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Overcoming Resistance To BIM: Aligning A Change Management Method with A BIM Implementation Strategy

BIM TUDublin
bim@tudublin.ie

Sarah MacLoughlin
Technological University Dublin

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Sarah MacLoughlin[1] and Emma Hayes[2]

School of Multidisciplinary Technologies,

Technological University Dublin, Ireland.

E-mail: [1]c11353901@mydit.ie [2] emma.hayes@digitalbuiltconsultants.com

Abstract—The adoption of Building Information Modelling (BIM) in the Irish construction industry has risen from 10% in 2011 to over 70% in 2018. Where there is criticism towards BIM concerning its ability to reduce environmental impact, it is not about the ambition to adopt BIM but more so the capacity to embed BIM within the industry. The National BIM Council introduced a Roadmap to Digital Transition for Ireland's Construction Industry 2018-2021, which defines a strategy to transform the construction industry to digital. This research paper explores how small to medium size companies within the Architectural, Engineering, and Construction (AEC) industry in Ireland can respond to both organisational and individual resistance to the implementation of BIM processes in practice. A literature review and stakeholder interviews from organisations at various stages of implementing BIM have demonstrated that to change how the industry works there must be an overall goal to adopt BIM. In order to achieve business goals, it is important to investigate change management processes which can support the reduction of resistance from employees. While it has been found that implementation needs to come from a bottom-up approach, more importantly it is top-down from management that will make BIM practices the norm. As a response to the industry's introduction of BIM and the transition to digital, companies are embarking on organisational change through the review of business structures and operational strategies. To reduce resistance companies have come up with new approaches, such as introducing an implementation team, developing training programmes, and altering the organisational structure with new roles and responsibilities. A BIM adoption roadmap that aligns change management methods with a BIM implementation plan can bridge the gap and ensure that BIM becomes commonplace within an organisation.

Keywords – Building Information Modelling, BIM Adoption, Digital Transition, Change Management, Implementation Roadmap

I INTRODUCTION

As the Architectural, Engineering and Construction (AEC) industry in Ireland embarks on the transition to a more digital and collaborative working environment, businesses are being challenged to meet the sophisticated demands of clients [1]. With the rapid adoption of Building Information Modelling (BIM) across the globe, companies are reviewing their organisational structures and changing the way in which they carry out their day to day tasks. It has been identified that one of the largest barriers to overcome is the behavioural resistance to change that is found amongst both client and the construction industry [2].

Within the Irish industry small to medium size companies are defined as having less than 50 employees and an annual turnover not exceeding €10 million [3]. Verheugen [4] describes micro, small and medium-sized enterprises as the engine of the European economy, and that these companies are a vital source of jobs while creating entrepreneurial spirit and innovation within the EU. Table 1 below highlights the size of architectural firms in Ireland recorded from a survey carried out to study the strategic leadership of architectural firms in Ireland [5]. With an astounding 86% of firms in Ireland employing five or less staff, it is essential to assist these firms during such a widespread industry transition to digital, and the welcomed introduction of BIM.

Table 1 Architectural firm size Ireland 2010

Total No. of Employees	2010 (%)
1	45
2	14
3	14
4	8
5	5
6-10	8
11-20	4
21 +	2

Research in the area of BIM tends to focus on finding solutions to technical difficulties with BIM [6]. There has been less research carried out focusing on how BIM implementation influences work practices, and the processes required by an organisation to reach overall goals and employee expectations [6]. Lasting BIM adoption has stalled not because of technology or business, but because of human factors. Managing employee expectations is vital. "BIM doesn't work" [7], that is in many cases true as BIM does not work for those whose expectations are too high. BIM does not work for someone who does not know how to use it, and for someone unwilling to change how they think and work.

With the publication of the NBC Roadmap to Digital Transition for Ireland's Construction Industry 2018-2021, Knoster, T (1991) states "Without Vision, you will have confusion; without Skills you will foster anxiety; without Incentives you will meet resistance; without Resources you will breed frustration; without a Plan you'll make false starts"[1]. This statement provides insight of the requirements that the management of AEC practices must consider with the introduction of BIM to the Irish construction industry.

