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BIM manager, coordinator, consultant, analyst..., what does a confused AEC industry need?

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BIM MANAGER, COORDINATOR, CONSULTANT, ANALYST..., WHAT DOES A CONFUSED AEC INDUSTRY NEED?

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Abstract. The rapid growth of Building Information Modelling (BIM) in the Architecture, Engineering and Construction industries since its introduction around 2002 has highlighted a skills shortage within the industry whilst also leading to some confusion over the roles involved with BIM, particularly the BIM Manager. These factors can make recruiting the perfect BIM Manager difficult; especially with evidence also suggesting retaining personnel is a problem with many averaging less than two years per post before moving on. These issues are down to the industry having poor awareness of the skills and expertise BIM Managers can provide. This paper seeks to investigate the requirements for becoming a BIM Manager in terms of experience, training, skills and knowledge, whilst also assessing the different responsibilities between the various BIM management roles currently being used within the UK Construction Industry in order to clarify the current confusion.

The investigation employed two research techniques. First, a comprehensive literature review that reviewed BIM roles and responsibilities at both project and corporate levels, before examining the characteristics of what is required to work with BIM. Second, a quantitative research survey that involved extracting key information from 25 BIM related job adverts that were posted throughout this study. The extracted data was then analysed to determine what is expected of potential BIM Managers in terms of education, working experience and skills. By comparing the findings of the two research techniques, it was possible to define what it takes to become a BIM Manager, whilst also separating responsibilities between management levels.

The findings of this research culminated in defining a Project BIM Manager Job description/advertisement that responds to industry requirements. This job descriptor features the optimised role responsibilities at an SME alongside improved academic, professional and competency requirements that should lead to a higher quality recruitment process for employers.

Keywords: BIM Manager, Role, competency, job descriptor.

1. Introduction

Building Information Modelling (BIM) is a process for creating and managing the information on a construction project across the whole lifecycle, enabling much greater collaboration between all the parties involved. The concept of BIM has existed from the 1970s however, it

was not until the early 2000s that it started being further developed and used within the Architecture, Engineering, Construction (AEC) industries where it has since proved to be a valuable tool when properly utilised.

Due to this rapid rate of BIM adoption along with its complex nature and ever-increasing potential there is a severe skills shortage (BRE Academy, 2016b) which follows Smith and Tardif's (2009) statement "it is expected that the demand for highly skilled design specialists will outstrip supply over the next 20 years". Despite the skills shortage there has still been a host of specialised BIM related job titles created, such as BIM Modellers, BIM Analysts, BIM Facilitators, BIM Co-ordinators, BIM Consultants and BIM Managers to name a few (Barison & Santos, 2010) but there is no published guidance on the responsibilities related to these roles. Instead they have always been decided by the hiring company, which will be dictated by its area of expertise and size. With all these roles, and many more such as the Information Manager (CIC, 2013) and the Project Information Manager (BSI, 2013), there are inefficiencies in the industry from overlapping roles and confusion of who does what?

Over the last 17 years, BIM has been developing at a quick pace and has since reached a point in the UK where BIM level 2 is mandatory for all public sector projects from 2016 (Cabinet Office, 2011) whilst also becoming a preferred route for private sector companies as well (Philip, 2013). This means companies within the construction industry who wish to be involved in large-scale projects need to be BIM competent; however, the rush to get to that stage has left a cloud of ambiguity over BIM related job titles and the responsibilities associated to each.

Information published with regards to BIM roles and responsibilities can also be very generic (some purposefully for broader coverage) and therefore does not suitably cover the varying scales of businesses which has a large impact on the distribution of responsibilities within it. There is also insufficient guidance on the skills and competencies required to be a successful 'BIM Manager' which leads to skill shortages through lack of training, poor recruitment practices and potentially a high turnover in personnel.

An extensive literature review identified the following as clear gaps to fill:

- What should the roles and responsibilities be when using BIM and how does the size of the project and/or organisation affect this?
- How can competent individuals be identified for these roles and what experience and skill levels must they have?
- Do the current sources of BIM education provide sufficient levels of learning for individuals to enter the industry and, if not, what are the gaps?
- Should the project BIM Manager be hired independently by the client or are they best employed by the main contractor?
- Could project level BIM management ever become part of general project management responsibilities or should/will it always be a specialised area?
- Would regular built environment clients benefit from greater consistency in BIM role titles and responsibilities, such as increasing their understanding of the BIM Execution Plan (BEP)?
- How can industry recognised guidelines & definitions be put in place that separate the project model development BIM management roles and responsibilities with those responsible for the overall implementation and strategic management of BIM within an organisation?

- Where can industry codes and standards be improved to provide better guidance to all these questions?

The aim of this paper is to identify the key managerial roles and associated responsibilities required from a BIM professional on both a corporate level and an individual project in order to a better and clearer implement of BIM. This aim is set to be achieved through the following objectives:

- Provide a comprehensive review of the various roles, responsibilities and requirements associated with BIM projects within the UK Construction Industry;
- Distinguish between the various roles of BIM users, with a particular focus on management positions in order to determine their specific responsibilities on individual projects considering both SME and large organisations;
- Determine the requirements for becoming a BIM Manager in terms of experience, training, skills and knowledge;
- Assess different responsibilities between various BIM management roles currently being used within the UK Construction Industry;
- Collate the key findings of the research in order to provide guidance on the key managerial roles and the associated responsibilities.

2. Background

For the AEC industries, today's digital era means technology is now the ideal platform for creating, managing and storing their data. The introduction of BIM is one of the most important and promising developments for these industries because of the unique, effective and efficient collaborative approach it brings throughout each project lifecycle (BIM Task Group, 2013c; RICS, 2014; Ghaffarianhoseini et al., 2017; Lester, 2017).

To justify some of the true benefits of using BIM tools and processes, BIM enables immediate and accurate comparison of different design options (Ghaffarianhoseini et al., 2017), the parametric features enable systematic and simultaneous changes to all linked components. The details of the change, as well as the author, date and time are recorded enabling the design at any point in time to be rolled back to a previous configuration resulting in BIM having a very rigorous design change control system (Crotty, 2012). BIM can also facilitate various design and construction simulations such as the analysis and comparison of energy performance options to help managers reduce their environmental impacts and operating costs (Haines, 2016).

