Exploring the expansion of planner's engagement capabilities via accessing the data from a building information model for public consultation

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A thesis is submitted in partial fulfilment of the requirements of the University of Northumbria at Newcastle for the degree of Doctor of Philosophy

Research undertaken in the Faculty of Engineering and Environment in collaboration with PlaceChangersLtd, Newcastle

2022

Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of others. The work was done in collaboration with PlaceChangers Ltd, Newcastle Upon Tyne.

Any ethical clearance for the research presented in this commentary has been approved. Approval has been sought and granted through the Researcher's submission to Northumbria University's Ethics Online System on 5/17/2021.

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Abstract

A statutory urban planning consultation is the only opportunity to address concerns of the public regarding the shared built environment. However, current methods for consulting the public on urban planning proposals are archaic. They are often uncoordinated and can potentially fail to provide an inclusive forum for all socio-demographics.

Face-to-face consultations are noted as the best method to consult. However, they only provide a means for those with time and mobility to attend the discussions, workshops, and exhibitions regarding the built environment.

Urban planning consultation processes are also limited by stakeholder relationships. It is not often that stakeholders acknowledge each other. This thesis focuses on approaches to stakeholder identification, management, and engagement. Stakeholders can be identified at any stage of project development and addressed as internal (who have a direct hand in changing a project) and external (who are impacted by changes.) Stakeholder management and engagement can vary in theory and practice, and this thesis will explore this.

Internal stakeholders utilise their own communication methods and processes to cooperate and consider risk at each stage of the project. Building information modelling (BIM) is a collaborative tool which shares textual and image data among the building development project team. Planners implementing a consultation with the public do not use BIM, as it is software for internal stakeholders to share information for the project development in a common data environment (CDE). BIM is a technical methodology primarily used to communicate the strategy of the project (including usual details and specifications) but is limited in its further applications for encouraging communication beyond this initial scope.

External stakeholders rely on planners to reach wider audiences, but without mediation from an expert to explain the technical language in layman's terms, there remains a gap in knowledge making it difficult for the public to understand specific design decisions.

This PhD study aims to understand how 3D Building Information Models (BIM) and associated data can be utilised to facilitate communication throughout each stage of the planning consultation and explores how BIM may be used to address the knowledge gap specifically through an online planning consultation platform.

This is increasingly important as more digital tools are being introduced into the planning sphere and incorporating the views of the public and other stakeholders, should be central to planning consultations in the UK.

This research presents mixed methods in order to identify the requirements for a digital planning portal that best presents BIM data for the use of public consultations.

The visual and textual information of a BIM model is documented and validated with a case study and recommendations are made for using BIM data within a public consultation.

Throughout the study, the concepts of what consultations are in currently in place are considered, in parallel to current policy and best practice. The author presents the impact digital tools and how these might be utilised within the current planning consultation process.

The findings show that, with the incorporation of digital platforms in planning consultations, a greater focus on stakeholder perspectives and relationships can be established.

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I am also grateful to the designers who helped create the materials to be tested for the thesis' Case Study.

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Chapter 1 Introduction

Public consultations have been used in public planning in the UK since the 20th century, due to a change of statutory requirements, under section 106 of the Town and Country Planning Act 1990. Whilst the purpose of planning spans multiple dialogues, this thesis primarily focuses on the academic nature of planning, the involvement of local authorities, and industrial best practice. Emerging from political science and concepts of representation within public spheres (Pitkin, 1967), the idea of planning is seen as part of a network of communication that shapes the environment. From this emerged an idea that the built environment is shaped as one single organic beast.

This thesis specifically focuses on the emergence of digital methods of communication amongst the public regarding urban planning in the environment and how incorporating tools can bring the stakeholders together. Previous studies have considered the use of digital technology and its applications within public consultations in order to improve responses from the public (Boland et al, 2021). By examining the current state of urban planning via mixed methods (predominantly qualitative), this thesis begins to query the use of digital tools currently used within the construction industry to better communicate with the public. Specifically, the use of Building Information Modelling (BIM) is examined as a digital tool for public consultations. To validate the findings of this thesis, a series of recommendations are provided which expand the capabilities of BIM within the public consultation process.

1.1 Research Background

A key characteristic of most public consultation methods is that they require citizens to be physically present at a particular time and place (Ministry Communities Housing Local Government, 2018). This has begun to change with digital methods gaining approval and research (Boland et al, 2020). However, as noted by Kleinhans, Van Ham, and Evans-Cowley (2015) there are limitations of time and costs in the process of policy-making, a lack of motivation among citizens, a lack of citizen expertise or difficulties in including socioeconomically disadvantaged and less articulate groups in the process. The concept of a planning paradigm (coined by Kuhn, 1970) has aided the examination of what makes a productive consultation method (Muller, 1998). Amongst these paradigms and theories are those that would be recognised as participatory planning (Healy, 1998), a theory informed by the concepts of communicative rationality (Habermas. 1985) and understanding the role of a planner as a mediator.

A mediator acts to include the public democratically in their built environment. Research within participatory planning theories considers the adoption of participatory tools by planners to provide normative insights on ways of creating collaborative processes that are inclusive, fair, and communicative. Nevertheless, planners have

found it difficult to keep up with society's changing communication styles and attitudes towards a shared built environment. For instance, in the last decade, there has been more interest in environmental preservation (Miller, Hauer, & Werner, 2015), and the use of digital technology for decision-making within public consultations (Boland et al, 2020).

Many authors have commented on a shift in the planning paradigm with regard to incorporation of technology into the planning process. Gordon (2011) suggested further practical steps in planning that could incorporate the introduction of technology, especially to discuss changes in the built environment within the public sphere. The application of digital tools can span different uses for designing the public dimension of the built environment (Evans-Cowley & Hollander, 2010). How these tools might lead to an immersive style of planning (Gordon, Schirra, & Hollander, 2011), is reflected in the emergence of digital planning platforms in industry. Nevertheless, there is research to suggest that planners would still rely on methods they are aware that the public would be familiar with (Afzalan & Brian Muller, 2018).

In addition to this while research has focused on more technological means (Potts, 2020; Gordon, Schirra, & Hollander, 2011), in practice planners in the public sector is restricted by tradition and circumstance (Houghton, Miller, & Foth, 2014). Alizadeh (2017), expressed that the age of digital planning has been embedded in social media, and social media has been useful brining planners into using more technical means of public consultation. Social media platforms are developed by third parties for social or other purposes and are not designed for urban planning, thereby limiting their effectiveness in consideration of the built environment.

There has been broad research into the value of producing 3D models for public consultation (Polys et al, 2018; Lovett et al, 2015). It reflects a geographical interpretation visually and might add potential value to the consultation. Tools such as Geographic information services (GIS) have been essential in the ongoing research of collaborative digital tools (Gordon, 2011). GIS is a digital map accessible via technology like mobiles and personal computers. The map can then be overlaid with further information regarding an area for viewers to browse (Brown & Kyttä, 2014). Over the last decade, users have become accustomed to a bird's eye view of an area, with access to sites such as Google Maps. Planners, similar to many other professions within the construction industry, are likely to adapt to technology, however, they might not use potential digital tools due to being unaware, having a lack of time to trial these tools, and being unable to afford pioneering tools (Houghton, Miller, & Foth, 2014). Urban planning documentation consists of approved copy and graphics (drawings, specifications, information, plans, schemes, maps, passports of buildings, etc.) that

regulate planned usage of the area. While this will usually be scanned and shared via cloud technology, connecting data is lagging between planners, the public, and the construction industry. Since The Ministry of Housing, Communities and Local Government ‘s (MHCLG)’s white paper; ‘Planning for the Future’ (2020), there has been more discussion regarding the potential of technology for understanding land usage better, increasing better community engagement, facilitating communication and driving better decision making.

Collaborative technology has been widely adopted for stakeholder engagement in other construction processes through the introduction of the Building Information Modelling (BIM) methodology. BIM provides a common file format for data exchange, which means complex designs can be interpreted across disciplines. The network of BIM specialists, spanning a diverse a range of sectors, including engineering, architecture, construction, facility management, environmental, etc., is becoming increasingly dense (Wang et al, 2020). This is a clear step away from the tradition of a single broker of BIM within a prject team. In short, it is no longer an efficient model to have a single professional using such technology within a project. Educating professionals in different aspects of the construction industry is a worthwhile endeavour, as early adoption of BIM is proven to reduce common industry challenges such as wastage (Eastman, et al, 2011), regardless of the size of the project (Garcia, Mollaoglu, & Syal, 2018). BIM is currently being pioneered by early adopter professionals who are leading the industry (National BIM Survey, 2021), but driven only by its current users, so is limited in its expansion into other areas of the industry. While BIM or similar tools could be useful for public consultations, BIM is restricted as a communication methodology amongst internal stakeholders (project teams) and is not currently established in the professional field of regulatory planning.

This thesis builds on current research into digital planning tools and explores the challenges faced when engaging in a public planning consultation. Through exploration of BIM as a medium for conveying planning proposals, the thesis widens its scope of what is interpreted as a stakeholder and seeks to understand what further digital toolscan bring to public consultation.

1.2 Research Aim, Questions and Objectives

The aim of this thesis is:

To examine the capabilities of digital tools for BIM that would serve to encourage participation in an urban planning consultation.

The research questions (RQ), research objectives (RO)are as follows:

RQ.1 What are the advantages and limitations of the current planning consultation methods?

- RO. 1 Study the current of public consultation methods used in urban public planning.
- RO. 2 Explore the digital tools within the urban planning public consultation.
- RO. 3 Examine BIM and its characteristics when used within the consultation process and design process within a project development.

RQ.2 What is the relationship between the information required for BIM and the information required for public engagement at the point of conceptual design?

- RO. 4 Understand what BIM can bring to the planning process within a planning application for a building project.

RQ.3 In what ways does the public engagement aspect of the planning consultation process need to be extended to incorporate BIM?

- RO. 5 What is the impact of using BIM visuals in a public consultation?

The overarching theme common to all research questions is the role of potential stakeholders within a public consultation. In doing so the thesis contributes a taxonomy of stakeholder's including the external and internal within an urban planning consultation additionally exploring their approaches to consultations.

The next sections elaborate on each of the research questions raised within this thesis.

1.2.1 RQ1. What are the advantages and limitations of the current planning consultation methods?

Planning consultation is a statutory requirement in the UK (Ministry of Housing, Communities and Local Government, 2018), and there is much literature based on current consultation methods used by planners in project development. There is a specific timeline for planning integrated into the industry's plan of work (Royal Institute of British Architects, 2020), and it is noted that early consultation is best for the public to have a better understanding of a design. Nevertheless, this was shown to increase pressure on architects to produce a 'complete' design at the earliest design stages of the project. There is an additional concern that the public would not understand what is being produced by the project team (Basbagill et al., 2013). Public consultations are affected by the project team's lack of confidence in its value. Findings from a consultation are limited by the participant's knowledge.

While collaborations with the public are noted as best practice (Royal Institute British Architects, 2020) a knowledge gap has emerged as a consistent problem throughout

the public engagement process. The knowledge gap is apparent in both traditional planning practice (Gordon, Shirra, & Hollander, 2011) and within the use of technology to support this practice (Munster et al, 2017, Gordon & Silva. 2011). The choice of how to proceed relies on how planners work around these methods. The internal stakeholders' objectives of a building project might not emphasise the inclusion of external stakeholders, and Butt, Naranoja, and Savolainen (2016) argued that this leads to the public being inadequately informed of the consequences of the decisions made.

This serves to highlight the critique from those advocates of the participatory paradigm, who noted that consultations are failing to meaningfully engage citizens and are emblematic of what has been considered Arnstein's `tokenism' (Gordon, Shirra, & Hollander, 2011). This is due to the fact that there is an issue as to how planners construe public responses to consultations (Lyles & White, 2019). So, while methods have expanded in use, the industry still isolates the public (experts of the area) from becoming included in the design stages of the project. This provides an opportunity to further explore new approaches to the current practice of public planning consultations so that they provide the detail required to enable the public to make their own informed decisions whilst better understanding the consequences of any decisions made.

1.2.2 RQ2. What is the relationship between the information required for BIM and the information required for public engagement at the point of conceptual design?

The information required for the design stage of a building project is not isolated from the information presented to the public during a consultation (Adamu, Emmitt, & Soetanto, 2015). Ideas will continually be developed throughout the concept and design phase of a project, but the intention of certain ideas will not fundamentally change. What happens with wider participation is the need for clarification within the design, and in many ways, the Architectural, Engineering, and Construction (AEC) industry has resolved this within its own circles through the introduction of BIM. For example, Construction Operations Building Information Exchange (COBIE) files are needed for describing asset data which aids the organisation of later information requirements (Asset Information Requirements, Exchange Information Requirements, Operation Information Requirements) and presents much of the collated textual data needed for the production of a building. This information is provided alongside visual information created by a designer. The 3D BIM presents a visual representation of what is expected, and aids later collaborators (construction) to complete the project without any fundamental mistakes made via traditional methods (i.e., misreading blueprints).

Whilst BIM is used for articulating complex designs to professionals across disciplines, its ability to describe complex designs to the public for planning consultations is an area that requires further exploration. This raises questions how developed a design should be for the public. RQ.1 noted a knowledge gap which creates unease for how much information should be shared with the public. Planners in practice must establish a relationship and quantify whats needed for the public comprehension of a project development (Healy, 1998).

1.2.3 RQ3. Does planning public engagement need to be extended to incorporate BIM?

Planners act as the mediator between a potential project design and the public. Planners must be included in project development. BIM can support information distributed transparently, but planners must understand how to use the model before they can provide insight. Currently, planners are seen as external to their production, even though they are seen as quality assessors of a potential project by publicly elected councils (Royal Institute of British Architects, 2020). For planners viewing a project, it is through the lens of a planning application, and even though it does incorporate digital methods, such as emails (Houghton, Miller, & Foth, 2014), this is not linked to the data collated throughout the design of the building. A recent survey by NBS (2021) demonstrates the increasing adoption of BIM within the construction industry. Understanding what this technology can provide in terms of insight strengthens the relationship between the design decision makers. In doing so strengthen the relationship between stakeholders and improve confidence across the industry. Currently, the data collected through the consultation process is not guaranteed to be archived or even contextualised correctly for later collaborators (such as construction). By engaging with the information that BIM can provide in a planning consultation, the design process could recognise more stakeholders' views to improve project development. This thesis's final research question will examine how textual and visual data from a model can be incorporated into a digital tool.

1.3 Contribution to Knowledge

The research carried out in this thesis contributes to the existing literature via four distinct components of knowledge. These are:

1) The technocratic language used in public (consultation?) is a major barrier to effective consultation.
2) Integrating BIM into the consultation process can help mitigate the technocratic language barrier in building proposals.

3) Current digital tools can contribute to best practice, but the lack of a mediator makes responses difficult for planners to create actionable results.
4) Using digital information from the industry builds confidence in the planning process.

A further contribution is a taxonomy of the stakeholder within an urban planning consultation within project development. Understanding the objective and subjective focus of a stakeholder, and the origins of the stakeholder's key knowledge.

1.4 Reflexivity of the Thesis

The thesis was carried out at a time in which the normal was no longer possible. Through the pandemic, much of the industry was unable to put into action tasks for project development. The exploration phase of the thesis took part prior to the pandemic, but the validation of the thesis findings took place in the summer of 2021 during the UK Government's mandatory lockdown. In light of the pandemic, the author presents how these tools can benefit the wider community. Technology became more relied upon for connectivity in this period. This research examines the advantages of using industry tools within a consultation.

1.5 Nature of relationship with the industry partner

PlaceChangers Ltd worked with Northumbria University, as part of the European Regional Heritage Fund (ERDF) in order to encourage research projects within the North East region. PlaceChangers Ltd provides modular, easy-to-use town planning software which achieves more liveable spaces for communities and caters to a digital planning system. The company was interested in the application of Building Information Modelling (BIM) within planning software. The research of this thesis therefore began with a conversation about the potential of using such software for Urban planning, with the research direction decided by the author. The author regarded the taxonomy of the stakeholder within project development as key to understanding the place of digital tools for the future. In doing so, this became a qualitative leaning research project. The insights from this research have been shared with the industry partner, in order to help innovate the business.

The digital methods used in this case study included the PlaceChangersLtd (https://www.placechangers.co.uk), social media and emails to the community engagement officer operating the consultation.

1.6 Organisation of the thesis

The thesis is organised into eight chapters; the structure and content of the chapters are described in this section. **Figure 1** shows the process model which maps out the key themes of the thesis and how these related to the research objectives.

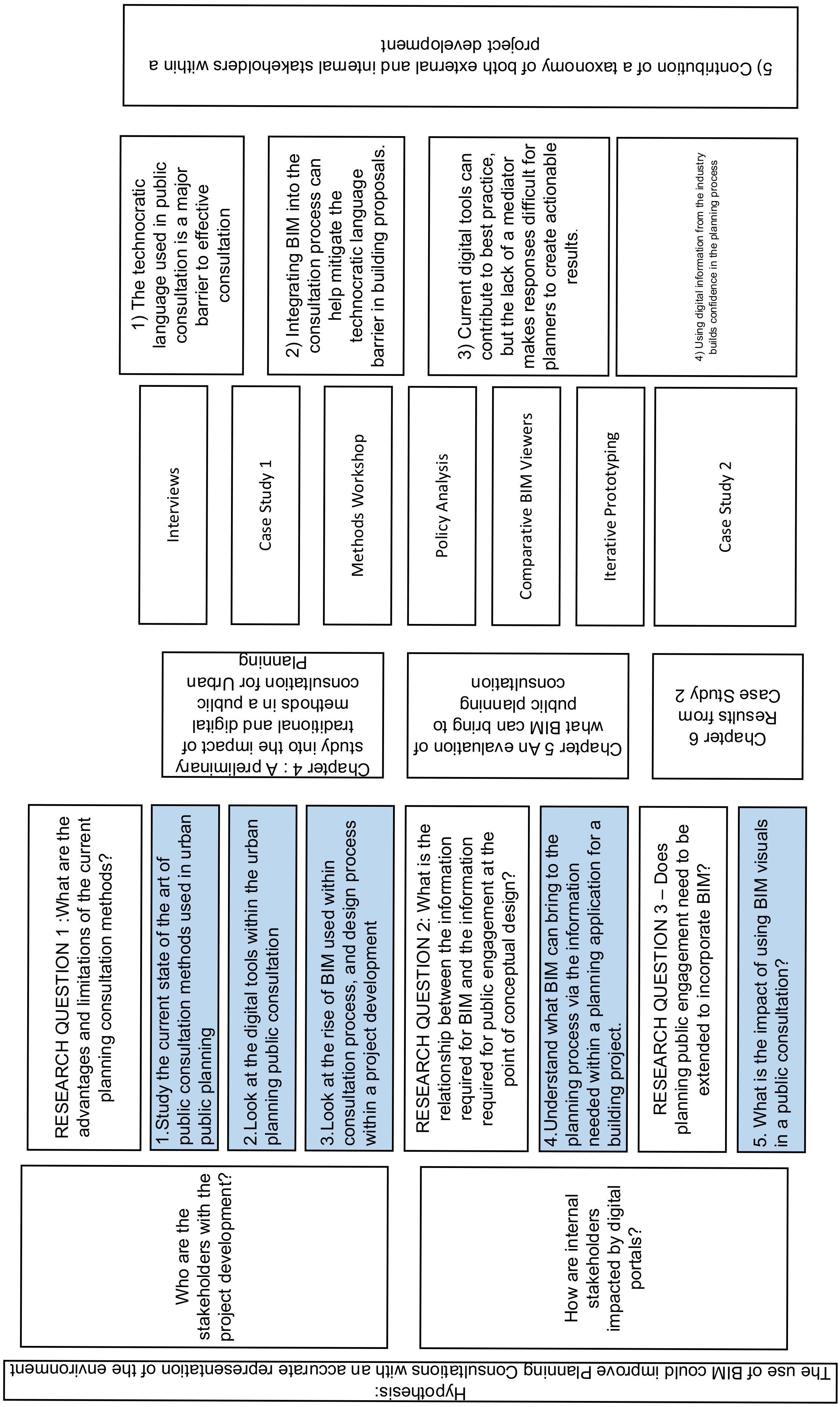

Figure 1. Diagram of Thesis Overview

1.6.1 Chapter 2 – Literature Review

Chapter 2 begins with a review of current planning practice an exploration of the history of public planning consultations, the methods developed to support practice, and the theory that underpins them. Chapter two then considers the current adoption of technological innovation within planning practice, and the existing barriers that current practice and technological integration bring which prevent the public from fully engaging with the consultation process. Finally, this chapter explores the use of BIM for stakeholder engagement and the potential opportunities it can bring to the public planning consultation process.

1.6.2 Chapter 3 Research Methodology

The research methodology is explored in this chapter to test the hypothesis; that using BIM can improve public consultations for urban planning. The epistemological framed research methodology is presented in four stages: 1) the exploratory stage; 2) data collection; 3) developing a prototype BIM platform for planning consultation; and 4) validating the findings of the study. The mixed method approach was used to research and validate the findings.

The exploratory methods, consisting of case studies, interviews and desktop research are described. The process of data collection and analysis is explained in detail; including the observational field notes, audio recording process, in-person questionnaires, think-aloud protocols, video recording, transcription, coding, and thematic analysis. The iterative process of the development of a software prototype that integrates BIM for planning purposes is set out, alongside an explanation of how the thesis validated the findings of the research (as recorded in Chapter 6). Finally, the key findings are explored through the lens of the literature (as noted in Chapter 7).

1.6.3 Chapter 4 Understanding stakeholder information needs for effective public consultation

Chapter 4 addresses RO. 1, RO. 2, and RO.3, in consideration of RQ.1, which determines where the issues and opportunities lie within the use of digital planning tools in the industry. The remainder of the data collection and analysis is completed within the subsequent chapters. This chapter clarifies the key stakeholders involved in the consultation process by reflecting on the findings of Case Study 1 the chapter clarifies certain themes of limitations and practice, these are:

- Sustaining dialogue
- Stakeholder restrictions
- Balancing regulation
- Need for a communication strategy

The summary of the chapter concludes with a reflection on how digital applications might help the concerns of the experts examined in this preliminary research and with a hypothesis that using a digital tool like BIM can aid public consultations.

1.6.4 Chapter 5 Developing a BIM enabled digital platform

This chapter goes through the process of designing a planning tool. As so to understand what BIM can bring to the planning process is the information needed within a planning application for a building project. This is done via a series of evaluation design activities exploring what information from a BIM model could be used within a digital platform model (RQ.2). The findings of the chapter demonstrated that height, access, aesthetic, and spatial information from a BIM model could be used within a consultation. The study also suggests the use of environmental data, which is noted as having the potential of being integrated into public consultations.

1.6.5 Chapter 6 Findings from Case Study 2

This chapter examines the findings of *Case Study 2, s*pecifically looking at the conclusions drawn by participants using technology, their response to news media, and their understanding of a public consultation. Demographic data is outlined and the impact of using BIM visuals in a public consultation is explored.

1.6.6 Chapter 7 Discussions and greater findings of the evaluation

Chapter 7 outlines the findings of the study and considers the requirements of the stakeholders within the planning system The chapter also highlights the ways in which BIM could be integrated into the public consultation process effectively by considering the software requirements, language, design details, landscape and recognition and layout, as well as the overarching role and rationale for the integration.

1.6.7 Chapter 8 Thesis Conclusion and Recommendations

Chapter 8 concludes the thesis by setting out the findings of the research, the recommendations for BIM integration within the planning consultation process, as well as recommendations for further work in this area of research to inform the next steps within this space. The research questions will be summarised with the author's reasoned answers. The last chapter would also consider if the findings of the project proved the hypothesis. Finally, the last chapter sets out a summary of recommendations and best practice for BIM in consultations, and incorporation of tools for planning processes.

Chapter 2 Literature Review

This chapter reviews the literature that informed the direction of this thesis by uncovering the knowledge gap. Examining within the literature the corresponding points between urban planning's reasoning for public consultations (and how it relates to the statutory regulation in the UK), and the industry's approach to stakeholder management in the design stages of the plan of works, presents a background of a complex political, social, and economic structure within the UK's built environment. The literature review explores Building Information Modelling (BIM) as a technology-based methodology for creating communication and sharing both visual and textual information within construction project teams (i.e., architects, engineers, construction). Additionally, the issues of the current consultation procedure are explored, and BIM is discussed as a potential means to bridge this gap.

2.1 Statutory Practice and Public Consultations

2.1.1 History of Statutory Practice and Public Consultations in the UK

Public planning entered political and social dialogue in the 19th Century as a direct reaction to poor housing in the UK. The prominent professional property associations, including the Town County Planning Association (TCPA), the Royal Town Planning Institute (RTPI) (founded in 1914), and the Royal Institute of British Architects (RIBA) (founded in 1834), started to invest time into understanding where consultations would exist within the project development (Skeffington, 1969). The organisation of planning associations coincided with the Town and Planning Act of 1990 which instigated the requirement for pre-application consultations with the public. It is important to note, that despite being legislated, there was ongoing confusion on what size a development needed to be in order to require a consultation, particularly without a development order. In 2011, the Localism Act was created, which defined the size of the development. The 2011 Localism Act also instigated the use of the National Planning Policy Framework, whereby individual councils were given the freedom to act upon their own design requirements within an area. This included responsibility for the economic implications of development. By incorporating the use of local plans collated by local councils, the planning authority of any area was able to have more control over the conditions of development within their area.

The purpose of external international bodies, such as the International Association of Public Participation (IAPP), is to encourage the principles of public participation within democratic countries. This correlates with the ethical codes of practice among professional planning practices, such as the practice directives of the RTPI (2011), the American Institute of Certified Planners (2005), and the Canadian Institute of Planners

(2004). These bodies act as a guiding force to what governments across the world might consider as regulation of best practice of the industry.

2.1.2 Timelines for public participation within the consultation process

Whilst there is currently an expectation that stakeholders will follow a clear progression through the consultation process (see Figure 2), defined as discovering, learning and deliberating on aspects of the project (Marušić, & Erjavec, 2020). the literature suggests that consultations do not always follow such a clear progression (White & Lyle, 2019). The role of mediation is an important one that the planner should maintain, as according to Zammit and Šuklje Erjavec (2016), planners should be able to facilitate and intervene with a range of different stakeholders. Even for an advisory role, this concept can be criticised due to the planner's disregard of the public who respond unobjectively (White & Lyles, 2019). Therefore, while consultations might be standardised, its integration with the public is often uncertain.

Timeline of Participant within Consultation				
Discovery				
	Public Consultation			
	Learning			
		Deliberation		
Learns of Project	Learning of Project / response through social media	Public Engagement - Response to plan / Community reflection	Public Engagement - Response to plans planning application results / Community reflection	Public Engagement - Response to plans planning application results / Community reflection / Ongoing Legacy of Public Relationship

Figure 2. Timeline of a Consultation (Marušić, & Erjavec, 2020)

Planners and public administrators view public consultations as valuable (Marušić, & Erjavec, 2020), but they fear losing ordered control over what could potentially be the final project development, and so rely on strict timelines to allow discovery on behalf of the public (Figure 2). In the UK, this is confined to the statutory process of planning consultations (National Planning Policy Framework, 2018) a compromise in which

internal stakeholders are concerned that without ordered control, consultations might be considered too risky. This strips away much of the artifice of planning, as good planning would be considered within the realms of a community of motivated individuals discussing the environment (Whites & Lyles, 2019). This would be done by representing public participation as a long-lasting communication strategy with real people. The figure above would then be considered part of a receptive strategy which, through the process of feedback, continually returns to the public for further refinement of public needs in the built environment.

2.1.3 Government policy

Consultations are part of the statutory planning practice within the United Kingdom, but the essence of being upheld by a legal system means that it is subject to change. Current practice includes a formal consultation with the public when a planning application relates to a development. This was prescribed in Article 15 of the Development Management Procedure Order, and as a planning obligation by a person with an interest in the land and the local planning authority (under Section 106 of the Town and Country Planning Act 1990) (gov.uk). Article 15 notes that the publicity for applications should be handled by the local government if it is a development which might impact the 'Environment Impact Assessment' (EIA) application, accompanied by an environmental statement. This is to fit in accordance with the provisions of the development in accordance with the Wildlife and Countryside Act 1981 (public rights of way) is applied (Town and Country Planning, 2015). Many developments are impacted by this as the EIA application to local government covers planning applications, subsequent applications, planning zone schemes, developments subject to a planning enforcement notice, applications to review mineral permissions, permitted development rights, applications under Section 73 of the Town and Country Planning Act 1990, as well as crown development, demolitions and EIA orders and permission (Town and Country Planning, 2017).

Details of the consultation need to be made available to the public in at least one place on or near the land to which the application relates for not less than 21 days; and 'by publication of the notice in a newspaper circulating in the locality in which the land to which the application relates is situated' (Town and Country Planning, 2015). Planning applications are published on the local council's website and include the location address and details of the proposed development such as the environmental, transport, and urban structure information. In terms of the process, it sets out the date by which any representations about the application must be made, where and when the application might be inspected, and any representation made about the application (Town and Country Planning, 2015). There are various requirements for documents

throughout this process. Planners typically follow the National Planning Policy Framework (NPPF) and create design statements and statements of community involvement as part of the planning process (Ministry of Housing Communities and Local Government, 2018).

2.1.4 Typical methods of consultation for planning

As noted in the National Planning Policy Framework, 'the planning system should be genuinely plan-led' (Ministry of Housing Communities and Local Government, 2021, p.8). Planners should know how to conduct workshops, charrettes, interviews and surveys, and how to make the case for good city form public officials, residents, and experts from allied professionals (Ellis, 2005). Table 1 below sets out a description of the tools used by planners in their consultations with the public.

Method	**Description**	**Reference**
Public applications for planning	*Mobile phone applications for urban planning*	Wilson, Tewdr-jones, Comber (2017) Wu, He, & Gong (2010) Ertio (2015)
Social media	*Utilising tools such as social media in which stakeholders are already occupying the space. This allows planners to discuss with the public ongoing planning applications.*	Alizadeh, 2017
Public Posters	*Public posters in community shared areas to allow more information about ongoing planning projects to be seen.*	Bevan, 2014
Letters & Leaflets	*Materials to be shared in the shared building environment is important for the public*	Al-Kodmany, 2001
Newspapers	*Local authorities place planning announcements*	Bevan, 2014

	in local newspapers to inform the community about the current planning applications.	
Community meetings	*Inviting the public to discuss the planning application and the designs of the development.*	Ellis, 2005; Al-Kodmany, 2001

Table 1: Sample of current methods used by planners

Making planning consultations more 'accessible through the use of digital tools to assist public involvement and policy presentation' has become more crucial for Local planning authorities (LPAs) (Ministry of Housing Communities and Local Government, 2021, p.8) Participatory planning research sets out those methods can either be considered as traditional and computerised (Al-Kodmany, 2001). A series of methods can be used for a quality preapplication in which 'discussion enables better coordination between public and private resources and improved outcomes for the community' (Ministry of Housing Communities and Local Government, 2021, p.13.) Since the emergence of the internet, there has been much discussion about what the internet can bring to the urban planning consultation (Al-Kodmany, 2001), and a series of methods has emerged (Ertio, 2015).

2.1.5 Local Plans and Consultations

The Town and Planning Act of 1990 initiated the statutory requirement of pre-application consultations with the public. Giving the public a voice regarding the built environment was further supported under the 2011 Localism Act which defined the size of the development and extended requirements to include the need for a local plan which reflected the needs of a specific area. The 2011 act required planners to use the NPPF as a set of guidelines to allow councils to act upon their own design requirements within planning. Incorporating the use of local plans, collated by the council itself, provided the local planning authority of any area with increased control over the conditions of a development. The planners, therefore, act as a regulatory figure within the industry and the built environment, though they can also act as a private guiding force for project teams to meet planning criteria. The rationality of a practicing planner has the epistemology to produce the knowledge constructed predominantly from a techno-scientific analysis and the planner's deductive reasoning (McGuirk, 2001). This invites the voices which appeal to these forms of knowing/reasoning to contribute ideas. Planners help shape the built environment through a broad national perspective of environment, economy, community, and

political incentives (Hall & Tewdr Jones, 2011). This exceeds the spatial understanding of the built environment towards community partnerships and long-lasting strategies (Fillion, Shipley & Te, 2007).

A development of a local area is drawn up by the local planning authority in consultation with the community. The development plan documents are adopted under the Planning and Compulsory Purchase Act 2004, but this was simplified under the Localism Act of 2011 which introduced the NPPF to clarify planning regulation. Various documents, such as core strategies, council plans, local plans, local development frameworks, neighbourhood plans, and neighbourhood action plans can describe the aims and requirements for a designated area (council, region, parish, neighbourhood). This can incorporate aspirations for the area's economy, agricultural land, coastal area, and ecological protection, but it is defined primarily by the area. Documents such as local plans will outline various design recommendations that should be considered in future project developments, and failure to do so can impact the success of a planning application (National Planning Policy Framework, 2018).

The local plan can consist of either strategic or non-strategic policies, or a combination of the two. Non-strategic policies should be used by local planning authorities and communities to set out more detailed policies for specific areas (National Planning Policy Framework, 2018). Local plans retain information and documents which guide the development of the area, including evidence and background studies, sites suggested and assessed for development, community led planning ideas, Local Development Schemes (LDS), Supplementary Planning Documents (SPDs) and a statement of community involvement and engagement strategy. A completed plan will state the policies needed for the provision of infrastructure and community facilities at a local level, establishing design principles, conserving, and enhancing the natural and historic environment and setting out other development management policies. Neighbourhood development plans (which are referred to as neighbourhood plans) are created by town councils and parishes to set out planning policies for smaller areas and acts to incorporate further detail for an area which might not have been covered in a local plan. It works in accordance with the local plan to identify further aspects of land that must be considered when developed. Development plans are limited in use and can be used in conjunction with the neighbourhood plan to grant permission for a single development or type of development in an area.

There are various criticisms of the current state of planning in the United Kingdom's statutory practice, as professional membership bodies such as the RTPI and TCPA have recognised that planning practitioners have failed to take on their 'inherently political' role within the everyday lives of the public (RTPI, 2015, p. 6) This implies that

the mediator relationship between industry and the public has begun to wane since the introduction of the statutory public consultations in the 1990s. Recent research has suggested that the planning process is not technically advanced enough for the 21st century. Robert Jenrick, Secretary for Housing, Communities and Local Government stated, ‘we are moving away from notices on lampposts [or printed newspapers and posted in libraries] to interactive and accessible map-based online systems’ in order to move into the 21st century (Ministry of Housing, Communities and Local Government, 2020).

The MHCLG’s white paper, ‘Planning for the Future’, is split into three pillars. The first is planning for development. There is a greater emphasis on local plans having a clear role and function, identifying what land should be developed and sites that should be protected, in order to create greater certainty about what land allocated can receive planning permission. The second pillar stated in the planning white paper is planning for beautiful and sustainable places, and this simplifies the planning process by highlighting what can be built, as well as allowing for greater flexibility in the way in which land is used to meet the changing economic and social needs of the UK (Ministry of Housing, Communities and Local Government, 2020, p.44). This white paper, published to reform the planning system within the United Kingdom, discusses the implementation of digital tools. It specifically calls for a radical, digital-first approach to modernise the planning process (Boland et al, 2021), ‘harnessing digital technology to make it much easier to access and understand information about specific planning proposals ‘(Ministry of Housing, Communities and Local Government, 2020). The next section will explore the digital tools currently used within planning practice.

2.2 Advocacy for the shift towards Digital Planning

Research into public consultations, from an urban planning perspective, has created stakeholder cohesion underpinned by the frameworks proposed by some notable frameworks, including Davidoff’s advocacy planning (1965), Friedmann's transactive planning (1973) and Healy’s communicative planning (1998). Coined as participatory planning by Kuhn in the 1970s, this paradigm aims to develop better cohesion with the public when developing the shared built environment. Arnstein’s ladder (1969) of participation sets the foundation for how different consultation practices can manipulate citizen control (see Figure 3) (1969, p.217).

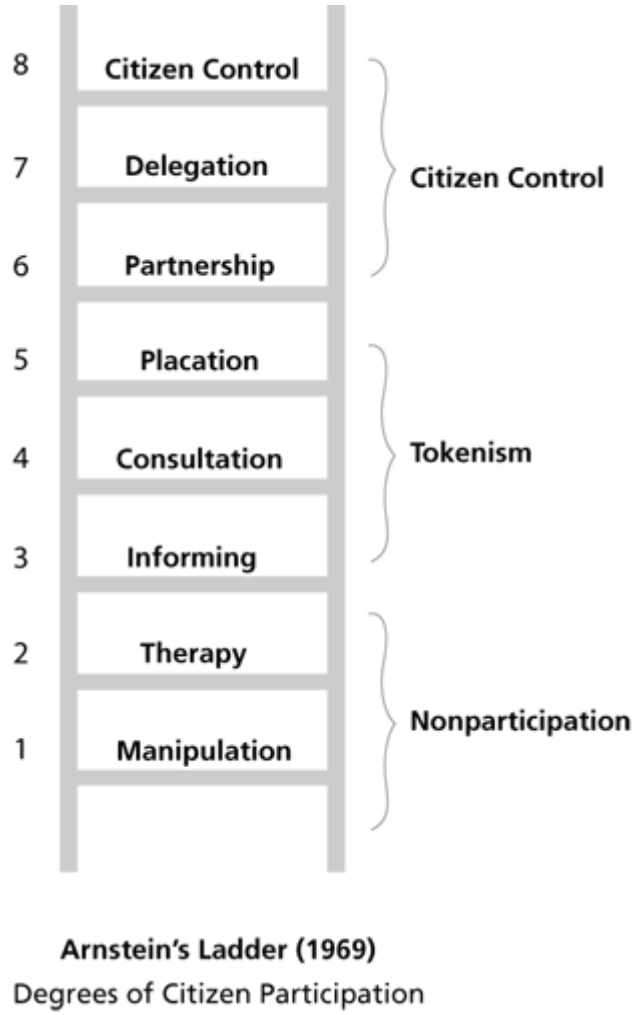

Figure 3. Reproduced from Arnstein S.R., A Ladder of Citizen Participation, Journal of American Planning Association, Volume 35, Issue 4, pp. 216–224, Copyright © 1969 Routledge

A prominent criticism of Arnstein's participatory ladder (Figure _) is that it assumes decision making within planning occurs at a single point within the process (Lane, 2005; Painter, 1992). It is important to note that currently policy only requires one point of consultation with the public (Ministry of Housing Communities and Local Government, 2021), but research has suggested that consistent dialogue with the public promotes best practice (Healy, 1998).

