

# VIRTUAL REALITY IN ARCHITECTURE

DISSERTATION

"IMMERSING ARCHITECTURE BEFORE ARCHITECTURE  
THROUGH VIRTUAL REALITY"

ROLE: individual,dissertation paper

INSPIRED BY

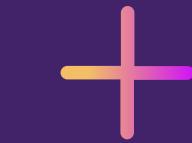
METAVERSE

# JOURNEY FLOW





## ABSTRACT



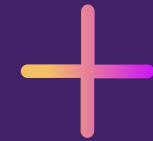
The importance of the use of advanced technology, such as the popularity of virtual reality in the architectural space, is increasingly necessary. There is an ongoing need to put the use of this technology at the professional level.

Virtual reality (VR) refers to a computer-generated environment in which a person participates and determines the performance of the space.

The advantages of using this immersive experience is in the way they can be used early in the stages of thought and till the execution phase in order to further explore the **relationships between different spaces, light, construction, and physical**. The use of focused representation allows for the opportunity to **quickly understand and comprehend these design elements**, as opposed to just looking at a scale model or visual presentation. People who may not be associated with the work of a designer or architect may not be able to understand the relationship of space and scale if they look at a two-dimensional supply, however, the use of virtual reality is very common and can evoke positive responses in the same way physically. properties can.

This paper examines **how VR is used in architecture**. It is a process-driven study that enhances its extensive function as a cognitive function and research aimed at understanding the implications of understanding spaces in VR. It concludes by identifying VR as an exciting new phenomenon, with its own set of rules, pros and cons very helpful to the industry. This approach therefore **enhances user experience as it becomes a major part of interacting with the environment while designing**.

# Vision & Mission



01

## RESEARCH QUESTION

- What is the Role of VR in architecture in understanding spaces better?
- How to use VR to design effective solutions for presentation and communication?
- how is the complexity reduced in the design process and design-decision process?
- is VR more effective than 3d models and 2d drawings?

02

## AIM

This paper aims to understand the high-fidelity architectural visualisation that is significantly contributing to the design industry

03

## OBJECTIVES

- Judge the practicality of VR in architecture
- Applications of VR in architectural profession
- How to effectively increase the communication between architect and his client with its impact .

04

## LIMITATIONS

Paper will not be exploring solutions to induce VR into architectural field rather focus on analysing its potential and giving an immersive experience in design process. Paper doesn't involve the use of AR and only talks about role play of VR

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## SCOPE

- Research and bring out the qualities of VR environment.
- Brief on how VR is evolved today and its existence in the professional field.
- Show the use of VR and how can it be fitted in architecture work.

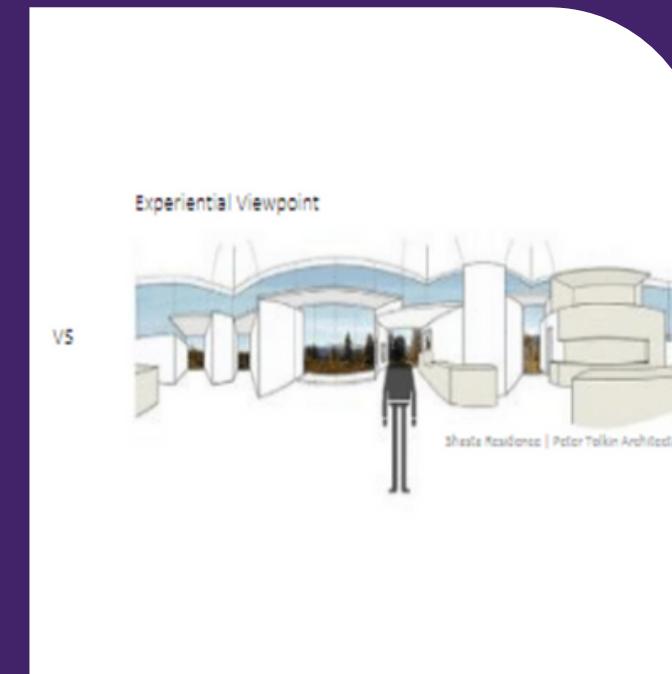
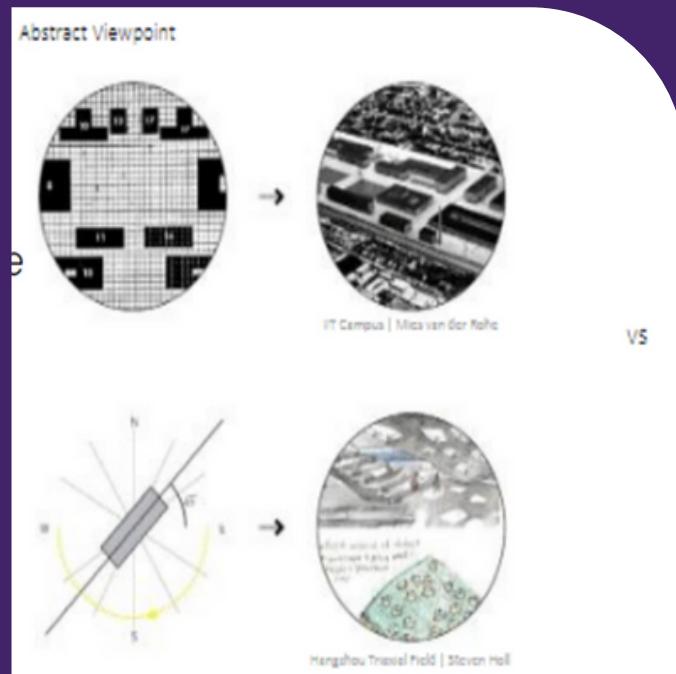


# LITERATURE STUDY

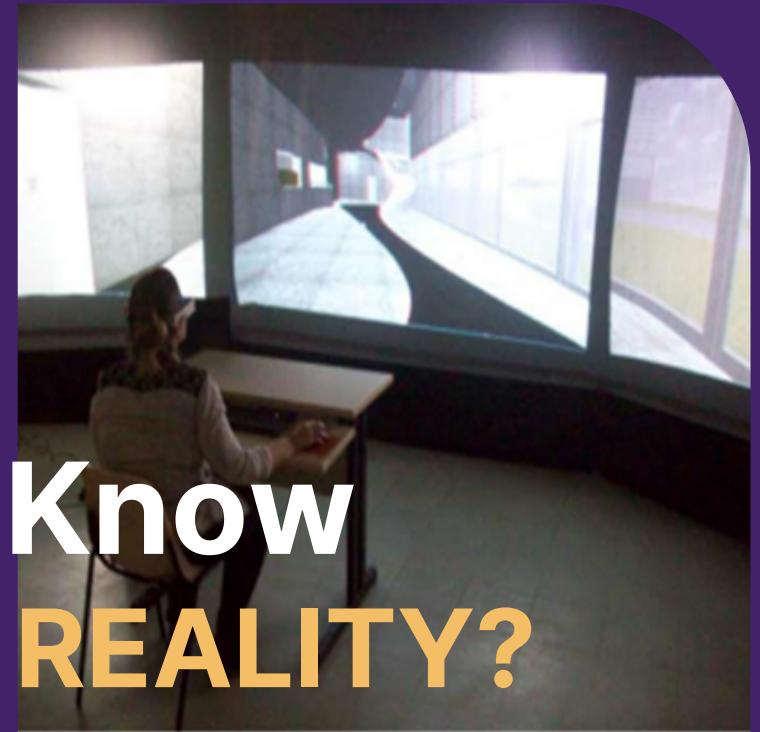
VIRTUAL REALITY (VR) is a three-dimensional realm created by computers and software simulations that **recreates an artificial environment that the user believes and accepts as real**. Virtual reality can be experienced physically via devices such as customized helmets with screens built in, sensor gloves, or other sensorial electronics that control one of the five human senses.

Nonetheless, a number of developers are working on **user-friendly Virtual Reality approaches**, and there have been a number of early experiences with architectural walk-throughs that have demonstrated **benefits in design communication and development**. After that, we might see a rise in the usage of virtual reality in architecture.

Virtual reality provides a more realistic experience .By wearing headsets, the **user can experience a 3D environment**, which allows for a greater knowledge of objects in **space, material perception, and more precise calculations**.



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## What Do You Know About VIRTUAL REALITY?

### Level of Specification:

The designer is able to **perceive spatial features** of the design that were not obvious with other design media after a key level of detail was portrayed in VR. As the model's level of detail (**colour, transparency, and geometric complexity**) increased, **real-time simulations became more valuable as a design tool**.

### The Medium's Immediacy :

The impression of three-dimensional space is enhanced by three-dimensional media. VR can provide designers with a digital design medium that gives them **rapid, direct, and intuitive control over their three-dimensional design**.

### Tool for Making Presentations:

It allows professionals and design critics, not simply clients and laypeople, to picture one's design objectives more clearly than traditional forms of representation. Experiencing a project spatially rather than abstractly also allows for the designer to better **understand the physical experience** of the building, which allows for them to make **more accurate assessments** of the comfort level of the space

# strike of VR in the user experience

**Immersive VR provided the designer with a better sense of space and the ability to observe the design from the inside. The designer is able to analyse details and connections more naturally with an easy-to-control viewpoint at the scale of a person within the structure. Later in the design process, this came in handy because the designer was able to see minor defects in the model. Non-immersive VR, which used a monitor and a space ball, provided higher resolution and frame rates, which became increasingly important as the model became more sophisticated. The non-immersion allowed for easier and faster viewpoint manipulation.**



# What is design decision

## IMPORTANCE OF DESIGN DECISION:

Wrong decisions can be **costly in terms of time, quality, cost and relationships**. This means that in a real construction environment, making informed decisions rather than relying on self-understanding and assumption is important. So there is a visible lack of the **right decision-making platform** which creates a huge change . people view **VR as a tool** that brings value to design updates, conveys the **purpose of design and improves the efficiency** of meetings.