II Review of Literature

The literature reviewed for this paper considers the changes that have come with the adoption of BIM from both an industry and a business perspective. The Irish construction industry is growing concerning BIM adoption with 76% of respondents to the Irish BIM study reporting confidence in BIM skills and knowledge. 79% of those also reported an increase in demand for BIM in Ireland [8].

a) Barriers of BIM

The focus of current research looks mostly at the industry, company and project level of BIM adoption. Several obstacles which have been identified include; low awareness, lack of training, dissolution of the industry, difficulties in changing traditional work methods, the introduction of new roles and responsibilities, as well as software interoperability. However there has been one impediment which has not been investigated, and that is the perception of BIM by users [9]. Individual users of information systems react in different ways to new technologies. Users of technologies may; reject it completely, partially use it, resist it, unwillingly accept it, or fully embrace it [10].

The UK National BIM survey 2018 identified that the largest barrier to BIM adoption within organisations that have yet to adopt BIM is the lack of in-house expertise (71%), closely followed by no client demand (69%), lack of training (61%), and cost (50%) [11]. In comparison to the findings from the UK market, within the Irish industry, the top five barriers reported [8] were client awareness, implementation within smaller companies, lack of standardisation and protocols, lack of in-house expertise, and issues regarding data ownership and liability. It is expected that with the growth of BIM, traditional work methods will diminish as more and more clients see the benefits of BIM.

Another significant obstacle affecting BIM adoption may be the demographic of the industry and the enthusiasm to adopt new technology. It has been identified by the Irish Prospects to 2016 [12] that the ageing of the Irish workforce and the availability of new graduates to the industry are key barriers to be overcome. Technology is playing an increasingly more critical role in the construction industry, the most recent trends within the green building and BIM shift in technology implementation. Technology brings many opportunities to workforce development including non-construction audiences. The opinions of Uddin and Khanzode [13] is that BIM is enhancing people's careers both with existing professionals and in creating new career paths for young professionals [14]. It is believed that the Irish construction industry can address skill shortages through the utilisation of BIM, increasing the attractiveness of the construction industry to young professionals according to Construction 2020 [8]. Given the uptake of digital technologies within the industry, this is expected to increase the demand for highly skilled labour [15]. To address skill shortages, it is clear that more needs to be done to reverse the stereotypes associated with the construction industry. It seems, even amongst those working in the construction industry that the perception is comprised of hard hats and hi-vis vests. There is a lack of awareness in terms of careers in construction management, and offsite activities such as design [15].

b) Changes BIM Brings to a Company

A case study in Sweden of how a large public client is initiating BIM implementation within their organisation has identified the changes which occur with BIM implementation and categorises these changes into four areas; BIM management systems, BIM measurements, BIM skills, and BIM education [6].

BIM management systems look at changes such as; defining the lowest level of BIM use within the organisation, the mentoring of BIM, new role descriptions such as BIM coordinator and BIM manager, and the adoption of industry standards. BIM measurements investigate the level of knowledge within an organisation regarding BIM and the attitudes towards BIM, this also includes measurements of BIM such as key performance indicators (KPIs). Meanwhile the BIM skills level looks at competencies and framework agreements for BIM coordinators and BIM managers, as well as BIM education considering BIM training courses [6].

Research which aims to extend the Unified Theory of Acceptance and Use Technology model to understand the perceptions of BIM users resulted that Performance Expectancy does not directly affect Behavioural Intention, thus signifying that BIM is often perceived as an unrewarded addition to traditional work processes [9]. The findings from this survey show the need to redefine organisational strategies, standards, and incentives to advance user acceptance of BIM.

c) Organisational Change

Organisational change is described as a process which is undertaken by a company to change its working methods or aims [16]. Organisational change is categorised into two categories, planned and unplanned change. Planned change is described by Windell L French [17] as a deliberate effort to modify an organisational system to respond to environmental and internal forces.

