

'Facilities Management's Adoption of Building Information Modelling within the National Health Service'

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Abstract

As the UK's National Health Service (NHS) turned 70 years old in 2018, there have been rising questions about its future, while it continues to run a budget deficit. Now faced with doing more with less, it is imperative the NHS finds more efficient ways of working in almost all respects to ensure its longevity. An area where this is particularly true is the way in which it maintains its built assets. Concurrently, Building Information Modelling (BIM) continues to spur ever greater productivity and efficiency in the Architecture, Engineering and Construction industries. The information generated and collected during a construction project has the potential, if utilised, to aid in the more cost-effective running of an asset.

This research examines Facilities Management's (FM) adoption of BIM within the NHS. Assessing the current awareness and understanding of BIM and exploring the barriers to adoption and what could be done to alleviate these issues. The research methodology comprised of; a comprehensive review of literature on the topics, in particular looking at trends in the NHS FM and the wider FM industry's approach towards BIM integration; an online questionnaire distributed to facilities managers in the NHS and other healthcare organisations within the UK; and a series of interviews with Facilities Managers within a number of NHS trusts and Boards as well as prominent advisors to these organisations.

From the research conducted, various issues are discussed that were highlighted as obstacles to BIM adoption. Issues such as; data and information management throughout a building's lifecycle; the embrace of new technology for the FM; the current organisational hierarchy and structure both in the NHS and its FM departments; the image problem that FM professionals face and the resulting lack of representation in key decision making processes; the availability of investment into the development and adoption of BIM within NHS FM and possible funding options that could incorporate BIM such as Private Finance Initiative (PFI); and the irregular implementation of the UK BIM level 2 Mandate.

In conclusion, while there have been a number of barriers to the adoption of BIM in the NHS FM made apparent during the research, given that the process of implementation is still very much at the early stages, there will still need to be a great deal of research and development carried out on how the NHS Facilities Management and the wider Facilities Management industry will adopt BIM. However, if this is done now then it will allow for the groundwork to be correctly laid down for future implementation.

Keywords: Building Information Modelling (BIM), Facilities Management (FM), Healthcare

1. Introduction

Building Information Modelling (BIM) application has the potential to greatly reduce waste, reduce time and cost overruns, lower carbon emissions and in the future has the potential to give end users the ability to better utilise the built assets (UK. HM Government, 2013). The adoption rate of BIM in the UK has been spurred on by the Government's 2011 and the subsequent 2016 update of the Government Construction Strategy, which mandates the use of BIM Level 2 on public sector construction and infrastructure projects. A quarter of all construction output in Britain comes from the public sector. As a result of this, the government is acting as an informed client in relation to BIM adoption, hence, benefiting from its impact (McPartland 2017). Not only does the mandate aid the adoption of BIM in the construction industry, the government itself greatly benefits from the mandate, as it aims to empower clients and their capability to procure better built assets. Two of the key principles of the Government Construction Strategy that will drive this change are: greater collaborative working, and the early involvement of the supply chain and the future operators of an asset (Mills 2016).

The National Health Service (NHS) in the UK currently holds £44 billion in assets (Arcadis 2016) and it is estimated that around £30 billion is spent on facilities and estates management within the NHS each year (CENSIS 2018). Following the 2008 financial crisis and the ensuing economic downturn, as well as the strict austerity measures implemented by the UK government, there was much more demand for added value within public sector spending. Much like various other public sector professionals, facilities management (FM) professionals found themselves in the position where they had to do more with less, hence, the public projects FM sector searching for new and innovative opportunities to improve working and aid their business strategies (O'Brien 2017).

During the recent Embracing Technology to Move FM Forward (2018) report, the UK industry body of British Institute of Facilities Managers (BIFM) acknowledged that technological advancement opportunities such as BIM, Computer Aided Facilities Management (CAFM) systems and Building Management System (BMS) and also a growing amount of emerging technologies such as people analytics and Artificial intelligence (McDonald 2017) are all likely to play a big role in FM in the future and streamline the way in which built assets are managed. However, there is an uncertainty and a number of different opinions in the industry about what type technologies should be adopted and the changes these could bring about (NBS, 2018). As with any industry that is seeking to embrace new technology, a certain degree of new understanding must be developed. It is likely that there will be a combination of numerous technologies that complement one another and allow for the FM to carry out their duties in the most efficient way possible (Newton et al, 2015). Although the adoption and integration of numerous technologies might also serve to create more problems for the industry as current awareness of some of the technologies still requires a great deal of development. This issue has already been identified by the industry as a barrier to their development and is thought that it might be in part due to the disruption to current working styles that any new systems might bring about (Watson 2016).