## COMPLEXITIES

Some of the things that add to the complexity of a project include **timelines, unexpected domain conditions, structural problems and much more**. In addition to the impact of the difficulty and its features, employees often face difficulties in understanding what is expected. A few studies have also shown that traditional project management tools are lacking in dealing with project complexity.

## IMPORTANCE OF DESIGN DECISION:

it is very difficult to maintain contact records and **communication within the flow**. This complex situation might lead to information inflow and a lost flow of information among participants. **Loss of information** in a traditional work program is often due to a lack of trust or inadequate communication tools. credibility of data transactions that is the proper information about the space in this context . **VR can close the communication gap** between the design team and the client by producing a more accurate representation of the quality of design .



## CASE STUDY

Possibility of integrating VR with the Geographic Information System (GIS). The goal from the study was to find out how VR and GIS can provide solutions and ideas to city planners and authorities in the Gaza Strip, Palestine.

The authors argue that using **VR in urban planning** can improve the way engineers, **designers and decision-makers understand a project**. They can get real-time design results in the project environment. They can deal with different situations and compare them in a short time

The results highlight the potential for VR in urban planning and especially when integrated with GIS. It **enhances the designer's ability to express design ideas**.



# virtual world is how?

## IMMERSIVITY IN THE VIRTUAL WORLD

It gives audiences additional opportunities to act as though they are in the real world, allowing them to **develop a more realistic mental sense of imagined space.**

. It can assist architects, clients, and other architectural design participants in better **understanding the design concept and making more informed decisions.**

## INTERACTIVITY:

People's interactions with the **physical world are interactive in nature.**

The audience can walk through the environment, rotate the viewpoint, open the door, move things, play videos, switch off the lights, and engage in a variety of other interactions in virtual reality.

## SENSORY FEEDBACK:

Virtual reality **provides sensory feedback** to the audience, which is superior to other traditional visualization technologies

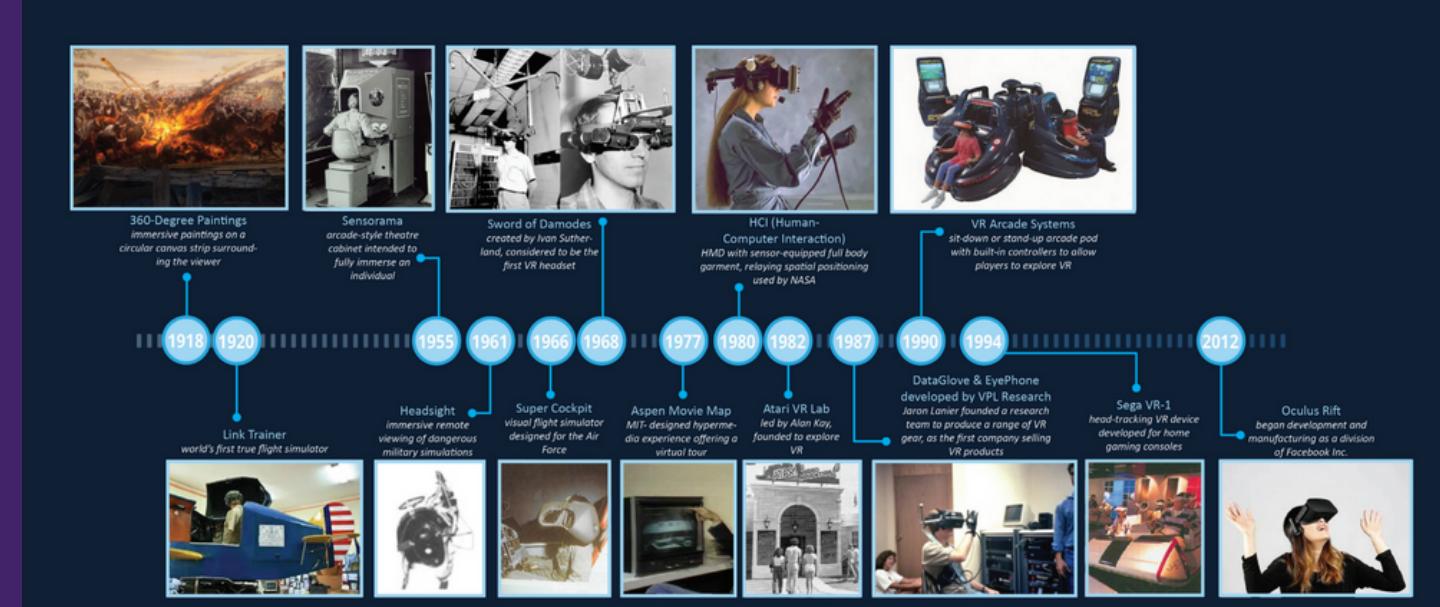
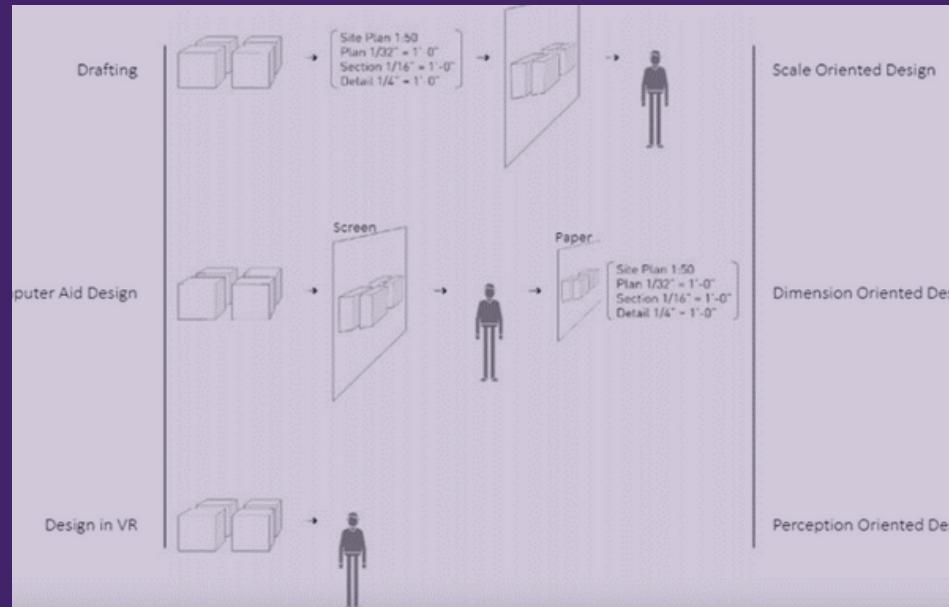
. However, architects can use aural input to keep the audience engaged and provide a more **realistic virtual experience.** For opening the door or playing a video, the appropriate sound can be created.



Try The Best  
Experience  
Using VR Tool

# Our History

## + In Here



- Technology In 2018
- Technology In 2019
- Technology In 2020
- Technology In 2021
- Technology In 2022

Boom of VR

Virtual reality has previously only existed in the laboratory, primarily as a tool for research and development in the educational, medical field.

The introduction of **accessible virtual reality to the public sphere** in the last decade has sparked a surge of interest in the technology among designers, architects, and visualization specialists. Any room can be transformed into a **virtual world into which a user can walk and experience the sensation of actually being there**.

VR may be used to realistically **imagine any environment**, regardless of whether or not the architectural space existing in the present, because it **isolates the user from the physical world** by commandeering sight. As a result, it is more broadly applicable to the entire spectrum of architectural work.



# case study



## Design Review And Approval Of Tunnel

The project's main challenge was to construct the new tunnel without disturbing the trains flow in the old tunnel beside the commitment of the project time and budget. In the traditional design, the method of testing and approving the signalling system requires a long time after the signals are installed. Therefore, the design team implemented VR and combined it with the BIM model to enable the train operators to drive and test trains in the VE and before even the tunnel being built.

### INFERENCE:

- Using VR for simulating operation on infrastructure projects **could facilitate and speed up design approval**  
Design engineers could understand the infrastructure operation better when watching simulating the operation process
- Involving the operation team could help in **enhancing the design and finding better alternatives**
- The maintenance team could **simulate infrastructure maintenance** plan even before the project completion.



