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From Roadmap to Implementation: Lessons for Ireland's Digital Construction Programme

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Abstract ─ As part of their Future of Construction initiative in 2018 the World Economic Forum published an action plan to accelerate Building Information Modelling adoption. The WEF report highlighted actions that companies, industry organisations and governments are advised to implement to accelerate BIM adoption and better capitalise on delivering better project outcomes. According the authors of the report BIM is seen as the centrepiece of the construction industry's digital transformation, however they acknowledged that BIM adoption globally remain slow. Anecdotal experience would suggest that BIM usage in Ireland is also very low and that a similar initiative or an adaptation of the WEF BIM Adoption Circle would be applicable to driving the digital transition programme in the Irish construction industry. This paper highlights the actions that companies, industry organisations and governments are advised to implement in order to contribute to the acceleration of BIM adoption. The authors document the results of a consultative survey of representative stakeholders in Ireland in mid 2019. This survey was designed to investigate the relevance of some twenty seven specific actions identified by the WEF to drive digital transition in the Irish construction industry.

Keywords ─ Building Information Modelling, acceleration, adoption.

I INTRODUCTION

Building Information Modelling (BIM) has been a source of considerable debate throughout the world in recent years. Whilst the World Economic Forum (WEF) recognises the relevance of BIM as an important first step for the construction industry to embrace the benefits for digitisation, the adoption throughout the world has been relatively slow [1] [2].

Despite the slow speed of adoption, globally BIM is gaining considerable traction in recent years with governments across the world mandating it use on public work projects [3]. There is also increased evidence that tier 1 companies are increasingly adopting a 'model first' approach when seeking out

increased productivity and efficiency benefits. However, the debate has broadened in more recent years 'beyond BIM' with the industry seeking out

further productivity benefits by using an array of innovative digital enabled solutions.

The authors concur with the WEF and remain resolute that BIM is a logical first step that must be adopted more widely in the Irish construction industry if the benefits that are widely reported can be fully realised and experienced.

The complexity of construction requires a focal point where all the design elements of a project are coordinated into a single digital design record prior to a commitment to build. This concept of model creation and co-ordination has more recently been developed into the concept of a 'digital twin' [4].

In this paper the authors present the WEF vision in respect to successful BIM adoption by investigating the applicability of adopting the WEF 2018 BIM Adoption Circle of actions designed to accelerate the adoption of BIM in international markets [1].

The findings of a structured consultation study in Ireland with relevant stakeholders is presented in this paper. It is clear from the findings that while there was much support for the WEF adoption accelerators there remains a lack of understanding as to the precise meaning of 'BIM Adoption' and that there would need to be an adaptation of the WEF model for it to have direct relevance in Ireland.

As part of their 'Shaping the Future of Construction' series the WEF described BIM as a

'collaborative process in which all parties involved in a project use three-dimensional design applications, which can include additional information about assets' scheduling, cost, sustainability, operations and maintenance to ensure information is shared accurately and consistently throughout total assets' lifecycles'.

Whilst this explanation is helpful, evidence would suggest that there are relatively few projects where all parties routinely use three-dimensional design applications.

What is clear from the authors' findings is that an order needs to be brought to supporting the industry to transition towards BIM with companies, industry representatives and government all playing a part in the delivery of a digital concept that will lead to improved projects outcomes for all concerned.

This order will be helped by the funding of the National BIM Council (NBC) Roadmap to Digital Transition 2018-2021 [5] but also by the introduction of an implementation plan of actions, such as, envisaged by the WEF in 2018.

This implementation plan will help in motivating, fostering greater collaboration and enabling the industry to adapt to a future where BIM will become business-as-usual leading to a more productive and less adversarial industry in the future.

II BIM IN IRELAND

In Ireland the first formal reference to BIM was included in a 2013 Forfás report which focused on Ireland's Construction Sector [6]. Specific mention was made of BIM in the report as an advanced technology that will ensure increased competitiveness and innovation in the sector. This was followed in 2014 by the Construction 2020 Strategy which aimed at restoring a properly functioning, sustainable and dynamic construction sector, operating at an appropriate level for the size of the economy. The report outlined two specific actions which included implementing a BIM staged development programme to support companies advancing to level 2 BIM capability, which subsequently led to the

development of the *BIM Enable* and *BIM Implement* support programmes for Enterprise Ireland clients [7].

