

2019-05-25

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BIM TUDublin
bim@tudublin.ie

Trina Turner
Technological University Dublin

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Recommended Citation

Turner, T. (2019). *A critical appraisal of the potential for public works contracts' and design-build clients in Ireland to leverage benefits from BIM processes*. Capstone Report. Dublin: Technological University Dublin. doi:10.21427/yeak-0e65

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A Critical Appraisal of the potential for public works contracts' and design-build Clients in Ireland to leverage benefits from BIM processes

Trina Turner^{1 2}

School of Multidisciplinary Technologies,

Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland.

E-mail: ¹trina.turner1@mydit.ie ²D11123076@mydit.ie

Abstract – The zeitgeist of the Irish Architecture, Engineering, Construction and Operations (AECO) Industry is digital construction and collaborative processes. However, Clients don't know what they want from BIM, and are confused about how to get what they need. This paper critically appraised the potential for public works contracts' Clients to leverage the benefits from BIM processes. Key stakeholders were interviewed to establish where possible barriers and issues arise in order to enhance Client engagement throughout the capital/ delivery and operations phase of the built asset. A Toolkit, derived from the Literature Review, was investigated by the interviewees. This detailed research resulted in 4 Key Insights: (1) Improved Education & a BIM online portal to be provided by the Government; (2) The urgent revision of GCCC/CWMF Public Works Contracts to include reference to BIM technologies, standards and processes, and include confirmation of Client ownership of the BIM Model; (3). A new role of Client BIM Consultant, to be included in the Mandate from Government; (4) The requirement of a BIM Mandate for Ireland in order to drive engagement. It is proposed that the implementation of the 4 Key Insights will enable Clients to leverage the benefits of BIM would result in better outcomes on Public Works, in the short, medium and long term for all Stakeholders.

Keywords – BIM; Benefits; Client; Engagement; Barriers; Solutions/Toolkit.

I INTRODUCTION

The zeitgeist of the Irish Architecture, Engineering, Construction and Operations (AECO) Industry is digital construction and collaborative processes. This industry has emerged from the worst recession in living memory and is currently undergoing the global transition towards an information revolution. BIM is a structured process which ensures a building is delivered as efficiently as possible and can drastically reduce the detritus prevalent in the Irish AECO Construction industry.

The Winfield Rock Report (Winfield & Rock, 2018) contests that innovation and change are critical to leverage radical efficiencies and improved productivity across the entire asset life-cycle. Building Information Modelling is at the heart of digitisation which is spearheading a transformation of

the built environment, enabling the creation of a space where digital and physical assets interact (Philp, 2016).

This research will ascertain how to leverage the benefits of BIM for Clients on Capital Works Management Framework (CWMF) / Government Construction Committee Contract (GCCC) public works contracts and design-build contracts in Ireland. Would better Client engagement in BIM processes on public works and design build contracts in Ireland leverage benefits for the Client, Stakeholders and end-users of the built asset?

In the United Kingdom, despite the legal mandate of BIM Level 2 introduced in April 2016, a recent survey carried out by BIM+/CM found that 'only 38% of centrally-funded government

clients made BIM a requirement on all of their projects' one year after the mandate for Level 2 BIM on public-funded projects was introduced (Chevin, 2017).

The major benefit of Building Information Modelling is that it enables us to build the building twice- once virtually, where all the clashes and construction issues can be resolved- and then flawlessly in the real world (Philp, 2016). This ensures cost savings, both in terms of accurate quantities, and projected operational savings. The BIM model can also facilitate enhanced safety during the construction phase and into the operations phase.

This research will critically investigate what barriers exist, if any, to Client engagement with BIM processes, and where and why they occur. Following in-depth analysis of these barriers, a set of solutions, referred to as a Toolkit, will be proposed for discussion with selected stakeholders of the AECO industry in Ireland. It is hoped that the Toolkit could assist with driving the adoption of BIM in Ireland. Due to time-constraints the research could not include longitudinal or cross-sectional analysis, however, previous research by professional bodies/institutes and other reliable sources has been incorporated.

II & III RESEARCH OBJECTIVES & ALIGNED METHODOLOGY

- **Objective 1:** Critically appraise the current state of Client engagement with BIM processes on public works and design-build contracts in Ireland.
- **Research methodology:** Qualitative methodology comprising interviews with selected stakeholders of the AEC industry in Ireland including CitA BIM Information Capability Programme (BICP) researchers, in addition to critical assessment of the literature including existing publications and annual surveys by CitA, Engineers Ireland, RIAI and others.
- **Objective 2:** Critically examine the barriers to Client engagement in BIM processes and evaluate why these barriers occur.
- **Research methodology:** Interviews with stakeholders and critical analysis of the literature.
- **Objective 3:** Perform a gap-analysis between BIM process requirements from Clients and Clients current ability to engage, with particular emphasis on the Organisation Information Requirements (OIR) Asset information Requirements (AIR), Employer's Information Requirements (EIR) and BIM Execution Plan (BEP).
- **Research methodology:** Structured interviews with various stakeholders of public works contracts in Ireland: including advocates/ proponents and opponents of BIM technologies on public works and design-build contracts, and synthesis with existing publications and journals.
- **Objective 4:** Propose a definitive set of solutions, or Toolkit, for better Client engagement in BIM processes on public works and design-build contracts in Ireland.
- **Research methodology:** Thorough critical assessment all previous findings.
- **Objective 5:** Evaluate the set of solutions suggested to enable better Client engagement in BIM processes on public works contracts in Ireland to enable the maximum benefits of BIM to be leveraged by the Client.
- **Research methodology:** Evaluate with each of the interviewees the proposed set of solutions, the Toolkit, for leveraging the maximum benefits of BIM for the Client on public works contracts in Ireland.

