Designing a user interface for serious games:

Observing differences in user response between gamers and non-gamers within the West Yorkshire Fire and Rescue Service

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Copyright Statement

Abstract

As entertainment games become an established part of our media, public and private sector companies will look to utilise the benefits of games to train, educate and assess their workforce in engaging ways. This may require a generation unfamiliar with games technology to use them for the first time. As designers we need to consider this, to make sure that the User Interfaces (UI) we create are usable and easily understood to those unfamiliar with the medium.

This body of research is a study into the design and testing of a serious game for West Yorkshire Fire and Rescue Service (WYFRS).

Do players of video games develop an understanding of the convention, knowledge and skills over time, which could be seen as a distinct language? – A kind of 'game literacy.' If so, then a serious game, which may have a mixed skill group, cannot solely rely on the conventions that work in entertainment games. Therefore, can a recognised UI design process from another discipline be used to develop a serious games UI?

To investigate this, Goal-Directed Design is used as a research methodology with a particular focus on the impact learning domain knowledge has on the designer's ability to create a suitable product for the client. This includes the author undergoing introductory Incident Command training to see the benefits that had on the project.

In response to learning the Fire Service's domain, a prototype product was developed to help the creation and examination of Incident Commanders for the Fire Service. This was then tested on five Fire Officers, of varying ages, to observe how they used and interacted with software unfamiliar to them. This provided an insight into aspects of UIs gamers and non-gamers have problems with and also to see if there is a technological gap between generations.

This research suggests there may be a technology generation gap but it is not as polarised as either 'native' or 'immigrant' but more gradual. Goal Directed Design appears to set out a suitable approach for serious games developers to conduct user research.

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Introduction

Outlining the challenges

This research explores and tries to find solutions to some of the challenges faced by User Interface (UI) designers of serious games. To do this the author worked with a small games studio to develop a product for West Yorkshire Fire and Rescue Service (WYFRS).

One potential challenge faced by designers is the possibility that a technological gap exists between generations. This research tries to address whether a technological gap does exist by looking at the 'Digital Native vs Digital Immigrant' argument and using it as a lens to focus and analyse the results gathered from testing the final product.

Following on from this, is there a language or knowledge attached to game UIs? Is this then a branch of digital literacy? An understanding of the convention, knowledge and skills in playing computer games could be seen as a distinct language – a kind of 'game literacy.' Can you then rely on this 'game literacy' to help the designer to develop the UI for a serious game? As serious games are nearly always bespoke, it could be argued that it is not possible to rely on this literacy and that in itself creates a new problem.

Therefore, because the knowledge is not necessarily transferable to a bespoke game, a suitable method has to be determined to develop a UI for a serious game to meet the needs of the client. For the purposes of this research, three different methods were explored and as Goal-Directed Design seemed the most appropriate, it was adopted as the methodology for the research into the Fire Service. Although Goal-Directed Design is usually used for software, part of this study was to see whether it could be applied to the development of a serious game. This is explored further in the methodology section.

Having investigated game literacy and established a methodology this led to the developmental phase of the project which introduced two separate problem areas. Firstly, the wider project (the creation of not just the UI but the entire software) was being developed by a small team. In order to be effective, the team needed to agree upon a working philosophy and an understanding of team roles. Agile development was chosen as the team's predominant approach.

Secondly, in order to create the UI it was necessary to carry out some research into UI theories to provide a deeper understanding of the subject. This included exploring UI

channels of information and elements; flow theory, immersion, navigating virtual environments and persuasive technology.

All of these challenges are covered further in the research and methodology sections.

The relevance of the challenges

The players of serious games have the potential of having a wide range of game experience and thus ‘game literacy.’

It cannot be taken for granted that the players of serious games will have had enough of a wide range of game playing experience to have acquired ‘game literacy.’ It is possible that those playing any serious game can range from having never played a game before through to people that may consider themselves ‘hardcore gamers.’ If this is a generational gap, then one would expect the younger players to be faster learners and adapters and that the older players may struggle and need more support.

A designer may not necessarily be able to rely on the interactive elements that work in traditional entertainment games. Conventional game UIs are perhaps too complicated for those with little experience. Serious games may also have custom elements that do not fit with the traditional game UI convention. For example, a heads up display (HUD) may impact on player immersion which will determine how appropriate the use of one is within a serious games context. This is a topic explored further in the research section.

The assumption throughout all of this is that a good UI improves the delivery of a serious game. UIs impact upon things such as immersion, engagement and user acceptance and all of these play a role in how successful the function of the game will be, whether that is learning, training or assessment. Users will have different motivations for playing a serious game and may not wish to be doing it. A frustrating and difficult to use UI will only exacerbate the user further.

As more public and private services investigate the benefits of serious games, it is important then that designers are able to get the UI right for their clients.

The context in which the challenges have been tackled

In the context of this research, the public service involved with this project is the West Yorkshire Fire and Rescue Service (WYFRS). The Service is the authority responsible for the region's fire and rescue safety. It operates across 800 square miles and serves over two million residents, dealing with not just fire but a wide range of emergencies including transportation, natural disasters and chemical incidents. The service is structured as a hierarchy across five main departments; legal and governance, service delivery, service support, strategic development and finance. This research primarily works with the service's ICT and command training teams who are both contained within the service support department.

Alongside the Fire Service, the research has also been assisted by Canalside studios, a small in house game studio at the University of Huddersfield. It employs a new team of students each year as an industry placement from its two games degree courses (design and programming). They are managed by academic staff who bring in a variety of projects for the team to work on. One of these project strands was a collaboration with the WYFRS to create a fire engine driving simulator – the success of which kick-started the project to create an incident command training and assessment tool which forms the basis of this research.

The Canalside team chosen to collaborate with the WYFRS had no knowledge of the Fire Service in terms of the culture and ethos and the practical and technical aspects of their work. It was therefore vital to the success of the development of the software, not just the UI, that some team members gained sufficient understanding of how the Fire Service works, in order to make it fit for purpose.

The author worked as middle management across all the projects within the studio and not just the WYFRS project. The author's responsibilities went beyond the focus of this research, which sat alongside the main project objectives. The author's team role in addition to middle management was as a UI and game designer. With regards to this thesis only the UI aspects are discussed.

The initial brief from the Fire Service was to create a prototype to demonstrate what could be achieved with game technology. They wanted an immersive training product that would allow them to create and act out command incident scenarios in a 3D environment with the potential to be assessed in some way.

Prior to the start of this research, the team at Canalside had constructed a game prototype in response to the Fire Service's initial design brief. Scenarios were put together using a 'Sim City' style building tool and were acted out in a first person firefighting mode. This will serve as a base starting point to compare against later.

Figure 1: *The 'Sim City' style scenario builder. Single clicking a building in the game world brings up the menu shown in Figure 2.*

Figure 2: *The menus and sub menus for setting up a scenario, many of the options bring up another sublevel of menu.*

Figure 3: *First-person firefighting exam scenario mode using a scenario created by the city builder.*

Figure 2 demonstrates how complicated the menu systems were when building an exam scenario. The programmers had put together the GUI to allow themselves to build scenarios to show the Fire Service rather than designing with an end user in mind.

This is the starting point for the research as the author had no involvement in this prototype. It will be used to compare against, in order to evaluate the success of the methodology.

Project Overview

The chapters and their main contents are outlined below.

Research

The initial background research phase for the project explores ‘game literacy,’ the ‘digital native’ vs ‘digital immigrant’ argument, finding a suitable method for developing a UI for serious games, finding a design philosophy when working as a team and game UI theory.

This section also covers the complexities involved in this project, a review of the Fire Service’s current approach to Incident Command Assessment and concludes with the research aims for the project.

Methodology

The methodology covered using Goal Directed Design as a research framework, leading to the development and then testing of a product.

Goal Directed Design

This section of the research uses Goal Directed Design as a framework to carry out research relating exclusively to the Fire Service in order to be able to make informed design decisions.

Development

The overall design of the software was split into two sections; one for carrying out an incident command exam (a scenario) and the other for creating the environments to host an exam in (a scenario builder.) These exams would take place in a virtual 3D environment controlled by an external facilitator via a tablet Graphical User Interface (GUI.)

Thus the developmental phase for this research focused on the creation of the tablet GUI for a facilitator to control an exam and the scenario builder to help the IT department construct the virtual exam environments.

Both of these sections followed the same design process of ideation, iteration, internal testing, prototyping and further iterations before settling with a final build to test with officers from the fire brigade in Huddersfield.

Testing

A summative usability test was carried out to observe user behaviour, with particular focus on age and previous gaming experience to see if there was a correlation between the two in terms of proficiency when interacting with a new piece of software. The test results were used to evaluate the products worth to the Fire Service.

Evaluation

The project is then evaluated to see if the aims for the research were met. The feedback and results from the test are contrasted against the very first prototype the team presented to the Fire Service to evaluate the impact that the method and research had on the progression of the project.

Conclusions and Recommendations

Conclusions are then drawn from the entire project and recommendations are made.

Research

This chapter expands upon the challenges presented in the introduction and explores them in more detail; discusses their relevance and the complexities involved in tackling them, the context in which they were tackled and concludes with the research aims for the rest of the thesis.

To start at the most basic level, what is a User Interface?

A User Interface (UI) is the communication point between human and computer.

> *"A successful UI design blends good usability, functionality and aesthetics to facilitate a successful outcome, based on the user's requirements and expectations. UI designers should therefore focus on a user's needs and expectations, not on what a programmer or designer thinks is logical or cool."*
> (Wood, 2014)

Practically this means that any information that is passed from computer to human, or vice versa, needs to be simple to understand; has to work in a way that the user expects it to and should look appropriate to fulfil and accentuate those expectations.

What is a serious game?

According to Ritterfeld, Cody and Vorderer (2009) a serious game is defined as an interactive computer-based game developed for any platform and provides more than just entertainment to one or more players.

Dumbleton and Kirriemuir (2006) state that serious games are used by schools to educate pupils and a variety of other public and private industries to deliver staff training, help with product creation and knowledge. Serious games have a wide range of applications in design, business and economics, as well as military and medical simulations.

Game Literacy

The user interfaces of entertainment games often share similar functionality and look. People who play games regularly, therefore, learn and become familiar with these systems. This means that as a designer, if you create something that conforms to the rules of other UIs, you can expect players to be able to use your system easily.

To investigate whether it could be argued that games share a common language, 4 titles from the Multiplayer Online Battle Arena (MOBA) genre were compared. From this comparison Figure 4 was created by the author to show a generic heads-up display (HUD) for the MOBA genre.

Figure 4: *Generic layout created to illustrate the HUD convention used within the MOBA genre.*

The similarities between game heads-up displays (HUD) of the same genre suggests that a convention is often used by game developers. Figures 5 to 8 show the four games analysed and despite being developed by different studios, they all roughly share the same HUD layout. The size and shape of the elements within the layouts change slightly from game to game, however the general convention is there. Figures 5 and 6 are almost identical, and Figures 7 and 8 are almost identical in terms of the content that is present in each element.

The elements that make up the HUD are balanced and positioned around the edge of the screen offering a large viewing area to the player and also acting as a vignette to focus the player into the centre of the screen where the action takes place.

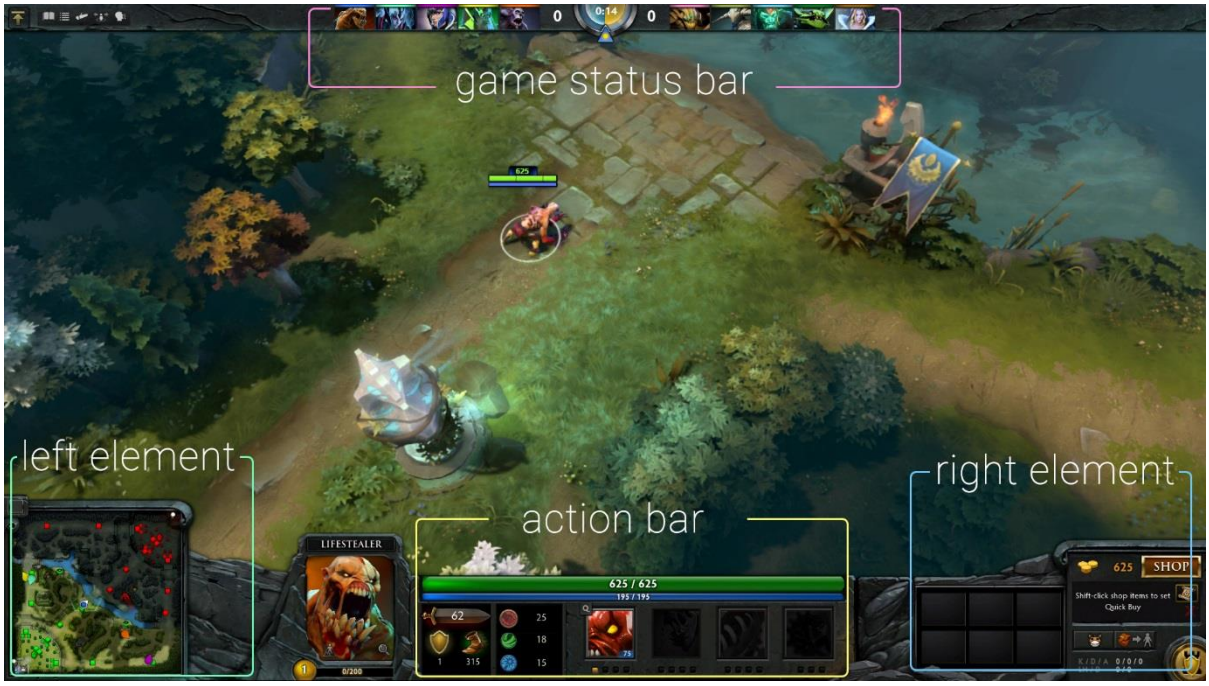

Figure 5: *"Dota 2" developed by Valve Corporation. Image source: Screenshot taken from in game.*

Figure 6: *"Heroes of Newerth" developed by S2 Games. Base image source: http://dota2.ingame.de/kolumnen/dota-dota-2-doch-lieber-lol-oder-hon/2/*

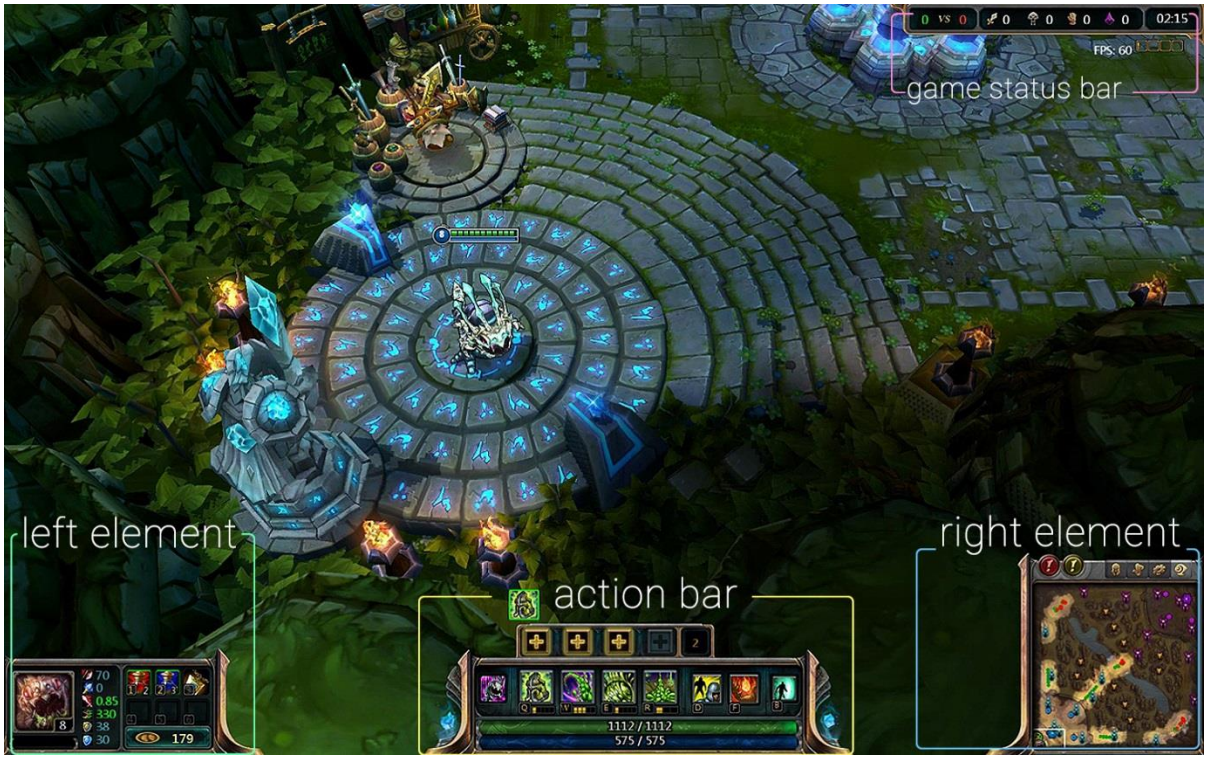

Figure 7: *"League of Legends" developed by Riot Games. Base image source: http://fanboygaming.com/league-of-legends-game-hud-and-item-shop-update/*

Figure 8: *"Heroes of the Storm" developed by Blizzard Entertainment. Base image source: screenshot taken from a live Twitch stream at www.twitch.tv/zp_tv*

If a convention is used amongst the same genre it could be a sign that developers have found an optimal HUD layout for delivering information to players of that genre. Alternatively it could indicate that the persistent use of a standardised convention has conditioned both players and designers into expecting a certain HUD from a genre. This has meant that HUDs have become increasingly complex over years of iteration, as Wilson (2006) points out, experienced players are comfortable with this complexity, whereas, he feels casual gamers suffer and can be overwhelmed by them, as they are unwilling to spend time learning them.

Perhaps, this is part of a 'game literacy' that has been created which allows experienced players to transition between multiple games with ease, as they have learnt the language.

If 'game literacy' can only be acquired through play, then there is an assumption that non-gamers cannot 'speak' the language. A serious game developer cannot rely on this language if non-gaming speakers are playing their game. Therefore, a different approach is needed to develop a UI for a serious game that does not rely on 'game literacy.'

The 'Digital Native' vs 'Digital Immigrant' Argument

The language metaphor, more broadly, has been used to describe learning and using new technology. Prensky (2001) coined the term 'digital native' to describe the generation born between 1980 and 1994. He likens the experience of learning technology to learning a foreign language, saying that those born within the 'net generation' (1980 to 1994) grew up alongside rapid technological development and as a result 'speak it fluently'. Taking his metaphor further, he says that when an adult learns a new language it is put in a separate part of the brain than languages when learnt young, insinuating that any new language learnt is not natural. He describes the older generations who experience this when learning to use technology as 'digital immigrants' – they lack the technological fluency of the younger generations of today.

Prensky (2001) reasons that there is a technological divide between generations. His particular focus is on the educational system of today and how the teaching methods are outdated to provide for a more technologically confident generation.

While his focus is on whether the traditional education model fits with today's generation that has grown up with technology, subsequent research has carried this idea forward. Both Gaston (2006) and Long (2005) support this idea of a generational digital divide between 'Digital Natives' and 'Digital Immigrants' and argue that there should be educational reform to support this new generation.

However there are opposing arguments on this theme. In a critical review Bennett, Maton and Kervin (2008) described this topic as “academic moral panic” saying that this phrase was based on anecdotes rather than conclusive evidence. They found that while there was a high percentage of technology ownership amongst young people (in the United States of America), only one in five displayed the characteristic described as ‘digital native.’ A more determining factor is the socio-economic circumstances of the person; in that ethnicity, gender and social and cultural background all influence a young person’s technological exposure and therefore confidence. Whilst they found that there is a proportion of highly skilled IT users, it is not as widespread as Prensky suggests. As even within the ‘Digital Native’ age boundary set by Prensky they found a wide range in technological capabilities.

Wang, Myers, and Sundaram (2013) present another critical review and put forward a model which they state:

> “… is a continuum rather than a rigid dichotomy between digital natives and digital immigrants, and this continuum is best conceptualized as digital fluency”

This seems a more reasoned rationale rather than basing expectations of fluency on when a person was born. The idea of fluency fits with the language metaphor or ‘digital literacy’ – some young people speak it fluently, others less so, some not at all. This is an important point to make, rather than simply coexisting with technology, one actually has to engage with it in order to become more fluent. If we take this back to the idea of ‘game literacy’ this means that in order to acquire the knowledge of, for example, the operations of a MOBA HUD you would actually have to play MOBAs or games that operate in a similar way.

Much like Bennett et al. (2008) they too list socio-economic reasons for why there is varying degrees of skill or fluency between the two groups. Again this reiterates that technological exposure is a crucial factor in how ‘fluent’ a person becomes.

The depth of discussion and argument surrounding the ‘digital native vs digital immigrant’ debate far exceeds the scope of this project and could be a piece of research by itself. Nevertheless, within the context of this research it is important to note that the debate exists; as it shows that some academic thinking believes there to be a technological divide between generations, although there have been criticisms that this is a generalised view. More specifically, it means that a serious game is likely to encounter users of varying levels of technological experience, meaning that any UI experience needs to be considered, straightforward and easy to use.

Finding a suitable method for developing a UI for serious games

Having established that the design of serious games UI differs from that of an entertainment game, one should perhaps look at methods from different disciplines to see if they would work in the context of serious game development.

According to Williams (2009) the three main interaction design methods to consider for web sites and software applications are User-Centred Design (UCD), Activity-Centred Design (ACD) and Goal Directed Design (GDD). The focus of UCD is understanding the end user, it recommends that a designer monitors the user so that the user can influence the design. As Williams puts it “UCD is a collaboration between designer and user.” UCD has three development phases: research, design and evaluation. The objective of UCD is to explore the tasks that the user needs to perform.

ACD shifts the focus of UCD away from which tasks need to be performed to how the software can enable the users to perform that task. Because of this nominal shift, the author suggests that ACD is more a theoretical method than a suitable one for industry use.