In January 2017 the Government launched its *Action Plan for Jobs 2017* [8]. A particular action flowing from the Action Plan for Jobs 2017 included a requirement for the Office of Government Procurement and Enterprise Ireland to prepare a strategy for the adoption of BIM across the public capital programme and to mandate the manner in which it is to be adopted across the public sector.

Following consultation with public bodies engaged in public works projects, the government Construction Contracts Committee (GCCC) prepared a position paper in 2017 for the purposes of inviting responses from industry. Titled *A Public Sector BIM Adoption Strategy,* it outlined the context and rationale for the adoption of BIM on Irish public works projects and put forward a proposed timeline for adoption, ranging from 12 - 48 months, for projects to adopt BIM. These projects range from Band 1, which are of low complexity, such as low density housing projects, to Band 5, which are complex projects with a specialist operation and maintenance regime, such as acute hospitals [9].

In December 2017 Ireland's National BIM Council published the Roadmap to Digital Transition for Ireland's Construction Industry 2018-2021 [5]. The Roadmap consists of the four parallel pillars of leadership, standards, education and procurement with particular milestones to be achieved for each of the pillars during the programme period 2018-2021. Unfortunately, at the time of writing this paper, no funding has been secured from the Irish government for the implementation of the first three pillars. The procurement process of introducing on a phased basis a BIM mandate for public works projects is on schedule to commence in Q2 2019.

The increased level of interest in BIM in Ireland has been driven primarily by Construction IT Alliance (CitA) in the delivery of specific monthly BIM events, a CitA BIM Gathering International conference in 2013, 2015, 2017 and 2019, and its successful CitA Skillnet training funded programme. In early 2016, CitA secured funding for the BIM Innovation Capability Programme for Ireland to capture the current state of readiness of the Irish construction industry to work with BIM. In late 2017 CITA published a BIM in Ireland report [10] which provided a detailed account of the various initiatives and communities of practice advancing BIM in Ireland. An updated version of the report is due to be published by CitA in Q3 2019.

In February 2018 the Government of Ireland published the Project Ireland 2040 report which took a radically different approach to future planning (2018-2017) in Ireland. The initiative involved the

formation of a Construction Sector Group (CSG) that would report directly to the Project Ireland 2040 steering group [11].

The CSG was established in order to ensure regular and open dialogue between Government and the construction sector. The CSG formed a Growth and Productivity Sub-Group to look at a wide-ranging analysis of productivity to inform new industry approaches for improvement. Their remit also included taking forward proposals from the BIM Roadmap.

III WORLD ECONOMIC FORUM BIM ADOPTION CIRCLE

The World Economic Forum's Future of Construction Initiative in collaboration with The Boston Consulting Group developed the *BIM Adoption Cycle* [1].

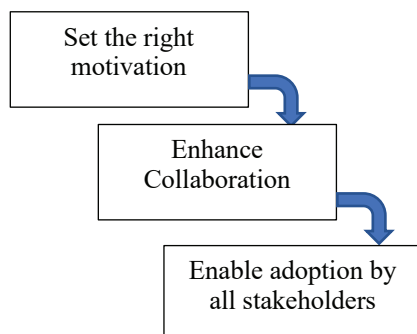The implementation framework is shown in Figure 1.

Figure 1 – WEF Implementation Framework

The authors of the WEF report suggested that '*increasing BIM adoption requires greater collaboration and that stakeholders should be motivated and given the right capabilities*'.

In addition they stated that

'*Successful BIM adoption requires a high level of collaboration among stakeholders. Steps toward that include increased use of integrated contracts and open standards for data sharing. Adoption also requires a coordinated effort to attract new talent with digital and BIM skills, upskill existing workers, and changing corporate cultures to support new processes. As major owners of built assets, governments must make a long-term commitment to the technology by piloting it in public works projects and creating regulations conducive to its acceptance, including backing innovative forms of financing*'

The report identified actions that companies, industry bodies and governments can take responsibility for to

accelerate BIM adoption and better capitalise on delivering better project outcomes. The output of a consultation roundtable discussion with over 35 globally respected stakeholders in construction is illustrated in Figure 2.