2.1. EVOLUTION NOT REVOLUTION

As of its introduction around 2002, BIM remains one of the most recent acronyms to appear within the AEC industries (Race, 2013) however the concept of BIM is not new with Eastman et al. (2008) referring to an article called "Building Description System" published in the now defunct AIA Journal by Charles Eastman in 1975. This article described elements and processes such as "interactive defining elements", "any change of arrangement would have to be made only once for all future drawings to be updated", "cost estimating or material quantities could be easily generated" and "contractors of large projects may find this representation advantageous for scheduling and materials ordering" – all of which are now

routine in today's BIM technology. Prior to this paper though, Barnes & Davies (2015) refer to the true origin of BIM as the emergence of Computer-Aided-Design (CAD) in the 1950's. CAD was originally seen as a fad that wouldn't catch on, but it soon became the standard tool to use in the AEC industries for creating drawings for all sizes of companies and projects (Crotty, 2012). Rutland (2017) and Suchocki (2017) have both reported similar short-term trend doubts have previously been cast about BIM but agree with McPartland (2016a) that BIM isn't a fad and will one day be business as usual just as CAD became.

The development of Bew-Richards' maturity wedge in 2008 brings more explanations of BIM concept not only within the UK but also across the world. There are several versions of that model, one of which is the version published in PAS 1192-2: 2013 (BSI, 2013). The maturity model is presented in figure 1 purely on four levels of BIM maturity.

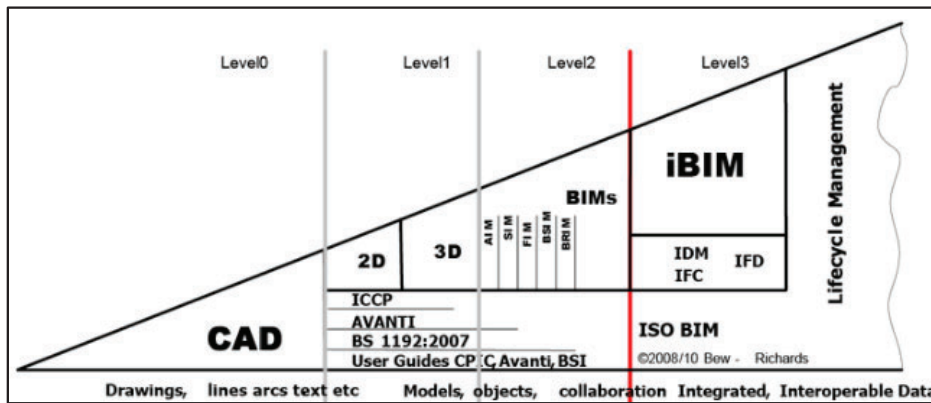


Figure 0.1. BIM maturity diagram (RIBA, 2012; BSI, 2013)

Within the UK, the Government have been one of the major drivers for the increase in BIM adoption. Their 2011 Government Construction Strategy (Cabinet Office, 2011) stated that the construction industry was lagging behind other industries in using digital technology, due to a lack of compatible systems, standards and protocols and the widespread requirements of clients and designers. It then went on to declare that the Government will require a fully collaborative 3D BIM (with all project and asset information, documentation and data being electronic) to be used on all public sector projects as a minimum by 2016 for the following reasons:

- The implications of alternative design proposals can be evaluated with comparative ease;
- Projects are modelled in three dimensions (eliminating coordination errors and subsequent expensive change);
- Design data can be fed direct to machine tools, creating a link between design and manufacture and eliminating unnecessary intermediaries; and
- There is a proper basis for asset management subsequent to construction.

Another key objective of the 2011 Government Construction Strategy was reducing capital cost and the carbon burden from the construction and operation of the built environment by 20% and BIM was central to this ambition due to its potential of allowing more efficient ways of working at all stages of the project life-cycle. To help achieve these objectives, the BIM Task Group was formed bringing together expertise from industry, government, public sector, institutes and academia (BIM Task Group, 2013a). As early as 2015, HM Government (2015) reported that their Level 2 BIM programme had already played a significant role in £840 million of savings in 2013/2014. Prior to the 2016 mandate, a suite of BIM standards was

developed as publicity available standards (PAS) to facilitate the implementation of BIM level 2 and lead to level 3 under the remit of the Digital Built Britain Strategy (HM Government, 2015). Furthermore, early adopter departments will be sought to help understand the full potential benefits of BIM Level 3.

Since BIM’s introduction in the industry, there have been several research papers and published books that have highlighted the benefits BIM can bring to the built environments design, construction and asset management stages. Table 1 summarises the benefits identified.

TABLE 1. Benefits of BIM from various literature sources

Author / Reference	Benefits of BIM
Alreshidi, Mourshed & Rezgui (2017)	<ul style="list-style-type: none"> - Workers have the flexibility to work from any location and still be heavily involved in the collaborative process. - BIM can be used with Cloud technology for portable access.
Eastman et al., (2008)	<ul style="list-style-type: none"> - Generate accurate and consistent 2D drawings at any stage of the design. - Automatic low-level corrections when design changes are made. - Identifying clashes in the design before construction. - Improved energy efficiency and sustainability. - Better manage and operate facilities.
Ghaffarianhoseini et al., (2017)	<ul style="list-style-type: none"> - Substantial technical advance on traditional CAD, offering more intelligence and interoperability capabilities. - Increases knowledge management by enabling more detailed information to be captured and developed in the design stage. - BIM is bringing standardisation benefits through quicker such as exchange standards allowing for better collaboration. - Optimised 4D planning and scheduling through integrated tools. - Visual verification of design intent and knowledge sharing through virtual design and construction increase the clients’ satisfaction levels.
Kubba (2017)	<ul style="list-style-type: none"> - Improved productivity due to easy retrieval of information. - Coordination of the construction reduces construction time and eliminates change orders. - 3D geometry fosters confidence in Prefabrication enabling higher quality, lower labour costs, and accelerated schedules. - Contractor and Subcontractors’ costs and risks are reduced. - Embedding and linking of vital information such as vendors for specific materials, location of details, and quantities required for estimation and tendering.
Lester (2017)	<ul style="list-style-type: none"> - Easier to work with a BIM model and to explore the building in 3D with rich information, than looking at hundreds of drawings and having to understand the industry drawing conventions. - Overall project cost savings.
Zou, Kiviniemi & Jones, (2017)	<ul style="list-style-type: none"> - Assist in early risk identification, accident prevention and risk communication.