## Design Review And Approval Of Tunnel

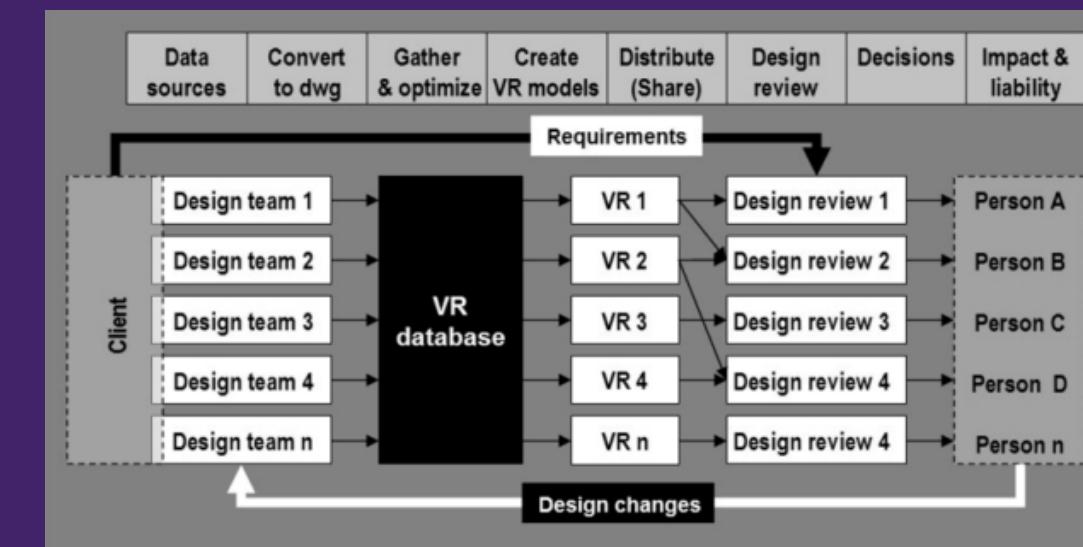
In the north of Sweden, the Swedish mining company LKAB was planning to build a pelletizing plant called "MK3". The CVE implemented directly from the beginning in the design process aiming for improving the communication between partners, reducing the risk, and achieving the goals of stakeholders. The project team produced different VR models for multiple reasons. For instance, there were models for planning the spatial space, understanding the facility and machines inside, training the workers, and simulating the production process. Using VR models increased the understanding of information during communication.

### INFERENCE:

Efficient data exchanging tools such as **VR can lead to precise earlier decisions**

Team working, sharing responsibility and trust within a CVE increase **transparency and clarity**

Involving clients in daily design activities through VR models reduces the **time needed for making decision**.

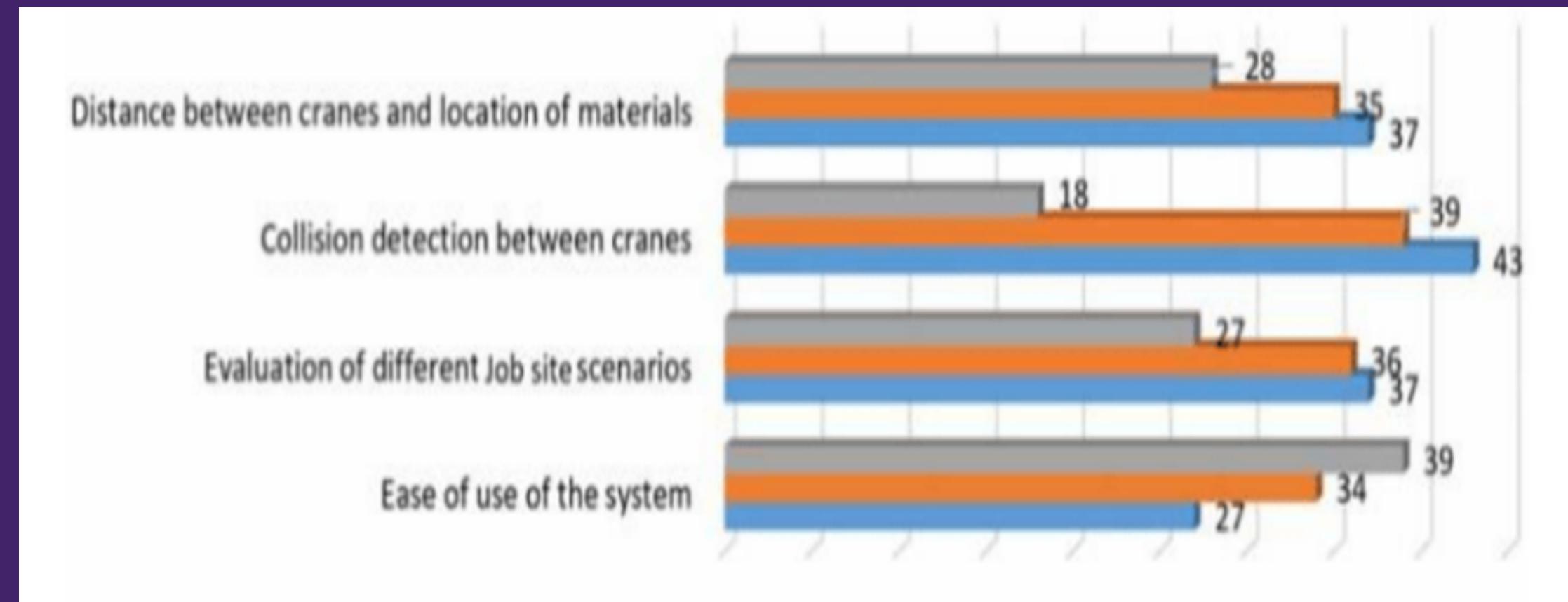


# results from case study

VR is more effective than 3D model and 2D drawings regarding planning the site components and placing materials

VR is more effective than 3D model and 2D drawings regarding detection of future collisions of construction equipment and testing different site planning scenarios

VR is difficult to use and handle compared to 2D drawings and 3D models, which means training needs to be considered when using VR.





# what did I ask ?



## INTRODUCTION

1. HOW IMPORTANT IS VIRTUAL REALITY IN
2. VR IS MOSTLY IMPLEMENTED TO WHICH TYPE OF PROJECTS ?
- 3.. WHAT MADE YOU CONSIDER USING VIRTUAL REALITY FOR THE PROJECT
4. WHAT STEPS WERE TAKEN TO PRODUCE VR CONTENT
5. WHAT WERE THE GOALS SET TO ENDURE BY USING VR
6. HOW WAS IT DIFFERENT FROM NOT USING VR ?
7. HOW DO YOU THINK VR IS GOING TO CHANGE THE ARCHITECTURE

## CONCLUSION

1. WAS THE TIME REQUIRED TO FINISH THE WHOLE OF PROCESS BY USING VR IN THESE STAGES REDUCED THE OVERALL PROJECT TIME AS COMPARED TO NOT USING VR WITH TRADITIONAL PRACTICE ?
- 2.. DID APPLYING VR SUCCESSFULLY HELP IN MEETING THE DESIRED EXPECTATION OF CUSTOMERS NEEDS ?
3. WHAT ARE THE DISADVANTAGES OF THE USE IN THE PROFESSIONAL PRACTICE ?

## DESIGN STAGE 1: CONCEPT AND IDEATION

1. DOES IMMERSION TECHNIQUES ( VIRTUAL REALITY ) HELP IN UNDERSTANDING THE COMFORT OF SPACE BETTER THAN ABSTRACT VIEWS FROM 3D MODELS AND 2D DRAWINGS ?
2. IS THERE A BETTER UNDERSTANDING OF SCALE AND PROPORTION FROM TRADITIONAL 3D MODELS AND 2D DRAWINGS .

## DESIGN STAGE 2 : DESIGN DEVELOPMENT AND COLLABORATION

- 1.. HAS THE ITERATION NUMBER OF THE REVISION OF DESIGNS REDUCED SIGNIFICANTLY AFTER THE INCLUSION OF VR IN THE PROCESS OF COLLABORATION WITH THE STAKEHOLDERS , OTHER ARCHITECTS ,USERS.
2. DOES THE DESIGN ERRORS GET DETECTED EASILY AND FIXED ? DOES THAT REDUCE THE CONSTRUCTION COST BY SIGNIFICANT AMOUNT ?
3. WAS IT EASIER FOR VR TO COMBINE BETWEEN OFF-SITE AND IN-SITE PARAMTERS AND CONSTRAINTS TOGETHER

## DESIGN STAGE 3 : DESIGN PRESENTATION WITH THE USER OR CLIENT GROUP

- 1.. DO CLIENTS UNDERSTAND THE VR VISUALISATION BETTER THAN AXONOMETRIC PLANS ?
- 2.. DOES THE USAGE OF VR INCREASES THE DESIGN APPROVAL TIME PERIOD OR EFFECTIVELY DECRESE THE TIME ?
3. DOES IT MAKE THE CLIENT UNDERSTAND A SPACE BETTER THAN THE MODEL .



# QUESTIONNAIRE SURVEY

## SELECTION OF PARTICIPANTS

The first phase of the experiment was data collection and validation. The main purpose of this phase was to measure the reliability of implementing VR in the construction planning. The researchers used a sample comprising 6 professionals working in the construction industry. I selected participants from different specializations in construction such as construction management, design management, architectural design, and structural engineering who has experience in working with an architect who has worked with the virtual reality in their design process . The participants were from different positions such as BIM specialists, site supervisors, site engineers, architects, design managers, construction managers, and structural engineers. The participants were asked to assess, monitor, compare, and rate three different approaches for site planning 2D drawings, 3D model, and 3D in VR. The rating scale was from one (highly ineffective) and five (highly effective).