2.2.1 Shifting paradigms in planning

The communication and rationale of planning decisions constrain the working relationship between planners and the public and there have been numerous calls to disrupt the current system, reliant on traditional methods, in favour of more technical methods to improve communication with the public (Afzalan & Muller, 2018; Gordon, Schirra, & Hollander, 2011). Potts (2020) notes that there is a shifting planning paradigm towards Web 3.0 which establishes a new era of the internet as it presents

far more participation than just consumption (Dodge & Kitchin, 2013). Gordon suggests that there are some practical steps in the next stage of planning that will also incorporate the introduction of technology, to coincide with a society comfortable with the Internet of Things and mobile technology rooted in communication (Gordon, 2011).

The application of digital tools can span across different uses for developing the public dimension of the built environment (Evans-Cowley & Hollander, 2010), however, an overview of Information Computer Technology (ICT) demonstrates the urgent need for further research and engagement. Future trajectories for ICT planning continue to form a highly debated field between new possibilities of management and co-operation with the public. The influence of technology within planning has encouraged discussion as to how these digital tools are used within practice. With the ability to identify and collect new sources of information, there has also been consideration as to how this data should be approached within planning practice. Sentient, algorithmic, and immersive planning models are examples of the areas in which planners believe that technology can improve the planning profession.

Technology and Planning 3.0 Model	**Reference**	**Description**
Sentient Planning	Deal et al, 2017	The ability to collect, process, learn, contextualise, and present locally significant information for implementing the management and analysis of big data through the lens of a city's own geographical map.
Algorithmic Planning	Safransky, 2020	The use of citizen data to shape policy, planning and investment via an algorithm.
Immersive Planning	Gordon, Schirra, & Hollander, 2011	Replicating the function of the collaborative planning system within digital technology.

Table 2. Technology and Planning 3.0 Models

How this data should be collected, used and archived has been an important feature of the planning debate since it has the potential to impact the lives of citizens both negatively and positively. Aside from the concerns of data security, there has also been concerns raised regarding the algorithms used in such tools (Kitchin, 2017) and how a planners' decision making might be concealed from the public (Boland et al, 2021). Despite this, planners within academia are still encouraged to utilise data as it lays out the potential for smarter cities of the future.

The term 'Smart Cities' is used to incorporate references of information technology and knowledge-based concepts in the context of urban economies, such as Dutton's 'weird cities' (1987), 'digital cities', e-governance, Komnino's 'intelligent cities' (2008), the knowledge economy, and the 'smart growth' agenda (Sengupta, 2018). The concept doesn't have a clear cut definition, but a consistent feature is the use of information and communication data to create higher standards of efficiency and sustainability within a city (Hasler, 2017). These conceptualised cities can include aspects of evidence-based decision making (via big data), citizen centrality, sustainability innovation and entrepreneurialism, equality, citizen engagement, and resilience (Gil-Garcia et al, 2016). Among spatial planners, the interest in smart cities relates to the use of big data which ranges from geo-located social media to live infrastructure updates (Sengupta, 2018). The focus on cities beginning to be "smart" comes through the development of an integrated and strategic urban digital strategy to speed up the pace of change, ensuring a digital economy is a high priority (Alizadeh, 2017). Barriers to the evolution of the smart city arise from data sets being incomplete and inaccessible (Sengupta, 2018), however, planning departments still need to play active roles in the revision of the city's priorities within broader strategic planning (Alizadeh, 2017). This is made more difficult with the skill shortage that exists within planning (Houghton, Miller, & Foth, 2014).

The technological gap (Atzmanstorfer, 2014) within society directly impacts the progress of smarter cities and more effective strategic planning, especially as existing within these data sets requires technical action from the participant to be considered (Levenda et al, 2020). This has impacted smart city research frameworks, which have focused on the confidentiality, integrity, availability, and the security of smart city information (Barthel, 2020). An effective smart city would present an iterative process of identifying data for decision making (Sengupta, 2018), and so addresses data in terms of collecting, organising and analysing it in order to discover patterns. However, there are issues in relying on algorithms as it is hard to separate the single citizen from the big data (Kitchin, 2017).

The planner utilising technology is both collecting and analysing data for the purpose of decision making within the planning system. While there have been some attempts to create new tools within planning academia (Wilson, Tewdr-jones, & Comber, 2017), much of the study and practical use of digital methods comes from the use of existing digital tools (Alizadeh, 2017). Table 3 provides a taxonomy of existing tools and e-participation that have been studied for use in planning consultation practice.

Digital Tool	**Reference**	**Description**
Chatrooms	Gordon, 2011	*Utilising tools such as chatrooms (both anonymous and non-anonymous) to build urban planning conversations with the community.*
Geographic Information Systems (GIS)	Brown & Kytta, 2014 Kahila-Tani, Kytta, & Geertan 2019	*GIS has the potential to provide digital mapping and visualising technology to encourage wider engagement.*
3D Models	Kitchin, (2021) Polys et al, 2018 Lovaine, 2016	*Using 3D models, either created from scratch for public engagement or using BIM models for spatial planning.*
Interactive Screens	Roth (2013)	*Using interactive screens for the public to learn and engage with potential changes in the built environment.*
Virtual Reality (VR) systems	Bourdakis (2004) Thompson et al, (2012)	*Developing VR tools for focus groups to deliberate urban planning.*

Table 3. Digital methods/tools explored within existing literature

Digital planning has utilised various tools to date, and while there is promise, the limitations underlined in the research demands a rethink of the entire planning system (Hasler, 2017). Nevertheless, digital techniques for planning consultations are increasingly being adopted with well-documented benefits (Munster et al, 2017). Opportunities for meeting online have increased since COVID19 (Ministry of Housing Communities and Local Government, 2020; Milz & Gervich, 2021). Planners may use

mobilisation tools for a variety of purposes, such as to build attendance at public events or mobilise participation in specific projects deemed of public interest (Afzalan & Muller, (2018). However, the communication presented in these tools are not equivalent, as suggested by Kingston (2002) and set out in Figure 4.

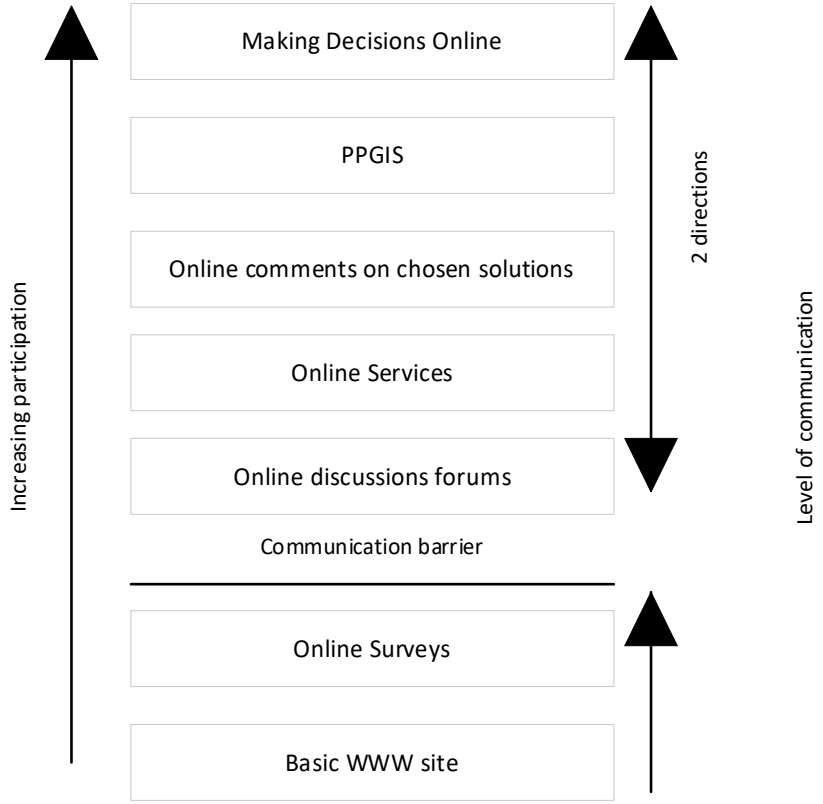

Figure 4. Kingston's (2002) Ladder of e-participation

Within the realm of planning there are various methods, spanning non-specific and specific digital tools, which can be used to reach out to the public.

2.2.2 Non-specific digital tools

These are defined as the tools that are used within planning consultations but were not specifically designed as a planning consultation tool. Social media, for example, is a tool that is used to communicate planning consultations, though it wasn't purposely designed for that activity. Implemented correctly, non-specific digital tools can facilitate a diverse discussion over common concerns (Hollander, 2011). Social media and sharing platforms can reach communities online without the greater cost of implementing (new?) systems by public planning officials. Established social media platforms have already helped planners explore the current dialogue between citizens and city landscapes (Afzalan & Muller, 2018). However, as these tools are not purposefully built for the planning system, it can be problematic to involve them as a single method to reach out to the public. While the discourse of active citizenship, financial austerity and government retrenchment favours citizens taking matters into their own hands, seeking citizen involvement through social media and mobile

technologies will probably increase the workload (Seltzer & Mahmoudi, 2013). Agencies need to be prepared to manage new flows of information and ideas from citizens (Kleinhans et al., 2015).

2.2.3 Specific digital tools

Planning support systems have reconceptualised the space of planning via the use of technology in planning practice, as these decision-making support systems incorporate earlier planning theories to produce predictive models of the area (Choi & Lee, 2016). The incorporation of further digital methods in spatial planning has created interest in using digital methods for further areas of the planning practice, including areas of communicative planning with the public.

Neighbourhood forums such as Nextdoor have been able to mobilise actions at a local scale by helping people organise in-person gatherings (Ertio, 2015). These online forums can build trust and develop self-organised communities and foster social mobilisation or collective networked action at the local level (Sawhney et al., 2017). Presentation is key for planning portals and digital platforms. Using methods that span across community workshops and tools with the interactive components, such as CommunityViz (Salter, 2008), something that creates an aspect of full immersion might better present proposals in urban design (Jutraz, 2016). Crowdbrite facilitates brainstorming through combining online and face-to-face interactions (Hamilton, 2014); MySideWalk (Erraguntla et al, 2017) and PlaceSpeak (Hardwick, 2012) provide interactive online discussion forums; CitySourced crowdsources citizens' requests; and NextDoor facilitates neighbours' social interaction. While each one of these tools has unique capabilities, they all use the internet to facilitate collaboration or interaction (Afzalan, Sanchez, & Evans-Cowley, 2017). This has expanded from desktop to mobile applications, such as MapLocal, which enable wider engagement with early phases of planning processes but may simultaneously face attempts by growth-oriented urban planners to marginalise dissenting voices in order to promote the interests of powerful developers (Kleinhans et al. 2015). Consultations can be improved with the use of surveys, twin cities, digital platforms, Participatory Geographic Information Systems (PGIS), and heat maps (Brook, & Dunn, 2016). There is also more flexibility provided to the information that can be produced with the use of technology. For example, Virtual Newcastle and Gateshead (VNG) can generate a City Information Model (Thompson, et al, 2012). Thompson (2016) proposes the use of integrating planning data, together with a geometric visualisation, to improve the practice of spatial planning amongst practitioners. This suggests non-specific tools can support a better communicative strategy and produce better perspectives to aid public understanding of planning proposals.

2.5.4 3D Models

When compared to traditional planning consultation processes using 2D artefacts, the application of digital techniques, such as web-portals and three-dimensional displays, enable more practical dialogue with the community (Gordon, Schirra & Hollander, 2011). From Salter's research into interactive visualisations within a planning workshop, the modelling tool was shown to make the participant feel more comfortable addressing issues, than prior to viewing the 3D display (2009). It was proposed that in using digital tools, platforms can present aspects of the real world, integrate 3D visuals, provide the ability for participants discuss their views and collate this information as a collaborated vision for the future. Figure 4 sets out how a collaborative planning tool would collate views to then be fed back into the consultation process.

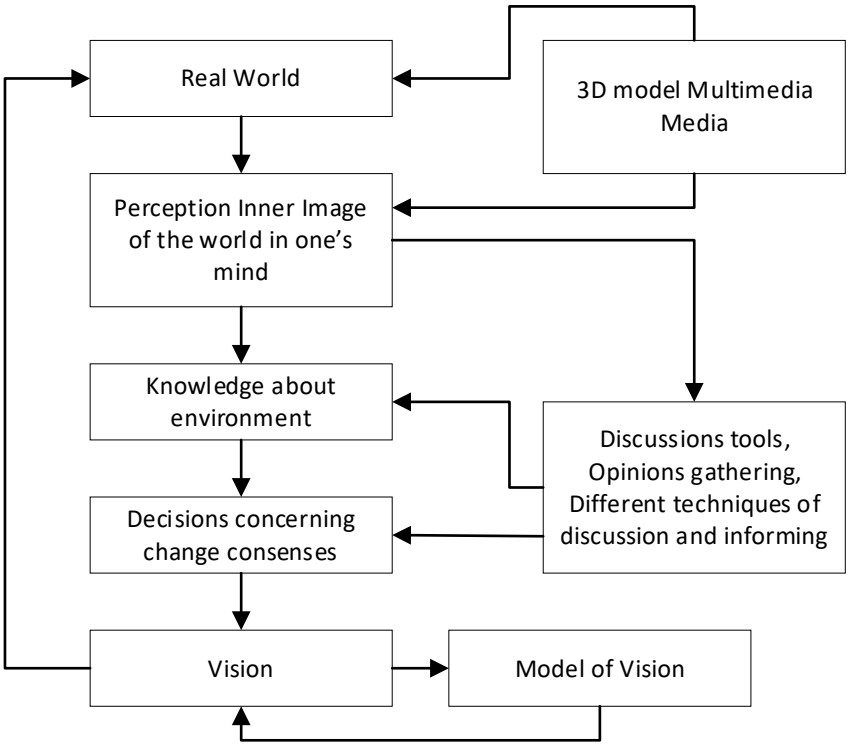

Figure 5. Diagram demonstrating an Informatoin Technology as a tool for public participation (Hanzl, 2007)

Visualisation, presentation, interaction, and display methods have often been described as advantages of a 3D system (Lovett & Appleton, 2015). When researching urban design and its potential in empowering participants, it is important to represent the design's empowerment goals and the expected capabilities of participants as well as the functionality of the systems provided by the planner (Gun Demir Pak, 2019). While Figure 4 presents a clear interpretation of how digital public consultations would impact building development, it does not incorporate the internal functionality of the construction industry. Researchers have suggested that visualisations offer a more suitable medium for clarifying certain complex data than the written word or voice alone

can offer, due to the lack of technical language needed to describe alterations or design elements (Gill, 2013; Tufte, 1990). With the increase of BIM to support public consultations (Milovanovic, Moreau, Siret, & Miguet, 2017), there is substantial evidence showing that 3D models are easier for non-experts to understand than 2D technical CAD drawings during consultations (Gill, Lange, Morgan & Romano, 2013; Appleton & Lovett, 2005).

2.3 Industry stakeholders

Due to the span of the construction industry in the UK, it is not always clear how to explain who a stakeholder of a project development is. This section of the literature review focuses on the perspective of planning professionals and project management who identify stakeholders to for improving design ideas for a project development. Internal stakeholders are clearly indicated within industry literature as part of the project team (Royal Institute British Architects, 2020) and those who would directly gain from a building project (Freeman, 1984).

2.3.1 Stakeholder management theory

There is a significant number of studies that have tried to demonstrate that being socially responsibly or serving a purity of stakeholders leads to competitive advantage or an improved financial performance (Margolis & Walsh, 2003). Project management could be considered as having moral obligations to the other constituents, as it impacts more than just the stakeholders who gain economical value from a project. Project development can balance various interdependent relationships. Value from stakeholders cannot be maximised, but the creation and distribution of value to a variety of stakeholders can improve the projects chances for success. Successful project development relies on the cooperation and support of the stakeholders themselves. Therefore, key decision makers have ethical commitments to moderate the relationship between stakeholder management and stakeholder commitment to foster cooperation. In the stakeholder view, the ultimate purpose of the firm is the combined production of economic and social welfare (Minoja, 2012).

2.3.2 Project management

Building projects usually have various resources that are carefully monitored, for example, plans of works, organisation of roles, budgets, and tasks. (Royal Institute British Architects, 2020). Stakeholders are also carefully observed. Tasks must be completed within a specific scale of time, and the public who are aware of the potential project should have a positive attitude towards it. This can be complicated as the professionals are directly involved with the design, operation, preservation, and development of the built environment' (Hartenberger, Lorenz & Lützkendorf, 2013). In communicating with the public, stakeholders are not only trying to communicate ideas,

but to translate public reservations back to the designers of a project (Butt, Naaranoja & Savolainen, 2016). The degree to which this is applied differs in practice (Olander & Landin, 2008).

Recognising the importance of engaging end users in the building design process has received increasing emphasis since the Grenfell Disaster, with community responsibility becoming a larger focus within industry (Hackett, 2018.) The revised plan of works identifies stakeholders, including specialists from planning departments, building control teams, utilities companies, community groups, environmental bodies, specialist interest groups and insurance and warranty providers (Royal Institute British Architects, 2020). When incorporating the public or external stakeholders, utilising management tools, stakeholder identification and narrative building is all part of the project strategy to reduce risk to the economic and social outputs of the project (Davis, 2016). Projects are considered successful when communication is built and maintained with external stakeholders and the project develops in a way that minimises the negative impacts of changes to the built environment (Olander & Landin, 2008).

The industry has recognised that a good relationship with external stakeholders (the users that inherit the use of a building e.g., facility management) can lead to better project outcomes (Royal Institute British Architects, 2020), and subsequently become part of best practice. RIBA has used a long standing Plan of Works to develop the industry. The recently revised plan of works reflects the substantial shift with the future objectives of the built environment alongside the industry's trepidations towards sustainability and responsibility (Royal Institute British Architects, 2020). While usually there are no contractual agreements, project managers are advised to manage the contributions and involvement of these groups. This is the accepted cohesion from established stakeholder's (such as the client team, design team and construction team) the risk of engaging with external stakeholders should complement the success of the project's mission, vision, and objectives (Davis, 2016). Methods such as Soft Landings have become more prominent in recommendations for building strategies, as they encourage strategies such as plan for use, and inclusive design, to incorporate external voices in the design process (Royal Institute British Architects, 2020). This reflects the last decade's anxiety towards accountability and acknowledges the industry's discourse towards tighter commitment to planning to avoid disruptions.

2.3.3 The role of planners

Planners act as a regulatory figure within the construction industry and the built environment, though they can act as a private guiding force for project teams to meet planning criteria. The rationality of planning has existed with an epistemology to produce a practice whereby 'knowledge is constructed predominantly through techno-

scientific analysis and deductive logic, and through the privileging of voices which appeal to these forms of knowing/reasoning' (McGuirk, 2001). Planners help shape the built environment through a broad national perspective of environment, economy, community, and political incentives (Hall & Tewdr Jones, 2011).

Historically, planning in the United Kingdom has questioned the place of public engagement in the planning structure (Fillion, Shipley & Te, 2007; Brooks, 2002; Healy, 1999) and this has developed with the evolution of Online Participatory Tools (OPT) in planning stages (Afzalan & Muller, 2018). Still, the underlying challenge of public consultation remains unclear in urban planning; with a lack of education as to how professional procedure might be improved (Munster et al, 2018). The challenge for planning specialists in the United Kingdom is to create a significant step for the practice in which its innovation stands equal amongst the rest of the construction industry.

2.3.4 Stakeholder relationships

The stakeholder is a specific character focused upon regulatory practices (such as urban planning) that is directly impacted by the decisions of others. Who the stakeholder is, however, can vary within these practices. Project developments consist of a complex design phase entailing the interactions with different stakeholders, including clients, contractors' designers, and local government authorities (Molwus et al, 2017) with internal stakeholders recognised as the decision-making party of the project (Cova & Salle, 2005). External stakeholders are not a decision maker within this process. When stakeholders are identified within the industry, the roles and responsibilities are monitored by project leads and this incorporates internal stakeholders (Davis, 2016) and the project teams who are contracted to work on a project. It is the project lead's responsibility to maintain the communication throughout the project lifecycle with a focus on the project management consultant's communication with end-users, ensuring "end-users' understanding about the engineering design and to translate their reservations for the engineers and architects" (Butt, Naaranoja & Savolainen, 2016, p.1593). The role of stakeholder management is to adapt the project's plan of work by integrating a framework of outreach for external stakeholders (Oppong, Chan, & Dansoh, 2017). Projects are considered successful when communication is built and maintained with external stakeholders and the project develops in a way that minimises the negative impacts of changes to the built environment (Olander & Landin, 2008), and by doing so, arbitrating the future of the built environment amongst all stakeholders.

Stakeholder Type	**Definition**	**Reference**
Internal Stakeholders	The decision makers of a project.	Cova & Sava, 2005

Internal Stakeholders	Roles are coordinated amongst project teams for various decisions to be made within a project.	Davis, 2016
Internal and External Stakeholders	Project leads define the communication shared amongst internal stakeholders and external stakeholders.	Butt, Naaranoja, & Savolainen, 2016
External Stakeholders	Engaged through the aid of a stakeholder management framework.	Oppong, Chan, & Dansoh, 2017
External Stakeholders	Engaging is facilitated via a set of required tasks to communicate ideas.	Shipley & Utz, 2012
External Stakeholders	Engagement must be managed to negate negative impacts within a project.	Olander & Landin, 2008

Table 4. External and Internal Stakeholders as described in the literature

While the approaches to public consultation in stakeholder management and participatory planning differ, they do co-exist in industry practice. This is because, by its very nature, construction is a disruptive process that alters the built environment. Construction projects can detrimentally affect the geographical neighbours and users if carried out without observing their requirements.

The requirement for better communication with external stakeholders, is well documented in the paradigm of participatory planning (Shipley Utz, 2012; Hall & Tewdr Jones, 2011; Lane, 2005, Innes & Booher, 1999; Healy, 1998; Arnstein, 1969) and Freeman's approach to stakeholder management has influenced a collection of works within project management since 1984 (Oppong, Chan, & Dansoh, 2017, Aaltonen & Kujala, 2016, Davies, 2016; Butt, Naaranoja, & Savolainen, 2016, Olander & Landin, 2008, Freeman, 1984).

There are ongoing challenges for relationships within the industry, as multiple stakeholder groups do not always acknowledge one another, and there is limited communication between the internal stakeholders who develop and produce the project and the wider public who are external stakeholders connected to communal space (Cillers & Timmerman 2014). How stakeholders (external and internal) link is not usually discussed within literature unless it is in regard to how one might communicate

with the other. For instance, Stakeholder management (teams?) will adapt a project's plan of works to integrate a framework to contact external stakeholders (Oppong, Chan, & Dansoh, 2017), as to negate risk. In doing so, the concept of engagement is not seen as a heuristic activity, instead it is perceived as a task for internal stakeholders to carry out in order to improve a project's output.

Using the stakeholder management and planning literature (Table 3) the various roles within a building project can be categorised as either an internal or external stakeholder (figure 6). Figure 6 sets out the relationship between external and internal stakeholders (specifically regarding a building project) as an interconnected network with direct flows of responsibility between internal stakeholders, and potential links to external stakeholders who will inherit (socially and economically) the project after completion.

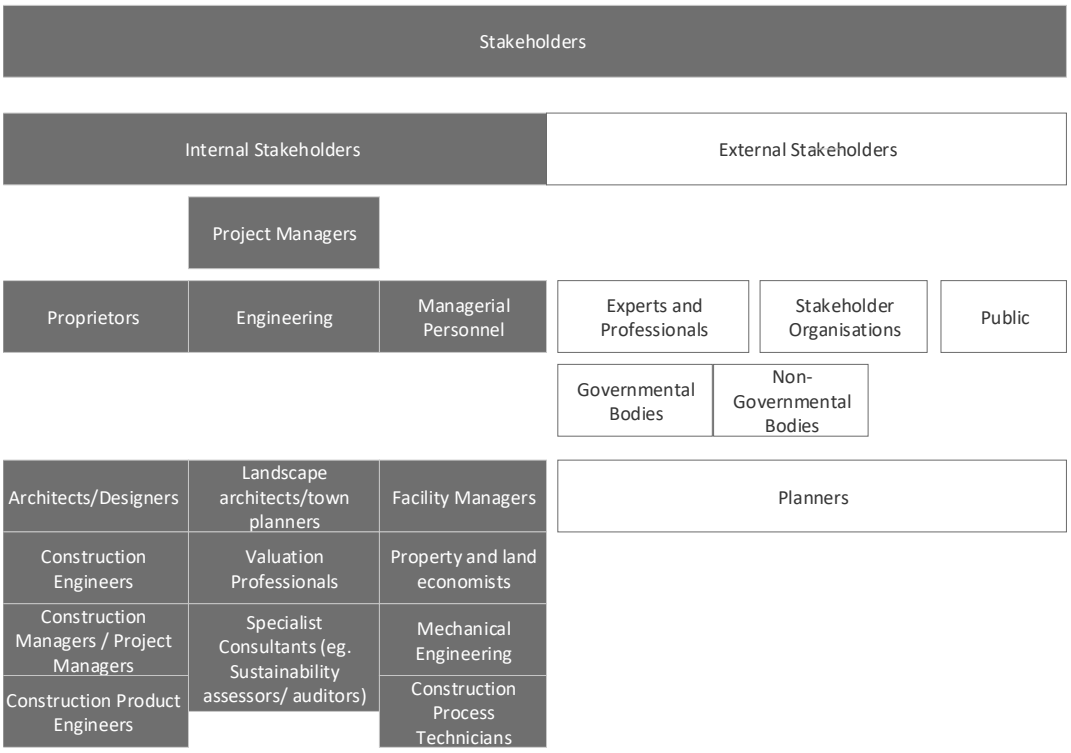

Figure 6. The roles of external and internal stakeholders

Where changes to the built environment are planned, there are many perspectives on how the proposed changes will impact the environment and the users connected to it. Not all perspectives are considered equal, and the influence stakeholders have on a design is dependent on who is leading the consultation and their motivations for engaging the stakeholders involved.

Urban planning can view the relationships between internal and external stakeholders in a multitude of ways (Lane, 2005), with an overview of these theories, the stakeholder relationship is a collaborative activity. One less of management, and that relies on the

negotiation between the social, economic, and political lines of the shared built environment. Communicating with external stakeholders is explored in the paradigm of participatory planning (Shipley & Utz, 2012), especially as planners look towards building further institutional capacity for collaborative action within urban planning (Healy, 1998). The rationale is that advocation for greater quality understanding between all stakeholders involved in development suits a democratic society best (Cillers & Timmerman 2014). It is harder to source views from an external stakeholder and identif those who are most likely to inherit these projects in the built environment (Davis, 2016).

Understanding what an external stakeholder means within the context of the construction industry relies on a social and political perspective. The impact of a building project will affect professionals, organisations, and the public physically, thus why material planning considerations must be adhered to. Governmental bodies and non-governmental bodies will be impacted if stakeholder unease is brought into the political focus. Planners would then be involved in their role as acting mediators. Within the context of a democratic state, it is typically an elected government official (Local Government or Central Government), who is also able to address concerns as a representative of the community.

Stakeholder management is more rigid and relies on stakeholder identification and a clear roadmap to avoid potential discrepancies that external stakeholders highlight through the project's inception (Davis, 2016; Butt, Naaranoja, & Savolainen, 2016). Within the context of project development, it is a question of who is the decision maker that shapes the perception of who might be viewed as a stakeholder. Project development teams will rely on both internal professionals and sub-contractors to complete a project; however, it is project managers and the client who will fundamentally have the largest investment and the final decision on a project. In doing so, they will decide who is an internal stakeholder.

2.4 Challenges in current planning practice

Despite the accepted benefits of planning consultations, there are still many issues regarding the delivery of consultations and the practice of capturing meaningful feedback from the public to inform project designs. As noted in the work of Healy (1997), there is a disconnect between the language between mediator and that of the public. By examining the literature of participatory planning and project management, it's clear is not just a communication problem, but there are specific implications arising from miscommunication, including misunderstanding the stages of planning and the technocratic language used within these interactions.

2.4.1 Planning Stages

A prominent criticism of Arnstein's participatory paradigm is that it assumes decision making within planning occurs at a single point within the process (Lane, 2005; Painter, 1992). However, a project leader would recognise that within a project's lifespan there will be various planned and unplanned decisions made, and it is through project management that these are organised through a set plan of works (RIBA, 2020). The statutory requirement for public engagement makes it difficult for planners to address what aspects of the design can be altered at certain times of the project's development (Munster et al., 2017) and this can be further constrained by the present-day practice, with decisions related to building component selection usually postponed until the detailed design stage (Basbagill et al, 2013). This mismatch of information released to the public can create confusion amongst participants as to what might be a useful contribution to future decisions and thus inhibit feedback to current design plans. Complex design issues presented earlier in a project lifecycle when concepts are unformed are 'hard to convey to non-specialists' (Munster et al., 2017), even though they are less problematic to influence and re-direct (Davis, 2016). The public is often not aware of the stages within a project, and it is often the role of the mediator of a consultation to direct participants through the current phase (Brooks, 2002). Furthermore, there is a lack of interest coming from developers into public consultations due to the uncertainty of economic and social returns (Butt, Naaranoja, & Savolainen, 2016).

While it is widely accepted that earlier engagement can easily translate into design amendments (RIBA 2020), public engagement often may not be implemented until later in the project's development, and thus internal stakeholders must rely on a design plan interpretation within a consultation that results in informing, rather than consulting, as part of the stakeholder management (Davis, 2016). The internal stakeholders' objectives of a building project might not emphasise the inclusion of external stakeholders, such as the public, and so, 'if project stakeholder meetings become ineffective, in-prompt decisions are made outside the meetings' in order to rectify any scheduled time lost within projects (Butt, Naaranoja, & Savolainen, 2016, p.1580). As a result of this, the public is rarely informed about decisions and 'understand the consequences of those informed decisions only inadequately' (Butt, Naaranoja, & Savolainen, 2016, p.1580). This all serves to highlight the critiques made by advocates of the participatory paradigm who note that consultations are failing to meaningfully engage citizens and are emblematic of Arnstein's `tokenism' (Gordon, Schirra, & Hollander, 2011).

Establishing this idea that public engagement might have erroneous significance should be documented, as it implies that the industry has taken an arm's length

approach to public engagement due to a professional distrust of the effect of an unrestricted consultation (Butt, Naaranoja, & Savolainen, 2016). Since the mandating of public consultations in the early 1980s, the typical stakeholder has not had their role expanded other than in the expected responses to a consultation. It is less likely that more experimental immersive public engagement opportunities would be approached to foster deeper understanding. Project teams can fail to view the public consultation as valuable and just a statutory requirement performed. Exacerbating the problem is that the system only requires project teams to produce evidence of a single consultation haven taken place. There is no further advantage for further engagement with the community.

While the industry hails the importance of stakeholder engagement at early stages in order to develop relationships and avoid 'inappropriate social interactions,' there is not much assessment of these external networks within the context of success (Davis, 2016). Instead of engaging with the consultation process, data is taken directly from public engagement and integrated into the architectural design phase, however, its context is not taken forward. Information disseminated by the public is altered by architects and developers into a form which better fits the narrative of the project.

2.4.2 Technocratic Language

Technical language used in consultations creates barriers to non-specialists, as the project team's input, expertise and decisions are typically applied prior to public engagement. Due to this it creates a technocratic styled language gap. This knowledge gap is an underlying issue affecting public engagement as participants are seen to be influenced by their prior understanding and level of knowledge (Munster et al., 2017). Expert language is criticised for creating obstacles in public engagement (Conroy & Evans-Cowly, 2006). Gordon, Schirra, and Hollander (2011) attribute this to creating a technocratic hierarchy between facilitators and participants. Research into the planning process has identified the existence of disadvantaged and non-articulate groups within the population (Ertio, 2015), however, this thinking has led to projects that focus on specific social, geographical, and economic groups. Those who engage with the planning system are seen as the "usual suspects" (Kaika, 2017) who provide unwanted emotional language to the planning system (Lyles & Swearingen White, 2019). This usually overlooks the public's own comfortability with engaging with the democratic process (Arnstein, 1969).

Explaining specialist terms to the public (due to lack of planning literacy) gives them the ability to understand decisions within the realms of planning (Gordon, Schirra, & Hollander, 2011). Many digital applications promote citizen-centric design, aiming to collate citizen knowledge (Ertiö, 2015), without guaranteeing a participant's

understanding of the planning designs. Standard approaches to presenting plans (such as detailed architectural models, drawings, or maps) are difficult for non-experts to understand and this can create an impression of lack of transparency and commitment to consider public opinion (Münster et al., 2017).

For the next generation (including native and immigrant communities) engaging with planning, the technical language used in consultations often serves as a barrier to non-specialists. Designs that require professional expertise are made before public engagement and left to the planner as a mediator to explain these decisions. If not disseminated correctly this can lead to further confusion. Expert language has been criticised in creating boundaries in the engagement phase (Conroy & Evans-Cowly, 2006), and it maintains a technocratic hierarchy between engagement facilitators and public participants (Gordon, Schirra, & Hollander, 2011). Consultations necessitate a mediator (Mazza, 1995), which is often the responsibility of the planner, however, this reduces (the quality and quantity of?) feedback through the narrative of the masterplan.

Standard methods to present urban plans (such as detailed architectural models, drawings, or maps) are not necessarily easy for external stakeholders to understand (Münster et al., 2017). As a result, planners are required to explain a project's status and reach a consensus of understanding with the public as to what is being built. A reliance on physical exhibitions to communicate planning ideas is usually only acknowledged by a fraction of the population, as potential contribution is often restricted by unsuitable times for the public. This literature frames the planning process as lacking in transparency and a strong enough commitment to communicate with the appropriate users of the built environment (Münster et al., 2017). This is exacerbated by the participants, whose own prior understanding influences their understanding of these plans (Munster et al., 2017), and their own level of knowledge of the project. Therefore, it remains a challenge to remove previously held beliefs within a public consultation's small timeframe.

Project management research suggests that even when designing communication routines, stakeholder identification and analysis models can be insufficient to ensure stakeholder engagement (Butt, Naaranoja, & Savolainen, 2016). As a result, there has been scepticism around the data produced by public engagement and its effect on the building project. In Butt, Naaranoja and Savolainen's research, they found that the varying level of stakeholder know-how made communication routines ineffective during the project implementation phase, with "the sub-contractors evidently overlooking the end-user opinions considering their lesser know-how about the construction process" (2016, p.1593). The constraints of knowledge and technical insight continues to create a divide between external and internal stakeholders of the built environment, with

internal stakeholders utilising models of management to direct external discrepancy away from notable consultations regarding the development project.

2.5 The Potential for BIM in Planning Consultations

The primary criticism of the construction industry usually relates to the poor flow of information among stakeholders (Al-Ashmori et al, 2020). The introduction of BIM, a recent part of the industry's development, saw the adoption of a system which provides access to 3D visual models augmented with qualitative and quantitative data (Paavola, & Miettinen, 2019). BIM has been defined within the industry as a central means of improving the productivity amongst project teams (Eastman et al, 2011). While technology is revitalising the construction industry, it has been a contentious subject within urban planning. The absence of suitable methods for communicating information to communities has led to a reduction of public interest over time (Gordon, Schirra, & Hollander, 2011). There has been a rise in the use of 3D spatial models to aid planners via comprised datasets (Kitchin, Young & Dawkins, 2021) and organise project teams (internal stakeholders) as project management (Gaur & Tawalare, 2021). The same [be specific here] has not been the case for external stakeholders. There remains a professional distrust of the consultation process, due to concerns over producing unpredictable and possibly costly responses affecting the design and construction schedule of a project (Butt, Naaranoja, & Savolainen, 2016).

While CAD has been a fundamental design tool for architects for many years, the use of BIM now challenges the traditional practice of design collaboration in building projects amongst all other project team members, especially for those in construction (Paavola & Miettinen, 2019). This has challenged the current status quo of the industry as digital methods become more effective for delivering information between the stakeholders within the building project.

Using BIM, project teams can share information involving a building via a cloud-based system. This is perceived as useful since much of the information can occasionally get lost amongst traditional paper-based management systems (Czmoch & Pekula, 2014). Additionally, the traditional tools of trade were constrained by stakeholders not having access to specialist CAD or related software to view building artefacts. BIM offers a solution to internal stakeholders with the ability to view the project from various perspectives (i.e., geometry, spatial location, and a scalable set of metadata properties) (Tang et al, 2019). Whilst there is substantial research on the artefacts and objects, such as visual representations, sketches, drafts, drawings, and prototypes used in design (Paavola, & Miettinen, 2019), researchers and advocates are still in the process of exploring the capabilities that BIM can offer users within the construction industry. In exploring BIM's capabilities, researchers have explored the advantages of

using 3D models within the design process amongst architects. By incorporating communication tools as an integral feature, BIM attempts to address the lack of dialogue in the construction industry (Eastman et al, 2011), and has drawn attention to the significance of communication within a project, especially when for client, customer, or user involvement (Davis, 2014). BIM has the potential to facilitate further aspects of project planning to widen its scope throughout the project process.

2.5.1 Current Tools within Industry

BIM tools originate from CAD software, which developed commercially in the 1980s. Prior to AutoCAD (Autodesk), programmes were run on mainframe computers or minicomputers. This allowed professionals to utilise more accessible hardware to access the software. Leaders of the market, such as Autodesk, have been able to encompass a wide range of software programmes, from AEC tools such as AutoCAD and Revit, the flagship product for BIM, to tools such as genetic engineering, manufacturing, media, and entertainment. Rendering and visualising tools are important to process and distribute the models created through the design process. The technical details of rendering methods can vary. The general challenges to overcome in producing a 2D image on a screen from a 3D representation stored in a scene file are handled by the graphics pipeline in a rendering such as a Graphic Processing Unit (GPU). Howard and Bjork noted that software vendors play an important role in guiding the accessibility of BIM for industry stakeholders (2008). BIM technology includes both a website and a desktop view (Autodesk, Dalux). This allows more stakeholders, both internal and external, to become informed with the current progress of work.

2.5.2 Regulation within Industry

International standardisation was introduced to synergise the UK BIM market with other international partners to make the UK a leading partner in the international use of BIM and industry 4.0. Since 2018, the UK standards for the BIM lifecycle have been integrated into the international standards by the BSI (BS EN ISO 19650_1/ BS EN ISO 19650_2). This was necessary to ensure that guidelines were controlled through regulatory documents via directives, standards and white papers. Crucially, it was seen that BIM must align with the needs of project development, and this is most effectively done via the information requirements of the building project (Vieira et al., 2020). Within the UK, there is an expectation from the industry to incorporate a range of information. The Organisational Information Requirements (OIR) focuses on the strategic business operation, asset management, and regulatory duties. It contributes to the Project Information Requirements (PIR) in that it helps explain the information needed to answer or inform high-level strategic decisions. The OIR also encapsulates the

commercial and technical aspects of producing asset information. This is devised as Asset Information Requirements (AIR), which contain technical aspects specifying the detailed pieces of asset information linked to the OIR. For the final requirement, there are contributions from both PIR and AIR, and the Exchange Information Requirement (EIR) oversees the managerial, commercial and technical aspects of producing project information. The EIR (formerly the employers information requirement) must include the information standard and production methods for the managerial and commercial aspects of a building proposal. The role of the EIR is to specify the Project Information Model (PIM), which aids the delivery of the project and the asset management activities. PIM details the geometry, method of construction, location of the equipment, schedules, project construction, maintenance requirement, and system components. Finally, PIM helps contribute towards the Asset Information Model (AIM) which supports the day-to-day asset management process from the appointing party. It provides information at the start of the project delivery process, calculative costs, records of installation and property ownership details.