The current ways of working and the standing of the FM professionals in the NHS is traditionally split into two factions, hard and soft FM (NHS Property Services 2015), while the differences between these styles of working and the variety of services that they provide further highlight the complex issues that the FM industry faces in BIM adoption (Kelly 2018). As well as the internal structuring of FM the external image of the profession is an issue with allied industries and in the general public failing to understand what FM really entails (Moriarty, 2018) often oversimplifying its work. BIFM is currently exploring resolutions to this one of which is the aligning of FM with other professions such as HR, marketing or sales in what is referred to as workplace FM. Another way in which this is being tackled is the use of the Government Soft Landings (GSL) which strives to involve an assets FM in the design and construction phases of a project and also the design and construction in the operation.

Use of BIM within NHS FM systems has the potential to help the health service maintain and develop its assets, as well as providing cost saving benefits to allow government cost saving targets to be met. One potential applicator explored for BIM in the whole lifecycle of an asset could be via the use of Privately Funded Initiatives (PFI or NPD in Scotland), the Department of Health and Social Care (DoHSC), who NHS belongs currently holds the greatest capital value of PFI projects of any government department (UK. HM Treasury, 2018). Generally, under PFI contracts private sector

companies finance, building and maintain assets used by a government department and are required to meet Key Performance Indicators (KPI) in order to receive reimbursement via the unitary payment system (NHS Scotland, 2009) which normally extends over a period of 20+ years. It is thought that through the KPI mechanism BIM could be specified and implemented over the entirety of an asset's life cycle. The paper aims to gain a deeper understanding of the current barriers to the future adoption of BIM within the NHS Facilities Management teams through review of theory and empirical data analysis to address the following objectives:

- Understand the current restrictions to the use of BIM within FM in the NHS and identify current legislation that may need to be updated, reduced, created or removed to enhance the use of BIM within FM.
- Evaluate the current industry understanding of BIM and its uses/benefits to the FM industry while assessing the FM industry's current and future abilities and strategies to adopt further BIM working within FM healthcare delivery.
- Examine whether the use of Privately Funded Initiatives (PFI) has an influence on the adoption of BIM.

2. Methodology

It was decided that a two-fold approach would be adopted for the research; the first half of the research was to create an online questionnaire and then distribute it to the relevant facilities, asset and estate managers in healthcare facilities throughout the UK. The second stage of the research conducted was a series of structured interviews both in person and via telephone to facilities and estates managers in the NHS Trusts and Boards across the UK as well as a select number of industry-specific BIM specialists from both the FM industry and in healthcare facilities management.

2.1 Questionnaire

During background research it became apparent that there had been a number of comprehensive surveys and polls conducted that sought to establish the awareness and understanding that facilities managers possess of BIM. In turn, the questions asked in this survey built upon a similar survey conducted by BIFM in August of 2017 (Ashworth & Tucker, 2017), which sought to assess the awareness and understanding of BIM in the FM industry as a whole. The majority of questions that were asked in both surveys were of a quantitative nature, which enabled the direct comparison of the awareness and understanding of BIM in the NHS FM with that of the industry as a whole. The survey took the format of an online self-completion questionnaire, the online distribution allowed for the quick and effective collection of data from a large sample group (Wisker, 2007). The survey was comprised of twenty questions that were selected or created as to adhere to the primary objectives of the research that were outlined at the offset. Using a series of closed questions that asked participants to select from given answers or to rank options, the results were mathematically analysed allowing for trends to be established and the direct comparison to be made with the previous survey.