USER DETAIL

EXPERIENCESURVEY

## PERSONA



NAME: ADITHYAN  
JOB: VDC coordinator . L&T  
EXPERIENCE: 2 YEARS



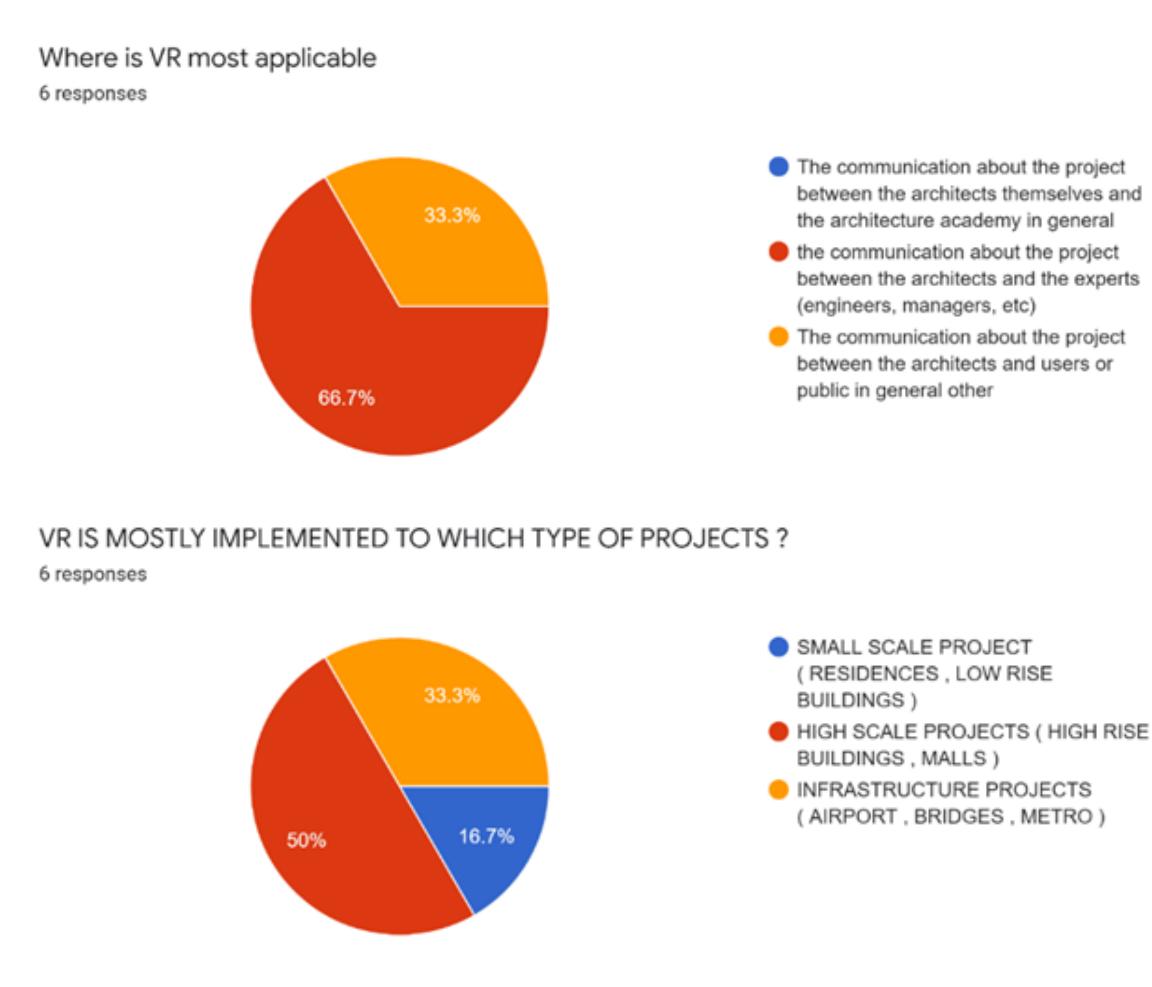
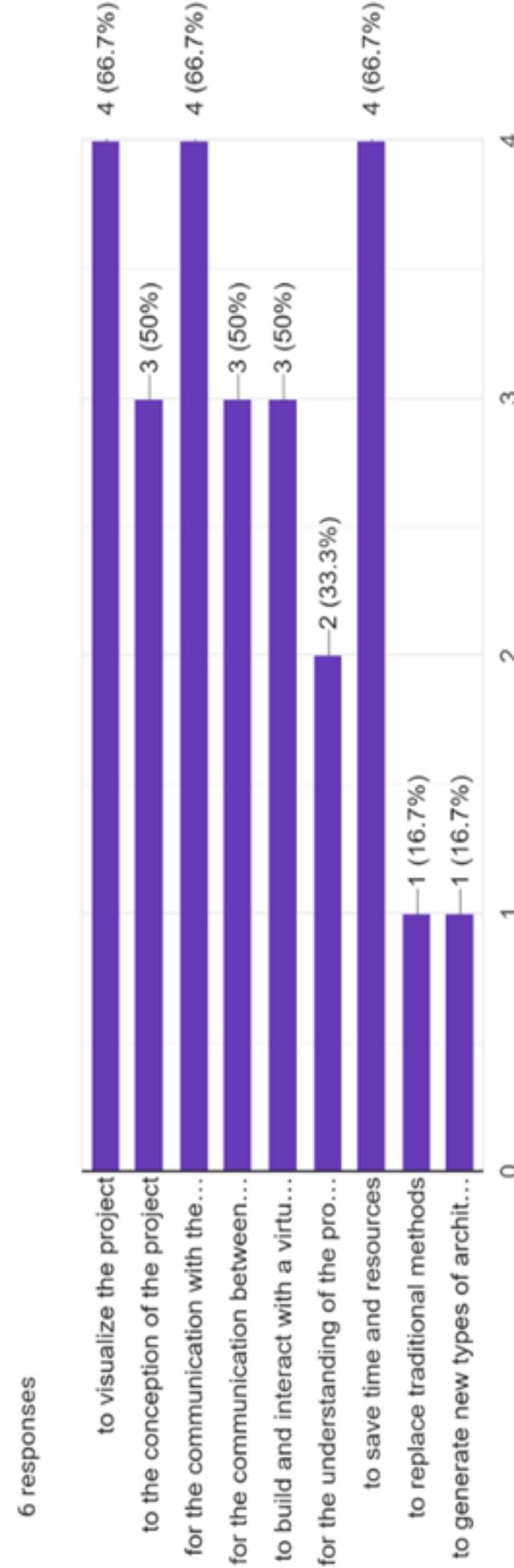
NAME: JAGADISH  
JOB: Construction Analyst / Faithf  
EXPERIENCE: 2 YEARS



NAME: OSAMA KHARODIA  
JOB: Student assistant at Virtu  
Assist  
EXPERIENCE: 3 YEARS

# Technology

## HOW DO YOU THINK VR IS GOING TO CHANGE THE FIELD OF ARCHITECTURE



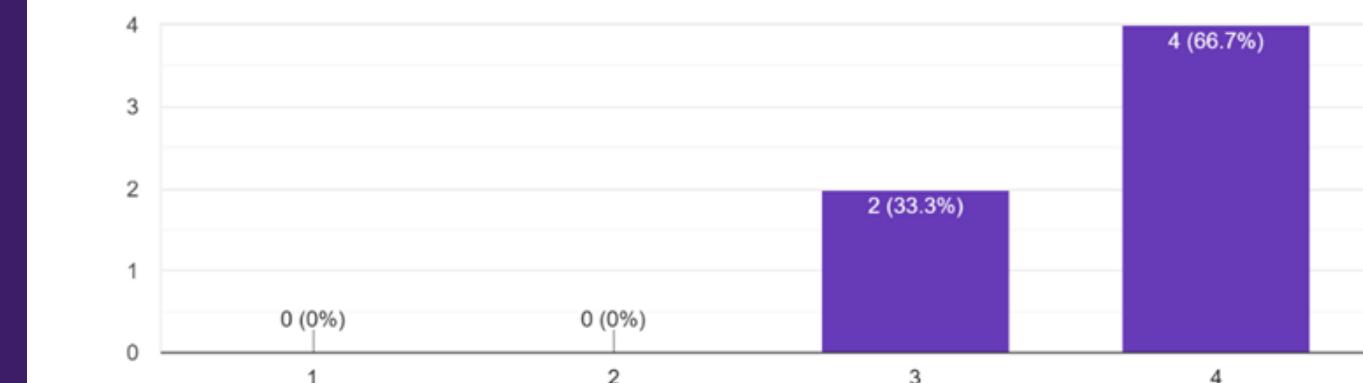
## CONSIDER USING VIRTUAL REALITY

- Easier understanding of project goals and issues
- Visualization
- The ability to visualise better in identifying the utility clash
- Small projects require more details
- Ability to visualize and synchronized work flow
- VR provides designers and architects the freedom and flexibility in aiding users visualize and -experience designs that aren't restricted to a physical model.

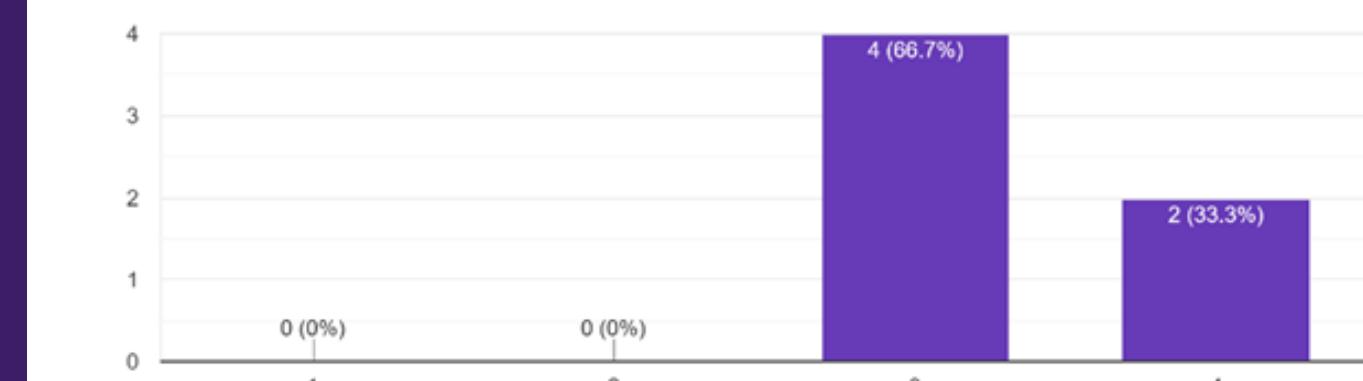
## HOW WAS IT DIFFERENT FROM NOT USING VR

- VR allows better visualization and hence better understand the project
- Difficult to make any design changes during construction due to change in scope. This often resulted escalation of in cost factor
- Get a overall idea about the project
- Very time consuming and not accurate
- The client could visualize an almost finished project in virtual reality, provide critical feedback that was to be implemented in designing the final model.