2.5.3 Future Development

The potential of BIM management is broad due to the collaborative nature of the tool. Pioneering development has focused on the architectural, engineering and construction aspects, and collaborators' recent development has focused on the later stages of the building's lifecycle (Succar, 2009). It is clear There is substantial interest in the possibilities of BIM and its potential applications (Kamble, Gunasekaran, & Gawankar, 2018). With the increase in tools to display models, there has also been an increase in the ability for a BIM model to be utilised later in a building's lifecycle. As a method of communication amongst stakeholders, its full capabilities are not exhausted as its true value lies amongst the information flow and the potential that the future developments might have from the material achieved. Amongst stakeholders of the building development the main advantage of using BIM is that "the model provides an easy to manage data format" (Ahn & Cha, 2014). The information gathered to serve the multiple needs of systems like Facility Management (FM) can assist in maintaining a flexibly built environment, capable of adapting to changing business needs (Wijekoon, Manewa, & Ross, 2018, p.4).

Even with the progress in digital collaborative spaces, such as CDE's and the use of international focundation classes IFC's, there is still a concern as to if personnel are implementing this correctly in industry. Data remains a concern for some stakeholders in the AEC industry and the promise of more information can be an overwhelming prospect to stakeholders approaching BIM for the purposes of business and client needs (Ashworth, Tucker, & Druhmann, 2019). The lack of practical knowledge implementing information requirement documents (AIR, OIR, EIR) means that

companies cannot rely on software advancement to reach an effective level of BIM use, but rather a better implementation of BIM through the workforces' ranks. There is also a need for understanding what responsibilities are required from each individual stakeholder, as hesitation from potential BIM users may be overcome when encouraged by the aspects of communication that these information requirements offer (Ashworth, Tucker & Druhmann, 2019, p.115).

Nevertheless, difficulties exist in the implementation of BIM. For instance, the high modelling/conversion effort, the updating of BIM data, and the handling of uncertain data, have made the opportunities of BIM difficult to establish among the AEC industry. The Digital Construction Report 2021, which records the adoption of BIM amongst construction industry professionals, showed that their awareness and use of BIM currently stands at 71% with only 5% having no intention to use BIM (NBS, 2021). In many ways, due the commitment required amongst the range of different stakeholders; BIM is seen as too large a task to take on for some practitioners. Perhaps due to this, researchers have found the industry has gone against expectations, with an analysis of current research and industry interviews differing. Some research has concluded that BIM implementation is restricted by an industry, that while it is beginning to use technology, it has inherited the previous issues noted in the construction industry (Volk et al, 2014). An example of this is the mapping of potential issues within BIM, there are silos of knowledge representing a fragmented AEC industry (Pierre et al., 2020). This, in turn, is disadvantageous to potential projects. The fact that this is a social implication that might need to be addressed is complex as a barrier. BIM "requires contractual relationships shifting from traditional to integrated procurement methods," alongside a substantial shift from the current practice that hinders collaboration (Georgiadou, 2017, p.306). In this perhaps there be a stronger move towards a better standardisation of work to promote better outputs than currently practiced in the UK.

One prominent issue in the implementation of BIM is the lack of involvement of a BIM expert in the early project phases when BIM is evolving (Dixit et al, 2019). Data archiving becomes a tedious task after design and briefing is completed on a project, and such a task could be perceived as a waste as it represents time spent with a lack of return. As a result, there is the fear that the promise of the BIM structure is thus seen as a false sell. Relevant literature therefore must be explored to identify the challenges to integration as to achieve standardisation of BIM and to create a functional integration framework to resolve issues and effectively use BIM for decision making.

The Government has also been criticised in its efforts empowering the industry with the adoption of BIM. In the NBS 2019 survey, 49% participants understood that the 2016 government mandate had not been successful, with only 11% disagreeing with this

statement (NBS, 2019, p.24). Solutions to the integration have come about from various levels of authority, and this can be seen in larger development changes, with government mandates such as the requirement to use Level 2 BIM for government building developments (The Infrastructure and Projects Authority, 2016). However, but SMEs remain hesitant to use technology such as BIM on smaller projects due to cost and training (Olbina, 2019). In the digital construction report of 2021, 55% of small organisations (under 15 members of staff) have adopted BIM, with 10% noting that they are unlikely to. There have been contributions to the discussion examining how different groups of professionals will work together through the current collaborative measures, especially when these practitioners might not use design technology the same as other stakeholders, such as those within the AEC industry. Whether BIM knowledge produced in design and construction could be used with other parts of the built environment industries is a large question in BIM's own development, especially as there is a fundamental challenge as to how relevant information could be included in the BIM model and integrated with these systems (Miettien et al., 2018).

2.5.4 Using Building Information Modelling for Wider Participation

There is an underlying argument that in consideration of design values, there is a correlation between the use of a digital network and the encouragement of face-to-face interaction. Kitchin noted that 3D models created from BIM can be used for better spatial planning within practice (2021). The creation of a piece of software that would integrate BIM and planning processes would create a 'real scope for planning strategy, decision making and negotiation to be evidenced in real time' (Thompson et al., 2016). BIM has also been seen as a process for the stakeholder management (the project team) to improve its ability to align goals and objectives (Guar & Tawalare, 2021). Expanding the use of BIM could therefore be used to tackle these two issues.

If planners were to engage with BIM, it might be possible to extend the capabilities of BIM and translate useable data between designers and the public. Framing the technocratic language against visual representations would not replace a mediator (Mazza, 1995), but it would make the consultation more inclusive by using 3D models to reorientate participants and direct them to visual representations of the design decisions (Polys et al., 2018, Lovett et al., 2015).

The underlying problems that have been identified emerge from a fragmented relationship between external and internal stakeholders of the built environment (Allmendinger & Haughton, 2012), but additionally, it's unclear for external stakeholders as to what their role is within a public consultation (Boonstra & Boelens, 2011). For future academic research, in engaging with BIM, there is potential to present clearer design stages so that external stakeholders can better understand the planning

process, and in doing so, encourage more useful responses for a particular stage of a design.

2.5.5 The potential of BIM within public consultation

Currently BIM is being pioneered by early adopter professionals leading the industry (Waterhouse, 2019) and driven only by its current users, omitting its potential for application in other areas of industry. Restricted as a communication methodology amongst internal stakeholders, it is not currently established in the professional field of regulatory planning. Nevertheless, a substantial change in the industry has opened the opportunity for stakeholders to analyse and tackle concerns within the construction industry. By doing so, internal stakeholders can benefit from improved health and safety (Getuli et al., 2020), and design management and implementation (Waterhouse, 2019). The introduction of data-reliant technology has made it possible to restructure the conditions of the industry to better suit the individual project teams, as it presents a wider perspective to a project development. There has been discussion of the introduction of BIM in areas of spatial urban planning (Kitchin, 2021), and when discussing introducing 3D models, planners have proposed that data might come from a BIM model (Milovanovic et al., 2017). In using 3D models, there are concerns that the use of 3D graphics is both costly and time consuming, and thus difficult to present to the public (Hanzl, 2007). However, BIM models are now becoming the standard of a building project (NBS, 2021), with data being collated for the purposes of examining and verifying a design. There is the potential to use BIM to aid in framing the planning process for members of the public, via visual prompts throughout the consultation process, and framing technical language against visual prompts to help explain and explore plans produced by architects for the consultation.

2.5.6 Reframing the technical language that can serve as a barrier to non-specialists against a visual counterpart

Technical language creates an obstacle for the public. The lack of knowledge surrounding the construction industry can undermine the consultation process. The role of the planner is to organise the public's attention towards aspects of the examined design (Innes & Booher, 2002) and while elements can be shared through these tools, more developed design and discussion is potentially lost through the noise of social media. Even with interactive tools, to be effective in engagement, planners must guide participants through engagement (Gordon, Schirra, & Hollander, 2011) to make sure that appropriate information is being extrapolated from the community. This is also incredibly important to explain design choices and clarify some of the terminology used within the plan. Reliance on surveys and social media omits the presence of an active mediator, and therefore, this approach cannot inform participants about functionality or

explain to them the more intricate details (Afzalan & Muller, 2018). Consultations using social media and surveys lack mediation, and this effectively amplifies the external stakeholder's knowledge gap within the construction industry.

It is important to note the material being produced for public consultations is directly sourced by internal stakeholders, therefore, there is a connection between a potential BIM model and the information presented within the public consultation. Presenting an early draft of a 3D model can aid the exploration of how a project development might impact the environment and present more visual prompts for the public to consult upon. There have been previous examples within planning research using 3D visuals to explore new perspectives within the consultation method (Lovett et al., 2015; Polys et al, 2018). Unlike this previous research, however, the information would come directly from a project team, and therefore would drastically reduce the costs of introducing technology into planning consultations. Additionally, while the success of public meetings has often been measured in terms of citizen voice and opinions (Gordon, Schirra, & Hollander, 2011), there has been problems in the examination of how communication with stakeholders has been observed in stakeholder management (Davis, 2016).

Industry praxis relies on using a management strategy to increase support and decrease the negative impacts of the external attention of the public (Davis, 2016; Cillers & Timmerman, 2014). In developing BIM to include external stakeholder participation, the project team would be able to archive prominent observations from the public for future project conceptual designs. This would be advantageous to understand where the public might be misinterpreting development project plans and to bridge the potential knowledge gap of the public. Therefore, in using BIM, the consultation process can be accorded further visual information for a better planning consultation experience and aid project teams within the development to have a better understanding of what information is being misunderstood by the public.

Since the project team's responsibilities within a building project can be hard to follow for the layperson, and the steps of project development, such as the project development framework are not always clear for participants, the planning process can be rather disorientating to the public. Research has demonstrated that presenting digital techniques such as web-portals and three-dimensional displays can enable a more practical dialogue with the community compared to traditional planning consultation processes using two dimensional artefacts (Salter et al., 2009; Gordon, Schirra & Hollander, 2011). Visualisations within BIM tools are also seen as a contributing factor to the improved focus within the consultation (Gill, 2013; Appleton & Lovett, 2005). In addition to this, BIM has provided an understanding of what is

required from internal stakeholders at different stages of a building's lifecycle. Algnagger and Pitt's research presented that a well-structured approach to manage COBie data throughout the building lifecycle could prevent confusion regarding the roles and responsibilities of the internal stakeholders in creating and managing asset data (2019). BIM connects the project team (internal stakeholders) with the full lifecycle of a building and creates clear benchmarks for those involved (Patacas et al., 2015).

In utilising BIM, there is not only an opportunity to explore the spatial aspects of a model within a consultation, but also to provide the public with key identifiers on how much progress has been made on a project development, and therefore, the full scope of what could be addressed in a public consultation emerges. This is something which could resolve the planner's dilemma of trying to involve citizens in the planning process, but not being able engage with anything other than the statutory process of planning (Boonstra & Boelens, 2011). In engaging with BIM, external stakeholders might be provided with clear identifiers on what has and has not been decided on throughout the design consultation process. Currently, the diversity of different methods of public consultation has grown stagnant "in favour of reproducing strategies that favour certain groups or interests" (Allmendinger & Haughton, 2012, p.93). As a result, engagement seems less meaningful and appears to be overlooked. Engagement with the public quickly becomes considered just a tick-box activity for the construction process, that if chosen, can be ignored by internal stakeholders due to external stakeholder lack of knowledge (Butt, Naaranoja, & Savolainen, 2016).

In using something like BIM, there is not only a sense of connection to the project development within the consultation, but a sincere demonstration of the project's current design plan. When compared to other technological methods, such as email, websites, social media and internet surveys, which do not facilitate intelligent responses to participants or evolve alongside the project (Afzalan & Muller, 2018), there are obvious benefits to utilising a technology like BIM which develops throughout the building's lifecycle.

2.5.7 Further exploration for planning practitioners

Munster noted that there is a knowledge gap when engaging with the public in a consultation (2017), however, progress in utilising urban planning immersive tools has been constrained due to the capability of planners in using increasingly different amounts of technology (Riggs & Gordon, 2017). In engaging BIM models, planners will have to engage with more aspects of the building development and the potential technologies that might be available for a public consultation. Currently, without guidance, the range and scope of digital tools can create confusion on what practicing planners should utilise to digitally inform participants (Afzalan & Muller, 2018). In a

recent taxonomy carried out by Riggs and Gordon, planners were described as using basic managerial programmes to increase workflow ‘including word processing programmes, instant messaging, email, web browsers, presentation applications, and GIS’, but staying away from more complex software (2017). In summary, planners must fully commit to engagement with the BIM process once it is deemed advantageous for carrying out the responsibilities within planning.

2.6 Discussion

Technology has been proven to broaden access to the consultation process, particularly for individuals usually unable to engage with the consultation process. Despite this, industry appears hesitant to implement these tools. Where there has been engagement, the area of focus tends to be facility management (Wetzel & Thabet, 2015) and even spatial planning (Ktichin, Young & Dawkins, 2021), while its potential for use in qualitative data has not been explored. Planners engaging BIM tools might find that it’s possible to extend the capabilities of industry-wide communication via the integration of various tools to translate user information into useable data for the designer. Quantitative data could be translated into qualitative, since the data archived in a BIM model is logged as a fraction of data and understood by the professional body that creates it. It is possible that framing the technocratic language against visual representations will not replace a mediator (Mazza, 1995), however, the research has the potential to make a consultation more inclusive by using 3D models to reorientate participants and direct them to visual representations of the design decisions (Polys, et al, 2018, Lovett et al., 2015). Planning academia has engaged with immersive tools within the participatory paradigm (Gill, 2013; Gordon, 2011; Salter, et al. 2009), with visualisations seen as a contributing factor to the improved focus within public consultations which had faltered in traditional methods (Gill, 2013; Gordon, Schirra & Hollander, 2011; Appleton & Lovett, 2005; Al-komany, 1999). The UK government is now increasingly supporting digital efforts within the planning sector as set out in its recent white paper, ‘Planning for the Future’ (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government, 2020). It’s not a question of if these tools would be effective in public consultations, but how they are implemented within industry.

Currently, the public is unclear on the planning process. Such barriers pre-date any attempt to the use of BIMin public consultationsand public consultations require mediation alongside traditional methods (Mazza, 1995). Existing technology used in the UK’s planning processes has inherited issues with speed and quality decision making (Allmenger & Haughton, 2013) and this has contributed to the negative experiences of the past planning techniques (Gordon, 2011). Public consultations are a diplomatic

process and, therefore, it is possible that many of the failures of digital tools have originated from a lack of mediation, and separation from the planning process, both of which are necessary to inform participants about the functionality of the future built environment.

The ‘usual suspects’ (Lyles & Swearingen White, 2019) who contributed to past planning efforts are now isolated due to the poor user experience of tried technology which has led to low levels of citizen engagement (Boland et al, 2021). The future generation faces additional underlying problems from a fragmented relationship between external and internal stakeholders of the built environment (Allmendinger & Haughton, 2012), while external stakeholders remain unclear about their role within a public consultation (Boonstra & Boelens, 2011). Integrating BIM into the public consultation means that the industry could present clear design stages (as seen in the RIBA structure) (RIBA, 2020) and therefore provide external stakeholders with a consultation process which has clear roles and expectations. The lack of clear roles and expectations has created internal scepticism in the contributions brought forward by external stakeholders (Butt, Naaranoja & Savolainen, 2016), which has stunted any progression towards a developed understanding between stakeholders and the project development. By engaging with BIM in future research, there is a potential to present clearer design stages for external stakeholders to better understand the planning process, and in doing so, encourage more useful responses for each stage of a design.

While this has been an interdisciplinary literature review to explore issues that exist in the industry, it is important to also note the restrictions that will be faced by either side, the planners and the project team, in order to expand the capabilities of BIM into areas of consultation. Specifically for planners, the reluctance to recognise how technology could be embedded in public consultations has led to a reliance on technology such as social media (Afzalan & Muller, 2018). This can lead to one-way consultations that reproduce the tokenism of Arnstein’s Ladder (Gordon, Schirra, & Hollander, 2011). This is important to rectify in the field of project management and planning., While the responses of external stakeholders are recognised as important to the success of a project, they remain overlooked and fail to be given the focus of innovation in practice. Reliance on older methods and unestablished digital tools can inadvertently promote a cycle of mistrust as they fail to identify prominent concerns (Munster et al., 2017). Without amending the underlying issues of the public consultation, technology misses the opportunity to aid fundamental social problems that surround the project’s development.

It is clear that project management and the project team involved in a development must strengthen ties with planners and the democratic process of planning itself in

order to better retrieve the benefits of the consultation process. In terms of public consultations, there have been obvious limitations that stem from a breakdown of communication between stakeholders. Consultations have been identified in stakeholder management and participatory planning as important to maintain ongoing trust (Shipley & Utz, 2012; Lauber & Knuth, 1999), satisfaction (Davis, 2016) and communication (Münster et al., 2017; Butt, Naaranoja, & Savolainen, 2016) with affected external stakeholders. The actions of the industry must be analysed and reviewed. In meeting the objectives of stakeholder management, reliance on traditional methods (.i.e. press relations) (Oppong, Chan, & Dansoh, 2017) relates to 'tokenism' in planning literature (Gordon, Schirra, & Hollander, 2011).This hints at a lack of substantial communication and trust within public consultations, as confirmed by Butt, Naaranoja and Savolainen, who stated that there is a clear distrust of the capabilities of the public in management (2016).

When exploring industry methods in public consultations, the underlying issues of stakeholder communication emerge in external stakeholders comprehending the information and the internal stakeholder's apprehension towards collaborative engagement. The outcome of public consultations is often lost due to the informality of reporting responses to architects and developers. There are often no paper records, and therefore, the context of decisions can be lost for later project teams. There is currently little in the way of tracing publicly decided design ideas in the standard information exchanges used in project development, due to a reliance on traditional methods and difficulty in strategically implementing information from computer-based tools into a project's development.

Essentially, the challenge for planning specialists in the United Kingdom is to create a significant step towards change, in which its innovation stands equal amongst the rest of the construction industry. There have been fundamental deviations from the original understanding of planning as a regulatory body that focuses on spatial requirements. Planning professionals in the UK are challenging the current standards for public consultation (Fillion, Shipley & Te, 2007; Brooks, 2002; Healy, 1999), and are assessing technical tools for various planning stages (Afzalan & Muller, 2018). It is conceivable that planning could be expanded to utilise more influential BIM data tools that may connect more stakeholders into the development of the building project. Having a tool that potentially feeds back into the construction lifecycle may address the known challenges impeding the planning process, including the lack of information, lack of trust and lack of clear and defined roles.

2.10 Conclusion

In this chapter, we have discussed the complications and the lack of accessibility within the consultation process, as well as how this might be remedied by utilising a tool, specifically a BIM tool, which facilitates collaboration for planners. IWe argue that the public consultation process, as it is currently used, presents significant difficulties, due to (1) its lack of accessibility; the technical language used in consultations often serves as a barrier to non-specialists, and (2) a fundamental lack of understanding of the planning process on the part of members of the public. These issues contribute to an industry anxious to allow external stakeholders to effectively participate in design. It is clear that the planning process, as a whole, has been hindered by a lack of developed (insightful) communication with the public and poor technological integration with the rest of the construction industry.

We conclude that, while certain technology has been utilised to assist the public consultation process, it has not eliminated its inherent problems. The systemic knowledge gap of external stakeholders remains alongside a hesitation by internal stakeholders to embrace public consultations. While technology has improved the breadth of public inclusion, consultations do not always find the right participants, the information does not always go both ways and there is a lack of effective mediation. We conclude with a hypothesis that integrating planners into the BIM process, specifically the 3D modelling. With clear staging and development of design, BIM might address some of the challenges identified in current practice. While the industry has embraced a technology that streamlines data amongst the project's internal stakeholder, there is still the option to embed external stakeholders in the consultation process and explore how peripheral data might complement a project's roadmap.

2.11 Further Research

The context of public engagement is essentially lost when transformed into the architectural design decisions and content that is instrumental in construction. The recommendation of this chapter is to highlight these underlying issues, with a solution that better technically mediates the built environment for participants and creates qualitative and quantitative feedback for designers. In doing so, an evaluation framework is required to support the development of a prototype which presents a geometric (3D) BIM model for external stakeholders to evaluate within the confines of a public consultation.

. Therefore, within this thesis, the integration of BIM, a technical method used by the construction industry to coordinate design and information regarding a project throughout the building lifespan, is proposed for use in planning consultation. This tool would effectively connect the space between the stakeholder (community), mediator

(planner) and project teams (developer, architect, client). There is great potential for communicative industry tools such as BIM, that communicates data and the direction of a project, to reduce the knowledge gap between internal and external stakeholders. There is also scope for such a tool to inspire better trust amongst project leaders to conduct public consultations more openly with the public.

Chapter 3 Research Methodology

The purpose for this chapter is to outline the underlying interdisciplinary research and justify the approach that was taken. This study tries to understand the current ethos of the UK's construction industry and urban planning culture by exploring the opinions and decisions of key stakeholders. A mixed method approach was utilised so that qualitative opinions could ground the data collated throughout the study. This chapter addresses the research questions of the project and how the study was structured.

3.1 Research Theory

, In terms of research design, an interpretivism epistemological stance was adopted since it facilitates subjective viewpoints from the industry and external stakeholders commenting on project development. As noted by Bryman (2012), from an interpretivist's perspective, reality is dependent on the members being interviewed and their social setting. This is due to the authors perspective in noting that the data collected throughout this thesis was based on the varied experience of industry. As stated by Bryne and Ragin (2009), the social dialectic between what 'is' and what is 'useful' is especially significant when clustering this data to understand negative and positive feedback. In many ways, this research is critical social science as it relies on the experience of stakeholders within constructs (such as business, and local democracy). The benefit in taking this stance within this research, is that the barriers discussed in this thesis are not technical, but social and systematic in nature.

Blomberg's ethnographical participatory design was observational in nature, constructed from planning practitioners' attitudes towards various traditional methods of public engagement and what traits, if any, could be implemented into a digital platform for public engagement (Bloomberg, 1993). Observation has been described as fundamental to the research methods of behavioural social science (Angrosino & Rosenburg ed. Denzin & Lincoln, 1996). When using case studies, this approach covers events in real time, though it can have a very narrow focus (Gray, 2020).

3.2 Research Design

A general approach to research design is to choose either a qualitative or quantitative approach (Creswell 2003), however, when discussing an interdisciplinary subject that applies a range of data collection procedures (e.g., focus groups and comparative analysis) the use of a mixed method design research is more suitable (Tashakkori & Creswell, 2007). Mixed methods design is a research orientation that integrates techniques from both qualitative and quantitative paradigms to tackle research questions that can be best addressed by mixing these two approaches.

While qualitative and quantitative data are grounded by two different approaches to categorising and explaining data. In using mixed methods, deductive findings from a quantitative approach can become contextualised through the qualitative context which refers to a research paradigm that hypothesises about the relationship between variables (Gray, 2021). A mixed methods approach is pragmatic, as it specifically addresses what methods would work within a particular context, even if they differ in qualitative or quantitative approaches (Denzin & Lincoln, 1996). Using a mixed methods approach is complementary to carrying out research within the planning consultation domain as it leads to more complete conclusions regarding the use of technology within the socio democratic activity of planning consultations (Greene, et al, 1989). Complementary design occurs when a researcher integrates methods to develop a complete picture by addressing different research questions or objectives within the same study with both qualitative and quantitative means (Bryman, 2006). The advantages of the mixed method model can compensate for the complexity of a research design, as it is not a linear process, but something that can be both iterative and incorporate further measures from the study at different stages of the project.

A mixed methods approach supports capturing data from different aspects of an interdisciplinary study (Gray, 2021), exploring the use of both quantitative and qualitative data to address a variety of participants' needs. A study that is comprised of various methods, empirical resources, observations, and participant backgrounds has added rigor, breadth complexity, richness, and depth of inquiry (Flick, 2007). Using this method, a researcher triangulates the results from a mixed method study (Clarke, 2005), as the use of multiple methods reflects an attempt to secure an in-depth understanding. Objective reality can never be captured, and knowledge is built from representations (Denzin, 2012). The objective is to neutralise bias that can be found within certain data sets when they are compared with other information within the study (Clarke, 2005). The data sets collected within this study, via interviews, case studies and evaluations (qualitative data), were cross analysed with quantitative data collected from an analysis of policy, in order to validate the research questions and hypothesis.

3.2.1 The implication of Digital methods in Research Design

As noted in section 1.4, this thesis was completed during the pandemic, and therefore access to participants for the validation of the thesis was reliant on digital methods. The use of digital methods can redefine the outlook of study. Repurposing a research design to engage with digital methods develops a researcher's reflection on how to approach the medium for research purposes (Rogers, 2019. p.19). Reliance on digital methods for research can also impact the recruitment of participants, as it instantly creates a lens between researcher and participant. A detailed focus, therefore, is required from a researcher to better understand the context that might interact with the

participant's experience (Kaye, Monk, & Hamlin, 2018). In a similar vein, the researcher may experience feelings of 'distance' from the qualitative data being collected via digital means (Flick, 2017). In addition to this, there is also a concern that the participant has adequate technical expertise to comprehend digital platforms for the researcher to develop processes and tools (Kaye, Monk, & Hamlin, 2018).

3.3 Addressing the Research Questions

Prior studies have used collaborative techniques to understand participant perceptions of digital tools in the public sphere. Salter used structured workshops, aided by Likert scales, to observe the requirements for Nextdoor (2009). Mysidewalk was designed via a comparative analysis, in which researchers examined each case study using a common set of criteria that would expose the effectiveness or ineffectiveness of crowdsourcing as a public participation tool (Hamilton, 2014). Crowdsourcing information has been an underlying theme for many of the tools explored in Section 2.5.3. Literature reviews have focused on crowdsourcing (Erraguntla et al., 2017), and the typology of different mobile applications (Ertio, 2015), so to design an effective public tool. These methods have differed from traditional design activities (Kleinhans, Van Ham, & Evans-Cowley, 2015), as researchers have relied on digital surveys to collate information from hard-to-reach participants and are better suited to a digital presence.

Research questions and objectives (as noted in section 1.2), are investigated a variety of research methodologies, as follows: -

Data collection and Analysis

- Interviews
- Case Studies
- Audio Recording
- Transcription
- Coding

Prototyping and Investigating Software Requirements

- Iterative Prototyping
- Low Fidelity and Paper Prototyping
- Medium Fidelity Prototyping
- High Fidelity Prototyping
- Software Requirements
- Policy Analysis of documents
- Comparative Analysis
- Evaluating Prototypes

Validating Results

- Case Study
- Think Aloud Protocol

3.3.3 Data collection and Analysis

In depth interviews were carried out during the preliminary research stage and for *Case Study 1*. The data from these interviews was captured, transcribed, and formed the initial dataset that was then developed further throughout the study. In addition to the interviews, observational notes were taken by the researcher during *Case Study 1*.

3.3.3.1 Interviews

Interviewing to inform qualitative research (Patton, 2014) has been described as useful for investigating phenomena with context. The preliminary research was widened to incorporate an understanding of consultations in project development and the various stakeholders engaged in the process. Interviews such as qualitative inquiry have been fundamental to research within social fields, as the ethnographic interview can present conversational interactions that are part of a long-term piece of field work which better articulates an observation (Patton, 2002). A general set of questions are recommended by Wolcott (1990) as so to act as open questioning for the participant. There are informal conservational interviews which act as the most open-ended approach to interviewing (Patton, 2002). This allows interviewers to approach each participant on equal footing when it comes to informing research. Data gathered from unstructured interviews is not as unfocused as it may appear, due to later thematic analysis. This meant, for this study, that some interviews can incorporate a background with an ongoing case study, in accordance with Yin (2009).

The participants identified and interviewed for this study were chosen for their knowledge regarding public consultations, the industry, and digital applications. Participants recruited for this study were industry professionals that were accessed via various industry and university workshops, networking events and through personal introductions from the project supervision team.

3.3.3.2 Case Studies

Stake (2006) identified case studies as instrumental tool to understand the context of research, as cases examined at a holistic level can play a significant part in testing a hypothesis (Gray, 2021). Observation has been described as fundamental to the research methods of behavioural social science (Angrosino & Rosenburg ed. Denzin & Lincoln, 1996). This approach covers events in real time, though it can have a very narrow focus (Gray, 2021). *Case Study 1* had in-person field events discussing the plans for the area. The researcher took photos and observational notes regarding the

events taking place with the planning participants. *Case Study 2* involved online discussions with participants as they used digital tools based on real-time consultations. The researcher recorded conversations and the recorded the use of prototypes to define software requirements.

3.3.3.3 Audio and Video Recording

Patton (2002) suggests that the ideal objective is to collect enough data for the transcription of the research. As Gray notes, “there really is no substitute for being able to see all the transcribed data at a glance during the analysis stage of the research” (2021, p.393). Thus, using a video recording is a helpful method to collect data as it can be used to analyse reactions of the participant other than verbal responses. Recording visual data has obvious advantages over audio recordings, however, being filmed can make respondents feel uneasy about being recorded (Gray, 2021). The decision to use video and audio recording should be adapted to the environment, participants, research questions and objectives. It should be noted that participants should be given the right to turn off recording and retract data if they wish to do so (Gray, 2021). The author decided to ideo record use of the prototype for accurate evaluation.

3.3.3.4 Transcriptions

Producing verbatim transcripts from interviews, case studies and workshops allows researchers to return to the findings of the research, after the research has been completed (Hepburn & Bolden, 2017). This allows findings to be compared with later research as well as with preliminary research. A strong transcript with identified speakers, recorded action and images (possibly from video recording) aids investigative methods, which can be more immersive than just interviewing alone. While technical platforms are currently available to transcribe (Hepburn, & Bolden, 2017), there are restrictions due to accents and information language which might not be picked up by these systems. This meant that even with the aid of technology, transcriptions needed to be reviewed with a human researcher to pick up uncommon industrial and colloquial phrases.

Data collected from the interviews and workshop were coded in line with best practice standards (Saldaña, 2016), and this, paired with the literature review, was used to build a picture of the public consultation process and the stakeholders, via a persona building activity (Pruitt & Adlin, 2005). Thematic analysis was used within these interviews given the clear objectives and subjective perspectives sought on the use of visual data within BIM. Interviews were analysed as qualitative data to identify any repeated patterns across the interviewees’ expectations in using BIM (Braun & Clarke, 2006). Thematic analysis is a method for describing data, but it also involves

interpretation in the processes of selecting codes and constructing themes. The authors performed the thematic analysis as set out by Boyatzis (1998) in a two-phase method involving (1) identification; and (2) consolidation.

3.3.3.5 Coding

A code book was manually created and updated in the form of a Microsoft Word document (appendix 2). This combines themes found within the literature review's knowledge gap and the thematic analysis. The literature review highlighted that there was an ongoing concern with communication and breakdown of different stages within planning public consultations and (examined?) how this has impacted the industry's interaction with external stakeholders. Deductive coding from the literature review was used to create a first pass of data analysis, and this was followed by an analysis of interviews, workshops, and case studies to build on the research themes.

The following categories were added to the code book at this stage:

- Who – who are we interviewing within the industry?
- What – what is expected within a project development?
- Where – where are these interactions expected to be carried out between stakeholders?
- When – at what stage do they introduce visual data?

These codes were returned to continually throughout the study, so as to guide the development of the technology and maintain focus on the research objectives. Certain codes served as a placeholder until they were validated by the data collected through this process.

Additionally, these interviews were analysed for to obtain keywords and insights from the participants. These keywords were collated to understand the concerns and expectations from the industry. The themes emerging from this process were:

a) Relationship with the stakeholder

b) Stakeholders' barriers to consultations

c) Balancing regulation with best practice

d) Communication strategy (Consultations)

3.3.4 Iterative Prototyping

The design of the prototype was informed by the findings from the literature review and the initial research phases of this study. A full breakdown of the prototype requirements and a discussion of how they were developed can be found in chapter 5. Low fidelity prototyping was integrated throughout the project. For co-design activities in Activity 2,

the output of the workshop was used to develop a wireframe design of a new planning platform. The design was then further developed into a medium fidelity prototype which included a 3D visualisation platform for understanding how users interacted with BIM models for planning consultation activities. The medium fidelity prototype was evaluated with potential users and the output of this evaluation informed the design of a more refined high-fidelity prototype. The final process was then used to evaluate the research hypothesis RQ2 and RQ3 through a final case study labelled as *Case Study 2*.

The prototyping iteration stages carried out in this study include:

- Iteration 1: Low fidelity prototype co-design with experts in planning and construction industry
- Iteration 2: Development of a set of information requirements for a digital planning consultation platform
- Iteration 3: Medium fidelity prototype design and evaluation
- Iteration 4: High fidelity prototype design and evaluation

3.3.5 Validating Results

Gibbert et al. (2008) suggested three measures for enhancing internal validity, as case studies should formulate a clear research framework to demonstrate that variable x comes out with variable y. Additionally, through pattern matching, researchers should compare the empirical evidence of bserved patterns with predicated ones (Denzin & Lincoln, 1994). Campbell coined the term ‘pattern identification’ as a characteristic of qualitative analysis that was noted as a holistic approach (analysing the patterns within a study) rather than analysing the characteristics of the participants (1966). Yin noted that pattern matching is the most describable strategy within a case study as it can be effectively divided between dependant variables and independent variables being identified throughout the case study process (2009). Dependant variables relied on previous conceptions of the potential findings of the study.

Case studies rely on the use of research, according to Innes and Booher (1999), Mackintosh and Whyte (2008), Cullen et al (2010), Project Initiation Document, National Project on Local e-democracy v3.0, Tait and Hansen (2013), Anttirioko (2003) in order to present clear framework of best practice for public consultations, to test the strength of the consultation tool, and therefore to validate the use of BIM within a digital tool. However, dependant variables are rare in practice as they cannot adhere to a complete holistic approach (Yin, 2009), and usually require a case study to configure the findings of the analysis to the researcher’s own recognition of changes throughout the project.

Yin defines an independent variable as something that comes from expected and observed patterns arising from a specific and singular case (2009). This means, in observing a case study, a researcher must be aware of where the necessary and sufficient conditional propositions might be situated, and therefore impact the findings of the case study (Yin, 2009). In observing and interviewing participants, the facilitator must be aware of any potential variables that might impact the findings which might not have been predicted or predicated.

3.3.5.1 Think Aloud Protocol

The evaluation was supported with a think-aloud protocol (Beasley, 2013; Barum, 2010), which acted as triggering (Kovhavi et al, 2009). This was used to reduce the variability of the actions of the participant (Kovhavi, & Longbotham, 2017). The think-aloud protocol was carried out via an introduction to both methods and the context of the project development. As a concurrent think-aloud protocol (Barum, 2010) the participant was also informed that any queries regarding the provided information, the language and the platform would be answered. This enabled any concerns and ongoing bottlenecks to be managed (King, Churchill, and Tan, 2017) that might otherwise halt the evaluation. Several tasks were carried among the participant and the researcher. The participant was encouraged to explain the completion of the tasks with any errors and observations recorded (Jacobsen & John, 1998). Does the participant: -

- Understand the task but cannot complete it within a reasonable amount of time?
- Understand the goal, but go about completing it differently?
- Give up the process?
- Complete a task but not one specified?
- Express surprise or delight?
- Express frustration, confusion, or blames themselves for not being able to complete the task?
- Assert that something does not make sense?
- Suggest changes to the interface?

According to Barum (2010), observations from the participant and the researcher should be recorded and the researcher should note aspects of usability testing to understand the progression of the participant. In line with this, for this study, these tasks were carried out via a computer (provided by the University) and were marked as either being completed, or incomplete by the participant, or the participant finding an alternative route.

3.4 Structuring the Study

The methodology is broken down into four stages: 1) exploratory stage; 2) data collection; 3) prototyping and software requirements; and 4) validation of findings. Detail of the methods implemented at each stage are set out as follows:

Stage 1: Exploratory Stage

- Interviewing
- Observational Case Study

Stage 2: Data Collection

- Expert Workshop
- Policy Analysis of Documents
- Comparative Analysis

Stage 3: Iterative Prototyping

- Evaluating Prototypes

Stage 4: Validating the Prototype's Findings with a Holistic Case Study

- Case Study Design

This represents a summary framework as to how the research has been undertaken and to clarify the reasoning for taking a qualitative approach to research within this study. The next section sets out the research paradigms used within the study and include those which would be considered interdisciplinary and those taken from areas of participatory planning and stakeholder management.

3.4.1 Stage 1: Exploratory stage

An observational case study was used to explore the detail of the 'real-life' consultation process expected from urban planning. The case study involved a focus group with an architect, a community engagement officer, and a community leader, using both traditional and digital tools and also included an interview with each of them on their experiences carrying out planning consultations.

3.4.1.1 Case Study Organisation Information

The researcher observed a public consultation in the North East of England. This consultation, which used both digital methods and traditional methods, involved a housing estate partnered with an architect (P 11) to have a four-million-pound environmental upgrade made to a grade-listed housing estate in the North East. A community engagement officer (P12) was responsible for researching the area and its

residents to understand the community requirements to the project. The design team took the view that addressing the concerns of the stakeholders (i.e., the occupants) would directly correlate with the success of the project. Prior to the tender, the design team met with the Steering Group (the housing estates occupant feedback group), to understand local community's knowledge and insight into the environmental impact of the project.

The digital platform PlaceChangers is a public consultation platform that allows participants to view information about planning proposals, such as a description of the plan, a map of the site and images associated with the site. Users can submit comments and attach images to places on a map that support their comments on the proposal.

The public planning consultation observed by the researcher used a technology platform in order to garner the widest range of feedback and capture the opinions of the residents who were unable to engage in traditional planning consultation meetings. This would overcome the barriers for attending a physical consultation meeting including age, physical restrictions, or unavailability due to work or other commitments. The digital platform was provided to gather more specific insights than what might have been capable via traditional means.

The consultation observed by the researcher was a not-for-profit housing project, so the focus on the consultation was not an economic one but a social one. The client had previous experience consulting inhabitants. This meant that the consultation was reflective of the users of the environment, as the digital tool mapped identifiable areas within the residential area. In turn, there was a strong logical link between the communal attitude of the area and the values in which the community engagement officer was trying to explore within the consultation. The traditional methods used in this project included public letters, posters placed in the area, and public stalls (tables located in a public area to inform the local community).

The digital methods used in this case study included the PlaceChangersLtd (https://www.placechangers.co.uk), social media and emails to the community engagement officer operating the consultation.

