Northumbria Research Link

Northumbria University NEWCASTLE

University**Library**

BIM IMPLEMENTATION IN THE UK RESIDENTIAL SECTOR: CURRENT BARRIERS AND POTENTIAL SOLUTIONS

Turnbull, L.[1], RazaviAlavi, S.[1,*], and Gledson, B.[1]
[1] Department of Mechanical and Construction Engineering, Northumbria University, United Kingdom
[*] reza.alavi@northumbria.ac.uk

Abstract: Despite the interest gained throughout the construction industry to BIM and more modern methods of construction, the uptake in the UK residential sector has been slow and hampered by several barriers and misconceptions towards the concept. The unwillingness to change by house builders and residential stakeholders alike is exacerbated by the barriers encountered with costs, training and procurement, which have generated a negative perception of the BIM implementation. This study aims to identify the barriers currently faced within the UK residential sector influencing the uptake of BIM. The study examines further both the drivers and current rate of BIM implementation along with the main barriers to the progress of BIM adoption specifically to the UK residential sector. A survey across a diverse range of industry professionals was conducted to recognise the differences in opinions and views to the BIM adoption in the residential sector including BIM's barriers and benefits, the UK government strategies, and respondents' belief about whether BIM can be successful in the UK residential sector in the future. The results reverberated what was found in some secondary data confirming that the main barrier to the BIM adoption in the residential sector is lack of the clients' demand. The responses illustrated a scepticism towards the UK government's mandate and its effectiveness whilst highlighting potential solutions offering grounds for the further improvement in the residential sector.

Keywords: BIM Adoption; Residential Sector; United Kingdom; Survey

1 INTRODUCTION

Statistics show that the UK construction industry currently represents around 6% of the national economic output, which equates to approximately £116 Billion a year (Chartered Institute of Building, 2020). From this economic output, an assessment produced from Chartered Institute of Building (CIOB) estimates that a total of £38 Billion is generated by house building and in 2018 equated to around 224,000 homes being built (Home Builders Federation, 2018). The poor productivity and poor performance of the sector is, however, highlighted by a report compiled by the 'National Housing Federation' which suggests a staggering backlog of almost 4 million homes which would require a total of 340,000 homes being built every year till 2031 (National Housing Federation, 2020).

The construction industry continually faces many issues from multi-disciplinary organizations with fragmentation, conflict and uncertainties with its prevailing traditional practices, processes and procurement strategies (Khosrowshahi & Arayici, 2012). These institutionalized inefficiencies have cascaded through all the UK construction industry including the residential sector; a sector which Georgiadou (2019) claims to have the longest lifespan, worst environmental performance with a collection of developers, who are motivated only by profits and legal aspects. This entwined with the severe backlog of suitable housing to

meet the UK's socio-economical requirements as Wilson and Barton (2021) portrayed a disquieting vision into the future of the UK residential sector.

To address these ongoing issues within the UK residential sector, the government's introduction of its 2016-2020 construction strategy to implement BIM level 2 on all centrally procured projects has been met with mostly a positive welcome from the industry. However, the residential sector is still unquestionably distant from full adoption and possessing the means to progress to the next level of BIM with complete and total collaboration throughout the lifecycle of a project.

Despite the well documented evidence to prove the benefits of BIM, there is little evidence to demonstrate where the promotion and awareness of BIM comes from within the residential sector and why it has been less welcoming than other sectors. To put the implementation of BIM into context, Eynon (2016) argued no-one would now think of not using CAD, the internet or emails; it is part of the industries everyday life and in time, it will be the same with BIM. The sticking point now is how to make the transition and be fully collaborative and integrated to the concept of BIM within the UK residential sector.

The aim of the study is to understand the preeminent factors relating to the barriers surrounding the adoption of BIM within the UK residential sector and investigate further the reasoning from industry professionals why the sector is yet to benefit from its potential. To this end, a survey across a diverse range of industry professionals is conducted to recognise the differences in opinions and views. The rest of this paper consists of the literature review section, methodology, research findings and discussion, and finally the conclusion section.