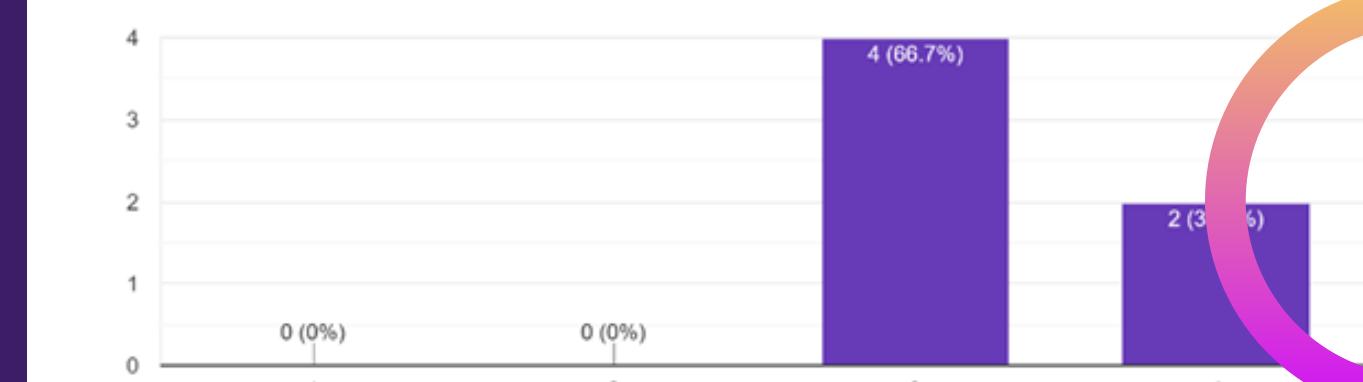
DESIGN STAGE 1: CONCEPT AND IDEATION :DOES IMMERSION TECHNIQUES ( VIRTUAL REALITY ) HELP IN UNDERSTANDING THE COMFORT OF SPA...T VIEWS FROM 3D MODELS AND 2D DRAWINGS ?  
6 responses



DESIGN STAGE 1: CONCEPT AND IDEATION :IS THERE A BETTER UNDERSTANDING OF SCALE AND PROPORTION FROM TRADITIONAL 3D MODELS AND 2D DRAWINGS .  
6 responses

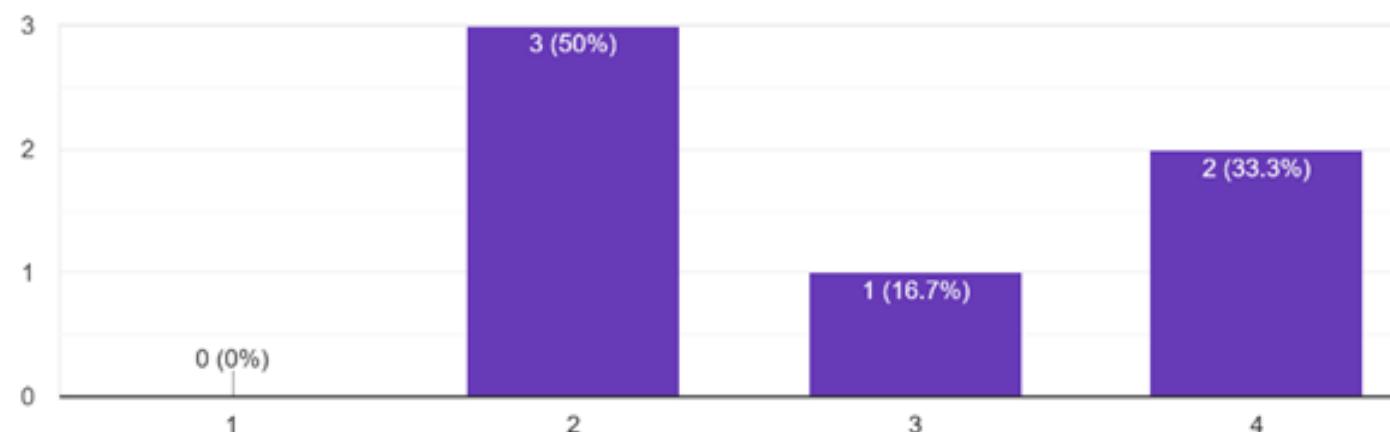


DESIGN STAGE 1: CONCEPT AND IDEATION :IS THERE A BETTER UNDERSTANDING OF SCALE AND PROPORTION FROM TRADITIONAL 3D MODELS AND 2D DRAWINGS .  
6 responses



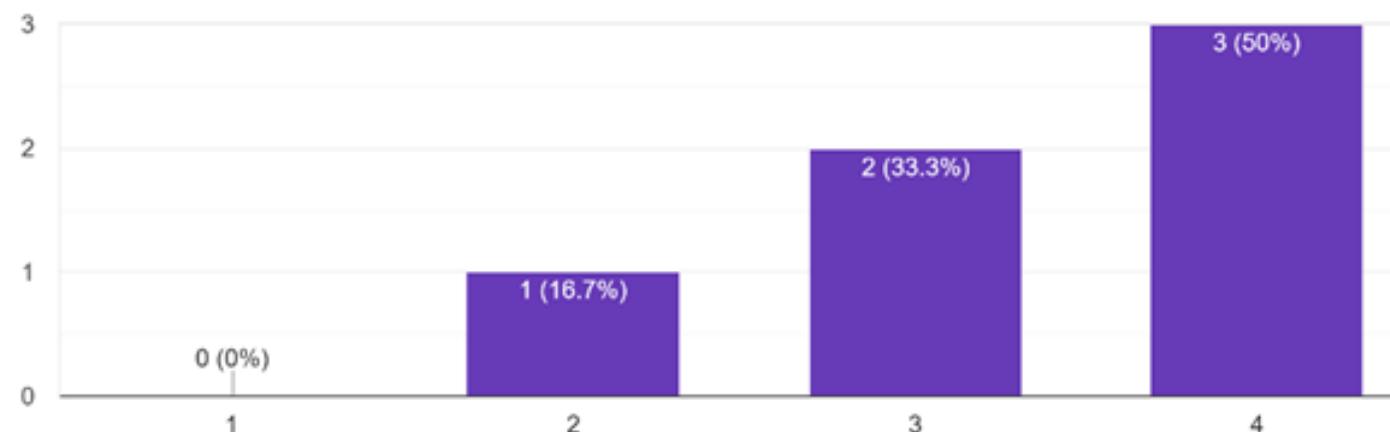
DESIGN STAGE 2 : DESIGN DEVELOPMENT AND COLLABORATION :DOES THE DESIGN ERRORS GET DETECTED EASILY AND FIXED ? DOES THAT...CONSTRUCTION COST BY SIGNIFICANT AMOUNT ?

6 responses



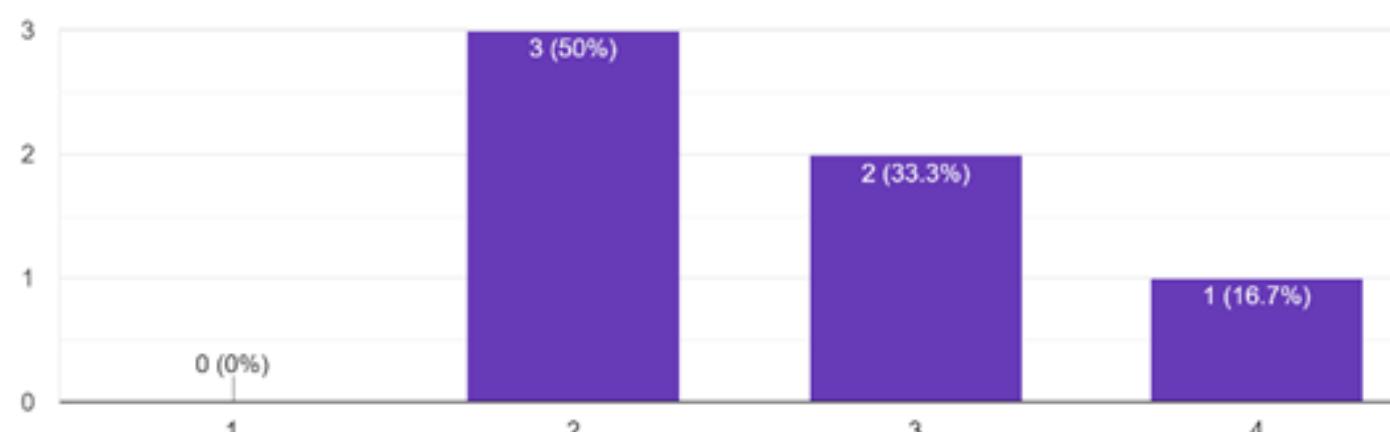
DESIGN STAGE 3 : DESIGN PRESENTATION WITH THE USER OR CLIENT GROUP :DO CLIENTS UNDERSTAND THE VR VISUALISATION BETTER THAN AXONOMETRIC PLANS ?