The evidence of a relationship between BIM and organisational change can be argued as it is suggested in research that BIM is a driver for change [18]. Succar [19] suggests that in order to achieve successful BIM implementation, a company must first make use of the potential benefits and understand the need of how BIM implementation is dependent on changes within an organisation. Froese [20], suggests similarly that for BIM to reach its full potential within a company there is the requirement to alter the skills and work practices of its users. Succar [19] describes within the research framework presenting BIM in a multidimensional setting, that the higher the maturity stage of BIM implementation within a practice, the requirement for larger changes will gradually increase.

Adopting BIM without a plan is described by Deutsch [7] as taking a trip unaware of the baggage that can slow you down, and with regard to BIM these items relate to workflows, learning curves, interoperability, insurance, identity and role, mindset, and communication [7].

d) Individual Resistance

Individual resistance to change resides in the basic human characteristics such as individual's perceptions, personalities and needs. In understanding the importance of change, having the clearest vision or plan is not enough to succeed. There are a number of barriers to implementing change and individual resistance is one of them [21].

Due to the likelihood of employee resistance, change should only be done to accomplish an overall goal and not for the sake of it. Change provokes resistance as people can be afraid of the unknown, do not have an understanding for the need to change, or share the same vision for change [22]. Employees may see change as a threat to their current position within a company and therefore resist the change. This type of change is primarily due to the lack of communication between managers and employees causing rumours and speculation [21].

Change occurs at the individual level and for a company to successfully change all individuals within the organisation must change; therefore it is essential to understand how change affects one person at a time [23]. ADKAR is an acronym that represents the five key milestones an individual must achieve to succeed with an overall goal. These five milestones are; awareness, desire, knowledge, ability, and reinforcement.

Table 2: Change management milestone definitions

ADKAR	Definition
Awareness	Business reason for change
Desire	Desire to engage with change
Knowledge	Having the information to change
Ability	Action planning / implementing change
Reinforcement	Ensuring that change sticks

III Research Description

The objective of this research area is to explore the following:

a) The potential barriers faced by BIM implementation within micro, small, and medium AEC practices in Ireland,

b) The identification of the changes BIM brings to AEC practices and how those changes may transpose into challenges,

c) The effect of changes introduced by BIM implementation on the people within AEC practices,

d) How AEC practices are currently overcoming resistance which has arisen from BIM implementation,

e) Aligning a change management plan with BIM implementation to allow BIM to become common practice within AEC practices in Ireland.

This research was carried out through literature review of currently available published material, and stakeholder interviews with AEC practices at various stages of BIM implementation.

a) Pre-Interview Questionnaire

Participants were chosen from three different levels within AEC companies in Ireland. The three levels defined were;

- General Management,
- BIM Management,
- BIM Users.

A pre-interview questionnaire was completed by each participant to give insight to the research area and to allow for openness and transparency from the interviewees when partaking in the semi-structed face-to-face interviews. The questionnaire was completed by six of the seven interviewees and covered the following topics:

- Background and professional experience.
- Understanding of BIM and BIM maturity levels.
- Understanding of company's vision for BIM.
- The most significant barriers to BIM.

b) Semi-Structured Interviews

Seven individual qualitative interviews were used for the purpose of stakeholder research to collect data from individuals currently working through BIM processes daily. The face-to-face interviews were carried out with a selection of employees from each level within companies in the Irish AEC market. Figure 1 identifies the number of interviewees from each category.

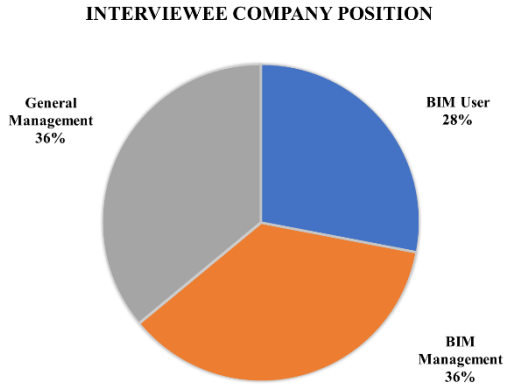

Fig 1: Chart demonstrating company position interviewed

IV Results

The results discussed are based on deductive analysis of qualitative data collected from semi-structured interviews with individuals from AEC companies currently implementing BIM, along with data collected from the pre-interview questionnaires. Descriptive analysis of interview data was carried out using Excel. All interviews were commented on by the researcher and responses were categorised with general topics discussed.