On the other hand, the previous positive examples of BIM just discussed are not guaranteed on all projects involving BIM. There have been cases of ‘bad BIM’ caused by, amongst others,

contractual constraints, procurement problems and an under-skilled work force. Holzer (2016) compiled a list (Table 2) of common bad BIM pitfalls based on the responses from 40 of the world's leading BIM Managers about what has caused BIM projects to go wrong in their experience. Kubba (2017) also suggests a number of firms using BIM tools are unable to reap the benefits of their investment due to these pitfalls. To address such issues, Kubba (2017) states that it is “strongly recommended to bring on board a new professional with a special role specialising in the application of BIM technology, standards, modelling and who would also undertake the coordination needed in BIM contexts. Such a BIM Manager (the precise title of such a specialist is immaterial) would be an integral part of the project team and would be a small investment compared to the potential benefits”.

TABLE 2. - Examples of where BIM can go wrong (Holzer, 2016)

Bad BIM	Cause and Effect
Pseudo BIM	Those who use BIM tools simply to produce their 2D documentation more efficiently, but disciplinary coordination or data-integration opportunities are not considered as the geometry is being separated from the intelligent data attached within the models. This lack of information sharing (which is/can be another major issue in itself) can have severe effects on other project members.
No BIM Execution Plan (BEP) or Not Using it Properly	BEP's are an agreed way of working and sharing information therefore not adhering to or the complete lack of one reduces the chance for teams to work synergistically towards common BIM goals.
No Data Integration / Over-modelling	This is defined as either an over-focus on geometric modelling with little to no data attached or when the datasets are developed in parallel to existing BIMs meaning the two remain disconnected allowing for the possibility of misaligned data. Over-modelling with too much unnecessary detail can result in models being too heavy to use.
Lack of Well defined Client objectives	When clients request undefined or even over-specified goals, without an understanding of how the data will be generated, managed and used. This can lead to the project team second-guessing what is wanted.
Lacking tool Ecology	Trying too hard to resolve all design aspects within one model with one software platform whereas using a suite of tools with inter-operability would be a more efficient solution.
Model Inaccuracy	BIM models should be created with construction tolerances in mind however if the modelling is done by users with little knowledge about the specific trade it is unlikely to be considered which could lead to buildability issues on site.
Workarounds	Whilst workarounds can be important in achieving specific goals outside the suggested method, they can become too complicated and designed to only benefit the workaround author, which could negatively affect other authors down the line.

2.2 BIM AT A PROJECT LEVEL: ROLES & RESPONSIBILITIES

There are a number of different roles required to support a project that is utilising BIM. Wienerberger (2017) believes that the most important aspects to consider regarding BIM roles are that they are well defined and that the individuals in those positions are trained, competent and have the correct authority to carry out the role. Thoughts that are echoed by Barison and Santos (2011). People within these positions can have BIM orientated job titles such as a BIM

Modeller, BIM Analyst, BIM Facilitator, BIM Consultant, BIM Technician, BIM Coordinator, BIM Leader, BIM Information Manager and BIM Manager (Barison & Santos, 2010; Joseph, 2011; Mathews, 2015). Whilst other titles such as CAD draughtsman, Revit Modeller, Revit Coordinator, CAD Manager and VDC Manager are also being used (Mathews, 2015; Uhm, Lee & Jeon, 2017). It is important to note that job title is not the key aspect, as these can vary between companies, but it is the roles and responsibilities of each project team member (Uhm, Lee & Jeon, 2017). These should be relatively similar between companies as they are producing a comparable final output whilst following the same BIM focused protocols, codes and standards, especially for attaining BIM Level 2 (BRE Group, 2017).

Tables of agreed roles and responsibilities are normally included in the BIM Execution Plan (BEP) once a prospective supplier has been selected. The post-contract BEP template document available from the Construction Project Information Committee (CPIC, 2017), has a ‘role authorities’ table (Table 3) and also features a BIM model ‘responsibility matrix’ where someone is allocated to each of the aspects in table 4 for each stage of the project. It also indicates the software and file formats they will be using for added information.

TABLE 3. Role authorities table from the post-contract BEP template (CPIC, 2017)

Role	Authority
Project Information Manager	Enforce the Project BIM Standard and ensure delivery of the Information requirement in the EIR.
Lead Designer	Enforce spatial coordination
Task Team Manager	Enforce documentation standards
Interface Manager	Negotiate space allocation
Task Team Information Manager	Reject non compliant models, drawings & documents
CAD Coordinator	Enforce CAD related Project BIM Standards

TABLE 4 - Role authorities table from the post-contract BEP template (CPIC, 2017)

Model Authoring	Model Analysis
Space Planning	Brief Development
Site, Urban Design Context	Alternative Design Options Analysis
Site and Existing Buildings	Design Performance Analysis
Architectural Model	Sun and Shadow Studies
Structural Design Model	Structural Analysis
HVAC Design Model	Thermal Simulation
Building Services MEP Design Models	Sustainability Analysis
Lighting Design Model	LCA Analysis
Electrical Design Model	Model Clash Detection Rendition
Hydraulics Design Model	Cost Planning and Control
Interior Layouts and Design Model	Construction Scheduling / 4D Animation
HVAC Fabrication Model	Security Analysis
Structural Steel Fabrication Model	Code Checking and Regulatory Compliance

Curtain Wall Fabrication Model	Acoustic Analysis and Design
Road and Civil Design	Disabled Access and Egress
Landscaping and External Works Options	Fire Protection
Renovation and Refurbishment	FM, Operation and Maintenance
Facility Management Model	Automated/Linked Specifications
Construction Model	Heritage Documentation and Assessment
-	Solar Envelopes
	Over-shading
	Daylight Analysis
	Solar Analysis
	Photovoltaic Collectors

2.3 BIM MANAGER – A ROLE STILL BEING DEFINED

Knutt (2015) and Holzer (2016) both suggest that describing what BIM Managers do is a difficult task. As what was once associated with responsibilities for supervising BIM model development has now become associated with information management, change facilitation, process planning and technology strategies. However, due to the benefit they can bring, AEC companies are continuing to hire BIM Managers even though their precise function and responsibilities frequently require redefining due to the speed at which BIM is evolving (Knutt, 2015; Kubba, 2017).