6 responses



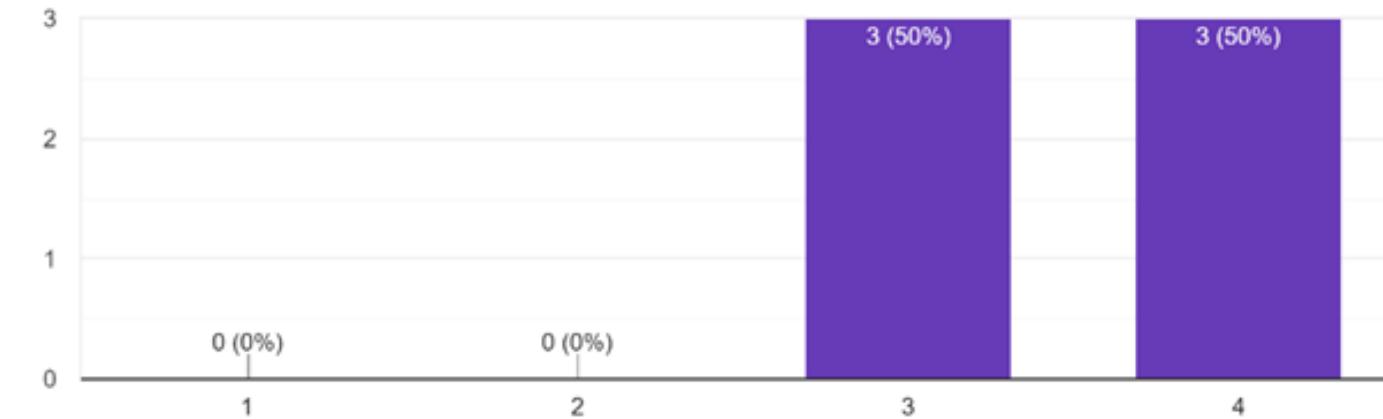
DESIGN STAGE 3 : DESIGN PRESENTATION WITH THE USER OR CLIENT GROUP :DOES THE USAGE OF VR INCREASES THE DESIGN APPROVAL TIME PERIOD OR EFFECTIVELY DECREASE THE TIME ?

6 responses



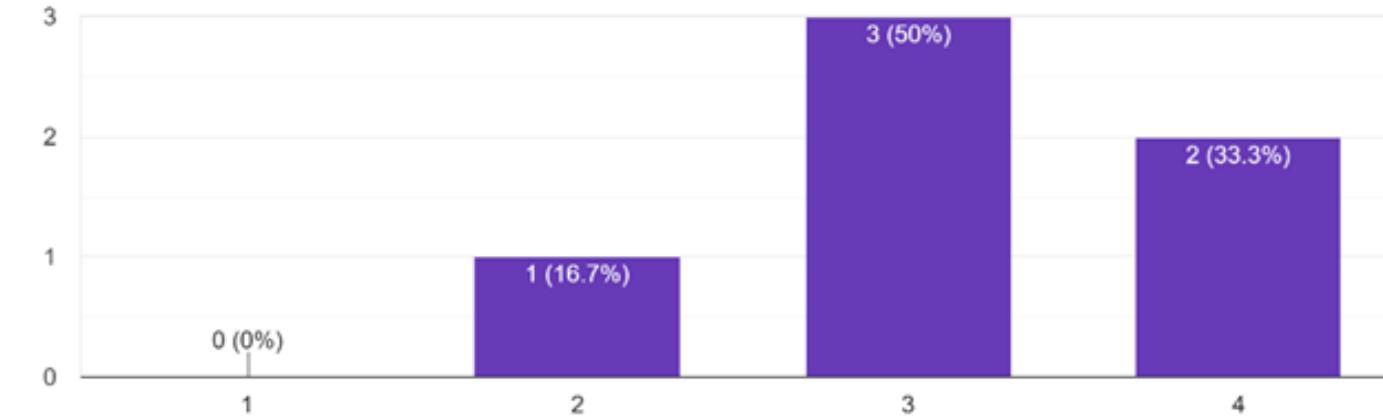
DESIGN STAGE 3 : DESIGN PRESENTATION WITH THE USER OR CLIENT GROUP :DOES IT MAKE THE CLIENT UNDERSTAND A SPACE BETTER THAN THE MODEL .

6 responses



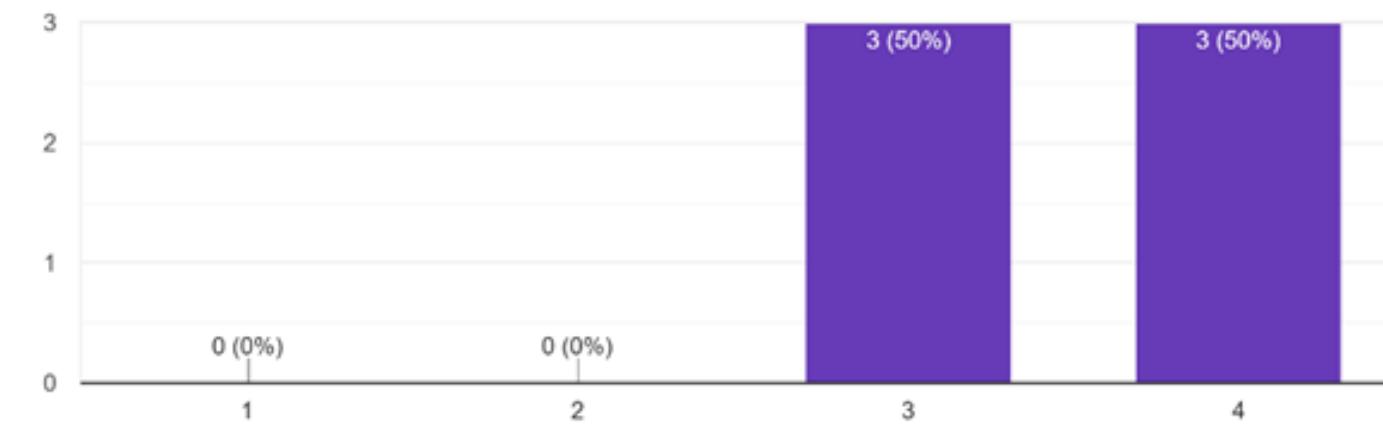
CONCLUSION : WAS THE TIME REQUIRED TO FINISH THE WHOLE OF PROCESS BY USING VR IN THESE STAGES REDUCED THE OVERALL PROJECT TIME COMPARED TO NOT USING VR WITH TRADITIONAL PRACTICE ?

6 responses



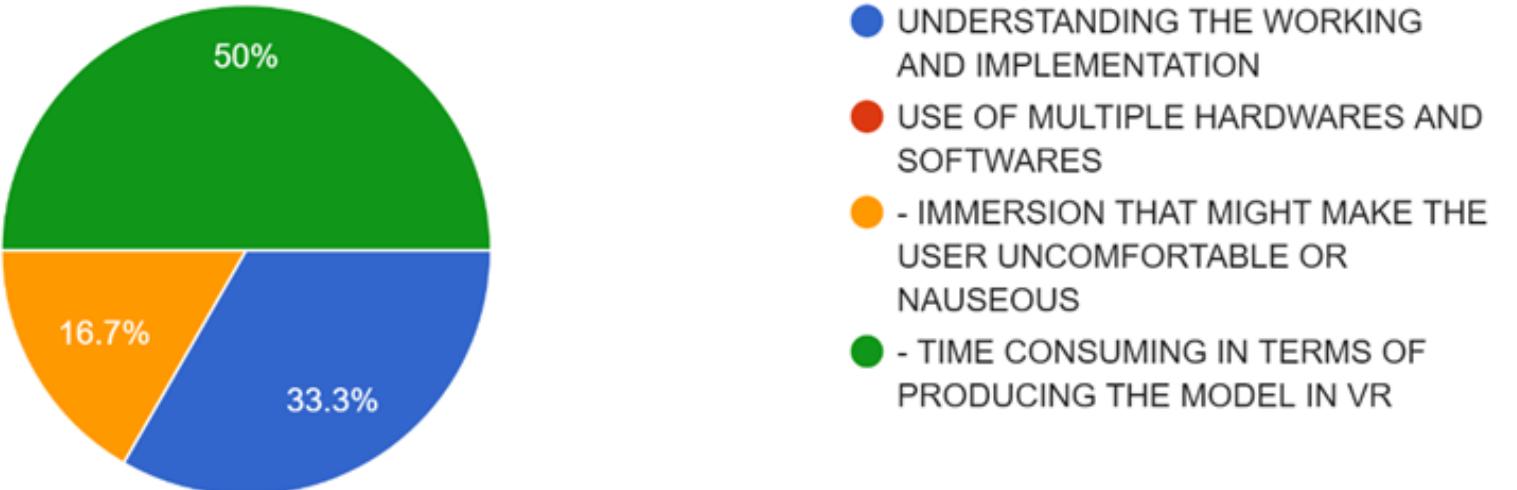
DID APPLYING VR SUCCESSFULLY HELP IN MEETING THE DESIRED EXPECTATION OF CUSTOMERS NEEDS ?(UNDERSTANDING THE DESIGN)

