Andrew O'Neill C19311366

INTRODUCTION

Motivation

Provide a *DECISION SUPPORT SYSTEM* that can be an advancement in the use of technology in Fire Safety and FireFighting and be used for Fire Safety Design, Compliance and Certification.

PROPOSED AMENDMENT of Technical Guidance Document Part B - Fire Safety

13 Fatalities in medium to high rise buildings during **2019-2021**

Changes in Design & Construction of taller and larger, more complex layouts.

The use of new and innovative building systems and materials

Improvements in energy performance

Dublin Fire Brigade responded to **372 call outs** relating to medium to high-rise buildings in Dublin during the years **2019 - 2021**

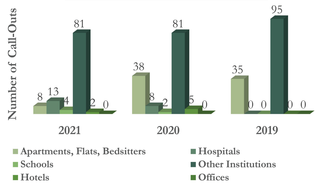
2636 Fire Safety Certificates Applications submitted to the Dublin Fire Brigade

1.3% of call outs attended by Dublin Fire Brigade were related to medium to high-rise buildings

Building Typology: Looking at Medium to High-Rise buildings of high occupant load in the Dublin City centre and county area.

Apartments, Flats, Hospitals, Schools, Hotels, Offices

Location & Number of Fires in Dublin



FACTS AND FIGURES
taken from https://www.gov.ie/en/organisation/department-of-housing-local-government-and-heritage/

Aim

Create a **Decision Support System** to aid Fire Officers and FireFighters by means of a BIM digital model that can be scanned to show specific 3D views and 2D plans that provide all necessary information regarding fire safety and fire fighting.

Investigate the use of **Augmented Reality & BIM technologies** for Fire Safety Design, Compliance and Certification.

To provide a **Technological Advancement** in regards to knowing the layouts of the buiding.

Objectives

Investigate the potential of **AR** and how it can used with **BIM** software.

1. Create a Digital Model Case Study to show how BIM can be used for Fire Fighting and Fire Safety Prevention, Compliance and Certification
2. Test this research proposal and develop pratical uses between Augmented Reality, BIM Digital Models that can be used for Fire Safety design, training and application.
3. Create a system that provies valuable information for a Fire Service Crew that can aid in the event of a fire and save more lives.

Methodology

Desktop Research

Interview with Industry Experts

Digital Model Case Study

INTERVIEW RECRUITMENT PROCESS

Interview Methodology

STEP 01 — Research Interview Methodologies

STEP 02 — Create Questions to suit each interviewee

STEP 03 — Seek Mentor's Evaluation to ensure all are suitable

STEP 04 — Amend Questions to any changes needed

STEP 05 — Run Mock Interview with a peer to ensure they are clear and coherent

STEP 06 — Contact suitable interviewees to participate

STEP 07 — Conduct Interviews (Face-to-face or Online)

STEP 08 — Analyse Key Findings & Answers

STEP 09 — Write - Up !!

Interviewees - Industry Experts

Architect Technologist | Fire Engineer / Consultants | Fire Fighter | Fire Safety Officer

#01
- **N.McB**
- Executive Fire Officer / Former Fire Engineer Consultant
- Dublin Fire Brigade / Dublin County Council
- Non-BIM User - Experience with CFD Modelling

- **C.McN**
- Associate Fire Engineer
- Michael Slattery Associates
- Non-BIM User

#02

#03
- **P.McE**
- Architectural Technologist. PG.Dip (Fire Safety)
- McElroy Associates Multi-Disciplinary Engineering Practice
- BIM Manager

- **I.A**
- Technical Consultant / Grenfell Fire Advocate
- RISCAuthority - Fire Protection Association
- Non-BIM User

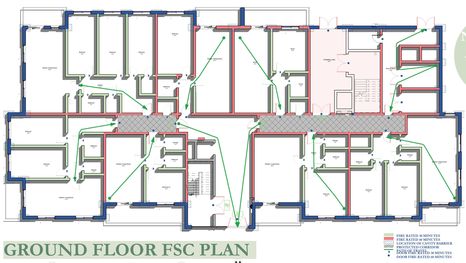
#04

#05
- **J.F**
- FireFighter - Rank - Sub-Officer
- Dublin Fire Brigade - C Watch - DFB Headquarters
- Experience with Virtual Reality in training simulations

- **G.M**
- Senior Fire Engineer / Ex-Retained Fire Fighter
- Michael Slattery Associates
- Non-BIM User