Figure 2 – WEF BIM Adoption Circle [1]

Specific actions are further delineated in twenty seven actions with responsibility apportioned to each of the following stakeholders.

1. Companies
2. Industry bodies
3. Government

III METHODOLOGY

The authors selected a sample of respondents representative from the three stakeholder groups identified earlier with the purpose of reflecting on the recommendations of the 2018 WEF Action Plan for BIM Acceleration.

A total of six representative stakeholders from each of the above stakeholder groups were targeted. The sample consisted of senior/middle management who had a particular responsibility, knowledge and interest in the digital transformation of the Irish construction industry.

Table 1 is a summary of the respondent organisations that participated in the survey.

Stakeholder Category	Respondent Organisation
Company	Arcdox
	Undisclosed
	BAM Ireland
	Undisclosed
	Ardmac
	Varming Consulting Engineers
Industry Bodies	Construction Industry Federation

	Engineers Ireland
	Society of Chartered Surveyors Ireland
	Association of Consulting Engineers of Ireland
	Royal Institute of Architects in Ireland
Government	Department of Housing, Planning and Local Government
	National Standards Authority of Ireland
	Dublin City Council
	Transport Infrastructure Ireland
	Irish Water
	Grangegorman Development Agency

Table 1 – Survey Respondents

Each sector representative was presented with the WEF BIM Adoption Circle and asked a series of questions pertaining to the likelihood of their organisation accelerating their use of BIM as a direct result of actions identified in the report. Respondents were asked to elaborate on their responses where possible.

1. Would you make any changes to the THREE KEY actions identified as accelerants to motivate your organisation to use BIM?

2. Would you make any changes to the THREE KEY actions identified as accelerants to foster collaboration and risk sharing in your organisation to use BIM?

3. Would you make any changes to the THREE KEY actions identified as accelerants to help enable stakeholders to gain the necessary skills and knowledge that will in the long term change behaviours to achieve better project outcomes in the Irish construction industry?

In addition, respondents were asked to identify which of the 27 actions identified by the WEF could be applicable in Ireland and to share any additional actions that Ireland could introduce to accelerate BIM Adoption.

IV SURVEY SAMPLE

A total of 17 out of the 18 sample identified responded providing a sound platform for analysis..

The following is a brief summary of the profile of the respondents.

a) Industry

The contributors were broadly drawn from three categories, namely:

1. Tier 1 contractors

2. Design firms

3. IT companies

The tier 1 contractors included BAM Ireland and Ardmac who together had a combined turnover in 2018 of in excess of €600 million. Both organisations are renowned companies in their deployment of digital on signature projects and both respondents were of a very senior level and active in the Irish BIM and lean construction communities.

The design firms contributing included Arcdox who are an established BIM specialist providing consultancy service, support and training. In addition Varmings Consulting Engineers are market leaders in commercial, education, healthcare and industrial projects with a mature aptitude and proficiency in BIM. Both respondents are very knowledgeable in respect to national BIM initiatives with one in particular who is recognised as one of the leading authorities in respect to BIM in Ireland for the past decade. Two additional respondents in this category preferred that their organisation was not listed as a contributor to the survey. Both of these organisations are world renowned creators of digital solutions for professionasl across the globe and are presently very active in Ireland.

b) Industry Bodies

Five out of the six representative industry bodies who make up the Construction Industry Council contributed to the survey with each respondent holding an executive role within that organisation. These bodies included representatives from the following Irish construction stakeholders.