6 responses



## WHAT ARE THE DISADVANTAGES OF THE USE IN THE PROFESSIONAL PRACTICE ?

6 responses



### Results and Discussion:

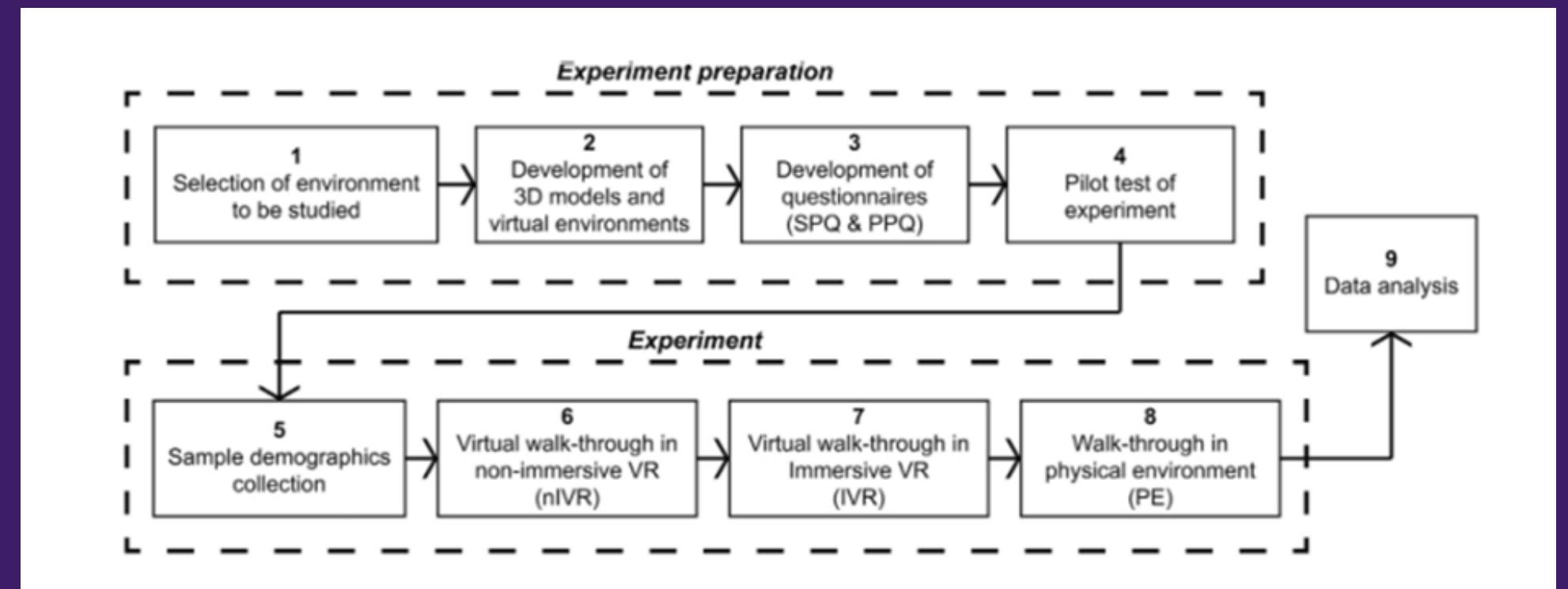
The participants answered all the questions and provided rates for the design planning for both scenarios in the three different environments and their effect in 3 different stages : 2D Drawings, 3D Model, and 3D in VR. In 2D Drawings, the average rate was 4.5 out of 5 regarding the ease of using the 2D document. However, the participants provided a rating 1.9 out of 5 regarding the sufficiency of the information in 2D drawings for example the possibilities of collision between the cranes was difficult to detect in 2D drawings only. **According to the participants' responses, the 3D model increased the understanding of the design plan.** This was clear when comparing the overall rating for 2D and 3D; the 3D model was 3.9; However, the 2D was 3.0. The participants provided an overall rating for the 3D model when using in the VR environment, which shows **that VR enhanced the understanding of the site planning.** The participants rated the ease of using VR by 2.9 out of 5, which shows that training might be needed before implementing such a technology .After analyzing the answers of the questionnaires for the participants of this experiment, the researchers discovered that a 2D drawing in planning is easy to understand and less time-consuming compared to the virtual environment. However, **the participants believe that VR increased the understanding of the site planning, the ability to detect collisions, and predicting the site constraints through better evaluation of different scenarios** . The research recommended that the architects that practice more using the visualization tools ,will help them, **visualize the planning better and increase the level of details for** the site space. Comparison between the answers of professionals in 2D, 3D, and 3D within VR.

### Conclusions :

- **VR is more effective than 3D model and 2D drawings regarding planning the site components and placing materials**
- **VR is more effective than 3D model and 2D drawings regarding detection of future collisions of construction equipment and testing different site planning scenarios**
- **VR is difficult to use and handle compared to 2D drawings and 3D models, which means training needs to be considered when using VR.**



# LIVE CASE STUDY





## LIVE DOCUMENTATION



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# TRADITIONAL WORK ENVIRONMENT

In this documentation , there is a focus on finding the work flow of a certain design project and how its carried out with 2D plans and 3D models . During the documentation every pain point was identified and the points where the role play of virtual reality with its tools and applications can make a significant change in the quality of design decision .

**Traditional communication methods** in design may not convey all of a client's problems or requirements. Correcting and altering a design without a complete understanding of the client's objective can be a **slow and tedious procedure**. Although designers frequently utilize CAD to aid in the visualization of potential solutions, clients with inadequate technical knowledge cannot be expected to use these sophisticated digital tools appropriately.

- this company uses a web-based virtual reality (VR) system that can be used by professionals and non-professionals to view and alter 3D visuals using a standard web browser. Clients would be able to convey their design intent by creating a virtual design utilizing standard design components provided by interior designers if they had access to an **interactive 3D environment**.

- Rather than being used as a design environment throughout the design process, the immersive environment is employed as a **presenting tool during the final evaluation** stage.Each alternative was created by combining virtual objects from the designer's catalogs.

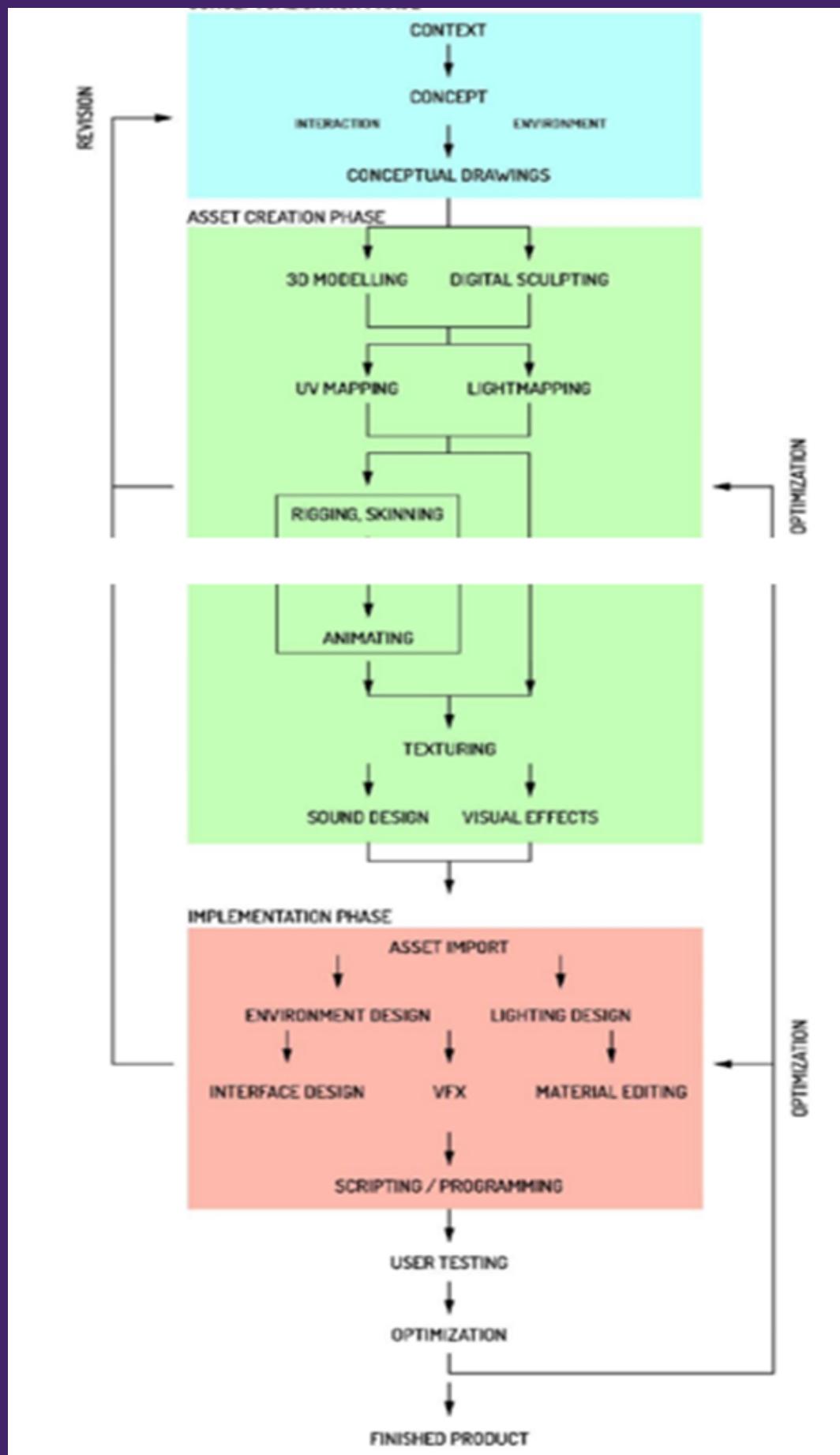
- This procedure would provide enough time for the **client to communicate with the designer**.