2.2 Interviews

It was highlighted that the need for a first-hand insight into the ability of the FM within the NHS to adopt BIM would be essential in this research. In light of this, a series of semi structured interviews with relevant professionals within FM in the NHS and relevant bodies were conducted. The series of interviews run concurrently with the survey, with most participants contributing to both. The majority of the interviews were conducted face-to-face, with a small number being carried out over the phone. It was decided to conduct the interviews, where possible, face-to-face, as it was felt that it had the potential to provide more detailed answers. The interview process sought to obtain as much qualitative data as possible; in order to achieve this, a detailed series of open questions were formulated in accordance with the research aim and primary objectives. These were then structured into a schedule of questions to be put forward during the interviews. It should be noted that while there was a question schedule, it

was not always strictly adhered to and the interviewer was at liberty to change the order if they saw fit. When necessary, follow up questions were also asked to elicit more thorough and in-depth answers or to seek clarification.

3. Results Analysis

3.1 Questionnaire Analysis

The survey began with overwhelmingly positive results, there was the apprehension that there may be a lack of understanding at a basic level that had been derived from the literature and language used when talking about BIM in the FM industry. However, when asked had they heard of, BIM before the survey, 96.7% of respondents stated that they had. Following this, participants were asked if they thought that BIM will have a significant impact on facilities management in the NHS. This was posed as a neutral question not requiring the participants to decide whether it would have a negative or positive effect on FM; 73.3% of respondents stated that they thought it would have a significant effect but perhaps more surprisingly 10% of respondents selected they felt it will not have a significant impact on FM in healthcare. In addition, a number of participants (16.7%), stated they were still unsure of BIM's impact. Directly following this, participants were asked if they thought that BIM will help them in their delivery of FM and results favoured BIM with 80% of respondents thinking that it would, however the number of participants that answering that BIM would not help them rose to 13.4%. These initial questions show that while there is an understanding of BIM within the industry, it is not cohesive and there is still work to be done to demonstrate the benefits of BIM adoption to all.

The lack of consensus was further shown when participants were asked to indicate the time scale upon which BIM will have an effect, with just as many people (23%) stating that they thought it would take 3-5 years to implement, as said it was already having an effect, this may be due to the difference in the different subdivisions of the NHS Estates Departments that this survey was issued to, such subdivisions as Capital Planning are likely to have encountered BIM already as they are involved in the procurement of new assets and are often the drivers for the implementation of BIM in the NHS, on the other hand the Soft FM providers are unlikely to have experienced BIM. But by far and large, more than a third of participants (36.7%) thought that it would take 5 years or more for BIM to take effect, indicating that there is still work to be done before the majority of FM feel that BIM will take effect. This theme continued when asked whether they considered their organisation to have adopted BIM at a strategic level, 60% answered that they did not, showing a lack of awareness and understanding at strategic decision-making level or that there is not the drive from the higher levels that is required for implementation.

As part of this survey participants were required to select five statements that they felt best showed the restrictions that the organisation faced in the adoption of BIM, they had 13 defined statements to choose from and the additional option to contribute their own. The top five results saw the repeat of answers; software and training, but also highlighted additional issues such as the traditional work culture within FM. This statement was included in this question as in early conversations with professionals, it became evident that there may be an issue with long term staff members being unwilling to alter the status quo as they feel it is a system that works, again potentially showing the need for training of frontline staff. These results were echoed when participants were openly asked about what they thought would better their organisations implementation of BIM with points such as training programs, and FM software that incorporated BIM being the top responses showing these issues are those that concern the FM by far the most. The reoccurring issue of training shows that while there is an understanding of BIM, it may not be in-depth nor widespread, it also creates a feeling that there may be an uncertainty in the current knowledge of BIM that the FM industry holds.

3.2 Thematic Analysis of Interviews

Whilst the interviews were conducted in a semi-structured manner, the open nature of the questions fielded to the interviewees meant that the responses given varied greatly in the issues that they

highlighted and the future solutions to issues that were discussed. Due to this it was opted to conduct a thematic analysis of the interviews, where recurring themes were deduced and expanded upon.

3.2.1 Culture Change

One of the largest issues that arose out of the interviews with nearly all participants making comment on the issue in one form or another, was the systemic cultural changes that are required in the FM sector of the NHS and in the broader FM industry. Due to the proportions of this issue it was decided to further subdivide it into three distinct parts; the way in which FM services in the NHS are provided, the early involvement of the FM in a project and the standing of the FM role.