Finally GDD, places the emphasis on why the user must perform the task in order to better understand the user’s motivations rather than focusing on which tasks the user should perform.

This research will look to see if the initial GDD research phase presented by Cooper, Reimann, & Cronin (2007) is transferable from software to serious games. Serious games will often have a specific user group that needs to be explored and understood. This research phase will provide a framework for gathering information which will allow better design decision making. The research phase contains the following:

• Acquisition of Domain Knowledge

• Identifying Project Roles

• SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis

• Review of Competition

• Personas

• Interviews

Working as a Team

As discussed in the contextual introduction section, this research sits alongside a larger project with the WYFRS. This creates a few minor challenges in that a team is working on the overall development of the project. To work effectively, teams need a development philosophy. According to Keith (2010) Agile Development is a suitable method for small scale studio teams. It places an emphasis on short term goals and a flexible approach to client needs. This flexibility is important to this research as the game will need to be changed as a clearer understanding of the service's needs are discovered.

Another 'Agile' philosophy is iterative design, placing the focus more on implementation of features and less on documenting them. This allows the project to progress quicker rather than get stagnated in technical documentation. As the timeframe for not only this project but also the research is limited, rapid prototyping, testing and fast iterations are central to ensure enough content is created to be able to test and receive feedback in order to evaluate the success of the research.

The approach to iterative design expressed by agile development also works well with Wood's (2014) design process for creating a UI. He breaks the process down into several stages; user research, ideation, testing, building and further testing. This again fits within the agile development framework.

Wood (2014) also defines the roles that he believes to ideally form the most basic UI team. These are an information architect, a user experience designer, a graphic designer and a front and back-end coder.

Agile development is over-arching development philosophy for the whole team to follow. It is both suitable for the team's needs, the timescale of the project and works with creating UI.

UI Theory

Fagerholt and Lorentzon (2009) give a comprehensive overview of various theory and design options available to UI designers, with a particular focus on designing UI for First Person Shooter (FPS) games. They present that there are three possible UI channels of information; visual, auditory and haptic and five separate types of UI; Meta, diegetic, non-diegetic, spatial and signifiers.

This paper provides a broad understanding of game UI and presents techniques that will provide useful to the development of the UI for the Fire Service.

For the purposes of this research only the visual channel will be investigated, however the wider project would benefit from auditory information. Audio is an effective way to increase levels of immersion and from the Fire Service's brief, immersion was an essential part that they were looking for.

When considering immersion in games, Csikszentmihalyi's (1990) flow theory is sometimes referred to. It is a model of enjoyment, a person is perceived to be in a state of 'flow' when a task is equal to that of their skill. From this Sweetser and Wyeth (2005) applied flow theory to games and created their model 'GameFlow'.

Whilst a serious game does not have to be built with enjoyment in mind, what is relevant about flow theory and 'GameFlow' is their link with immersion. Csikszentmihalyi (1990) describes one element of flow as *"a deep but effortless involvement that removes awareness of the frustrations of everyday life."*

As noted by Sweetser and Wyeth (2005) this lends well to the notion of immersion in games. This is relevant to the Fire Service as they want a scene to be believable. During an exam they want Commanders to make the same decisions that they would in a real world situation rather than being aware that they are in a simulation taking an exam.

How can a UI benefit or break immersion? One example of this is by comparing the immersive impact of having a HUD versus no HUD. Llanos and Jørgensen (2011) found that the player's reason for playing the game is a crucial determining factor in how much immersive impact a HUD has. A player will accept the need for a HUD in order for the game to function and wouldn't necessarily put a player off from playing a game, even if it was distracting.

This study only focused on entertainment games, within the context of this project, how appropriate would a HUD be? Given that the user's reason for playing is one of assessment you can make the argument that it is unsuitable.

In a real world incident, if an incident commander wanted to know how much water was left in their tank, they would ask a member of their crew to go and check. Conventionally an entertainment game UI could have a water meter on the HUD as this would make the information readily available to the player and in turn, speed up the game. This assumes that the player wishes to trade accuracy for ease of use. However, if the accuracy of a scenario influences the immersion and immersion is an essential factor of a particular serious game, then perhaps a HUD is unsuitable.

A more relevant way to present the problem of the water meter would be to have it embedded as a diegetic element in the game environment.

Another essential game UI consideration is the control system used. Player and camera control inside a 3D environment is not immediately obvious or easy for non-gamers. Nilsson and Wendt (2010) carried out experiments on a mixed skill user group to test out various navigation methods for 3D environments. This included tool bar buttons, direct control via the mouse, WASD, multiscale navigation, chase camera, speed control and limited user movement.

Psychology also plays a role in the UI. Fogg (2002) found that people perceive computers as if they have personality and therefore social cues and conditioning affects people's engagement and interaction with them. From a design perspective, this allows a designer to influence people's response to their software through five social methods; attractiveness, psychological, language, social dynamics and social roles. Fogg's term for this is "persuasive technology."

This is particularly relevant to this project as the Fire Service has a brand, a domain language and social cues and roles attached to its hierarchical nature. These factors can be applied to the product through the use of colour, language and tone to shape how users perceive and interact with it.

Complexities involved and relevance

UI is a broad subject involving multi-disciplinary skills. The creation of a UI for this project will require a wide range of skills. There are artistic ones such as aesthetics, colour, balance, composition. It requires technical and graphic design skills; including knowledge of semiotics, iconography, and typography. Then there is knowledge relating to the user; experience, expectations and psychology. The research is part of a project being worked on by a development team, so there are skills associated to this; team work, communication and management. Finally, there are design skills; information architecture, instructional design and usability.

In addition to all the UI related skills, having no prior knowledge of firefighting and incident command, necessitates a brand new domain of knowledge to be learnt.

All of this knowledge has to come together in order to create the UI for a game which addresses the needs of the Fire Service.

Contextual reality of the Fire Service

Incident commanders must take a formal graded assessment before they are allowed to go out in the field. There are four levels of BTEC qualification offered by the exam board Edexcel; initial, intermediate, advanced and strategic (Levels 3, 4, 6 and 7 respectively.) The Fire Service refer to these levels as Bronze (operational), Silver (tactical) and Gold (strategic) ranks. These signify the level that you are able to command and your role within larger incidents; for instance a cross agency large scale incident requires the commander to be of ‘gold standard.’

The service operates so that each fire engine or ‘pump’ has a commander on board. Regardless of rank, whichever commander arrives on the scene first has command for the duration of the incident. It is important that the early decisions are well reasoned, as poor judgements or early mistakes are hard to correct, due to how quickly incidents can escalate. Depending on the scale of the incident a higher ranking officer may be sent to the scene to assume control, this is described as ‘handing over’ and because of this, there are set procedures taught in how to assess and manage a scene. This means a commander can quickly describe the procedures that have been carried out when handing over to their superior. The highest priority for a fire commander is to ensure the safety of the firefighters and regardless of if there are causalities in the building. If it is deemed too unsafe to enter the building, then nothing can be done for the causalities.

Each exam is carried out by a small team; one person facilitates the exam and uses role play to provide contextual information, characters and a mechanism to advance the exam forward. One examiner records the commands issued and another monitors the entire process. These three examiners are then able to debrief, review and collectively determine whether the commander has passed or failed.

According to the IT technician who creates the multimedia for the exams it takes him roughly two weeks to put together a single scenario ready for an exam.

Research Aims

This research has three primary aims:

- Create a UI that can be tested on a small sample of Fire Officers (intended end user) with a diverse range of ages and video gaming experience. This is to see how age and past experience impacts on a user's ability to interact and use a new piece of software. The outcome of which may provide additional evidence towards the generational technological divide.

- This test will also provide the opportunity to observe user behaviour of a diversely skilled group. This gives a better understanding of 'game literacy' as we can directly compare the differences between how gamers and non-gamers interact with a GUI.

- Investigate how useful the research phase of Goal Directed Design (GDD) is for serious games with a particular focus on the acquisition of domain knowledge. The impact of GDD can be identified by comparing the initial prototype the Canalside team made before the research had begun with the final product post-research. This investigation should also inform the importance of domain knowledge in a designer's ability to adequately develop software for an intended user from a specific work discipline.

Methodology

Goal Directed Design

The goals of this phase were to apply the GDD method to define design constraints relating to the user's need of the product.

The process of this will allow comparisons to be drawn between the first prototype and the final prototype. From this a more informed decision can be made on the overall impact the GDD process had on the project and then reflect on its suitability to be used in a serious games context.

The team's initial prototype had several problems. Pushing the exam in a games direction was too much of an overhaul of the Service's current system. The UI for the original scenario creator was too complicated and the team lacked an understanding of how the Service operates and what the best product would be to match their needs.

To address these problems it was clear that a period of user research was required and to do, this the initial research phase of Goal Directed Design (GDD) was used as a framework to shape this. As discussed in the literature review GDD is a goal orientated design method which focuses on why the users are using the software rather than which tasks they have to perform. This next chapter will follow the research phase guidelines set out by Cooper et al. (2007) to establish if this is a valid method for serious games.

Some of the stages were omitted due to the particular focus on commercial goals or did not seem to fit the context of this project. The stages chosen are as follows:

Acquisition of Domain Knowledge – This is a hugely vital aspect of the research**.**

Identifying Project Roles – This establishes an overview of all the people involved in the project. It also highlights who the main users are and what they need.

SWOT Analysis – This stage reviews the Fire Service's current exam system to identify which design aspects should be kept and which can be improved upon.

Review of Competition (Similar Products) – This identifies what products exist and can help recognise how other developers have tackled problems.

Personas – This is a method of envisioning the experience each user has with the product so that it can be designed to fit into their daily lives.

Interviews – These formed a part of the overall task of obtaining domain knowledge. This section gives further information regarding the interviews and explores some of the themes that came from them.

The following sections explore each of these stages in greater depth; an introduction into each section, the findings and how it shaped the design of the product.

Acquisition of Domain Knowledge

Domain knowledge is the collective understanding relating to a specific field. In the case of this project, it is the knowledge relating to being an Incident Commander and how that fits within the rest of the Fire Service. There is a shared language relating to firefighting which firefighters will speak regardless of brigade.

As a designer with no prior contact or experience of the Fire Service, it was vital to delve into this realm and learn as much of the language as quickly as possible in order to design a more relevant product for them.

This is a significant skill; the designer's ability to learn and then be able to communicate what has been learnt to the rest of the team becomes a part of the overall success of the project.

Part of the research philosophy behind GDD is learning the 'client's' domain. This was suggested to the Service and the commanding officers agreed that in order to design a better product, including UI, then the author should undergo a certain amount of fire training.

To facilitate this training the Fire Service provided two textbooks to read and a variety of video references documenting different types of fire and smoke. This was supplemented by three separate visits to the training HQ to observe three mock exams and a live fire training session. Each visit was documented by taking notes and the live fire training session was filmed via a video camera.

Figure 9: *Photograph of the author dressed in fire protective clothing having just observed a live training session at the HQ in Birkenshaw, December 2013.*

Textbook Resources

To begin with the Fire Service provided two textbooks to read; the first was Edexcel Level 3, 4, 6 and 7 Awards in Incident Command in Fire and Rescue Services (Edexcel, 2012), which is the exam specification documenting the learning outcomes and assessment criteria for each level. The second was the Fire and Rescue Manual (HM Government, 2008) which provides detailed information on the procedures commanders should follow, specifying the overall doctrine; risk management and tactical strategies employed nationally.

The Fire and Rescue Manual (HM Government, 2008) provides a background into the steps that a commander should take when first dealing with an incident. This is a series of decisions that a commander has to make based on what they can observe. From these observations there is then an appropriate action. For example, when a command arrives at an incident they carry out what is referred to as a '360 of the building.' This means they walk and evaluate each side of the building. During this process the commander is doing a risk assessment; *what type of building is it? What are known hazards associated with this type of building? Can I see smoke or any other evidence of fire? If I can see smoke, what does the smoke look like, what does that tell me about this fire?* These are just some of the first questions a commander will have to answer.

The design response to this is that the entire environment becomes a part of the UI. This element in particular is described by Fagerholt and Lorentzon (2009) as a signifier. To explain this they use a game example of a flaming barrel. A barrel on its own poses no threat to the player, however, a flaming barrel will signify to an experienced player that this barrel is likely to explode and is therefore a threat. This is the exact same process being used by commanders.

While sources of UI theory such as Stonehouse's (2014) only list four game UI elements, as previously mentioned Fagerholt and Lorentzon (2009) list a fifth. They classify them as signifiers. This is interesting because it is a counter-intuitive find. The creation of an environment in game development would be handled by a level designer and environment artist – it would not be expected of a UI artist to be involved in this.

The full extent to which the environment serves as a part of the UI was not realised early in the project. One of the earliest criticisms officers had of the team's initial prototype was how unrealistic the fire and smoke was. The team had hoped an abstract representation of fire and smoke would be sufficient, given the teams limited artistic capabilities. When the Service asked for more realistic graphics, the assumption from the team was from a gaming perspective of pushing visual quality – resulting in a particular focus on improving building realism. Yet from learning and understanding the services needs it became clearer that rather than a frivolous desire for fancy graphics the accuracy of elements of the environment are vitally important in a commander's ability to assess a situation.

This reinforces a problem presented in the introduction section of this thesis. There is a challenge for game developers to make a serious game as they share the same language and technology but require a different way of thinking and working. By acquiring domain knowledge the team were able to shift away from a game developer's mind-set and think more in terms of the Fire Service's needs.

Another important signifier learnt from the Fire and Rescue Manual, is that the Fire Service uses a system of coloured and patterned bibs to identify roles and responsibilities at an incident, see Figure 10. As fire brigades operate and work beyond their boundaries they collaborate on incidents with people that they are unfamiliar with. An agreed visual identification on bibs helps people be easily spotted and identified. This provides another layer of depth that a UI signifier could work on, in that it could test the commander's knowledge of the roles associated with each pattern.

Figure 10: *This is an illustration of the roles and responsibilities that are distinguished by pattern and colour at an incident. Image taken from the Fire and Rescue Manual (HM Government, 2008)*

First Visit to the Training Headquarters

The first visit to the WYFRS Training Headquarters in Birkenshaw, West Yorkshire, was for the entire development team to observe how the training officers conduct an exam scenario to provide a clearer understanding of the process.

The exam scenario ran directly from windows explorer; the scenarios were constructed on webpages, opened in a browser and displayed on an interactive whiteboard. The webpage displayed a photograph of a two storey commercial shopping street with animated smoke billowing from a window on the first floor. It featured a HUD with numbered buttons and a forward arrow. The numbered buttons, 1 and 2, snapped between two different photographs of the scene; a photograph from street view and one from behind the building. The arrow button would move the scenario forward in a predetermined manner, in this instance the backdoor would open and smoke would flow out and then the final stage where there was no smoke visible at the scene. This was the only digital assistance they used, the rest of the exam was conducted through role-play between the two officers.

After witnessing the mock exam scenario take place, the team were invited to demonstrate the initial prototype (presented in the introduction section) and receive feedback from the training officers. This prototype's exam mode was very games orientated, it had freedom of movement, first person perspective, faux-realistic cartoony graphics and rather being decision based it was more action based. The player took all the roles at an incident carried out by the firefighters and did jobs that a commander would not usually do. It is worth remembering that this prototype was created with very little knowledge of the Fire Service – hence why the team were observing a mock exam.

The officers seemed reluctant to fully embrace the idea of a gamified exam without fully realising that the exam was played out as a traditional role-play game. They both pretended to be characters detached from themselves; one took the role of a commander being examined, the other played the facilitator, or in Dungeons and Dragons terms the 'dungeon master'. The facilitator shaped the entire scenario scene within his mind, reacting and adjusting it to the commands issued. Whenever a new character was needed for the scenario he would change his guise, taking on a new persona and accompanied with a change in accent and vocabulary. Whether it was the driver, the shop owner or a crew member, the 'dungeon master' would switch between them upon request.

This was not restricted to human characters either, as he would also verbally describe visual changes or events. For instance, if the commander requested a thermal imaging camera to investigate the scene, the facilitator would point to each room on the photograph and

describe it as either hot or cold. When the commander asked the shop owner the layout of the building the facilitator pretended to draw out a plan and handed an invisible piece of paper to the commander. He then loosely described the layout of the building. The facilitators attention to detail to remain in character and try to create as much immersion as possible for the commander accentuated how closely this act was to a game that from the outside looked as if they were in 'flow'.

For the commander, the game is to match your orders against what the facilitator is expecting or for even more *'points'* solve the puzzle in a way that the facilitator did not expect but would still work within the guidelines and rules governed by the Fire Service. The reward for successfully completing this is an achievement; unlocking a command rank, allowing you to progress further with your career in command. The game board is the webpage showing the context of game, hinting at possible rules and strategies.

The format of the exam had strong game elements through role play rather than explicitly being labelled a game. The distinction is made here as the firefighter's feedback of the team's prototype was that it was 'too gamesy'.

To review this question in the most balanced way possible we have to consider, again, that the team had no prior knowledge of the service's exam system and had created a game, albeit a very limited prototype of a game, which would completely overhaul the current system. Rather than there being a technological generation gap, a more likely possibility is that the team's prototype was just too different and unsuitable for their needs. Having observed the role play exam, this could well have been the case as our prototype was severely lacking in terms of complexity and levels of information transmitted between game and player.

The number of choices and decisions an examinee can make which would alter the dynamic of the scene and create knock-on effects later on in the scenario are vast. Human intelligence, intuition, experience and skills far outweigh what is possible for a computer AI to currently achieve and creating anything close would be both massive and costly.

The training officers also raised more concerns with our approach; if it is an exam in decision making, then one would not want people failing it because they have never interacted with a game before. The exam is not a test of your gaming experience, it is testing their firefighting knowledge, risk assessment and leadership skills. It also has to be consistent between exams so that each individual commander experiences the same. While random elements would mimic a real scenario, within the context of the exam, this would be unfair because it must remain the same for all candidates. They also felt that the graphics needed to be more realistic so that examinees could not make the excuse that the scene was not "real" and

therefore they had not performed as they would in real life. Following on from this feedback it was clear that a new direction was needed.

Second Visit to the Training Headquarters

Observing a Breathing Apparatus (BA) Training exercise (the Fire Service refers to units that enter the building to extinguish the fire as BA) to be able to watch a commander in action. This included having to wear protective clothing as a safety procedure due to the close proximity to the simulated house fire, see Figure 10.

Figure 11: *A still taken from the video filmed by the author during the BA training exercise.*

Before the exercise had begun the training officer gave a brief to all the trainees explaining the scenario and showing an architectural floor plan of the building. This was important in that it showed that firefighters are familiar with seeing buildings displayed from top down in an architectural floor plan style. This knowledge informed the design for a tablet GUI used by the facilitator in the development section later.

Third Visit to the Training Headquarters

The third visit to the training HQ was to observe the command training unit going through scenarios with retained fire officers. Even part-time and voluntary officers go through the same training process as the full time staff and must complete their qualification to be able to

operate in the field. This ensures brigade and nationwide consistency from all commanders. This is a further example of the importance that their own domain language and knowledge serves.

The officers delivering the training were different from those at the very first HQ visit, which allowed a different set of officers to voice their opinions on the training and assessment tool. The officers felt there was a definite need to modernise the current approach. The session contained a younger generation of commanders and when I was introduced to them, there was a lot of vocal support from them in favour of using game technology. One comment was that fire fighters are very visual and that they, personally, struggle with the auditory nature of the exam and because of this they felt that more visual feedback would benefit them.

During the training session two full mock scenario exams were observed. These consisted of one of the training officers being the facilitator and one of the retainers taking charge of the scenario while the rest observed. This experience firmly established the format of the exam, in particular how crucial the facilitator's role is in playing the 'dungeon master.'

Identifying Project Roles

This stage is to identify the different roles involved in the project, to be able to understand and manage expectations. This gives an overview of the structure of the project and identifies any preliminary goals that would need to be addressed. The GDD framework recommends splitting the roles into four groups of user; stakeholders, users, subject matter experts and the development team.

***Table 1**: Project Roles*

Stakeholders
Every individual involved in the project had a stake in it. There were external stakeholders from the Fire Service, such as the Training Officers, IT staff and the Officer who acted as a liaison between the Fire Service and the Development team at Canalside. The internal stakeholders were the academic staff responsible for the studio's management, the author and the team of developers.

User

The product would have at least three types of end user; scenario creators, the facilitators of the exam and the examinees. Each would have a different user experience of varying levels of ease, knowledge required (in terms of both domain and technical) and immersion. This would translate to having three separate sections in the product for each user group. The scenario creators and examinees were identified from the initial brief; the ability to create and act out an exam. The third user group, the facilitator, was identified having observed an incident command exam.

Subject Matter Experts (SME)

These people are the command training officers and the IT technicians who collaborate to create the current scenarios. These two groups have all the knowledge regarding how the exams work and what must be present in them. The IT technicians also have knowledge relating to the different types of fire, how they look and behave. This would be relevant knowledge to have shared between the Fire Service and the development team.

Development Team

When creating a game within a small studio with limited resources, across multiple projects, it is key that you create, nurture and maintain domain knowledge relating to the area that is being worked on. The team must all become familiar with the language and process of the client so that if additional staff are reallocated to the project they are not behind in their knowledge.

The team inside the studio consisted of four programmers, three designers and one researcher (the author). Over the development period, one of the programmers worked full time on the Fire Service project, two programmers assisted when needed, one designer worked on the 3D environments and fire and smoke effects and the UI was entirely developed by the author for this research.

From applying the process in Table 1 a number of design constraints were identified.

The table below specifies the user groups, the area of the software they would work in, the method of interaction with the software via an input device and the level of immersion they require.

Table 2: *User types and needs*

User Group	*Area of Software Used*	*Input Device*	*Level of Immersion*
Expert / Technical	Scenario Editor	Keyboard & Mouse	Low
Facilitator	Exam Facilitation	Tablet	Low
Examinee	3D Virtual Environment	None	High

The original prototype developed by the Canalside team had two user groups; the scenario creators and the commanders taking an exam (examinees.) This process of considering user groups, following on from the first visit to the training HQ, clarified the need for a third user; the facilitator.