Scott Chatterton (2015) is a BIM Manager who states “that when I joined my current firm a number of years ago as their first BIM Manager, my role was to develop standards and templates etc. and to maintain those standards, similar to the traditional role of a CAD Manager”. However, he goes on to highlight that as these standards, protocols and processes developed quickly over time his role naturally transitioned to tasks way beyond basic standards maintenance. As the firm’s BIM Manager, he has now implemented BIM processes and strategies that his BIM employees use to facilitate the BIM process throughout all stages of the project. His role as BIM Manager has progressed past the point of maintaining standards to now being responsible for all aspects of BIM throughout the firm. He adds that this is an evolution that never happened as a CAD Manager. Thus, it is not to say that CAD Managers cannot and should not be BIM Managers, it is just to highlight that, additional knowledge and training is required before the official switch in titles should be made (Light, 2013).

3. Methodology

Quantitative research is the primary approach used (UoB, 2017; Liu, 2015). Comparative analysis is focused around real published job adverts in order to determine employers’ sought requirements for a BIM Manager in terms of experience, training, skills and knowledge; and responsibilities that are expected of the BIM Manager role.

The focus on widely used employment website as listed in 3.1 below, instead of AEC specialist, for data sources is intentional. The rationale lies in the fact that some of the skills required for a BIM Manager may come from other disciplines beyond AEC such as IT, data management and manufacturing. Furthermore, a pilot exploration of job websites revealed that job adverts on AEC specialist websites also appear on the ones selected for better reach and

presumably in recognition that the skills sought may come from other unrelated disciplines and professions.

3.1 DATA COLLECTION

Job advertisements come in various forms, sizes and level of detail however, each should at least provide the information in table 5 for potential candidates to base their applications around.

The published job adverts are taken from the online job sites listed below and have been found by primarily using the search term “BIM” along with management titles such as “Manager”, “Leader” and “Director”.

- Indeed - <https://www.indeed.co.uk/> The #1 job site in the UK
- LinkedIn - <https://uk.linkedin.com/jobs/> The largest professional social network service
- Monster – <https://www.monster.co.uk/> A major UK job site.

TABLE 5 - Information typically found within a job advertisement

	Purpose
Job Title	When creating a job advert this is one of the most important things to get right. The job title should be clear, descriptive and concise in order to make it easier to find for those interested. For example, “Call Centre Worker” is more likely to be a suitable candidate’s search term than “Front Line Customer Support Facilitator”. (Mills, 2014)
Role Responsibilities	The main tasks the successful applicant will be expected to undertake. They should be related to the company’s business objectives so the applicant can envisage how the position fits into the company's plans. (Monster, 2017)
Person Specification	The minimum skills, competencies, qualifications and level of experience the applicants should have. (University of Kent, 2013)
Company Information	Relevant additional information.
Location	
Salary/Benefits etc.	

3.2 DATA ANALYSIS

Each job advert found using the data collection techniques described in Data Collection section had the key information listed in table 5 extracted and entered into a database on Excel which was used to collate information such as the various competencies and skills required.

A range of statistical analyses are then performed on the collated data with the outputs shown through a mixture of graphs and tables. These can be seen in the results and discussions section below.

4. Results and Discussions

A total of twenty-five current BIM related job adverts were reviewed and analysed during this research. A summary of the role being advertised and the employer is given in table 6.

The adverts were found using the search term “BIM” along with management titles such as “Manager” and “Leader”. Of the twenty-five adverts reviewed, ten were titled “BIM Manager” with the remaining fourteen all being unique titles as shown by the summary in Table 7.

Despite a relatively small sample size of just twenty-five adverts, the variation in titles highlights that BIM management titles are decided very much on a company basis rather than a standard/common approach.

TABLE 6. List of the job adverts reviewed in this research

Adv ert	Role Title	Company	Found On
1	Digital Engineering Manager	Balfour Beatty	Indeed.com
2	BIM Manager	Plowman Craven	Indeed.com
3	BIM Manager	WSP	Indeed.com
4	BIM Manager	Galliford Try	Indeed.com
5	UK BIM Manager	Jacobs	Indeed.com
6	BIM Model Manager	MACE	Indeed.com
7	CAD/BIM Manager	Unknown ¹	Indeed.com
8	Programme BIM Manager	Transport for London	Indeed.com
9	BIM Implementation Manager	Interserve	Indeed.com
10	BIM Manager	NG Bailey	Indeed.com
11	BIM Manager	Turner & Townsend	LinkedIn.com
12	BIM Manager	Trant Engineering	LinkedIn.com
13	BIM Manager	Unknown ¹	LinkedIn.com
14	BIM Technical Consultant Manager	Autodesk	LinkedIn.com
15	BIM Manager	Unknown ¹	LinkedIn.com
16	BIM Lead	Unknown ¹	Monster.co.uk
17	Regional BIM Manager	Unknown ¹	Monster.co.uk
18	CAD/BIM Lead	Aecom	Monster.co.uk
19	Principal CAD/BIM Manager	Aecom	Monster.co.uk
20	BIM Manager	Kier	Monster.co.uk
21	Head of BIM - Europe	Multiplex	Indeed.com
22	BIM Mechanical Manager	Unknown ¹	Indeed.com
23	BIM Manager	Waldeck Consulting	Indeed.com
24	BIM/CAD Regional Manager	Unknown ¹	Indeed.com
25	Information Manager	WSP	Indeed.com

Note: 1) Employer unknown as position is being filled through recruitment agencies.

A total of 29 responsibilities were considered from the literature review and compared with those set out in the twenty-five job adverts. The number of times each responsibility was deemed to match at least one from each advert is presented in Figure 2, with its total occurrences on Figure 3.

The most common responsibility, which was recorded a total of 39 times across 20 adverts highlighted the importance of ensuring all work is performed in line with the company’s own protocols. The creation and updating of these internal procedures were also found to be one of the most common responsibilities as it featured on 18 of the 25 adverts. Seven other responsibilities matched on at least 15 of the adverts indicating their importance in the sound management of BIM within a company. These include assisting in the creation of project BEPs, being responsible for staff training, providing technical assurance and keeping up-to-date with the latest BIM news and developments.