The picture that was portrayed of how the NHS conducts its FM services indicated there are clear divisions between the multitude of services provided under the single estates department umbrella. FM services both in the NHS and the general FM industry tend to be split into two; hard and soft, however in the NHS it seems that even in the hard and soft factions there are silos of working and information with little to no inter working. One participant stated that they thought that the separation that had been made between hard and soft FM within their organisation was counterproductive. However, there was also the counterargument made that due to the large scale of delivery and the geographical distribution of the services that integrated, working of FM was not entirely feasible. In spite of this, it is clear that for the benefits of BIM adoption to be holistically felt then collaborative working within the Estate Department was crucial.

Another alteration to the current FM working culture that is required is for the implementation of the GSL process as part of the wider BIM implementation. FM professionals must understand the later benefits of their early involvement during the design and construction stages and how it could lead to a better functioning asset. However, when speaking to HFS it was said that in past instances where the FM had been included in earlier processes it had been difficult for them to make active contributions as the nature of FM day-to-day working can be quite reactive and, in the moment, rather than 'preparing for the future'. It was also thought that perhaps this is due to the fact that they are simply not allocated the time for this and was considered additional to their daily workload. In later interviews it became evident that this might not be the case across the NHS with other interviewees stating that in their personal experience being included at the earlier stages of a project they felt that they could make valid additions. Making it clear that there is the potential for the different Boards of the NHS to learn from one another in this process, if they were to actively share their ways of working.

The standing of the FM profession in the NHS's organisational hierarchy, was an issue that emerged repeatedly, with the phrase 'not in the boardroom' being referenced. This is in response to a feeling that FM professionals are often undervalued and unable to actively contribute to corporate level decision-making and attain additional resources as they are not seen as being part of the primary objectives of the NHS, despite the business-critical nature of their activities. One participant stated that "FM is at the bottom of the pile and in the case of PFI, the private FM provider is even further below them." For BIM to be adopted, it is first necessary to realise that FM could be a main driver of efficiency and cost saving measures for the NHS.

3.2.2 Education

To incite such a large cultural change within the NHS a detailed education programme is required: currently it is clear that heads of Estates and Facilities Departments realise the advantages of BIM but are restricted in implementing it by the lack of understanding around them. Thus far in BIM adoption there has been a top down drive which has stemmed from a government level in the form of the mandate, on the other hand in the NHS this seems to be the middle out, with heads of departments required to demonstrate the benefits in relation to the cost and impact on the business plan to decision makers at an organisational level such. In several interviews it was mentioned that the challenge is making the board realise that BIM could greatly impact the way in which they deliver healthcare and streamline this service. In addition to this, they must also educate the workforce on how BIM will affect them highlighting that this is done in the name of productivity and efficiency, and not staff monitoring as has been the fear in the past. The largest part of the education process at this level will be showing staff

how to utilise the new technology upgrade in both software and hardware, this is likely to be a major hurdle to overcome as previously the systems used were either very low tech or were paper exercises.

3.2.3 Technology Upgrade and Information Handling

For BIM to be successfully employed, then the NHS is likely to undergo a considerable technological revolution. On a number of occasions in interviews, participants spoke of their current BMS or CAFM systems' incompatibility with the way information is presented in BIM and its file formats. This means that either significant alterations need to be made to the current systems or completely new programs must be deployed. This sort of software update is unlikely to come alone and will need the hardware capacity and capability to match. The issues surrounding this sort of upgrade was highlighted by contributors stating that it is difficult for the Estates Departments to get any sort of tech upgrade as they are prioritised for primary services such as patient records and clinical administration. The future management and storing of information was a major concern for all of the professionals interviewed, with them voicing their apprehension about a number of issues. The predominant points covered were in relation to the maintaining of the BIM model's accuracy once an asset is operational, as there will be a constant flow of data being used and edited for an indefinite time period. This also raises the question of how this information will be stored and shared. Two scenarios were mentioned in relation to this; a central server with dedicated access points or a cloud based system that could be accessed via any device anywhere, both have their merits and both create further questions such as who has access and editing privileges to this information; is it an information manager or is it a tech-savvy workforce? These issues arise from the lack of a clear vision as to how the FM can conduct itself in the BIM environment. An interesting aspect that emerged in the interviews were the different aspirations for the new technology that is to be implemented such as sensor monitoring, lifecycle maintenance, scheduling etc, coupled with the autonomous nature of the NHS bodies means that we could see very different outcomes.