Table 3: Data source figures

Data Source	Respondents
Pre-interview Questionnaire	6
Semi-structured Interviews	7
Total	13

a) Awareness of BIM

The interviewees were asked a series of questions to determine an understanding of BIM within the office environment. Concerning the company's vision for BIM this was something that most stakeholders found difficult to define. Five of the seven respondents discussed in one way or another that they believed their company's vision for BIM was to deliver all projects within the office through the BIM process. While this was the consensus, many of the interviewees from both a management and employee level felt a clearer vision was something that would benefit the company and individual's understanding of what the company is working towards. Figure 2 below illustrates the results from the pre-interview

questionnaire regarding understanding of company vision for BIM.

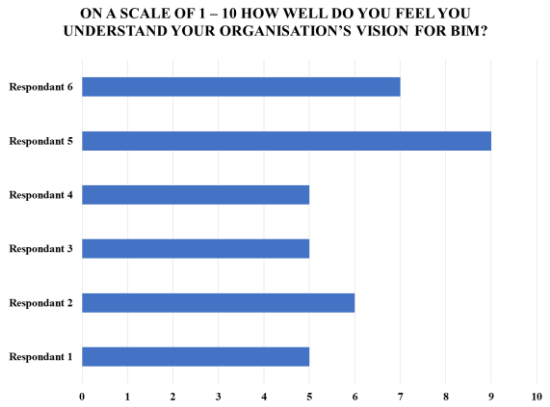

Fig 2: Understanding of company's vision for BIM

Interviewees were asked to describe why there would be a need for BIM implementation within the company which 57% responded that due to the organisation's client demand it was necessary. 14% responded that it would be a requirement due to the company working on government contract jobs, which under the BIM mandate due to be published later this year it would become necessary to deliver jobs through the BIM process. Others felt that company size had to do with BIM implementation, and if BIM wasn't implemented the company would be left behind.

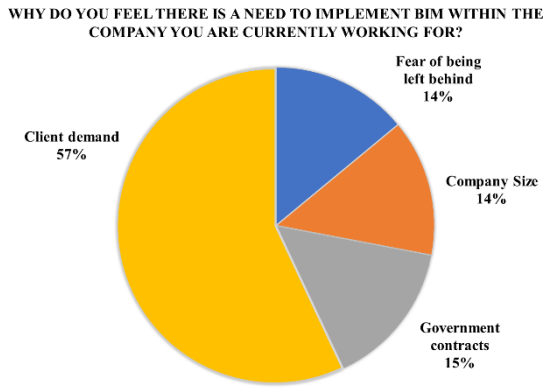

Fig 3: Why there is a need for a company to implement BIM

In understanding the awareness of BIM within the companies, management were asked a series of questions relating to corporate BIM strategies, the introduction of new roles and responsibilities, and how these roles are defined within the companies. The response to these questions was mixed from individuals within the same companies. The response was that corporate BIM strategies were in place, but it was not something written down and is a broad statement that alters depending on what the client for a specific job wants. Concerning new roles and responsibilities 67% of respondents agreed that the BIM process had brought new roles to the companies, while the new roles are not defined within the company's organograms. One interviewee discussed the longevity of these roles and whether these roles would be better assigned to existing roles within the company.

b) Building Desire Within Companies

Building on desire within the companies' employees were asked about the involvement of managers regarding BIM implementation. 50% of the respondents reported that managers were actively and visibly involved, while the remainder respondents said that some of the management were more involved than others but in general everyone was trying to come to terms with the understanding of the BIM process. Respondents felt that management could provide more clarity with a visible BIM implementation plan, standards, and protocols, as well as management having a more meaningful understanding of what goes on regarding the modelling aspect of BIM. A topic which was discussed with all interviewees was personal views regarding openness and transparency during an organisational change such as BIM implementation, and 100% of all respondents felt that this is extremely important to avoid the harvesting of resistance within teams throughout the offices.