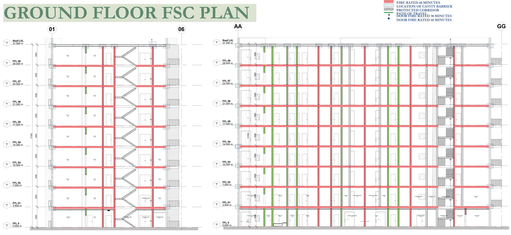
#06

CASE STUDY - BIM DIGITAL MODEL

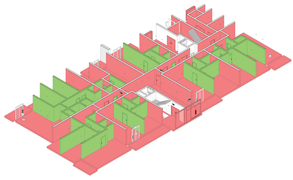


Nine-Storey Apartment Block

GROUND FLOOR FSC PLAN



SECTION AA & SECTION BB



3D VIEW SHOWING FIRE RESISTANCE RATING OF ELEMENTS

ELEVATIONS - NORTH & SOUTH

ELEVATIONS - EAST & WEST

3D VIEW - EXTERNAL

Can Augmented Reality & BIM technologies improve v?

DESKTOP RESEARCH - AR & BIM

Augmented Reality

What is AR ?

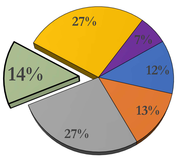
Augmented Reality (AR) is the real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects.

Fully Immersive Digital Environment

Digital Layer over Physical Element

AR takes 'real-world' elements and information and adds value to the user's interactions. This differentiates it from Virtual Reality (VR).
VR creates an immersive virtual environment, while AR augments a real-world scene. It enhances the virtual world and the real world.

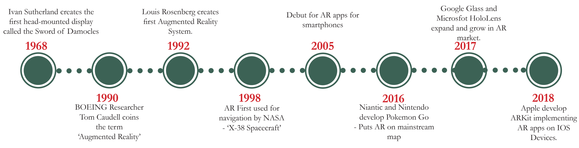
Use of AR in Various Industries



- Automative
- Entertainment
- Software Developers
- Construction Industry
- Social Media
- Healthcare

Unity Reflect is an Augemented Reality software that can transform BIM models into real-time 3D experiences & enhance decision-making.

History of Augmented Reality



Building Information Modelling

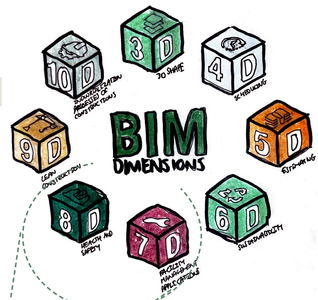
What is BIM ?

Building Information Modelling (BIM) is a process for creating and managing information on a construction project, throughout the project's life cycle

NBS

BIM integrates structured, multi-disciplinary data to produce a digital representation of an asset across its lifecycle

Autodesk Revit



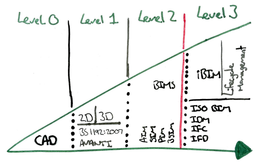
Facilites Management Applications

- As-built Digital Model showing fire related information and be used by Building Owner, Facility Management as well as the Fire Brigade for Fire Fighting Strategies / Planning.

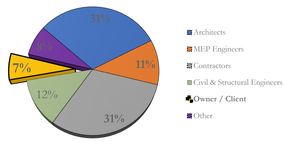
Health and Safety

- The Fire Safety Design and Prevention information falls under this Dimension. Can be used by Fire Officers and Building Control to ensure all Health and Safety Regulations are met.

AEC/BIM Domain



Use of BIM in the AEC Industry



INTERVIEW QUESTIONNAIRE

Seek **Validation** of thesis proposal from a professional experts from the Industry

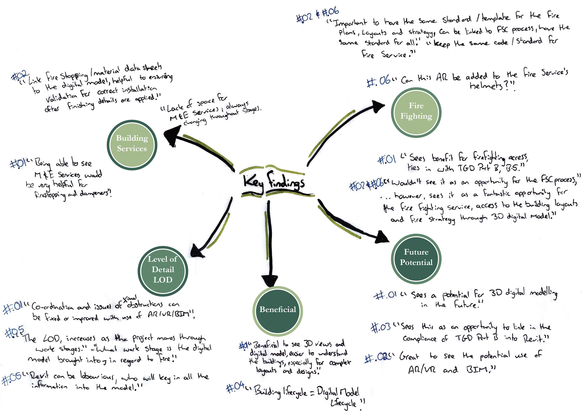
QUESTIONS

Conduct an interview with Industry Experts regarding current strategies and the potential use of this proposal