TABLE 7. Breakdown of the roles reviewed from the adverts

Title	Number of Adverts
BIM Manager	10 (40%)
BIM Implementation Manager	1 (4%)
BIM Lead	1 (4%)
BIM Mechanical Manager	1 (4%)
BIM Model Manager	1 (4%)
BIM Technical Consultant Manager	1 (4%)
BIM/CAD Regional Manager	1 (4%)
CAD/BIM Lead	1 (4%)
CAD/BIM Manager	1 (4%)
Digital Engineering Manager	1 (4%)
Head of BIM - Europe	1 (4%)
Information Manager	1 (4%)
Principal CAD/BIM Manager	1 (4%)
Programme BIM Manager	1 (4%)
Regional BIM Manager	1 (4%)
UK BIM Manager	1 (4%)

All 29 of the responsibilities were matched at least twice over the 25 adverts showing the wide range of tasks a BIM Manager can be asked to do. This agrees with the statements by Knutt (2015) and Holzer (2016) in Section 2.3 that it is now a difficult task to describe what a BIM Manager is, as what was once associated with responsibilities for supervising BIM model development has now also become associated with information management, change facilitation, process planning and technology strategies. To add to this, quite often job adverts will only state the main responsibilities associated with a role, this was the case for some in this research. This means, the number of occurrences recorded for each responsibility in this analysis should be considered as a minimum, as in reality the BIM Manager will be accountable for more than just the main responsibilities advertised.

After all twenty-five job adverts had been processed, the total occurrences of each responsibility and the number of job adverts which featured the responsibility was determined (Figures 2 & 3). This gives a good overview of what the industry is looking for, in terms of

requirements and responsibilities when hiring personnel for BIM management roles without going into the details of each role advertised.

The level of education results is shown in Figure 4, with experience in Figure 5. Education requirements were stated in 16 of the 25 adverts, indicating that for 9 employers the candidates' academic qualifications are not a decisive factor in their recruitment. However, this was found to be not the case for Multiplex, as their Head of BIM position requires potential candidates to have a minimum HND or Bachelor's degree in architecture, engineering or construction along with a BIM related MSc. This was the only request for a postgraduate level degree, whilst there were six adverts that required a minimum undergraduate level degree, seven for HNC/HND and three which specified an industry related degree is desirable but not essential indicating industry experience is of greater importance. These three adverts however, (by Plowman Craven, Galliford Try and MACE) do not properly define their expectations of experience; they instead state that candidates must have a background of working within the construction industry. This, 'appropriate level of experience in a relevant field' requirements matched with another 18 of the 25 adverts, potentially indicating that the majority of employers are unsure what experience level the role requires. However, another more likely reason could be that due to BIM still being a relatively new technology they are aware that very few people will have the 5, 10+ years' experience that is typically required for senior roles in other professions. Balfour Beatty set the most stringent experience requirements found in this research, as they require all Digital Engineering Manager candidates to have a minimum of five years' experience working with BIM technologies, a minimum of five years' experience working as a BIM/CAD Manager and a minimum of ten years' experience working in an Engineering/CAD environment. Two adverts (numbers 7 and 17) which were both posted through recruitment agencies gave no direct experience requirements, however they do state that candidates must have the ability to manage people and have worked with BIM technologies previously.

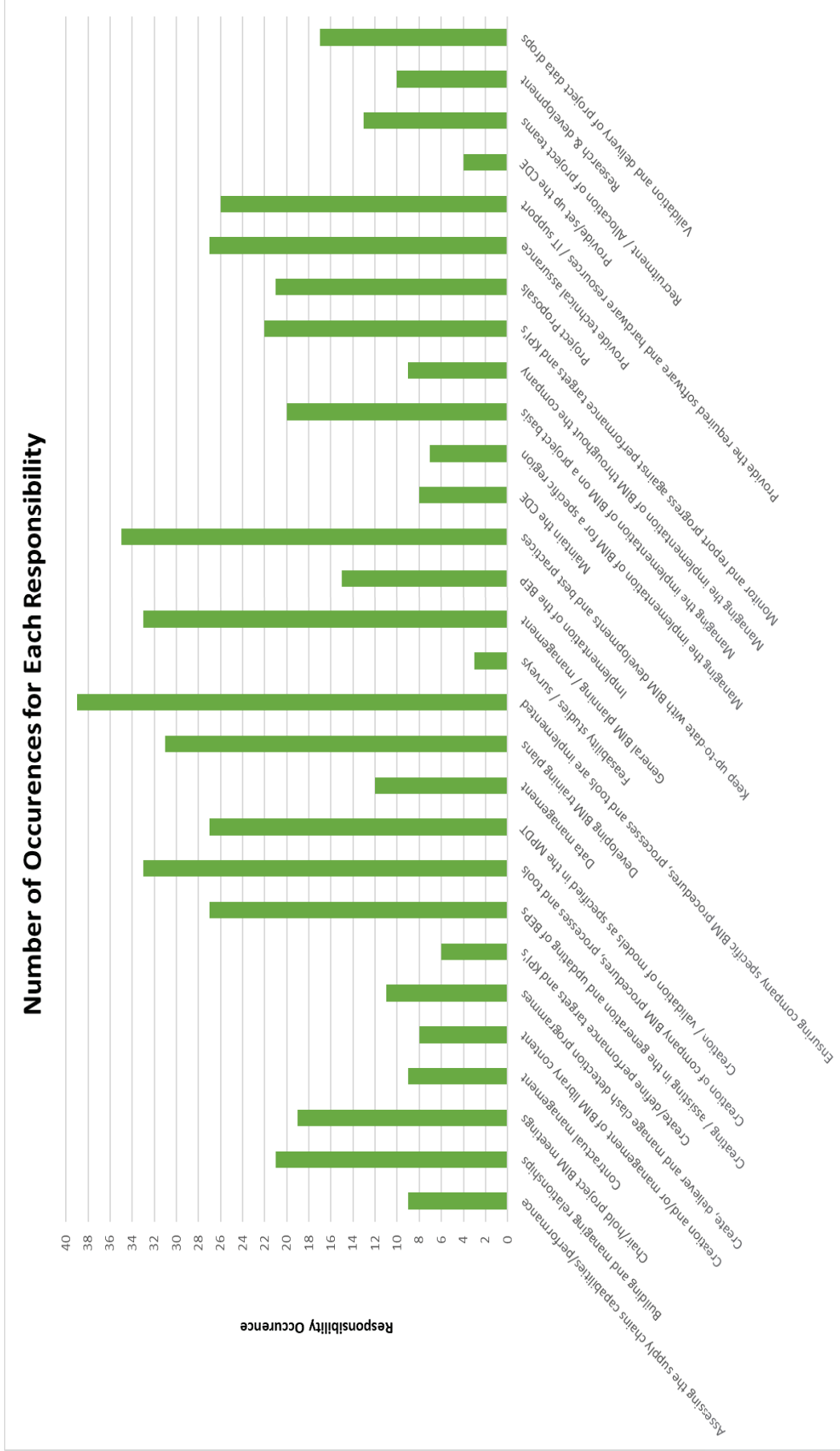


Figure 3. Total number of occurrences of each responsibility in all 25 job adverts