IV LITERATURE REVIEW

The scope of published research in the area of Client engagement in BIM processes is limited in an Irish context, and research from other countries where BIM is more established will be employed.

Eadie, Browne, Odeyinka, McKeown, & McNiff, (2013) suggest that substantial impacts may be achieved through BIM implementation throughout all stages of the construction process. Murphy (2018) contends that it is only in last 12 or 18 months that there has been any real engagement (by Clients in BIM) "without them fully understanding what it is about". Ghaffarianhoseini et al., (2017) suggest that despite major technical advancements in BIM, it has not been fully adopted and industry stakeholders have not fully capitalised its definitive benefits. The lack of widespread uptake of BIM appears to be linked to risks and challenges that are potentially impeding its effectiveness (Ghaffarianhoseini et al., 2017). These risks and challenges will be discussed in the

Barriers section of the paper, and also evaluated in the qualitative analysis section.

Despite the introduction of the Digital Strategy 2021 (2017) Ireland has yet to mandate BIM, and BIM adoption rate in the AEC sector is relatively slow. A Public Sector BIM Adoption Strategy questionnaire was recently circulated to relevant stakeholders in the Irish AEC industry by the Office of Government Procurement. One of the questions posed requested the respondent to outline the obstacles that exist to the successful adoption of BIM in the construction sector. Clients need to be convinced of the benefits of BIM, but Guthrie attests that “clients still do not understand what they are asking for or what BIM is. The majority don’t have any idea and basically see BIM as a cost” (Chevin, 2017).

In Ireland, the Digital Roadmap 2021 (Irish Government, 2017) aspires to attain a 20% reduction in the initial cost of construction and the whole life cost of built assets, 20% reduction in the overall project delivery time, 20% increase in construction exports. BIM is an integral part of achieving these goals, and these benefits would apply to Clients on public works contracts in Ireland.

2021 - Key Roadmap Performance Targets

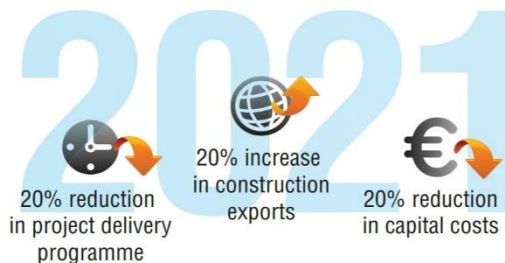


Fig. 1: NBC Digital Roadmap 2021 Key Performance Targets. These indicate the benefits from digital construction and BIM.

Wong & Fan (2013) assert that the pursuit of sustainability has become a mainstream building design objective. Building information modelling (BIM) has the potential to aid designers to select the right type of materials during the early design stage and to make vital decisions that have great impacts on the life cycle of sustainable buildings (Jalaei & Jade, 2015). In regard to Health and Safety, (Wetzel & Thabet, 2015) suggest a BIM-based framework to support safe maintenance and repair practices during the facility management phase, through safety attribute identification/classification, data processing and rule-based decision making, and

a user interface. This is a major benefit to the Client on public works contracts as the necessary parameters for sustainability, energy-rating and lean construction can be embedded in the BIM model, and this ensures compliance with the relevant statutory legislation.

Clients also benefit from early synchronization of designs, synchronization of design with construction, and enhanced building performance through analysis/simulation resulting in the delivery of comprehensive data at project completion. BIM enables improved outcomes to public sector Clients providing buildings better aligned to the Client’s needs, and the company’s image/brand, which are built quicker and cheaper. However, the most important benefit to the Client is certainty, because collaborative BIM results in reduced risks to the Client (Montague, Slattery, Mockler, & Adlem, 2015). Collaborative working results in minimal re-working, as clashes are identified and resolved within the federated model, saving both time and cost and reducing waste. In addition, integrating the management of information across the longer term activity of asset management with the shorter term activity of asset construction for a portfolio of assets should deliver real savings (BSI, 2014).

Mcauley, Hore, Kane, & Fraser, (2015) suggest that a more collaborative approach to the public works contract in Ireland is required. Roberts, Blundell, Dartnell, & Poynter-Brown, (2016) suggest that collaborative working is not merely a vehicle for cost reduction, but more significantly, a structured means of enhancing team performance and value-added returns from investment in construction. (Eadie et al., 2013) contend that collaboration aspects of BIM produce the highest positive impact, and suggest that the process aspects are more important than the software technology. The federated BIM model becomes an as-built Asset Information Model following handover, which, if maintained, will provide an invaluable tool for the operational phase and throughout the lifecycle of the built asset.