3.2.4 The Cost of Implementation

The availability of capital investment for the upgrade of technology as well as the education required initially for the implementation of BIM is a major obstacle that has to be faced. The ROI of the initial money spent has to be realised and a clearly beneficial business case put forward to support it. Currently at NHS Grampian they are in the process of creating a business case that highlights the return on investment of the adoption of BIM to be put forward to the board. The education of key figures will play a large part in the successful acquisition of investment.

There was a great deal of scepticism around the issue of finance with a number of interviewees expressing the difficulties that both the NHS as a whole face as well as that of the FM. While at North Cumbria University hospital, it was said that the money needed for the upgrade of systems would not be received unless the payback was near immediate for it to be justified, giving the example of a system upgrade they were undergoing where the Board of the NHS Trust was given the option to spend a marginal amount more on the upgrade to save a great deal in the future. In spite of the clear benefits, it was opted to keep upfront costs to a minimum. A number of participants also discussed the need for a clear example similar to that of the NHS Pathfinder projects that were used to show best practice for construction projects or be provided with a proven mechanism to show the ROI.

Later, after the initial investment has been made and the new systems are in place and operational, the issue of what is to be done with older buildings in the NHS portfolio arise, some of which are over a hundred years old. There is a fear that surveying would be costly and disruptive to a hospital's daily running. However, estates teams also made it clear that they could not solely rely on new builds to bring their FM into the BIM environment and there would be a time where it would be necessary to survey the existing buildings to some extent or run the risk of forever running a two-tier system.

3.2.5 The use of PFI

During the research, participants were asked about their thoughts on the ability of PFI and NPD (Scotland) to be the vehicle for change for BIM in the NHS. The responses received were varied. While most believed it was possible, they also thought that in its current use, a lot would have to change for it to be effective. Whilst at NHS Lothian it was stated that PFI has the potential to push through the use of BIM greatly in both the projects side and in the future management of the asset created but it is reliant on two crucial factors changing; firstly that the NHS and other public bodies need to be able to specify clearly what they want both in terms of a finished asset and the BIM management strategy into the future, and in turn they must also be aware of what they are specifying in real terms as in the past there have been misunderstandings. The second factor being that the private FM companies bidding for these PFI projects must also realise the benefits of BIM adoption prior to them putting forward a bid on a project. The use of PFI to implement BIM would not come without cost, it was mentioned by one FM in PFI professional in interview that while it is possible for the specification of the use of BIM in FM to be integrated into a PFI contract there would be a monetary cost to that and it would be factored into any bid and ultimately shouldered by the NHS.

4. Discussion

4.1 Data Management

There is great apprehension about the future management of BIM data, mostly in relation to how to integrate BIM into the current FM systems and ways of working, in particular the need for continual upkeep information throughout a building's lifecycle. Other concerns involve the storage and sharing of the data and an issue that arose repeatedly was how the existing NHS estate, the majority of which is over 30 years old (Arcadis, 2016) can be incorporated into the BIM environment.

One potential solution being pursued by HFS was the acquisition of a CDE for the use of the NHS Scotland Boards, so that at asset handover the Boards could centrally store the information generated in a structured and openly accessible depository that would be provided and maintained by the NHS itself. This would also serve as a Data bank of both project and operational information from across Scotland that could highlight lessons learned. However, even with the acquisition of a CDE, there is a great deal of work to be done in order to get the current data held, collated and organised in a manner that would make it of use. At this point there would also be a need to verify the validity of the information held, as there may be situations where the information is as designed or is of a previous iteration. During the research, it was said that this practice would only be the beginning of a process that would be likely be routinely required (every 2-3 years) once BIM is operational in FM to ensure that the information stored is current, up to date and most of all useful to those working with it.

As for the surveying and cataloguing of the existing estate, there is currently no strategy laid out or in development by the NHS as to how its Estates Departments will bring their existing estate into the BIM environment and are currently relying on the procurement of new assets to generate BIM information. While there are some examples of BIM models being produced for existing assets such as Northumbria University's program which saw the surveying and creation of a BIM model of its Newcastle campus (Open BIM, 2012), it was felt that the NHS would require an exemplar project, specific not just to healthcare, but to the NHS itself.