Being that this was a consultation that explored the environment of the residential area, maps were intrinsic to both the digital and traditional methods of communication. Photos were also important here as they helped to visually convey the aesthetic and practical implications of the environment in which the estate developers wanted to investigate. The tasks didn't differ between the traditional methods, but the engagement officer acted as a mediator within the area to ask residents to pin concerns, issues, and things they enjoyed about the area on a physical board, or via an

anonymous postcard. The digital platform had a similar function, but this was a much more independent process which did not include the conversational atmosphere offered by the community engagement officer in the traditional method.

Case study 1 recorded the observations of the ongoing consultation and its use of traditional and digital methods (Patton, 2014). Visitation of the area was planned and agreed upon. Photos were taken throughout the observation of the planning consultationOnly written notes were taken throughout this stage (Yin, 2009) to respect the privacy of the public living in the consultation area. These notes were used to structure the questions for the semi-structured interview (Bryman, 2016) carried out with the community engagement officer and architect. These were audio-recorded and thematically coded from the written transcripts of the interview (Braun & Clarke, 2006).

3.4.2 Stage 2: Data collection

3.4.2.1 Workshop with planning professionals

The activity was designed to address RQ1 to understand the opportunities and limitations of current consultation methods. These workshops were comprised of various professionals from different areas and backgrounds who participate in the design and development of housing, both social and private. The purpose of the workshops was to utilise the findings of *Case Study 1* to find common ground and language in order to facilitate better communication and interaction with the public in future developments.

Case Study 1 involved a series of activities that were developed to act as an exploratory tool for the group discussion (Activity 1) and to co-design new approaches with industry professionals (Activity 2). This was an in-person workshop and the researcher acted as a facilitator to the focus group discussion. Participants were sat around a table and provided materials to discuss the current state of planning, the wider industry and tools currently being used. The focus group was audio recorded, transcribed, and coded for themes (Braun & Clarke, 2006), and video recording was utilised to analyse the groups interaction with Activity 2 (Bryman, 2016). The results of the activity were used as a basis to develop a proof-of-concept prototype for a new digital approach to supporting planning consultations. The design details of the prototype are discussed further in Chapter 5. One of the key points of focus for the workshop was consideration of the various hurdles of public engagement and optimum techniques to garner feedback from the public.

3.4.2.1.1 Workshop 1, Activity 1

The first activity evaluated how participants felt about the current choice of methods that can be used within a consultation. This was done via a series of cards which were provided to the group to prompt discussion (see figure 7), and followed a scoring

system (Halskov & Dalsgård, 2006). This promoted an open-ended discussion amongst participants (Yin, 2009). The paritipant s were given cards to score from least likely to use and most likely while they discussed the reasoning for this.

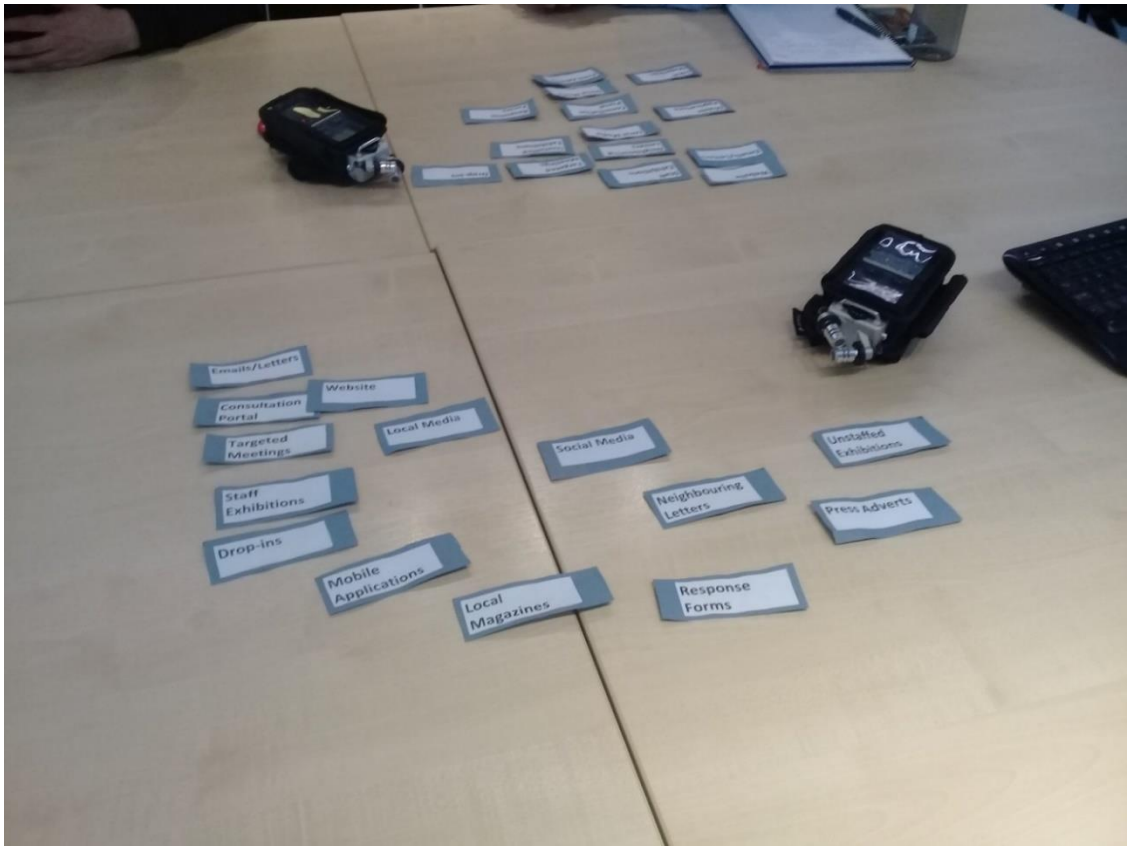

Figure 7. Scoring Cards for Workshop 1, Activity 1

3.4.2.1.2 Workshop 1 Activity 2

A paper prototyping activity was used to co-design an interactive digital planning consultation. Participants were presented with a fictional scenario involving a council building a in a new residential area. The participants were invited to help design a platform to interact with the public, which was able to demonstrate how the housing development would work with the surrounding environment on the map and how potential problems could be signified on the platform, as well as how authorities could be notified about problems raised by the community with regard to the housing development project. Participants were provided with paper, a map, coloured paper, moulding clay, highlighters, information regarding the area, and images of other buildings in the area.

The participants were asked to observe and collate what they believed would be useful for an interactive discussion with the public. This technique was used to extract information on what specific systems should be incorporated into the design of a digital planning platform. This activity was used to analyse the impact of interaction and how these might impact stakeholders of the process. The activity was documented through

video recording and participant observation. Participants used the maps provided as a point of dialogue.

3.4.2.2 Analysis of policy documents

This review of 104 documents across the Northeast's County, Town and Parish Councils were used to cross analyse what common information was often required from these planning authorities. Local plans and policies can differ within the UK. There are overarching themes amongst these policies, but it can be difficult to objectively note the obvious requirements in an area; other than the material planning considerations (figure 1). Literature reviews and policy reviews have been used in the past to analyse secondary evidence within areas of planning applications and to identify the direction of developments (Edwards, 1995). The NPPF acts as a framework, but it allows local areas to create context on what would be acceptable within the policy (NPPF, 2018). As the specific context of public policy can reveal the limiting and exclusionary nature of the policymaking process (Manuel 2006). These documents were found via a search engine and cross-referencing the list of councils within the North East. The documents were analysed, and certain themes were logged respective to what information was required.

The series of documents chosen for this analysis included a variety of rural, urban and coastal areas and so provided a range of distinctive frameworks across the North East. This allowed planners and developers alike to address the specific housing, economic, social, and environmental priorities required in the areas. These are prepared by the LPAs of the area, usually the Council or national park authority for the area and provide evidence of discussion with the public about forthcoming changes. The details from these documents were recorded and logged in an Excel spreadsheet, and then analysed to pick up the urban planning requirements as noted in Appendix 5.

3.4.2.3 Comparative Analysis

Various BIM platforms that could present Revit, IFC and Navisworks files were analysed to understand what was viewable from these BIM files. This was either on a desktop which could be accessed by a layperson, or a client of a building project that might not have access to more complex software systems. The tools were analysed in terms of ease of use and access to visual and textual data. Observations were made and used in consideration of potential software developments.

3.4.2.4 Evaluating Digital Platforms

A digital platform was evaluated to identify effective and ineffective traits within a digital platform, and specifically, how knowledge can be bridged to non-experts. The digital platform PlaceChangersLtd, which allows participants to annotate a GIS map (like what was described in Section 2.5.3), was discussed and evaluated by participants. The

activity was evaluated with a criterion to analyse the user's accuracy and completeness when achieving specified tasks (Park & Lim, 1999). The specific comprehension criteria for the planning platform are as follows:

- Number of references to help with specific language used in the platform
- Number of references to help with specific locations presented in the platform
- Proportion of users understanding the role of the platform within planning consultation
- The time taken for a participant comprehend a geographic area
- Percentage of users responding to the information

3.4.3 Stage 3: Iterative Prototyping

3.4.3.1 Evaluating Iterative Prototypes

The objective of this phase was to evaluate the prototype against a user-based assessment. Usability is a multi-dimensional concept that cannot be categorised by a single set of criteria, as implementing multiple measures, and more picked up throughout the iterative process of prototyping. According to Nielsen, usability is a general concept that cannot be measured but is related to several usability parameters that can be measured (1993). Criteria are related to these usability measures (see Table 4). A wide variety based on factors such as the specific interface evaluated within the field or lab conditions is used (Park, & Lim, 1999). Some of these measures include; the time tasks are completed, the ratio of successful interactions of errors, recovery time, the number of user errors, and the frustration recorded in the test (Nielson, 1993). These are uncovered via a think-aloud protocol (Ericsson, 1993) or through interviews with a participant (Yin, 2009).

3.4.4 Stage 4: Validating the Prototype's findings

3.4.4.1 Case Study Design

A final case study (*Case Study 2*) was used to address RQ3 which sought to understand the ways that consultations could be extended to incorporate BIM in its consultation process. *Case Study 2* focused on a development in the North East in its planning consultation phase. The case study was a collaborative project to refurbish a building on campus at Northumbria University. The researcher was able to identify stakeholders alongside the planners who were contracted by the University and could utilise the planners' own digital method as the standard practice method to compare and contrast against the newly designed fidelity prototype.

Case Study 2 represents the validation stage of this study and involved collection of visual and audio data from all participants via Microsoft Teams. The online nature of

the data collection reflects how planning is currently carried out via digital methods, especially following the social distancing restrictions imposed byCOVID-19 .

The deductive interviewing that emerged from the case study produced data for thematic analysis, as it specifically looked at the demographic information (segmented) from the participants (King, Churchill & Tan, 2017). This contrasted with the larger amount of information collated through the next two stages, since the think aloud protocol (Ericsson, 1993) and interview data (Barum, 2010) were coded via content analysis (Wilson, 2013) and specific segmented structured questioning throughout the case study (see appendix 4). This information would be viewed as participation being split into cohorts as participants explored their experience when given an application of BIM visuals and data to examine (King, Churchill, & Tan, 2017).

The data collected was analysed with specific outputs being tested by the participants and reported back to the interviewer. The responses of the participants were analysed via content analysis, and with qualitative methods being more socially grounded, coding was done manually (Parker et al., 2011). The idea of using manual coding has, in the past, been supported by the idea that using computer to code is only of benefit if the researcher is coding thousands of messages rather than a smaller sample, especially if that method potentially decreases the validity of the responses within the content analysis (Krippendorff, 2004). The codes from the earlier stages of the research were used to specifically indicate if the hypothesis of the study was accurate, and if further research was required. The think-aloud activity was audio recorded and the activity on the computer visually recorded. The think-aloud activity was then transcribed and analysed.

The prototype was then compared with an ongoing digital method of public consultation being used within the project. The participants were observed using the tool with a think-aloud protocol and then interviewed to investigate their experiences on either the prototype which would act as the test, or the current digital method which acts the control. The interviews were based on their own experiences, the findings of the thematic analysis, and what would be considered best practice from planners (Innes & Booher, 1998). The research methodology focused on an iterative process of prototyping to revise the information discovered through the phase of prototyping a platform for digital planning.

Chapter 4 A preliminary study into the impact of traditional and digital methods utilised in a public consultation for Urban Planning

4.1 Introduction

A preliminary study of public consultation methods was carried out to both validate the findings from the literature review and to understand the role digital tools bring to planning in practice. This chapter examines current public consultation methods, identifies any opportunities for improving practice through digital approaches and specifically addresses Research Question 1:-

RQ.1 What are the opportunities and limitations of the current consultation methods?

The preliminary study seeks to address the following research objectives:-

- R.O.1 Research the current public consultation methods used in planning consultations
- R.O.2 Look at the digital tools currently utilised within the urban public consultation process
- R.O.3 Look at the rise of BIM within the consultation process, and design process within a project development

The themes that have been identified include stakeholder restrictions, sustaining dialogue, balancing regulation and best practice, and finally communication strategies. This study identified the expert's opinion on who was attending public consultations, why they might go to a consultation, and when (and how) they might be able to go to a consultation. In doing so, exploring the who, why, and when, helped this study reach conclusions and the research objectives as stated above.

4.2 Participants of the exploratory stage

The participants that took part in this exploratory stage were chosen due to their extensive practical knowledge of the industry.

Participant	**Title**	**Role within public consultation**	**Research method**
P1	Community Engagement Officer	Project management / Social Enterprise	Initial Interview
P2	Council Planner	Planning	Initial Interview
P3	Facility Management	Design Collaborator	Initial Interview

P4	Architect	Design Collaborator	Initial Interview
P5	Community Engagement Officer	Design Collaborator	Initial Interview
P6	Landscape Architect	Design Collaborator	Initial Interview

Table 5: Expert Participants of the Initial Interviews

The participants of table 5 were part of the broad investigation into better understanding why consultations were used within practices, companies, and public offices. They were asked about who they might interact with within these consultations, and how they might choose to interact with the public.

P7	Public Leader (Council)	End users / Design collaborator	Method Workshop
P8	Survey Officer	Project management / Design	Method Workshop
P9	Public	End user / Design collaborator	Method Workshop
P10	Planner / Engagement Expert	Design Collaborator	Method Workshop

Table 6. Participants of the Method workshop (cont.)

The participants of table 6 were drawn on to investigate the use of digital methods within public consultations, and specifically, why they continue to use traditional methods. In asking about the choice of method to interact with the public, this group were also asked about who they identified as stakeholders.

P11	Architect	Design Collaborator	Case Study
P12	Community Engagement Officer	Design Collaborator	Case Study

Table 7. Participants of *Case Study 1* (cont.)

The participants of table 7 were introduced to the purpose of this research and agreed to be shadowed and interviewed as they carried out their public planning consultation, as observed in *Case Study 1*. These participants were professionals working within an ongoing consultation that this investigation has used as a case study. The participants

were observed to understand how they interacted with the public within a consultation, noting the use of tools and who they identified as a stakeholder. They were then interviewed to understand how they felt the consultation was carried out, and the issues that they identified within the consultation. This was important to identify as it provided context for the barriers experienced when trying to implement public consultations.

4.3 Results of the Investigation

This section will go over the research objectives of the study, as so to produce various findings that contribute to the conclusions for RQ1. Specifically, the answers as to who the experts identified as the stakeholders of a planning consultation are, what digital tools are used within the consultation, and finally, the current state of planning will be explained.

4.3.1 The current state of planning

The initial interviews with the six participants, as set out in table 4, represented a reflection of the industry as a whole and the current concerns within public consultations. The participants involved in public engagement (1,2,3,5,7), and who were part of the design process (5,4,6) discussed how they felt about the current state of planning.

Participants expressed difficulty in reaching out to the public via the means accessible to them. The designers explained they were unfamiliar with the consultation process as it is not usually an integrated part of the process. Participant 4 noted:

> *"Generally, architects are trying to complete the building as soon as the planning stage is finished, as so much needs to be done. There can also be too many comments at an early stage, so you only get one first impression."*

There was also a concern from the participants of the methods workshop (table 6) as to how the industry might work collaboratively in the future as "*consultants don't talk to one another" (*P9*)*. This workshop actively explored the different methods used throughout the consultation process and which method actively helps specific individuals within the project development. What the discussion in this workshop noted was that currently public consultations are carried out by the local planning authorities (LPA) who rely on delivering the proposals made by private developers. However, in the workshop, the concept of public engagement was met with contention as the participants no longer recognised planning engagement as a reflection of a collaboration with the public, but instead a statutory requirement and moderation of public outcry.

The case study for this research was a North East social housing estate's environmental consultation, and included interviews with the experts an architect (P11), and a community engagement officer (P12). The context of the consultation presented more field experience of what could be considered an opportunity and an obstacle. The ability "*to do something out of the box*" (P11) with more methods and a larger timescale provided more examples of what could be considered best practice and not just what is expected by the industry. As P12 noted, "*from my experience, the best way to make contact with a lot of these people is being on the ground in the place and having discussions with people".*

Participants (1,2,3,5,7,8,10,11,12) noted that creating dialogue was important for public consultations to be seen as successful, as it encouraged confidence between stakeholders and stimulated future discussion. Participants supported the use of public consultations either as it is currently used within the statutory process within the UK, or as an opportunity to use innovative methods of engagement with the public. The results of the interviews presented themes of sustaining dialogue, the restrictions of external stakeholders, the industry's attempt to balance regulation with best practice, and the use of a communication strategy within consultations.

4.3.1.1 Balancing regulation against best practice

The industry at large needs to balance the expectations of the growth, the regulations of the industry, and the ambitions of the design. That ambition invites the public to consult with the designers in project development to better design the project for the stakeholders who inherit the building environment, but this is not always possible due to working within tight deadlines. As P11 noted, LPAs must carry out press adverts, letters (agreed upon by ward councillors), and site notices, and expressed there is a larger concern that this might be seen as a *"tick box exercise".*

It was difficult for the participants of the interviews to note what might be considered 'best practice' due to their unfamiliarity with different environmental requirements across the UK. P11 noted that planning information was key before any boundaries could be made on a design since local authorities differ in needs and potential interest to that environment. Nevertheless, P8 explained that the consultation doesn't stop a development and perhaps the *"the input isn't necessarily going to make massive changes."* As P9 noted:

> *"I've run consultation events where effectively you know you're briefing the portfolio. And literally, you're managing people's expectations, rather than actually doing a proper engagement process."*

This was supported by P4, who noted that the industry wasn't against community engagement, but it was hard to present the different facets of the design. It was also

hard to get different participants to come up with ideas. With regards to best practice, however, whilst there were different variations between the participants, there was a consensus amongst the participants of the importance of early engagement. Modifications to a design can be made to a project much earlier in the lifecycle, however, most public engagement is carried out in the technical stages of the programme of work where less substantial changes can be made.

4.3.2 Stakeholder Restrictions

Participants who engaged with the consultation process reflected on the restrictions that the public might have to contend with when trying to engage with planning. The advocation of consultations can be restricted by daily obstacles in the public's life and the choice of consultation method can dissuade engagement due to technical ability, temporal constraints, or even a lack of knowledge regarding the industry's practice. For instance, P12 and P13, who used a digital application to provide their feedback for the case study, noted that 35% of the area was without internet access. They also shared a concern that traditional methods of face-to-face engagement would not reach the public, and that the technical method was necessary to cover a wider spectrum of input.

Stakeholders can be restricted by their own circumstances. While group dynamics within a planning consultation was considered useful by participants (P7, P8, P9 and P11) it was generally considered not to (be a restriction?) for everybody due to the destination and timeframe.

There have been various attempts to tackle the technical capability of stakeholders, but in practice, this has not been via pushing technology onto stakeholders, but engaging within the limitations of stakeholders. P13 used stalls within the local area connected to the environmental consultation, and P1 described the use of door-to-door surveys by a social housing organisation to ensure that all housing customers were involved in the consultation process.

As noted in the literature review, there is consistency in identification from the planning experts and stakeholder management professionals as to who is considered as a stakeholder. There are many individuals that economically benefit from building projects, whose professional survival relies on the work that comes from the construction industry. These individuals are usually within a project team, and the literature would consider them an internal stakeholder. Such stakeholders are considered as decision makers within the design process. As a collective, they have exclusive power over the project development.

Council and private planners are expected to carry out consultations as part of the statutory requirement of larger project developments (as noted in section 2.8.2 of Chapter 2) and will have a stakeholder relationship with the architect to deliver information to the public. They are often considered the mediators and expressed within this study that planners would invite “the same old” stakeholders of the area to engage with a consultation. Planners working within the constraints of statutory planning consultations were afforded less time and materials for public engagement. Older techniques of public collaboration, such as a village meeting, would lead to older groups of stakeholders addressing concerns to the consultation. This was opposed to what was observed in *Case study 1*, as the project specifically looked to identify stakeholders prior to the consultation and set about targeting areas to engage with specific external stakeholder groups. the data collected from the interviews taken with P11 and P12 was considered highly informing for the decision-making process. This is because P11 and P12 provided in-depth insight into the consultation with a walkthrough of the process observed in real-time.

The public can be considered an external stakeholder for a consultation, however, while consultations are considered an obligation, this does not result in far-reaching engagement. Instead, there are concerns from planners that utilising outdated techniques within constricting time limits is reducing the amount of potential participation within public consultations. This can create constraints, as confirmed by P10 who would admit to recognising the same faces at physical consultations, usually an older generation who had more available time to engage with the ongoing activity with the area. P2 noted a core group who would regularly attend these events, which encouraged the use of a set group to provide quick-fire responses from the community. More tools used in this consultation over a longer amount of time would be advantageous to guarantee better quality information from the public, especially as the digital tool would present geographical locations connected to comments from the public. The technocratic gaps are linked to concerns that minority groups are not considered within the planning process. This seems to suggest that there is a socio-economic restriction that the public might experience when enacting democratic actions in planning.

4.3.3 Digital Tools

The use of digital tools was a cause for both concern and interest amongst participants, as industry developing technology has been considered instrumental to the property sector’s survival. As noted in Chapter 2 (section 2.8), the industry has utilised software, such as BIM, to better collaborate and reduce wastage. However, as noted in section 2.5, there is still outstanding research when applying technology to planning. P2 explained University provides teaching the fundamentals of planning but not the

emerging use of technology. However, the practice of planning is still behind various aspects of technology in the industry. Planning falls behind other AEC (architecture, engineering, construction) areas.

Amongst all participants, those who identified themselves as the design team explained that they had closer relationships with other project team members and the internal stakeholders of a project. The also explained that they did not have the same closeness with the future users of the building project as they were viewed as external stakeholders. Technology within the industry (such as Building Information Modelling) supports the relationships among internal stakeholders. The intertextuality of the system retains the consistency of project management Though the use of a technical system is not always enforced by the project team, as the end client of a project as participant explained: “the project design will go over budget as the client requires designers and a technical understanding to produce the planning and application of BIM.” The project team acts as a pioneering force for this communication methodology, although as P4 explained: -

> “*When using BIM models, there is a lot of extra work clients don’t understand. There is an issue that these clients don’t do it earlier. So, when designing the study of the area it is hard to transcribe it to BIM.”*

The relationship of the industry has become far more technical as more skills are required amongst the project teams overseeing a building development. The workshop participants (P7, P8, P9 and P10) explored more of the tools that are incorporated in the planning and design process. The workshop enabled these participants to have a group discussion about the viability of older methods of engagement via interaction with the newer tools of the industry. The workshop was comprised of two experts that practiced public consultation (P7 andP10), an expert of technology (P9) and an expert from industry (P8).

The workshop helped the investigation understand what planners might envision to be the future of public engagement, as current traditional methods only reach out to the “*same groups and individuals*” (P10). However, as noted above, the ability to afford more time and materials to a consultation belonged to contractors, and not the council. Even though, as noted in section 2.5.1, the UK Government has identified promise in using technology within planning, there are still tight deadlines within planning applications, and there is a concern that with more data offered by technology, the Council will not be afforded adequate manpower to analyse it.

4.3.3.1 Sustaining Dialogue

Sustaining dialogue was a major theme amongst the public engagement participants (P1, P2, P3,P5,P8,P9,P10) of the thematic analysis. The ability to discuss with the

public face-to-face methods such as targeted meetings, public stalls, staff exhibitions, and consultation portals were considered the best way to engage with the public as it allowed more time to address confusion and concerns about the built environment. P12 noted that consultations undertaken with the public on their doorstep allowed engagement to better reveal any underlying problems within a built environment. P10 noted that consultations don't require a large degree of detail, instead they should focus on stakeholder needs.

The challenges of these methods were seen as "labour intensive" (P7), as discussions with the public not only had to be recorded but also analysed for public insight. Traditional engagement methods, such as letters, public notices, websites, and newspapers, are usual statute requirements. Smaller development projects do not need much focus from the planner and might provide one example of consultation. The current statutory approach was criticised by group workshop participants (P8, P9, P10) for engaging with the public because they were viewed as merely delivering information to the public without encouraging further interaction, engagement, response, or dialogue with the public. In the opinion of P7, letters and emails were only reaching invested stakeholders of the building project.

The use of social media and websites has become common practice within the planning practice, as local authorities' have increasingly recognised the UK public's day-to-day use of technology. This may remove dialogue between stakeholders and remove an opportunity of understanding as nuance is removed. The context of the development absent from the consultation. It might also emphasise an issue of current tools within the practice, in which only interested parties are engaged with this process and not the wider scope of the public, as noted by P8. While there are no significant immediate effects of using new methods, the participants tasked with community engagement did agree that new technologies had a long-term positive affect. Specifically, P2 noted the current regulation (as noted in section 2.1) created rapidity and presented challenges for the team, as inattention to the community supported anti-establishment feelings amongst the community "because it is easier to share negative feedback".

4.3.3.2 The need for a Communication Strategy

Communication strategies can be a great aid in thinking out the combinations of methods to access the public and understand the built environment, for both groups of industry participants (P4, P6, P7, P8, P9, P12) and consultation facilitators (P1, P2, P3, P5, P7, P8, P11, P13). Implementing a strategy to access local information about the environment is an effective means to demonstrate what is needed within the area. Effective consultation was agreed upon, utilising a strategy of different techniques,

penetrating the public discourse and to intervene with effective dialogue about change in the civic area. P3 noted that sessions for feedback on projects can be useful, however, there is a lack of ways to communicate feedback. There had been interest in taking in this information and archiving it digitally, as highlighted by P11 and P12, who were drawn to using a digital platform since it logged information geographically. Meanwhile, there remains a problem with transferring the traditional methods of collating data into more technical methods of design. P4 explained that “the traditional process can’t just import BIM models, but the problem many potential users have is the cost of the software”.

The combination of both, technical and traditional media is important, so as to reach a more diverse population. Public engagement was framed as a communication strategy with various inputs and outputs. These outputs could be better premeditated from community officers researching the area and its possible restrictions regarding certain communication strategies. Understanding the limitation of knowledge that the public will have as non-professionals and the possible questions that may come could improve the queries raised for building projects.

4.4 Discussion

This section will reflect on the issues and opportunities of planning consultations in the UK. The results of the investigation, as presented in this chapter, clarify that creating dialogue is important for public consultations to be seen as successful, as it encourages confidence between stakeholders and stimulates future discussion. This creates opportunities, not only for the single project development but for civic learning amongst all stakeholders that builds trust (Gordon, & Baldwin-Philippi, 2014). Nevertheless, the interviews presented a dichotomy when approaching a public consultation, and considerations of best practice were balanced against the expectations of the industry.

In addition to this the section will also relate to Research Findings (RF) 1 and 2. These are:

- RF. 1 The technocratic language used in public is a major barrier to public consultations.
- RF 2. Integrating BIM into the process can better help understand technocratic language in building proposals.

Participants supported the use of public consultations, either as they are currently used within the statutory process within the UK, or as an opportunity to explore innovative methods of engagement with the public. The discussions carried out with experts have unveiled themes regarding sustaining dialogue, stakeholders’ restrictions, balancing

regulation with best practice, and finally, the incorporation of a communication strategy. Finally, this investigation concludes by considering how the incorporation of BIM could improve dialogue between internal and external stakeholders for consultations.

4.4.1 Sustaining Dialogue

The results of this study have shown that public-facing professionals (i.e., the planners, community engagement officers and councillors) held an ongoing concern that the dialogue around the planning process was not consistent. The statutory practice within the UK requires a single announcement of a public notice of project development (Bevan, 2014), and these single information drops involved distributing emails, letters, and response forms to the public notifying them of public consultation details. This approach was criticised by participants (P7, P8, P10) as an effective method for engaging with the public because they were viewed as merely delivering information to the public without encouraging further interaction, engagement, response, or dialogue. This falls into what is considered tokenistic within the Arnstein ladder by many academics in the field of planning (Lane, 2005), as it was seen as not truly cooperative with the community. Traditional methods presented little in the way of attributing any design commentary on a project (also noted in Kingston, 2002). The public as an individual is seen as a responding party but not as part of the wider community, and in the opinion of P7, letters and emails were only reaching invested stakeholders of a building project. The practicalities of planning within the industry can make it problematic to find enough time to engage with the population as the industry considers the project development too technical for end-users to comprehend (Butt, Naaranoja & Savolainen, 2016).

Research Finding 1:

Targeted meetings, staff exhibitions and consultation portals were spoken quite highly of amongst participants. P10 observed that effective engagement came from table discussions with the public and did not even require a large degree of detail. The planner, as the mediator, could be considered a fundamental part of the participatory paradigm (Healy, 1992), can build upon a role which already organises the public's attention towards aspects of the examined design (Booher, 2002).

However, the enthusiasm for such a role, using all these methods, has its challenges of being seen as "labour intensive" (P7), as discussions with the public not only had to be recorded but also analysed for public insight. P12 explained that true insight into the discussions within the consultation was only possible after accounting for a dedicated time to listen to unrelated problems.

The consultation case study (*Case Study 1*) was given an atypical amount of time in comparison with other public consultations led by local authorities, and as a social housing organisation, the decision to do so was supported. This allowed for longer and in-depth consultations, and in doing so, this study presents sustaining dialogue with a community in practice. While there are no significant immediate effects of using these methods, the participants tasked engaging with the community agreed that consultations had a long-term positive effect. P2 noted the current regulation created rapidity and presented challenges for the team, as inattention to the community created anti-establishment feelings amongst the community “because it is easier to share negative feedback”.

Sustaining dialogue acts as a rather untechnical approach to creating homogeny between stakeholders. Not all methods are effective or even poised to help sustain dialogue between planner and public. Where there is a longer amount of time to consult and address public concerns, there is a higher interest in doing so, but the regulation and expectations of the industry work predominately to dissuade planners.

Research Finding 2:

The responses received by those engaging with the public are given time to be digested and broken down to identify the stronger themes of dissatisfaction amongst the community. These are seen as “physical and tangible” contributions (P10) and can allow objections to a project to become more apparent. The use of social media was advantageous (P7), able to detect niche data, however, the use of response forms did not always create a consensus on the designs presented. While there has been specific interest in producing a digital-first approach to modernising planning (Boland et al., 2021), there are still considerable concerns in the use of digital methods creating an algorithm of data from community participation (Kitchin, 2017). This may limit dialogue between stakeholders and prevent proper understanding as nuance is removed. The use of digital tools might also emphasise any issues around current tools within the practice, in which only interested parties are engaged with the process, limiting the views of the wider scope of the public, as noted by P7.

4.4.2 Stakeholder Restrictions

Advocating public consultations can be restricted and arises dependent upon the type of consultation method. Some methods of consultation can dissuade stakeholders to engage due to technical ability, temporal constraints, or even a lack of knowledge regarding the industry practices.

There have been various attempts to tackle the technical capability of stakeholders. Planning academia has become more interested in the use of technical capabilities

(Boland et al., 2021), but there are still concerns that they are unable to engage digitally (Kitchin, 2017). P11, who used a digital application for the consultation in *Case study 1,* noted that without internet access, face-to-face engagement was relied upon even though engagement officers acknowledged the potential restrictions to engaging with the community. The more tools used in a consultation, over a longer amount of time, would likely extract better quality information from the public, especially as digital tools could present geographical locations connected to comments from the public.

Research Finding 1:

Some technocratic gaps in public planning consultations highlight concerns that minority groups are not considered within the planning process. This is a socio-economic restriction experienced by the public when enacting democratic actions in planning. P8 noted that 'in person' events would often only encourage similar groups of people within the area. P10 admitted to recognising the same faces in consultations, generally described as an older generation who had more available time to engage with the potential plans for an area. The workshop participants expressed concern that in transitioning to more digital methods, an invested group who held a lot of local knowledge might be lost due to the technical barriers set in the planning process.

Stakeholders can be restricted by their own circumstances. While group dynamic within a planning consultation was considered useful by participants (P7, P8, P10), it was also considered to be not appropriate for everybody due to the location of the consultation and time restrictions. P12 worked around this barrier for their own environmental consultation by setting stalls at local areas of interest, including pubs and schools. This was done so as to engage specifically with the stakeholders of the estate who would not necessarily have time to seek out engagement opportunities in their own capacity. Meanwhile, smaller events relied upon the attendance of an older demographic who could afford their time to address issues in the environment. This outlook was supported by P2 who expressed their understanding of a usual core group commonly speaking for a whole area. Those who reach out to the community for consultation often can struggle to unite such divided groups, separated due to their own circumstances and the constraints of the methods used within the consultation.

Gaps in knowledge within the general public act as another obstacle to engagement in the consultation process. The varying level of stakeholder know-how can make communication routines ineffective. Project teams generally consider that the end-users of a project do not understand the construction process (Butt, Naaranoja & Savolainen, 2018). This has posed the question about when and at what stage the public should be able to access a project. When addressing a potential public

engagement tool at the beginning of a project, P10 responded by expressing their concern regarding public opinion:

> *“If something changes, because your original plan wasn't with the public, we have an issue that people go out with the first iteration of a plan and consult on it. And then make the iterative changes throughout the whole thing. And now it's different, and I don't like it, it's too late. So, it's making sure that your absolutes are absolute or down. But where things are flexible, that you know, it's clear to people that those things might change in the future.”*

P1 noted there was a natural reaction of fear to environmental change and noted the emergence anti-establishment feelings amongst the community when communication is mismanaged. The lack of education can also extend to the project team, as P5 noted that architects are not usually educated in the way of consultation. This is also supported by P4 who commented on the lack of training in community engagement. These trained architects present an industry that relies on professionals organised for similar jobs. There is a lack of knowledge of what is necessary for consultations. As P6 explains, that projects are consulted with external stakeholders at the end stage of the design process. Architects will only release design information when they it met a satisfactory level. This usually meant consultations delivered a finished designing hesitant for further amendments. Intercepting this process can be problematic, as P12 explained their requirement to provide pinpointed nuanced information to a design team, and that within a larger time scale, it was possible to deliver this before the larger decisions were made by the architect. This would determine what could be changed in a project’s design, as suggestions evolving from public engagement, made at the time of an established technical design, would be unlikely to impact significant alterations on the design. The earlier public engagement was frowned upon by planners in the workshop as it encouraged concerns regarding the public relationship with the planner and the possible reaction to a non-completed design. The lack of knowledge on both sides can create a problematic timescale, contributing to delays and creating a disjointed planning consultation process.

4.4.3 Balancing regulation against best practice

The industry at large needs to balance the expectations of the growth of the market value, the regulations of the industry and the ambitions of the design, whereby the public are encouraged to consult with the designers of a project development to implement the best possible design for the stakeholders who inherit the building environment. This is, however, not always possible due to working within tight deadlines.

As the literature review stated, the information required from a consultation is a minimum statutory requirement in applications for planning permission, dependant on the type of development and the impact it would have on an environment. It is noted that if an applicant was to refuse carrying out a consultation, then the application would be denied. For the public, this might be the sole opportunity to discuss a project development, as additional consultations are not always guaranteed. Whether or not the opportunity for discussion is provided depends upon local planning authorities, who would consider whether, without consultation, any of those who were entitled to be consulted on the application would be deprived of the opportunity to make a representation.

In terms of statutory requirements, LPAs must carry out press adverts, letters (agreed upon by ward councillors) and site notices. A major concern perceived by the workshops participants was that public engagement was merely a 'tick box exercise' (P11), whereby property professionals are just consultants to the designer and have no power in changing designs, only the ability to veto something that might be considered unviable in the environment. P8 explained that the consultation typically doesn't stop the development, and that the input of the public "isn't necessarily going to make massive changes". The statutory requirement of a planning consultation and the speed of that consultation can make it difficult for planners to address what aspects of the design can be altered at certain times of a project's development (Munster et al., 2017). As P7 noted: -

> *"I've run consultation events, where effectively you know you're briefing the portfolio. And literally, you're managing people's expectations, rather than actually doing a proper engagement process."*

Research Finding 1:

It was difficult for the participants of the interviews to note what might be considered 'best practice' due to their unfamiliarity with the different environmental statutory requirements across the UK. P10 noted that planning information was key prior to the consideration of any boundaries that could be made on a design, as local authorities differ in needs and potential interest to different environments. A planner's dilemma, when engaging with citizens (external stakeholders), is that they are restricted in their discussions of the planning process, specifically with regard to industrial information that might contextualise the project (Boonstra & Boelens, 2011). This inherently means they are not taking into consideration the benchmarks within the industry as a matter of course.

Research Finding 2:

The best practice of a consultation is balanced with the regulation and expectations of the industry. Using a system such as BIM could potentially help to manage this balance with a wider incorporation of stakeholder data available to various project team partners within the project development framework. BIM has expanded its capabilities to integrate more visual and textual data since its conception, and in doing so, it has incorporated more traditional practices and project teams (Paavola & Miettinen, 2019). There is a potential for more stakeholders to be included in consultations based on a collaborative methodology, and in doing so, more information may be shared in relation to the context of a project development's design. Best practice was observed as early engagement amongst participants.

4.4.4 The need for a Communication Strategy

When certain methods of communication are used to reach the public, strategizing can be helpful, particularly when managing large development projects. In identifying stakeholders (Freeman, 1984), organising when they are informed and creating opportunities to communicate ideas (Davis, 2016) the industry can manage expectations and structure inclusiveness. Stakeholder management, as P8 noted, was an obvious standard for the industry as "information is publicly available". This raised the question as to why this information wasn't being analysed alongside the historic objections of the area to ensure it was addressed in policy. Analytics are an obvious choice for planners (Boland et al., 2021), with mobile data collected for spatial decision-making. However, this might only represent a partial solution, as P10 explained that within analytics you are only looking for keywords within a consultation, and not looking deeper into the public perspective.