Why then, are Clients not insisting on BIM? (Moore, 2015) contended that education is needed for clients to better know their requirements, and for them to demand that projects are completed to a BIM standard. The Transformative Power of BIM (Gerbert, P., Castagnino, S., Rothballer, C., 2016) identifies the significant savings to be realised from digitisation, and the Boston Consulting Group Report (2016) identifies that full-scale digitisation of construction projects could lead to cost savings of 13-21% in the design, engineering and construction phase, and 10-17% in the operations phase. However, a possible barrier to Client engagement in BIM may

be that there is no clarification of who is making these savings? Is it the Client, the contractor, the design Team or the end-users? The Client ultimately wants to know how he/she will directly benefit by employing digital construction and BIM.

Another barrier may be that Client does not adequately identify what they are looking for in the OIR, AIR, EIR and BEP. The Organisation Information Requirements (OIR) relate to the entire portfolio a large Client may have, and is a document which should set out what is required at a strategic level for all of the assets e.g. sustainability, LEED rating, carbon footprint etc. The Asset information Requirements (AIR) relate to the specific single building or asset the Client wants to build, and will include the design brief. Both of these documents are incorporated into the Employer's Information Requirements (EIR), which then informs the BIM Execution Plan (BEP). The EIR is a very important document, and Clients need professional advice to draft this document to ensure all their requirements are met. Montague (2017) asserts that the independent and impartial advice of a BIM consultant on a project, can significantly assist client organisations who do not have the knowledge and skills to properly ask for BIM, to defend or counter any reasons they are given not to use BIM, or to know that what they are receiving is a proper BIM service. (Wallbank, 2015) contends that the appointment of an Information Manager should take place on all Level 2 BIM contracts, and this appointment is often taken as an additional responsibility for an existing contributor (usually the Lead Designer or Architect) rather than a separate consultant. (Mathews, 2015) suggests that additional roles for the BIM process may be required, and this Capstone will ascertain whether a new BIM Information Consultant role, directly appointed by the Client, working exclusively on behalf of the Client and independent from the design team, will enhance the BIM process and drive significant improved outcomes for the Client on a large public works contract in Ireland.

The GCCC CWMF Public Works Contracts

There are ten forms of Contract for Public Works, each for different purposes: PW-CF1 up to PW-CF10 (*Capital Works Management Framework Guidance Note Introduction to the Capital Works Management Framework GN 1.0 2 Introduction to the Capital Works Management Framework Document*, 2009). These contracts are prepared by the Government Contracts Committee for Construction (GCCC). PW-CF1 relates to Building Works designed by the Employer, and uses the Traditional Contract type. PW-CF2 relates to Building Works designed by the Contractor, and uses the Design-

Build Contract type. These are the contracts pertinent to this Paper.

The development of the Construction Works Management Framework (CWMF) was introduced expressly to reform construction procurement in the public sector. The strategic objectives of that decision were: Greater cost certainty at contract award; Value for money; More efficient delivery of projects; To ensure as far as practicable that the accepted tender prices and the final outturn costs are the same; and to allocate risk so that there is optimal transfer of risk to the Contractor. The public works contracts are fixed price contracts, where the risks of added costs (e.g. inflation, costs of materials or labour etc.) is borne by the Contractor. In Design/Build & PPP projects, BIM will help support early contractor engagement to help influence the long-term asset management, through better information and analysis.

The Public Works Contracts make no reference to BIM. The Public Works Contracts are structured in a way that means they cannot be amended at all, and nothing can be added to them. In practice, the CIC BIM Protocol is attached to the Public Works Contracts for projects requiring Level 2 BIM, but there is no direct reference to BIM in any of the actual contract documents. The Office of Government Procurement is currently reviewing the contracts in relation to their BIM Strategy, however, they have not made any announcements or publications in this regard.

The Digital Strategy was written to inform the Irish Government but has not yet been officially adopted as yet by any Department, which means that it has not been funded. Therefore, the target actions set out in the plan have not been achieved.

V QUALITATIVE ANALYSIS & SYNTHESIS OF INTERVIEW FINDINGS

In order to ascertain the current 'real world' situation, a number of structured one-to-one interviews were completed. These interviews included clients, architects, main contractors, and stakeholders specifically chosen to obtain a 'fully rounded' picture of client engagement in BIM processes on various PPP and design-build projects. Many of the interviewees worked together on the same projects but in different roles, and were specifically chosen so that the findings would reflect different perspectives of BIM on the same project. In this way a 'rounded' investigation of the barriers, gaps and issues were explored, and the Toolkit, or set of proposed solutions, which had been derived from the Literature Review could be evaluated and

interrogated by each interviewee. In this way the final proposed Toolkit would propose tangible solutions for leveraging the benefit of BIM for Clients on public works and design-build contracts. All interviewees were anonymised in order to protect both their identity and confidentiality. Each interviewee was presented with the same questions relating to the objectives of the research, and some additional questions tailored specifically to each interviewee. The proposed Toolkit, which had been derived from the Literature Review, was also provided in advance of the interviews to allow the interviewee to prepare and with the intention of garnering valuable insight into current commercial practices. Fourth generation analysis (Guba & Lincoln, 1989) was also employed with all interviewees asked to comment on pertinent findings (anonymous) from previous interviews.

