised under stress.
S	16.	Other than the excellent VR – the fact that once started the event will run to a conclusion in real time. This is probably the biggest pressure builder.
W	17.	Training on actual incidents with built in problems, using the benefit of hindsight.
W	18.	Graphics/sound.
S	19.	The ability to make you feel it was real and not an image.
W	20.	Would appear to be cost effective means of training for the rescuing of lives.

S	21.	Performance can be assessed, scenarios re-run with different tactics adopted. It can also be stopped, taken back and restarted allowing different actions to be tried and analysed.
S	22.	Being able to see the results of command and control decisions.
S	23.	Its ability to draw you into the incident, almost as though you are in it for real.
W	24.	A longer or protracted incident can be developed, because its real time all the frustrations can be added.
S	25.	It has the ability to put you on the spot and generate levels of stress encumberation at operational incidents. It is extremely realistic.
W	26.	Develop skills under realistic conditions – real time delays.
W	27.	Realism of scenario's and their development.
S	28.	Virtual reality, the situation responded and developed consequently on the actions you take.
V	29.	Giving a feeling of actually being at the incident.
V	30.	The ability to train for major incidents and re-run the scenarios which would not always be possible live.

23. What was the major weakness?

S	01.	Possibly some movement of crews and response from appliances.
W	02.	Screen causing sickness.
S	03.	Nothing specific, I feel some more time to experience the joystick reaction is needed.
W	04.	N/A
W	05.	N/A
S	06.	N/A
S	07.	It was hard to clarify what all the crew were doing at a particular time.
W	08.	None.
W	09.	I feel the joystick should be replaced if possible by some form of body movement activated device.
W	10.	Not being under pressure.
W	11.	No major weakness. Only minor ones i.e. as mentioned previous lack of noise, heat, wind etc. as a real incident.
W	12.	No major weakness.
W	13.	I don't believe there is a major weakness.
W	14.	Working with strangers – re: no communication with the appliances about progress.
W	15.	Time delay to commands (not used to equipment).
S	16.	Haven't found one yet other than those already discussed.
W	17.	Cost? – availability at local level.
W	18.	Number of scenarios, would the 'word' go round and lead to false assessment?
S	19.	Lack of time/experience to develop personal skills.
W	20.	Speed of the joystick movements to the screen caused slight motion sickness.
S	21.	The way in which BA is not able to be donned on the move. No dry powder, and whether it is possible to programme in dual agent branch in lieu of one f/j for halon/op and lf/j for water.
S	22.	The inability to call on other services and the inability to communicate with individuals.

S	23.	Response to commands. Unable to carry out multi commands.
W	24.	All I can say is a lack of feeling.
S	25.	Unfamiliar with the actual joystick. I felt that controlling the movements were an additional mental requirement. However, with further use this would be eliminated.
W	26.	–
W	27.	Slowness of action being taken on certain commands.
S	28.	As mentioned before inability to produce en route, apparent lack of action once commands issued, lack of flexibility and crews (and in my case lack of joystick skills).
V	29.	The movement of crew members.
V	30.	The ability to move too fast using the joystick which has the potential to promote sickness.

24. Do you have any other comments about the programme which could make it a more satisfactory training experience?

S	01.	Please see 20, also perhaps some voiced panic from passengers and voiced orders from crews.
W	02.	Availability to all airports.
S	03.	I think more time on the simulator is needed before commenting.
W	04.	–
W	05.	–
S	06.	–
S	07.	The phase 1 and phase 2 procedures would obviously assist.
W	08.	Release from airports who do not have the resources (money) to come to the University to learn the skills.
W	09.	Scenarios to respond from other locations on the airfield as some AFRS crews are deployed on other duties, and some vehicles could arrive before others.
W	10.	No.
W	11.	Use of hand radios possibly to add realism, possibly multi-use i.e. with more than one response (different voices to distinguish).
W	12.	The control joystick will not allow the operator to look up.
W	13.	To view the incident from an appliance rather than the OIC.
W	14.	–
W	15.	–
S	16.	Slightly improved interface i.e. chair position/perhaps headphones.
W	17.	It would be easier (accepting that the unit was not available locally) if all the officers from a certain airport attended together.
W	18.	At the end of the experience debrief candidates and show them the ideal conclusion.
S	19.	No, once civil scenarios are adopted and increased.
W	20.	Insulate the play via headset and microphone to the controller so that the background noise is reduced.
S	21.	Inclusion of incidents in areas not accessible by vehicles – need to run extended sidelines.