2   LITERATURE REVIEW

2.1   BIM implementation in the UK construction industry and residential sector

Th UK government plans to combat the current deficit of outstanding homes that require building by dedicating £44 Billion over the next 10 years (HM Government, 2022) enforcing the requirement for efficient construction processes with the reassurance of a solid pipeline of future work for companies operating in the residential sector. In 2011, the Government Construction Strategy (GCS) set out conditions to drive the standards of centrally procured government projects and required fully collaborative 3D BIM for all data and documentation being shared electronically (Cabinet Office, 2011). GCS also stated that construction has generally lagged behind other industries and failed to fully adopt the full potential of digital technology (Cabinet Office, 2011).

The proceeding GCS 2016 – 20 sets further initiatives to strengthen and establish BIM level 2 and aimed to develop the industry standards for the eventual implementation of BIM level 3 (The Infrastructure & Projects Authority, 2022). The survey in 2020 by National Building Specification (NBS) in the UK show 73% of participants which range from varying disciplines are now aware and using BIM in oppose to only 13% when the survey originally took place in 2011 (NBS, 2022). NBS (2022) claimed that the most prominent use of BIM in the construction sector as a whole comes from repeat clients within the public sector in new build projects and the main barrier to BIM is lack of the clients' demand. The report by UK National House Building Council (NHBC) in 2013 indicated that the use of BIM adoption in the UK house building sector as 'not very widespread' with only 11% of house builders asked using BIM (NHBC, 2013). The conclusion and reasoning for such low levels of interest stem from lack of knowledge, misconceptions of benefits to the business and the costs involved for training and equipment (NHBC, 2013).

Park and Kim (2014) state that although the requirement for BIM in the domestic sector is high, the current uptake of BIM in housing is still relatively low at only 25%. Walley (2017) further enforces this statistic quoting "house building is arguably the BIM industry's most notable failure to date, with only those parts exposed to public sector procurement having made significant progress." Georgiadou (2019) described the housing sector a priority research area which differentiates itself from all other sectors by having the longest lifecycle despite the fact it carries the worst environmental impact and least funding available to facilitate refined technological advancements. Bosher et al. (2007) recapitulates this feeling by characterizing house

builders as only concerned with profits, focusing predominantly on legal aspects, and lacking motivation in this area.

2.2 Barriers to the BIM implementation

Research for BIM implementation within the UK private house builders is limited with reports indicating that the welcoming of BIM towards this sector is relatively low. This analysis of research naturally prompts a requirement to develop further research towards the public sector where BIM is mandatory and the awareness to adopt its concepts is widely recognized. Literature from Eadie (2015), Georgiadou (2019), Bosher et al. (2007), Park and Kim (2014) suggest that publicly funded projects are the most appropriate place to analyse further what is preventing the adoption of BIM in the UK residential sector. Eadie et al. (2014) discovered through questionnaires carried out by the top 100 UK contractors that the main barrier to BIM adoption is the doubts towards return of investments (ROI) and lack of vision of benefits.

 Small and medium-sized enterprises (SMEs) play a substantial role in the UK construction industry by having nearly 1 million SMEs, which constitutes a fifth of all SMEs in the country (Department for Business, Energy & Industrial Strategy, 2020). Dainty et al. (2017) asserts the idea of smaller firms lacking the capacity to invest and take advantage of new technological advancements. A study carried out by Vidalakis et al. (2019) shows a low level of familiarity and knowledge of BIM within SMEs, which stems from the limited resources and demonstrates how the BIM implementation in the smaller companies highly relies upon cost. Poirier et al. (2015) further advocates the necessity of SMEs to be given a clear strategy and assistance to fully benefit and incorporate BIM into their working culture claiming very few will have the capacity to establish BIM independently.

One of the leading challenges facing the Architecture, Engineering and Construction (AEC) industries is the interoperability of shared software (Grillo & Jardim-Goncalves, 2010) and inability of the existing industries' procurement strategies to adopt electronic procurement (e-procurement) (Grillo & Jardim-Goncalves, 2011). Bolpagni (2013) advocates the assertion that interoperability is the greatest element to overcome the BIM adoption barriers with regards to procurement but claims that "this transformation requires time and education to overcome the actual barrier".

The next section described the methodology used in this study to explore BIM adoption in the UK residential sector.