The interviewees were as follows:

1. BIM Manager 1: A BIM Manager and Project Architect at one of the leading main contractors that actively uses BIM on projects.
2. Architect 1: A Company Associate Architect and Software Developer at a major design office that actively uses BIM.
3. BIM Manager 2: A BIM/ Information Manager at major Government Mixed Use Development Agency.
4. Solicitor 1: A senior solicitor specialising in Irish Construction Law.
5. Client 1: A Sector Head & Development Director, PPP Programme Manager at a Government Development Agency.
6. Client 2: Head of Capital Projects & Planning of a Major Government Campus.
7. FM Consultant 1: A Director of Property and Facilities Management Agency.
8. Architect 2: An experienced architect from a city Local Authority.
9. BIM Manager 3: Digital Construction Manager at a Tier 1 main contractor that actively use BIM.

In addition, David Philp was interviewed in order to gain insight into what Ireland can learn from the British experience of BIM implementation and engagement. David Philp is Global BIM/IM Director of Construction Institute of Building (CIOB) and a high-profile advocate of BIM.

It proved a Sisyphean task to get responses from the proposed interviewees for a 'negative' perspective i.e. a client who does not want, or refuses, to engage in BIM processes. The author has been told

anecdotally that there is resistance, but found no-one willing to speak against the corporate stance of 'we are a progressive company/body engaging in modern digital procurement processes'.

As outlined in the Literature Review, Architect 1, Client 1, BIM Manager 1 and Client 2 identified the fact that the Public Works Contracts make no reference to BIM. In practice, the CIC BIM Protocol is attached to the Public Works Contracts for projects requiring Level 2 BIM. However, Architect 1, Client 1, BIM Manager 1, and Client 2, agreed that this issue should be addressed, and that all the Public Works Contracts should be revised immediately to include references to BIM technologies, processes and standards.

a) Barriers: BIM Term & Definition.

BIM Manager 3, a Digital Construction Manager at a Tier 1 main contractor that actively use BIM, asserted that "the biggest single mistake was the inclusion of the term Building Information Modelling in terms of the PAS, because this has misled people. If I was walking around, waving that document and it didn't mention Building Information Modelling, people might realise that this is about documentation". The Mayfield Rock Report (Winfield & Rock, 2018) contends that all the BIM experts interviewed gave a different definition of BIM, and no two people gave the same response. This means there is still no standardised definition of BIM Level 2, and definitions can vary from project to project. However, one can define the 9 pillars of BIM Level 2:

1. PAS 1192-2
2. PAS 1192-3
3. BS 1192-4
4. PAS 1192-5
5. PAS 1192-6
6. Government Soft Landings
7. Digital Plan of Work
8. Classification (Uniclass 2015)
9. CIC BIM Protocol

Packham (2018) suggests that BIM as meaning 'Building Information Management' or 'Better Information Management' is a better definition for what the "true purpose of BIM" actually is. In a recent UK report, British Institute of Facilities Management (BIFM) 'Awareness of BIM' survey (August 2017), two-thirds of respondents reported that they had either none, or very little knowledge or involvement, in BIM.

BIM Manager 3 asserts that “BIM is how you deal with your information- The Holy Trinity: the graphical model, the non-graphical model, and documentation”.

b) *Barriers: Clients are not clear in defining what they need from the process.*

BIM Manager 3 contended that it is only in last 12 or 18 months that there has been any real engagement (by Clients) “without them fully understanding what it is about”. FM Consultant 1 concurred suggesting “We are definitely seeing more clients ask for it [BIM]: some are closer to it; other have it as almost a tick-box requirement and may outsource the delivery of it to others. And that has its challenges”. He also advised “as with anything that is new, there is an element of resistance to change; lack of understanding; a hesitancy”.

Although it is widely purported that BIM technologies and processes ensure greater certainty and reduced risk to the Client (Montague et al, 2015), FM Consultant 1 suggested that many Clients query who is making that saving: “Who is making those savings? [through using BIM processes]? In the construction phase, if there is a 10% saving, who is making that? Is it being shared among the participants, including the Client?” He further contended that Clients ultimately ask “What’s in it for me?”. In relation to the significant savings from full-scale digitisation (Gerbert, P., Castagnino, S., Rothballer, C., 2016), FM Consultant 1 questioned “In the post-construction/ operations phase, if there is a 10-15% saving, who is making that? Usually, the saving will be derived by the occupiers, [and] it is not a direct benefit to the client”.

Packman, P. (2018), Client 2, and BIM Manager 3, concur that BIM provides us with the opportunity to define the Asset information requirements from the outset, so that the required information is available in the prescribed format immediately on moving to the operational phase.