1. Contracting

2. Engineering

3. Surveying

4. Architecture

The combined representation of these organisations accounts for up to 30,000 businesses across the Republic of Ireland. Each of the representative bodies are represented on the CSG and have active interest groups looking at BIM and digital construction, as discussed earlier in this paper.

c) Government

The government respondents were purposefully selected to provide a representation from key government departments, local authorities, standard authorities and special public sector infrastructure agencies and authorities. The particular respondents were all very senior in their respective public sectors organisations with a particular responsibility to

embrace BIM and other digital innovations in the delivery of public works projects.

IV FINDINGS

The respondents were broadly asked to comment on the WEF BIM Adoption Circle looking at their motivation, collaboration and enablement framework and how they might make changes to these implementation tactics. A summary of the high levels actions are shown in Table 2.

Pillars	Actions
Motivation	Articulate BIM's benefits across the entire lifecycle.
	Think of BIM as a value creator, not as a cost factor.
	Approach BIM as the essential first step to IU digitization[i].
Collaboration	Use integrated contracts and redefine risk-return mechanisms.
	Set up early collaboration and communication among stakeholders.
	Establish data sharing standards and open systems.
Enablement	Establish BIM skills along the full value chain.
	Change behaviours and processes, not just technologies.
	Make a long-term commitment and support innovative financing.

Table 2 – WEF BIM Adoption Circle Action

a)   Motivation

In respect to the motivational theme examples of feedback received from the respondents are included below.

'Yes to articulating the benefits of BIM and seeing BIM as a value creator. DHPLG priorities would be foremost to address housing, building standards and planning needs, including prioritising the delivery of housing with value for money and efficient programme to address the current urgent national housing crisis'

'Education, CPD events, seminars etc so that people start to become comfortable and familiar with BIM as BIM can be daunting for non-bimmers or people on the periphery'

'In terms of digitisation of contractors, BIM does not have to be the first step. Use of mobile applications for data collection and use on projects are considered low hanging fruit with digital construction related processes in the field'

'Use examples such as highlighting compliance with Client statutory duties e.g. Project Safety File compliance - BIM links to associated docs such as certs/O&M manuals at handover stage'

Although half of the respondents suggested changes to the three broad actions identified under the motivation pillar there were no specific changes recommended.

It was clear however from the respondents that the government need to play a key role in any driving the adoption of BIM in Ireland by setting an example and mandating BIM on public works projects. Respondents were also of the opinion that the government needs toc commission an entity to manage the digital transition programme and fund the NBC Roadmap in a sustainable way moving forward. Both the industry and the representative need to play their part but these actions should flow from specific actions funded by a national BIM programme.

b)   Collaboration

In respect to the collaboration theme examples of feedback received from the respondents are included below.

'Establish a leadership and co-ordination platform to drive digital transformation in the short term'

'Standardised government led guidelines are needed to support the implementation of any BIM mandate to ensure its adoption consistently, otherwise its adoption becomes fragmented, confusing to the industry and by default loses any potential value from the mandate intent'

'It is not clear what is meant by 'integrated contracts' and also what is meant by the redefinition of 'risk-return' mechanisms'

It is clear from the feedback from the respondents that the three actions presented in the model will need to be refined further and that the government once again must play a key role in encouraging collaboration by incorporating this practice in future government public works projects and also demonstrate leadership by driving the digital transformation of the sector.

c)   Enablement

In respect to the enablement theme (Table 3) examples of feedback received from the respondents are included below.

'A cultural change to the delivery of building needs to be enabled'

'Again provide more education, seminars, workshops, media coverage etc so that people learn and become familiar with BIM almost by osmosis'

'In relation to (c), is it government that it is proposed should make a long-term commitment? If so this is not clear. In relation to (a) it is not clear what exactly is meant by 'BIM skills'? and the 'full value chain'? Overall, in order to provide clarity to stakeholders, it is important to limit the use of jargon where possible in these accelerators'

'Embed BIM as a contract requirement on a pilot basis in public works projects – the actions are non-specific and read more like general objectives and read more like specific actions will flow'

The imprecise nature of the language used by the WEF meant that a number of the respondents found it difficult to endorse the three actions presented in their present form.

In particular, there was a lack of a lack of understanding by the respondents on the meaning of the reference 'innovative financing' and the particulars of the 'long-term commitment' referred to in the WEF model.