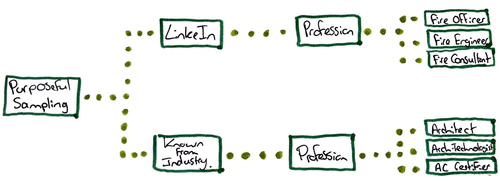
- ☐ Would access to digital 3D models and views be helpful in in FSC certification and assessment process?
- ☐ Is there an opportunity for the use of AR and VR technologies in the FSC certification and assessment process?
- ☐ Are there any issues that tend to appear during later stages and the process of certification and assessment that may be solved earlier using AR/VR and BIM Technologies?
- ☐ Is there an opportunity for digital models to be submitted alongside 2D and 3D format drawings that can be easily accessible and navigational?
- ☐ Can this technology be used for Fire Safety Design and Compliance as well as certification and assessment?
- ☐ Can you give your own insight to digital technology being used for fire safety design, compliance and certification based on your expertise and experience?

Open Discussion

Interview Findings and Answers



Recruitment Process

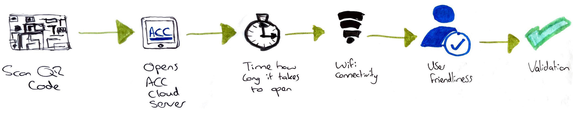


What's Next ?

Conduct Interviews — Gather Answers & Results — Analyse Data & Answers — Write-Up

TESTING/ RESULTS

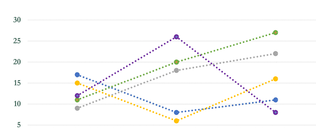
Testing Methodology

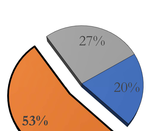


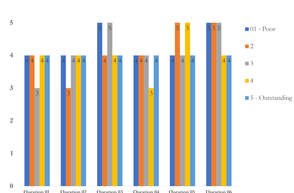
Testing Usability and Accessibility of Cloud-Based Server

Tester	BIM Status	Time A (secs)	Time B (secs)	Time C (secs)	Connectivity Good or Bad	User Friendly Yes / No
01	BIM – User	17	08	11	Good	Yes
02	BIM – User	11	20	27	Good	Yes
03	Non-BIM – User	09	18	22	Good	Yes
04	BIM User	15	3	16	Good	Yes
05	Non-BIM – User	12	26	08	Good	Yes

Results of Test and Likert Scale Form







Analysis and Efficiency of AR & BIM Technologies

Fire Safety Officer

Analysis & Efficiency

AR and BIM can be used as part of the certification process. Used for visualising the proposed building in a 3D and Digital Model and be able to access information.

Get a better understanding of the building as part of the certification process.

Fire Safety Officer may need to learn how to use the AR & BIM software to utilize and benefit from the idea.

Fire Engineer / Consultant

Analysis & Efficiency

Fire Engineer can use the AR & BIM technologies to understand certain parts of the building, particularly in complex layouts and designs.

Can speed up process of fire safety design.

Ensure compliance of TGD Part B.

Can be used to visualise building services that may impact or obstruct fire safety design or elements.

Architect & Architectural Technologist

Analysis & Efficiency

AR can be used to ensure compliance to the design of the building. Better collaboration between services / disciplines for design and construction.

Better collaboration with fire officer and fire engineer.

Prevent issues, obstructions and faults

Fully benefit from BIM Digital Model across all Work Stages.

Fire Fighter

Analysis & Efficiency

A Fire Fighter / service crew can get a better understanding of the building related to the call and receive relative information of the building while en-route to the scene.

Increase efficiency of response time of search and rescue.

Help save a life due to these efficiencies.

AR can map a pathway to the element they need, through AR goggles or tablet.

Supervisor: Dr. Malachy Mathews

FIRE SAFETY & FIRE FIGHTING

Fire Safety and Fire Fighting

What is Fire Safety ?

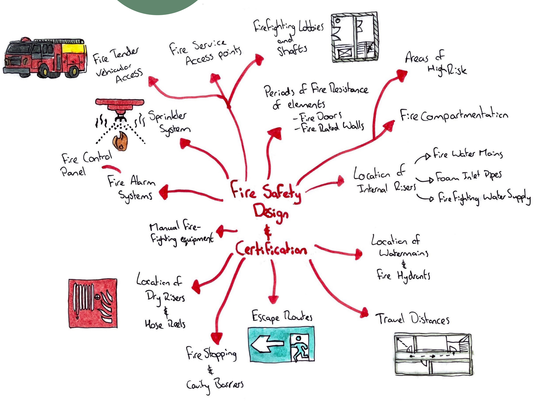
Fire Safety is the set of practices intended to reduce the destruction caused by fire.
Fire safety helps to prevent the ignition of an uncontrolled fire and those that are used to limit the development and effects of a fire after it starts.