When looking at desire from a company management perspective, managers were asked to describe any incentives the companies had considered to aid the implementation of BIM. All mangers who were interviewed spoke about educational assistance as an incentive to employees, while employees were aware of the educational assistance it did not appeal to some as it would involve additional hours outside of work. 67% felt that there needs to be more done to show employees the benefits to their working life with the introduction of BIM processes, and that, that alone is an incentive in itself. Further incentives would be worth considering as there was a general feeling that it would be beneficial in achieving the overall vision for BIM.

c) Learning About Knowledge

The structure around knowledge within the interviews was based on gaining an understanding of in-house standards and protocols, as well as how companies were managing the growth and spread of knowledge within the practices.

Interviewees from the management category within the companies were asked questions regarding in-house standards and protocols of which 66% responded yes that there were standards and protocols in place, but that these were very much a work in

progress and not always adhered to by staff. When the employees within the companies were asked a similar question regarding in-house standards and protocols, there was an uncertain response from many of the interviewees. 75% of the respondents were unsure if there were standards and protocols in place, or respondents were aware of some form of standardisation but did not know what this standard was. Interviewees from the employee level were asked if standards and protocols would be beneficial to the day-to-day tasks of the company, of which 100% of respondents agreed some form of structure is required in order to know what should be achieved.

Similarly, both management and employees were asked questions regarding strategies for building knowledge within the companies. Management discussed the availability of educational assistance to staff, as well as a continuous professional development (CPD) program within the offices. While these are in place one interviewee spoke about the need for more formal training as it was very much dependant at the moment on staff being self-driven to want to learn and upskill in the area of BIM. 50% of respondents from the employee level responded that there is an unawareness of any specific training plans regarding BIM, but that there is assistance available if desired. The remainder 50% agreed there was a form of training plan in place for individuals and this was covered within CPDs and within annual KPI reviews.

d) Ability

While looking at the ability section of the interviews, here an analysis of how companies action the previously studied area of knowledge was reviewed. With management the following topics were discussed; BIM implementation plans, change management strategies, provision of time and tools to learn new processes, and any changes in the output of work since the introduction of BIM to the offices. 66% of respondents stated that there was no BIM implementation plan within the office or that it was not something that was used. The mangers felt that this is something that would be beneficial to the company and that it needs to be made visible to all staff. Respondents also felt the implementation plan should cover BIM as a general topic and not just the information model.

In relation to a change management strategy each respondent covered this aspect differently. Respondent one felt that BIM was not a dramatic change to the company and therefore it had not been put through previous change management techniques. Respondent two felt that change management is a challenging aspect for smaller companies due to the need of recourses to manage it. Respondent two also felt that BIM very much introduced a social aspect in a manner whereby it requires the need to interact with others, as well as the cultural change aspect of BIM. There was a general feeling towards cultural change that difficulties are experienced with all aspects of it. The third respondent described change management as a work in progress. The shift from 2D to 3D within the office was a significant change that was probably not managed in the way it should have been, the interviewee felt that this may have been the case due to initial resistance from the management team when first introducing BIM processes.

When reviewing the questions asked at the employee level within the companies, the main focus was on the provision made for people who are changing daily work processes. All respondents at this level felt that the provision of CPD training was available to them, that the managers are aware of the competency level within the office regarding the new software, and that this is something that is taken account for within project planning as well as team structures. Two out of the four respondents often felt that a lot of the focus is about getting the modelling aspect of information right which does not always benefit the project. One respondent in this area felt that previously there was a safety net provided by management within the company, but that this seemed to no longer be evident something that can harvest anxiety within employees trying to learn new information.

e) Reinforcement

Within the reinforcement section of change, management interviewees were asked to identify the barriers which had been exposed within the company during the implementation of BIM. Within the pre-interviewee questionnaire, interviewees were asked to rank a list of identified industry barriers to BIM in order of importance Figure 4 below identifies the results from the pre-interview questionnaire. The most significant barrier identified was differences in expertise (13%), closely followed by no contractual framework for BIM (10%), and cost of implementation (10%).