BIM Manager 3 also asserts that Clients have yet to understand how to get the most out of the AIM. He also asserted that what Clients are looking for when requesting BIM is quite “ambiguous” and “in terms of asset handover, it is still very vague”. He then explained that the FM team were “very concerned in best maintaining these buildings [Schools 4 Bundle PPP] for 25 years, whilst working within the contract, which had some very specific [financial] penalties in it...There would be very severe financial penalties for every hour that that [teaching] room is unavailable”.

In order to resolve this, and with agreement of the Client, BIM Manager 3 suggested how their FM team approached how the information in the BIM Model would be identified and tagged in order to prevent penalties accruing: “We started grading assets, using the principles of Part 3 [PAS 1192-3]. A Category 1 asset would be something that could cause a cluster of rooms to be unavailable. Category 2 would apply to lesser assets, and so on”.

Client 2 contended that clients only care about the operations phase of the building, and need their information formatted in terms of (i) reparability, (ii) replaceability and (iii) upgradability. Client 2 further asserts that this is where a major ‘gap’ exists, because design teams are concerned with gathering the COBie information in the models, whereas, the information required for operations is currently stored in a way that is not useful.

In terms of the supply chain, Philp (D., Philp, personal communication, 19th September 2018) attests that product manufacturers have a major role to play in removing one of the barriers to the adoption of BIM by providing digital representation for their products with classification to facilitate providing the “right object, with the right level of detail at the right time”. The Construction Products Association is driving this agenda by setting up BIM for Manufacturers to enhance engagement in that sector (Philp, 2018).

Client 2 attested that BIM was demystified by the UK Government strategy in driving BIM adoption because “it was approached from a cultural and not a technical perspective; there was an understanding that a ‘cultural’ change was required”. It is suggested that Irish Government need to adopt a similar approach in driving the Roadmap to Digital Transition 2018-2021 (NBC, 2018).

It was suggested by Client 2, that many contracting authorities who do not fully appreciate the benefits of BIM, and there is little empirical evidence to show these benefits either. He further contended that “All we [contracting authorities] can do is say that it ‘must surely’ be beneficial. This makes the argument weak, and I think the communication [of the benefits of BIM processes] is already poor, making the argument even weaker”

Other Benefits of BIM:

Montague et al (2015), BIM Manager 1, BIM Manager 2, BIM Manager 3, Client2 and Architect 1 propound clash detection as one of the major benefits of BIM. Architect 1 purported: “In terms of clash detection, we had little or no clashes (at

construction phase), and that is the experience we are getting from other projects”.

The use of 3D modelling within BIM processes enables efficient and effective exploitation of the full benefits of the information measured in a point cloud survey. Architect 1, affirmed that a point cloud survey of the site was completed, including “the buildings adjacent to the new build we were doing, and the existing buildings to be demolished (surveyed) to a certain level of detail...more than sufficient to generate sections, elevations that were very accurate for planning”.

The Client & the BIM Model- contractor benefit

Solicitor 1 contended that a number of main contractors sell the BIM model to their clients as a value-add in order to give them a competitive advantage at Tender Stage. BIM Manager 1, concurred that many contractors generate a BIM model even when not required on a project, because of the all the benefits of BIM- clash detection, quantification, sequencing etc.

Architect 2 revealed what can happen when clients do not use BIM on public works contracts. He cited examples of where the main contractor took the tender drawings and, either in-house or using external specialists, generated a BIM model of the proposed development specifically to identify where the clashes would be so that additional extras could be claimed during the project.

The advantage of having the BIM model generated also allows the contractor to derive accurate quantities and enables an accurate tender price to be furnished, or one which allows a significant profit margin. The contractor also can use the BIM model to schedule work packages and site logistics, again major advantages on fixed price contract. BIM Manager 1, BIM Manager 3 and Architect 2 all attested to this.

Architect 1 purported that “contractors are claiming for everything they can on public works contracts”. The GCCC Contracts assume everything is designed when the project goes to Tender. Client-led changes after Tender are easy targets for claims, in addition to unforeseen delays due to unforeseen site conditions, and delays in the programme which the contractor cannot control, all enable the contractor to submit financial claims. Errors or omissions in information can be curtailed if the client’s designers can provide information in a timely manner as part of the standardised RFI process.

VI TOOLKIT/ SET OF SOLUTIONS

- a) *Toolkit Suggestion 1: Clarification that Client owns the BIM model throughout the entire process*

The first Toolkit proposal is that written contractual clarification that the Client owns the BIM model be included in the contract documents. This would be subject to Copyright law, throughout the entire process of design, tender, construction, and consultancy procurement, and continue through the operations phase for the entire lifecycle of the building. Current practice means that the Client gets access to the models at Data-drop stages, but direct access can prove challenging between these stages. This is a situation that the author, who is Project Information Manager and BIM Manager on a large design-build multi-use headquarters for a semi-state body, personally experienced during a lengthy construction phase.

The literature analysis states that the Client owns the model and Solicitor 1 asserted that, subject to usual copyright, this is already the case in terms of the legal perspective. Solicitor 1 also contended that the copyright issue remains the same for traditional processes as for BIM processes. However, the author has experienced instances where members of the design team refuse to share the .RVT BIM model with the Fit-out design team. This lead to protracted delays using the incompatible .IFC model, and subsequently resulted in the .RVT model being shared, subject to onerous caveats. This situation would have been avoided if this was clearly identified as a separate clause in the contract documents.