3 METHODOLOGY

This research adopts both qualitative and quantitative methods to collect primary and secondary data. Qualitative methods are followed for reviewing literature and identifying the leading factors towards the barriers of BIM in the UK residential sector. Then, the identified factors are used in designing the questions of an online questionnaire to conduct a survey across a diverse range of the construction industry professionals in UK. The survey aims to recognise the differences in opinions and views to the adoption of BIM in the residential sector including BIM's barriers and benefits, the UK government strategy and respondents' belief about whether BIM can be successful in the UK residential sector in the future. Quantitative methods are then adopted to statistically analyse the data obtained from completed questionnaires. The questionnaires consisted of 19 multiple-choice questions. The first few questions were designed to identify the demography of the respondents, and their BIM awareness and level of BIM maturity in their organizations. The remaining questions were focused on collecting the opinion of the respondents regarding BIM adoptions in the residential sector and its barriers.

4 FINDINGS AND DISCUSSION

4.1 Demography of the respondents

The questionnaire was distributed to professionals in the construction industry from varied background with

a total of 54 responses, from which 51 was male and 3 was female. 45% of the respondents was between the ages of 36 and 49; 24% between 25 and 35; 20% between 50 and 60; 9% between 18 and 24; and only 2% over 60. 83% of respondents were working within the residential sector, which provided a good sample for the purposes of this research. The respondents were working for principal contractors (52%), clients/owner (28%), design and engineering consultants (11%), and subcontractors (9%).

4.2   BIM awareness and implementation

The results of the survey showed that BIM awareness in the sector is high (93%). Of the 4 respondents who were unaware of BIM, three were subcontractors and one part of a client team. This aligns with the 2020 NBS's report showing 99% of the participants in their survey were aware of BIM (NBS, 2022).

The respondents were asked their companies current usage of BIM or whether they intend to use BIM in the future. Only 46% of the respondents answered YES to this question. As shown in Figure 1, most of the respondents who answered NO to this question were principal contractors or subcontractors. In this regard, the 2020 NBS's report demonstrated a higher percentage (73%) for the BIM usage in the industry. It might be related to the weight of the sectors other than the residential sector participating in their survey (NBS, 2022).
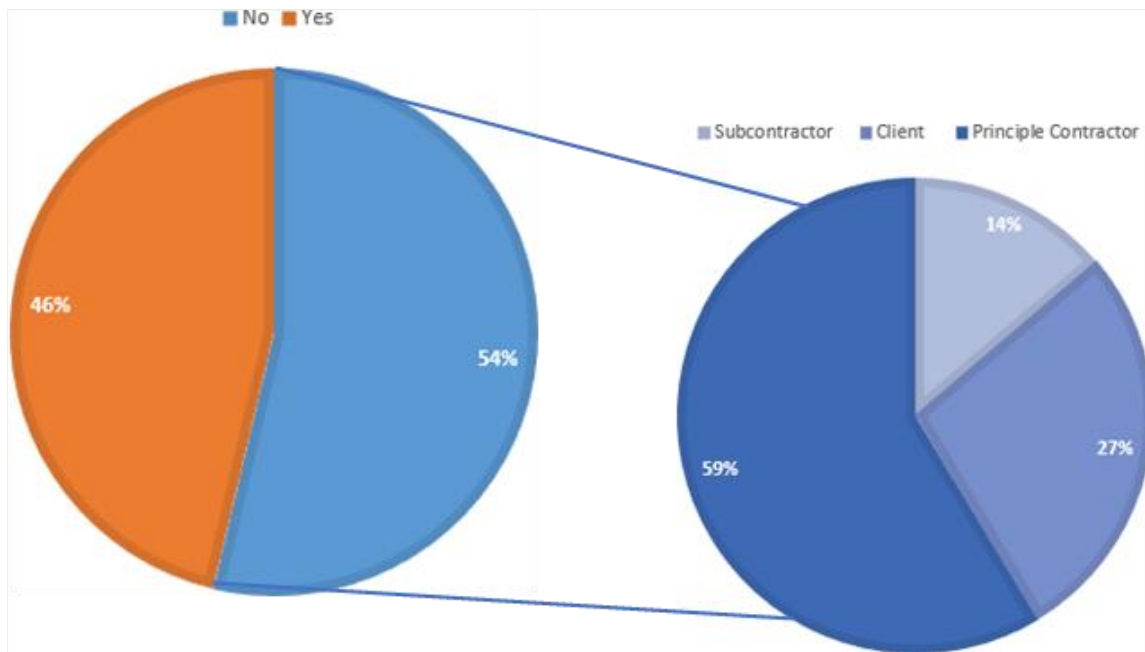

Figure 1: BIM usage or intended usage by the organizations of the respondents

Another question was about the level of BIM maturity they are currently operating at. As shown in Figure 2, most of the respondents were operating at Level 1, and then Level 2. 19% of the respondents was not aware of BIM levels, which could be related to their limited knowledge about BIM. The distribution of the respondents' organization type for each BIM level is shown in Figure 3. As seen in this figure, majority of the principal contractors are using BIM at Level 1, while the design teams and consultants are using BIM mainly at Level 2. The clients are using BIM at different levels; mostly at Level 0 or Level 2, and some at Level 1. Some subcontractors are using BIM at Level 1.