4.2 Embracing Technology

During background research, the FM industry literature alluded to the FM being in a position to adopt new technology into their methods of working and it was thought that from such reports as the BIFM's Embracing Technology to Move FM Forward (Ellison & Pinder, 2018) and Top Trends in Facilities Management (CBRE, 2017) that while adoption of technology was slow in the FM industry, it was nonetheless happening. It had seemed as if the FM was in a position to begin BIM integration into existing and emerging technology already using. In spite of this, during the interview process, it

became apparent that there was still a great deal of work to be done and progress to be made in the area of embracing new technology into their daily working. Teams reported running rather antiquated and inadequate systems which leaked resources, with paper-based systems still widely being used. It may be that there has to be a digital overhaul of FM similar to that mentioned in the BIFM report (Ellison & Pinder, 2018) before the full benefits of BIM can be felt. However, it is possible that the NHS does not entirely represent the whole FM industry but interviewees that had worked in FM in and out of the NHS for a number of years, did not indicate that there would be any great disparity between the two. The position that the NHS estates and the broader FM industry find themselves in could be the result of the vast amount of new technology available to them that could aid in the delivery of the multitude of services that they provide under the FM or Estates banner.

4.3 Organisational Structure

In the earlier research, it was established that there are subdivisions within the FM industry, mostly in the form of the hard and soft FM providers, and because of this, there are differences in the levels of ability and willingness to adopt BIM between the two. This situation is no different in the NHS while hard and soft services are grouped under the Estates Department, it makes they are no more integrated: they remain fragmented and sometimes even at odds with one another. It was said in interviews that the currently separated hard and soft elements of FM delivery should be combined. There may also be an argument to be made to better integrate the Capital Planning faction of the Estates Department, as they are currently the ones leading the BIM implementation in the NHS. This would feed better into such BIM components as the development of the EIR and the use of the GSL. In particular, the day-to-day running would benefit from greater collaboration and shared process and technology. In order to achieve this, it will be necessary for changes to be made to the organisational hierarchy and separation of the NHS Estates Departments, so that they lend themselves to greater collaboration and interworking between their various deliverables. However, as it stands, the nature of FM delivery within the NHS seems to provide an even greater barrier to the adoption of BIM.

4.4 The Standing of FM

There is an image problem that the FM industry and its professionals have long been enduring, the misunderstanding of what their role entails, often being referred to as ‘the people looking after the building’ which greatly falls short of the reality. Due to this, often FM professionals are being left out of key strategic decision-making processes, that affect them or where it may have been valuable to have their input. This problem was even apparent in HFS’s BIM Development Group which is primarily comprised of Capital Planning members of the Estates Departments, despite it being said that the group had always been developing BIM in the NHS with a view of implementation in the operations stage. The BIM Development Group is not the only example of this occurring in the NHS, there is also the lack of Estates Department members in the NHS Digital organisation, which was purposely created to discuss and develop the integration of new and emerging technologies into the NHS ways of working to improve efficiency and productivity. This further highlight just how the standing of the FM greatly impacts their ability to bring about change and adopt new technologies such as BIM. This issue is so embedded that many industry governing bodies, both in the UK and internationally, offer schemes to improve awareness and understanding about the work FM conduct. However, there is some reprieve in sight with businesses slowly realising the importance of their built assets (Institution of Civil Engineers, 2013) and how they can improve their core business through better use of their assets. In turn, it is hoped that this will also bring about better acknowledgement of what the FM industry can provide especially in terms of optimisation of an asset which would further the BIM agenda.

4.5 Funding and Capital

The availability of investment into development and adoption of BIM within the NHS FM will have a large influence on the capacity to adopt and to what degree that emerging digital technologies

can be incorporated into FM working. Throughout this research the possibility of the use of PFI as a catalyst for the adoption of BIM was explored: it was suggested that PFI did have the ability to integrate BIM into its contract and require FM providers to use BIM. The use of PFI to implement BIM in FM is dependent on two primary factors being achieved; the first being that NHS bodies procuring in this way must be confident in their ability to create a comprehensive specification outlining the desired use of BIM for FM over a prolonged period as PFI contracts normally last 20+ years (UK. HM Treasury, 2018). Secondly that any private sector company looking to take on the operations of such a project would have to realise the benefits of BIM use. It is likely that these hurdles could be overcome, however the use of PFI is likely cause backlash from the public, due to past endeavours (Moore 2018).