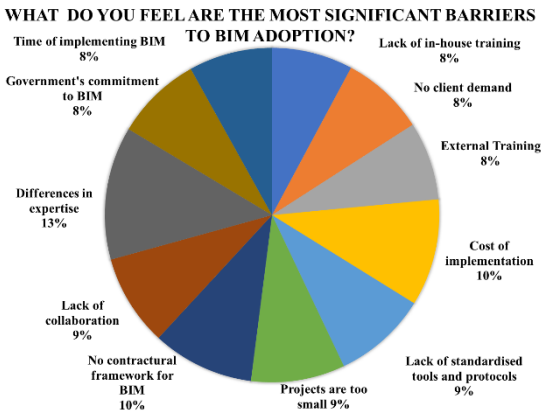

Fig 4: Significant barriers to BIM adoption in the Irish construction industry

Figure 5 highlights the personal barriers interviewees have experienced which were expressed during the interviewing process. The results from these questions have similarities with regard to lack of collaboration and time, but many of the responses highlighted by individuals differs from the barriers the industry is facing. The most significant barrier in this case, is time with 28% of respondents highlighting this as a personal barrier.

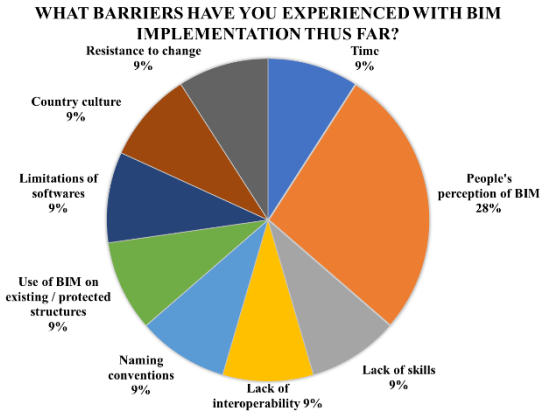

Figure 5: Personal barriers faced during BIM implementation

Interviewees were also asked to describe the valuable lessons which the companies have learnt through the introduction of BIM processes. 57% of respondents felt that the most valuable lesson learnt is the importance of the collaborative work environment which BIM has introduced. A number of interviewees expressed the reluctance to work with other consultants in the future who do not a least provide a 3D information model. 26% of respondents also took valuable lessons learnt from the less linear process concerning BIM. One interviewee described the process as "*everything is happening at once",* while another described the work that is currently going on within the industry as "*we are building at an exaggerating rate which is only made possible by BIM*". Other valuable lessons learnt described by interviewees included; the value in a 3D information model, federated site models and clash detection.

Finally, within reinforcement, it was essential to look at the way people were working on a day to day basis. Interviewees were asked if it was often easier to revert back to traditional work methods before the implementation of BIM when external pressures of time etc. were applied. Figure 6 below illustrates the findings from this, whereby 57% of responded yes, it is often easier to revert to traditional work methods.

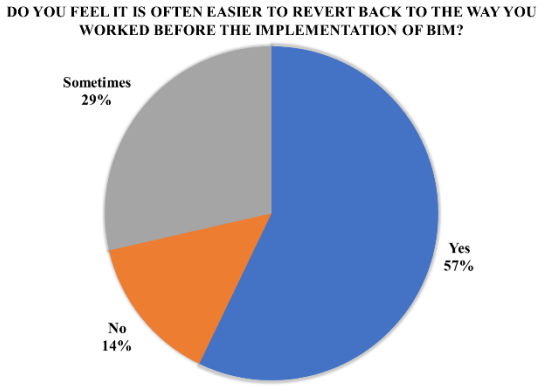

Figure 6: Interviewee likelihood to revert to traditional work methods.