The facilitator's goal is to be able to modify the virtual environment in response to commands issued. Therefore they need a way of interacting with the virtual environment but in a manner that does not break the immersion of the examinee. To achieve this the idea of a tablet controller was proposed.

A tablet controller provides numerous benefits for both the facilitator and examinee. It firstly allows the facilitator the freedom to remain standing and present during the exam, preserving the current format. Secondly the interaction is touch based and can be designed so it is both quick and intuitive. Thirdly it removes the need for a HUD on the screen displaying the virtual environment for the examinee. As noted in the research section, removing the HUD has the potential to increase immersion for players (Llanos & Jørgensen, 2011.) In this instance, the examinee has no need to interact with the environment directly they only need to issue commands to the facilitator. The HUD is not part of their goals or motivations and therefore removing it should increase immersion.

Having identified three user groups and realising that each would use a different input device, there was an obvious need for separate control systems for each.

For the scenario editor, a team decision was made to use ‘WASD’ and mouse controls for navigating around the 3D creation environment. This was largely due to the team feeling confident with that control method and its ease of implementation within a game engine. More technical control systems discussed by Nilsson and Wendt (2010) would take longer to implement and we wished to rapidly prototype this section. From interviews with the IT technician responsible for creating scenarios he was familiar with games and it was hoped that he would find this a natural control system.

The virtual environment would be navigated in a similar manner to the current exam but applied into the 3D world by creating a camera that follows a path between a series of observational points. The camera path is specified in the scenario editor and controlled by the facilitator via a tablet. This in effect is ‘limited’ or ‘restrictive movement’ but allows the navigation of the scene without needing a joystick or interface for the examinee to interact with. This means we are not testing their ability to play games; an issue raised in interviews and from observing similar products.

SWOT Analysis

This section uses the SWOT (Strengths, Weaknesses, Opportunities and Threats) method to review the Fire Service’s current exam system to identify how it currently works, what flaws may exist, what features could be implemented and what problems may the project face? This would highlight the features that should be kept and signal areas that could be improved upon.

This analysis was formed by observing three mock exams conducted at the Fire Station HQ with different facilitators and commanders. Two of the exams took place in front of a small audience of officers (the exact number was not recorded but it was around 10) which also allowed the capture of thoughts and opinions from a wider demographic of the Fire Service.

Table 3: *SWOT analysis of the service's current exam system.*

Strengths
• The exam uses photographs from real world locations - local architecture will provide a sense of familiarity which should not be distracting. • The exam allows a vast amount of information to be transferred between facilitator and examinee. This can be dynamically altered to tailor any scenario from the same building. • The very minimal HUD is simple to use and requires little prior technological knowledge to operate.
Weaknesses
• No transitions between the photographs displaying the different sides of the building. Facilitator will explain ambiguous routes if not obvious from photographs. • Scenarios have predetermined stages and the photographs show very little progression. This can contradict the method the examinee has chosen. • Lack of visual clues, the exam relies heavily on the examinees ability to visualise the verbal descriptions from the facilitator. • Both facilitator and examinee can lose track of the resources deployed and available during an exam scenario. • **It takes an IT technician two weeks to create an exam scenario.**
Opportunities
• We can create a navigable 3D environment for the scenario to take place in. • Facilitators should remain in control of scenario, as they can transfer a greater amount of information than an AI. • 3D environment will allow verbal descriptions previously given by the facilitator to now be visualised. • Dramatically reduce the time taken to create a new scenario by developing a tool that builds scenarios.

Threats
• Reluctance to embrace new technology. • No shared vision of ‘ultimate product’ as each training officer briefed had a different opinion on what would be required and these were often contrasting and contradicting opinions. • Constraints on using game technology; possible networking issues, restricted internet access and limited computing power. • A pre-programmed scenario would reduce the amount of flexibility available for a facilitator to weave into an exam.

The SWOT analysis, Table 3, forms key design considerations and constraints.

Review of Competition (Similar Products)

This stage of the GDD process is to review digital products relating to firefighting. The goal of this process is to find out what exists and to see how other development teams tackled problems. Eight different products varying between serious and entertainment games were reviewed and their UIs were analysed.

The products were found through a variety of methods; some were recommended by members of the Fire Service, some were found from internet searches and others were found on online marketplaces. Primarily all these products were analysed from YouTube gameplay videos due to how expensive some of them are. Where YouTube videos were unavailable, screenshots from product websites were analysed instead.

The analysis consisted of noting the name, type *(entertainment or serious)*, genre, location *(North America or Europe)*, the overall UI style, whether they used a HUD, what input device was used and any other information regarding the UI which seemed relevant.

Table 4: *Review of Similar Products*

Flame-Sim

Figure 12: *Screenshot of Flame-Sim taken from a YouTube video: https://www.youtube.com/watch?v=zhS0cZDNtqA*

Name	Flame-Sim
Type	Serious
Genre	Simulation
Location	North America

Analysis

Mixture of first person and third person, minimalist HUD showing inventory icons and character stance (standing or crouched), interfaced via game controller, prominent use of spatial UI elements and occasional control prompt popup messages.

REVAS

Figure 13: *Screenshot of REVAS taken from a YouTube video: https://www.youtube.com/watch?v=1WtstbO212A*

Name	REVAS
Type	Serious
Genre	Simulation
Location	North America

Analysis

First person, simple action bar providing buttons to use the radio or hose. Browser based and interfaced via keyboard and mouse, use of spatial UI elements, breathing apparatus game overlay (meta element) and help messages.

ADMS Fire Training

Figure 14: *Screenshot of ADMS taken from a YouTube video: https://www.youtube.com/watch?v=Of9ZxG4F4Lg*

Name	ADMS Fire Training
Type	Serious
Genre	Simulation
Location	North America

Analysis

First person, a skeuomorphic meta display in the bottom right corner of the screen is the only HUD element. The game is controlled via a joystick, very few game UI elements used; breathing apparatus game overlay (meta element) appears to be the only one.

Vector: Tactical Command Trainer 2

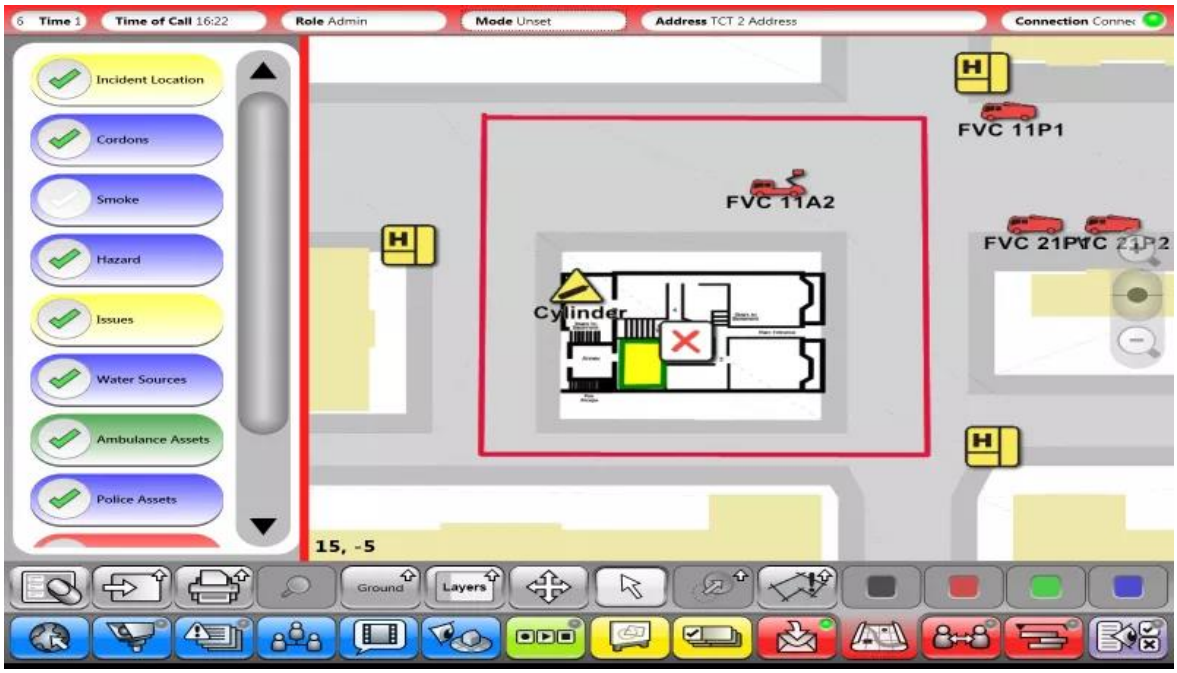

***Figure 15**: Image from the official Vector TCT2 website - http://www.vectorcommand.com/tct2-gallery-ukfrs/*

Name	Vector: Tactical Command Trainer 2
Type	Serious
Genre	Simulation
Location	Europe

Analysis

Combination of first person simulation, scenario overviews (pictured above) and in-depth incident command menus. Very complicated HUD using ambiguous iconography. The simulation aspect is controlled via a joystick. No game UI elements used.

RescueSim

Figure 16: *Screenshot of RescueSim taken from YouTube: https://www.youtube.com/watch?v=CS3wZxGhyeA*

Name	RescueSim
Type	Serious
Genre	Simulation
Location	Europe

Analysis

First person simulation, very simplistic HUD (pictured above) that only displays when actions are required. Unsure of control method. No game UI elements used. Of note, the scenario creation tool for this product is very reminiscent of a 3D game development engine.

Real Heroes: Firefighter

Figure 17: *Screenshot of Real Heroes: Firefighter taken from YouTube: https://www.youtube.com/watch?v=ofMy6kIfD_I*

Name	Real Heroes: Firefighter
Type	Entertainment
Genre	First Person Shooter (FPS) / Action
Location	North America

Analysis

First person action game, simplistic HUD and classic FPS UI (crosshair, damage indicators, objective text) The game supports both keyboard and mouse and console controllers. All game UI elements used; diegetic, non-diegetic, meta, spatial and signifier.

Rescue: Everyday Heroes

***Figure 18**: In game screenshot of Rescue: Everyday Heroes being played on the PC.*

Name	Rescue: Everyday Heroes
Type	Entertainment
Genre	Real Time Strategy (RTS)
Location	North America

Analysis

Conventional RTS HUD (mini-map, unit action bar, time controls) The game is controlled via mouse and keyboard. Most game UI elements used; non-diegetic, meta and spatial.

Emergency 2012

Figure 19: *Screenshot of Emergency 2012 taken from a YouTube video: https://www.youtube.com/watch?v=3230lXrKKsU*

Name	Emergency 2012
Type	Entertainment
Genre	Real Time Strategy (RTS)
Location	Europe

Analysis

Very similar layout to Rescue: Everyday Heroes. Conventional RTS HUD (mini-map, unit action bar, time controls.) Slightly more options on display than Rescue: Everyday Heroes. The game is controlled via mouse and keyboard. Most game UI elements used; non-diegetic, meta and spatial.

It is interesting to note that the entertainment games each had a conventional GUI relating to the genre of the game, compared with the serious games where fewer conventions were used. This would seem to give weight to the hypothesis as outlined in the introduction and explored further in the research section that games have a ‘language’ and serious games may not be able to rely upon this.

It would appear that within the serious game genre there could be cultural differences in the balance between the serious and the gaming elements. The North American serious games tended to favour UIs with an emphasis on game elements, as opposed to the European games where the emphasis appeared to be more on the ‘serious’ and less upon the game elements.

Personas

Having identified the three main user groups of the software, this section creates a persona for each user group detailing how they interact and use the software. Persona writing forms a character which forces the designer to consider the person they are designing for. It removes the designer’s ego and forces them to consider the people that will use the software and how it will fit into their daily lives.

The personas were created from meeting different officers and staff at the training headquarters (HQ) and drawing upon the personalities met there.

Table 5: *Personas*

Stuart (Facilitator)
Stuart arrives at work knowing that today he will be examining trainee commanders for their level 3 Incident Command qualification. He goes to the IT suite at the fire HQ and logins into a computer to run through a scenario on the new software to prepare for the exams later. Here he looks through the existing scenarios saved on the local network, chooses one and starts to consider likely scenarios that could happen at this scene. Having studied the scenario, he is happy with the direction he will take it and closes the software and logs off.

Later in the day he goes to the exam room shortly before the first exam is scheduled to setup. Here he loads up the software on the room's PC making sure it is connected to an interactive whiteboard. He then also loads up the companion app on a tablet and joins the exam session he creates on the PC. With the tablet and PC connected he is ready and ushers in the first examinee.
The exam goes smoothly, Stuart is able to control the scene from the tablet app to visually change in response to the commands issued from the examinee. This helps the examinee and allows Stuart to focus on keeping track of the scenario.

Mike (Scenario creator)

Mike gets to the fire station and has a morning meeting with the command training team to decide on a new scenario. Following this meeting Mike is tasked with creating a new scenario based on what was discussed. He loads up the scenario creation tool, decides from a list of options what the building on fire in the scenario will be. The software also allows options for nearby scenery quickly populating the 3D environment. He is then able to decide upon the layout of the building, and the various camera positions and pathing around the scene. Having completed these steps he is then able to save, test and upload to the local network so the commanders can view, test and give feedback on the suitability of his scenario.

Ted (Examinee)

Ted is nervous, today is the day of his level 3 Incident Command assessment. He has heard that the service have a new piece of exam software and isn't confident using computers. He has heard about other brigades using computer games, he does not play them and is hoping that this new technology will not force him to.
When the exam starts Ted is relieved to find that he does not have to interact with any technology at all. This allows him to focus on the scenario at hand rather than being distracted having to use technology. He finds the onscreen visual information useful and can see it reacting to his commands. At the end of the exam he leaves feeling confident that he had performed well.

Having observed several examiners play the role of the facilitator, this persona was created by imagining how the product would fit into their daily routine.

The idea of replacing the 'sim city' style scenario builder with step-by-step ‘wizard’ was formed whilst writing the scenario creator persona. The steps taken to create a scenario using the sim city builder were analysed. These were broken down into the key components which then provided the steps for the ‘wizard’. The ‘wizard’ would be able to guide a user through the process in a logical order and splitting the overall goal of creating a scenario into simpler mini-goals.

Finally, the examinee persona was based on a particular feeling expressed by several officers that adding a digital immersive experience to the exam would somehow frighten less technologically able commanders. It was made clear that an exam should be about testing a candidate’s ability to make the right decisions, not their ability to play a video game.

Interviews

Semi structured or at times informal interviews and discussions were conducted with an array of different officers. Over the course of the research a total of fourteen officers and IT staff (not including testers) were interviewed. The purpose of the interviews was to establish background information and to receive feedback on the direction of the project.

These interviews happened at a variety of places and times; car journeys, during the live training exercise, inside the training HQ or at the studio on the University campus. Any interview that took place at the studio would also run alongside a demonstration of the progress of the product in order to get design feedback which would feed into the next iteration.

The interviews were a chance to get to know some of the people that worked at the Fire Service to have a better understanding of who they are, how they think, what the sort of features they might want from the game and to get them to articulate what their ideal Incident Command Assessment Tool would be.

The amount of knowledge gained from the interviews is hard to articulate as it fed into every aspect of the design decision making process. The conversations built a collective identity for the Fire Service – an understanding of their culture.

There was not a singular vision for the product shared by the officers. One of the biggest points of contention was the differing opinions on NPC (non-playable character) avatars.

One argument was that avatars would be distracting, they may carry out the wrong actions or stand in the wrong places. This will lead commanders to question “why are they doing that?” or “why aren’t they doing what I told them?”

The counter argument is that it would populate the scene, bringing life to it and adding to the immersion. One senior officer, in particular, was hugely in favour of avatars. He indicated that whenever he sees a BA team entering a building it immediately triggers a set of safety concerns and dangers he needs to look out for in his mind – which otherwise he may forget. This is an indication of the encoding specificity principle at work; if the context is more accurate, he felt his memory would recall more information.

There are more potential benefits to having avatars present within the scenario. The acquisition of domain knowledge revealed that the Fire Service throughout the country used patterned bibs to identify roles at an incident. Avatars within the virtual 3D environment could then wear these bibs, adding an extra layer of depth to test the commander, which the current exam system does not. Again this adds more immersion, not only is the world populated, but it is also populated with relevant avatars which you can tell apart simply by what they are wearing. The avatars would also indicate the amount of resources at the disposal of the commander. As mentioned in the SWOT analysis, during some training scenarios both facilitator and examinee forget how many units have arrived at the scene, how many are available and where they are positioned. Traditionally in a game, these resource statistics would be displayed on the HUD – however the aim of this design is to remove the HUD to create more immersion. A way of doing this would be to use avatars so they can see the resources in front of them. Thus, the avatars act as both a signifier and also as a diegetic UI element, whilst reinforcing immersion.

The major flaw in using avatars is the development time needed to create the avatar asset. Not only does modelling, unwrapping, texturing, rigging and animating of a character take considerable time but then you also have to make various different alterations so that the avatars have some variety. The most important aspect of this process is creating a believable animation set. Rigid or inorganic looking animations will break immersion. It is likely that those arguing against avatars are particularly aware of this – possibly because they have only experienced low budgeted games for the Fire Service which do have poor quality animations and this is an entirely justified argument. Due to the limited resource pool available and lack of expertise in this field at Canalside Studios the team were unable to create or test the UI benefits of avatars.

Conclusions to GDD

The facilitator plays a major role in the exam process, acting as a ‘dungeon master’ and cannot be replaced by an AI. To keep this role part of the exam, it requires the use of a tablet device to connect to the exam PC to control parameters in the virtual environment. A tablet GUI has to be created that is simple and fast to use so it does not interrupt the flow of an exam.

The tablet controller has added benefits for the examinee, as it allows the HUD to be removed from the exam screen potentially increasing immersion. The facilitator’s attention to detail in the mock exam highlighted how important immersion is to the exam. This is both in terms of believability and helping inform decision making with accurate signifiers.

The tablet also allows the facilitator to navigate the exam environment. This removes the need for an input device for the examinee; they can focus entirely on the scene rather than having to worry about the technology.

The movement path for the exam would be defined in the scenario builder. This builder would be split into a series of stages handled by an IT technician. It would define which type of building was used, details about the building, i.e. room names, which floors can be set on fire and finally the pathing around the building.

Having explored the Fire Service domain through a variety of sources and means I now possess a grounding in incident command and have a greater appreciation of how fires are dealt with and managed. Going from knowing very little to having a reasonable understanding can only benefit my judgement as a designer. Transferring this knowledge to the rest of the team had an impact on not just the approach of the UI but also the entire design of the game. It has also meant that I was able to communicate with the client more effectively having learnt their processes and in particular their language. Table 6 displays a list of terms and abbreviations that were learnt during this phase of research.

Table 6: *List of terms and abbreviations*

Term or Abbreviation	*Meaning*
BA	Breathing Apparatus
IC	Incident Commander
Pump	Fire Engine containing a water tank and pump.
PPV fan	Positive Pressure Ventilation fan.
TIC	Thermal Imaging Camera
USAR	Urban Search and Rescue

As an anecdotal example of the worth of acquiring domain knowledge, I was able to observe a real life scenario in which I could test the extent of my learning.

The fire alarm went off in the block of flats where I was living. A single pump was dispatched and before it arrived, having learnt the basics of incident command, I went through the initial steps to test my knowledge of fire risk assessment. My assessment of the scene was that there was no fire. When the fire crew arrived I observed them carry out the same method I had just performed and they reached the same conclusion. This incident appeared to vindicate the benefit of learning domain knowledge.

Development

The developmental phase of the project required the design and implementation of three areas of the game for three separate user types. As seen from the GDD research these users were a facilitator requiring a tablet GUI, an IT technician using a step by step builder to create the exam environment and the examinee needing an immersive environment.

This next chapter goes through the development process of the tablet GUI and then the step by step 'scenario wizard.' The exam aspect of the game was built to show off the tablet functionality, however the 3D environments (models and textures) and visual fire and smoke effects were not created by the author and are therefore not included in this research.

Tablet GUI Design

The first part of the development phase was ideation and conceptualising the different aspects of each separate area. One of the programmers prototyped the best way to send packets of data from a tablet to a PC through the game engine Unity 4.0. This provided the opportunity to develop how the GUI would look on the tablet.

The first strand of ideas took the current exam interface and arranged that on the tablet display.

Figure 20: *The first tablet GUI mock-up based off the current exam display.*

The current exam layout looks very similar to Figure 20, the numbers represent the sectors or sides of the building you can walk around. I have added the ‘action bar’ on the right to utilise the extra functionality we can add. This design employed the language abbreviations I had encountered.

The next major iteration, Figure 21, was to overhaul the colour palette and aesthetic design favouring a modern flat approach. The other change was to remove the action bar in favour of contextual menus that allows the facilitator to interact with windows and doors of the environment. It was felt that replacing the action bar with contextual menus would be more intuitive to the facilitator.

Figure 21: *A design idea trialling colours, adding the TIC (Thermal Imaging Camera) button and replacing the action bar with a contextual menu.*

There were a number of flaws with this design. Firstly, it would require the tablet to load and display the model of the building and this creates a reliance on using tablets with sufficient GPU power. Secondly, the facilitator’s overall goal is to quickly update the scene; having to find the object you wish to interact with, open the context menu and then select you the action you wish to carryout seemed needlessly complicated and could be streamlined. Thirdly, how would the facilitator interact with a room if there were no windows or doors? This question could not be answered and the idea was moved away from.

An alternative design idea, Figure 22, was to divide the screen up into four viewports showing the different sides of the building. This idea did not get developed further as it suffered from the technical constraints of having to render four views at once and problems with spatial confusion.