There is also the reality that any additional costs incurred by the private sector for the use of BIM or if they felt that they would hold a greater portion of the risk would result in this being accounted for in their tender and ultimately result in the NHS still paying more.

The capability to show ROI of BIM use in FM will be of vital importance when seeking capital investment from NHS bodies, since ROI will have to be included in a detailed business case that will be required as part of a proposal for NHS Boards. It must be remembered that the primary objective of the NHS is to provide medical care and funding will be prioritized towards achieving this. An option to stop this competition for funding between primary care and other activities, is to replicate NHS Property, which saw the creation of a separate private property company that is still owned by the public sector and oversees the development and maintenance of the NHS estates and guarantees fixed and regular funding (NHS Property Services, 2013).

4.6 The Mandate

One of the unforeseen upbringings was the sporadic application of BIM level 2 in the design and construction phases of NHS projects, with a number of participants highlighting that a variety of their recent and current projects had not used BIM level 2. It should be noted that while the UK BIM Mandate only came into effect as of 2016, the path to its instatement started back in 2011 with the GCS (2011). Nevertheless, the intention of applying it like this was to give public bodies time to adapt and equip themselves to be ready to apply in 2016 and great strides have been made towards this. However, it did become apparent in both the literature and research conducted, there is the question of what level of BIM should be applied to a project or sometimes if it should be applied at all. In Scotland, the Scottish Government have set themselves a project budget threshold of £4.32 million, any public procurement above this amount must be conducted in fully collaborative 3D BIM level 2 and anything below the threshold must perform an assessment to show whether BIM would be of benefit to the project (UK. Scottish Government, 2015). In doing this, there is the risk that BIM could be omitted from a project with relative ease in the name of cost of implementation and in turn leaving a gap in data of any future estate wide BIM model. It should be noted that it was suggested during the interviews that the lack of BIM or BIM level 2 on some projects was not entirely a result of strategic decisions made during the procurement but instead due to the adoption of BIM by the contractors, despite them having shown BIM competency in their BEP proposals during the tendering process. The issue of enforcing the mandate was a point that was highlighted by the NBS's National BIM Report (NBS, 2017) and during the interview series, both raising the question as to how the government would enforce the mandate and whether it would be required.

5. Conclusion

The process of implementation is still very much at the early stages and there will need to be a great deal of research carried out on the matter. However, if this is done now then it will allow for the groundwork to be correctly laid down for the future implementation. There are a number of barriers to implementation that the FM in the NHS must address if they are to fully adopt BIM into their asset management strategy: the updating of current systems such as CAFM or BMS to include new digital technologies that would complement and utilise BIM information; the reshuffling of the current Estates Departments divisions and hierarchy to all for greater interworking and collaboration between team members; the ability to show ROI is essential when seeking capital investment for BIM development

but it must form part of a robust business case to ensure that that it can contest against funding allocations for primary care objectives; and the education of a multitude of NHS staff members, ranging from the board members to frontline staff. Some of the obstacles that have been highlighted are already beginning to be addressed such as the issue of data storing and structuring, which is likely to resolved through the acquisition of a central NHS CDE, this in turn will likely raise the need for the existing assets to be incorporated into the system requiring a surveying strategy.

Over the course of the research, it was said on a number of occasions that the NHS would benefit greatly from a best case example and while there are projects that have incorporated such elements, none are in the NHS, and it was expressly stated that any example project provided would have to be in the NHS and even further, be specific to any one of the devolved nations' NHS. In the future we could see a number of very different responses to these current barriers in each of the NHS Boards and Trusts as a result of their autonomous nature meaning that they could end up taking contrasting approaches to BIM adoption.

An issue that not only the FM will have to address but also the AEC industries as well as legislators; is to ensure that the BIM level 2 mandate is being upheld and if not the options for enforcement. It is crucial that full BIM level 2 is continued to be applied to as many projects as possible now, so that the benefits of future adoption of BIM in FM can be felt.

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