There was, however, a clear and consistent message among stakeholders of the importance that the government must make a long-term commitment to BIM by incorporating this concept into future public works projects and the urgent need for the public sector entities involved in these projects to up skill in BIM workflows and technologies.

It is clear from the feedback of this first component of the survey that the model and the nine actions that were present had merit but did not have sufficient detail in order for the majority to confirm their full applicability in an Irish context. The consistent reference to the government to take responsibility and leadership however was very evident.

The second phase of the survey involved presenting to the respondents a more detailed breakdown of twenty seven actions together with how the WEF envisaged the particular stakeholder taking responsibility for those actions.

A summary of the feedback received for this part of the survey is shown in Tables 3, 4 and 5.

Motivation Pillar	Companies	Industry Bodies	Government
Articulate BIM's benefits across the entire lifecycle			
Develop and pilot use cases that include BIM 6D and 7D applications	27%	**40%**	33%
Leverage BIM data to optimize design regarding O&M costs	**80%**	13%	7%
Use BIM in O&M for public assets and demonstrate benefits in pilot projects	14%	0%	**86%**
Think of BIM as a value creator, not as a cost factor			
Develop benchmarks against which BIM costs and benefits can be measured	13%	**74%**	13%
Allocate BIM costs and savings separately from other financial data to increase transparency	**73%**	7%	20%
Develop an industry standard for calculating BIM ROI	27%	**52%**	20%
Publish BIM ROI assessments of pilot projects	14%	36%	**50%**
Approach BIM as the essential first step to IU digitalization			
Implement BIM as platform to store, manage and share data required by new technologies	**73%**	7%	20%
Develop BIM standards and specifications for digitized built environments	27%	13%	**60%**
Build up digitized built environments and use them for financial planning	33%	13%	**54%**

Table 3 – Feedback on Motivational Actions

In respect to the motivational pillar there was a large degree of similarity between the results of this survey and the findings of the WEF recommended distribution of responsibilities.

1. In respect to the companies there was agreement that they should take responsibility for leveraging BIM data to optimize design regarding O&M costs; allocate BIM costs and savings separately from other financial data to increase transparency and implement BIM as a platform to store, manage and share data required by new technologies. There was varied agreement on whether this stakeholder should take any further responsibility or indeed share responsibility with other stakeholders as envisaged by the WEF.

2. The industry body responsibilities were broadly agreed in respect to developing benchmarks against which BIM costs and benefits can be measured and developing an industry standard for calculating the BIM ROI.

3. The respondents concurred with the government responsibilities identified by the WEF, namely :

  a. Use BIM in O&M for public assets and demonstrate benefits in pilot projects.
  b. Publish BIM ROI assessments of pilot projects.
  c. Develop BIM standards and specifications for digitized built environments.
  d. Build up digitized built environments and use them for financial planning.

In conclusion the respondents largely concurred on the distribution of the actions in regard to the motivational pillar.

In respect to the collaboration pillar (Table 4) there was a degree of variation between the results of this survey and the findings of the WEF recommended distribution of responsibilities.

1. In respect to the companies there was agreement that they should take responsibility for revising corporate cultures, structures and processes for more comprehensive collaborations and support bottom-up consortia to standardize BIM data exchange.
2. Whilst the WEF had allocated particular responsibilities to the industry bodies in in respect to establishing data-sharing standards, the respondents did not concur. No particular actions were identified as the responsibility of the industry bodies in regard to the collaboration pillar.

Collaboration Pillar	Companies	Industry Bodies	Government
Use integrated contracts and redefine risk-return mechanisms			
Increase the share of projects that use integrated contracts	13%	13%	**74%**
Set up early collaboration and communication among stakeholders			
Revise corporate cultures, structures and processes for more comprehensive collaborations	**60%**	20%	20%
Develop BIM collaboration procedures (e.g. CIC BIM Protocol)	13%	33%	**54%**
Establish data-sharing standards and open systems			
Support developing global conventions for data generation	7%	27%	**66%**
Support bottom-up consortia to standardize BIM data exchange	**47%**	27%	26%