S	22.	Orientated to local conditions i.e. manpower, appliances, aircraft local operating procedures.
S	23.	Nothing that advances in technology won't bring along.
W	24.	–
S	25.	I am convinced that this training aid has a very important part to play in command and control management. I look forward to the day when it is available and specific to my airport. An enjoyable/stressful experience.
W	26.	–
W	27.	–
S	28.	Apart from comments already made no.
V	29.	–
V	30.	–

25. Do you consider that the simulator could be used for developing and practising new tactics and techniques for handling various fire situations?

S	01.	There is great potential in this type of training.
W	02.	The variety is a good bonus.
S	03.	Yes.
W	04.	Yes
W	05.	Yes
S	06.	Yes
S	07.	Without a doubt, there are many uses for this type of simulator.
W	08.	It is always ongoing, learning all the time for all we were/are officers. To learn our trade and get it right.
W	09.	I think the scenarios are virtually endless and I feel that the FRS would be extremely foolish not to follow this up.
W	10.	I think you still need practical situations.
W	11.	Most definitely yes, it would be good to change aircraft types etc.
W	12.	Yes, more practice would make me more effective.
W	13.	Yes, or confirm the current method.
W	14.	A major part of the simulators benefit to the fire service.
W	15.	Yes, this is probably the only time you can try out command skills and correct it if needed.
S	16.	Most definitely.
W	17.	Yes, re-run facility to amend actions after evaluation.
W	18.	Yes, backed up with practical application.
S	19.	Definitely.
W	20.	Yes, previously stated.
S	21.	Yes, allows conditions and scenario to be pre-set and run over number of sessions.
S	22.	The ability to discuss actual incidents and to practice possible incidents would help develop techniques.

S 23 Yes.

W 24. Yes as long as the results truly reflected the actions.

S 25. Yes, in conjunction with the present development on fire grounds etc.

W 26. Yes, all fire fighting personnel could develop their skills under such realistic conditions.

W 27. Yes, without a doubt.

S 28. Yes, it is after all a simulator, you can try out different tactics and techniques without hurting anyone.

V 29. Yes.

V 30. Yes.

Section Two – Airport Fire Station Training Facility (Desk Top Trainer)

1. Do you consider that the Airport Fire Station Training Facility (Desk Top Trainer) is able to provide a realistic method of training in developing the command and control skills of fire service personnel?

S	01.	The trainer is a very good starting point, but I do not believe it would be as realistic as the simulation.
W	02.	Yes, it can be used from basic levels up to senior levels.
S	03.	Yes, at all levels.
W	04.	With command and control being so important the trainer would be ideal as an introduction for new commanders.
W	05.	I believe it has a part to play.
S	06.	Yes, especially to develop basic principles.
S	07.	Yes.
W	08.	Again the answer is yes and again it is cost.
W	09.	I feel that this combined with practical training will be second to none.
W	10.	Yes that part looked very good.
W	11.	Not in its own right, only with VR5.
W	12.	Only if conducted under supervision (it may end up as a game).
W	13.	Not realistic, but an additional aid to practical skills/knowledge.
W	14.	Yes, valuable for all crew members giving confidence in their officers.
W	15.	Yes.
S	16.	Having been 'spoiled' on the big screen, and not having 'run through' the desk top model, I don't know. However, having played numerous 'games' on PCs, I know it is very easy to become engrossed whatever the size of the screen. Yes.
W	17.	Yes, as part of a training package.
W	18.	No.
S	19.	Yes, the benefits are endless.
W	20.	Possibly.
S	21.	Yes.

S	22.	Yes.
S	23.	Yes.
W	24.	Yes.
S	25.	Yes.
W	26.	Yes, safe environment – pre-set own airport situation.
W	27.	Yes.
S	28.	Yes, the sooner the better.
V	29.	Yes, it would assist present methods.
V	30.	Yes.

2. Do you consider that the Airport Fire Station Training Facility provides a level of training which is not currently possible within an airports operational environment?