Most of the participants that did not know about their BIM maturity level are from subcontractors, and principal contractors, which could be related to not using BIM or their limited knowledge about BIM levels.

Only one respondent, who is from a principal contractor, mentioned that they use BIM at Level 3. That is, the progression of BIM implementation towards Level 3 in the residential sector is very slow and needs more work. Overall, the design teams and consultants are a head of other stakeholders in using BIM Level 2. Principal contractors are mostly at Level 1, and need to enhance their BIM maturity level to reach at least Level 2. For subcontractors, further investigation is required as they mostly do not know about BIM maturity level.
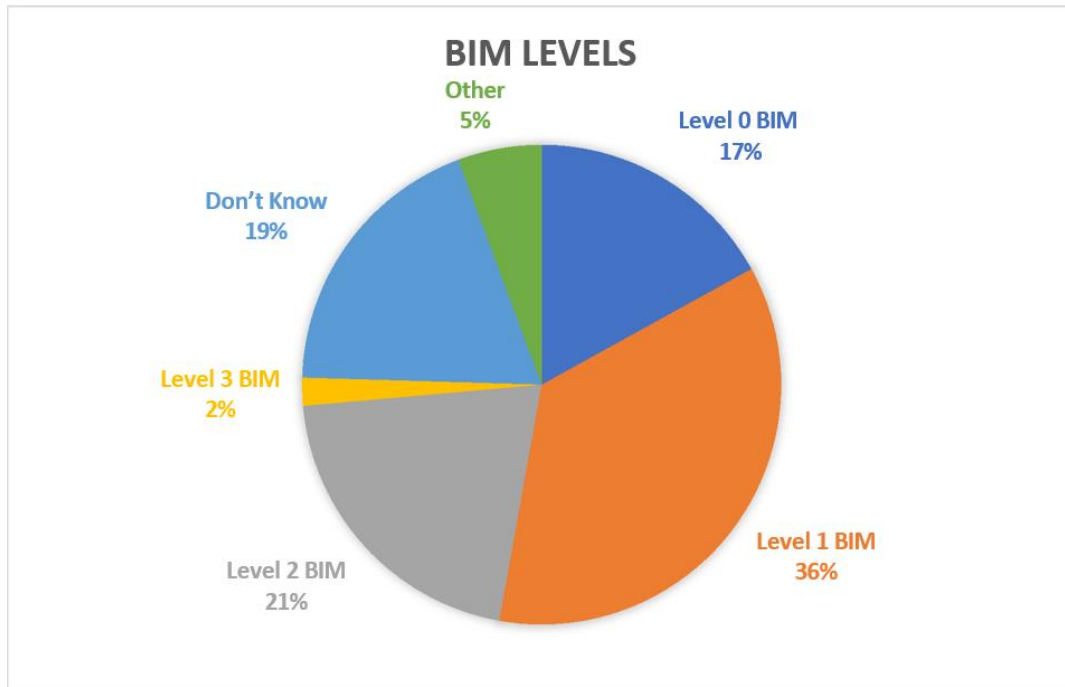