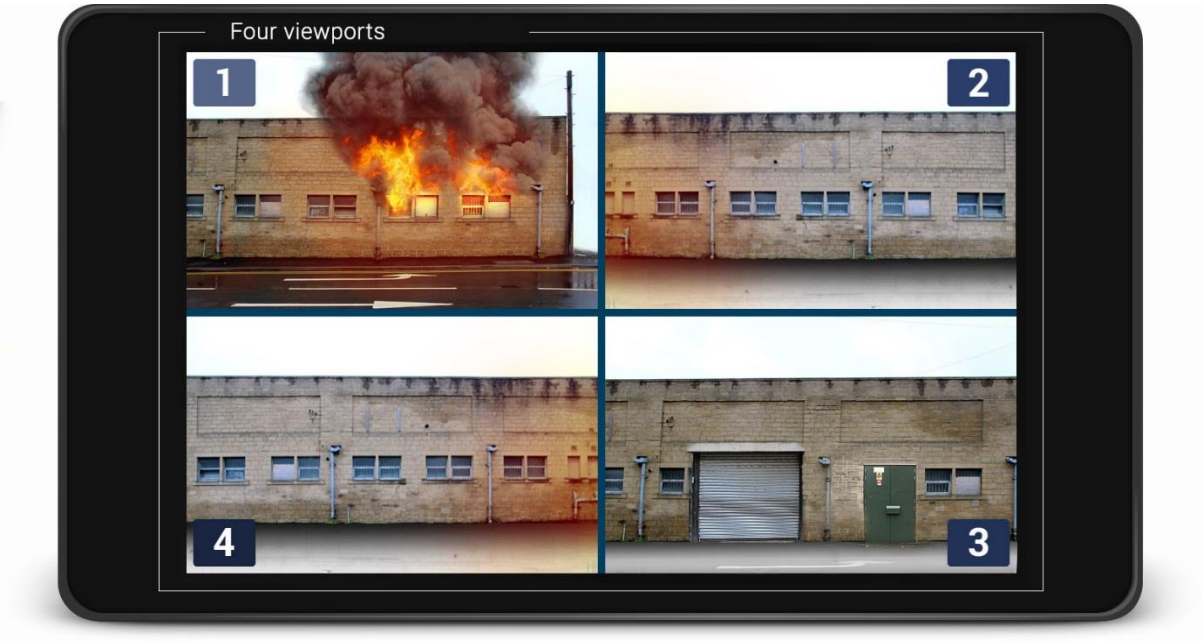

Figure 22: *This idea would employ contextual menus to interact with the environment. Displaying four viewports at once requires a powerful tablet and it is difficult to tell which side of the building is which.*

The design ideas already explored started to create a set of constraints that a successful design would have to follow.

Figures 23 and 24 show the final set of design ideas focused on an architectural floor plan theme. As discovered from observing the BA training scenario, the Fire Service use architectural floor plans to map buildings and are therefore familiar with the format. Once again the colour scheme was slightly altered to better reflect the branding of WYFRS. This tried to take advantage of persuasive technology (Fogg, 2002); knowing that using team and brand colours could build a positive relationship between user and software.

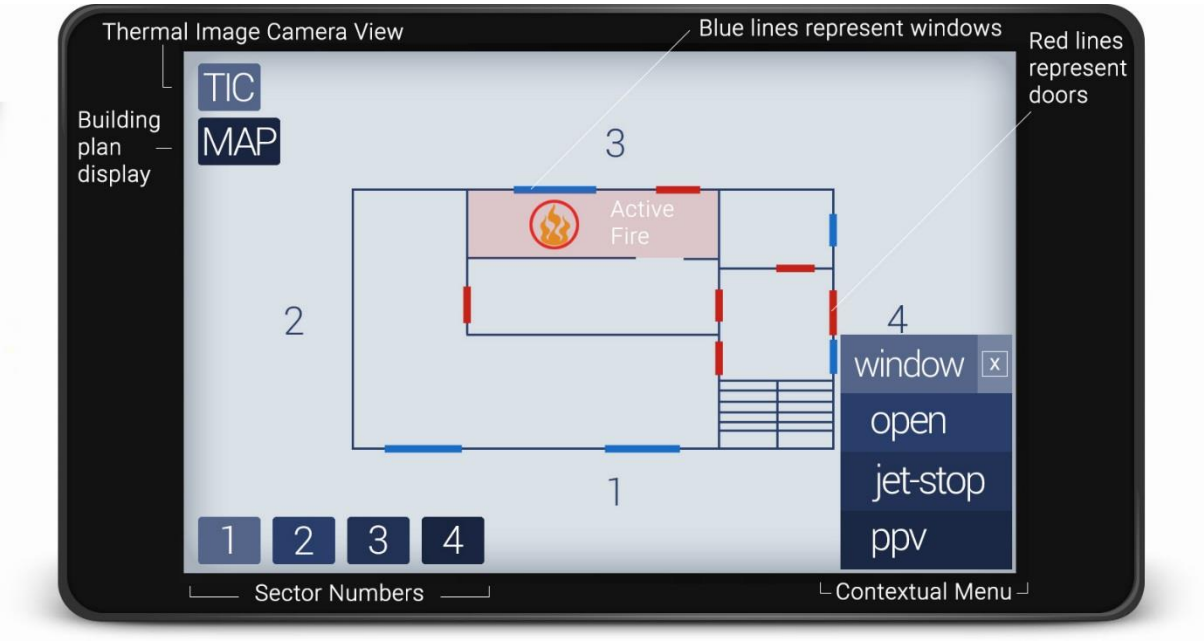

Figure 23: *The first architectural floor plan style GUI mock up. A contextual menu was still being considered at this stage.*

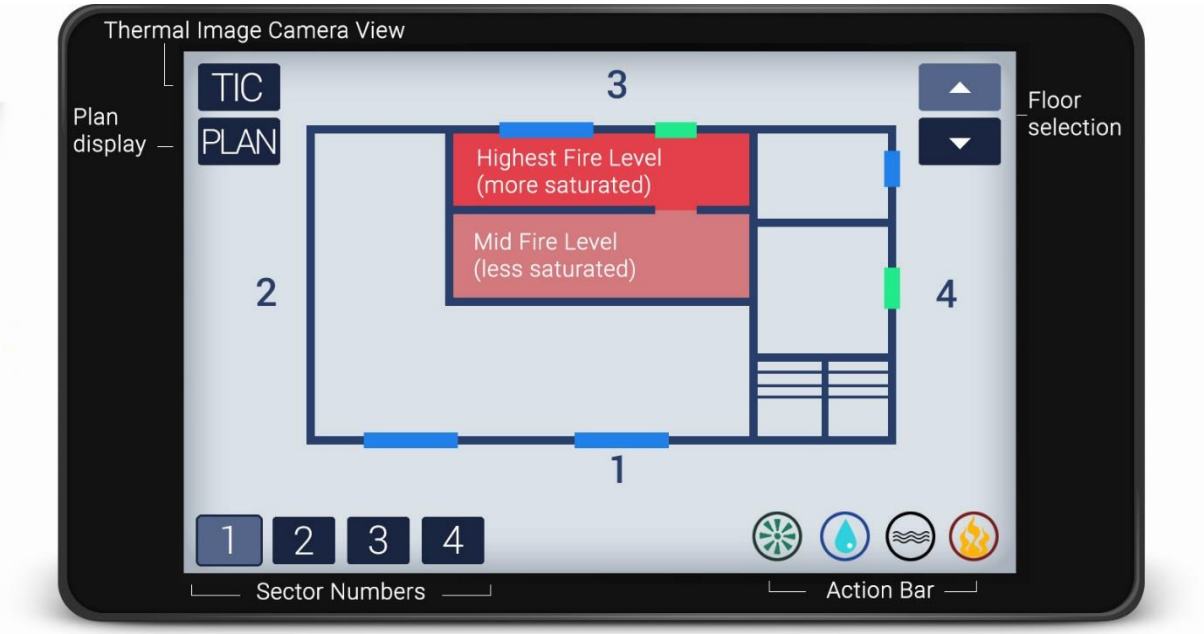

Figure 24: *A later iteration, removed contextual menu and reverted back to an action bar. The style of the icons on the action bar seemed out of place. This iteration also added the ability to change floor of the building.*

The idea of using architectural floor plans met the design constraints created by the earlier ideas. The idea was iterated further but the core layout was used for the rest of the project.

The interaction was simple, in that the user could see all the rooms contained within the building at once. You could either select a room and then choose an option from the action bar or drag and drop an icon onto a room. This gives the facilitator control over selecting where the fire starts, how it spreads and how it is put out. If you keep applying fire to the same room, the level of fire grows and it becomes larger in the virtual environment. The colour of a room on the tablet would become more saturated as the levels of fire were increased.

The options to switch to thermal imagining or displaying the building plan on the main display have stayed fairly consistent throughout the entire process. Any changes that were made, were based off internal testing with other developers inside the studio, as well as feedback from interviews and demos with fire officers. For example more space was allocated between each button, as when observed the buttons were too close and people had difficulty selecting the button they wished.

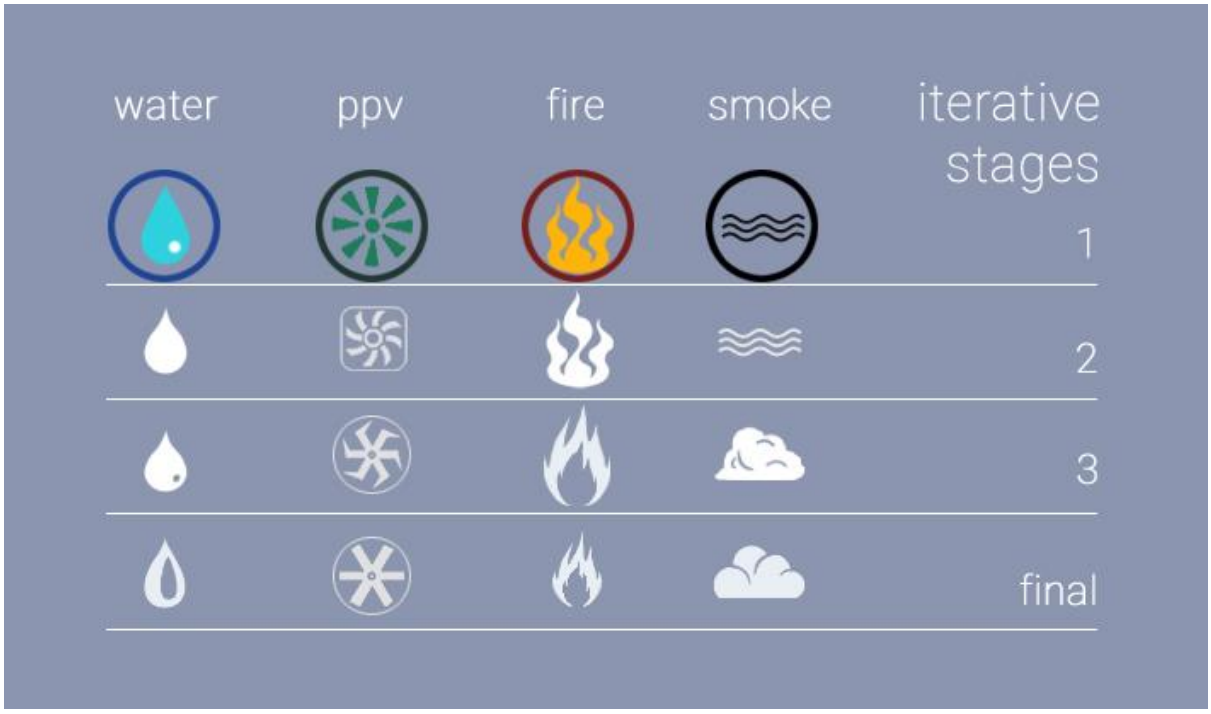

***Figure 25**: Iterative design stages showing the development of the tablet GUI icons*

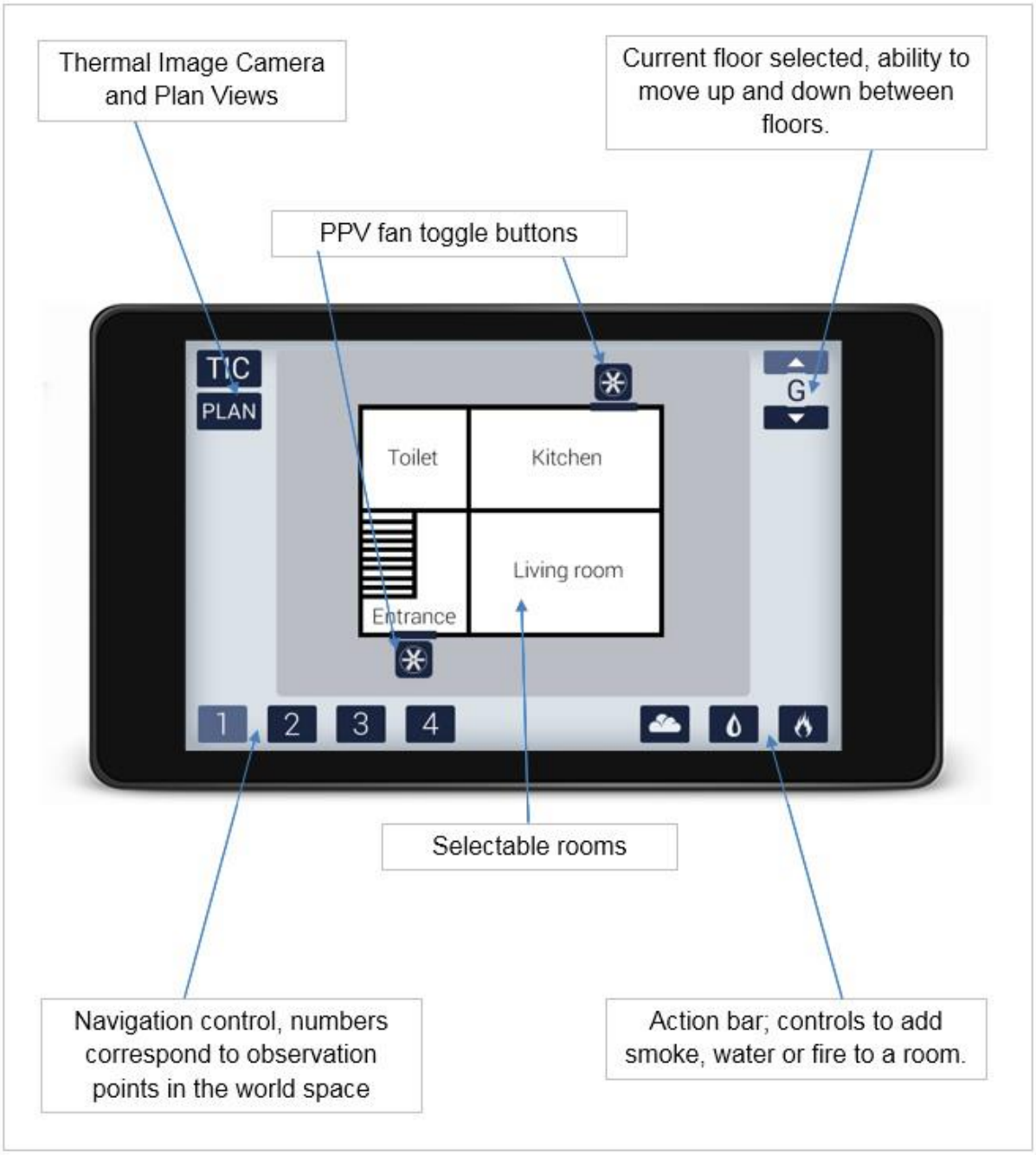

Figure 26: *The final tablet GUI design.*

The final table design featured in Figure 26 is used as the GUI for the final test.

Scenario ‘Wizard’ Design

The following section relates to the development of the UI for the step by step scenario ‘wizard’ to be used by IT technicians to build scenarios for the examination process. The tool was created for the PC using the game engine Unity 4.

The scenario wizard was a design alternative to the very first prototype which used a ‘sim city’ style builder to allow users to create a fire incident scenario and the surrounding 3D environment. The idea for this change came from writing the personas as part of the GDD process. From internal testing, although the change was less enjoyable for users, the wizard was simpler to use and produced quicker exams – which were two of the main goals identified by the SWOT analysis.

Defining a Visual Style

Before the menus could be created a visual style had to be defined. Much like the tablet, the colour palette would reflect the WYFRS brand; this is a combination of pale and darker blues. The theme for the aesthetic would be a minimal, corporate look with a mixture of hard and soft edges. This would look both professional but also more relaxed reflecting that whilst it is serious work there is a sense of friendliness – this product is assisting you in your work.

Typography

The typography used was restricted to two typefaces for both the tablet and PC. The font used for all titles used the same as the WYFRS brand and that is Century Gothic. For the main body of text, a typeface which favours both clarity and readability on digital screens was chosen. In this regard, Google’s Roboto was selected as it is not only default to android devices and free of charge but also because it was created with the intention to be clear and easy to read on a screen.

Menu Hierarchy

The menu hierarchy was developed through the course of writing the persona for the scenario creator and analysing the original prototype's building process.

The early conceptual designs for the scenario wizard can be found in the appendices at the end of this report (page 97.)

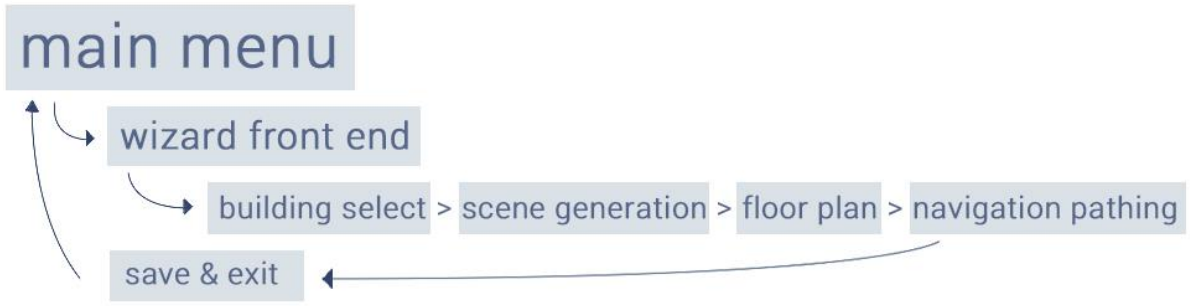

Figure 27: *Hierarchy and flow diagram for scenario creation, Scene generation was later merged into the building select process.*

Step Process Design

Breaking down the 'sim city' builder into its stages and knowing what the exam environment should look like, gave a rough idea of what each stage should be. The scenario editor steps would need to specify all the content that would be needed for both the facilitator's tablet and the visual look of the exam. It would need a way of selecting the building that would be used for the incident, a way of defining how the interior layout of the building should look when displayed architecturally on the tablet and a way of defining where the commander can walk around the building. Everything else, such as the fire and effects would be handled by the exam backend. Four stages would be needed to carry these things out; building selecting, floor plan, camera setup and a finish screen.

This next section will briefly go through the design of each step, to establish the function of each as they are discussed in detail during the feedback from the summative usability testing.

Step One: Building Selection – The first stage allows the user to populate the world by inviting them to select a building from a list. Having selected a building, two sliders appear allowing the user to customize the environment. This procedurally generates an environment based on the constraints of the two sliders.

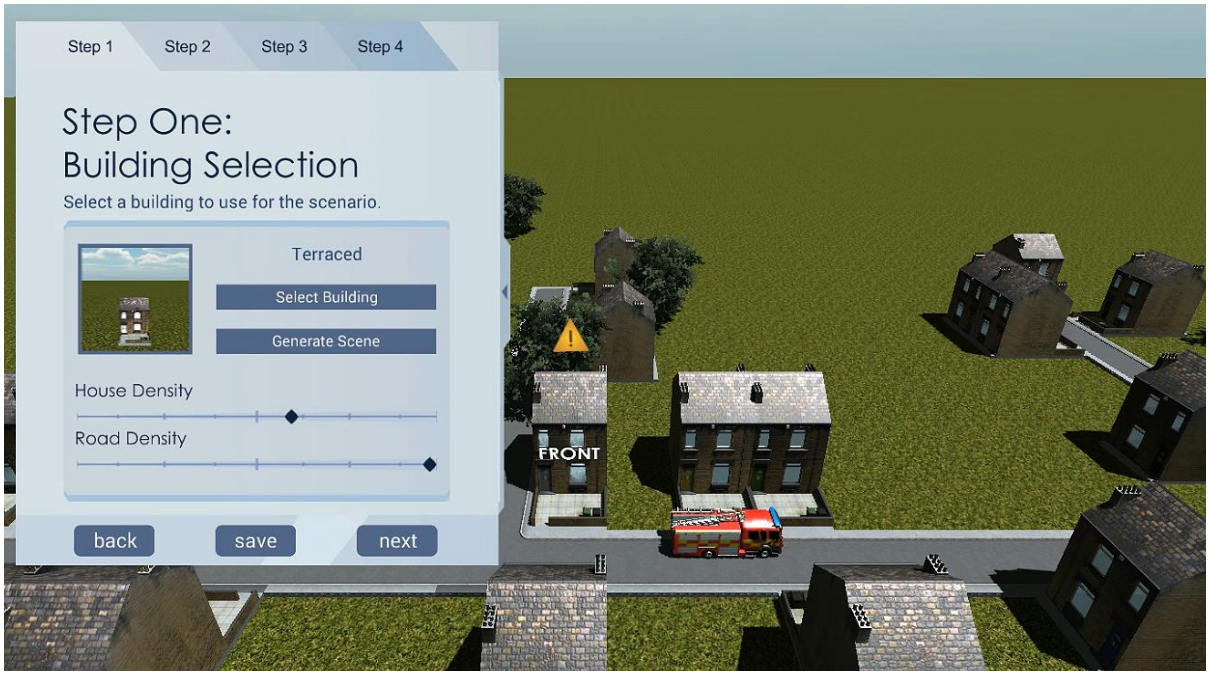

Figure 28: *Screenshot of Step One having just been completed.*

The scene generation options were hidden until a building had been selected, this created hierarchy within the step. Although perhaps obvious, by hiding the options to begin with the user is guided into selecting a building, once selected, the new options appear and the user then focuses on those.