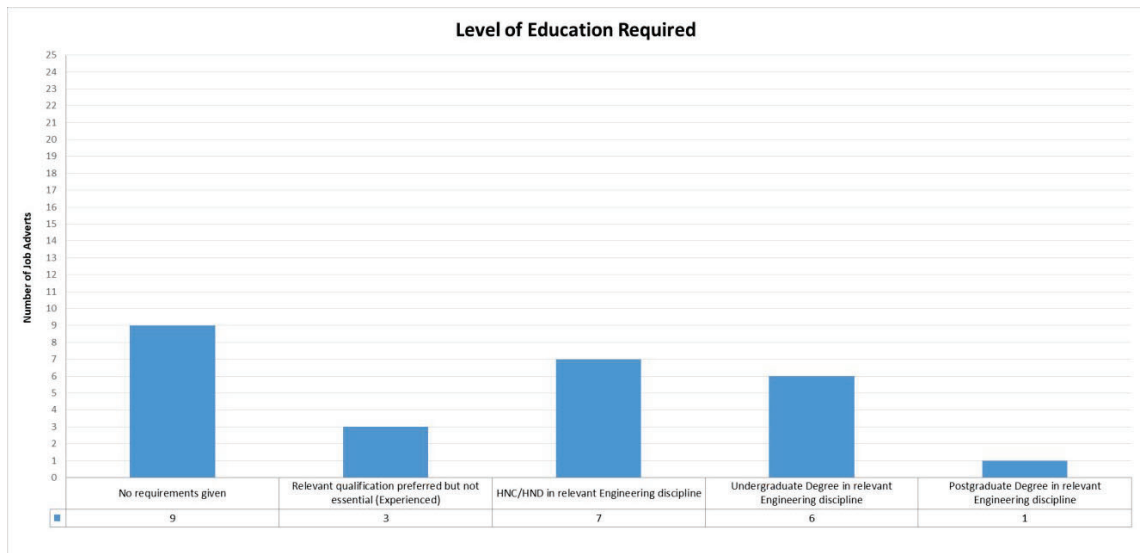


Figure 4 – Level of education required from the 25 job adverts processed

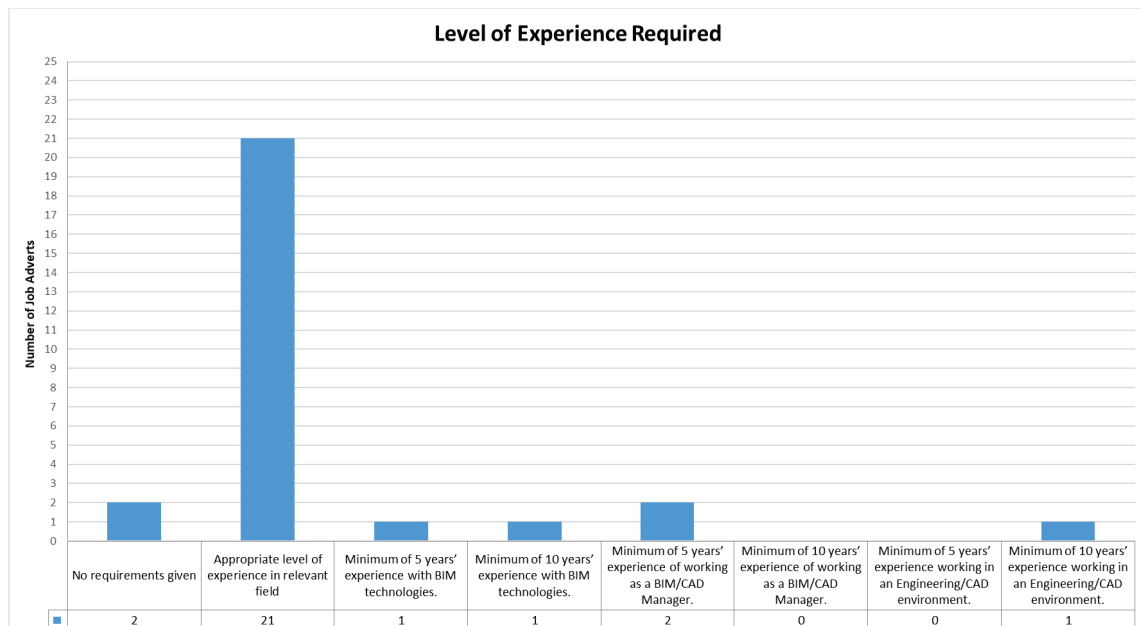


Figure 5. Level of experience required from the 25 job adverts processed

On the basis of information from reviewing the 25 job adverts alongside a comprehensive literature review, a full job description for a competent project level BIM Manager has been defined.

In terms of academic qualifications, they should ideally hold an undergraduate degree in a relatable subject such as architecture, engineering or construction. A postgraduate qualification related to BIM would also be extremely beneficial however, as the relevant courses are relatively new and still being developed, very few candidates will have this, therefore experience can be used instead. It should become an essential requirement in the future when courses have been refined due to closer links between the industry and academic institutions.

Previous experience as a BIM Manager shouldn't be essential when hiring a Project BIM Manager because the skills and knowledge can be found in other BIM users who have had a good amount of exposure to the technology and way of working. Therefore, it is suggested a minimum of 5 years' experience working with BIM technologies along with a minimum of 5 years' experience of working in an engineering/CAD environment would be sufficient industry experience for the role.