Currently stakeholder management might come across as "a man behind the curtain" (Kurtin, 2016) since the quantitative data dissonates the community to the environment that they inhabit. In creating networks alongside the public, the planner can address more qualitative data that can be provided by the public. P5 stressed the need to create relationships with the community, as the participatory planning aims for equal partnership which relies on trust (Gordon, & Baldwin-Philippi, 2014). Trust can be difficult to achieve with any stakeholders unclear on the structure of the industry and the language that signposts the building development process. This can be undermined with misconceptions regarding an unclear process., P8 explained *"there are misconceptions as soon as people see what's going to be developed"* as the documentation seems sacrosanct and will be protected, but as soon as a developer changes aspects, *"that's when you lose trust with a member of the public consulted, because suddenly your boundaries shift."*

Research Finding 1:

This is inevitable within industry as decisions related to building component selections are usually postponed until the detailed design stage (Basbagill et al., 2013), and it impacts public attitude towards their power when sharing opinions about plans (Gordon, & Baldwin-Philippi, 2014). A public consultation can be better mediated when clear outputs are provided to the public. P12 explained they were able to provide a methodology within the social housing estate's environmental consultation. In doing this, clear directives emerged for the engagement officer and architect when analysing the data from the public. This was due to the participants own history of consultations with "*feedback being broad" and therefore it was "hard to retrieve aspects of the fabric of the environment."* In using a digital tool to geographically derive detail from stakeholders, aspects of change were clear for P11 and P12, who found it easy to decipher what change was required.

Research Finding 2:

A strategy of communication aids stakeholder identification and management, as it coincides with a plan of works within the industry. As industry has become more introspective, with project strategies introduced within the RIBA plan of works (inclusive designs etc.), it is not inconceivable to imagine that the use of tools such as BIM can support the interoperability of design amongst a larger scale of stakeholders. In the past decade, the use of visuals displayed have been adapted to integrate with a planner's dialogue and consultation (Gordon, 2011). Therefore, the effective utilisation of 3D models within spatial planning better prepares planners for the future of the industry (Kitchin, 2021). Understanding the limitations of knowledge that the public hold as a non-professional, and the possible questions that may be raised, could better shape the public planning process and lead to a reduction of delays and a more streamlined timeline.

4.5 Conclusions of the Preliminary Research

Creating dialogue is crucial for project development as it stimulates discussion and encourages confidence amongst stakeholders. The analysis presented the themes arising from the property professionals in terms of sustaining dialogue, restrictions on stakeholders, balancing best practice with regulation, and the use of a communication strategy.

This investigation concludes with a hypothesis that a digital platform presenting data directly from project development, such as BIM, could benefit the public consultation process and expand on the ideas and vision for the future. Such technology might also involve more external stakeholders within a building project.

Sustaining dialogue can be a benefit of public consultation as inter-subjective communication (Healy, 1992) can build upon a role that just organises the public's attention towards aspects of the examined design (Booher, 2002). While there are no significant immediate effects of a successful consultation, the participants who were engaged within the analysis agreed that the community was positive and that repeated consultations reduced negative feedback and feelings of anti-establishment. The case study consultation gave the participants an opportunity to analyse these longer and in-depth consultations, and in doing so, presents stronger evidence for use of technology within the sector.

The promotion of best practice within the industry could be considered an opportunity for pioneers to promote the use of public consultations, but the industry expectations of business growth while, working within tight deadlines, can make this a challenging concept. It was difficult for the participants of the interviews to note what might be considered 'best practice' due to their unfamiliarity with different environmental requirements across the UK. It was noted that within the consultation process, planners are managing people's expectations. Much like the industry's own method of stakeholder management, there are vested interests in completing a consultation in good time for the design phase to be completed prior to the commencement of construction. The statutory requirements of a planning consultation can sometimes not account for in-depth discussions about the shared building environment and how what aspects of the design can be altered at certain times of a project's development. However, there are limitations in what external stakeholders understand in the planning process.

Stakeholder restrictions highlighted the concerns of planning academia around the technical capabilities and temporal constraints of the public. An obstacle for the consultation process was initial engagement with the public, as this could impact the potential commitment to discussions regarding the shared built environment. Reliance on a singular method for consultations has proved risky, with traditional methods being impacted by the public's temporal constraints, and digital methods restricted to the public who were technically skilled. These technocratic gaps link to current concerns within planning academia that minority groups are not considered within planning due to the lack of stakeholder identification. This represents both a socio-economic and a socio-political problem if public consultations are to be considered a democratic process within planning and in the UK. This is further impacted by the wider industry's lack of education about the consultation process, as participants noted architects were generally unfamiliar with the consultation process, with little of the context of a design choice's reaching construction personnel.

Communication strategies were considered an opportunity as they can be a base for combinations of methods to access the public and understand the built environment. Implementing a strategy to access and extract local information about the environment is an effective means to demonstrate what is needed within the area. Creating as many communication networks as possible gives planners the best potential for understanding the community that, as Civil workers, they are expected to serve. The combination of methods, of both technical and traditional media, is important so as to reach a diverse population. Public engagement was perceived by as a communication strategy with various inputs and outputs.

4.6 Summary

Participants supported the use of public consultations either as it is currently used within the statutory process within the UK, or as an opportunity to use innovative methods of engagement with the public. Concerns regarding the language and the stage of the project development at the time of the consultation impacts the industries interest in public insight. The thematic analysis of the interviews highlighted themes including the relationship with stakeholders, stakeholders' restrictions, balancing regulation with best practice and finally the incorporation of a communication strategy. There is a potential to widen stakeholder involvement with better acknowledgement of external stakeholders utilising a technology such as BIM, but external stakeholders are restricted by a lack of knowledge regarding the planning process. The next chapter considers the incorporation of BIM into consultations in greater detail and states the requirements of what such a platform would require.

Chapter 5 An Evaluation of what BIM can bring to the Public Planning Consultation Process

The preliminary study (noted in Chapter 4) revealed 2 research findings (RF) and 3 distinct areas where BIM could improve the current planning consultation process:

RF 1. The technocratic language used in public is a major barrier to public consultations

- BIM could improve the current planning consultation by improving dialogue between internal and external stakeholders

RF 2. Integrating BIM into the process can better understand technocratic language in building proposals.

- BIM could support the balance of public consultation regulation in practice by visualising the impact of design changes in response to public comments on plans.
- The visual aspects of a BIM model could better enhance the public understanding of project design with more defined elements for participants

In order to evaluate how BIM could improve current practice, a digital prototype was developed to understand the benefits BIM can bring to current planning consultation methods. This chapter focuses on the study's RO.4:

- Understand what BIM can bring to the planning process by way of delivering the information required within a planning application for a building project

A prototype was initially designed from the requirements elicited from the literature review, the preliminary research and the co-design phase. The interactive prototype design stages are described, with phase 1 using the findings of the exploratory phase (noted in

Chapter 4) for a low fidelity prototype, phase 2 investigating local plans and current BIM tools to develop a medium fidelity prototype, and phase 3 explaining the completed findings of the iterative process which is validated in *Case Study 2* (as noted in section 3.4.3.1). The user requirements, interface design, and system architecture are described. The 4th phase, which validates if BIM improves the outcome of public consultation through a digital platform in a final case study (*Case study 2*) will be noted in Chapters 6 and 7.

The iterative prototyping phases in this chapter are:

Phase one

The aim of this phase was to produce a low fidelity prototype based on the findings of the literature review and explore the opportunity to develop digital platform tools with planning consultation experts. The primary elements of phase one are as follows:

- Establishing the design concept
- Co-design of low fidelity paper prototypes
- Prototype evaluation
- Initial software requirement development

Phase two

The aim of this phase was to explore the information requirements for planning consultations from a review of current BIM industry tools.

- Creation of medium fidelity prototype
- Policy document analysis
- Comparative analysis of BIM tools
- Prototype evaluation
- Further development of software

Phase three

The aim of phase three was to further develop the proof-of-concept design into a high-fidelity prototype that could be used within the case study to test the thesis hypothesis.

- Development of high-fidelity prototype software
- *P*rototype evaluation
- Developing recommendations for future software requirements

The findings of *Case study 2* are specified in Chapter 6 and the discussion based on these findings is described in Chapter 7.

5.1 Phase 1: Low Fidelity Prototype Development

A low-fidelity prototype was developed from the requirements elicited from the literature review. This took the form of a paper prototype which was co-designed with the participants of the workshop (as noted in section 3.4.1.2.2 of the research methodology).

5.1.1 System Requirements

An initial set of requirements for the prototype was developed (which can be found in appendix 7) taking into consideration the statutory planning requirements in the UK as well as what potential data might be useful within a planning tool. Understanding the ideas and interpretation of digital media from the experts of planning and the

construction industry explored in Chapter 4. Then understanding the flow of information through a consultation IT tool. Figure 4 provides an outline of what the flow of information should be within the prototype.

The production of a low fidelity prototype emerged based upon a set of software requirements (appendix 7) established by the user scenarios, flow diagrams and information requirements to be displayed in the platform. The design process will note any standard software requirements that might already exist when using a BIM model on a sharing platform amongst the project team.

5.1.2 Exploring the Method Workshop with Activity 2

Participants were invited to interact with and critique the potential layout for a planning platform. A simulated planning consultation scenario was devised that included aspects of a consultation area, development, design, information requirements, and the local plan. This activity is described in detail in Chapter 3, under Stage 1 and 2, and provided the background for the low fidelity prototype design as detailed in section 3.4.1.2.2 of Chapter 3. During the activity, participants were asked specific questions based on the requirements of the planning consultation scenario to see how participants would interact with the paper prototype.

The simulated planning consultation was used to analyse the impact interaction alongside stakeholders (Walker, Takayama & Landay, 2002). The prototype was based on a geographical area that connected aspects of the local area, and included images of current housing projects, diagrams provided by local public consultations, and conceptual artwork from local projects. Post-it notes and modelling clay were provided as visual tools to help develop the ideas of the industry experts in conceiving a digital tool. There was a variety of maps used to show different information, including satellite visuals, ordinance maps, and historical maps.

The participants for this activity were recruited via email after an introduction was made at various industry networking events. Participants were contacted due to their knowledge of public consultations and best practice within urban planning. These participants were also involved in the exploratory stage of the thesis (Chapter 4) and, for consistency, are identified with the same number. The range of participants from this stage can be found in table 8.

Participant number	**Occupation**	**Position within the project design**
P7	Public Leaders (Council)	End users / Design collaborator
P8	Survey Officer	Project management / Design
P9	Public	End user / Design collaborator

P10	Planner / Engagement Expert	Design Collaborator

Table 8. Experts from workshop

5.1.3 Findings

The workshop revealed that the participants relied on their knowledge of the area before being able to understand the implications of the plan. For example, the details found in the local plan, neighbourhood plan, client requirements, and social standards within the community were all required before the participants felt confident to engage in the consultation process. The activity revealed insight into what specific information and tools should be provided in a digital platform that would act as an effective public consultation tool.

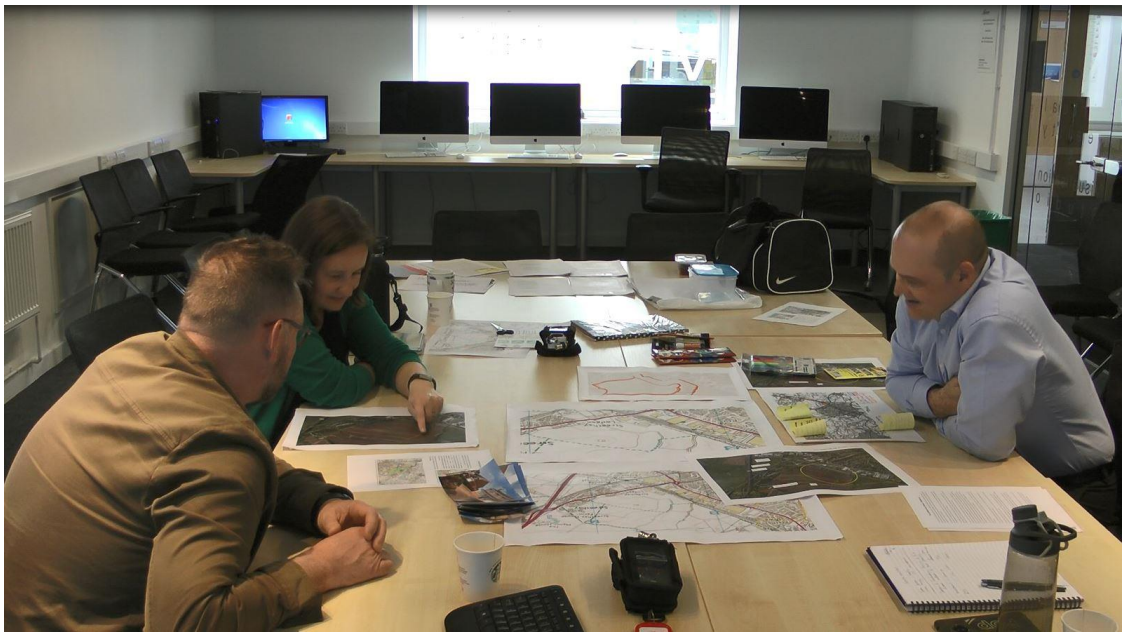

Figure 7. Participants of the Methods Workshop

Themes emerged from the workshop discussion related to the study's direction in incorporating better data for a public consultation, and it was hypothesised that this would positively affect the quality and quantity of information produced by external stakeholders. These conceptual themes are discussed below.

5.3.3.1 Sustaining dialogue with stakeholders via digital methods

The workshop participants discussed the intricate relationship that was required for a public consultation to be carried out. The expectation to "translate this information to a member of the public" as noted by P7 was a responsibility of a mediator. It should be noted that the group agreed that there is only a handful of things external stakeholders want to acknowledge as important. When industry compiles information in a nonstrategic manner, this creates barriers between public and industry, as expressed by P7, who stated, "no wonder the public gets confused".

In contrast to this, P9 stated, “there is a lot of information that is not accessible to the public”. P7 responded to this by explaining that in their experience, experts might only be willing to only engage in a consultation if they get a positive response from the public. If the environment is a shared area, it should be democratically owned by the community. This idea was expressed by P9, who noted the severity of the consultations as “if it is planned wrong, we have public health outcomes, and it gets affected for a very long time”. The confidence of the public can be long lasting and impactful. This is why there was an ongoing and strong commitment to sustaining the dialogue external stakeholders as expressed amongst the workshop participants.

5.3.3.2 Constraints in moving towards digital methods

When discussing the digital elements of public consultation with the participants of the workshop, it was obvious that there are practical ramifications in using digital tools in public consultations. P7 commented on the difficulty the public can have finding relevant information in accessible tools such as PDF’s, stating that the information can be “buried quite deep in these documents” and it may not be clear what these changes mean, such as for “the bird that lives in the backyard”. The use of digital technology does not reduce a stakeholder’s subjective perspective. Instead, there only seems to be more technocratic information used in the documents for planning distributed in the online planning portals on a council website. This can be avoided by practitioners, who instead rely on traditional methods of consultation with the public. P9 noted “there seems to be one way of doing this; with pens and paper” even though it was also noted by P9 that it is a very “labour intensive” method of consulting. This was supported by P8, who noted it would be beneficial to include a non-technical summary, as technical summaries can be large in volume and not created with the layman in mind. P8 expressed the idea that “planning portals don’t work” as “you might get bombarded” with information, with the result of overwhelming the public within the consultation process. Overloading the public with information can make it difficult to clarify the main points of discussion that facilitators want to engage the public in.

5.3.3.3 Timelines with stakeholders via digital methods

The RIBA plan of works describes the different phases of a construction project timeline. These phases are not always clear to the public. This is a significant shortcoming since the RIBA Plan of Work is a professional project management tool. Timeline information within the digital methods have become much more publicly distributed, but it is still hard to disseminate amongst the public and the targeted stakeholders of a consultation. There is an expectation that a community becomes part of a public consultation when discovering the changes being proposed in the environment. As P7 noted, “you need a trigger within public consultations [before the public will engage with the process]”. The staging of the project development, along

with the timeline, impacts what power the public stakeholder might have on the project. P8 notes the public does not want to be overlooked. However, while they “might not like the style of a design”, the public has limited power in these consultations. While certain planning strategies allow for earlier engagement, this is not always possible. The RIBA plan of works states that planning can be completed in the later stages of design, by which time the design may be too far advanced to consider implementing changes from the public. This is not always clarified in planning and, therefore, it can be confusing for the public to understand when they are permitted to consult about project development.

High-level requirements were identified during phase 1 of the requirements process and are listed in appendix 7: software requirements.

5.2 Phase 2: Developing Information Requirements

5.2.1 Policy and Evidence review

As stated in Chapter 2, local plans and policies can differ across the UK. There are overarching themes shared amongst these policies, but it can be difficult to objectively note the obvious requirements of an area, other than the material planning considerations (appendix 5). The specific context of public policy can reveal the limiting and exclusionary nature of the policymaking process (Manuel 2006). Table 9 below sets out an analysis of 104 documents across the North East’s County, Town and Parish and shows that [insert additional context]

Document Type	**Name of Document**	**Number of documents found in search**	**District / regulation**
Council Planning Policy (Local Plan)	Local Plan	15	County / City Council
Part of Local Plan	Vision Document / Sustainable Community Strategy / Sustainable appraisal	3	County / City Council
Part of Local Plan	Statement of community involvement planning	2	County / City Council
Part of Local Plan	Pre-submission Draft	1	County / City Council
Part of Local Plan	Consolidated Planning Policy	2	County / City Council
Part of Local Plan	Development Design Principles /	4	County / City Council

	Residential Design Guide		
Local Plan	Local Plan	6	Town / Area / Neighbourhood
Local Development Framework	Local Development Framework	2	Town / Area / Neighbourhood
Neighbourhood Plan	Neighbourhood Plan	33	Town / Area / Neighbourhood
Neighbourhood Refusal Document	Neighbourhood Refusal Document	4	Town / Area / Neighbourhood
Neighbourhood Plan Stage 1	Neighbourhood Plan Stage 1	18	Town / Area / Neighbourhood
Masterplan	Masterplan	2	Town / Area / Neighbourhood
Supplementary Material	Supplementary Material	1	Town / Area / Neighbourhood
Conservation Area Revival	Conservation Area Revival	1	Town / Area / Neighbourhood
Neighbourhood Action Plan	Neighbourhood Action Plan	5	Town / Area / Neighbourhood
Neighbourhood Investment Plan	Neighbourhood Investment Plan	5	Town / Area / Neighbourhood

Table 9. Sample of Data collection

The documents analysed showed that the overwhelming concerns expressed in planning consultations were related to the impact of a development on the living inhabitants of an area. The environment was discussed as an issue that not only impacted people who were living in the area, but also the impact on ecology as the environment would then be discussed as more of living habitat for other living things. Concern for the environment would also be expressed in mentioning themes such as landscaping, hedgerows, and trees, as this would directly impact the use of land for farming and impact on land ownership. It is significant to note that neighbourhood plans (noted in section 2.1.5) highlighted the effects on health and managing air quality, while local plans did not. No council local plan stated aspects of housing or development sites, as this was specific to neighbourhood plans only. The building information model based on the findings of the planning analysis and the evaluation regarded the height of the model, the density of the build, the space around the building, the design and architecture, and the eco-sustainability. The information is significant because it was the most apparent detail regarding the area available within the local and neighbourhood plans in the North East. Local plans are democratically compiled

documents regarding information and detail of the Council. It would matter to the public when regarding the shared built environment. Table 10 sets out the breakdown of information needed for planning applications in the North East as noted from their local plans.

Theme	**Local plans connected to Larger Councils**	**Neighbourhood Plans / Smaller area Local Plans**	**Total**
Settlement and Housing	0	41	41
Ageing Consideration	0	14	14
Economy	4	28	32
Green Belt	10	37	47
Landscaping, Hedgerows and Trees	13	23	36
Development Sites	0	30	30
Heritage	9	34	43
Transport	15	31	43
Flooding	1	11	12
Community Life	0	22	22
Sustaining Local Resources	6	17	23
Conserving Assets	0	32	32
Sports	0	19	19
Design	0	29	29
Tourism	0	8	8
Education	0	14	14

Environment	12	29	41
Culture	0	12	12
Housing	0	16	16
Social Needs and Disabled Access	0	12	12
Parking	4	14	18
Digital Community	0	12	12
Built Design/Scale and Density	8	1	9
Rural*	0	5	5
Gypsy and Traveller Site Provision*	0	4	4
Managing Air Quality and Low Carbon Energy*	0	5	5
Recycling and Waste	10	4	14
Sustainable Vehicles *	0	5	5
Military*	0	1	1
Farming*	0	2	2
Anti-crime**	0	4	4
Architecture	5	0	5
Unity	3	0	3
Neighbourhood	10	0	10
Effect on Health	0	5	5

Table 10. Breakdown of information needed for planning applications in the Northeast

5.2.2 Comparative Testing of BIM platforms

In designing the software for the BIM prototype, tools that were currently being used by project teams within the industry were observed. The detail of this activity is stated in Section 3.2.4.1 Additionally, the various existing applications that utilised BIM for the construction industry were analysed to identify typical users, key functions, (examples of 3D modelling?) and optimum visual layout. This enabled the researchers to understand how users might interact with BIM data on a web browser platform, the capabilities of BIM as it is currently used in the market, and any potential problems that may arise within the prototype.

The BIM evaluation was carried out by the researcher. For accuracy, the evaluation was recorded, and notes were taken. The details of this evaluation can be found in table 11. Unlike the BIM users set out within the comparative analysis, in a planning consultation individuals would be unfamiliar with the industry. Therefore, the information required from the BIM model is not comprehensive but is indicative of what the design might provide for a built environment. The BIM viewers evaluated within this table differ as they are specifically created for internal stakeholders and project teams (architects, developers, engineers, construction). This seems to be indicated in various areas of the platforms; what can be uploaded (specific Revit files or IFC), what tools are available, and who can you share the platform with.

Name	**Platform**	**Level of Detail (LOD)**	**Textual Data**	**Visual Data**	**Functionality**
Dalux	Online desktop viewer	Levels Geometry	n	y	Cutting tools Switch between 2D / 3D Hide objects Measure with triangulation tool. Colour coded details Dashboard
3D Repo	Online	IFC Data Model data	y	y	Dashboard Live Chat Response tools GIS tools

BIM Vision	Desktop viewer	Model IFC Data	y	y	Simple Dashboard IFC or Revit Identifies Different Levels File header Properties and Metadata 2D is a little messy X Y Z 2D blueprints pinned to the 3D model First Person View Clickable objects that standout Open-source software Measurement's calculations Volume calculations Export into BCF / VCF Save comments to XML file
Autodesk Viewer	Online Access	IFC REVIT	y	y	IFC and Revit Zoom into objects Clickable objects IFC information observable First Person Teleport to any area Mark up tool
BIM Flex	Desktop Viewer required for use	REVIT	n	y	IFC and Revit Zoom into objects Clickable objects IFC information observable

	Online access				
Open Design Alliance	Online Desktop Viewer	IFC REVIT	n	y	IFC and Revit Zoom into objects Clickable objects IFC information observable Mark up Tool

Table 11. Findings from comparative analysis

5.2.3 Evaluation of an existing digital platform with a think-aloud activity

The preliminary study (noted in Section 5.5.1) set out to identify aspects within a digital platform which annotates GIS maps with the information gathered from a master plan and the commentary from the public (Figure 8). The study included 4 participants who were asked to identify and evaluate a master plan.

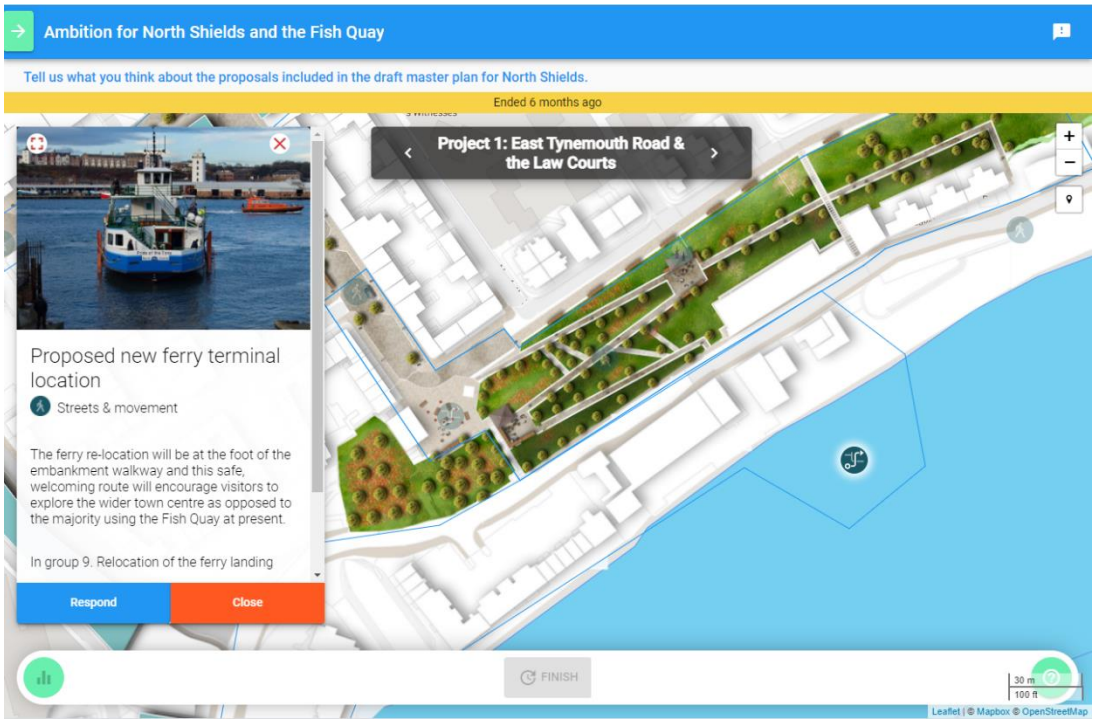

Figure 8. A digital platform annotated with a Master Plan

5.2.4 Participants

Participants were recruited via social media and physical posters. Participants were provided access to the platform to be analysed and asked to share their thoughts whilst completing the following tasks:

- Find locations on the map

- Read the information displayed on the map about a building development
- Describe what information they thought the platform was conveying
- Comment on how they might respond to information about the building development.

Participants were interviewed about their experience and asked additional questions about their level of education, use of technology and familiarity with public consultations. The think-aloud activity and interviews were audio-recorded and transcribed, and transcriptions were deductively coded (Braun, & Clarke, 2006) with items relating to the knowledge gap theme (Münster et al., 2017).

Participant number	**Student / Graduate BA/MA/PHD**	**Type of Digital Platform**
P1	Student BA	Digital Planning Platform
P2	Student MA	Digital Planning Platform
P3	Graduate BA	Digital Planning Platform
P4	Graduate MA	Digital Planning Platform

Table 12. Participant overview of the digital planning platform think-aloud activity

5.2.5 Findings

The software requirements would focus on the orientation and recognition of the objects in the prototype as it would impact a user experience. When users engaged with the planning consultation, they noted that the public might not so easily identify the aspects on a GIS map, or detail provided by a planner. In analysing current BIM tools, it was noted by participants that being able to provide observable detail, such as COBIE data, or being able to switch between 2D and 3D views, would be advantageous in terms of allowing users to better understand the information the BIM tool was aiming to convey. The evaluation of the digital platform also highlighted that recognition of the elements within a platform was an important aspect of a planning tool. The map within the digital required something to indicate certain spaces being presented. Providing the height of a building via the platform as well as presenting the levels of the building and the tools to query the environment presented on the map within the platform would help participants explore the detail provided by the platform.

The medium fidelity prototype was based on the requirements captured from these findings.

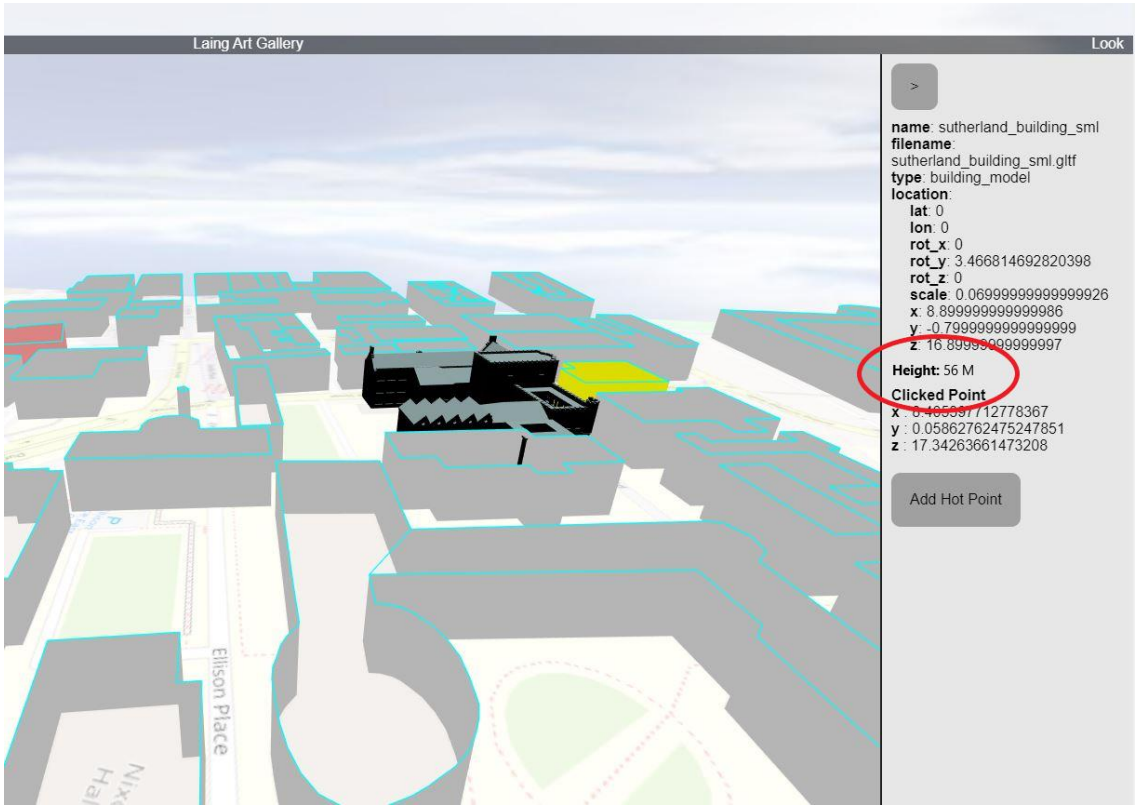

Figure 9. Medium fidelity prototype

5.2.6 Information from Planning needed in prototype

Property experts participating in the workshop who used a low fidelity tool (see section 3.4.3), expressed that it was unclear to them what should be used as information in a consultation, due the fluctuation of requirements in the different geographical areas of the UK. As P8 noted, the low fidelity prototype needed further information to be included, since there was a lack of confidence in the context being provided. This was supported by P9 who expressed that, without a local authority, it was difficult to talk about the site demonstrated in the prototype. The areas of information identified that could be supported, as set out in Table 13, were as follows:

- The height of the model
- The space around the build
- The density of the build
- The Design and Appearance (Architecture)
- The ecosystem

Information Required	**Descriptive Examples**	**Early Design Sheet**	**Detailed Design Sheet**

Height of the Model	(Overlooking - loss of light – skyline – appearance)	Early design sheets – floor	Detailed Design Sheets – components + assembly
Density of the Build	Layout – density of build – appearance – sustainable infrastructure – effect on health	Early design sheets – Facility + Type	Detailed Design Sheets – Component + Assembly
Space around the Building	Footpaths – disabled access – traffic – waste recycling – movement – streets	Early design sheets – Space + Zone + Type	Detailed Design Sheets – Component + Assembly
Design and Appearance (Architecture)	[List examples in bullet point form]	Early design streets – Type	Detailed Design Sheets – Component + Assembly
Eco-sustainability	[List examples in bullet point form]		Detailed Design Sheets – Eco sustainability

Table 13. Identified data that can aid the planning consultation

5.2.6.1 Height of the model

Planning applications require the height of a building, and this is deemed important in public consultations, as it directly impacts the lighting within the area. Within local plans, aspects such as overlooking, loss of light, skyline, and appearance will directly impact the inhabitants of an area. This was supported by participants of the methods workshop, who agreed that the height was important for relating to light and the appearance of the area. BIM data can specifically suggest geometric visuals of the height, alongside the textual data which specifies the floors within the early design

sheets. The detailed design sheets set out relevant information on the components and assembly.

5.2.6.2 Space around the Build

The space around the build is important due to its accessibility, as it directly impacts how an individual would interact with the project development. Participants of the evaluation of the medium-fidelity prototype and the digital platform expressed a reliance on the use of the transport infrastructure to orientate themselves around a platform. In the local plans of the North East, the transport was also key to the success of a planning application, with all accepted local plans and neighbourhood plans noting the key roads and points of access as fundamental for an area, as it also impacts the local economy and residential moveability. There was information available within the BIM's COBIE files regarding the use of these spaces.

5.2.6.3 The density of the building

The density of the build was important, as expressed by participants, as it directly impacts the access to a building. The discussions with the property experts showed there were considerations about the health implications in a public consultation, categorised under the banner of "public health outcomes". This is further supported within 8 local plans within the policy analysis, which all noted the scaling and density of the building in question.

5.2.6.4 Architecture

Architecture is important to a community as it signifies a character that the community will attest to being intrinsic to an area. Architecture is usually noted in the defined local plans and neighbourhood plans of an area, and it relates to the intrinsic heritage of the community.

5.2.6.5 Eco-Sustainability

Data regarding the eco-sustainability within construction has become more visible, as more tools have been able to identify and analyse data that can be used to indicate energy usage and other sustainability issues throughout the lifecycle of the building. Currently, the information that identifies eco-sustainability is restricted to the detailed design sheet, however, a large proportion of the local and neighbourhood plans noted aspects such as the environment and sustainability. Environmental awareness increasing significantly within areas such as construction, and so it is important now to including this information in any future BIM software.

A medium-fidelity prototype was developed from the requirements captured in phase 2.

5.3 Phase 3

The last phase of prototyping in this Chapter explores the ongoing findings of the medium-fidelity prototype, when compared with an evaluation of a current digital platform used for public consultations. Information regarding the details of this evaluation is stated in section 3.4.3.

5.3.1 Prototyping the user interface

The prototype was only able to be accessed by participants when a facilitator shared the platform. The singular functionality of the prototype allowed the users of the site to observe a model within a GIS map. The users were able to comment on the platform and see comments from others, though none could be hidden or deleted from view. The model presented a visual from the users University campus.

5.3.2 Exercise resource

Users can explore the consultation area via a GIS map extracted from the Open Street Map and to explore a 3D model from the Revit file. While certain information is extracted from this model, it does not provide a full list of textual data. The users can explore the map with the use of the keyboard functionality (W, S, A.D).

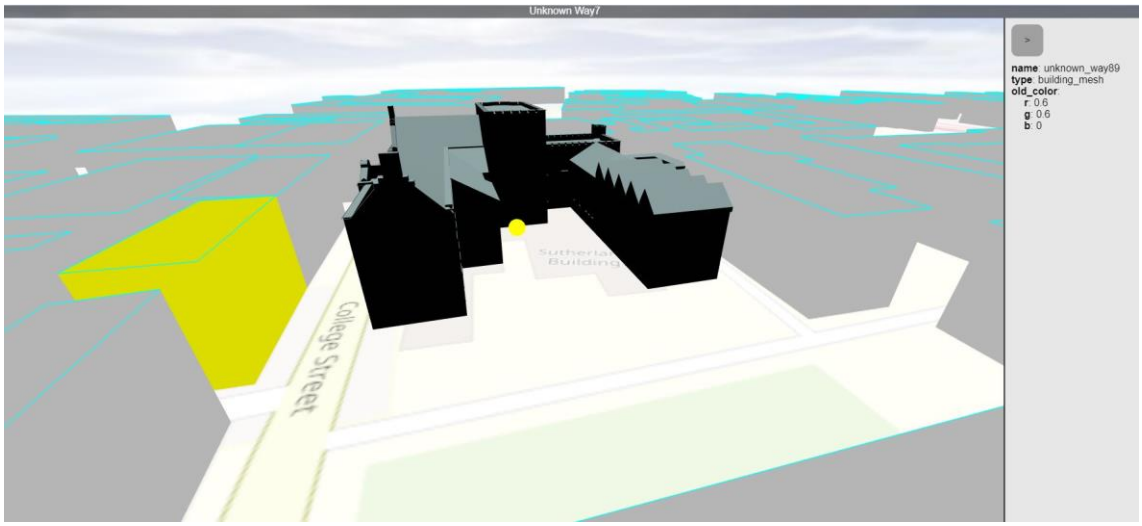

Figure 10. Example of the 3D visual that could be viewed on this platform.

5.3.3 Prototyping Participants

The participants identified and interviewed for the evaluation were chosen as they were viewed as the end-users of the building project. Different individuals interested in the research project were contacted and recruited for the protocol.

Participant Number	**Student / Graduate BA/MA/PHD**	Type of Digital Platform
P5	Student PhD	Medium fidelity Prototype

P6	Student PhD	Medium fidelity Prototype
P7	Student PhD	Medium fidelity Prototype
P8	Student PhD	Medium fidelity Prototype

Table 14. Medium Fidelity Prototyping participants

5.3.5 Findings

The requirements examined in the evaluation of the medium fidelity prototype was as follows:

- Orientation of the user within the prototype
- Recognition of objects within the prototype by the user

5.3.6 Orientation (Or 2D versus 3D modelling)

The main concern expressed by the think-aloud activity participants was orientation in order to help position participants within the virtual environment. Manoeuvrability around the map and the controls of the platform were related directly to the participant's understanding of the platform. This means that the user experience within a platform is directly impacted by the controls of a tool.

Using 3D models, P5, P6, P7 and P8 were able to create a more conceptual understanding of the outline of the geographic area in question, without becoming disorientated by flat images. The digital planning platform used a master plan to overlay the information onto the 2D map. Some concerns arose amongst participants (P1, P3, P4) as to how all these different points interacted with one another, as P4 noted, “there is a load of this stuff” when referring to the number of points on the master plan. With the flat GIS representation, it was difficult for participants to visualise design information in its current static state which might overlap with other points. It was also difficult for participants to identify if the design improvements were treated equally or if there was a specific priority (P2), as the master plan did not demonstrate levels of importance. Without the addition of points addressing areas of interest however, participants P5, P6, P7 and P8 had a stronger comprehension of the environment. P5 expressed that using 3D models was worthwhile because “if you use 2D, people tend to get distracted and lose orientation.” Unlike the points of interest on the 2D map, the geometric information allowed participants to find various areas of the campus when asked by researchers to locate where they might work or study within the campus.