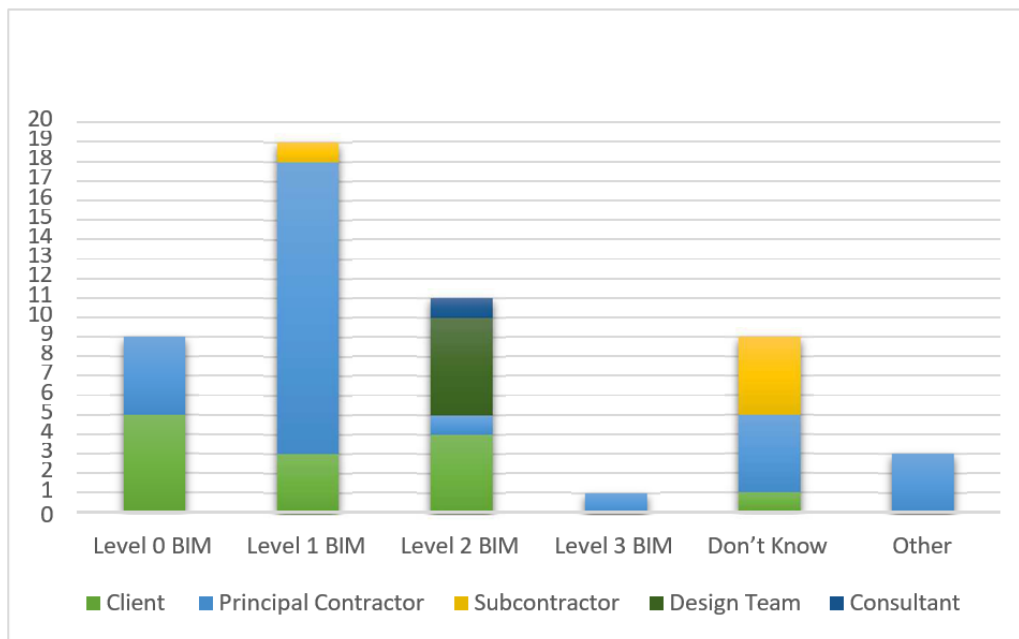Figure 2: Levels of the BIM maturity in the organizations of the respondents

Figure 3: Level of the BIM maturity based on the organization type of the respondents

4.3   Opinion about the success of BIM implementation in the UK residential sector

The respondents were asked who has the most important role to the success or failure of the implantation of BIM with 43% of the answers directed towards the client, and 34% towards the design and engineering team. Almost half of the respondents (47%) agreed that the residential sector will be left behind other sectors if BIM is not more widely adopted while 65% of the respondents believed BIM can be successful in the UK residential sector and the remaining either disagreed that (7%) or had a mix opinion (28%). The respondents mentioned that the main reasons for the residential sector being less responsive to BIM than the other sectors are "residential projects are less complicated" and "lack of capacity of subcontractors for BIM adoption."

For the entire construction industry, 46% of the respondents believed that the Governments Construction Strategy 2016-2020 was not successful, and only 19% believed that it was successful while 35% was not sure about it.

4.4   BIM Benefits and Barriers

Most of the respondents (48%) recognized "improved design coordination and clash detection" as the main benefit of BIM in their organization. "Improved communication between the project team" was recognized as the second benefit of BIM by 31% of the respondents.

Figure 4 shows the opinion of the respondents about the barriers to BIM. As seen in this figure, "lack of clients' demand" and "lack of understanding" were found as the main barriers to BIM adoption in the residential sector, which corresponds to the 2020 NBS report claiming lack of clients' demand as the main barrier to BIM. As a solution for promoting BIM in the residential sectors, the respondents indicated that the most impactful actions are: 1) a change to the clients' traditional procurement strategies, 2) subcontractor incentives for BIM adoption, 3) extra government funding to SME for training and set-up costs, and 4) more investment from principal contractors to staff training.

Figure 4: The frequency of the responses to the barriers to the BIM adoption

5   CONCLUSION AND RECOMMENDATIONS

This research explored the BIM adoption in the UK residential sector and attempted to find the main barriers and some solutions to address these barriers. In addition, the opinion of the industry professionals about the current state and the future of the BIM adoption in the residential sector was collected. The results reverberated what was found in some secondary data pertaining to the main barriers to the BIM adoption in the sector. It was found that there is a scepticism among the respondents towards the effectiveness of the UK government's mandate. Despite the steady increase of BIM awareness and use in the UK over the last 10 years, the findings showed that lack of clients' demand is the main barrier of the BIM adoption and a change to clients' procurement approach, incentives and training are necessary to facilitate the wider uptake of BIM in the residential sector.

Overall, the main barriers and benefits often found with BIM have been echoed through both sets of primary and secondary data. The most prominent barrier lies at the very inception of a project with the client, a basic supply and demand of BIM; that is, why should contractors, design teams and consultants invest in a process if it is not required by the owner of the project. The participants of this survey recommended some solutions for eliminating these barriers and promoting BIM implementation in the sector including changing procurement strategies, government incentives and funding, and more investment and training by principal contractors for BIM adoption.