Step Two: Floor Plan – Originally this stage allowed the user to draw an interior 2D top down layout of the building that would be saved with the scenario and loaded onto the tablet during an exam. This allowed a scenario creator the ability to create differing scenarios from the same building model. Through the course of development the programming team worked on a method that would automatically detect the outline of the building and layout of rooms from the 3D model and then display them on the facilitator's tablet. To some degree this made the floor plan step redundant.

Despite this, it remained in the program as it was found that when loading a high rise building, due to the way the system handled the fire effects, the exam would suffer performance issues on low end systems. The floor plan step then became a way of trying to increase the efficiency of the exam. By default, floors would be unable to be set on fire. The effect of this constraint was that the IT technician when setting up the scenario would have to specify which floors could potentially be on fire. In effect, the UI was trying to compensate for the fact that the back end system was not optimized.

From a UI design perspective this is not what a designer would want. Ideally, a finalised product would have this removed; as you should not expect users to go through a step to increase the efficiency of your own product.

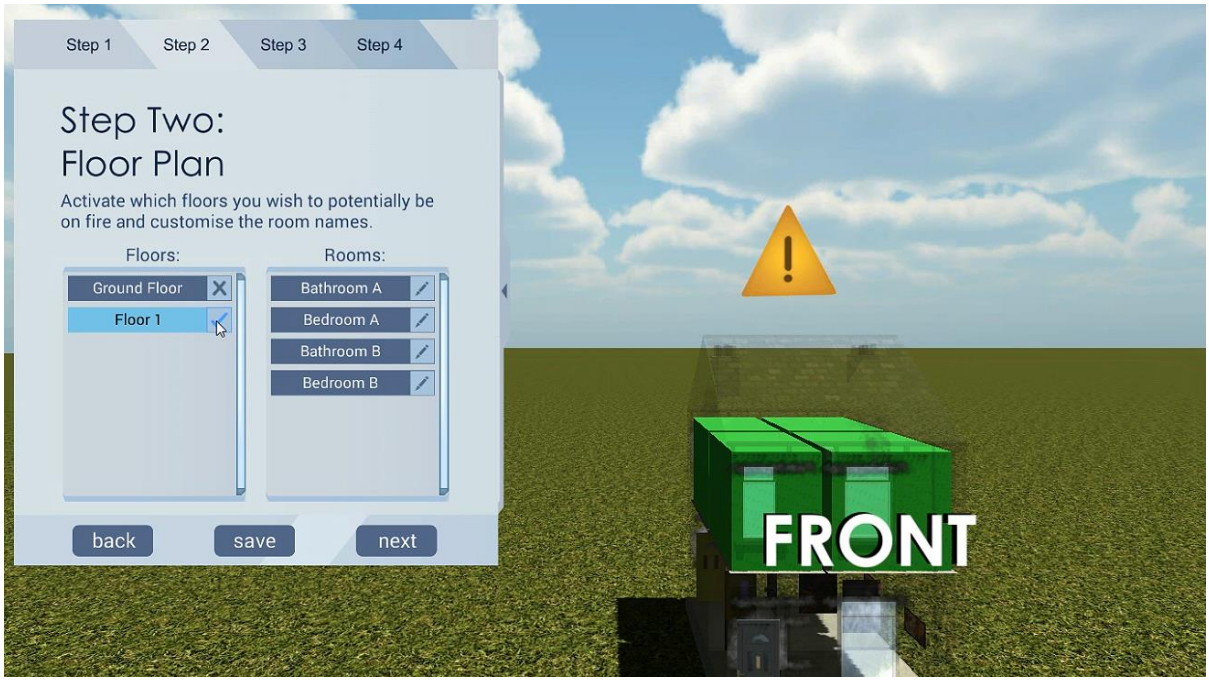

Figure 29: *Screenshot of Step Two demonstrating the use of spatial UI elements; the floating icon to signal the house involved in the scenario and also the floating text to help orientate the user to the front of the house.*

Step Three: Camera Setup – This was the hardest step to design and went through the most iterations. Even by the end of the development, as seen in the user testing, it was still a challenge for users to complete and could have been improved.

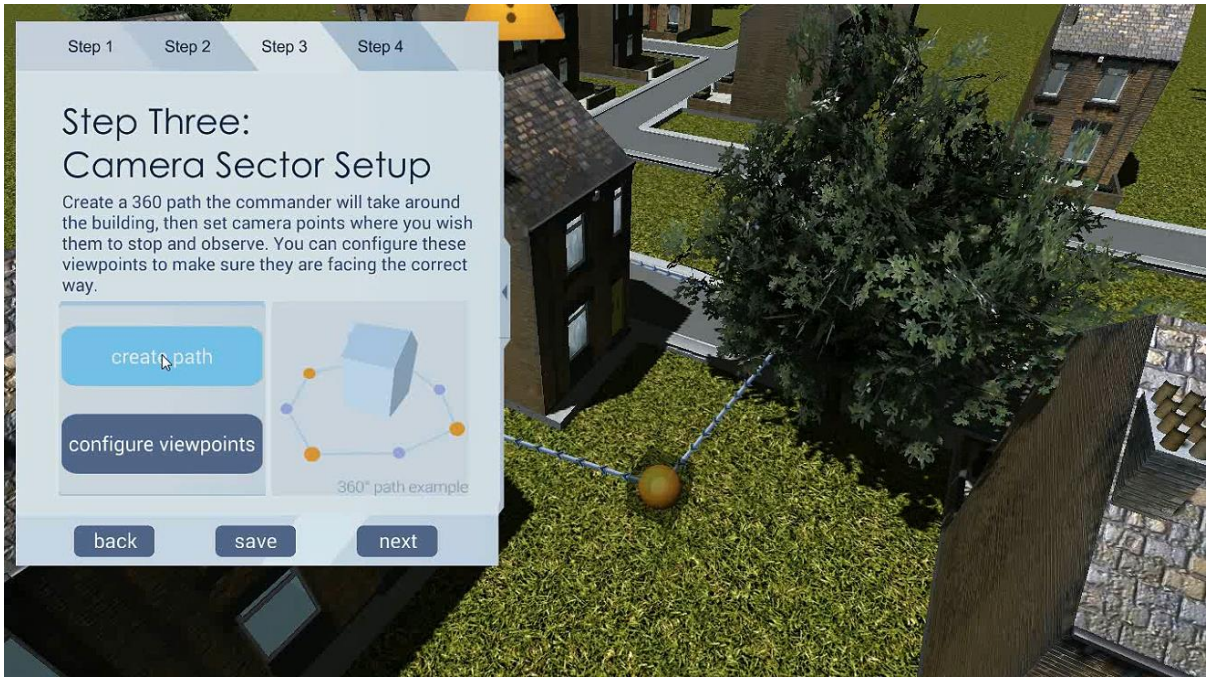

Figure 30: *A screenshot of Step Three having just been completed.*

The concept of it is simple: place ‘observation’ points around the building. This is a direct mimic of what the IT technician does when they find a building they wish to use for a scenario.

The challenge arises when trying to design a system that will be flexible with any type of building, one that will allow the camera to move through alleyways, upstairs and around tall buildings. This means a user cannot just place observational points, they have to place intermediate path points as well, so that the route does not clip or get obstructed by geometry.

Then should the path loop round in a circle? Or do you want there to be a dead-end? Or is one side of the building is obstructed preventing a full circle? - Suddenly there needs to be an option to toggle looping.

Where should the target focus be for the camera? The centre of the building? The base of the building? The roof? An automatic approximation can be made, but what if the user wants to manually correct it? – Then there needs to be an option for that.

All these options need to be integrated into the GUI, but these options are quite bespoke and each has a specific and complex role which is difficult to signify as an icon.

Figure 31: *Creating the navigation path for the exam in Step Three.*

There is a challenge associated with creating widely recognised icons for things where there is no real world equivalent. The pathway point, 'node' deletion icon, as seen in Figure 31, is a cross within a box, however several alternatives could have been used:

- A waste paper bin – a windows convention
- A bulldozer – city building game convention
- A stop / no entry sign – software convention borrowing from road traffic
- A broom – to signify clearing away or tidying up.

None of these alternatives particularly fit. The bin would seem out of place without the context of print or paper, you are not throwing a node away. A bulldozer would fit better if we were deleting buildings – but in this instance we are deleting a digital artefact with no real world equivalent. So how would one get rid of a node in the real world? The cross in this case seemed the best suited icon to choose from.

A similar thought process can be applied to each of the other icons; camera or observation point placement, loop toggle or adding a node between the currently selected node and the

previous node. To try and help the users with this a space for tooltips was designed into the context menu.

Step Four: Save & Finish - The final step of the process is to save the scenario. This allows the user to go back and make any further changes or to exit the scenario builder. A checklist is displayed at this stage and any steps that have not been correctly completed are flagged to the user. If any of the steps are flagged then it prevents the scenario being submitted to the exam area. It was recognised that the exams take place independently from the IT technicians. An unfinished exam mistakenly or otherwise submitted would create a problem for the examiners. This was a fail-safe built into the software to try and prevent this.

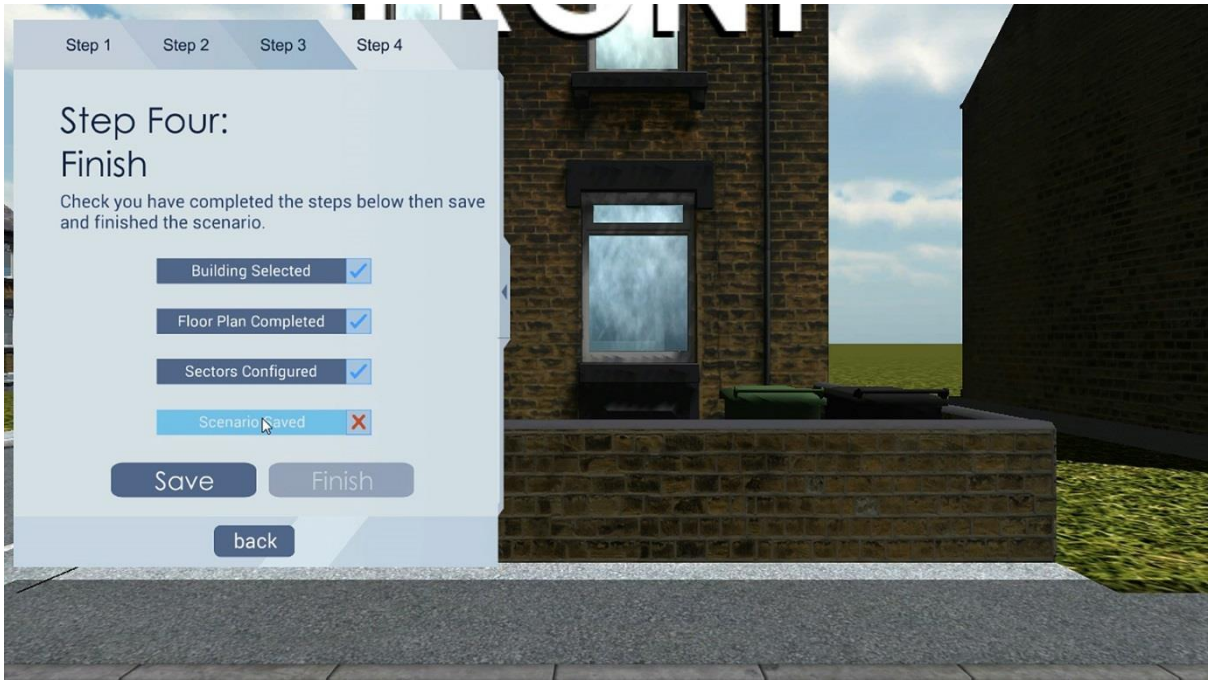

Figure 32: *Screenshot of step four displaying the checklist of tasks which need to be completed before you can submit the scenario to the exam section.*

Summative Usability Test Using Subjective Measures

To evaluate the final product, the Fire Service agreed to partake in a usability test. This test would focus on subjective measurements to assess the success of the product. In particular, the analysis of the test results would pay attention to user's technological background and age to see if there was a correlation between the two in terms of proficiency when interacting with a new piece of software.

This would be achieved by first asking the testers of their expectations for this test, to identify any bias, and then conducting a short survey to determine age ranges, a variety of technology usage questions and whether the testers played games and on what platform. This was followed by observing the testers creating a scenario; using the tablet GUI to facilitate and to experience the team's approach towards incident command assessment. Finally, a debriefing survey was used to record feedback about the overall experience the testers had during the testing.

Test Setup

The test subjects were a crew of five Fire Officers from the local brigade and the testing took place at Canalside Studio. The studio was divided into two separate areas:

The first area had two computers with the scenario building tool installed. Microphones and screen capture software were used to record the tester, their actions and the conservation had with an observer (members of the development team.) Each observer was given the same set of questions and observations to make while the testers followed the step by step 'wizard' to create a scenario.

The second area had a projector displaying the exam aspect of the software accompanied by a tablet to control the scenario. Each officer was given the opportunity to use the tablet device to act as a facilitator. An open forum was also conducted alongside this to evaluate the software, observe how they interacted with the tablet and collect any suggestions or feedback the testers had. Two cameras were placed in this area; one captured the officers

using the tablet GUI (Figure 33) and the other to record the discussions. Very brief notes were also taken and can be found in the appendices (page 94.)

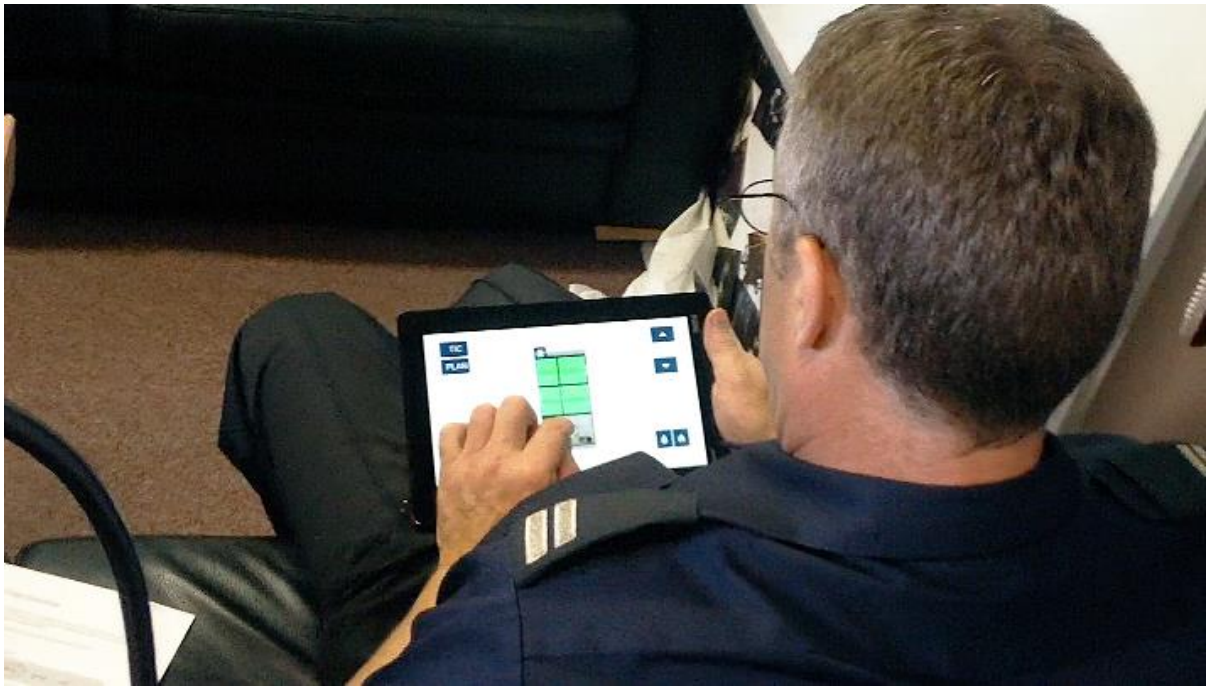

Figure 33: *One of the testers in the exam area using the tablet to control the scenario, taken from a video camera recording their actions.*

A finding from having the two separate areas of testing was that the officers who had experienced the exam first appeared to have a better understanding of what to create in the scenario builder and therefore found it easier. This could be because the exam area gave them a contextual understanding of what they were creating. It provided an opportunity to see how the elements of the scenario editor fit together to achieve the end goal. This emphasises the challenge faced by the users unfamiliar with the software, who were unsure of what they were working towards.

Pre-Test Questions

Once the officers arrived, they were introduced to the studio team and given a brief explanation of the history of the project, how it was started and the aims for the future. The crew were then asked their expectations for the session and if they had any prior knowledge of the project. These questions were asked to gauge how prepared they were to use the software. The development team were unsure of how much the officers had been briefed by

their superiors beforehand. Any preconceptions the officers had could influence how they performed during the test. Raita and Oulasvirta (2011) found that both positive and negative user expectations have a direct impact on a user's ability to use software and their opinion of it after a test session.

These pre-test questions found that the officers were expecting to test computer software related to their job, but were unaware of the exact details. The questions did reveal that one of the testers had a preconception of the software. This tester had suggested 'years ago' that the Fire Department should look into developing software to help with training and assessment. His ideas were dismissed as unreasonable at the time by the commanding officers, stating that the Fire Service 'were not Microsoft'. As a result, this person was positively motivated to aid our progress. This may have had an influence on the opinions of the other testers, knowing that a colleague strongly believed in this sort of project.

The phrase 'not [being] Microsoft' may also suggest a hesitancy, from the higher ranks, towards adopting technology in this area as well as the lack of the technical capabilities and knowledge required to develop such a piece of software. This is important to note as the tone of this could spread negative feelings towards technology, again influencing people's perceptions of the use of technology within the Fire Service.

Survey

Following the pre-test questions, the officers were invited to fill out a short survey. This would supply some background information on them. The questions and responses to the survey can be found in the appendices (page 92.)

Age Ranges

The survey asked which age group the testers belonged to, rather than a specific age, although through the course of the session the testers did reveal who the youngest and oldest was. The group was a mix of ages ranging from at least 26 to at most 55 and there was no direct correlation from these questions between age and technological confidence; the youngest officer and the second oldest listed themselves as 'tech savvy'. However, during the test the older officers did seem to struggle more; needing more reassurance and

support but not necessarily taking longer to complete the task. There could be reasons why this is the case, rather than any technological incapabilities, there is a certain amount of pressure involved when taking a test in front of an observer; these are professional men who may not want the ignominy of appearing to fail. There was not enough evidence to suggest that this was the case of ‘digital immigrants’ struggling with modern technology.

Technology Confidence Questions

Two questions were asked on the survey to try and identify how technologically confident the testers were. The first was a general question asking the tester whether they regarded themselves as ‘tech savvy’ – in other words how technologically confident are they in their own opinion.

The second question asked how easily the testers felt they could navigate websites. Aside from being a general technology question, this was also used to judge how easily the testers would find navigating the scenario wizard, as it shares some similarities with websites.

The survey found that two out of the five testers felt they were ‘tech savvy’ and four felt they could easily navigate websites. The one tester who responded ‘no’ to each question was then identified as the least technologically confident. Within the context of the technology generational divide, it is worth mentioning that this tester was in 36 to 45 age group.

Smartphone Ownership

The purpose of this question was to found out how familiar with touch-screen interfaces the testers were. The survey found that each tester owned a smartphone and therefore, they were all assumed to be comfortable using a tablet device.

Identifying Gamers

The difficulty in classifying a 'gamer' revealed a flaw in the design of the survey. Does playing a game casually on a mobile put you in the same 'group' with people who play regularly on a PC or console? They are all equally valid forms of gaming, but when considering ‘game literacy,’ it does matter.

The survey asked which platforms, if any, the testers play games on to try and measure how familiar the users would be with using games. Unfortunately this question was too vague. Whereas identifying smartphone users would tell us whether they were used to using a touchscreen interface – playing a game on a mobile would tell us very little about how prepared they are to use our PC software.

Follow up questions should have been asked to identify not only which platform they game on, but also the types of games and the number of hours they spend playing. However, there was a reason for not including these questions, I wrongly assumed that a PC player would be familiar with a traditional PC control system. I also felt that asking hours played can be quite misleading, for example, I may only play a few hours a week of games at the moment, but historically I am an experienced games player. If you ask someone how much they historically play then it is very hard to give an accurate figure, you could offer them a scale but each individuals scale will be different – although perhaps this will give a better indication of experience than no question at all.

Findings from using the Step by Step Wizard

Every tester managed to finish creating a scenario by following the ‘wizard.’ The times taken did vary, ranging from 7 minutes 15 seconds as the fastest and 20 minutes and 10 seconds as the slowest time recorded. The least technologically confident tester said that even though he had found it a challenge, he expected he would find it much easier the next time around. This is a positive sign suggesting that even though their initial expectations were not met the learning curve is not steep enough to demotivate them.

When the testers went through the scenario building process, one of the hardest concepts to convey was what the step required you to do and why it is done in that way. This was

especially the case for the testers who had not seen the exam area first. Although the majority of testers found Step 1 manageable, Step 2 and 3 were more challenging.

Step 1: Building Selection

This step was the easiest for the participants to complete. The only part of this step which caused any problems to the testers were the environment generation sliders. The wording of each slider was unclear in how it would affect the scene. This meant that some of the testers were wary to use the sliders while others played with them to see what changed.

Step 2: Floor Plan

The team had not anticipated this step to cause as many problems as it did. As discussed in the development section 'Step 2' requires the user to specify which floors of the building can be set on fire – this is an optimization built into the program to try and cut any unnecessary CPU usage. This is not information that the user needs to know and is hard to explain to someone who is unfamiliar with game technology.

Four out of the five testers expected to use this step to specify where the fire would start, rather than which floors of the building could have fire on them. Interestingly, the least confident user who took time to slowly read the text describing the step found it the easiest. The PC gamer, who confessed that he never reads text in games and prefers trial and error, found it the most difficult.