- This company developed a specific way for integrating the VR application into the proposed communication framework.

- A proof of concept 3D was produced to test the practicality of this technology, allowing a client to build an interior scenario complete with furniture. Having different viewpoints allowed the client to **explore the design options and choose the solution that best met their needs**.



LIVE DOCUMENTATION



# VR IMMERSIVE WORK ENVIRONMENT :

In this documentation , there is a focus on the applicability of implementing VR in a full 3d immersive design environment enhance communication, collaboration, and coordination within the project team itself and with the client.

The main goal of the documentation was to explore and practice the integration between VR, laser scanning, and photogrammetry technologies to enhance the communication and collaboration with the client during the design process.

## **UNDERSTANDING WHERE WAS THE USE OF VR APPLIED**

**Communication:** Within a VE, the client can access the VR model from his or her office and chat with the designers in real time. The client can envision the facility features in true scale, as if they were in reality, without requiring an engineering experience.

**Collaboration:** The project team commits to a varied level of collaboration with the client during each phase. VR has the potential to improve collaboration in the design process.

**Coordination:** It can be used to envision the project's various features, such as structural elements and architectural finishes.

**Project location :** It is possible to develop a VR model using laser scanning, photogrammetry, and drones, allowing engineers to explore and investigate the site without having to travel to the location in the wild.

Design Space Software is a piece of software created by 3D TALO (a Finnish firm) that was used to create the VR content. The software allows you to combine several models, such as architectural, HVAC, scanned data, and so on. The same model can be used by multiple people in different places, with the option to edit in real-time. The user can utilize features like measuring and scaling, flying and walking through, drawing pipes or cubes, taking notes, and taking images within the immersive experience. The controllers and headset were moved in the space between the two base stations and placed on the floor for calibration.

# DOCUMENTATION at Larsen & Turbo

-When the model was viewed in the 1:1 scale , the glitches in the plans and clashes between different disciplines seemed to be not be identified but when with viewing the same with VR content , they were fixed immediately.

-The attributes like the space required and provided , for every design feature were causing troubles in making the design understandable by the stakeholders and clients , which was made easier with VR being introduced at this stage .

**For example** – How much head room was required Is the feature provided accessible like a valve that passed all standards of easy service access .

-Identifying the construction process called the pre construction planning phase which when viewed in VR makes the designer understand the flow of how efficiently it can be built which is a major flaw identified in 2D as these considerations are left unresolved .

-Safety checks are better considered and identified with the VR more than any 2D or 3D models as they don't let us experience it with the real 1:1 scale to actually feel the pain.

**For example** – identification of sharp corners , clashes in the design

-With this better identification and understanding of flow of design has made the supply chain flow easier and not get disrupted as easily as identified in the traditional methodologies .

## Conclusion from the study :

- Safety planners could simulate the construction and identify potential collisions.
- VR can provide simulation for the construction equipment and allow predicting future clashes in the site.
- Applying VR in site planning could help to predict the collisions between construction equipment
- VR with the help of laser scanning and photogrammetry could be useful for investigating hazardous sites





# summary of findings

The outcomes of the research give a thorough comprehension of the issues raised in the dissertation. The major goal of this article is to determine the effectiveness of virtual reality's contribution to the field of architecture. The goal was to bring out the attributes through various kinds of research on ideas and practices in order to have a thorough grasp of the problem.

To begin, the complexity of a decision-making process in the field of architecture is addressed, along with the requirement for a better platform to be introduced in order to create successful decisions. It is discussed about how VR can effectively bring about a change in this gap that has been identified as a stumbling block to the industry's growth. As a result of the use of virtual reality in various stages of the design process, more responsible judgments can be made.

Furthermore, through doing actual study on virtual reality laboratories in organizations that use them for the design process for a variety of projects, the role of VR has been clearly proven. The study is based on a good response from consumers who have witnessed a departure from traditional design techniques. The usage of virtual reality to interact with various features can be used to build a well-designed setting with more value than ever before.

Virtual reality has not only opened up new possibilities in architecture, but it has also enhanced current ones. Due to current Software and Hardware Technology restrictions, VR applied in architecture may not be as compelling as the real thing.

However, it allows us to execute tasks that were previously impossible or treated in such a way that they can be done more effectively, with much more to come from future technological advancements. Your difficulties are unlikely to go away very soon. According to our findings, even with its current limitations, virtual reality has the potential to change the way we think about and build the physical environment, pushing it beyond space and time limits.





# research inference And its significance

Multi-disciplined engineers, stakeholders with varying interests and backgrounds, high-profile clients, and wary end-users are all involved in construction projects, particularly infrastructures. As a result, in such projects, a lack of communication, collaboration, and coordination leads to errors and problems during the design and construction phases.

Furthermore, clients and stakeholders without an engineering experience may find it challenging to **comprehend the design, particularly early in the design process** when information is scarce.

During construction, the project may encounter allegations from end-users or stakeholders who misunderstand the project.

On the other hand, VR technology has advanced significantly, not only in terms of hardware and software, but also in terms of cost, which has dropped considerably in comparison to 15 years ago. As a result, several developers are striving to apply virtual reality to the architectural sector. The design team can employ VR within CVE to improve design review and approval by **enhancing communication and collaboration and minimizing revision and approval time during the design process.**

In addition, when a designer is immersed in a real-scale 3D model, their **comprehension of the space and design aspects can improve.**

Within CVE, facility operation and maintenance teams can simulate operations, maintenance, and even evacuation plans, as well as provide feedback and suggestions on the design. Within a VE, **clients and decision-makers can have access to accurate and up-to-date data, allowing them to make faster, more dependable, and precise decisions.** Within a VE, stakeholders and end-users may examine how projects will affect the environment in the future and even walk about and check out the facility virtually.

The method and ability to create the facility should always be considered in a good design. Before the construction phase begins, **VR can be used to replicate dangerous locations on future sites and give workers with pre-construction safety training.**

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# research inference And its significance

- Architects can also detect and rectify possible collisions that could result in accidents. Designers can model the succession of construction parts using construction stage management. When creating site planning and before to the start of the execution phase, architects can model the dynamic process on the construction site. This could help you get the most out of your job and your resources.
- We can give a framework and methodology to highlight the benefits and limitations of using VR in the architecture design process through a literature review, examined case studies, and participation in a documentation for incorporating VR in the design process. It may be determined that implementation will provide the department with numerous benefits. The VR model can be used to communicate with clients within the VE, allowing them to see the most up-to-date design and choose from many options. Meetings can be recorded in the VE with the ability to take notes and comments, which can then be used to create meeting minutes. The VR paradigm can be used in mega-infrastructure projects to engage stakeholders in the design process and boost end-user satisfaction.
- Within a CVE, designers and modelers may better comprehend and alter design components, as well as interact with one another. Finally, the model can be used for operational, maintenance, and as-built documentation planning.

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# LIMITATONS AND PROPOSAL :

## Accessibility to varied user group?

•**Use a variety of tools** : Various case-specific informal tools and approaches should be utilized to incorporate everyone who is expected to participate. While using technology tools, traditional approaches should not be omitted from the process. A flat screen version of the experience should be given for persons who do not want or are unable to utilize an HMD.

•Participants who struggle with mobility or other aspects of the experience should be given the option of using a simpler alternate mode of navigation and participation. Colour blindness, for example, might be considered during the conceptualization process and colours chosen accordingly.

•everyone's experience with tools is different, the only way to create natural and intuitive body-centered interaction design for a large audience is to conduct numerous test sessions.

•people, having a display close to their eyes or using locomotion techniques can be exhausting. Participants should not be forced to play for an extended period of time and should be allowed to do so if they so desire

Because the virtual body of the participant is based in that reality, its interactions should likewise follow the laws of that scenario, if not create them. Such interactions are expressed through body-centred interaction strategies. Ownership of the Human Body The illusion of having a virtual body can be created by tracking the body in sections or in its entirety.

To summarize, in a participatory project, using a well-designed VR experience with multi-sensory modalities and a human-centred interaction design approach will boost interest in the suggested design and motivate participants to think about and provide suggestions.



## FURTHER RESEARCH AND CONCLUSION



we can better understand how CAD and VR

- Affect perceptions of scale
- Object relationships
- Materiality
- Open spaces.



Scale, density, and immersion are all illusions created by CAD. In VR, both no texture and realistic produced textures can be used, with realistic drawn textures having a slight advantage. virtual reality has potential as a unique and worthwhile new medium for architecture design.

People saw virtual reality as a useful tool, but not as a substitute for traditional CAD modelling, and there were many varied perspectives on its location and role in the design process.

- These findings show that virtual reality has potential as a unique and worthwhile new medium for architecture design. The project also provided an opportunity for some brainstorming about future VR applications, such as children's perspectives or wheelchair users with unusual lines of sight.
- On a larger scale, the development of the VR review tool into a VR editor tool would be the next stage for this project and research
- This potential piqued my curiosity at the start of this project, but the problems in constructing adaptable VR metaphors to alter space proved to be quite a struggle. How items could be moved and operated far away from the body was one example of such a challenge. One of several object manipulation concerns was whether the user would have to move with the object in order to put it.
- For an immersive virtual reality environment, the metaphors that enable modelling would have to be rebuilt. Design, the act of producing, and architectural modelling in virtual space would all be transformed as a result.