Future researchers could direct their attention to the exploration of the most prominent drivers that have been identified in this research's primary data, and what is the most constructive route to the advancement of the BIM adoption for clients and contractors to lure them away from their traditional methods. The future research could attempt to determine what approach is more appropriate, mandatory or incentivized and how these methods could be formulated.

6   REFERENCES

Bosher, L., Dainty, A., Carrillo, P., Glass And, J. and Price, A., 2007. Integrating disaster risk management into construction: a UK perspective. Building research and information, 35(2), pp.163-177.

Bolpagni, M., 2013. The Implementation of BIM Within the Public Sector: A Model Based Approach for the Construction Industry, Espoo: VTT Technical Research Centre of Finland.

Cabinet Office, 2011. Government Construction Strategy, London: Cabinet Office.

Eadie, R., Browne, M., Odeyinka, H. and Mckeown, C., 2015. A Survey of Current Status of and Perceived Changes Required For BIM Adoption in the UK. Built Environment Project & Asset Management, 5(1), pp. 4-21.

Chartered Institute of Building (CIOB), 2020. The Real Face of Construction 2020: Socio-Economic Analysis of the True Value of the Built Enviroment, Bracknell: The Chartered Institute of Building.

Dainty, A., Leiringer, R., Fernie, S. and Harty, C., 2017. BIM and the Small Construction Firm: A Critical Perspective. Building Research and Information, 45(6), pp. 696-709.

Eadie, R., Odeyinka, H., Browne, M., Mahon, C., and Yohanis, M., 2014. Building information modelling adoption: an analysis of the barriers of implementation. Journal of Engineering and Architecture, 2(1), 77-101.

Eynon, J., 2016. Construction manager's BIM handbook. John Wiley & Sons, United Kingdom.

Georgiadou, M. C., 2019. An Overview of Benefits and Challenges of Building Information Modelling (BIM) Adoption in the UK. Construction Innovation, 19(3), pp. 296-320.

Grillo, A. and Jardim-Goncalves, R., 2010. Value Propositions on Interoperability of BIM and Collaborative Working Environment. Automation in Construction, Volume 19, pp. 522-530.

Grillo, A. and Jardim-Goncalves, R., 2011. Challenging Electronic Procurement in The AEC Sector: A BIM-Based Integrated Perspective. Automation in Construction, Volume 20, pp. 107-114.

HM Government, 2022. Construction Sector Deal. https://www.gov.uk/government/publications/construction-sector-deal Last Accessed on April 18, 2022

Home Builders Federation, 2018. The economic Footprint of House Building in England & Wales, London: Lichfield.

Khosrowshahi, F. and Arayici, Y., 2012. Roadmap for Implementation of BIM in the UK Construction Industry. Engineering, Construction and Architectural Management, 19(6), pp. 610-635.

National Building Specification (NBS), 2022. NBS' 10th National BIM Report (2020). https://www.thenbs.com/knowledge/national-bim-report-2020 Last Accessed on April 18, 2022.

National House Building Council (NHBC), 2013. Building Information Modelling - An Introduction for House Builders, Milton Keynes: BSRIA.

National Housing Federation, 2020. Exploring The Impact of Long-Term Funding on The Residential Construction Sector, London: Cast Consultancy and Harlow Consulting.

Park, K. S. and Kim, K. P., 2014. Essential BIM Input Data Study for Housing Refurbishment: Homeowners' Preferences in the UK. Buildings, 4(3), pp. 467-487.

Poirier, E., Staub-French, S. and Forgues, D., 2015. Embedded Contexts of Innovation: BIM Adoption and Implementation for a Specialty Contracting SME. Construction Innovation, 15(1), pp. 42-65.

The Infrastructure and Projects Authority, 2022. Government Construction Strategy 2016-20. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/510354/Government_Construction_Strategy_2016-20.pdf Last Accessed on April 18, 2022

Vidalakis, C., Abanda, F. H. and Oti, A. H., 2020. BIM Adoption and Implementation: Focusing on SMEs. Construction Innovation, 20(1), pp. 128-147.

Walley, N., 2022. Is BIM Failing the House Building Sector. https://www.bimplus.co.uk/bim-faili6ng-hou8se-bu2ilding-sector/ Last Accessed on April 18, 2022.

Wilson, W. and Barton, C., 2021. Tackling the Under-Supply of Housing in England, London: House of Commons Library