The use of the platform’s internal camera seemed essential as it could be used easily by the participants. The users first impression of the medium-fidelity 3D platform was

the controls, as all participants commented on the use of the desktop's keyboard. P7 directly commented that "I play a lot of games. So that might be why I'm familiar with it." P5 noted that these controls would made it feel natural. This was like the evaluation of BIM tools as the movable camera was noted as essential so that a model could be observed easily by all participants. The capacity of the camera to move around the model freely (360 degrees) and with simple controls (WASD and MOUSE) was deemed essential by participants. Zoomable cameras and the ability to click objects would also facilitate more detailed inspection. There was a concern expressed that users should be able to quickly return to the starting or a central position, possibly by teleporting as so to navigate quickly to a known area. It became clear that the medium-fidelity prototype and planning platform could make it difficult to return to a recognisable space after exploration without this functionality, as expressed by P2, P4, P6, P7 and P8 easily got lost within the medium fidelity prototype's map.

5.3.7 Recognition

The evaluation of the medium-fidelity prototype and digital platform showed how participants were able to interact with the virtual areas, as something they might recognise as a place or work, home or leisure. P7 commented on using the 3D platform as more personal than "just being given a PDF on the area", as the model seems to establish a better sense of a place. P2, P3, P5, P6, and P7 mentioned reliance on more subtle changes to the environment, which promoted their engagement. While realism demonstrates the actual potential outlay, the evaluation showed that the use of bold, colourful indicators (usually mapping terrain or zones) was necessary to orientate users to the map. All participants of the medium fidelity prototype suggested that these models were colour coded, for a better comprehension of the building's faculty, use, and as something to differentiate the internal and external buildings to the campus within the city. This was explored further with P6, who suggested if certain buildings could be grouped into subcategories, it would help to better showcase the campus', various faculties. This seems to suggest that participants moved quickly from recognition to exploring the area for additional information within the platform. The observable data of a model, which was noted in various BIM visualising tools, would potentially be useful here as a viewer accessing metadata can bring up the available IFC information and might identify different levels of the model. In platforms such as the Autodesk tool, the BIM object would light up and provide a very rough understanding of what was being observed. Unlike the concerns of the 2D map's overlap of points, the use of a 3D perspective would present aspects of the map, with a hint of how it might interact with their lives without any unnecessary visual density on the platform.

If such a tool was implemented, then information could be provided to interact with the participant's existing knowledge and form a metaphysical understanding of the area. In

the medium-fidelity prototype, the use of generic massing meant that all participants relied on using complementary secondary material, such as building names and street addresses, to secure a better idea of the area. It was limited to the end-user's access to the ground view, whereby bridges, parking areas, and cycling roads were all highlighted by the end-users as important to showcase within the platform. P6 was able to quickly identify the larger buildings laid out in the platform but noted that additional features alongside the generic masses might aid differentiation. Therefore, it might be that providing levels within the models provided (as noted in the BIM viewer tools) categorised the geometric data into levels which aided the observational data inside the BIM model. The geometric detail could create a much more immersive experience in which users could walk around the insides of the building, providing that these aspects of the tools allowed users to dissect a model. P3 suggested that "I'd have liked some icons telling me what something is, maybe if the gym had like a dumbbell". The BIM Viewers seem to use tools that would aid engineers, as there are tools to measure distance, a cutting tool to remove BIM objects blocking views, calculations in weight, size, volume, and finally, an 'explosion' tool that pulls apart all the BIM components.

5.4 Analysis

One of the major findings from evaluating the medium-fidelity prototype and the comparative digital platform tool for public engagement was the difficulty of perception experienced by stakeholders. Not only were participants unaware of the digital tool being used and required time to explore it fully, but they were also unclear of the rules and practices of the planning sector and what their expected role was. These themes were specifically tied to the digital methods being used by participants and included:

- Language
- Design Details
- Landscape and recognition
- Layout
- Role and Reason

5.4.1 Language

The public (internal stakeholder) relies on the information provided by planners, as the mediators of the building project. However, a major barrier has been the language used to explain projects. Workshop participants seemed to ask for an explanation of terminology and phrases regarding the master plan. The geography being presented on a GIS model was not enough for them to understand the terminology regarding certain design decisions. P3 queried what a 'gateway development' meant within the context of the area, as there was little other information provided regarding the design change. The master plan featured within this platform was designed specifically for the

public, and by being run by the Council it, would be expected that the digital platform was being used for a breadth of participation. However, as P4 stated, “I mean, there's a bit of jargon and Joe Bloggs might not necessarily know what that means with the wording or the language”, and this points to a fundamental issue with digital media. The participants were aided by the facilitator explaining what aspects of the Master plan was, but without a mediator, it’s unclear how much a participant will understand.

5.4.2 Design Details

The design detail of any project viewed through the lens of a digital tool can be skewed, as understanding, or misunderstanding. This links directly with the design functionality. Participants using the medium-fidelity prototype, which incorporated a 3D model, actually wanted more two-dimensional indicators, including pictures, photos and drafts. Meanwhile, the participants evaluating a digital tool that explored an area specifically with text, photos, 2D maps and architectural drawings expressed concern about the static exploration of the area. As P4 stated, “it's unclear if the road itself is going to be fully closed, if I look now, from a traffic perspective”. While using 2D images could explain the design details of a plan made by the Council, it was unable to alleviate the concerns of the public regarding the impact changes the built environment might have on an area. P2 also supported this notion of transparency, supporting the design details being provided by the planner, since a lack of information that impact the public. P2 stated that “surely there's some more information like, when's it happening, like, what the what the impacts are going to be and stuff?”. This is directly linked with the public’s lack of understanding of the stages within the consultation process. Currently the prototype and industry tool being evaluated presented a conceptual idea of change, but this was not linked to the reality of environmental change that the construction arm of the industry would bring to the area. When it was explained by the workshop facilitator that the information on the platform could just be considered suggestions there was a concern that it was unclear as to what would be considered the most likely change in the area. Both sets of participants suggested the use of colour coding of areas to demonstrate where they may have control over the say of the area through the digital tool. P3 noted that if the digital planning tool being evaluated could use different colours “and just have a key saying this colour is a final decision, this colour is not”. This was echoed by P7 who mentioned the use of different colours to “give you a better orientation”. This is rather interesting as it steps away from making a model photorealistic. P5 suggested that if you provide too much information, people can sometimes get distracted by the detail and focus less on whatever the task is. This is the case even with the use of 2D maps, where people tend to get distracted by detail and can sometimes lose orientation. All participants wanted design details, and especially “the right access to some sort of actual documents”. This raises the question

of where to balance reality and role of projecting physical space in an online application. It can be hard to establish the correct level of detail and to find the balance between what information could be presented for the benefit of the public and what could be overwhelming and/or confusing. P5 noted that the ideal tool should “envisage as a sort of more generic kind of way of commenting on the data at a wider scale’ and then added ‘you need to probably address more. Consider more things around the user experience and know what data is being shown”. This was interesting as the prototype was limited in terms of design details other than the geographic information and the visual model. This presents a key factor when exploring design details on a digital platform with the users of the environment, as the model was treated as a reflection of their own day-to-day experience. Participants examining the prototype wanted to understand how they would move through the 3D model shell, while participants evaluating the digital consultation tool queried the day-to-day impact that changes to an area might have on their livelihoods.

5.4.3 Landscape and recognition

Recognising an area is crucial to a participant understanding an environmental development. Landmarks were considered important, so as to orientate users and enable manoeuvrability around the platforms. Both sets of participants were drawn to characteristics of the environment, as it was a reliable way to identify for the workshop facilitator what they were specifically looking at. As P3 noted, “I'm pulling right where the park is about looks interesting.” In choosing where to start, the participants would try to draw on something that seemed large or important to an area to address where they might be. Within the medium-fidelity prototype, the participants would orientate themselves by the taller 3D model buildings, or within the campus the library was a popular point to understand where they were. P5 noted that “it’s quite easy to read how we would read if you were in a sort of generic mass of place over here, where it was less isolated buildings and streets of terraced houses might be a little bit difficult”. Landmarks seemed key for all participants for orientation P1 described themselves as “not very good with directions and stuff. So, I felt like I was trying to describe, I would probably describe by our features of it as well. Like, if there's anything in front of it. any statue or plaques or anything.” This would suggest that a visual landmark could be more reliable than participants own map skills. P5 stated, “I suppose it's how people interpret data and maps, and then their awareness of the context as well. Because you've got, you've got an underpinning map, which is useful, because it's picking up areas, you know, like green areas and roads and parking and bridges and stuff that your 3D data isn't, and vice versa”.

5.4.4 Layout of Technology

The layout of the digital platform was specific to the phases of the digital planning process, as it acts as a framing device for a planning consultation's activity. However, overlaying traditional methods on that of digital methods could be considered risky as it might incorporate and exacerbate problems that have been identified within the planning practice (see Chapter 4). Instead, rethinking the roles and requirements of the digital medium of planning might bring about a new set of challenges in the future, but alongside this, a bespoke digital platform is likely to bring new opportunities for planners integrating their practice into digital format. There was an underlying consensus among participants that these tools were actively seen as a positive influence on the practice of planning. P7 noted that, "I do see how these add value to make that process faster, of giving feedback". At the same time, however, there are certainly technical problems to be aware of when using digital means of communication, as P3 noted that "well, the first thing that the computer zoomed into was that that's like gateway improvements for like, that didn't seem which in like, really interesting to me". Planners will have to engage with the cultivation of technology if they want to better act as the curators of consultations for the public. The accessibility to further information is of paramount importance. As P2 suggested, "I want to have a link so I can look in further detail at where I can actually have an impact on". This is indeed an exciting prospect for the relationship between planners and the public.

5.5 Final Platform Developed for Case Study 2

The final phase of the prototype developed for the validation case study is described in this section. Appendix 7 sets out the finalised software requirements for this prototype. This section describes the campaign runner workflow, which details how a facilitator of the consultation would use this software, and how the end-user (the public / external stakeholder) would use this system. This includes software requirements as to what is required to test the hypothesis of the study, but within the constraints of the technology that could be achieved within the timeline of the study.

5.5.1 The architectural design of the system

The platform required a clear flow of information from the architect, client or project management professional. The information provided by an architect through the use of a BIM model would be delivered onto a platform with the specific data; height, access, use and look, and sustainability. What figure 11 presents is that there is no official start to a public consultation online. Dialogue regarding the environment can be rooted in the planner's role of collaboration, the developer (or) architect's role in the design, or a local grass root movement's activism. Therefore, at any point, the prototype slips into

the same process as noted in figure 5.

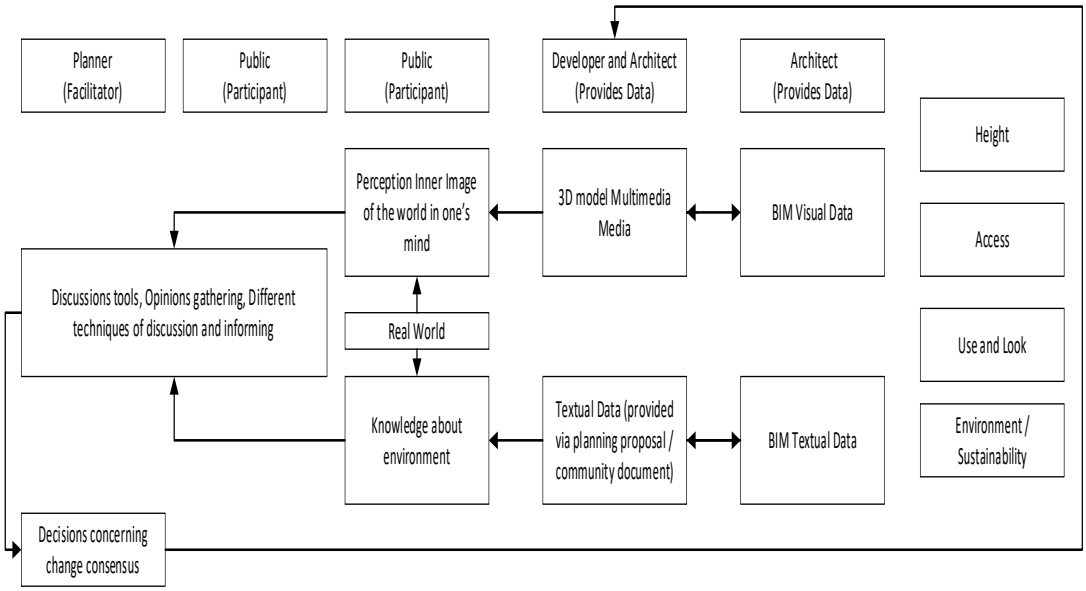

Figure 11. Architecture of Planning Consultation interacting with Prototype

Assessing the functionality at this stage of the medium fidelity prototype helped assist the subsequent steps for the design of the prototype. This prototype had limited functionality but presented the use of 3D models by framing the visual geometric imagery from a BIM model on to a desktop platform. There was a need to develop practical skills early in order to implement them within evaluation, but this simultaneously facilitates an iterative prototyping process. The usability aspects of the design were particularly important to make sure that there was no barriers to understanding the BIM elements and what they brought to the consultation approach. The prototype platform uses imagery to display an expectation of the environment, and the changes proposed within it. The dashboard describes the project development in detail (delegated by the client / architect) and clicking through to the consultation page

the stakeholder is led to the 3D model integrated within a GIS map (see Figure 11 and section 2.2).

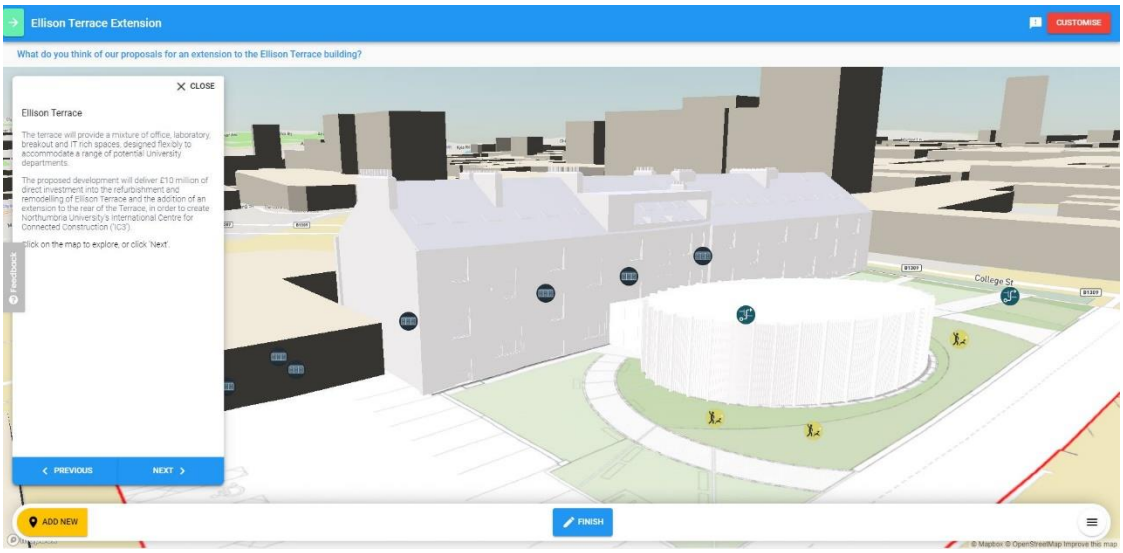

Figure 12. Prototype of the BIM model within the 3D GIS model

The scale of the model is correct to the measurement of what it would look like within the proposed project development's environment. The model can be observed with a 360-degree view and has 'hot spots' which allow the participant to click to get further information on certain design features regarding the project.

Chapter 6 Results from Case Study 2

Case Study 2 formed the final investigation of the role of BIM in the planning consultation process. This chapter describes the participants and activities involved in the evaluation and focuses on the last research objective:

RO. 5 What is the impact of using BIM visuals in a public consultation?

This case study presented the final prototype platform to a range of participants engaged in a live planning consultation of building development on a university campus. The proposed building designs were to be carried out on a historical part of the campus. A traditional public consultation was carried out by planning experts using a standard (traditional) website platform enabling an effective contrast to for evaluation of the final prototype.

6.1 The research samples

The study comprised of 20 participants. The participants were recruited via the (traditional) website used for the planning consultation for the building project. Detail about the case study was provided on the consultation website and participants wanting to engage in the study were asked to contact the researcher via email to register their interest. Each participant was then contacted, and a one-hour online meeting was scheduled to complete the study. Table 15 presents the details of the participants and includes their role in the consultation, their relation to the proposed building project and the planning consultation methods they evaluated i.e., the traditional website or the BIM enabled prototype.

Participant Number	**Method of Recruitment**	**Age Category**	**Role/Relation to Proposed Building Project**	**Tools Evaluated**
1	Business in Local Area	30-35	Uses area for work. Northumbria University Alumni	Standard Planners website platform (A)
2	Student at the University	30-35	International Student but has lived in in Newcastle for 8 years. Lives in	Standard Planners website platform (A)

			area with children.	
3	Student at the University	25-30	Works in University as part time tutor.	Standard Planners website platform (A)
4	Student at the University	45-50	Works part-time in cultural arts in NE. Family works with development.	Standard Planners website platform (A)
5	Student at the University	25-30	Family works in development. Interest in Heritage. Experience of campus 2 years.	Standard Planners website platform (A)
6	Heritage Expert (Duty Body)	60-65	40 years of experience working for Historic England.	Standard Planners website platform (A)
7	Student at the University	35-40	Experience in engaging with public consultations	Standard Planners website platform (A)
8	Student at the University	25-30	International Student	Standard Planners website platform (A)
9	Area Expert / Business	40-45	Experience in public consultations	Standard Planners website platform (A)

			and public volunteering	
10	Student at the University	20-25	International Student	Standard Planners website platform (A)
11	Student at the University	30-35	International Student	BIM enabled prototype (B)
12	Planning Expert (Duty Body)	45-50	RTPI representative	Prototype Platform presenting BIM enabled information prototype (B)
13	Student at the University / Student Representee	20-25	Student Union President – SU representative	Prototype Platform presenting BIM enabled information prototype (B)
14	Student at the University	20-25	Interest in architecture, as an interdisciplinary student	Prototype Platform presenting BIM enabled information prototype (B)
15	Student at the University	25-30	Experience in engaging with public consultations.	Prototype Platform presenting BIM enabled information prototype (B)
16	Staff at the University	40-45	Worked in University for 5 years	Prototype Platform presenting BIM

				enabled information prototype (B)
17	Student at the University	30-35	8 years of experience in the construction industry	Prototype Platform presenting BIM enabled information prototype (B)
18	Student at the University	30-35	Graduating student campus experience of 6 years.	Prototype Platform presenting BIM enabled information prototype (B)
19	Student at the University	20-25	Architectural student	Prototype Platform presenting BIM enabled information prototype (B)
20	Student at the University	20-25	Graduating student campus experience of 3 years.	Prototype Platform presenting BIM enabled information prototype (B)

Table 15. Research Sample

A large majority of the participants were mature students (over the age of 20) and brought their own practical knowledge to the consultation (professional, local, and social knowledge). Participants were either interested in the building as a service (staff, students, businesses) in the local area or of interest to heritage experts and the public as the building was a Grade listed building.

6.1.1 Prior use of Technology

The participants varied in age and experience in use of technology, but all participants had engaged with basic software applications such as Microsoft Office. The participants highlighted a similar level of average daily use of a wide range of technical applications, and many were accustomed to social media and government portals. However, a few participants noted having a higher level of insight into technology with an aptitude towards coding and creating digital models (via gaming engines, writing code, or use of employment specific to software.) The capacity for using technology was recorded about the participants as show the participants differing capabilities.

Participant number	**Office Packages (e.g., Microsoft)**	**Social media**	**Gaming and 3D modelling software**	**Software for writing code**	**Software specific for employment**
1	Yes	Yes			
2	Yes	Yes			
3	Yes	Yes			Yes
4	Yes	Yes			
5	Yes	Yes			
6	Yes	Yes			Yes
7	Yes	Yes	Yes		
8	Yes	Yes		Yes	
9	Yes	Yes			Yes
10	Yes	Yes		Yes	
11	Yes	Yes		Yes	
12	Yes	Yes	Yes		
13	Yes	Yes			
14	Yes	Yes	Yes		
15	Yes	Yes			
16	Yes	Yes			Yes

17	Yes	Yes	Yes		
18	Yes	Yes	Yes		
19	Yes	Yes			
20	Yes	Yes			

Table 16. Participants Prior use of Technology

Any aversion to social media from the participants stemmed from the participants own recognition of its negative impact, however, there were participants with a professional interest in social media, either as networking individuals, advertisers, a representative of an organisation or focusing on specific social media such as LinkedIn. Alternatively, participants noted the use of social media's messaging services.

6.1.2 Prior response to Public Consultations

The participants were asked of their prior experience of public consultations, as the researcher acknowledged that the public consultation process might have to be explained to participants throughout the validation process. Three specific questions were asked to all participants in order to understand their level of prior experience in public consultations, with their summarised responses set out in Table 18 below.

Participant number	**Do you read up on public consultation?**	**What kind of public Consultation do you engage in?**	**Do you engage in local news**
1	No (rarely)	I did a lot when I was at university with the law stuff. Human rights, for example, but again, it would have to catch my attention. I don't have the time to be reading all that.	No
2	No	N/A	No
3	Yes	I do. Because I work in education, and I used to work very close with the Department for Education. Because my line of work, I have to keep up with all	Yes

		the up-to-date legislations, but also with education changing every year, I need to make sure that I keep up to date with all the new changes that are coming into force.	
4	No	N/A	No
5	No	N/A	No
6	Yes	I do a lot of local stuff because I'm an active member of a political party. So, I do follow what's going on locally. And if there are any public consultations, I'll take heart because I think it's important that you should take part in what's going on around you. So, I don't go beyond that. Usually. I might support some national initiative or two, but mostly I stick to the local stuff, because it's that this is the world, I can actually make a difference to. It's unlikely I can make much of a difference anywhere else.	Yes
7	Sometimes	It’s quite hard actually, as it’s not so much about ignorance. It’s that I'd only want to engage if there was something in my back garden.	Yes

8	No	N/A	No
9	Yes	Only if I really have to. We've actually got one starting on today to deal with. We're redoing the timetable, three train mainlines. So that's directly affecting your job type thing. So yeah, so you read up on stuff like that. Especially if there's any planning going on in Newcastle City Centre, the council seem desperate to screw it all up. So, I'll take interest in that.	No
10	No	N/A	No
11	No	N/A	No
12	No	N/A	No
13	Yes	Not very often, but there's one going through in my local area at the moment to expand our old sixth form college.	Yes
14	No	N/A	Yes
15	Yes	Well, I tend to keep an eye on most of them. I'm particularly interested in ones around access, disability rights, things like that. So, if there is that NHS consultation that would probably interest me more than whether they were going to build. I	Yes

		don't know, sometimes it's for people that need houses or something. But I do tend to keep an eye on them. I don't tend to look into the minutiae of putting in for planning permission or things like that.	
16	No	N/A	Yes
17	No	N/A	Yes
18	No	N/A	No
19	Yes	Not usually, unless they're related to something I'm doing for work. But other than that, no. Again, I should probably be doing that based on my master's thesis.	No
20	No	N/A	Yes

Table 17. Interest in Public consultations

Participants seemed to engage with a public consultation if it impacted them directly, and this was applicable not only for planning but also including Government fact finding consultations. Some participants noted that maintaining an interest in past consultations (not restricted to planning) was relevant to their professional interests. A large majority of the participants of *Case Study 2,* however, did not engage with public consultations, and therefore, would be unlikely to understand the strategies and processes set out by a planner. If the participant felt comfortable about the subject, then they were more likely to engage with a consultation. Knowledge of the area, or subject of interest, were major factors in encouraging the participants to engage in a consultation.

6.1.3 Response to Design Details methods

After engaging with method A and method B the researcher interviewed participants. The researcher asked what 'design details' participants could recollect. This information was available in the method's text and imagery. Table 19 and Table 20 note the information that participants responded to when prompted about design details

(heritage, transport, urban, green, and functionality of existing area). The participant's results of a 1-5 Likert scale "in how confident they felt in recollecting this information" was noted in this table. There was no set time between the activity and when asked about the information regarding the urban planning consultation. Questions can be referred to in appendix 4.

Method A Participant Number	**Heritage**	**Transport**	**Urban**	**Green**	**Functionality of Existing Area**
1	“It talks into a little bit but doesn’t go into depth.”	“Could see local roads but I couldn’t see anything else”	“Not really”	“Not really”	“Little bit I don’t remember too much detail”
	2	2	2	1	1
2	“I’m not sure but I think that England is good about that”	I couldn’t see but I’m sure they have it”	“I think so”	“I think so with some if the picture”	“Yeah, I’m sure it did”
	2	1	2	1 / 2	1
3	“Yes”	“No”	“No”	“Yes”	“Yes”
	1	1	1	3	5
4	“Yes, it did”	Skip	“I think it did”	“It did / no”	“I’m not sure it looks better perhaps smaller”
	3 / 4		2	2	2

5	4.5	“No” 1	“I don’t think it went into architecture ” 1	“Lots of visuals very professio nal”	“The existing area – yes I believe it does”
	4.5	1	1	4	3
6	“didn’t notice them”	“No info here”	“No bad plan”	“No, I don’t feel I can at all”	“I couldn’t see anything there”
	2	1	1	1	1
7	“yes”	“Yeah, I can see the connection of roads”	“Yeah”	“A lot is mentione d”	“Yes of course the is main aspect for the whole conception”
	5	5	5	4	5
8	“Didn’t go into everythin g”	“No, but I suppose at the end”	“Yes, it talks about the building”	“It talks about the environm ent. It does talk a bit about landscap e”	“Yes, it’s said that it wasn’t being used”
	3	1	3	1	3
9	“It does”	“Yes, it is 2 minutes away”	“I didn’t pick on any of that”	“Did not pick up on any of those”	“The main streets and area”
	5	Skip	1	1	2 / 3

10	“Mentioned about it but didn’t go into depth”	“No, I mean I didn’t see that”	“I’m not sure I think they do”	“I just skimmed it”	“I can’t think so”
	1	3	1	1	2 / 3

Table 18. Participant confidence in the details of the design provided in the consultation via the planning website providing image, text, blueprints.

Table 19 presents the participants’ evaluation of the website tool (A). The website’s emphasis on textual data seemed to aid the discussion of heritage, something that was focused on due to the historical nature of the building in *Case Study 2* (noted in section 3.4.3). The website’s lack of visuals, however, seemed to impact the participants as they seemed unclear on aspects of transport, urban structure, and the design details.

Method B Participant	**Heritage**	**Transport**	**Urban**	**Green**	**Functionality of Existing Area**
11	“No”	“I actually didn’t notice it”	“Yes”	“Yes”	“Not very comfortable”
	1	1	3	2	1
12	“No, I mean they referenced the listed buildings”	“I couldn’t see anything”	“No, not that I can really”	“Not in the wider context”	“No, there was no upfront analysis”
	1	1	2	1	1
13	“Yes, I think so”	“Not that I saw other than the back”	“Yes, I think so it mentione	“Yeah, I think so”	“I don’t think I saw that”

			d the public”		
	1	1	1	3	1
14	“Yeah”	“Yeah”	“Yeah”	“Yes”	“I don’t think I saw that”
	4	4	4	4	2
15	“There were internal sketches”	“It definitely mentioned parks”	“Yes”	“I felt like it did”	“It may well have been mentioned but it didn’t notice it”
	4	1 / 2	5	3	2
16	Not sure skip	“Yes”	“Yes”	“Yes”	“Yes”
	skip	3	3	4	4
17	“I suppose”	“Says it in the map box”	“Okay, of course”	“Yes, there was”	“Yes, didn’t open the plans”
	3	3	3 / 4	4	4
18	“Yeah, somethin g”			“Yes”	“Not that I remember”
	1	4 / 5	4	1	1
19	“I may have missed that”	“Oh, didn’t see that”	“Not detailed”	“It doesn’t have design notes”	“OK”
	2	2	4	2 / 3	3
20	“Yes”	“I didn’t see that note”	“I think so”	“Yeah, the brownfield ”	“I think so”

	3	2	1	1	4

Table 19. Confidence in the details of the design provided in the consultation via a BIM model

Table 20 presents the participants' evaluation of results of the digital platform that presented BIM data (B). The platform emphasised the visual stimuli for the participants, and this seemed to encourage confidence for the participants in terms of the transport infrastructure, urban structure, and green infrastructure. It was noted by participant 15 that more internal visuals might have helped, as it seems that the platform actively made participants more curious of the internal usage of the building.

6.1.3.1 Heritage

Heritage details were provided in both method IA and B. In method A, the detail was provided within the text of the website. Within method B, the detail was provided in a pop-up information box linked to a hotspot on the 3D model, and the map displayed when the hotspot was clicked on. Participants from Method A were relatively confident in heritage being addressed in the work. Participants from Method B overall confirmed that they had a lower confidence from the information provided, as many asked about the internal heritage features of the project development.

6.1.3.2 Transport Infrastructure

Transport infrastructure provisions would usually feature external entry points and internal areas for domestic travel. Method A did not provide information regarding travel, roads, or road access to the project development. It did, however, produce a location map. Method B provided a 2D map on which the 3D models were placed. An open-source map as a flat platform provided current information on the roads in the studied geographical location (Newcastle upon Tyne city centre). Participants from method A had less confidence when talking about transport and when being asked about how confident they would feel in answering questions about transport infrastructure. This was in contrast with Method B, where the participants were able to note higher confidence in the transport details in the planning development. This wasn't a significantly higher level of confidence, but it was observed to be higher than Method A. This might be due to being able to see the model integrated into the current Newcastle upon Tyne city centre map. Roads were clearly set out in Method B as part of the design functionality of the platform itself.

6.1.3.3 Urban Infrastructure

Urban infrastructure discusses the provision of a defined public realm network using streets, squares, lanes and stairs. Additionally, it looks at a legible and permeable

urban structure which clearly defines public and private space. Urban infrastructure in the public consultation was noted in the imagery provided in the area. This was for both Method A and B, with Method B also providing a 3D model on a 2D map for the consultation. When discussing the model participants from Method A presented having less confidence when talking about the urban infrastructure surrounding the building project. Although though they could mention the building itself, it was harder for these participants to visualise the surrounding urban structure of this area. This was in contrast with Method B, where participants were not provided with a detailed set of models of the Newcastle area, but a visual of the basic structure of the surrounding area.

6.1.3.4 Green Infrastructure

Green Infrastructure is the provision of green spaces to form part of a green infrastructure corridor. For the development in question, this would include a series of pocket parks and squares linking to existing spaces to the west and east of the site. What could be considered the most important element within the consultation was that participants of both methods mentioned the importance of including more aspects of sustainability within projects in the built environment. Method B provided more participant responses related to the green infrastructure in comparison to Method A. This is possibly due to seeing the building embedded within its surrounding environment on a map, which gave these participants more confidence in the green aspects of the project.

6.1.3.5 Functionality of the Existing Area

The functionality of the existing area is defined as the provision of the new public space(s) which will provide opportunities for arts including performances, events and external exhibitions, essentially expanding the functionality of the existing area. Method B provided the 3D model and 2D map for users to engage with the design details of the functionality of the existing area. When participants were questioned on the design details of the project, relativity average to low scores were provided, with slightly higher scores observed in participants using Method A. Participants using Method A, when asked about design details, would note the uses of the potential building. and how the consultation mused on the building’s current useability, as well as any potential improvements it would bring for the University.

6.1.4 Summary

The first set of interviews included a number of participants across a range of ages, backgrounds and with pre-existing attitudes in regard to public consultations. The concept of the public consultation varied amongst the participants who mentioned past participation in a consultation. Out of this, only 2 participants mentioned a consultation

that incorporated the built environment. There is no direct correlation to participants following local news and engaging within consultations, so it is likely unrelated. What does seem to impact the participants own interest in consultations was their own understanding of the subject. This lightly touches on the idea put forward in this thesis that there is a technocratic gap currently existing within the planning sector if that is a barrier to engagement.

Chapter 7 Findings and Discussion

The key findings of this evaluation triangulate earlier findings from the literature review (Chapter 3), the exploratory study (Chapter 4), and the design activities (Chapter 5), and act as the key contributions of this research. The key findings are:

1. The technocratic language used in public consultations is a major barrier to public consultation.
2. Integrating BIM into the public planning consultation process can better help break down the technocratic language barrier by facilitating the communication of BIM data including:
    a. Environmental data
    b. Height data
    c. Access data
    d. The use and look of a building
3. Current digital tools can contribute to best practice, but the lack of mediator makes responses difficult for planners to create actionable results
4. Using digital information from the industry builds confidence in the planning process

A further contribution of this study is a taxonomy of the stakeholders involved within an urban planning consultation.

These key contributions are explored further.

7.1 The technocratic language used in public planning consultation is a major barrier to engagement

Language was an import theme in the evaluation of the digital methods of communicating with the public, as it impacted participants' understanding of the purpose and detail of the consultation. As noted in Chapter 5, the public (external stakeholders) rely upon the information provided by planners to mediate what is happening within a building project and to understand the potential impact on the environment. Misinformed perceptions amongst the public can emerge when the language is not fostered effectively between planners and the public, and assuming stakeholders will understand technical language will lead to a technocratic knowledge gap. There was also a concern that the language came across as "management speak" as noted by P9, who suggested that the proposal was not really written for public consultation but more for public information.

As P5 noted, “there’s this kind of language coming through those sorts of phrases, that sound good on these sorts of proposal type forms, but it’s actually quite difficult to actually, like, what does that mean, literally within a real-world application here”.

With the explanation of planning being conveyed through the lens stakeholder management can make it difficult for external stakeholders to be able to infiltrate specific details about the design. As P8 noted, “there are things like the use of brownfield that I’m not sure what it means”. While participants were likely to have a general understanding from the information provided, the facilitator of the evaluation of both methods asked the participants about the meanings of certain phrases and gained various responses.

There had been various recommendations that came from the participants to aid the understanding of the building projects’ aims and objectives. P3 noted that using something like a video would aid the consumption of information “especially for those whom the English language is a second language”. P7 felt the need to look online elsewhere to find other projects that the planner had done to better understand the planners’ objectives.

7.2 Integrating BIM into the process can better help understand technocratic language in building proposals

This study has found that the utilisation of BIM (Method B) within planning consultations aided participants’ understanding of a project development via a 3D display visualising the potential changes of a planning consultation described in the text. The text was copied from the planner’s own website (Method A), as so to better demonstrate a comparison of the layout changes. The changes shown within the integration of the BIM, better presented the visual design details, landscape and recognition of the area, and the information layout.

7.2.1 Design Details

Method A presented the design details of the project on the planner’s website which included a text description of the project, an image, a map view of the project location and blueprint. Method B used a BIM enabled platform displaying a 3D model of the proposed design embedded within an online street map (OSM). Within Method B, the building model contained clickable points that led to descriptions, images, and the blueprints of the project. Visual information was represented quite clearly and the participants using the prototype were able to note the correct number of stories on the proposed structure. P15 noted they had more confidence in the detail being presented in Method B as it was scaled to the OSM, and the geographical map. P15 said:

"What you usually get here with planning is just like a bird's eye sketch, and they're not always that accurate either, which is really worrying. So, I'm presuming this is actually accurate".

It should be noted that this might be less to do with either digital display or the design being presented, as P6 noted, "I don't understand the extension out of the back with the public space. It's all a bit impenetrable". This was further hindered by the amount of text displayed on the website (Method A), as a large amount of text being displayed negatively impacted the participants' ability to absorb the amount of data provided, as P2 noted, there were "so many bullet points and I'm put off, being honest you, I'm put off with so much information". The level of information was also criticised for not providing enough design detail, as noted by P1 who expressed, "it mentions to propose what it's going to do, but it doesn't then have the documentation for what the proposal is, in terms of the plans". This presents an issue with regard to information available for public consultations at different stages of the building project development. As a snapshot of the project, this can make it very difficult to establish what is being presented in the planning consultation, because as P6 noted, "I don't get a feel for this with what has been presented here".

7.2.2 Landscape and recognition

The landscape was identified in Chapter 5 as crucial for stakeholders to orientate themselves within a recognisable environment through the lens of a digital platform. For Method B, nine out of the ten participants recognised the area within a few minutes of the think-aloud activity, and when asked if the method aided their understanding, all participants using the prototype agreed.

Using Method B, the participants were able to manoeuvre themselves around the environment with an understanding of what they were looking at and what the building project was trying to represent. This differed to Method A, where participants expressed difficulty in linking specific landmark features from the information given as a location map and artistic impressions of the new build. The information was too specific to a location within the campus, and this made it very difficult for participants to understand where the development was meant to be, as P2 noted, "I cannot visualise it from a location map". The website relied on text and the location map (see figure 12) to explain where the area could be, and while on one hand P1 noted, "it mentions precise locations which is useful", on the other hand, it was problematic for participants that relied on visual prompts, such as P6 who said, "words can just go over my head".

P12 noted that "from a layperson's point of view, the 3D view would probably make the changes quite understandable quite quickly". This seemed to be linked specifically to the 3D modelling of the area, which made the environment recognisable, as P13

affirmed by stating, “3D is the way to go with… like it was nice to have the 3D as the primary way of looking around, just to that immersion thing that we've been talking about is being able to see what it would look like, with all the buildings around it, it's much easier to visualise.”

In Method A there was also an issue with the size of the location map, as “the image is a bit small” as mentioned by P10, and this idea is further expressed by P1 who acknowledged that there was an issue with embedding this information into the website, as it skewed visuals. In consideration of the design functionality, however, this can be recognised more as an issue regarding layout as discussed in the next section.

7.2.3 Layout

In comparing the two methods, via participant evaluation, the layout of the platform is the fundamental difference noted between Method A and Method B. The layout of the digital tool acts as an indicator for participants as it sets out the information regarding the building development, and the option to respond to the public consultation. The website was criticised for relying on text and this put off participants. There were examples of participants who would try to work around this by highlighting text as they read through the website (as observed with P7). This method placed the visual information at the bottom of the website, as P5 stated, “everything of value is at the bottom of the page”. This is problematic as it might lead to potential users of this method missing visual information. This means key features of the project development might be overlooked by the public, leaving them misinformed. The location map was embedded in-between the text, however due to “embedding issues”, as noted by P1, participants would have to zoom into the website page itself, in order to, as expressed by P8, “actually have some idea of where it is on campus”.

Method B presented the 3D model on a geographical map and overlaid this with hot points that noted information about the proposal provided by the planner. As noted by P14, “in terms of the tool, it's pretty self-explanatory, and easy to use” and they confirmed the platform was able to present the project development’s “benefits, both like environmental and the increasing productivity and stuff”. The hot points worked effectively on a map if they were well distributed in the area, as P11 noted, “what I will say, is with the map, maybe you can increase the hot points” and then added “if you don't want to put all the points in one thing”. This might point to this method being more effective for a larger project development, as the 3D model could not be penetrated due to the technical constraints of the web viewer. This might point to the prototype being effective in showing various models in plans such as a town master plan.