V FINDINGS

Having analysed the findings of the semi-structured interviews and research into the area of change management methods. Figure 7 below represents fourteen key issues identified within twelve BIM implementation plans. These issues have been identified through a comparison study of implementation plans from three categories; software, academic, and AEC industry professionals [24]. Figure 7 also defines the stages covered by the Prosci ADKAR change management model which highlights the five key milestones an individual must achieve for change to be successful [23].

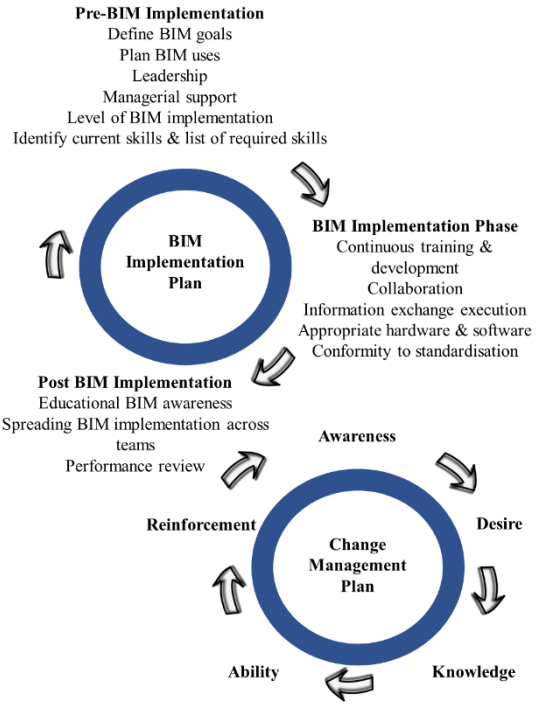

Figure 7: Identified stages of BIM implementation and change management

The findings of this research paper are represented in Figure 8 which represents a BIM adoption roadmap aligning change management methods with a BIM implementation plan.

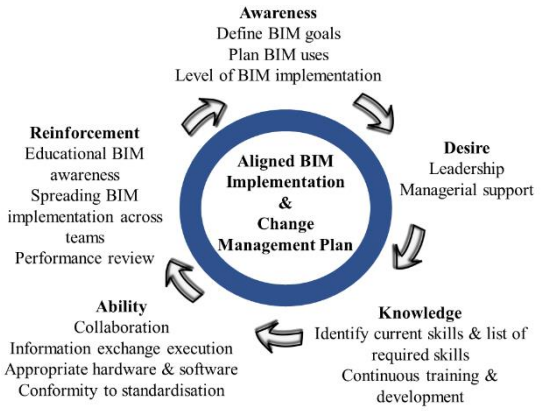

Figure 8: BIM adoption roadmap aligning change management methods with a BIM implementation plan

VI Conclusions

Comparison between the literature review and the analysed data from the pre-interview questionnaire and semi-structured interviews provided initial direction on how companies are currently managing the implementation on BIM within AEC practices in Ireland. The data collected from the literature review identified some of the barriers to BIM which the industry is facing, and furthermore, the data collected during the interview process identified a different set of obstacles to which SME practices have been exposed. The literature review also identified the changes that BIM brings to a company such as the new roles and responsibilities identified within the BIM process. The interview process with AEC company stakeholders investigates these changes and how companies are managing change within the business. The consensus from the interviewing process resulted that generally, BIM is a significant change to the daily operation of a practice in Ireland and that it is a change that needs to be carefully managed to avoid resistance from both an organisational and individual perspective. Respondents felt that a BIM adoption roadmap that aligns change management methods with a BIM implementation plan could only benefit the transition period, by providing measurable milestones and allow for reflection on change.

Further research into BIM implementation and change management methods is necessary to resolve issues highlighted by the respondents regarding the management of a large-scale change such as BIM. Future work to trial the proposed roadmap will be necessary to show the benefits of delivering BIM with change management.

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