Both BIM Manager 2, and Client 2, contended that difficulties exist in accessing specific details of a (BIM) building from the design team model originators. BIM Manager 1 and Client 2, discussed multiple instances where members of the design team refused to share BIM building details when requested to do so by the Client during the operations phase, claiming that these details were subject to copyright. Client 2 also cited an example of where a Client wanted to extend a building, and employed a different architect to design the new extension using the previous BIM model. He then required waterproofing details that were employed for the first phase in order to ensure consistency of construction. However, the previous architect refused to share the details, claiming it is subject to copyright. Client 2 also cited an example of where a Client wanted to insert a new door in an existing wall, and wanted to employ the same architectural details for the architrave and shadow gap, however, the architect claimed this was their

‘signature’ trademark design detail, and subject to copyright, and would not provide the pertaining details.

In an attempt to overcome this obstacle, or barrier to the BIM process, BIM Manager 2, now inserts a specific clause in the public works contract forms specifically to ensure that the Client ‘owns’ the model and all associated details, and the associated copyright. Client 2 also employs a similar clause in contract documents following previous difficulties with the design team refusing to share details claiming copyright constraints.

One of the reasons often mooted by the Design Team is the issue of copyright of the models. One of the changes in the revised (April 2018) CIC BIM Protocol (*Construction Industry Council, 2018*) relates to the copyright provisions, which are now more flexible. It states in Clauses 6.2-6.4 that the Project Team member retains copyright ownership and grants a licence, and that this only applies if the Agreement contains no provisions regarding intellectual property; if the Agreement contains such provisions, they will apply to the Material. This means that the Protocol can be used (unamended) even if the Project Team Member will not retain ownership of its intellectual property, because it will be transferred to the Employer. If ownership of the intellectual property in the Specified Information is being transferred to the Employer, the Agreement should make clear if there is any “background intellectual property” which the Project Team Member will retain ownership of (e.g. information model objects).

Solicitor 1 advised, in response to anonymous feedback from another interviewee, that the principle that the author, or originator of a piece of information (such as a model of drawing), is responsible and liable for that content and quality still applies (Ref: EU BIM Task Group page 74). Solicitor 1 contended that there have always been disputes as to who is responsible for inaccurate information. It is to be hoped that the more widespread use of digital tools in the future will make it clearer and easier to identify the responsible party.

In terms of Collaboration, and how the design team share information and models, Client 1, suggested “It is all about digitisation, the flow of information, but what is really difficult to crack, when the Design Team are working together, is the collaboration piece”. Collaborative working is a fundamental part of BIM processes and workflows on projects. Solicitor 1 asserted that it is imperative that each party signs the CIC BIM Protocol individually. He also contended that it is not “safe” to “assume that

by agreeing to comply with the EIR and BEP that any party could be taken to have signed up to the CIC BIM Protocol”. He suggested that this is because the CIC BIM Protocol sets out important clauses in relation to how the parties are to work together, and the safest course is to ask each of the parties to sign the CIC BIM Protocol at the same time as the Agreement. Current practice suggests that the separate signing of the BIM Protocol does not always occur, particularly when sub-contractors are appointed. This should be mandatory and should be expressly stated in the contract documents.

There are numerous references in the literature to the term ‘Building Information Modelling’ itself being a barrier to BIM adoption. This contention was supported by the interviewees. Client 2 and BIM Manager 3 concurred with Packham. (2018) who suggests that BIM as meaning ‘Building Information Management’ or ‘Better Information Management’ is a better definition for what the “true purpose of BIM” actually is. In a recent UK report, BIFM ‘Awareness of BIM’ survey (August 2017), two-thirds of respondents reported that they had either none, or very little knowledge or involvement in BIM.

Packman (2018), Client 2, and BIM Manager 3, concur that BIM provides us with the opportunity to define the Asset information requirements from the outset, so that the required information is available in the prescribed format immediately on moving to the operational phase.

Philp (2018) attests that product manufacturers also have a major role to play in removing one of the barriers to the adoption of BIM by providing digital representation for their products with classification to facilitate providing the “right object, with the right level of detail at the right time”. Philp (2018) contended that the Construction Products Association is driving this agenda by setting up BIM for Manufacturers to enhance engagement in that sector.

b) Toolkit Suggestion 2: Better Education including on-line portal

The second Toolkit suggestion is for better education of the benefits of BIM for Clients through an online portal similar to the UK’s Digital Built Britain or Scotland’s Scottish Futures Trust. In addition, easily-accessible information, backed up with real-life BIM exemplars, showing how the BIM model reduced cost, waste and improved processes throughout the construction/ life-cycle, in addition to showing ROIs and reduction in waste etc.

BIM Manager 3 asserted that a major barrier is the lack of education, “Clients don’t yet understand what BIM is”.