The 3D model (method B) presented external detail, but as a conceptual design, it did raise some concerns. P18 noted, “I think it's potentially not super clear” and expanding

on this idea meant that participants still had to rely on the textual data and visual data provided by the planner for design details that couldn't be presented in the model (e.g., environment, heritage, and economy). Information considered metaphysical allowed participants to find the specific details regarding themes of the project development. P11 noted that the font was easy to read, but on a mobile, it might be improved by only highlighting the most important information. This links to the concerns presented in Chapter 5, in which participants had requested the professionals communicating the consultation to provide an indication of the changes that were most likely to occur and those which might be subject to change.

7.3 Current digital tools can contribute to best practice, but the lack of mediator makes responses difficult for planners to create actionable results

Evaluating the BIM prototype against a currently used planning consultation method helped develop an understanding of what elements of the design of the prototype could be altered for improved quality and increased engagement by external stakeholders'.

The integration of BIM into a digital public consultation tool that can be altered and controlled more directly by an internal stakeholder assists in the ability to create changes in real time. This is in contrast to the stakeholder experience, which as mentioned previously, can be time consuming and difficult to follow through on.

The participant evaluation revealed attributes of the user that related to earlier aspects of the literature, whereby past experiences of a public consultation can impact on a participant's approach towards consultations. Specifically, it effects participants' perception as to how their responses would be received. This relates somewhat to the concept of a participant's activism, professionalism and localism, as those more active in the community were considerably more sceptical. P9 noted simply that "it's a case of air". Meanwhile, P6 was "happy to read through and give some feedback" but would be focused specifically on their own insight as "the architecture is the only thing I care about". Lastly, the participant who identified localism could come across as more neutral and subjective towards the information being provided, expressing the idea that "the quality and everything looks really nice, but it just looks a little out of place."

This is linked to the participants' understanding of the reason for the public consultation. As P19 has noted, "where's the shape of the building come from? You know, it's very hard and striking, and different to anything else" and P19 elaborated that as an architect, there was a specific focus on why the building project team had chosen this shape. This was comparable to P6 who, also as an architect, stated that they couldn't visually understand the relationship between the building and the surrounding

architecture. This seemed to suggest that the method of consultation did not impact professional focus and critique. The information was considered simplified, but any technical information was understood and could be responded to in a detailed manner.

Method B also impacted the non-professional participants, as the public consultation did seem to confuse those using the website (method A), as P5 noted “the basic question is what is this trying to do?”. This was like P10 who asked if this was going to be a “smart building”, as they relied on their own knowledge to explain the building development. Method B did effectively aid participants understanding, and this might be due to having more opportunities to respond to the specific geographical hot points on the model. However, this did require the participant to explore the area in greater detail, as noted by P18 that “unless you specifically click through all of them, you don't know which one it is going to be”. The information provided by the planner was noted as “well researched” by P8, but the Method A had made the information quite difficult to identify.

7.4 Using digital information from the industry builds confidence in the planning process

The concept of static consultations singularly building confidence between the public and the industry is not possible unless enduring efforts are made between the public and the mediators of the industry. Participants P4, P9, P15 were frustrated by official public consultations, as noted by P9, “it’s all management speak”. This in turn might have impacted the responses to design details (section 6.1.4), as while A and B did not change any information, participants recognised method A as a standardised consultation method. These tools are standard to public consultations, and those with prior experience of a consultation (section 6.1.3), could relate prior negative experiences with this as noted by Gordon (2011), when discussing the potential of immersive planning.

Participants with little public consultation experience (noted in section 6.1.3) would see both methods as acceptable, as P1 noted, “it has everything there”. This differs to those who have professional experience within various fields of the industry. It seems that as soon as a participant acknowledges how much information a consultation might potentially have, they can more easily identify gaps in the information provided within a consultation. This is linked directly to the methods of stakeholder management (as noted in section 2.6.1), and the efforts that Olander and Landin (2008) noted about minimising negative consequences.

Using digital methods that utilise industry data such as BIM can provide transparency for the public. However, there is further work to be done by the industry and the

research community to understand the use of technology within a long-lasting relationship with the public.

7.5 A taxonomy of stakeholders within urban planning consultation

The relationship between internal and external stakeholders has been observed throughout the study. While information is exchanged throughout a planning consultation, it is unclear how external stakeholders might approach a consultation (as noted in section 2.4.1). It was important to highlight traits of the external stakeholder and how this might impact their experience using planning consultation tools. In observing the participants from *Case Study 2*, various themes arose from the interviews that might impact their approach to consultation tools. These are:

a) The roles of passive stakeholders and engaged stakeholders
b) Subjective stakeholders and Objective stakeholders
c) factors that influence users' responses
    a. Activism
    b. Localism
    c. Professionalism

This investigation has uncovered the fact that the dynamics of the external stakeholder are still largely unknown by the planning community and the wider construction industry.

7.5.1 Passive and Active Stakeholders

Engagement was used throughout the evaluation process. This was identified through the amount of time that stakeholders used the method, what information they were picking up through the process, and any feedback they might have had about the experience. This was examined thoroughly through the questions in the in-depth interviews. Participants were categorised as highly engaged in the process by spending more time with the method and asking a series of questions about the purpose, functionality, and design of the building development in the consultation. The participant's responses were restricted by their own knowledge, as a participant engaged in the process who did not have a wide understanding of the industry could still provide insight (and therefore quality responses) to the consultation.

When examining the duration of time, participants of Method A would spend between 2-14 minutes engaging with the website. These participants would usually skim-read the text, note the headers, and address any language that they didn't understand. The participants of Method B would spend between 9-30 minutes engaging with the

platform. These participants would be able to utilise the platform quickly, and many of the questions arising could be quickly explained in order to focus the conversation on the project development.

The information that was retained immediately after using the method was not as clear as the study had expected. In fact, for the different methods, the participants remembered different aspects of the design and area. All Method A participants could discuss aspects of heritage, and the economic development of the project, as the textual display encouraged participants from this method to reiterate the impact of the building development. Participants using Method B presented a better understanding of the spatial use of the project development, geographically locating it, understanding its transport links, external environmental impact, as the visual display encouraged participants to understand the project development within its environment.

Feedback differed amongst all participants of *Case Study 2*. It was not always clear to the participant what they should give feedback on, as participants using Method B wanted to discuss the use of 3D imagery, and participants using Method A wanted to discuss the lack of feedback tools that the method offered. Specifically, P1 - P10 wanted a video to explain the project, as some of the language and reasoning behind the design was not clear. Often the participant was more likely to discuss the method than what was being explained unless they were connected to the industry.

7.5.2 Factors that influence

In examining how stakeholders would feel more engaged, either from a subjective or objective view, it was interesting to note what encouraged the stakeholders to retain the information provided by either method. Different methods encouraged different information to be absorbed, and there were aspects that participants would feel encouraged to discuss throughout the evaluation. Understanding the factors which encourage external stakeholder engagement will help to understand what information requirements are needed for a more effective public engagement tool. In examining how objective and subjective views create engaged interaction from the stakeholders; participants could be categorised in terms of activism, localism and their own professionalism.

- Activism: Participants who would take part in activism would note interest in addressing social, political or economic concerns in the shared build environment.
- Professionalism: Participants who come from a specific vocational background.
- Localism: Participants who would engage with their community and environment.

These factors aided how a participant might determine how they would respond to the design aspects of the building development.

7.5.2.1 Activism

Various participants noted how they were active in the community for a particular cause or issue. Participants P3, P4, P6, P7, P9, P12, P13, and P15 were all involved in activities that could be considered activism, either with political or social connotations. Those engaged in activism could also be motivated by a participant's own localism and professionalism.

7.5.2.2 Localism

Localism was something that could be acknowledged by all participants, and it should be noted that all participants within this evaluation noted that they thought that the consultation was led solely by the developer of the project. Localism, however, is not something that is pursued by all participants as professionalism can cut off aspects of localism for a participant, since localism relies on a stakeholder's subjectivity. However, this doesn't mean it can't exist within a stakeholder's life. Localism can provide a stronger connection to a stakeholder's activism, but as activism is not always geographically based.

7.5.2.3 Professionalism

Various participants' own profession and industry influenced their ideas and interactions with the consultation. While there had been an expectation that this would positively affect the participants reaction to various design elements of the project development, it also often made these stakeholders focus on only their own professional insight. For instance, P6 noted that architecture would be the only thing they discussed as that's 'what they cared about'. Participant 19, who also studied architecture, would also consolidate their language and questioning on that of the structural design of the project. Professionalism may impact the participant's own awareness of the information impacting their conclusive reaction to the building development. Participants P1, P6, P7, P8, P9, P12, P13, P16 and P17 could be categorised by levels of professionalism (within the construction, engineering, architectural, planning, and even legal industry) at various stages of their career and would often use objective language.

7.5.3 Subjective and Objective Stakeholders

The participants of the evaluation were identified as specific stakeholders being passive or active; and whose opinions might emerge from specific influencing factors. Finally, the outputs from these with either subjective or objective perspectives. This was connected to aspects of the factors that influenced These participants could be identified as having either a subjective or objective perspective on this project. The

subjective participant would review the consultation as something that might implicitly impact them. Their language reflects this as they put themselves in the middle of how they react to the design, though this language could also be applied to others such as students, or individuals, who might also be impacted.

Subjective stakeholders also show an interest in the human element, and interestingly, when participants who do not feel directly affected by a building development are presented with a model, they would reflect on the design objectively as if this was a conceptual or metaphysical object. They do not reflect on this design as if it will impact them, even though they understand its impact on an environment that they engage with. Subjectivity is not impacting the participants' ability to engage with the ideas of the consultation and their response would usually include useful suggestions, though some suggestions could be broad and not focused on the immediate project.

The stakeholders could also be identified on a scale of experience in the industry, and this could impact objectivity. Some participants presented as being professionally experienced in the industry, and those with experience, and lastly those not experienced. The non-experienced stakeholder could be described as an individual with little to no experience in areas of industry or public consultations. Those identified as non-experienced noted that the information was both high quality and enough for them to draw on to make conclusions on the project. The experienced stakeholder seemed to have more insight into the project development in one area or another, as the more experienced professional would understand what they might be looking at. However, they may also express concern as the consultation would not seem to give enough information to allow them to make an opinion based on their own professional experience.

Chapter 8 Conclusions and Recommendations for future work

The aim of this study was to examine the capabilities of BIM within a digital tool that would serve to encourage participation within an urban planning consultation. In doing so, this thesis has evaluated the use of information that might be provided by BIM in a digital planning platform. The hypothesis of this thesis is that the use of BIM could improve planning consultations by providing a more accurate representation of the environment. The findings support the hypothesis that BIM data improves public consultations regarding project development.

This study considered who were the stakeholders of the project development and how internal stakeholders were currently impacted by digital portals. This was considered in the research questions and objectives of the study.

The aim of this thesis was:

To examine the capabilities of digital tools for BIM that would serve to encourage participation in an urban planning consultation.

The research questions (RQ), objectives (RO), and research findings (RF) are as follows:

RQ.1 What are the advantages and limitations of the current planning consultation methods?

- RO. 1 Study the current of public consultation methods used in urban public planning.
- RO. 2 Explore the digital tools within the urban planning public consultation.
- RO. 3 Examine BIM and its characteristics when used within the consultation process and design process within a project development.

    - RF. 1: The technocratic language used in public is a major barrier to public consultation.
    - RF. 2: Integrating BIM into the process can better help understand technocratic language in building proposals.

RQ.2 What is the relationship between the information required for BIM and the information required for public engagement at the point of conceptual design?

- RO. 4 Understand what BIM can bring to the planning process within a planning application for a building project.

- RF 3: Current digital tools can contribute to best practice, but the lack of a mediator makes responses difficult for planners to create actionable results.

The research revealed the information that could be extracted from BIM for public consultation in the conceptual stage. These were:

- Height
- Density of build
- Spatial around the building
- Design and appearance
- Eco-sustainability

RQ.3 In what ways does the public engagement aspect of the planning consultation process need to be extended to incorporate BIM?

- RO. 5 What is the impact of using BIM visuals in a public consultation?

  - RF 4: Using digital information from the industry builds confidence in the planning process.

The overarching theme common to all research questions is the role of potential stakeholders within a public consultation. In doing so the thesis contributes a taxonomy of stakeholder's including the external and internal within an urban planning consultation additionally exploring their approaches to consultations.

Qualitative research methods were used for the data collection and analysis was undertaken to understand the relevant stakeholders within the interdisciplinary services and industries. The remainder of this chapter now presents major themes, contributions, and software recommendations that arose from this study, and is structured by setting this out in relation to each research question. Factors arising from the study are listed, and recommendations are made about the optimum way of integrating BIM within digital tools for effective engagement in public consultation. This thesis looks into how the research findings might impact the dialogue within the current planning policy of the UK.

To conclude the work, the research limitations are provided, with future research discussed and recommendations for future research set out.

8.2 Research Question 1: What are the opportunities and limitations of the current consultation methods?

The literature review and the preliminary chapter examined what opportunities and limitations are present in current consultation methods. The literature review highlighted:

- The restrictions imposed on internal stakeholders are due to the technocratic language that impedes understanding of the language and specific stages within construction (Butt, Naaranoja & Savolainen, 2018)
- Public dialogue between the public, the industry and planners are not consistent. Due to statutory requirements (Bevan, 2012), and industry restrictions (Butt, Naaranoja & Savolainen, 2016), it was very difficult for planners to carry out in-depth and sustaining dialogue.
- Planning practitioners and industry leaders in community engagement are restricted in balancing best practice with the public and the construction industry's goals. Citizens are not able to engage with anything other than the process of planning (Boonstra & Boelens, 2011) and not the benchmarks within the industry. The speed of that consultation can make it difficult for planners to address what aspects of the design can be altered at certain times of a project's development (Munster et al., 2017)
- There is currently a need for a communication strategy, as reliance on stakeholder management has created concerns regarding transparency (Kurtin, 2016). In postponing the public's opportunity to discuss concerns, the industry is impacting the public's attitude towards the industry and the social power when consulted (Gordon, & Baldwin-Philippi, 2014).

Chapter 4 (the preliminary study) concluded that there was an opportunity in acknowledging more of the stakeholders within the project building process, but this was limited by using technocratic language which created barriers between external stakeholders and the planning process. A set of key indicators were identified within the planning process, which was noted in Chapter 4, and included sustaining dialogue, stakeholder restrictions, balancing regulation against best practice, and the need for a communication strategy. The industry was described as having a contextualised multi-layered structure with both internal (individuals and organisations that directly benefit from a project development) and external stakeholders (who will inherit the project building in terms of their civic environment). This presents the industry as a heuristic system in which stakeholders do not acknowledge one another. While digital platforms, and the potential use of BIM, can help to increase planning consultation engagement, there still exists a technocratic gap between the public and the planning process.

8.2.1 Research Finding 1: Use of technocratic language is a major barrier to public consultation engagement

Technocratic language is an overarching concern for public consultations as it can negatively impact the relationship between the public and the planning sector. Technocratic language impacted how a participant views a project. This means that stakeholders within the public attending a consultation are complex by nature and hard to define. As technology grows in use and includes a wider population, planners must understand that the usual rules of engagement as they have practiced in past consultations might not apply. Technocratic language is an ongoing problem within the planning sphere and there remains an issue with encouraging mediation within technical applications. The study presented instances of participants relying on common knowledge to understand decisions made within a master plan. The preliminary study presented that experts in the field noted a reliance on face-to-face methods as a reliable technique. It also gave them the opportunity to explain complexities within a master plan. Information drops, such as emails, letters, and websites were used for convenience, as part of statutory practice. Relying on the growing use of digital methods for planning consultations has the potential of inheriting and continuing the previous obstacles faced, due to the technocratic gap.

8.2.2 Research Finding 2: Integrating BIM into the process can better help understand technocratic language in building proposals

There remain constraints of the industry that bring about a professional distrust of the consultation process. A significant constraint to moving towards digital methods for planning consultations is resources (time, manpower, cashflow). This supports the practitioner's attachment to using traditional methods, because they are considered practical and productive, given the time and financial means available to execute an effective communicative strategy. However, the quality of information received has also been called into question, as practitioners must overcome the technical language in a short amount of time.

Using BIM, project teams can share information involving a building via a cloud-based system, as much of the information can occasionally get lost amongst traditional paper-based management systems (Czmoch & Pekula, 2014). CAD has been a fundamental design tool for architects for many years, but the use of BIM now challenges the traditional practice of design collaboration in building projects amongst all other project team members, especially that of construction (Paavola & Miettinen, 2019).

BIM offers a solution for internal stakeholders, with the ability to view the project from various perspectives, and advocates are still in the process of exploring the capabilities that BIM can offer users within the construction industry. In exploring BIM's capabilities,

researchers have explored the advantages of using 3D models within the design process. BIM has attempted to address the lack of dialogue in the construction industry (Eastman et al, 2011), and has shown how significant communication is within a project (Davis, 2014).

Sustaining a dialogue with stakeholders via digital methods is not considered the silver bullet, and it was approached cautiously due to the cost of experimental digital initiatives. Digital methods should be considered amongst stakeholders and planning practitioners. This is because project developments still need to be translated to the external stakeholder, and in continuing the status quo, there are issues with meaningful consultations. Concerns have been raised because either information is sparse, too technocratic, or hard for the public to locate.

BIM provides transparency, as the data directly informs the current state of the design process of the project, unlike the mere snapshots of the subject on social media. BIM is tied to the design stage and RIBA plan of works. Methods unconnected to the design process can produce false expectations of the building project. Later consultations are not always clarified to the public, and it can be confusing for the public to understand what they are permitted to discuss in the confines of the consultation. This leads to stakeholders proposing unhelpful options regarding the environment and becoming distrustful when those options do not manifest. This is not the case with BIM. A plan of works directs what data is potentially found in a BIM model. Conceptual and technical phases of design are directly aligned with the level of detail observable.

Best practice critiques tokenism and champions cooperative design, but in the reality of planning practice, the public does not have much control, and this experience is carried forward impacting future planning consultations. If the public is presented something more reflective of the potential of a design; then a clearer dialogue might work to improve the relationship between the internal and external stakeholders.

8.3 Research Question 2: What is the relationship between the information required for BIM and the information required for public engagement at the point of conceptual design?

This research questions aimed to explore the information that is required within planning consultations, and the information that could potentially be provided by a BIM model. This objective was tackled with a series of design activities that went about examining available data. Specifically, to establish the software requirements of the tool, the thesis established three prototyping phases as follows:

Phase 1: Initial exploration of BIM tools and concepts for integration with public planning consultation with the experts in planning and to explore digital platform tools

Phase 2: Examining the required planning consultation data from a policy literature review and current BIM industry tools available via web viewers with a competitive analysis carried out.

Phase 3: Identification of the end-users of a potential bespoke digital tool in order to garner their feedback. A think-aloud protocol is used to evaluate the feedback on the GIS planning consultation tool, and this is then used to create the medium-fidelity prototype.

Current digital tools can contribute to best practice. There is research that supports the use of technical tools and the ambition to develop these tools for the benefit of the public. However, the lack of a mediator makes it difficult for planners to develop public discourse and create actionable results for the built environment.

While not a research finding, the thesis does explore the current relationship between the information required for BIM and the information required for public engagement at the point of conceptual design concluded with:

a. Environmental data
b. Height data
c. Access data
d. The use and look of a building

Outputs of the iterative prototyping are noted below:

8.3.1 Research Finding 3: Current digital tools can contribute to best practice, but the lack of a mediator makes it difficult for planners to create actionable results from responses received.

The study has shown that a digital tool could contribute towards best practice in both urban planning and the construction industry, as the various stakeholders involved in the process are afforded better insight into building projects. Planners have found it difficult to catch up with a changing society (Gordon, Schirra & Hollander, 2011). There has been a shift towards technical planning paradigms (Potts, 2020). Sentient Planning (Deal et al, 2017), Algorithmic Planning (Safransky, 2020), and Immersive Planning (Gordon, Schirra, & Hollander, 2011), have all been established as approaches to the integration of technology within the planning practice. This study has shown that there are more digital tools used within practice that are non-specific to planning (section 2.5.2), however, the practice is constantly developing to include more tools purposefully made for the public consultation experience (Boland et al, 2020). In this study, it is noted that current digital tools can contribute to best practice, but the lack of

a mediator makes it difficult for planners to create actionable results from responses received.

While information on the BIM platform was considered as simplified by participants, most of the technical information could be understood. However, there was unease with regard to where the information came from. This is linked to the participants' specific understanding of the public consultation. As noted by Innes and Booher, the planner must organise the public's attention towards aspects of the examined design (2002) Within a non-mediated, tool this is lost, as expressed by P18 who noted that clicking areas of a building still made it unclear what information might be possibly shown. The prototype did help aid the understanding of the participants, and this might be due to having more opportunities to respond to the specific geographical hot points on the model. However, this did require the participant to explore the area in greater detail. Even with interactive tools, planners must guide participants through engagement (Gordon, Schirra, & Hollander, 2011) to make sure that appropriate information is being extrapolated from the community.

The public (internal stakeholder) relies upon the information provided by planners to mediate what is happening within a building project and the potential impact on the environment. A misinformed public can emerge when the language is not fostered amongst planners and the public.

8.3.2 The software requirements of the tool when using BIM in an urban planning public consultation

Software requirements were compiled from the results of various design activities. These would specifically focus on the information that would be required for the device. The medium-fidelity prototype was analysed alongside another digital method that had been used by the industry partner. The key issue of orientation and recognition revealed themes of the user experience, and this was related to the language being used and the design details within the model; height, density of build, spatial information surrounding a model, design and appearance of the building, and the eco-sustainability.

With the rising interest in sustainable building projects and the public's increased awareness of their carbon footprint, it is recommended that further research is afforded to environmental data in a digital public consultation.

Height data is directly linked to many material planning considerations in the UK's planning policy, as it links directly to the public's right to light and privacy. Even in the earlier stages of the development of a building there should be a clear understanding of the height of a building, as this will link to budgeting and resourcing for the project as a

whole. This means that it can shared with the public as an early stage in the consultation process.

Access data was better received in the prototype's evaluation, as the visual data was suitable in terms of how participants might move in the external spatial area and enter the building. In a civic building such as a university, access is important as it presents valuable information that not all users might be disabled. This study recommends that further research is in terms of presenting internal model detail specifically on aspects of accessibility.

The aesthetics of a building are a feature that can often be minimised by planners in the consultation process as a point of focus, as the public can become too distracted with the aesthetics of a building. It is also difficult to establish what alterations to designs actually be implemented following a consultation. Earlier consultation is recommended including as much detail as possible. In doing so, it opens consultations up to a detailed discussion regarding the use and impact.

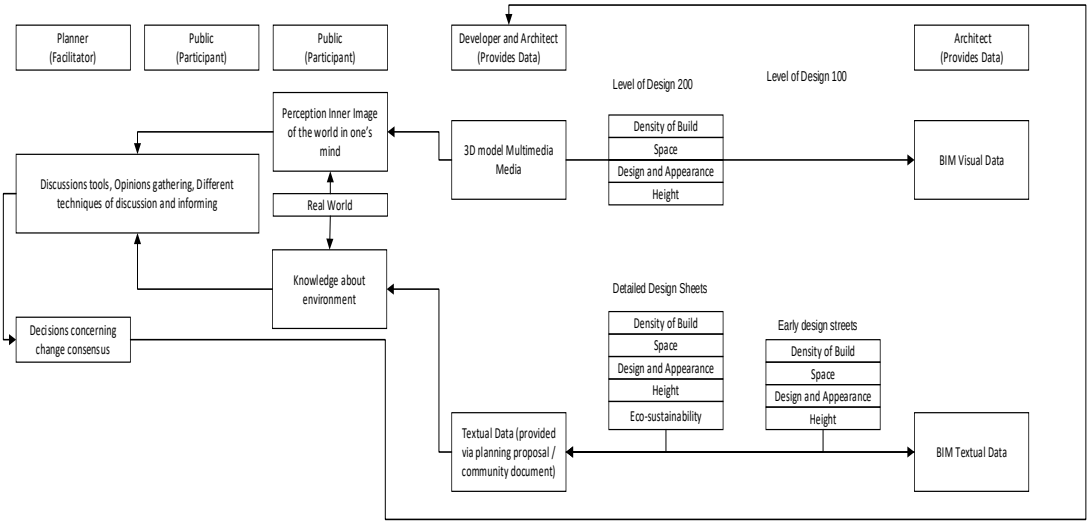

Figure 13. Diagram of Platform Flow

The main findings are that there is a level of expectation from the end-users of the digital platform (the public) that master plans and designs for a project development should be clarified by the body running a consultation. Figure 12 notes how the detail of the height, the density of a building, the space surrounding the building, it's design and eco-sustainability should be derived from the BIM model within the scope of a public consultation.

8.4 Research Question 3: In what ways does planning (public engagement) need to be extended to incorporate BIM?

This thesis assesses the scope for the integration of BIM. The integration of BIM into a digital public consultation tool that can be altered and controlled more directly by an internal stakeholder. Digital information builds confidence in the planning process with external stakeholders in the consultation process, so there is an argument for the industry to be persuaded to use BIM focused digital tools.

Phase 4: Validation of these findings was achieved through an evaluation of a high-fidelity prototype of a digital planning consultation platform, which integrated elements of BIM, and compared against another digital planning tool currently used in practice. Findings from the previous phases were used to comprise a structured in-depth interview amongst participants, and to establish the specific functionality requirements for BIM capabilities to be expanded into digital planning tools, and for the quality of planning digital tools to be improved. This phase examined how BIM tools can enhance the quality and quantity of consultation responses.

This study has found that certain aspects of the design could be focused on in order to facilitate more effective public consultations. since using digital information from the industry builds confidence in the planning process. This was supported by an overarching finding of the thesis which is a taxonomy of a building project development.

8.4.1 Research Finding 4: Using digital information from the industry builds confidence in the planning process. The industry should adopt it for public consultations.

The communal progress towards social learning (Dambruch, & Krämer, 2014), is an opportunity within a public consultation to allow the public to build confidence within the planning process. The expectation within a consultation is that the public would be carried through the consultation, discovering, learning, and deliberating on aspects of the project (Marušić, & Erjavec, 2020), and in doing so, would more effectively establish the objectives and design decisions of a project development. In an early stage of this study, in the workshops carried out as set out in Section 4.3, participants explained that there was an expectation that traditional in-person methods of consultations translated projects accurately to the external stakeholders of a project. When the industry is so disconnected that the information emerging from a project confuses the public, this in turn impacts upon the confidence of the public. The digital methods offered a fresh approach to displaying information about a consultation, as the case study presented details from the design for participants using a platform using BIM platform. Participants using just the website had less confidence when talking about transport infrastructure when compared to the BIM platform, where the

participants were noted as having a higher level of confidence in what was displayed. Due to being able to orientate themselves with the model in the OSM, participants could contextualise what would be impacted by the project development. This was similar to the response of the urban infrastructure surrounding the building project, as participants using the BIM model could more easily recognise the location of the area.

Digital tools used within planning can be further supportive by being included in earlier stages of RIBA's 'plan of works'. It is recommended that for a consultation that would provide better information regarding the design, a less developed model should be used. This could be problematic for buildings that currently exist as participants might query the reduction of certain aesthetic details, however, for new buildings, this might give participants more of an opportunity to discuss their own needs without being restrained by information which alludes to a complete design. This, in turn, would facilitate a transparent consultation which allows more engagement with the public. Earlier establishment of the project development would help designs be more focused on external stakeholder needs.

8.4.2 Finding 5: A taxonomy of stakeholder in an urban planning consultation within a project development

When identifying external stakeholders, either external or internal, it is important to present a description of their likely activity within the planning process. This study presents a taxonomy for the stakeholders within project development, and the wider scope of external and internal stakeholders (Figure 5), as well as examining external stakeholder motivation (Section 7.5). This is important as recent studies present a complex relationship between an external stakeholder (public) and an internal stakeholder (industry). Lyles and White (2019) have criticised planners acting within strict regulations that are not providing sufficient information to the public, leading to ‘passionate discord’. This suggests that planning consultations are volatile in nature. Consultations should create opportunities, not only for the single project development, but for civic learning. The public acknowledging the building of trust amongst a dynamic that is supported by the industry and public authority (Gordon, & Baldwin-Philippi, 2014). This research supports the idea that there is a dichotomy when approaching a public consultation, as considerations of best practice were balanced against the expectations of the industry.

8.5 Impact on Policy

Since the beginning of this thesis, the impact of the pandemic and other policy changes the landscape of current urban planning practice.

The local plan works toward the growth, renewal, and protection of an area. Approached with the renewal of the current local design codes and them being met

throughout the process of planning and public consultations. What the findings of the thesis presents is the technical implications of consulting with the public about planning when there is an absence of the mediator. The recent white paper, produced by Robert Jenkins, focused on the process of planning, however, there was a fundamental absence in the discussion of digital tools (MCHLG, 2021). This is especially significant when the white paper explored the potential to remove time frames with the development in terms of consulting with the public.

The use of technology has already been presented as creating boundaries between users (as noted in Section 2.2.3), however, with a change to urban planning on the horizon, more external stakeholders might be disinclined to engage the process of consultation due to even further complexity. The regulation and best practice for industry was explored in Chapter 4. Regulation creates the structure for external stakeholders and its removal will make the pace of a project development even harder to follow. External stakeholders are at risk of their built environment fundamentally changing and decreasing their quality of life. This is suggested in the white paper's 6th proposal which focused on how decision-making should be faster and more certain, with firm deadlines and greater use of digital technology. It is in the opinion of the author that the government's anxiety towards the current planning process is due to its productivity. However, relying on technology will not act as a silver bullet.

The RTPI has stated that the planning offices of Local Authorities are underfunded. Since the introduction of the Localism Act 2011, the government coordinated a reduction of funding to local authorities. The white paper fails with a lagging explanation of how to train planners using more digital technology without financial aid for LPAs. A lack of emphasis in this area will impact the planners' technical capacity using digital technology. Additionally, the author of this thesis is concerned that the proposal made in the white paper did not consider the external stakeholder as part of the decision-making proposal. The current white paper suggests that the planning process is a direct path from application to proposal. Such a perspective undermines the last 50 years of collaborative planning research.

8.6 Critique of the Research

A mixed-methods approach was applied to this research in order to capture data from different aspects of an interdisciplinary study. This produced rich and valuable qualitative data which provided insight into how external stakeholders approached the expanding use of digital media within planning consultations, and how industry methods might develop the process and facilitate further engagement with internal stakeholders. It was not clear at the beginning of this research what outputs might emerge, or even if the data within a BIM model would be valuable within a planning

consultation. Some of the earlier interviews with participants may have benefited from a focused selection of planners who were not restricted within the local authority system. The leap to discussing BIM technology was difficult to manage. Earlier initial interviews may have benefitted from a more methodical approach to capturing and organising data.

A study exploring the role of citizen engagement in planning consultations would have meant less emphasis on the application of BIM and its current relevance in wider industry outside of the scope of planning. Further work could explore the idea of introducing new tools like BIM with citizen science. This was a result of the interdisciplinary nature of the research. Research that covers urban planning in relation to other professions within the construction industry (Architecture, Engineering, Construction) are not common. This made it complicated to compare these disciplines and assess the various perspectives on stakeholder engagement. The breadth of the property industry, the different approaches, and the application of different technology resulted in a literature review that attempted to explore themes of citizen science but ultimately focused on industry practice. Instead, the literature review focused on the decision makers, tools, and participants within the shared built environment.

The thesis begun with the support of PlaceChangers Ltd who worked with Northumbria University as part of the European Regional Heritage Fund (ERDF) to bring more research in to the North East region. PlaceChangers Ltd was interested in the usability of Building Information Modelling (BIM) for planning software, but since the study began in 2018, the direction of thesis was taken by that of the author. This was due to more stakeholders being identified and focused on throughout the project development. This meant it stepped away from the linear perception of public engagement, that is usually held by professional planners, so as to understand the limitations of the project. These insights have been shared with the industry partner in order to help innovate the business.

The iterative prototyping stages relied on observations from end-users to speculate what data should be presented in a planning platform. This has been mentioned as providing a narrow in focus in the past, and therefore, the decisions made throughout the study have been broad and restricted to the time allocated to analysis and evaluation. It had not been expected, at this stage, that introducing the external stakeholders would have presented even more considerations to the implementation of a digital planning tool. Earlier introductions of external stakeholders within the exploratory stage may have neutralised this problem, though it would not have been equipped with enough insight into the needs of the industry.

In trying to capture qualitative results from participants, this study attempted to neutralise bias from data sets when compared with other information. The scope of the study meant that the long-term impact on stakeholders was uncertain. A larger, diverse set of participants might have presented more insight into the needs and requirements of users of a digital tool. For example, a study that involved participants of a social housing estate planning application, such as that descried in *Case Study 1,* may reveal different results given the diversity of the participants in that type of planning consultation. *Case Study 2* was restricted to the University area and had a very strict set of participants that the internal stakeholders considered external stakeholders, such as heritage experts and users of the university complex. A larger building project might be able to examine the participation of a wider, more diverse set of stakeholders, and in doing so, test the research ideas in the objectivity and subjectivity of a participant or user.

A critique of the study has been considered in this section, including recommendations for conducting further research in this area. Scope for further research has been identified as follows: -:

1. Defining the scope of the study at the onset of the research and creating a methodical approach with an earlier focus on the capabilities of BIM.
2. An earlier introduction of external stakeholders in the exploratory phase of the research as so to better define end-user needs.
3. Application of the study on further projects that can introduce participants from more diverse backgrounds to examine the ideas regarding the subjectivity and objectivity of a participant on the integration of BIM for planning considerations.

COVID19 impacted the industry throughout all the different stages of this research project. It has made researching the industry more complex, but also acted as a catalyst for digital tools to be taken more seriously, particularly within the statutory practice of planning. Attitudes may have changed since the beginning of this research in 2018, and further research into the opinions of industry professionals and the public should be considered.

8.9 Further Research

The research in this study has required a very broad overview of many different professions and academic schools of thought. However, in cross-examining the current state of planning, industry, and digital tools within the UK, this thesis recommends the following studies be taken on by the academic community:

- Further research into the use of BIM data for public consultation; specifically, the use of information that refers to sustainability and the impact on the environment.
- The impact of digital methods on the public over a longer timeframe – analysing if these methods do increase the quality of the responses.
- Research into the stakeholders as a user of digital technology, with specific focus on the understanding the catalysts for action in civic matters and the impact of experience.

It is hoped that others use this research to act as inspiration to further understand the shared building environment, impact of planning and impact of digital methods on planning.

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Appendices

Appendix 1 Abbreviations

Acronym	Full Text
BIM	Building Information Modelling
RIBA	Royal Institute of British Architects
IFC	International Foundation Class
NBS	National BIM Survey
NPPF	National Planning Policy Framework
COBIE	Construction Operations Building Information Exchange
AEC	Architectural Engineering Construction
VNG	Virtual Newcastle Gateshead
AIR	Asset Information Requirement
EIR	Employer Information Requirement
OIR	Operational Informational Requirement
RTPI	Royal Town and Planning Institute
TCPA	Town Country Planning Association
IAPP	International Association of Public Participation
OPT	Online Participatory Tools
SME	Small to Medium Enterprises
EIA	Environmental Impact Assessment
LDS	Local Development Scheme
SPDS	Supplementary Planning Documents
PGIS	Participatory Geographic Information Services

Table 21. Abbreviations

Appendix 2 Code Book

Summary of the Exploratory Phase

The following table contains the comments documented by the participants during the exploratory stages of the research. It was built throughout the exploratory stages of the research and used through the validation stage to provide insight into the participants. The reference column represents the number of participants who explored various themes within public consultations. Codes were linked, with codes only referenced removed from the analysis.

	Name	**References**
	Communication	8
	Public	7
	Feedback	6
	Community	6
	Stakeholders	5
	Design	5
	Engagement	5
	Decision makers	4
	Knowledge	4
	Trusts	4
	Digital	3
	Strategy	3
	Traditional Methods	3
	Regulation	3
	Perspectives	3
	Obstacles	3
	Diversity	2
	Discussion	2
	Incentives	2
	Usability	2

Table 22. Exploratory Phase Coding

Summary of the Iterative prototyping phase

The following table contains the comments documented by the participants during the prototyping stages of the research. It was built throughout the identification of information requirements and then later used in the validation stage of the research. The reference column represents the number of participants who explored various themes within public consultation. Codes were linked, with codes only referenced once were removed from the analysis.

	Name	**References**
	Orientation	7
	Recognition	7
	Digital	6
	Language	6
	Access	4
	Familiarity	4
	Information	4
	Perspective	4

	Priority of Interest	4
	Knowledge	3
	Decision	3
	Miscommunication,	3
	Local Authority	3
	Knock on Impact	3
	Causing Disruption	2
	Features	2
	Face-to-face	2

Table 23: Iterative Prototyping Coding

Summary of the validation phase

The table 24 contains the comments documented by the participants during the validation stages of the research. It reflects the analysis from the exploratory stages and the iterative prototyping, and from the interviews from the validation stage more codes are built up. The reference column represents the number of participants who explored various themes within public consultation. Codes were linked, with codes only referenced once were removed from the analysis.

	Name	**References**
	Knowledge	16
	Imagery	15
	Access	14
	Visualising	7
	Filtering	3
	Location	9
	Orientation	13
	Social	6
	Economic	4
	Maps	7
	Recognition	16
	Language	14
	Digital	14
	Green Technology	10
	Shared Information	11
	Collaboration	8
	Impact	5
	Identification	8
	Relationship between the space	5
	Use of area	12
	Functionality	13
	Productivity	9
	Reasoning	5

Table 24. Validation Phase Coding

Appendix 3 Material Planning Considerations

A material consideration is a matter that should be considered in deciding a planning application or on an appeal against a planning decision.