S	01.	At times this is the case with regard to wind conditions and the environmental issue.
W	02.	Yes, at present it is opinions and discussions only.
S	03.	Generally yes – certainly at smaller airports.
W	04.	With issues such as environment, category, name, whether it would be of definite benefit.
W	05.	Yes.
S	06.	Greater depth and potential.
S	07.	Yes.
W	08.	It does provide a good level of training.
W	09.	Yes, very much so as all vehicles are not able to be committed to training.
W	10.	It will help.
W	11.	Possibly.
W	12.	Yes.
W	13.	Again, it assists training already in place.
W	14.	Yes, the ability to repeat until things are right.
W	15.	Yes.
S	16.	Most definitely.
W	17.	The advantage would be availability and speed of use, without disruption to normal operation of airport.
W	18.	Very limited.
S	19.	Yes, due to other operational commitments.
W	20.	Yes, resources will not allow operational training at the levels required to be carried out during flying periods.
S	21.	Yes, current level of traffic at time inhibits training – always need to maintain ref: cat.

S	22.	Yes.
S	23.	Yes.
W	24.	Yes, the scenarios can involve all areas of this airfield which on a practical basis can not be used for operational reasons.
S	25.	Yes. To a certain degree, current table top exercises perform a degree of simulation. This facility takes this level much further.
W	26.	Yes.
W	27.	Yes.
S	28.	Yes, for reasons already mentioned.
V	29.	Definitely. Training can take place without any impact on the airports operational requirements.
V	30.	Yes.

3. Accepting the fact that further scenarios are currently being developed for use by Civil Airport RFFS personnel what other aspects do you feel need to be considered in order to develop the Airport Fire Station Training Facility?

S 01. Operator in booth with observers on the outside so that all can benefit.

W 02. Just to build on what is in place now.

S 03. Need to think about it.

W 04. –

W 05. My simulation involved one way communication on a real fire ground others will be calling you.

S 06. –

S 07. These would be customised for individual airports or in my case the company aeroplanes.

W 08. Reality. The real thing to train.

W 09.
1. Deployment of other secondary media.
2. Methods of rescue (use of cutting equipment etc).
3. Attendance of local authorities.
4. Automatic task deployment of 2nd and 3rd appliances (crew).

W 10. BA Training (BAECO).

W 11. Make if fireman proof! Make it cheap. £50,000 will not be easy to find.

W 12. Incidents which involve dangerous cargo, or post accident procedures.

W 13. More scenarios, individuals airport incidents, own airport layout, appliances, men.

W 14. The ability of individual appliance commanders to communicate with the Rescue Leader.

W 15. To be able to include individual crews to react to incident.

S 16. The obvious one is cost.

W 17.
1. Domestic fire fighting.
2. Chemical/hazardous cargo incidents.

W 18. Virtual reality works because of the realism, desk top PC takes all that away. Consider 'head up' telemetry.

S 19. Airport scenarios to cover domestic situations.

W 20. Answered at 20.

S	21.	Offshore incident up to 1000m and over. Off runway with bad ground. Off airfield.
S	22.	Local orientation.
S	23.	Internal fire fighting scenarios and incidents where all personnel wherever they are positioned are required to wear BA due to the materials involved – thus causing communications problems and reaction time etc.
W	24.	Built into the programme should be weather and ground conditions. Also terrain immediately outside the airport boundary.
S	25.	As per Q20.
W	26.	BA scenarios – all risk areas on airports.
W	27.	Speed of response to commands.
S	28.	User friendly, different scenarios, affordable.
V	29.	Could be used not only for command and control but for other subjects that have an effect on the operational requirements of the airport i.e. driver training – (topography of the airfield). Positioning at an A/C accident.
V	30.	–