A BIM Manager must have a strong range of technical, contextual and behavioural skills and attributes. They need to have knowledge of building designs and the engineering required along with the specialist software packages that are commonly used. Interpersonal skills, like teamwork and leadership are also very important for BIM Managers, as well as the ability to manage resources and projects effectively. Personal attributes such as being self-driven and motivated alongside a genuine enjoyment of the profession is also required for the company to reap the rewards of having a BIM Manager. Results of the ‘person specification’ i.e. the requirements of technical, contextual and behavioural skills/attributes are presented in figures 6, 7 and 8 below:

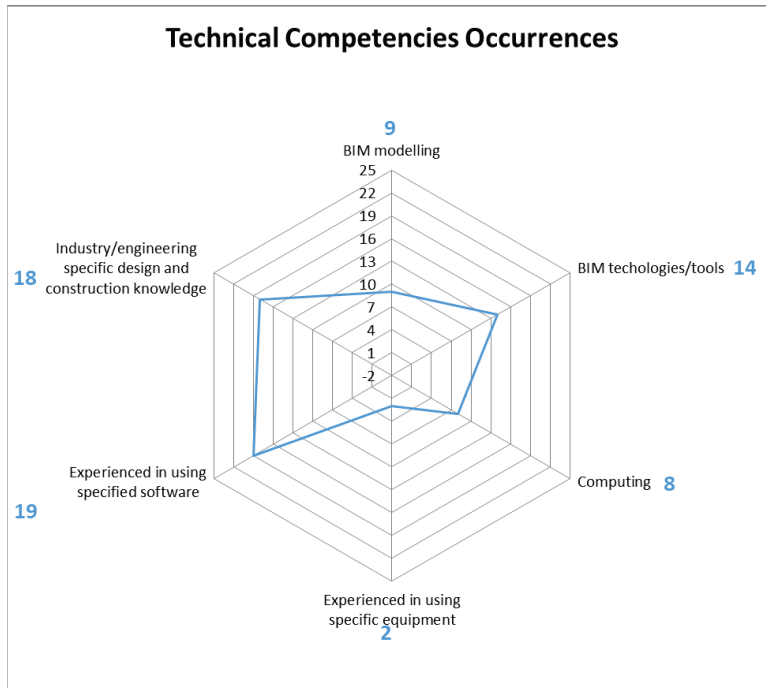


Figure 6. Technical competencies required from the 25 job adverts processed

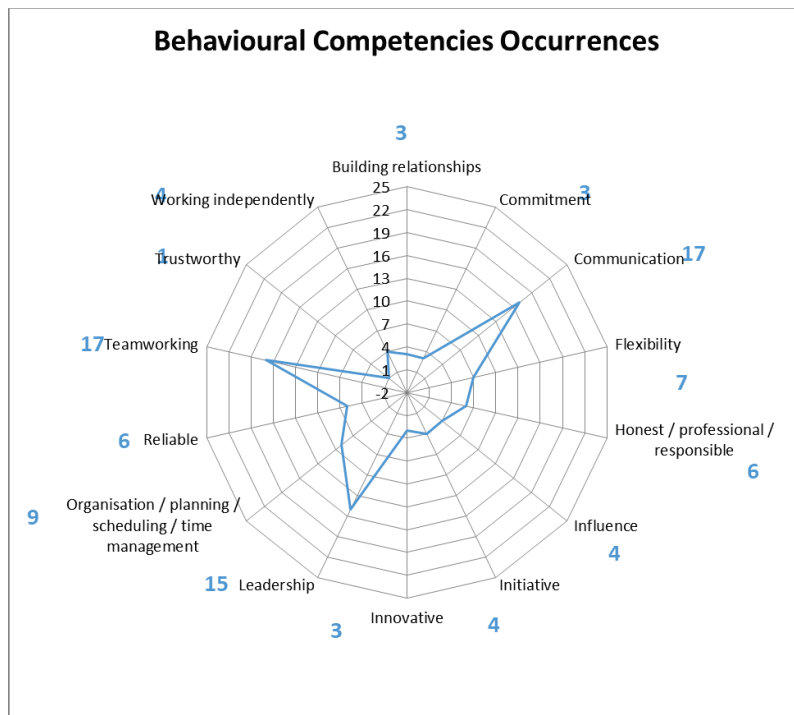


Figure 7. Behavioural competencies required from the 25 job adverts processed

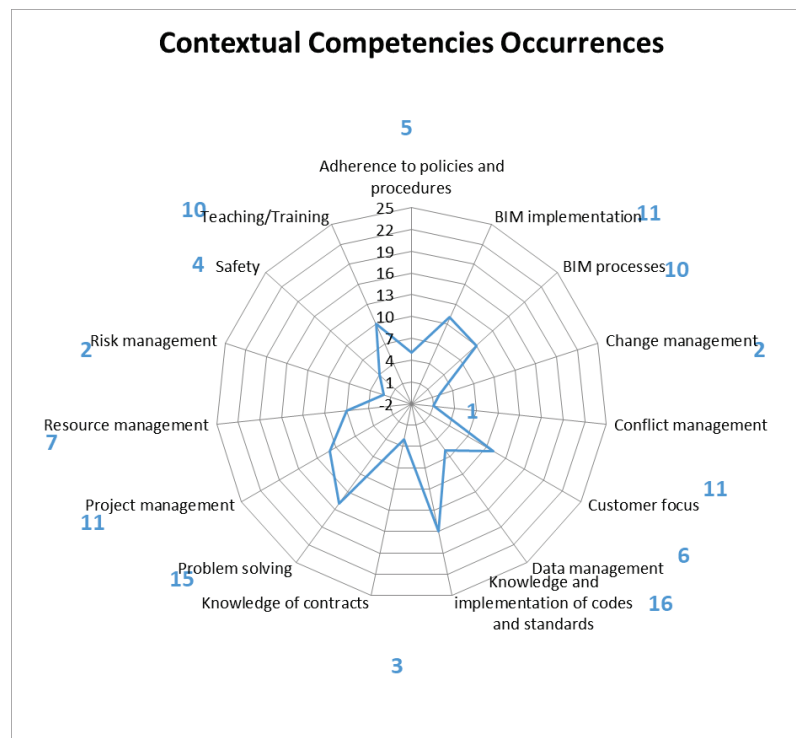


Figure 8. Contextual competencies required from the 25 job adverts processed

A full job description/advert for a Project BIM Manager has been created and is shown below:

Title: Project BIM Manager

Role Summary: Reporting to the BIM Director, the Project BIM Manager will be responsible for the day-to-day management of small project teams ensuring the successful delivery of BIM orientated client projects.

Responsibilities:

- Actively contributing to the development and improvement of company BIM processes and protocols.
- Building and managing relationships with all project stakeholders.
- Carry out multi discipline clash detection reports, and contribute to clash detection meetings and solutions.
- Chair BIM orientated meetings to discuss specific areas of the project.
- Checking and approval of the required drawings and 3D models (as specified in the MPDT) prior to model federation and handover to the client.
- Contribute and collaborate with technical personnel for developing and implementing new/future technologies.
- Day-to-day BIM support.
- Defining staff development areas and programs and providing ongoing feedback, training and development.
- Ensure all project data is correctly established and maintained in accordance with company standards and project requirements.
- Ensuring handover compliance through correct data seamlessly transferred at the correct project stages.