What is a Fire Safety Certificate?

A **Fire Safety Certificate** is issued by the Building Control Authority which states that the works or building to which the application relates will, if constructed in accordance with the plans and specifications submitted, comply with the requirements of Part B of the Second Schedule to the Building Regulations 1997.

Technical Guidance Document Part B - Fire Safety

- **B1** Means of Escape
  - Horizontal Escape
  - Vertical Escape
- **B2** Internal Fire Spread (Linings)
  - Cavity Barriers
  - Rate of Fire Growth
- **B3** Internal Fire Spread (Structure)
  - Fire Resistance (FR30) (FD60)
- **B4** External Fire Spread
  - Resistance to spread of fire
- **B5** Access and Facilities for Fire Service
  - Fire Fighting Lobbies
  - Fire Tender Turning Circles



Fire Fighting - Process & Strategy

Taken from Interview with Sub-Officer J.Forbes

What does a Fire Service Crew need to know?

Fire Fighters need to know any and all information regarding the building related to the emergency.
From inital call they look at the "Rick Card" related to the building, they must identify the type of the building as well as the construction of the building.
They must carry out a Dynamine Risk Assessment taking into account life risk, property risk, etc...

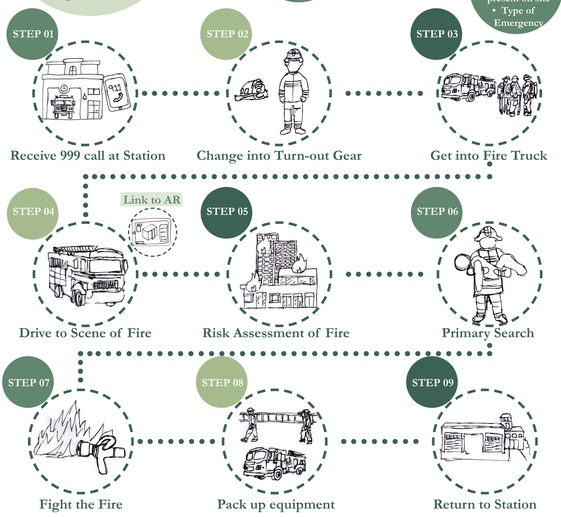
- Local Knowledge of the building
- Any Persons present on site
- Type of Emergency

AR / BIM Adoption

Fire Fighters can access the AR and the BIM Digital Model while en-route to the fire through a tablet. They can access the building information and gather any info need to fight the fire.

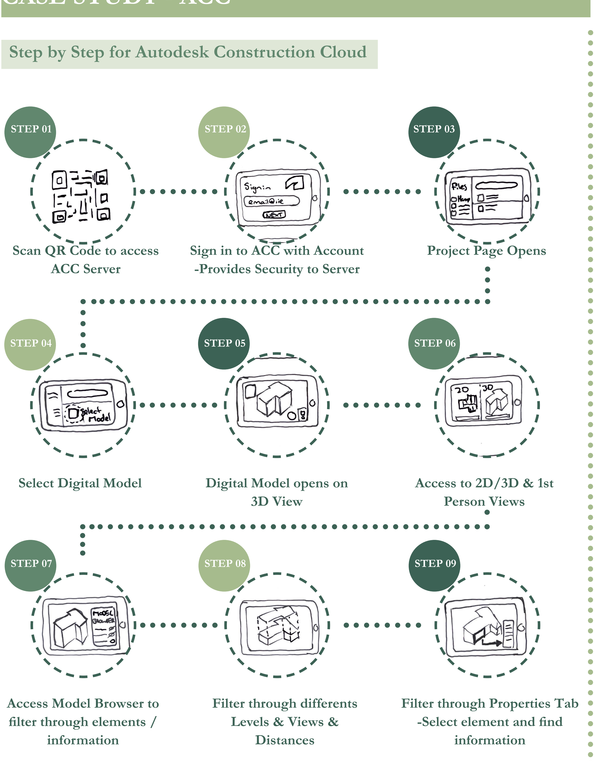
This can save valuable seconds and minutes for the fire service