Architect 1, a senior architect at a major design office that actively uses BIM, attested that “Education for Clients is the biggest barrier at the moment- it’s the same in the UK. Some are up to speed, some are not. The Client has to define the rules at the beginning (for the project) to stay on track”, and purports that lack of education “stops the Client getting what they want from BIM, at the end of the day”.

Client 1 purported that the [AECO] industry and client groups need to converge on a best practice way to do BIM. He further attested that “When you stand back and look at things from the client’s viewpoint, they want the service from the industry, [to provide] the school, the hospital or whatever, and BIM is really how the industry should be organising itself. To me [client] this is a supply-side process. It is about using digital processes and collaborating more together”.

Client 2 suggested that “one of the ‘barriers’ to Client engagement is the language used in the EIR, which is over-complicated, and needs to be simplified using ‘plain english’ and simplified technological terms”. However, as the EIR is project specific, this Client may be referring to an EIR produced by the Lead Designer or contractor. Thus, this perception that EIRs included difficult terminology may be misguided, and better BIM education for this Client may resolve this issue, or the new role of Client BIM Consultant who would ensure that the Client was getting what he/she requires in the EIR.

Philp (2018) “totally” concurs that the lack of education is a major barrier, and purports that education is required for new entrants, with upskilling for those embedded within the construction industry. Philp (2018) asserts that the focus should be on information management and data science before developing skills around the tools, and contends that academia has been slow to reshape undergraduate courses, which should “respond better to industry needs”, but, conceded that MSc and post-graduate courses are “good”.

c) Toolkit Suggestion 3: new role of Client BIM Consultant

This Toolkit suggestion involves the establishment of a new specialised Client BIM Consultant, appointed by the Client, and working solely for the Client, to ensure that BIM processes and standards are applied correctly throughout the project,

and on into the Operations phase of a building. Matthews (2015) suggests that new roles will be required for BIM technologies and processes, and are constantly evolving as digital construction develops. Mady (2017) suggests a new role of a Life Cycle Engineer for the operations phase, as digital technologies and BIM drive changes in the Operations and Facility management phase. Client 1 suggested that “When you talk about BIM, the Client should really only be saying I want the output at the end”. Clients, especially large corporate clients with multiple portfolios do not have the time to get involved in gaining a detailed insight into how BIM procurement works, and want to leave this to the Design Team and the other professionals they have appointed. Client 1 also maintained “I do not want to tell an Architect or other professional how to do his/her job”. BIM Manager 3, who works for a leading main contractor actively using BIM, contended that it is only in last 12 or 18 months that there has been any real engagement (by Clients) “without them fully understanding what it is about”. He further suggested that when a Client engages professions for the Design Team “Should a Client not have an expectation that you [as an architect] will deliver the best building in the best way humanly possible now [using BIM]?”. The new role of Client BIM Consultant would work only for the Client and independently of the Design Team. This role would ensure representation of the Client throughout the process, and ensure that what the Client needs to be getting from the BIM Model

BIM Manager 3, concurred with this proposed new role, describing it as “absolutely necessary”, and suggested that this role could also be carried out by the Employer’s Representative (ER), but agreed that currently that role is “generally conflicted. Clients think that making the ER part of the design team is good for them, but it is actually not”.

Architect 1, an architect at a major design practice actively using BIM, contended that a specialised Client BIM Consultant would be very beneficial “someone who is independent, who can spend a couple of hours initially advising them and then reviewing the information say to them this is what that means, so that they can tailor it to suit their (client) needs... Also, for checking (the information) throughout the project”. He further suggested “If I was a client, I would get the advice (of a BIM Consultant) in the beginning to help me set up the information (required), and then keep that company on board to assess the information that is being provided”. Client 2, who works for a university estates management department, and BIM Manager 1, who works for a leading main contractor actively

using BIM, also concurred that this new role is required.

BIM Manager 3 asserted that what Clients are looking for when requesting BIM is quite “ambiguous” and “in terms of asset handover, it is still very vague”. Client 1 suggested that “The client should only be involved at the Output [Handover] stage, and not have to get involved in COBie, Data-Drops etc”. However, as the Client needs to be involved to approve the information at the Data-drop stages, this can be resolved by the Toolkit suggestion of a proposed new role of Client BIM Consultant. This will ensure that the information provided by the design team is correct, and that the Level of Definition (Level of Model Detail and Level of Information) is correct for that stage. It will ensure the Client is being represented throughout the process, and will get the information he/she requires, in the correct format and at the right time for the Operations phase of the building.

Client 2 suggested that “one of the ‘barriers’ to Client engagement is the language used in the EIR, which is over-complicated, and needs to be simplified using ‘plain english’ and simplified technological terms”. However, as the EIR is project specific, this Client may be referring to an EIR produced by the Lead Designer or contractor, and therefore, it is proposed that this Client would benefit from having a Client BIM Consultant who would explain what is required, and act of their behalf throughout the entire procurement of the building.

BIM Manager 3 also suggested that the Professional Institutes are not tackling this [lack of education] properly should be providing education in BIM similarly to how they dealt with BCAR. The Professional Institutes (Royal Institute of Architects of Ireland, Institute of Engineers of Ireland, and Society of Chartered Surveyors of Ireland etc.) will need to provide new CPD courses to upskill existing professionals to take on the new role of Client BIM Consultant.

c) Toolkit Suggestion 4: Is an Irish BIM Mandate required?