Another reason why the testers struggled with this step, was that they found the icons slightly misleading. The testers believed the cross symbol (X) would delete a floor of the building as opposed to the real function of turning the floor's fire capabilities on (see Figure 34.) This frustrated several of the testers as they were unwilling to click this button but could not see any other way to complete the task.

Figure 34: *Enabling the floors of the high rise which can be set on fire in the exam.*

The cross symbol might have caused problems because of its connotations connected to its use in Windows. Historically lots of software for Windows would use negative reinforcement in its user experience. The cross symbol is one that is associated with the deletion of things, sometimes without confirmation or an undo button. Bad user experiences have trained people to be wary of certain things and that has lead people to be afraid of clicking icons that they do not understand. To them a cross inside a red button spells danger.

After seeing the testers' reluctance to click this icon it is an obvious problem. There are two potential solutions to fix this; either use the words off and on, or perhaps try a different visual metaphor such as a power switch coloured green when active and red when inactive. This in turn could help convey the overall goal of the step clearer to the user.

Step 3: Camera Sector Setup

Prior to the test, the team anticipated 'Step 3' would cause the most problems and be the hardest task to complete. Although that proved to be the case, the testers did at least understand what the end goal was and therefore could work towards achieving it. This is where the testers had the most difficulty with the camera movement control.

As the testers struggled with the camera controls they found it difficult to place suitable path positions. This lead to lots of mistakes where nodes (path points) were created clipping

geometry signalling an error message (see Figure 35) and icon to alert the user that the pathing is incorrect. Rather than correct the node by dragging it away from any obstacles, the testers preferred to delete the node altogether. The testers which encountered this problem all did the same suggesting that people prefer to delete and start again than figure out what is causing the problem and trying to fix it.

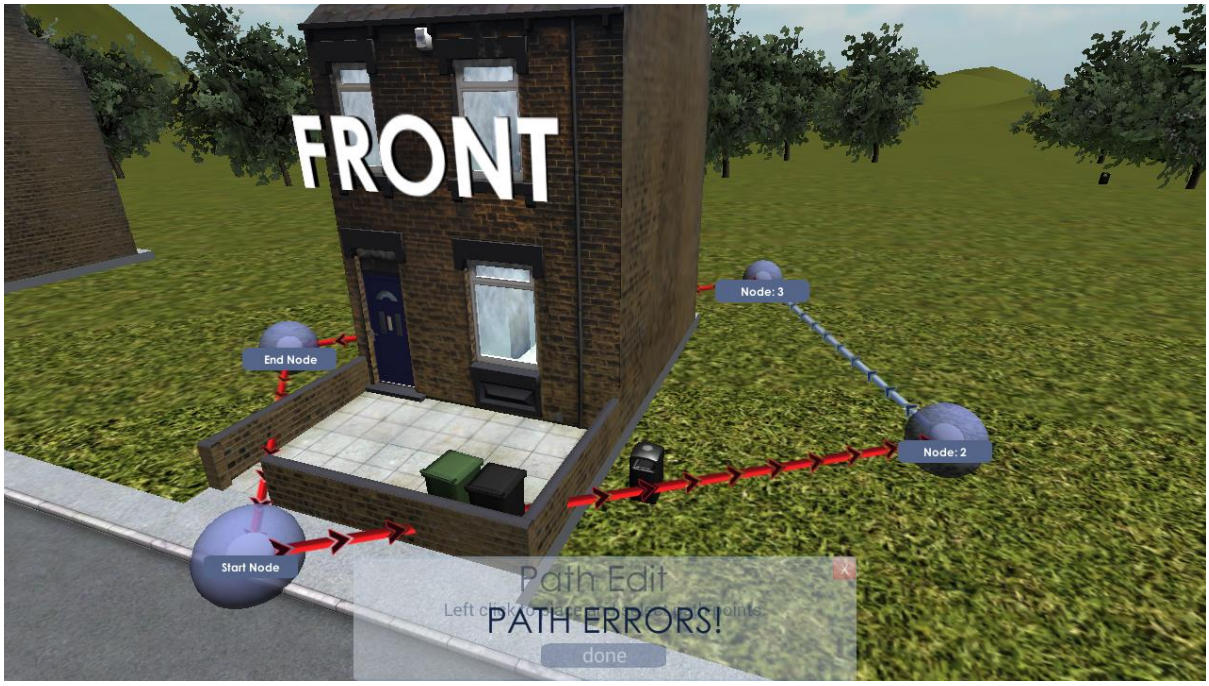

Figure 35: *An example from the scenario builder of the pathing clipping geometry signalling a path error to the user.*

Once the testers had created their path, it was not immediately obvious to them that they then had to specify which nodes became cameras. One asked whether the software could look at the building without them having to set anything up and seemed to be unsure why this had to be done. This reinforces the idea that at certain stages it was not entirely clear to the testers why some steps had to be taken.

Findings from the Exam Area (Tablet GUI)

The tablet and game system offered testers the opportunity to play with the virtual exam environment. The novelty of being able to set buildings on fire was something the testers seemed to relish. One of the officers went and set every room of the house onto the highest level of fire and then light-heartedly teased his colleague that this was typical of his command. This was significant as it implied that they were engaging positively with the software. The technology acceptance model proposes that if the person perceives the software as both useful and easy to use, then assuming they have a positive attitude towards its use then they are likely to want to use the system. (Mathieson, 1991)

One tester misinterpreted the orientation of the floor plan view instead reading the plan as a front elevation, a literal representation of what was on the projector screen, and expected the top rooms on the plan to control the rooms on the first floor. The use of architectural conventions for the plan view had been taken for granted so it was surprising to find that this caused confusion for one individual. In spite of explanations given about the plan view and the control system, he continued to perceive the view incorrectly. Out of all the testers he was the only person to have this problem.

This tester was one of the least technologically confident; listing himself as not 'tech-savvy' in the survey and sometimes having problems navigating websites, he did own a smartphone and played a “simple fishing game” on it – again highlighting a flaw in the survey in identifying ‘gamers.’ However the link between tech confidence and ability to interpret visual information is tenuous. He could have a specific learning difficulty such as Adult Dyscalculia (The British Dyslexia Association, n.d.) which can cause difficulty in interpreting map orientation and direction.

The rest of the testers had no problems interacting with the tablet and overall it seemed fit for purpose.

Further Observations Made During Testing

Control System

The control system implemented uses the mouse and keyboard together to control how the camera moved and navigated around the virtual world in the scenario wizard. The one tester that listed themselves as a PC gamer was unfamiliar with the 'WASD' keys for movement. Generally, he appeared to struggle more than what would usually be expected from a PC gamer, given the prevalence of 'WASD' in PC gaming. This is a counter intuitive find that goes against the idea of 'game literacy.' Perhaps games even at a platform level are too varied and broad and that really, the conventions exist within genres.

It is important, however, to stress that the PC gamer could have struggled due to outside influences. To make a more informed decision it would have been useful to find out which types of control systems he was used to, the genres he plays and the amount of time he spends playing. This would have provided more data to suggest whether it was an outside influence, part of the product failing or down to his unfamiliarity with this type of system.

Overall, the testers found the 'WASD' control system difficult to use. One tester thought that all software 'like this one' would use mouse only controls. If this is the case then other developers may have encountered the same problem. It also implies that non-experts do find it difficult to coordinate using the keyboard and mouse in conjunction. To reinforce this one of the younger testers was audibly surprised when told he had to use the keyboard. The observer instructed him to try using the arrow keys to move around. As the arrow keys are directional in their nature, the observer felt this should be an easier concept to grasp. Regardless of this, the tester still found coordinating the keyboard and mouse together difficult. These findings are similar to what Nilsson and Wendt (2010) found in their research when testing control systems on people with a mixture of technological experiences.

The feedback we received on the control system is that the testers thought navigating the 3D environment in the scenario editor should behave like Google 'Street View.' This would allow the user to click and drag to pan around the scene only using the mouse.

Figure 36: *Google Street View, picture taken of a terraced street in Huddersfield, England.*

Figure 37: *A screenshot from the exam showing the similarities between it and Google Street View.*

Figures 36 and 37 show that there is a similarity between the look of the scenario wizard and Google Street View. This could explain why the testers expected it to behave in a similar way. It would have been useful to clarify this with the testers at the time. This would have provided some evidence to suggest that when people are introduced to new software they

try and interact with it in a way that seems familiar based off of appearance. If this new software then behaves in a different way, it creates dissonance between what they are seeing, what they are expecting and how it is interacting.

Behaviours

Away from the general step by step process, there were several behavioural patterns that were observed from the testers. The first was that by having a save button at the bottom of every step it made a few of the testers uneasy about going forward to the next step and fearing their progress would not be saved. In actual fact, the save button was designed so that you would be able to save your progress if you needed to close the software, for any reason, in the middle of creating the scenario. This seemed like a reasonable feature but its mere presence caused more unease than reassurance.

When the testers went to save, they would look to select and overwrite a file that already existed rather than input a new save file. They were more comfortable with having to select something that existed rather than using the input form to create something new. Therefore a blank ‘save new file’ button that they can select at the top of list of files would reassure them.

Two of the least confident testers put their own name as the name of the scenario during the saving process. The form only askes for a name and is nonspecific about whether it should be your name, the scenario or a file name. They must have made the connection that the editor was asking who created it rather than what name to give the scenario when saving it. Would they have done the same within a different setting or was that a result of the test?

People go through menus from top to bottom and read left to right. Whilst this could seem obvious, is this is a western trait from how people are taught to read? Do other cultures, such as Chinese or Arabic who read right to left, consume digital information in the same way as the west? How much would it affect the user’s ability to operate the software if this western convention was reversed or broken?

When a user clicks on an option and new information or new options appear from that, they inherently create a link between the two. By hiding information early on that unlocks as a

user progresses, a designer can streamline and help guide the user through an intended process. Perhaps both steps 2 and 3 could be redesigned to make use of this.

Less saturated or greyed out buttons are recognised as unusable or inactive even by tech novices. If one option then illuminates or the colour is restored, they are immediately recognised as being able to be interacted with. This is part of the UI language that people have learnt.

Immersion and Player Freedom

The current exam system the Fire Service uses is a series of photographs to show different sides of a burning building. There is no walk around or 3D environment, just a simple HUD displayed on a webpage to snap between each separate photographic view. Although some officers have expressed their dislike of this method, it must work on a basic level to give a visual context to the scene, otherwise it would not have been used. Even though the media is displayed in a digital fashion, people still recognise this as a photograph, they are aware that they looking at a photograph and that this is not real – the level of immersion currently is low.

When demonstrating the exam aspect of the software to the officers it appeared that there is a much greater level of immersion than the current system, which is unsurprising given that it is an advantage of using game technology. This is still a positive result, as part of the design process was to try and maximise the immersive aspect of the exam.

There was, however, unexpected side effects of the immersive nature of the exam. The officers could tell that they were inside a world and that an environment existed beyond the building they are focused on. Because of this, the officers started to demand more freedom. Suddenly they want to go off exploring and hated being limited to the scenario path (even though it is exactly the same method as the photographs they are used to, just with an animated transition.) They want to look at the other buildings to assess what they need to implement to make sure other houses are not affected by the fire. They want to go down the road, where will other pumps go? How will the traffic be affected? Is there a nearby main road, where will the smoke travel? Suddenly they cannot answer these questions because they are stuck on predefined rails. It would appear that as a person becomes more immersed in an environment they start to demand more from it; freedom of movement

especially, they want to be able to do things that you can in the real world and when the system prevents this it is incredibly frustrating to the user.

Evaluation

The research aims were:

- Create a UI that can be tested on a diverse skill and age group to see how age affects user's ability to interact with new software for the first time.
- The test would also compare the differences between gamers and non-gamers to see there is any evidence supporting the idea of 'game literacy.'
- Compare the team's initial prototype to the final prototype post research to measure the impact GDD and the learning of domain knowledge had on the success of the project.

The following chapter analyses whether these research aims were met, as well as further discussing the test results; evaluating the overall success of the project and the author's personal feelings and responses to it.

Test Results

Each tester managed to build a scenario in roughly twenty minutes or less. This is significantly less time than the two weeks it takes the IT technician to create a scenario for the current format.

The test found no direct correlation between age and technological proficiency, as seen in Table 7, the two testers in the middle of the age ranges recorded both the fasted and slowest times respectively.

Tester FS-05 as well as being the slowest at completing the scenario builder was also the only tester to have any trouble with the tablet GUI, despite being a mobile gamer and in the middle age bracket.

Tester FS-02, as the youngest and the only PC gamer, surprisingly recorded the second slowest time. The expectation was that a young PC gamer would record a faster time than an older non gamer would – which was not the case.

FS-01 showed that even an older non-gamer can record a faster than average time. (*Average = 13m 42s*) This perhaps goes against the idea of 'game literacy.'

The fastest time, however, was recorded by FS-04 the second youngest tester and a console gamer.

Table 7: *Tester's age, gaming platform and time taken to complete scenario.*

Tester	*Age Range*	*'Gamer'*	*Time Taken to Complete Scenario*
FS-01	46-55	No	12 m 20s
FS-02	26-35	Yes (PC)	14m 35s
FS-03	46-55	Yes (Console)	14m 08s
FS-04	26-35	Yes (Console)	7m 15s
FS-05	36-45	Yes (Mobile)	20m 10s

The timestamps on the screen capture videos were used to calculate the time it took each candidate to complete a scenario. The testers were unaware that they were being timed, to make it as a natural process as possible.

Despite one tester having trouble with the orientation of the floor plan, all the testers found interacting with the tablet GUI easy. This is unsurprising as each tester owned a smartphone or tablet – meaning that they were familiar with touch-screen interfaces.

It was predicted that a PC gamer would find a WASD control system a natural way of navigating around a 3D environment and that was proven to not be the case. Considering this system was designed with a PC gamer in mind, it means that a designer cannot assume that playing PC games is enough for a player to be familiar with common control methods.

In general, all the testers found the control system the hardest part of the scenario building process. They were all far more in favour of a using Google Street View style mouse controls to navigate around the 3D environment. This is valuable knowledge to anyone designing 3D applications for non-gamers.

Success of Project

Before I had joined the project, the team had already put together a working prototype of a gamified approach to incident command assessment. Without the team's knowledge it was a complete overhaul of the current system and as a way of updating the current exam system

it was not fit for purpose. A product would have to fit within the framework of the Edexcel exam scheme. In terms of usability, the first prototype was difficult to use as well. The method of building an exam, although more enjoyable than the later prototype, was overly complicated and focused on needless details, such as what materials the interior walls of the building were made from.

The revelation came when observing the way the current exam is conducted. The facilitator is central to the exam process. They control everything that happens – the Fire Service's equivalent 'dungeon master.' What happens on screen is not hugely important, what matters is the dialogue between examinee and facilitator.

This began the process of acquiring domain knowledge. Learning this knowledge effected the design of the whole project. Having the role as both a game designer and being the one responsible for the UI, it makes it hard to separate how much direct impact GDD, and the acquisition of domain knowledge, had on the UI in isolation.

Analysing the tablet and scenario builder UIs may provide clues as to how many design decisions were informed by domain knowledge:

In terms of the tablet, the language used and colour palette all stemmed from studying the Fire Service. The concept of how to display the exam building on the tablet was a result of seeing architectural floor plans being used at the live training briefing. The navigation bar was a direct mimic of the current exam scenario. The tablet itself was a design response to seeing the importance of the facilitator.

As for the scenario builder, again the language and colour were informed from the Fire Service. The step by step process was both a design and UI change, this stemmed from the persona writing. The scene generation options are there to populate the world and make it feel more real. The camera setup stage is then also a 3D mimic of what the IT technician does to create the photographs for the current exam scenes.

Having briefly analysed both UIs created for this research, I have to conclude that domain knowledge has had a sizeable impact on not just the design but also the UI as a whole.

Certainly, if there had been more testers this would have given more data to draw conclusions from

To try and evaluate the success of the project, the testers were asked their opinions on the product to gauge how suitable they felt it was for the service's needs. Each tester responded to the post testing survey saying that they would considering using it or something similar for

their work. The general feeling was that the product, in its current state, was good but could be further improved by adding new features to the exam.

I conducted an interview with the training officer who initiated the project as a debriefing method to evaluate the final prototype. Over the year, he was the only member of the Fire Service with regular contact with the development team. He is also an avid gamer, so I thought he would have an interesting view on the project. A rough outline of what was discussed in the interview can be found in the appendices under the section labelled 'Interview Evaluating Project' (page 95.)

Overall, he was positive, he found the tablet easy to use and felt we had done about as much as we could for command assessment. He mentioned that there were a lot of gamers within the Fire Service and that every fire station has an Xbox – which may explain why 3 out of the 5 testers played console games. His main thoughts were that more could be done to modernise training aspects of the Fire Service by using game technology.

Personal Performance

The team in the studio were a great help and the project would have been impossible without them, but I think ultimately, it allowed too much freedom. The process of creating a UI was vast and way beyond what could be documented in this thesis. One element, for example, that I would have liked to explore further would have been 'signifiers' which Fagerholt and Lorenzton (2009) list as a 5th element of game UI – which does not appear in other lists, such as Stonehouse (2014), of game UI elements. This would indicate that there is a potential need for further exploration here. Within the context of this project, it made perfect sense to me that the game environment would form a part of the UI. If the UI is about the transfer of information, the environment telegraphs a tremendous amount of information to the player.

In the real world, the environment and previous experience forms a large part of an Incident Commander's risk assessment. The subtleties and nuances in the different formations of smoke and fire inform an officer about what stage the fire is at, how dangerous it is, what can be done about it.

If the accuracy of the virtual game environment becomes a central part of the design. Rather than simply having to be believable, the world needs to be accurate, so that a Command Officer can make the correct decisions – but is this technically achievable? Will this not suffer the same problems as uncanny valley? As an alternative is it possible to use

distinctive abstract representations of these signifiers to alert an officer into making the correct decision. Would this not be a cheaper and more worthwhile pursuit for the Fire Service to investigate?

This demonstrates just one ‘rabbit hole’ that emerged during this project, fascinating but no less distracting. Another was to design an alternative to command training by developing a prototype RTS game, details of which can be found at the end of the appendices section (page 102.) This would behave very similarly to the Emergency and Rescue: Everyday Heroes games but created with a more educational view in mind. This would be done by removing a lot of the macro world and focusing on the micro decision making a commander makes. Have players rely on unit positioning, decision making, tactics and strategy. Implement mechanics from the RTS genre such as ‘fog of war’ to encourage players to scout out the scenario - like a real commander would. The fire would almost become the enemy AI and could provide the objectives to stop, subdue or contain. Much like the signifiers, this would form an entirely new project.

The intention at the start of the research was not to cover so much, it was more a direct result of having an existing project, a client with needs and a development team to assist. My research aims were not necessarily the project’s aims. I found myself having to manage the team so that it fulfilled both my research aims and the aims of the studio. That is certainly a challenge faced when your research falls within a larger project.

Working with the Fire Service was brilliant, they were tremendously welcoming and helpful but the nature of their job made it difficult to keep regular contact with the same officers. As a result of this, a member of the Fire Service would see the product once but not see any of the subsequent iterations. This was only exacerbated when the West Yorkshire Fire and Rescue Service went to help with the 2013/2014 flood relief effort in the south of England.

This also meant scheduling testing was difficult, which is why I wasn’t able to get as many test results as I would have liked. I had also planned a follow up test which would take our prototype to a fire station and have a variety of firefighters use it to carry out mock exams. This would have allowed an opportunity to observe the tablet GUI in the context in which it was designed for. This would have allowed me to observe how easy it was to use under pressure and how fast a facilitator could react to commands being issued. Sadly, this could not be arranged and I had to make do with the results I had.

Conclusions and Recommendations

Is there a technological gap between ages?

Presnky (2001), coined the term ‘Digital Native’ to describe the generation that first grew up with technology. It was his belief that this generation were all naturally gifted with technology, where as those born before this generation (‘Digital Immigrants’) lack the same level of ‘technological fluency.’ His findings were supported by Long (2006) and Gaston. (2006)

The critical reviews of the ‘digital natives’ vs ‘digital immigrants’ argument suggest that it is not as extreme as perhaps Prensky (2001) and others first suggested. ‘Digital fluency’ presented by Wang et al. (2013) presents the idea that rather than a binary state, there is a wide range of digital skills throughout all ages and a more determining factor is socio-economic factors.

The findings by Wang et al. (2013) fit better with my findings, where it is not as dualistic as ‘native’ or ‘immigrant’ but more of a gradient ranging from highly competent to having little expertise.

Age did not appear to be a contributing factor when using the software, however with a fairly limited sample size this is inconclusive. There were also a lot of outside factors which could have played a part. More extensive testing would be needed to be carried out before definite conclusions could be drawn.

However, in the interview at the end of the project the training officer, who acted as a liaison between the studio and the Fire Service, felt that there was a technology gap within the service and that the older commanders (not necessarily the ones that were tested) were more wary of using and embracing it.

Perhaps this points towards slight technological acceptance issue within the older generations of the Fire Service, rather than a generational divide. As technology acceptance was not covered in this research it is impossible to draw any further conclusions. Research into the issue could provide further insight into the relationship the Fire Service has with new technology.

Is there a technological gap between client and designer, in terms of language and knowledge?

From a client relationship perspective, the lack of technological awareness is a significant obstacle a designer has to address when dealing with clients unfamiliar with serious games.

If they had been more aware of the benefits, constraints and what is technologically possible then perhaps they could have defined exactly what they wanted.

Maybe the team should have been proactive and tried to transfer some of our games knowledge to the Fire Service, so that the transfer of domain knowledge went both ways. Then not only could we understand their 'language' but they understood ours.

Certainly closer and more regular communication between development team and Fire Service would have been helpful. Something as simple as seeing the same training commander would have been invaluable to build a report and understanding. In a way, always demonstrating or talking to different officers may have prevented the transfer of our knowledge to them.

Can you assume that a gamer will be able to operate any kind of GUI?

No, there is difficulty in classifying what a gamer is and the term covers a broad range of players with different experiences of genre conventions and control systems. You cannot assume they will be able to use your GUI therefore when introducing it you should assume all users are at the most basic skill level, experienced players will quickly progress but this will benefit novices.