4. What do you consider the advantages and disadvantages of the wide screen trainer vis a vis the Desk Top Trainer?

S	01.	Advantages are: more realism with wide screen providing space and possibly price.
W	02.	Cost and sickness.
S	03.	Advantages are that you become part of the scenario. Disadvantages – cost.
W	04.	With the wide screen it feels that you are physically involved at the incident, making it realistic, the desk top is as it says desk top good for basic training but lacking realism of the wide screen.
W	05.	Disadvantage: cost/space. Advantage: definately more realistic.
S	06.	Greater depth and potential.
S	07.	Wide screen gave a good insight into a real incident and did produce stress. Desk top would be good for discussion/training the whole crew.
W	08.	With the wide screen trainer, it is virtually reality you are almost or think you are there.
W	09.	The main advantage of the wide screen is that feeling of being 'there' but a more discussive scenario could take place with all crew members using the desk top trainer.
W	10.	Being able to take control of an incident and to see that the mistakes you make won't be costly in life playing it back to try again are advantages.
W	11.	Desk top does not give a full clear picture of fire ground (zone 1) I felt I had 360 degree vision.
W	12.	The wide screen gives the realism to the programme, the sound is also very effective.
W	13.	Wide screen has advantage of being able to move around the incident, to view from all areas, desk top appears adequate for initial training.
W	14.	Wide screen is better – the individual receiving the training feels the pressure.
W	15.	Cost of wide screen.
S	16.	See 1. Wide screen, you're in the picture – smaller screen requires a little more imagination.
W	17.	The cost of a wide screen is prohibitive, hence central locations, desk top supplies more information on one screen, makes life easier.
W	18.	As above.

S	19.	Wide screen disadvantage – cost Wide screen advantage – total involvement. Desk top useful to whole crew in various scenarios. Disadvantage not as much total involvement.
W	20.	Realism.
S	21.	Need to have training room to install both wide screen, may only benefit one during training, screens could train 3/4 people during same incident.
S	22.	Cost implications. Lack of stress inducement as experienced with wide screen.
S	23.	The wide screen makes you feel part of an incident both in vision and sounds. A desk top would not have quite the same effect. They are both environmentally friendly which will become an ever increasing problem.
W	24.	Wide screen gives greater awareness of other things around you and can only involve one participant. I assume also it would be a greater experience than the table top. The table top could probably involve more personnel.
S	25.	A higher degree of realism and reality is present with the wide screen and is probably better for evaluating a fire officers competency. However, the desk top would be very useful for training purposes.
W	26.	Both aid personnel to develop their command and control skills under such realistic conditions.
W	27.	The realism of the wide screen (feeling of being there) will increase the possible stress experienced as opposed to the computer monitor.
S	28.	Wide screen obviously more realistic and effective but not widely available, desk top less realistic and less involvement, but more easily available.
V	29.	The desk top trainer does not have the realistic feeling as the wide screen has, but the cost factor would play an important part, and the desk top would be more likely to be purchased.
V	30.	The wide screen trainer really draws you into the incident whereas I feel that the desk top may be viewed as just another computer game.

5. Please circle your current responsibility:

SAFO	**Watch Supervisor**	**Vehicle Commander**
11	17	2

Appendix 11.3 Typical One Day Training Course using the Simulator

In order to optimise costs whilst at the same time providing maximum benefit to the officers attending for training it is considered that a maximum number of ten students per day would be the optimum level.

It is suggested that the following course outline should form the basis of the initial one day training programme.

0900-1100
Presentation on recent aircraft accidents in respect to the issues of Command and Control during the various phases of the RFFS response and intervention.
Required Competency levels of Incident Commanders.

1045-1245
Demonstration of Command and Control procedures using the Tactical Command Simulator. Various exercises would be demonstrated during which students will be asked to consider the issues confronting the Incident Commander, the options available, and the appropriate decisions to be made in view of the prevailing circumstances.

1345-1530
Exercises involving a serious aircraft incident will be run using the TCS. Each student will be required to take on the role of Incident Commander at various stages of the incident. Following each exercise the Incident Commander will be invited to evaluate his/her own performance. This will be followed by an Instructor led group discussion in which the Command and Control issues which confronted the Incident Commander will be discussed. The objective will be to agree a consensus on the appropriateness of actions taken at the scene.

1545-1730
Continuation of the above exercises which will conclude with a summary of the days programme and a reminder of the required competencies of an Incident Commander.

The above recommended initial training should be followed by a structured annual refresher course of a similar duration.

FUTURE TRAINING

Whilst it is unlikely that future training would commence with an exercise in order to evaluate any improvement in individual performance levels it is recommended that the actual content of any refresher training programme be considered after the initial training recommended has been in place for a six month period.