Whilst the Irish Government Roadmap to Digital Strategy 2018-2021 stops short of being a mandate, Philp (2018) suggests that the provision of a mandate in the UK, “helped accelerate industry adoption and build an apposite pipeline for industry to respond to and invest in” e.g. BIM technologies and training.

Philp (2018) asserts that a strong policy level would “focus client engagement” along with the creation of communities of client practice: UK Public

Sector working group, and Scotland Procurers BIM working group. Similar working groups should be established in Ireland to drive Client BIM engagement. Philp (2018) purports that simple KPIs to measure BIM readiness amongst clients would be another measure that Ireland should adopt from the UK experience.

Client 2 attested that BIM was demystified by the UK Government strategy in driving BIM adoption because “it was approached from a cultural and not a technical perspective; there was an understanding that a ‘cultural’ change was required”. It is suggested that Irish Government need to adopt a similar approach in driving the Roadmap to Digital Transition 2018-2021 (NBC, 2018).

VII CONCLUSIONS & RECOMMENDATIONS

In conclusion, and on reflection of synthesis of the outcomes of the Qualitative Analysis and the findings of the Literature Review, a number of Insights/Recommendations were derived and are hereby proposed:

Insight No.1: GCCC CWMF Contracts need to be revised to refer to BIM and to include clarification of Client ownership of the Model

The GCCC CWMF Contracts need to be revised to include reference to BIM technologies, standards and processes, and to confirm BIM Model ownership by the Client. This is required because of the difficulties the Client often has in accessing BIM Models mid-stage (e.g. construction stage which is a lengthy phase between Data Drops). It is also required because of difficulties Client 1, who works for a national government development agency, and BIM Manager 1, who works for a university development agency actively using BIM, expressed in accessing the BIM Model when subsequent extensions or alterations to the building were being carried out, and the authors of the BIM Model claimed copyright of the details, and refused access. Although, the revised CIC BIM Protocol has improved the copyright position, however, this has not been fully tested legally, and as the GCCC and CWMF Contracts make no reference to BIM, the legal position may be open to interpretation.

Insight No.2: Helping Clients get what they want from BIM – BIM Online Portal

Insight No. 1 is that Clients need better education, through the Toolkit suggestion of the dedicated BIM Online Portal. It is critical that this BIM Online Portal is engaging and easy to use and provides Key Performance Indicators (KPIs) and real-life examples of cost efficiencies garnered through

the use of BIM technologies, processes and standards. On reflection, it is essential that this is multi-disciplinary, and is hosted by an Irish Government Agency, as from the findings the Government needs to drive BIM as an efficient method of digital construction procurement (refer also to Insight No.4).

Insight No.3: Helping Clients get what they need from BIM- New Client BIM Consultant Role

This new role of Client BIM Consultant will assist the Client in obtaining what they need from the BIM process in term of outputs. The Client BIM Consultant will be an independent appointment, separate to the Design Team, to assist the Client to create the EIR and BEP, and will ensure the Client is being represented throughout the process, and will get the correct information, at the right time and in the right format throughout the entire procurement of the building, at handover, and into the Operations phase of the building. Clients are very busy, as attested to by Clients 1 and 2, and BIM Managers 1 and 3, and expect their Design Team to deliver the building to the best of their professional ability. The Client BIM Consultant will have the deep sectoral knowledge to provide an ‘overview’ checking of the information being provided by the Design Team, ensure that the correct BIM standards and processes are being followed, and ensure that the correct information is in the models, at the correct time, and in a manner that the Client and End-user want. This information varies from project to project. This new role could be attached to the BIM Mandate, issued from the Office of Government Procurement (refer Insight No.4).

Insight No.4: A BIM Mandate for Ireland is required

Whilst the Irish Government Roadmap to Digital Strategy 2018-2021 stops short of being a mandate, Philp (2018) suggests that the provision of a mandate in the UK, “helped accelerate industry adoption and build an apposite pipeline for industry to respond to and invest in e.g. BIM technologies and training. Philp (2018) also suggests that the lack of an Irish mandate “will create different tiers in the industry and the building of capability will be slower”. The Digital Strategy 2021 is not on programme. A BIM Mandate for Ireland would greatly assist in driving engagement in BIM.

In terms of future work, additional legal investigation should be completed regarding the use of the existing CIC BIM Protocol with revised Irish Public Works contracts, and whether a separate Irish BIM Protocol should be drafted. The professional bodies, (RIAI, IEI, SCSI etc.) should investigate how they can assist the sector with BIM engagement, and upskilling of existing professionals. Additional investigation is required of how adjustments can be

made to the requirement for full design information at tender stage, which is often then subject to client-led changes resulting in abortive work.

In conclusion, following the critical appraisal of the potential for public works contracts’, and design-build Clients to leverage the benefits from BIM processes, it is proposed that the implementation of these 4 Insights would result in better outcomes on Public Works, in the short, medium and long term.

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