Nilsson and Wendt's (2010) research suggested that players, in particular non-gamers, that were unfamiliar with control systems for navigating 3D environments would find them difficult to use. The observations made from testing the scenario builder on a range of game experienced players supports this. Each tester found navigating the 3D environment the most difficult aspect of the test.

Following on from this, it was anticipated that a PC gamer would be familiar with the 'WASD' control system and produce faster scenarios, however the testing showed that this was not the case. The only PC gaming tester struggled with both the control system and recorded the second slowest time to create a scenario. This could have been an exception to the rule. Without collecting more data it is hard to prove. In a single test such as this there are numerous outside influences. This does illustrate, that you cannot make assumptions of player proficiency solely on what platform of game they play on. The best way to find out about this through testing to see whether your intended audience are comfortable with the designer's UI choices.

How important was learning domain knowledge?

Goal-Directed Design (GDD) presented by Cooper et al (2007) puts a strong emphasis on the acquisition of domain knowledge. This project found that by learning domain knowledge communication with the Fire Service was more effective, and also formed a stronger picture into who the users were, what their needs and goals were and the language they used.

As discussed in the 'Success of Project' chapter in the Evaluation, domain knowledge had a large impact on the UI and design of the product as a whole.

How suitable is goal-directed design for use with serious games?

This research only used the framework for researching the user, in that regard this is suitable for use in serious games as it allows you to understand more about who your client is and what they require. Whether the entire process is suitable this research cannot answer. As noted by Williams (2009) GDD takes an experienced designer several years to fully understand and be able to implement. With my limited experience and restricted timeframe it did not seem appropriate to try and implement the entire framework.

Using a GUI is tacit knowledge.

There is an entire UI language that has not been explicitly stated or taught but that people who are familiar with technology recognise and understand; even by those who claim not to be 'tech savvy'. Just like an actual language people can interpret this in different ways; in particular visual metaphors. There are also behavioural patterns such as rather than figuring out a problem, users look to delete the problem and start again. A variety of control systems also exist that based off the users previous experiences are either usable or completely foreign.

People have also been programmed by negative reinforcement and are reluctant to interact with things that they do not understand. Gamers, on the other hand, seem more adventurous and are willing to experiment and take more risks.

To create a UI for a serious game, consider exploring what people of that domain are familiar with first, or better yet agree upon a UI metaphor with the client at the beginning of the design process.

It is also worth bearing in mind that smartphones have become very mainstream and as a result a lot of people are now comfortable with touchscreen interfaces. Certainly, Windows 8 and the new Windows 10 are signalling towards a touchscreen future.

The testers also appeared happy navigating the pages of the scenario builder and this is supported by 4 out of 5 of them responding to the survey that they found navigating websites easy.

This all points towards people being familiar with both touchscreen and website GUIs. This could well be a more sensible design approach when building applications for mixed skill user groups; rather than choosing a traditional gaming UI for a serious game.

Immersion creates more player expectations.

An offshoot from this research was observing a link between limiting control, immersion and player expectance. A 3D virtual world creates a deeper level of immersion within an exam scenario than an animated photograph. But when presented with restricted control over movement the player finds this jarring and starts to demand more freedom and expects to be able to do more within the world. The photograph has obvious limitations attached to it that the examinees recognise and accept; either subconsciously or otherwise, as soon as you provide the player with the ability to move around a world they immediately expect it to do more, to be able to interact with it more, suddenly they have a desire to explore the scene more thoroughly.

Recommendations

During the course of this research a number of things presented themselves

1. Fagerholt and Lorentzon (2009) present a 5th UI element – signifiers. A further exploration could be carried out to learn more about how visual clues in game environments inform player decisions. It would also be interesting to investigate whether this is a level design or a user interface ‘problem.’ Following on from this, signifiers also have implications for serious games. In situations, such as the research with the Fire Service, where visual accuracy is vitally important, can abstract representations of the environments work in correctly communicating the appropriate decision to the player? Would players learn these abstract graphics in

order to pass the exam? Would this impact on their real world abilities in recognising the potential dangers? Or is it that the decision making process is more important and more worthy in an exam, than their identification skills?

2. How would using avatars benefit the immersive aspect of the 3D virtual exam? Various Fire Officers offered both sides of the debate; there was a school of thought that suggested avatars would be distracting and that robotic animations would break the immersion. This forms a possible debate surrounding ‘uncanny valley’ and its impact on immersion. The second school of thought was that avatars provided a way of monitoring resources and better memory recall. This could provide the basis for a study looking at how the ‘encoding specificity principle’ relates to serious games.
3. Goal Directed Design appears to be a method that lends itself well to the creation of a serious games UI, where an identifiable user and domain is known. Can the same process be used on an entertainment game where the end user is less clear and no obvious domain exists? What steps would be taken? Would this ultimately work towards a method of creating game UIs?
4. A further study into ‘game literacy’ – a game specific take on ‘digital literacy’ and ‘digital fluency’ – would provide a deeper understanding of what skills or patterns people learn when playing games. For example, the usability test conducted in this research found that gamers did not read instructions – they seemed to prefer trial and error and exploration through play. The Internet Advertising Bureau (2014) conducted a survey that found 99% of British children aged 8 – 15 years old played computer games in some format. This shows that future generations may well be very game literate, but, as the test results demonstrated, this is no guarantee that they can use any game UI. The question then becomes; what, if any, are any game conventions that transcend genre and apply to all games? If they do exist, do they make up the core pillars of ‘game literacy?’ Would a study into this provide a structure of what ‘game literacy’ is and what would it look like?

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Appendices

Survey Results

What age range do you fall under?

1. 46 - 55
2. 26 - 35
3. 46 - 55
4. 26 - 35
5. 36 - 45

Would you describe yourself as ‘tech savvy?’

1. Yes
2. Yes
3. No
4. No
5. No

Do you find websites easy to navigate?

1. Yes
2. Yes
3. Yes
4. Yes
5. Sometimes

Do you own a smartphone?

1. Yes
2. Yes
3. Yes
4. Yes
5. Yes

Do you play games on any of these platforms (multiple choice)

1. Do not play games
2. Mobile / Console / PC
3. Mobile / Console
4. Mobile / Console
5. Mobile

Post-Testing Survey Results

(Four of the five testers completed this survey, the last ran out of time and did not get a chance to complete it.)

What is your overall impression of our product at its current stage?

1. Very Useable
2. Yes very good concept few things that could be added
3. Excellent, hope fire service help with development of product
4. Very good, hopefully our feedback will enable you to improve the scenarios

Are there any things we could improve on?

1. Moving around the building with more fluidity (not as robotic)
2. Smoke, openable windows, plus view with icons for resources and being able to move around building without restrictions of nodes.
3. Regular updates with fire service as product develops
4. Plan View, more facilities to improve / worsen the scenario

Would you want to use this product or something similar for your work?

1. Yes
2. Yes
3. Yes
4. Yes

Where would you expect to use it? (Eg. Training / Downtime / Home)

1. Training and assessment
2. Training and assessment
3. Training / assessment
4. On station training and nq assessment

Do you have any further comments or suggestions?

1. A more upgraded training / assessment program has been required for many years. Continue your good work.
2. Great product that gives real time feedback allows for decisions to influence the outcome. Just needs a few more changes that are mentioned.
3. Keep up the good work.
4. To develop scenario further we need to have more involvement from operational crews - I'm happy to facilitate this.

Exam area discussion

Specific questions asked during the exam area demonstration and general consensus from the officers:

How visually appealing is the tool?

Very, the game looks good.

Would the visuals impact on their ability to carry out the scenario?

No, they were happy with abstract visual elements, for example the accuracy of the TIC view, although not totally realistic, it gives the impression of what a real TIC looks like and that is enough.

How easy is the tablet to use?

Easy, only one tester had problems identifying the orientation of the plan view.

How clear are the features from the icons?

Very clear.

How accurate is the TIC view?

Not completely realistic, but good enough to get information regarding the scene from.

Would this or a modified version of this be useful for a crew to use to train tactics?

Yes, in its current state it might work, with a few features ironed out; more scenarios, scene needs smoke, resource tracking and could use a hazard map.

In downtime do Firefighters talk about games?

Yes, some firefighters are very keen gamers.

Is there a demand for games specifically for their work?

Yes, they felt there are enough gamers within the service to want to use the medium to aid their learning.

Interview Evaluating Project

Notes taken from the end of project interview with the training officer who worked as a liaison between the Fire Service and the Studio.

What was your first console or exposure to games?

1982 / 1983 - owned a ZX spectrum – moved onto SNES

Favourite game(s) of all time?

Final Fantasy series, Gran Turismo, Call of Duty: Modern Warfare

What do you see in games that could be applied to fire training?

Immersion. Current e-learning for the Fire Service is dull and dry. Easier get into and spend more time on a game. Rebrand it as a simulator rather than a game, so it sounds more adult. Would be able to deliver a training package and a separate assessment package.

Aside from the benefits to the service, do you see games as a good medium to educate the public on fire safety & procedure?

Definitely, could educate primary school children, show them how fire alarms work, what is contained on a fire engine and how that relates to their safety.

Could also raise awareness of fire plans; what should a family do when the fire alarm goes off?

Is there a technology generation gap? Are older commanders missing out on technological advances?

Older commanders are more wary of technology but some will have grown up with computers but a lot haven't – so yes there is a gap, there are crew managers who are scared to go and do command assessment as they do not even like the photograph on the wall, so a game is far outside of their comfort zone.

Do younger fire-fighters talk about games? Is there a demand from them for games to help with their work?

There tends to be an Xbox on every station and some people are playing games at the station during downtime. Guess it would be the younger guys playing but there is definitely a demand for it. For them, they would much rather play a game and learn than read a book.

Assessment is one area we have covered but since the initial prototype demo we have shied away from training, is there more scope there?

Definitely more scope in training, you can put together a diverse training package where people can learn in their own time.

Would this sort of product also be useful to team based learning, squads using it to create tactical knowledge?

Yes, a team could sit down with it, maybe have one person looking at a screen from behind the building, having to rely information to the commander – like at a real incident.

What features do you feel we are currently missing?

Nothing, in terms of command assessment, but there as said before there is a bigger scope for delivering training materials.

How easy is the tablet to use? How clear are the icons?

Simple to use and easy to understand.

Do you like the step by step approach to scenario creation or would you prefer the 'sim city' builder as that was more engaging?

Possibly the sim city builder – but ideally would want a prebuilt city or town with various different scenarios setup in.

Would a 'sims' like 'house builder' with drag-able walls, place-able hazards and mapped interiors be the ultimate scenario creation tool?

More complicated than the prebuilt level idea, but has the potential to be more useful. Being able to set the materials of walls and furniture would make a fire simulation much more powerful. Take a sofa from the 1980s and replace it with a fire resistant one from 2014 and suddenly the fire behaves differently. That level of customization would be useful.

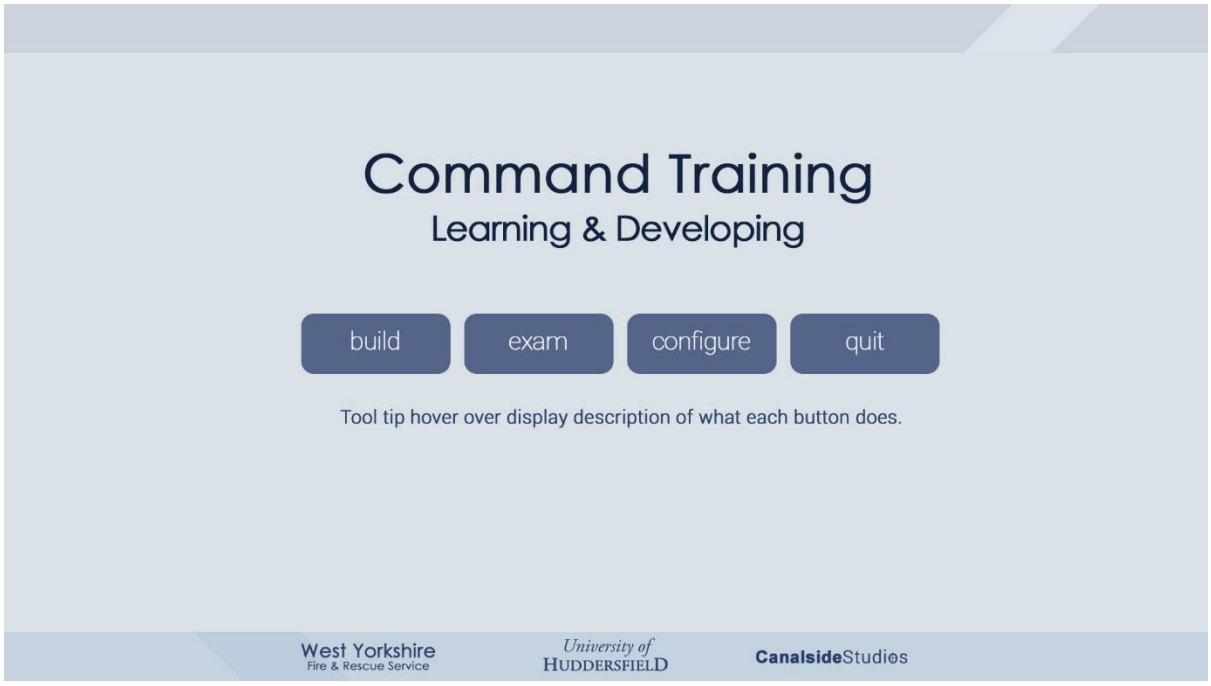
Any closing comments?

Global scope for a training package that could be sent out, especially to help third world firefighters. Same thing would also be useful for retained staff who cannot attend courses, especially if you could track their progress online.
Even the potential for a cross agency product, so airports, the police and armed forces could have product areas designed for them.

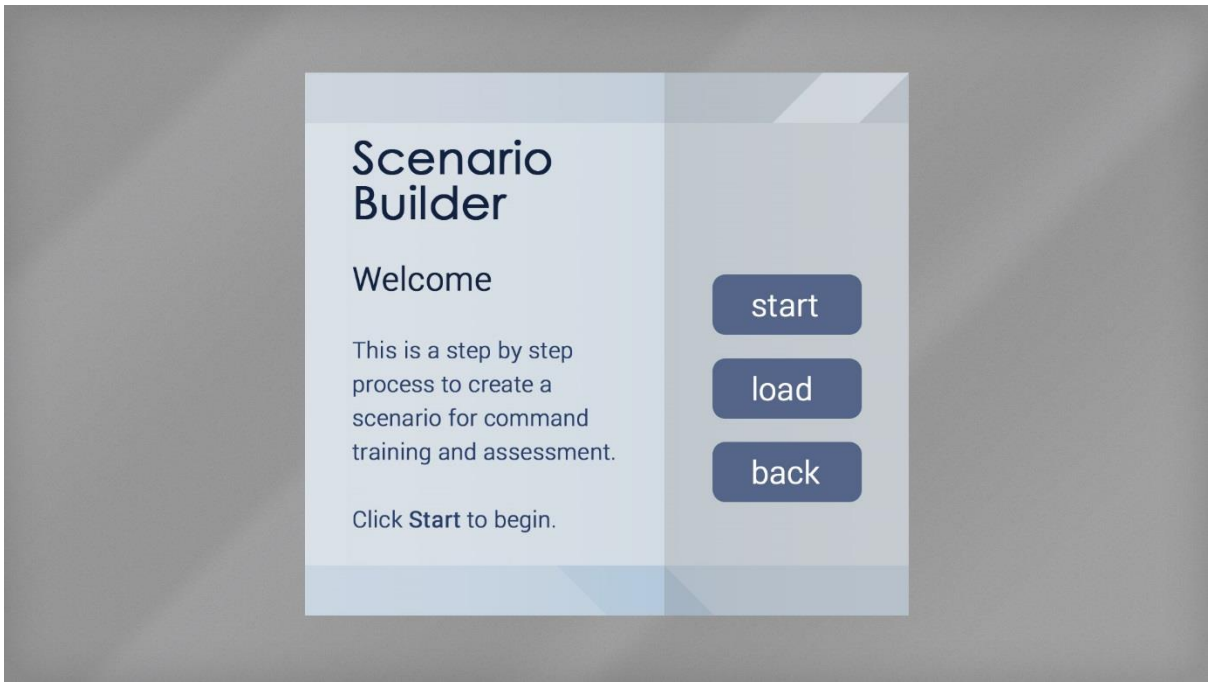
Scenario Wizard Design Concepts

The next pages of images show the initial concept designs for the scenario wizard.

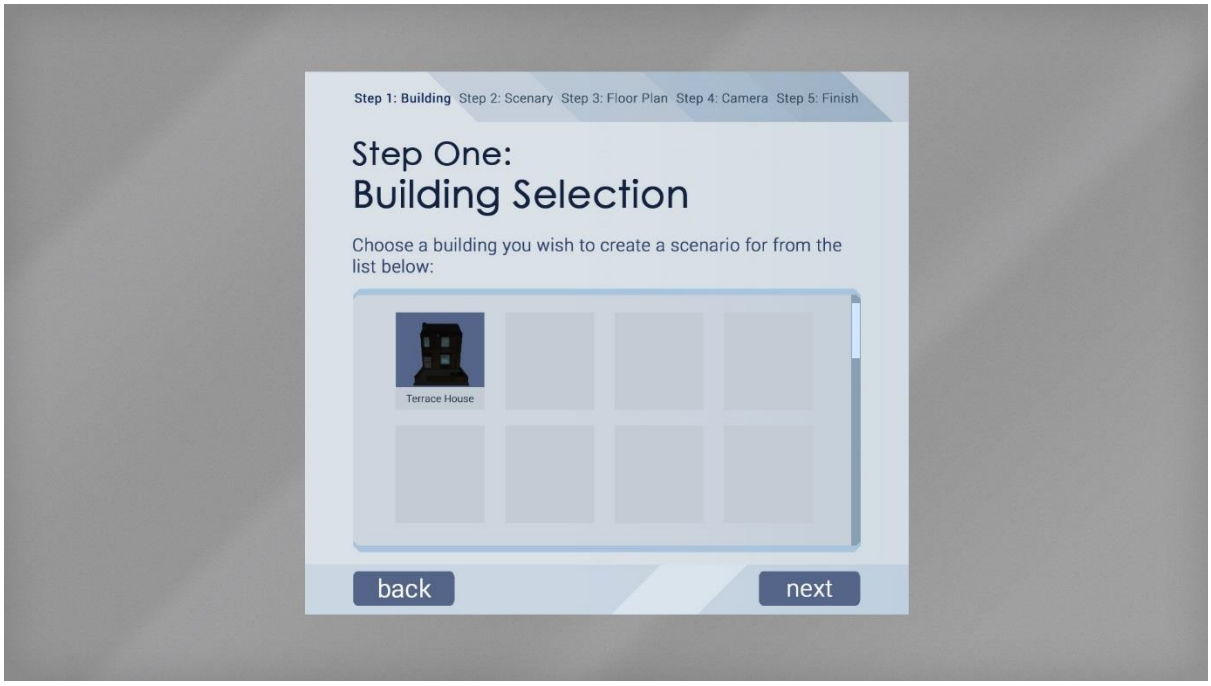
Reskin of the ‘sim city’ builder before the acquisition of domain knowledge had taken place and the design overhaul which followed.