Support emerging data marketplaces	47%	6%	47%
Develop regulations to protect BIM IP and data ownership	13%	20%	**67%**

Table 4 – Feedback on Collaboration Pillar

3. Whilst the WEF had allocated particular responsibilities to the industry bodies in in respect to establishing data-sharing standards, the respondents did not concur. No particular actions were identified as the responsibility of the industry bodies in regard to the collaboration pillar.
4. The respondents concurred with the government responsibilities identified by the WEF, namely :

  a. Increase the share of projects that use integrated contracts.
  b. Develop BIM collaboration procedures (e.g. CIC BIM Protocol).
  c. Develop regulations to protect BIM IP and data ownership.

It is clear that there was some variance between the respondents view and that of the WEF in respect of responsibilities for the collaboration pillar but largely the responsibilities allocated were similar.

Once again it is clear to see the dominant role expected of the government in developing guidelines, protocols and use of collaborative contractual frameworks coupled with the necessity of companies to start to change the culture within their own organisations. It can be seen that the industry body played a passive role in regard to fostering collaboration.

Enablement Pillar	Companies	Industry Bodies	Government
Establish BIM skills along the full value chain			
Integrate BIM into general design and engineering classes	20%	**47%**	33%
Create upskilling courses with professional education providers	13%	**60%**	27%
Institute a broad set of upskilling programmes (e.g. job rotation, mentorships etc)	**47%**	27%	27%
Develop simple BIM software that emphasizes usability	**73%**	27%	0%
Incorporate BIM skills training in public engineering, procurement and O&M organizations	7%	7%	**86%**
Change behaviours and processes, not just technology			
Adopt BIM as part of a comprehensive change management programme	**67%**	7%	26%
Streamline processes before adopting BIM	**67%**	13%	20%

Make a long-term commitment to include BIM in projects			
Create innovative BIM business and financing models (e.g. BIM-as-a-service, low budget BIM)	**93%**	0%	7%
Create a regulatory framework for private-investor BIM funding	7%	7%	**86%**

Table 5 – Feedback on Enablement Pillar

In respect to the enablement pillar (Table 5) there was a degree of similarity between the results of this survey and the findings of the WEF recommended distribution of responsibilities.

1. In respect to the companies there was broad agreement with the WEF distribution of responsibilities to ensure that that companies upskill their staff, change the culture within their organisations to use of new digital workflows but also commit in the long term to introducing BIM into their project portfolio.
2. The singular responsibility identified by the WEF of industry bodies to create upskilling courses with professional education providers was agreed by the respondents.
3. The respondents concurred with the government responsibilities identified by the WEF, namely :

    a. Incorporate BIM skills training in public engineering, procurement and O&M organizations.
    b. Create a regulatory framework for private-investor BIM funding.

    The action identified by the WEF in regard to introducing design and engineering classes was not seen as a government responsibility by the respondents.

In conclusion the respondents largely concurred on the distribution of the actions in regard to the enablement pillar. Respondents agreed that all three of the stakeholders should play take on responsibility to ensure that the industry is enabled to work routinely with BIM workflows and technologies.

The importance of the industry upskilling their staff, fostering a change management approach within their businesses and making that long-term commitment to use of BIM on their future projects was supported by the respondents.

The importance of the industry body stipulating the inclusion of BIM into accredited courses and the importance of the bodied developing a broad suite of BIM programmes was also widely supported by the respondents.

Finally the critical role of the government was once again clearly evident with respondents agreeing on:

1. The importance of their role in incorporating BIM skills training in public engineering, procurement and O&M organisations.
2. Creating a regulatory framework for private-investor BIM funding.

The respondents were asked to provide any other additional comments in respect to the WEF Adoption Circle. A selection of these comments are shown below.