Material considerations can include (but are not limited to):

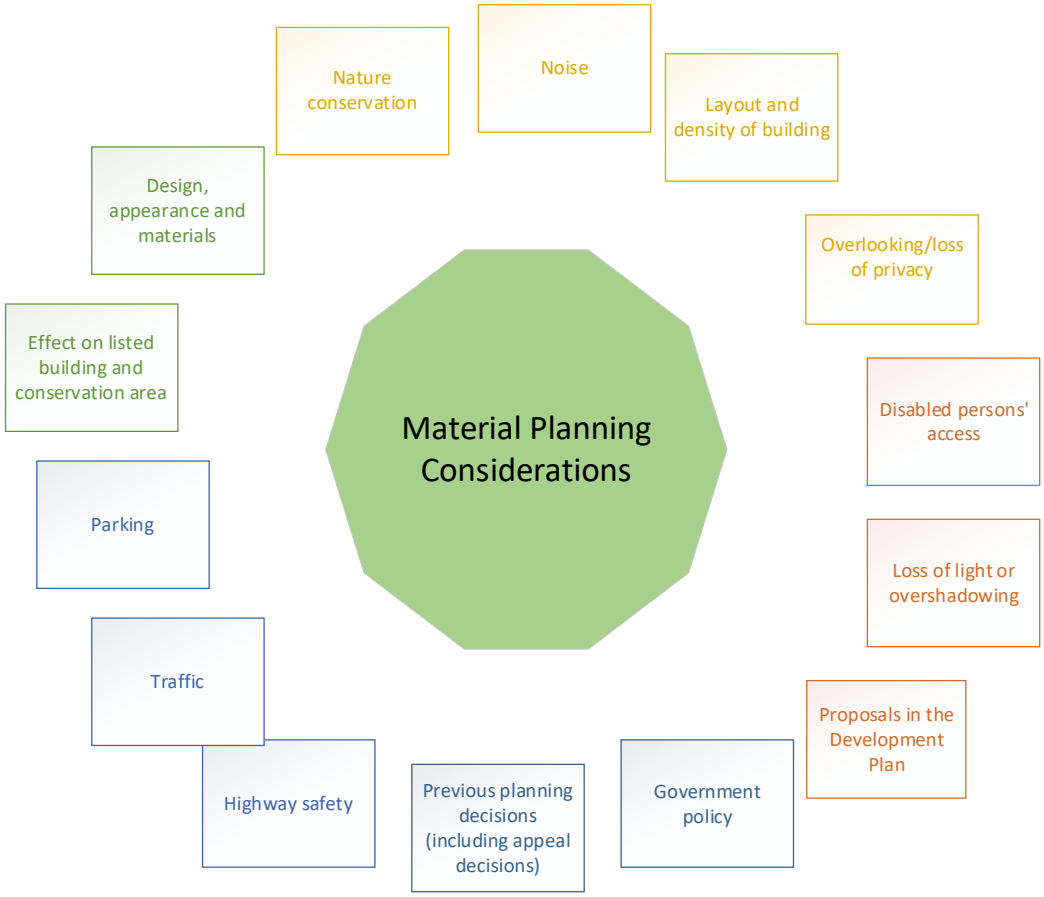

Figure 14. Planning Material Considerations

Appendix 4 Interview Questions for Case Study 2

The deductive interviews relied on this series of questions to examine the experience of the participant using the digital platform. These questions were carried out before and after the think-aloud protocol.

Opening Questions

- What is your education level?
- How involved do you feel with technology and applications?
- Do you use social media?
- Do you use social media to keep up to date with the community?
- Do you read newspapers either digital or non-digital?
- Do you read up on public consultations?
- Do you use the Council Website?
- How long do you get used to technology?
- Do you get frustrated with technology?
- How comfortable is the planning language observed in the application?
- Do you get frustrated with technology?

Knowledge Gap

- What is the model enquiring about?
- Does the method aid understand?
- What takes their focus?
- What were the priorities of the participant within a planning consultation?
- Do these priorities change after using the method?

Questions based on academic views of planning consultations best practice

Question	**Metric**	**Reference**
Do you think that your opinion might be considered more with a geotag / or through the use of this prototype?	“The value of democracy should be articulated through technology.” Influence. Are the eDemocracy experiments or practices such that people involved may truly influence the issues of interest?	Anttirioko (2003) Mackintosh & Whyte (2008)
Do you feel that this tool allows wide enough participation in your community?	Representation “Includes representatives of all relevant and significantly different interests.” Inclusive representation All parties with a significant interest in the issues and outcome are involved throughout the process.	Innes and Booher, 1999 Cullen et al, 2010
Do you feel that this consultation task invites wider	Engagement Projects need to support local identity and help individuals understand, and link into, the wider democratic processes that are part of their	Project Initiation Document, National Project on

engagement in the community?	community? “It is driven by a purpose and task that are real, practical, and shared by the group.”	Local e-democracy v3.0 Innes and Booher, 1999
Do you feel that this method of engagement is top-down or bottom-up?	Community-led / Tokenism The local eDemocracy projects had originally been classified as Top-down projects (which were government-led and mainly dealt with linking citizens to council processes), Ground-up projects (which are mainly concerned to encourage community networks)	Mackintosh & Whyte, 2008
Do you believe that this tool promotes clarity and transparency in the Master Plan?	Transparency Projects need to make decision-making processes more transparent Conflict and consensus Projects need to recognise that divergence of opinion may be an inevitable outcome of enhanced democratic engagement. Wherever possible, tools should incorporate an expectation of such divergence and provide opportunities for negotiation, mediation and consensus-building.	Project Initiation Document, National Project on Local e-democracy v3.0
Are you interested in seeing where this project goes, and would you want to have further discussion over its progression?	Sustaining Dialogue Engages participants, keeping them at the table, interested, and learning through in-depth discussion, drama, humour, and informal interaction.	Innes and Booher, 1999
Does this method help you as part of the community come up with solutions to disagreeable design ideas?	Problem Solving Encourages challenges to the status quo and fosters creative thinking.	Innes and Booher, 1999
Do you consider the information high quality?	High-quality Information Incorporates high-quality information of many types and assures agreement on its meaning.	Innes and Booher, 1999
Do you feel that deeper discussions about the area will emerge after	Consensus Building Seeks consensus only after discussions have fully explored the issues and interests and significant effort has been made to find creative responses to differences.	Innes and Booher, 1999

your contribution?		
	Self-design The parties involved design a process to suit the specifics of the particular problem and the needs of participants	Cullen et al, 2010
	Inclusive representation All parties with a significant interest in the issues and outcomes are involved throughout the process.	Cullen et al, 2010
Do you feel that this method has clear rules that can be followed by participants?	Clear ground rules As the process is initiated, a comprehensive procedural framework is established including clear terms of reference and ground rules.	Cullen et al, 2010
Do you feel that your opinion will be respected via this method? Do you trust this method? Do you trust that your opinion might be taken on in this consultation?	Principled negotiation and respect The process operates according to the conditions of principled negotiation, including mutual respect, trust, and understanding	Cullen et al, 2010 Tait and Hansen, 2013, 'Trust in abstract systems'
Did you feel that you had enough time to explore the method? How much time would you like to look over this method? Would you use this time for the method?	Time limits Realistic milestones and deadlines are established	Cullen et al, 2010
Did you feel that this method was managed well?	Effective process management The process is coordinated and managed effectively, and in a neutral manner.	Cullen et al, 2010

Table 25. Questions based on planning consultations best practice

Question	Theme	Reference
	Representation eParticipation should be used to support, complement or enhance the activities and understanding of representative government, and should not undermine the value of representative democracy	Project Initiation Document, National Project on Local e-democracy v3.0
	Integration Is the potential of technology used optimally in integrating the elements of the democratic process, including agenda-setting, planning, preparation, decision-making, implementation, evaluation and control?	Anttirioko (2003)
Does the information taken in this campaign, taken seriously by the industry partner?	Community control Democracy is about citizens collectively controlling those who take decisions on their behalf. The tools of e-democracy therefore must ensure that citizen engagement is closely linked to decision-making processes and that those who take decisions are responsive to the communities which they see.	Project Initiation Document, National Project on Local e-democracy v3.0
	Interaction Is the potential of technology in disseminating information, facilitating interaction and conducting political transactions used to increase the transparency, efficiency, flexibility, cost-effectiveness and inclusiveness of the democratic process?	Anttirioko (2003)
Does the researcher feel that the community had equal say across participants involved?	Political equality This criterion requires e-democracy to improve the inclusiveness of policy-making or, at the minimum, not to further disadvantage those who already are in some way excluded or less powerful in the political process	Project Initiation Document, National Project on Local e-democracy v3.0
Does the researcher consider that the public	Purpose and incentives	Cullen et al, 2010

(external stakeholder) and developer, architect, designer (internal stakeholder) have shared goals?	The process is driven by a shared purpose and provides incentives to participate and work toward consensus.	
Does the researcher feel the participants feel that the developers feel accountable for the design? Does the researcher feel that the developer is accountable for their design?	Accountability The process and its participants are accountable to the broader public, to their constituents, and to the process itself.	Cullen et al, 2010
Do these methods need facilitators? Would they be aided by the facilitators?	Independent facilitation Throughout the process, an Independent, a trained facilitator is involved.	Cullen et al, 2010
	Voluntary participation The parties participate voluntarily and are committed to the process.	Cullen et al, 2010
Is the method flexible? Were the participants able to use them in different ways?	Flexible, adaptive, and creative Flexibility is designed into the process to allow for adaptation and creativity in problem-solving.	Cullen et al, 2010
Did the participants use the information required when engaging with the method?	High-quality information The process incorporates high-quality information into decision making.	Cullen et al, 2010
Does the researcher feel that the developer would want to implement these decisions?	Implementation and monitoring The process and final agreement include clear commitments to implementation and monitoring.	Cullen et al, 2010
Does the researcher feel that a method aided the management of comments?	Effective process management The process is coordinated and managed effectively, and in a neutral manner.	Cullen et al, 2010

Table 26. Platform Collaborative Interview Questions

Questions based on the masterplan

To justify an understanding of the participant's knowledge conversion (i.e., did this method bridge the knowledge gap), we close the experiment by interviewing the participants. The interviews will consist of the functionality of the prototype and their usual attitude towards technology and public consultation. It will also ask questions based on the Master plan, and design details. Answers will be graded via a Linkert scale by the participant (system usability scale) but questions regarding the master plan will be noted as either true or false.

A. Does the Housing structure have design details for flood protection?

B. How comfortable do you feel responding to questions regarding the detail of flood protection in the Master Plan (1 - not very comfortable / 5 - very comfortable)

Theme	**Question A**	**Question B**
The provision of new public space(s), which will provide opportunities for performances, events and external exhibitions, expanding the functionality of the existing area	Does the master plan have design details regarding the functionality of the existing area?	How comfortable do you feel responding to questions regarding the detail of the functionality of the existing area in the Master Plan (1 - not very comfortable / 5 - very comfortable)
The provision of green spaces to form part of a green infrastructure corridor. This will include a series of pocket parks and squares integrated into the new development linking to existing spaces to the west and east of the site;	Does the master plan have design details noting the green infrastructure of the area?	How comfortable do you feel responding to questions regarding the detail of the green infrastructure area in the Master Plan (1 - not very comfortable / 5 - very comfortable)
The provision of a defined public realm network using streets, squares, lanes and stairs, with a legible and permeable urban structure, which clearly defines public and private space;	Does the master plan have design details noting the urban structure of the area?	How comfortable do you feel responding to questions regarding the detail of the urban structure of the area in the Master Plan (1 - not very comfortable / 5 - very comfortable)
The provision of a primary pedestrian route	Does the master plan have design details	How comfortable do you feel responding to questions

through the site to ensure improved pedestrian and cycle access from Central Gateshead to the riverfront.	noting the green infrastructure of the area?	regarding the detail of the green infrastructure area in the Master Plan (1 - not very comfortable / 5 - very comfortable)
	Does the master plan have design details noting the green infrastructure of the area?	How comfortable do you feel responding to questions regarding the detail of the green infrastructure area in the Master Plan (1 - not very comfortable / 5 - very comfortable)
The development of new public car parking in the city centre	Does the master plan have design details noting the transport infrastructure of the area?	How comfortable do you feel responding to questions regarding the detail of the transport infrastructure area in the Master Plan (1 - not very comfortable / 5 - very comfortable)
Ensuring that development of heritage in the city centre	Does the master plan have design details noting the protection of heritage in the area?	How comfortable do you feel responding to questions regarding the detail of protecting heritage in the area in the Master Plan (1 - not very comfortable / 5 - very comfortable)

Table 27. Questions based on the Master Plan

Appendix 5 Policy and Evidence for North East

104 documents had been reviewed to understand the requirements from the Local and Neighbourhood plans in the North East. Noted here are documents that are linked to information needed within the planning process and potential planning applications.

Local Plans

Council	Name	Link	Published
Durham County Council	A Vision for County Durham For 2035	https://countydurhampartnership.co.uk/wp-content/uploads/2021/09/VisionCountyDurham.pdf	2020
Durham County Council	Statement of Community Involvement Planning	http://www.durham.gov.uk/media/4562/Statement-of-Community-Involvement-planning-/pdf/StatementofCommunityInvolvement2020.pdf?m=637256575669130000	2020
Durham County Council	County Durham Plan Pre-Submission Draft	https://durhamcc-consult.objective.co.uk/portal/planning/presub?pointId=s1548157477303#section-s1548157477303	2018
Northumberland Council	Northumberland Consolidated Planning Policy	https://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Planning-and-Building/planning%20policy/Consolidated%20Planning%20Policy%20Framework/Northumberland-Consolidated-Planning-Policy-Framework-v28.pdf	2015
Northumberland Council	Statement of Community Involvement Planning	https://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Planning-and-Building/planning%20policy/Local%20Plan/NCC-SCI-February-2015.pdf	2015
Newcastle Council	Authority Monitoring Report	https://www.newcastle.gov.uk/sites/default/files/2020-03/2018-19%20Authority%20Monitoring%20Report.pdf	2018
North Tyneside	Local Plan	https://my.northtyneside.gov.uk/sites/default/files/web-page-related-files/North%20Tyneside%20Local%20Plan%202017-2032.pdf	2017
North Tyneside	Technical Report 9: Public Consultation and Stakeholder Involvement		

South Tyneside	Sustainability Appraisal	file:///C:/Users/w12001019/Downloads/WH_site_appendix.pdf	2019
South Tyneside	Local Plan	file:///C:/Users/w12001019/Downloads/Local_Plan_Pre-Publication_Draft_August_2019%20(1).pdf	2019
South Tyneside	East Boldon Neighbourhood Forum Constitution	file:///C:/Users/w12001019/Downloads/East_Boldon_Neighbourhood_Forum_Written_Constitution.pdf	2019
South Tyneside	Cabinet Report	file:///C:/Users/w12001019/Downloads/CabRpt__25_01_17_WhitburnNFA(Final).pdf	2019
Darlington	Darlington Local Development Scheme 2020-2023	https://www.darlington.gov.uk/media/11486/lds-2020-2023-final.pdf	2020
Darlington	Local Plan	https://darlington.objective.co.uk/portal/pp/draft_local_plan/dbdlp?pointId=4876541	2018
Hartlepool	Residential Design Guide Supplementary Planning Document	file:///C:/Users/w12001019/Downloads/Residential_Design_SPD___Adopted_Version___September_2019.pdf	2019
Gateshead	Making it happen' Residential Design Guide Supplementary Planning Document	https://www.gateshead.gov.uk/media/1911/Gateshead-Design-Code-SPD/pdf/Gateshead-Design-CodeSPD-versionJan2015-reduced.pdf?m=636669002180370000	2015
Gateshead	Planning for the future Urban Core Plan for Newcastle and Gateshead	https://www.gateshead.gov.uk/media/7765/Core-Strategy-and-Urban-Core-Plan-for-Gateshead-and-Newcastle/pdf/Core-Strategy-and-Urban-Core-Plan-for-Gateshead-and-Newcastle_SMALLER.pdf?m=636619103092500000	2015
Stockton Upon Tees	Local Plan	https://www.stockton.gov.uk/media/1585775/localplanmainreportcontents.pdf	2019
Stockton Upon Tees	Sustainable Design Guide	https://www.stockton.gov.uk/media/2834/sustainable-design-guide-spd.pdf	2011
Middlesbrough Council	Housing Local Plan	https://www.middlesbrough.gov.uk/sites/default/files/	2014

		PlanPol-Housing_Local_Plan.pdf	
Redcar and Cleveland	local plan	https://www.redcar-cleveland.gov.uk/resident/planning-and-building/strategic%20planning/Documents/Local%20Plan%20Adopted%20May%202018.pdf	2018
Sunderland	Local Plan	https://www.sunderland.gov.uk/media/20359/Sunderland-Local-Plan-Consultation-Statement-2018-/pdf/07_Consultation_Statement_Final_May_2018_Report_Full_Document.pdf?m=636644036755300000	2018
Durham County Council	A Vision for County Durham For 2035	https://countydurhampartnership.co.uk/wp-content/uploads/2021/09/VisionCountyDurham.pdf	2021
Durham County Council	Statement of Community Involvement Planning	http://www.durham.gov.uk/media/4562/Statement-of-Community-Involvement-planning-/pdf/StatementofCommunityInvolvement2020.pdf?m=637256575669130000	2020
Durham County Council	County Durham Plan Pre-Submission Draft	https://durhamcc-consult.objective.co.uk/portal/planning/presub?pointId=s1548157477303#section-s1548157477303	2020

Table 28: Council Local Plans

Neighbourhood Plans

Council	Name	Link	Published
Northumberland	Acomb	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Allendale	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Alnwick and Denwick	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Embleton	https://www.northumberland.gov.uk/Planning/Planning-	2018-2021

		policy/Neighbourhood.aspx#neighbourhoodplans	
Northumberland	Hexham	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Longframlington	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Longhorsley	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Morpeth	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	North Northumberland Coastal Area	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Ponteland	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Northumberland	Stannington	https://www.northumberland.gov.uk/Planning/Planning-policy/Neighbourhood.aspx#neighbourhoodplans	2018-2021
Durham	Durham City	http://npf.durhamcity.org.uk/the-plan/the-plan-as-pdf/	2021
Durham	Oakenshaw	http://www.durham.gov.uk/media/35112/Oakenshaw-Neighbourhood-Plan-Referendum/pdf/OakenshawNeighbourhoodPlan-Referendum.pdf?m=637517509213330000	2021
Durham	Cassopcum Quarrington	http://www.durham.gov.uk/media/34599/Cassop-cum-Quarrington-Neighbourhood-Plan-2020-2035-pre-submission-draft-/pdf/CcQNeighbourhoodPlan2020.pdf?m=637461348245200000	2020

Durham	Great Aycliffe	http://www.durham.gov.uk/media/22246/Great-Aycliffe-adopted-neighbourhood-plan/pdf/GreatAycliffeAdoptedNeighbourhoodPlan.pdf?m=636735567551370000	2016
Durham	Sedgefield	http://www.durham.gov.uk/media/31395/Sedgefield-adopted-neighbourhood-plan-23-October-2019/pdf/SedgefieldNeighbourhoodPlanAdoptedByDCC23102019Compressed.pdf?m=637084619393500000	2019
Durham	Whorlton	http://www.durham.gov.uk/media/22250/Whorlton-Village-adopted-neighbourhood-plan/pdf/WhorltonAdoptedNeighbourhoodPlan.pdf?m=636735567590330000	2015
North Yorkshire	Scarborough	https://www.scarborough.gov.uk/sites/scarborough.gov.uk/files/files/Scarborough%20Borough%20Local%20Plan%202011-32.pdf	2013
North Yorkshire	Ryedale	https://www.ryedale.gov.uk/images/PDF/Local_Plan/Local_Plan_Strategy_FINAL.pdf	2013
North Yorkshire	Hambleton	https://www.hambleton.gov.uk/downloads/file/1747/hdc-council-plan-2019-23	2020
North Yorkshire	Selby	https://www.selby.gov.uk/sites/default/files/Local_Plan_Preferred_Options_29-01-2021_%28Web%20Version%29.pdf	2021
North Yorkshire	Harrogate	https://www.harrogate.gov.uk/downloads/file/1935/introduction-vision-and-objectives-growth-strategy-and-economy-chapters-1-2-3-and-4	2020
North Yorkshire	Richmondshire	https://www.richmondshire.gov.uk/media/9616/core-strategy-2012-28.pdf	2014
North Yorkshire	Craven	https://www.cravendc.gov.uk/media/8733/z-local-	2019

		plans-ldf-314-local-plan-adoption-2019-lp-adoption-docs-final-adoption-local-plan-pdfs-craven-local-plan-appendices-and-policies-map.pdf	
Redcar	Skelton and Brotton	https://www.redcar-cleveland.gov.uk/resident/planning-and-building/strategic%20planning/SPD/Documents/Skelton%20%26%20Brotton%20Neighbourhood%20Development%20Plan%20SPD.pdf	2013
North Tyneside	Killingworth Moor	https://my.northtyneside.gov.uk/sites/default/files/web-page-related-files/Killingworth%20Masterplan%20Guidance%20Final%20for%20Web_0.pdf	2017
North Tyneside	Murton	https://my.northtyneside.gov.uk/sites/default/files/web-page-related-files/Murton%20Masterplan%20Guidance%20Final%20for%20Web.pdf	2017
North Tyneside	Tynemouth Village	https://my.northtyneside.gov.uk/sites/default/files/web-page-related-files/tynemouth.pdf	2014
North Tyneside	Fish Quay	https://my.northtyneside.gov.uk/sites/default/files/web-page-related-files/fishquay.pdf	2013
North Tyneside	Weetslade	https://my.northtyneside.gov.uk/sites/default/files/web-page-related-files/weetslade_dev.pdf	2007
Gateshead	Bensham and Saltwell	https://www.gateshead.gov.uk/article/3042/Bensham-and-Saltwell	2014
Gateshead	Deckham	https://www.gateshead.gov.uk/article/3070/Deckham	2014
Gateshead	Sunderland Road	https://www.gateshead.gov.uk/article/3072/Sunderland-Road	2014
Gateshead	Teams	https://www.gateshead.gov.uk/article/3073/Teams	2014
Gateshead	North Felling	https://www.gateshead.gov.uk/article/3071/North-Felling	2014
Stockton upon Tees	Wynyard	https://wynyardmatters.files.wordpress.com/2014/	2020

		02/2017-04-18-wynyard-neighbourhood-plan-draft-v2.pdf	
Sunderland	Coalfield	https://www.sunderland.gov.uk/media/22358/Neighbourhood-Investment-Plans-Coalfield/pdf/oce21899_Neighbourhood_Investment_Plans_A4_Coalfield.pdf?m=637377708791800000	2021
Sunderland	East	https://www.sunderland.gov.uk/media/22359/Neighbourhood-Investment-Plans-East/pdf/oce21899_Neighbourhood_Investment_Plans_A4_East.pdf?m=637377708793970000	2021
Sunderland	Sunderland East	https://www.sunderland.gov.uk/media/22360/Neighbourhood-Investment-Plans-North/pdf/oce21899_Neighbourhood_Investment_Plans_A4_North.pdf?m=637377708795870000	2021
Sunderland	Washington	https://www.sunderland.gov.uk/media/22361/Neighbourhood-Investment-Plans-Washington/pdf/oce21899_Neighbourhood_Investment_Plans_A4_Washington.pdf?m=637377708797930000	2021
Sunderland	Sunderland West	https://www.sunderland.gov.uk/media/22362/Neighbourhood-Investment-Plans-West/pdf/oce21899_Neighbourhood_Investment_Plans_A4_West.pdf?m=637377708799670000	2021
Middlesbrough	Marton West	https://www.middlesbrough.gov.uk/sites/default/files/PlanPol-draft_Neighbourhood_Plan.pdf	2016

Table 29. Neighbourhood Plan information

Summary of Council Local and Neighbourhood Plans

The summary of Council local and Neighbourhood plans

* North Yorkshire Area only	
** Sunderland Area Only	

	The Settlement and Housing	Aging Consideration	Economy	Green Belt
Neighbourhood Plans / Smaller area Local Plans	41	14	28	37
Local Plans connected to larger council	0	0	4	10
Total	41	14	32	47

Table 30. Summary of Local and Neighbourhood plans in the NE (part 1)

Landscaping, Hedgerows and Trees	Development Sites	Heritage	Transport	Flooding
23	30	34	31	11
13	0	9	15	1
36	30	43	46	12

Table 31. Summary of Local and Neighbourhood plans in the NE (part 2)

Community Life	Sustaining Local Resources	Conserving Assets	Sports	Design
22	17	32	19	29
0	6	0	0	0
22	23	32	19	29

Table 32. Summary of Local and Neighbourhood plans in the NE (part 3)

Tourism	Education	Environment	Culture	Housing
8	14	29	12	16
0	0	12	0	0
8	14	41	12	16

Table 33. Summary of Local and Neighbourhood plans in the NE (Part 4)

Social Needs and Disabled Access	Parking	Digital Community	Built Design / scale and density	Rural*
12	14	12	1	5

0	4	0	8	0
12	18	12	9	5

Table 34. Summary of Local and Neighbourhood plans in the NE (Part 5)

Gypsy and Traveller Site Provision*	**Managing Air Quality and Low Carbon Energy***	**Recycling and Waste**	**Sustainable vehicles ***	**Military***
4	5	4	5	1
0	0	10	0	0
4	5	14	5	1

Table 35. Summary of Local and Neighbourhood plans in the NE (part 6)

Farming*	**Anti-crime ****	**Architecture**	**utility**	**neighbourhood**
2	4	0	0	0
0	0	5	3	10
2	4	5	3	10

Appearance	**Effect on health**
0	0
9	5
9	0

Table 36. Summary of Local and Neighbourhood plans in the NE (part 7)

Appendix 6 Comparative Testing

Observation from other Professional BIM Viewers

In designing the software requirements for the prototype researchers observed other BIM viewer tools that were currently being used by project teams within industry. Competitive testing provided an opportunity to assess a competitor's products from the end users point of view (Kuniavsky, 2003). The competitors' applications were analysed, and researchers identified its expectant users, functions, and visuals. This pointed out the current capabilities of BIM viewers being currently used in the market and the potential problems that may arise from the research's prototype.

Design Area	**No.**	**Requirement**	**Type**	**MoSCoW**	**Justification**
Configuring/ User Interface		Render OpenStreetMap Tiles to a Render Texture Surface.	Functional	M	Provide a map for clients and participants to orientate themselves a geographical location.
Configuring	2	Render the 2D Buildings in the OSM tiles into 3D Models	Functional	M	This will create a recognisable environment for clients.
Configuring	2.1	Get the Extents of the Building in 3D	Functional	M	OpenStreetMap does not draw buildings. Retrieving the square foot size of the area from OpenStreetMap and placed as a rendered tile. *OSM Data model* with its data in either XML, JSON. In this data, geometries

					are described with three different elements: nodes, ways and relations [osm data model].
User Experience	2.1	Render Buildings as Complex Polygons		M	Buildings are not always a simple shape e.g., a rectangle. The buildings have convex, concave, and even contain holes when visualised as a plan. This is worked around by using a library that triangulates polygons.
User Experience	2.2	Extrude Buildings		M	Triangulating the OSM data alone will result in flat buildings. However, once triangulating the OSM data model for that building to extrude by repeating the triangulation higher than the base and joining between. (Please note, outside Unity you would

					have to check usage)
System Importation	3	Import an IFC file into the system.		M	There is a shortage of tools to render BIM files from a browser. IFC won't be observable in a graphic programme. It needs to be changed into a FBX / GTLF file. So, the system will need to transfer this IFC file into a reviewable visual file. IFC > FBX > GTLF
System Importation	4	Placing the Imported Model		M	The placed model is automatically sized since the OSM map base and buildings are rendered in Standard Index (dimensions are in meters for consistency). Next, remove the existing OSM extruded buildings and render the new model.

User Experience	4.1	Hide Models that will be Obscured		M	Identify which nodes are included using a bounding box sized by the new model. This is slightly complicated because we are working in latitude and longitude, however, there decent enough explanations that provide Java Script code e.g. [anmatuschek.de]. Once the nodes are identified we can stop the drawing of any building that intersects.
User Experience	4.2	Render the New Model		M	There are a number of model formats that can be rendered in JavaScript and in HTML 5 pipelines. Three.js does provide loaders for FBX, Collada or OBJ and others. However, the docs recommend using glTF [ref three js]

					which might be changed in S3
User Experience	5	Add other individuals to the comment system		S	Since the model is in 3D and we are not using the rendering pipeline of 3DJS (or similar) we should do the projection transform ourselves (google how to convert a 3D point to a 2D perspective projection [ref]). This will let us use the standard 2D rendering and text on an overlaid canvas.
Dashboard / Usability		Identify User Two entry points for the campaign.			Users will be split between campaign managers (architects / developers / community organisers) and participants. The system should have two entry points.
Usability - Dashboard		Users of the system should enter through a dashboard. The dashboard should present			The dashboard always suits a clear layout but also directional. How much should be accessible to

		the campaign, information regarding the project and an entry on to the immersive platform.			the dashboard and how might they link to other software or libraries.
Usability		Switch between 2D / 3D visuals		C	Comparable views between 2D and 3D imagery will help users understand what the outlay of designs might look like without professional knowledge.
Usability		Observable Data			A viewer accessing metadata can bring up the available IFC information and might identify different levels (though dalux requires you to fill in the different levels manually).
Usability		Visuals – Presentation of different levels within a 3D model			Being able to divide the geometric data into levels aided the observational data inside the BIM model. It created a much more immersive

					experience (like a fake sense of gravity) in which you would walk around the insides of the building. Tools that did not apply levels would lock out a user to look within the building.
Usability / Performance		Various Tools – Measure Tool (M) Cutting Tool Meta-data Hide Re-turn to the Centre Explosion			Various tools allow users to dissect a model. The BIM Viewers seem to use tools that would aide engineers, as there are tools to measure distance, a cutting tool to remove BIM objects blocking views, calculations in weight, size, volume, and finally an explosion tool that pulls apart all the BIM components.
Usability		Mark up Tools. Communication tools between users.			Only a few tools had a communicative aspect to these models. There should be active response tools for

					participants possibly through drawing tools, an outbox for comments on the model, the ability to export PDF's.
Performance		Camera to help the performance of the task making.			The movable camera is essential that it can be easily used by the participants. The capacity of the camera to move around the model freely (360 degrees) and with simple controls (WASD and MOUSE). Zoomable cameras and the ability to click objects will help user inspection. Then the ability to return to the standard centre position by teleporting will help navigate the area, as it can be easy to get lost on the camera and get stuck.

Table 37. Observations and evaluations of other BIM platforms

Appendix 7 Software Requirements

Software Requirements

Design Area	No.	Requirement	Type	MoSCoW	Justification
Configuring/ User Interface	1	Render OpenStreetMap Tiles to a Render Texture Surface.	Functional	M	Provide a map for clients and participants to orientate themselves a geographical location.
Configuring	2	Render the 2D Buildings in the OSM tiles into 3D Models	Functional	M	This will create a recognisable environment for clients.
Configuring	2.1	Get the Extents of the Building in 3D	Functional	M	OpenStreetMap does not draw buildings. Retrieving building data, the system would be from OpenStreetMap but this would have to be drawn these into the rendered tiles. *OSM Data model* with its data in either XML, JSON. In this data, geometries are described with three different elements: nodes, ways and relations [osm data model].

	2.1	Render Buildings as Complex Polygons		M	Buildings are not always a simple shape e.g., a rectangle. The buildings have convex, concave, and even contain holes when visualised as a plan. This is worked around by using a library that triangulates polygons.
User Experience	2.2	Extrude Buildings		M	Triangulating the OSM data alone will result in flat buildings. However, once triangulating the OSM data model for that building to extrude by repeating the triangulation higher than the base and joining between. (Please note, outside Unity you would have to check usage)
System Importation	3	Import an IFC file into the system.		M	There is a shortage of tools to render BIM files from a browser. IFC won't be

					observable in a graphic programme. It needs to be changed into a FBX / GTLF file. The system will need to transfer this IFC file into a reviewable visual file. IFC > FBX > GTLF
System Importation	4	Placing the Imported Model		M	The placed model is automatically sized since the OSM map base and buildings are rendered in Standard Index (dimensions are in meters for consistency). Next, remove the existing OSM extruded buildings and render the new model.
User Experience	4.1	Hide Models that will be Obscured		M	Identify which nodes are included using a bounding box sized by the new model. This is slightly complicated because we are

					working in latitude and longitude, however, there decent enough explanations that provide Java Script code e.g. [anmatuschek.de] . Once the nodes are identified we can stop the drawing of any building that intersects.
User Experience	4.2	Render the New Model		M	There are a number of model formats that can be rendered in JavaScript and in HTML 5 pipelines. Three.js does provide loaders for FBX, Collada or OBJ and others. However, the docs recommend using glTF [ref three js] which might be changed in S3
User Experience	5	Add other individuals to the comment system		S	Since the model is in 3D and we are not using the rendering pipeline of 3DJS (or similar) we should do the projection transform ourselves (google how to convert a 3D point to

					a 2D perspective projection [ref]). This will let us use the standard 2D rendering and text on an overlaid canvas.
Usability - Dashboard	6	Users of the system should enter through a dashboard. The dashboard should present the campaign, information regarding the project and an entry on to the immersive platform.		M	The dashboard always suits a clear layout but also directional. How much should be accessible to the dashboard and how might they link to other software or libraries.
Dashboard / Usability	6.1	Identify User Two entry points through the Dashboard		M	Users' will be split between campaign managers (architects / developers / community organisers) and participants. The system should have two entry points.
Usability	7	Visuals – Presentation of different levels within a 3D model		M	The ability to divide the geometric data into levels aided the observational data inside the BIM model.
Usability	7.1	Switch between 2D / 3D visuals		C	Comparable views between 2D and 3D imagery will help

					users understand what the outlay of designs might look like without professional knowledge.
Usability	7.2	Observable Data within the 3D Model		S	A viewer accessing metadata can bring up the available IFC information. Size / Weight / Model
Usability / Performance	8	Various Tools to manipulate the 3D Model for participants.		C	Various tools allow users to dissect and explore the model. The BIM Viewers seem to use tools that would aide engineers, as there are tools to measure distance, a cutting tool to remove BIM objects blocking views, calculations in weight, size, volume, and finally an explosion tool that pulls apart all the BIM components.
Usability / Performance	8.1	Clickable Objects - Available		S	The participants would be able to click parts of a 3D model to investigate

		Properties and Meta-data			elements of the model. This would present information regarding the 3D Model.
Usability / Performance	8.2	First Person Tool.		C	The participants would be able to explore the model in first person.
Usability / Performance	8.3	Mark up Tools - Communication tools between users.		S	Only a few tools had a communicative aspect to these models. There should be active response tools for participants possibly through drawing tools, an outbox for comments on the model, the ability to export PDF's.
Performance	9	Camera to help the performance of the task making.		M	The movable camera is essential that it can be easily used by the participants. The capacity of the camera to move around the model freely (360 degrees) and with simple controls (WASD and MOUSE). Zoomable cameras and the ability to click objects will help user inspection. Then the ability to return to the standard centre

					position by teleporting will help navigate the area, as it can be easy to get lost on the camera and get stuck.

Table 38. Standard Software Requirements - Low Fidelity

Design Area	**No.**	**Requirement**	**Type**	**MoSCoW**	**Justification**
Usability / performance	10	Detail in 3D models		S	Addition of windows, walls, and exterior additions.
Usability / performance	10.1	3D Landscaping		C	Addition of the environment to embed the urban architecture. This will make the buildings feel more lived in.
Usability / Topography	11	Topography of the map laid over the 2D Map		W	Participants being able to orientate themselves on the map.
Usability / Topography	11.1	Bridges and walkways to protrude on the map		C	Participants would be able to visualise their use of the environment.
Usability	12	Text (name) overlaying the buildings –		S	Text of the buildings overlaying work

		Bringing in OS Data			– possibly something that comes up when the mouse is over
Usability / Performance	12.1	Text (name) overlaying the buildings – Seen when mouse is over the building		S	Having Information only available when the mouse is held over the model will keep the desktop clear.
Performance / Usability	13	Ability to personalise the controls		C	This will make the controls much more usable.

Table 39. Standard Software Requirements - Medium Fidelity

Final prototype software requirements (High Fidelity)

The final platform evaluation resulted in the following software requirements being retained for the final case study:

- No.1 Render OpenStreetMap Tiles to a Render Texture Surface.
- No.2 Render the 2D Buildings in the OSM tiles into 3D Models
- No.2.1 Get the Extents of the Building in 3D
- No.2.2 Render Buildings as complex buildings
- No.2.3 Extrude Buildings
- No.3 Import an IFC / FBX file into the system
- No. 4 Placing in the imported model
- No. 4.1 Hide buildings that would be obscured
- No. 4.2 Render the new model
- No. 6 User Dashboard
- No. 6.1 Add other individuals
- No.7 Display visual information from BIM model
- No.7.0.1 External Visual Information should be displayed from the BIM Model (FBX file)
- No.7.2 Observable textual data within the 3D Model

- No.7.2.1 Observable Data within the 3D Model, input from *user 1*
- *No. 7.3* Clickable Objects - Available Properties and Meta-data
- No. 9 Response tools
- No.10 Adjustable Camera
- No.13 Text (name) overlaying the buildings – Bringing in OS Data

Software requirements dropped from the final prototype

Unfortunately, due to the constraints of the time of the research, specific textual data had to be input manually onto the platform. These points were retrieved from the planners own public engagement tool. Unfortunately, due to the timing of the project, the planner was only able to confirm some design points of the project.

- No.5 Rendering pipeline
- No.7.0.2 Internal visual design information accessible in the platform
- No.7.1 Switch between 2D/3D visuals
- No.7.2.2 Observable data within the 3D Model, input from the IFC data from the model
- No.8 Various tools to manipulate the 3D model for participants
- No.8.1 First-person Tool
- No. 8.2 Mark up tools
- No.11 Detail in 3D models
- No.11.1 3D landscaping
- No.12 Topography of the map laid over the 2D Map
- No.12.1 Bridges and walkways to protrude on the map
- No.13.1 Text (name) overlaying the buildings – Seen when mouse is over the building
- No. 14 Ability to personalise controls

Appendix 8 Prior approach to being informed (news, local news) Appendix

when removed note in the public consultation data

Participants were specifically asked about how well they stayed informed. They were asked specifically about their approach to news in the area, and national news. As noted in section 4.3.3.1 of chapter 4, news media acts as a connecting factor to public consultations due to the statutory requirement to post public consultations in local newspapers.

Participant	Newspapers	Online News Media	Digital	Traditional	Local News	National News
1	Yes	Yes	Yes	No	No	Yes
2	Yes	Yes	Yes	No	No	Yes
3	Yes	Yes	Yes	No	Yes	Yes
4	No	No	No	No	No	No
5	Yes	Yes	Yes	No	No	Yes
6	Yes	Yes	Yes	Yes	Yes	Yes
7	No	Yes	Yes	No	Yes	Yes
8	No	Yes	Yes	No	No	Yes
9	No	Yes	Yes	No	No	Yes
10	No	No	No	No	No	No
11	No	No	No	No	No	No
12	No	Yes	Yes	No	No	Yes
13	No	Yes	Yes	No	Yes	Yes
14	Yes	Yes	Yes	Yes	Yes	Yes
15	Yes	Yes	Yes	Yes	Yes	Yes
16	Yes	Yes	Yes	Yes	Yes	Yes
17	No	Yes	Yes	No	Yes	Yes
18	No	Yes	Yes	No	No	Yes
19	No	Yes	Yes	No	No	Yes
20	No	Yes	Yes	No	Yes	No

Table 40. Informed by news media

Restrictions to engaging with media were noted as well as the time that was available to participants to engage with local and national news. The use of sites like BBC were seen as trusted sites, and therefore would be the source of news for the participants.

Traditional newspapers, which might note a public consultation was an unpopular approach to seeking out news amongst participants. Unless the participant was unwilling to seek out a source of news the most popular method of acquiring information about daily on-goings was using online news media. Newspapers (both online and traditional) serve as an accompanying method to participants already engaged in news media.