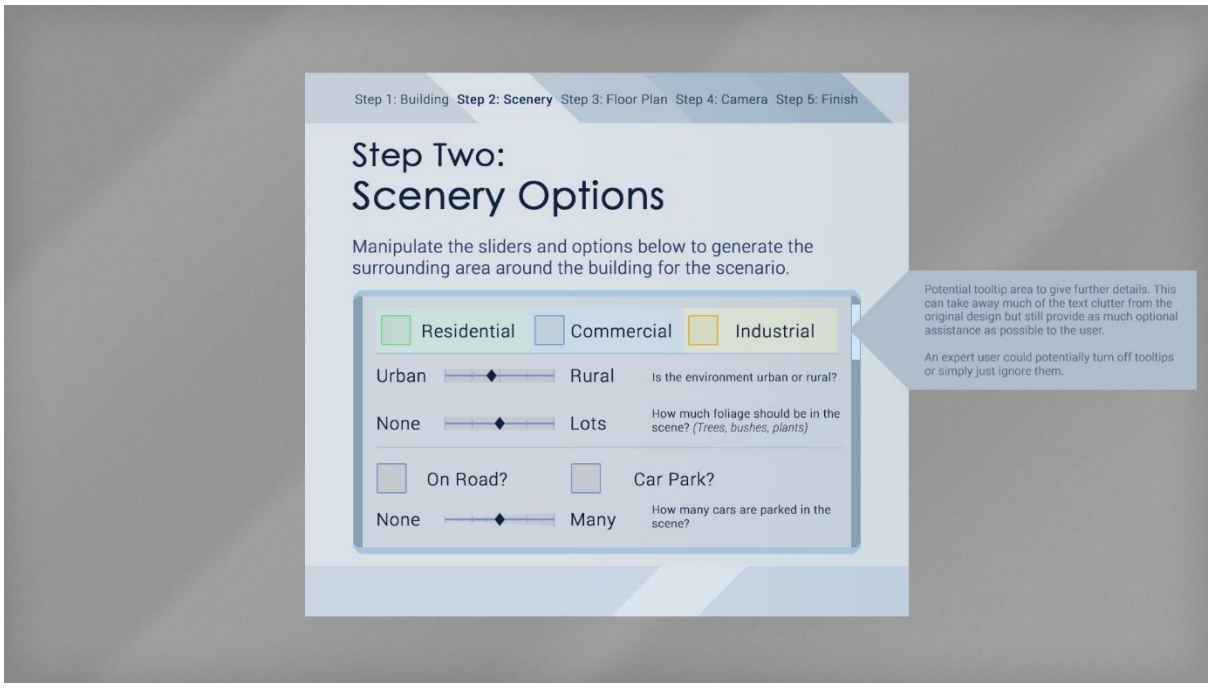
Main Menu



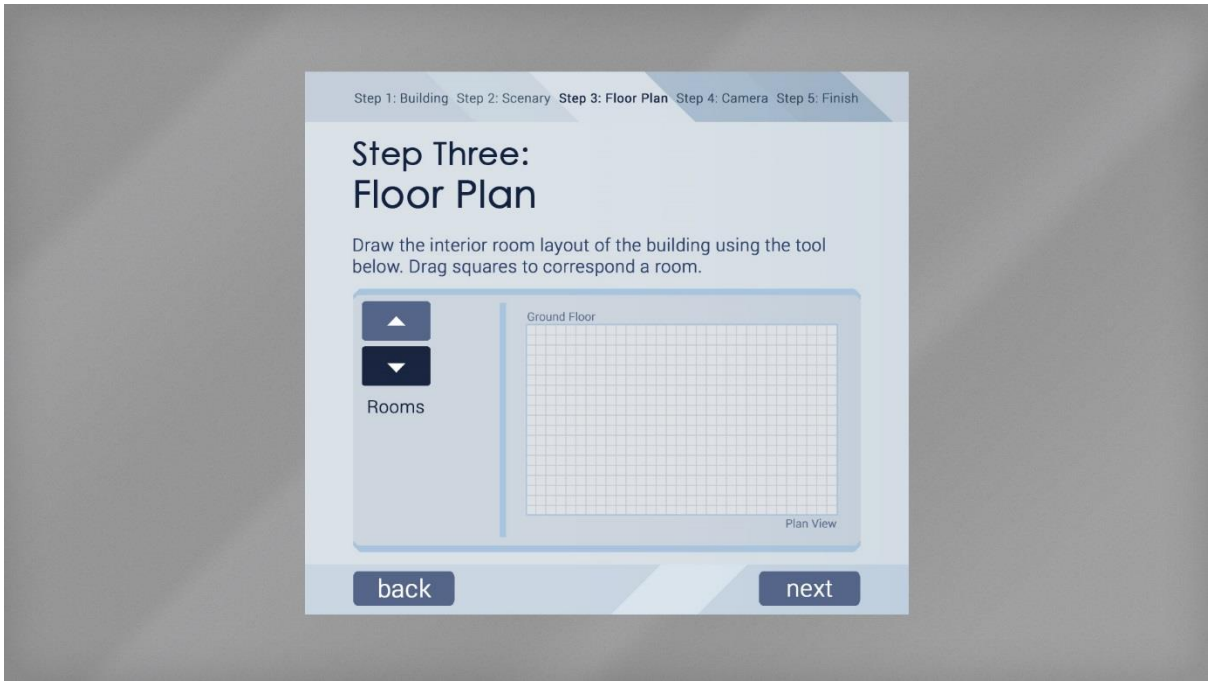
Scenario Builder front end menu



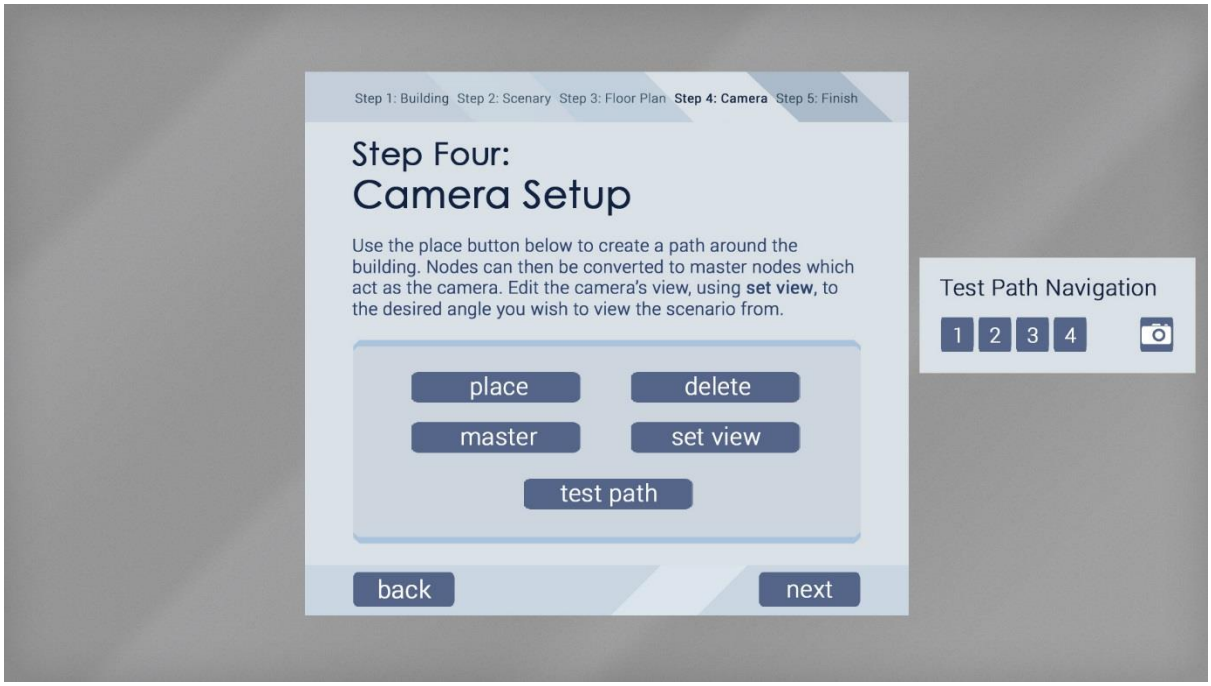
Step One: Building Selection



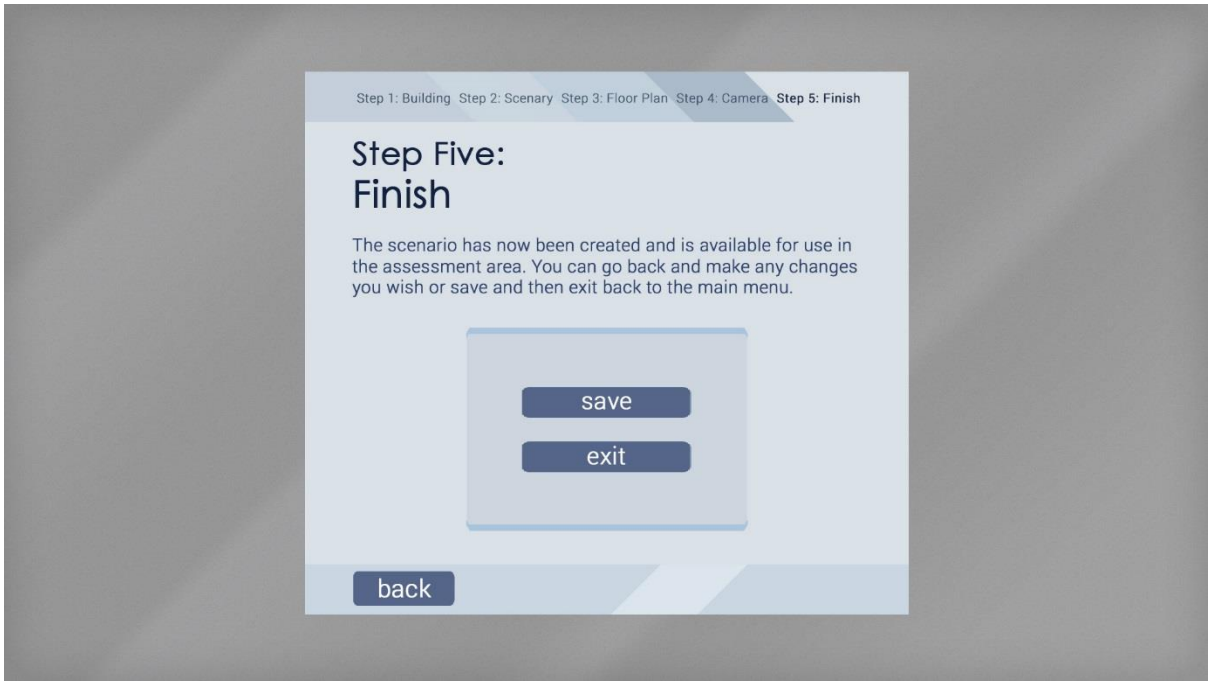
Step Two: Scenery Options – was later condensed into step one and would handle the scene generation.



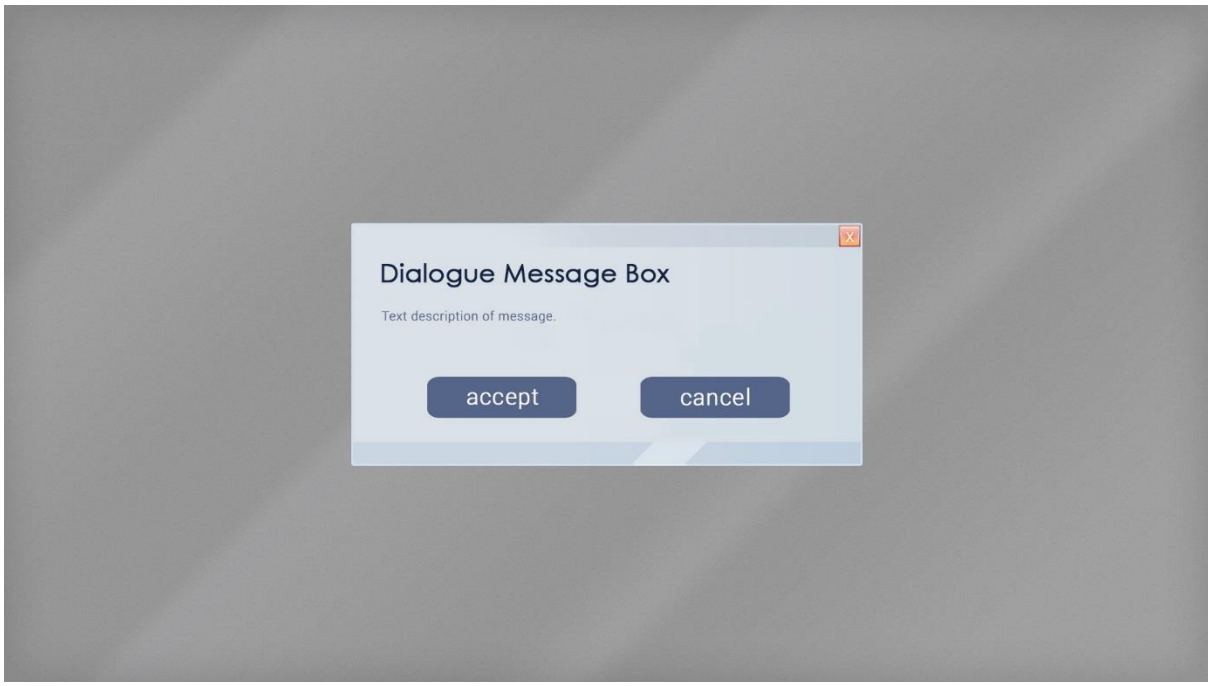
Step Three: Floor Plan – the initial design was for the scenario builder to draw the plan of the building. This would then get transferred to the table and displayed as part of the GUI. This was replaced when a method of automatically generating the floor plan graphics from the 3D models was developed.



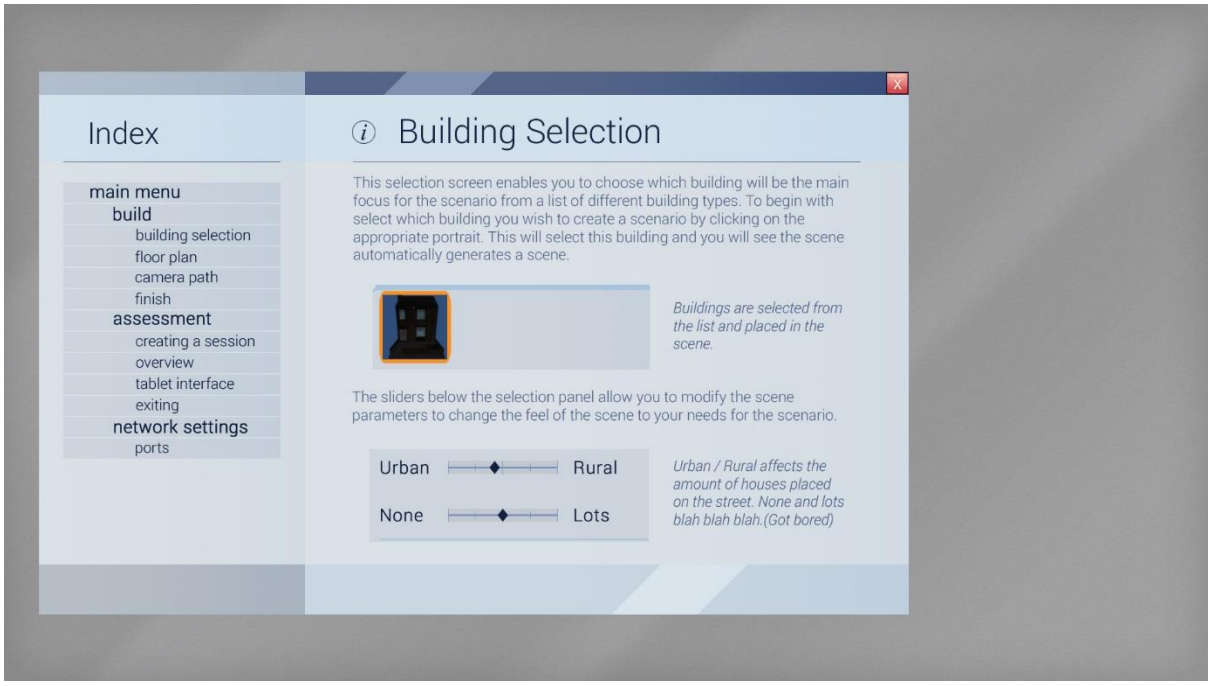
Step Four: Camera Setup



Step Five: Save and Finish



A concept for the dialogue message box.



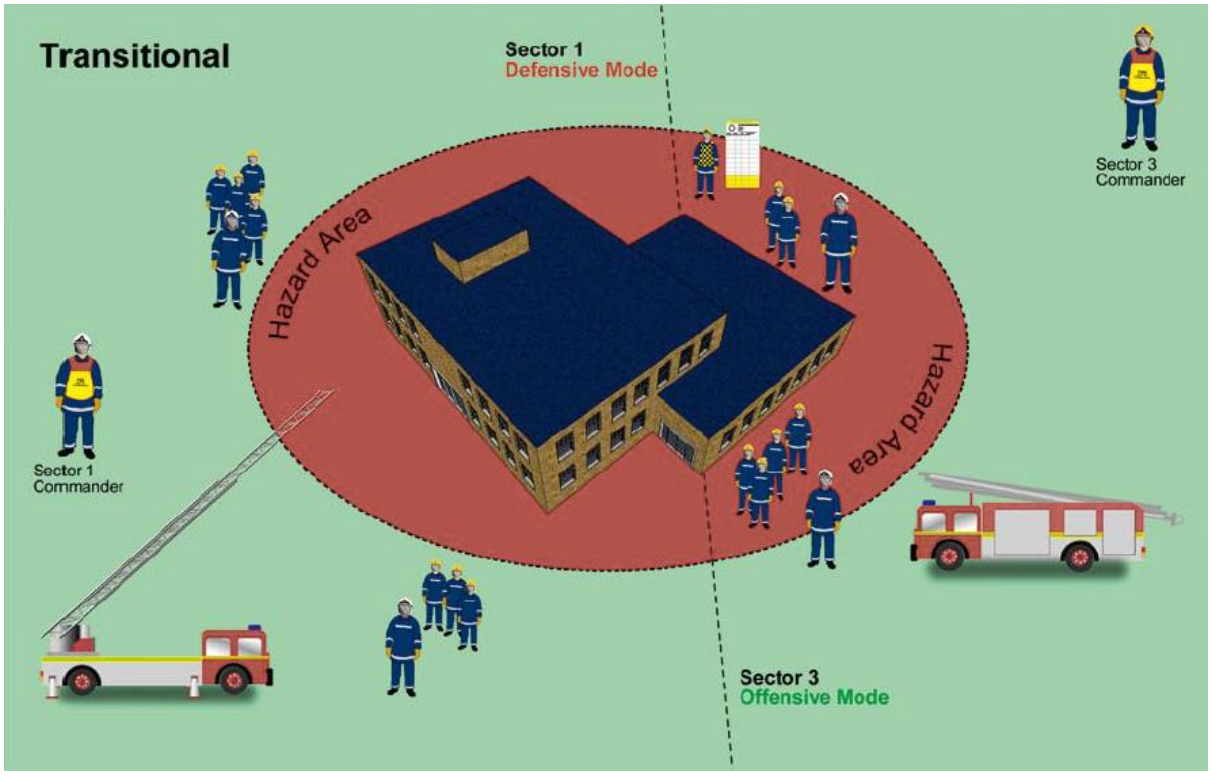
A concept for a help index, which would provide a further guide to not only each step but also the product as a whole. It was never fully implemented into the working prototype.

Development of a Real Time Strategy Game

An alternative approach to incident command training:

From the process of undergoing basic incident command training, I learnt of several tactical setups commanders can employ. These strategies seemed to lend themselves rather well to game mechanics. From this I explored whether it would be possible to make a strategy game based around the idea.

I found that tactically a commander is either on offense, where you are actively deploying units inside of a designated (determined by the commander) danger zone to put out the fire. Or you are defensive, where you remain outside of the danger zone and look to contain the fire and prevent it from spreading. You can also be in a transitional phase, where certain sectors are looking to contain the fire, while others are actively putting it out.



This image from the HM Fire and Rescue Manual shows a transitional tactical setup for containing fire in one part of a burning building and actively deploying men to put it out in another part.

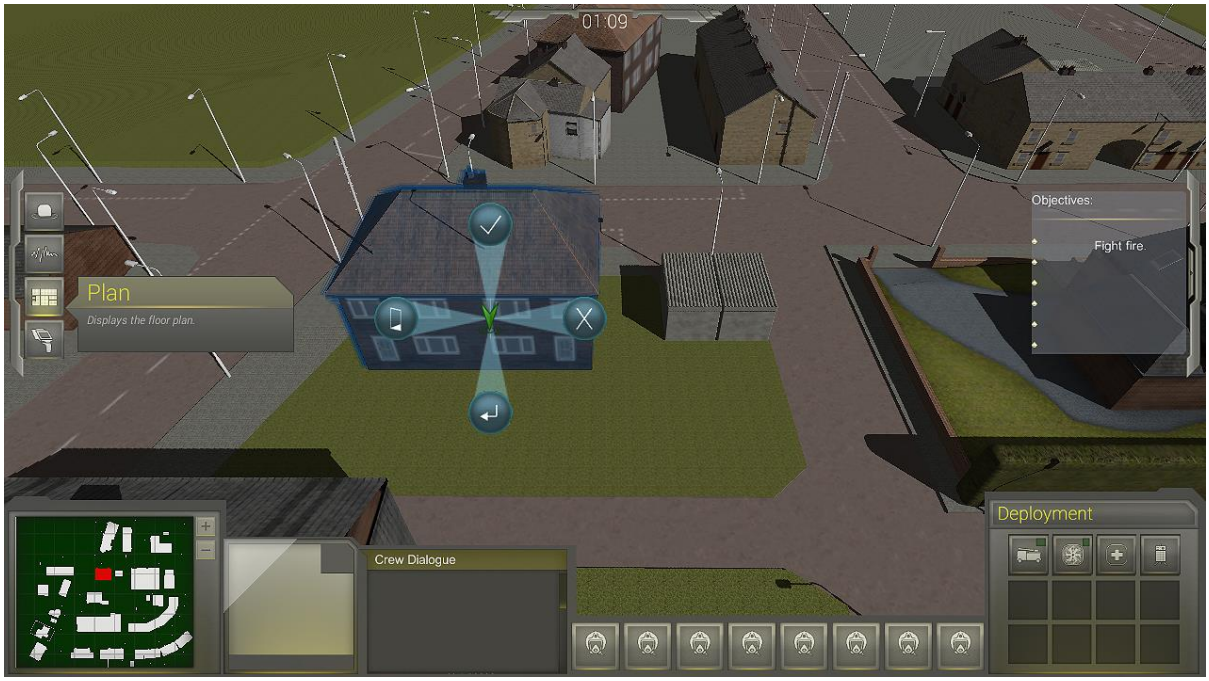
The success of each strategy depends on the specific scenario, where the commander has to scout as much information regarding the scene as possible to make a strategic decision. The ultimate goal for any incident commander is to preserve the life of their fellow firefighters. This means that a commander should not risk the lives of those they are in charge of in order to save any causalities trapped inside the building, unless deemed safe enough to do so. In fact, putting out the fire is often a low priority with a greater focus aimed at preservation of environment; a commander has to take into account the water damage a building and surrounding area is likely to suffer when using jets of water to put out the fire. The environment might change from scenario to scenario and the exact method will be different but the overall objectives remain the same.

All of this learnt knowledge could be adapted as the base mechanics of a real time strategy game. It has clear objectives, risks, rewards and gameplay. The player could control the commander and is able to command the units around the scenario in an attempt to solve it in the best possible way – without losing units, ideally by rescuing all missing persons reported,

by being conservative and clever with resource management and ultimately putting out and vanquishing the fire threat.

This was an offshoot from all the domain knowledge I acquired and is not directly related to my research. Without the time or resources to fully explore this game idea it did not go any further than a basic prototype. It was demonstrated to a RTS playing officer who immediately recognised the HUD style and could attach gameplay to it. He was interested in this as a game alternative for command training, not necessarily assessment, and felt it could also be used to educate the general public in how incidents are managed. This certainly has the potential for future work, as there are a few products on the market, such as Emergency 2014 or Rescue: Everyday Heroes, which are similar but do not employ the same level of accuracy to be fully usable as a command training tool.

Photoshop RTS HUD mock-up.



Screenshot of working prototype of HUD partially implemented into Unity 4.0 Game Engine.