'Great framework. But only useful if it is actually followed'

'I believe that some of the 27 actions suggested by the World Economic Forum should be a shared responsibility of two or more stakeholders identified'

'Maybe some renewed language/description in the motivation section ie future skills, climate change, sustainability understanding that these are all goals in their own right but speaks better to the cohort of people who'll be engaging with BIM'

'it is very comprehensive, but many of the action items would benefit from clarification/simplification before being applied in an Irish built environment context'

'I feel BIM as a process has too much jargon, simplifying the language will make BIM accessible to all members of project teams. From experience people can be intimidated by all the technical terms used in BIM execution plans and tend not to engage'

'Careful alignment should be given to the specific actions in the NBC roadmap'

It is clear from the final feedback from the respondents that careful consideration should be given to shared responsibility and refinement of language used in the actions.

In addition careful consideration should eb given to alignment the BIM implementation plan with those specific actions identified in the NBC Roadmap.

V CONCLUSION

The purpose of this paper was to stress test the WEF BIM Adoption Circle with a focused group of stakeholders. The methodology adopted followed that sued in the production of the WEF BIM Adoption Circle model.

It is clear from the feedback that there was broad agreement with respect to the WEF actions envisaged in 2018, however, a broader consultation process would need to be carried out in order to better refine the actions and the responsibilities for those actions.

Respondents were very clear in their feedback that no action plan will have 'teeth' unless the plan is funded and management by a central entity. Perhaps this could be an important role for the CSG's vision for a new Centre of Excellence for digital construction. At the time of writing this paper there is no clarity in respect to these plans in the near future.

It is also clear from the feedback to this survey that it is now time for the Irish government to take responsibility and drive the digital transition programme in Ireland and put into effect a robust BIM implementation programme that will support companies, industry bodies and the government itself to delivery the type of actions envisaged by the WEF in 2018.

Whilst the sample selected in this study was relatively small the results show that there is broad agreement on the applicability of the implementation WEF model in Ireland but that there would need to be further refinement by whatever organisation is given the task to produce such an implementation programme.

The role of each of the stakeholders identified in this paper cannot be underestimated and it will take a co-ordinated effort to but in place a robust implementation plan for an order to be brought to the formal introduction of BIM in Ireland.

There is no doubting the need for this order given that the Irish government have committed to rolling out BIM across the public sector building programme over the next number of years.

Whilst many stakeholders might question the application of the WEF model in Ireland the authors respect the position, respect, experience and authority that the WEF bring to the debate and would strongly advise those entities that will be the custodians of Ireland's national BIM programme to give it due consideration.

It is also important that any such implementation plan should be compatible with the vision and objectives set in the 2017 National BIM Council of Ireland Digital Transition Roadmap (2018-2021) despite the fact that the vision of this roadmap published in 2017 has still not been funded or an entity identified to manage its programme.

Time is now of the essence if the Irish government is to realise the efficiencies envisaged in its Project 2040

National Development and Plan and in the publication of the government's recent climate change action plan.

REFERENCES

[1] World Economic Forum, (2018), An Action Plan to Accelerate Building Information Modeling (BIM) Adoption, February 2018,In collaboration with The Boston Consulting Group.

[2] NBS (2019) National BIM Report 2019: The definitive industry update, RIBA Enterprises Ltd.

[3] Hore, A., McAuley, B. and West, R. (2017a), Global BIM Study: Lessons for Ireland's BIM Programme, CitA Ltd.

[4] Centre for Digital Built Britain, (2018), The Gemini Principles, Centre for Digital Built Britain and Digital Framework task Group.

[5] National BIM Council, (2017), Roadmap to Digital Transition for Ireland's Construction Industry, December 2017.

[6] Forfás, (2013), Ireland's Construction Sector: Outlook and Strategic Plan to 2015.

[7] Government Publications, (2014), Construction 2020, A Strategy for a Renewed Construction Sector, published by the Stationary Office, May 2014.

[8] Government Publications, (2017), Action Plan for Jobs, published by the Stationary Office, May 2017.

[9] Office Government Procurement. (2017). A Public Sector BIM Adoption Strategy: A GCCC positional paper. Government Construction Contracts Committee

[10] Hore, A., McAuley, B. and West, R. (2017) BIM in Ireland 2017, CitA Ltd.

[11] Government of Ireland, (2019), Project Ireland 2040, Build Construction Sector Performance and Prospects 2019.