- Access and Egress Points
- Water Sources
- Fire Alarm Panels

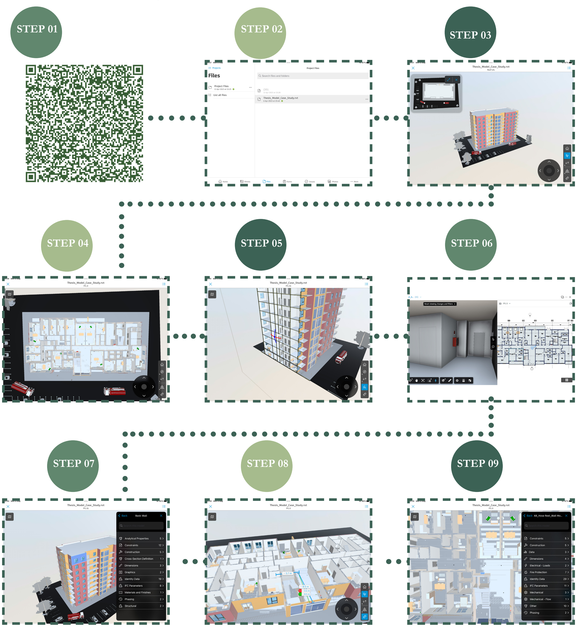


CASE STUDY - ACC

Step by Step for Autodesk Construction Cloud



AUTODESK CONSTRUCTION CLOUD

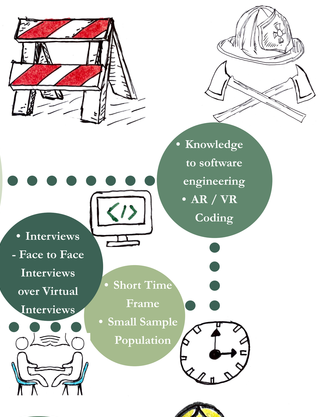


CONCLUSION / FURTHER STUDIES

Limitations

Limitations

- Due to the short time frame of the semester, the research and findings, as well as the small sample population for the interviews, were limited.
- Due to blended-working, some interviews were limited to virtual interviews
- Due to lack of knowledge and limitations to software and apps, coding for AR / VR was not applied but a further study along with an expert can be sought out.



- Knowledge to software engineering
- AR / VR Coding

- Interviews - Face to Face Interviews over Virtual Interviews
- Short Time Frame
- Small Sample Population

Further Studies

Recommendations

- Research how Virtual Reality can be used in Fire Fighting and Fire Safety Design.
- Set up a Revit Template that houses a standard for compliance of TGD Part B
- Set up a standard / database that is used by the Fire Service.
- Longer Timeframe for a more extensive research. Masters Research
- Further Interviews with more professionals from the industries
- Case Studies working with the Fire Service

Further Studies

- Virtual Reality
- TGD Part B Compliant Revit Template
- Fire Service Standard / Database
- Longer Timeframe
- Further Interviews
- Case Studies

Will the future FireFighters use Augmented Reality to fight fires?

Key Findings

Key Findings

"AR & BIM would benefit the Fire Service more than for Fire Safety Design."

The research in question would be very beneficial for both the AEC and Fire Industry.

The Level of Detail (LOD) plays a huge role in the BIM Digital Model.

Key Findings

There is a lot of future potential for the use of AR & BIM in each industry, and how they can play a role in aiding the Fire Service Crew fighting a fire.

The Lack of Knowledge and Experience using these technologies act as a barrier in the implementation of the research.

User Friendliness of the Digital Model and the technology play a huge role as well.

Analysis & Efficiency

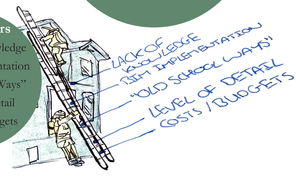
AR & BIM Technologies can be used and effective for several professions in the AEC Industry and the Fire Industry. Through the findings of the analysis, AR & BIM play similar, as well as different roles in the industries, where each professional can benefit from these technologies in their own way.

Key Barriers Recommendations

- To educate various softwares to those who may use this technology.
- BIM Implementation will need to be brought into all practices and firms.
- Timely change-over from 'Old to New'.
- A set template / standard with set LOD
- A pilot project could be constructed to demonstrate to industry professionals

Key Barriers

- Lack of Knowledge
- BIM Implementation
- "Old School Ways"
- Level of Detail
- Costs / Budgets



Conclusion

To conclude, in relation to the findings from the interviews conducted alongside the desktop research, there is a strong potential for the use of AR & BIM technologies for fire safety and fire fighting in both the AEC and Fire Industry. However, there are a number of barriers that impede the implementation of the use of these technologies, such as the lack of skill and knowledge in the technology and the current 'Old School' strategies in place at the moment. The future potential and benefits of this proposed idea laregely exceed the negatives and disadvantages.