- Evaluate and make recommendations regarding BIM software. Ensure the hardware has sufficient capabilities. Acting as a technical interface with IT support services.
- Implementation of company BIM processes and protocols on all work for quality control and assurance.
- Keeping up-to-date with the latest technology and how it's used.
- Lead the delivery of BIM deliverables for a project.
- Management of the company's internal BIM library ensuring all content meets British Standards requirements.
- Provide guidance on any technical and process issues associated with the BIM delivery.
- Representing the company at industry events and conferences.
- Resource management through assisting with the appointment of design teams on BIM projects including the recruitment of new personnel.
- Responsible for all things BIM in the tender stages.
- Review and report on progress against company and project specific targets and KPI's.
- Set up and maintain the CDE in the absence of a dedicated Information Manager.
- Sharing knowledge, experiences and lessons learnt.
- The implementation and maintaining of Project BIM Execution Plans (and EIRs) to ensure the company fulfils its deliverables to the required quality.
- Understand the company's contractual obligations on a project particularly in reference to model ownership and transfers.
- Working with clients to determine/understand their requirements and define the company's methodology within a BIM Execution Plan.

Demonstrable Knowledge, Skills and Competencies:

Technical

- A solid grasp of all aspects of civil, structural and building design with the ability to advise on and challenge design details, concepts and solutions.
- BIM Modelling: Experience in the preparation, use, interrogation and validation of BIM models and drawings.
- BIM Technologies/Tools: Working knowledge of BIM technologies such as the setting up and maintaining the CDE, clash detection, model federation and using 4D construction scheduling.
- Computing: Must be IT literate and a proficient user of Microsoft packages. Programming knowledge would be beneficial.
- Proficient in the use of at least one of the common industry CAD and BIM design software packages such as Autodesk (Civils 3D, Revit, Plant 3D, Navisworks), Bentley (MicroStation, Bentley View), Teckla, Aveva PDMS etc.

Contextual

- A clear understanding of Building Information Modelling and its benefits to the built environment.
- Ability to balance resourcing requirements to deliver various projects.
- Ability to explain and provide guidance to less experienced project members to aid their development.
- Be able to resolve issues in a timely manner.
- Builds relationships with internal customers, external suppliers and support teams.
- Commercial and financial acumen.

- Familiar with applying BIM Standards in accordance with UK best practice (Chiefly BS 1192:2007 and PAS 1192-2:2013 standards).
- Strong organisational and analytical skills with the ability to manage multiple projects and priorities simultaneously.
- Working knowledge of engineering contracts, preferably NEC3.

Behavioural

- Ability to communicate effectively, both orally and in writing, with people at all levels across the organisation and externally.
- Ability to lead teams and influence people at all levels across the organisation, to drive true change.
- Ability to use time productively and work under pressure.
- Able to work effectively both individually and enjoy contributing to the wider team to achieve targets and objectives as required.
- Driven to achieve results and goals, both personally and on projects.
- Flexible attitude to work and showing a willingness to take on additional responsibilities.
- Professional appearance and manner.

Experience Required

- Minimum of 5 years' experience with BIM technologies.
- Minimum of 5 years' experience working in an Engineering/CAD environment.

Academic Qualifications Required:

- Undergraduate degree related to the built environment such as architecture, engineering or construction (essential).
- Postgraduate degree related to Building Information Modelling (desirable).

Additional Requirements

- Member of a relevant professional organisation with the ambition to achieve Certified/Chartered BIM Manager status.
- Willing to travel and represent the company at BIM industry events.

5. Conclusions

The rapid growth of BIM since its introduction around 2002 has highlighted a skills shortage within the industry whilst also leading to some confusion over the roles involved with BIM, particularly the BIM Managers. A lack of understanding of the role has led to poor recruitment practices and a high turnover of staff therefore this study aimed to provide guidance on the responsibilities of a BIM Manager and the requirements to be one.

A thorough literature review was performed covering key areas such as BIM related roles and responsibilities especially at project level, the skills and competencies required to work with BIM. Additional quantitative research was performed through a job advert analysis. A total of 25 BIM Manager (or similar) job adverts were reviewed, all of which were 'live' during this research so the requirements are a true representation of the current industry requirements.

Considering the findings from both parts of the research a detailed description of a Project BIM Manager was created. An HNC/HND is a sufficient academic qualification to apply for 76% of the job adverts reviewed. However, the literature review revealing a current skills shortage from education not producing enough suitable candidates it is recommended that

companies become more stringent and escalate their academic requirements to a minimum undergraduate degree related to the AEC industries whilst highlighting a postgraduate qualification relating to BIM would be a serious advantage. Academic institutions and the industry need to form closer links so the current BIM related courses could be refined so fresh graduates are suitably skilled for entry-level roles straight away.

Concerning experience, the results show that most employers are requesting candidates have an ‘appropriate level of experience in a relevant field’ rather than specific requirements such as 10 years+ as a BIM Manager. It was discussed that this is most likely due to BIM still being a relatively new tool which is now only just beginning to be the ‘norm’ for built environment projects. This means there will not be many candidates who have 10+ years of experience in a similar role. Therefore, based on the research it is suggested that personnel with 5+ years’ experience working with BIM technologies and in an engineering/CAD environment will have developed sufficient skills and knowledge to become a Project BIM Manager at a SME where the project teams will be smaller. All current and future BIM Managers should be encouraged to complete an accredited scheme to become a Certified BIM Manager as this demonstrates one’s abilities, competence and knowledge to both employers and clients.

In terms of responsibilities, a distinction has been made between those of the Project BIM Manager and those of more senior personnel such as a BIM Director. Essentially the corporate BIM management roles are the strategists whilst those at the project level are in the trenches doing the work and recording their performance against targets and KPIs.

The aim of this research was to identify the key managerial roles and associated responsibilities required for the successful implementation of Building Information Modelling (BIM) on both a corporate level and on an individual project basis. This has been achieved through the set objectives. However, there has been a greater emphasis on the project level roles, responsibilities and requirements so future studies could be performed to look into the corporate side in greater detail.

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