The potential to enhance and develop BIM capabilities of companies in the AEC sector through collaboration with third level institutions in knowledge transfer partnerships (KTPs)

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Abstract –

Knowledge Transfer Partnerships (KTPs) are projects that are developed between third level educational institutions such as universities or colleges and companies through which these institutions share and develop knowledge and assist industry in business development. The KTP process provides businesses with the opportunity to improve their competitiveness and productivity through the better use of knowledge and technology. The KTP process also permits the increase in business relevance of knowledge based research and teaching for the educational institutions involved. This paper looks at the potential of KTPs between academia and companies in the AEC sector and how they could achieve a range of objectives in the development of theoretical and practical educational materials for BIM curriculums.

Keywords – KTP, BIM, ADOPTION, POTENTIAL, CAPABILITIES, BARRIERS, EDUCATION, LEARNING, ACADEMIC, COLLABORATION, IMPLEMENTATION

I INTRODUCTION

Higher education institutions have a responsibility for the dissemination of managerial knowledge in society (Rajat, 2012). This is developed further in the research of Hope (2016) who observed that the remit of higher education institutions such as universities in recent years has progressed beyond education and research to that of engaging with a diverse range of stakeholders to deliver services that provide social and economic benefits, shifting to an inclusive model for the exchange of knowledge.

With regard to the construction industry the Lambert Report (2003) recommended that universities should develop knowledge exchange activities with industry in order to complement and stimulate teaching and research capabilities within the higher education sector. The research of Arayici, Egbu & Coates (2012) also established that within construction organisations learning was increased and there was a better shared understanding of BIM was established through knowledge exchange. The research further noted that forward lean thinking was established which led to investigations as to how further efficiencies could be gained and also how BIM could benefit other aspects of construction activities such as health and safety, labour training, communication on site, construction planning and monitoring. Therefore, the construction industry's route map to collaboration and high efficiency can only be underpinned by BIM and the importance of its adoption cannot be overestimated (The Farmer Review of UK Construction Labour Model, 2016). The one key area that industry and academia could benefit from closer collaboration is on BIM. This need for to collaborate has been emphasised by the rapid evolution of BIM technology which has not only highlighted the importance of research and development to improve knowledge of BIM, but has also encouraged innovation in the application of BIM in real-world projects (Jack & Cheng, 2015). However, BIM is not just a technology; it is also a project management tool and process, which allows all project stakeholders to collaborate more efficiently and effectively than under traditional processes (Xianbo, 2017).

This paper outlines the Knowledge Transfer Partnership (KTP) process and how its philosophy of collaboration between academia and industry and focus on knowledge exchange and development can be harnessed to further promote BIM adoption in industry and to also enhance knowledge on BIM within both industry and academia. Kwawu et al (2010) observe that successful knowledge transfer will provide innovative ideas that can then be applied to

successive projects. This is further developed in the research of Hope (2016) who observed that KTPs have also been identified as being very important in promoting innovation (Hope, 2016). Innovation that is based on mutual interest and trust (Edwards, 2007).

II OUTLINEOF THE KTP PROCESS

Knowledge Transfer Partnerships (KTPs) have emerged as an important method of facilitating knowledge exchange as they address the limitation in the development of associated educational material (Coates & Arayici, 2010).
The KTP process is a formal relationship between a company and an academic institution, which will facilitate the exchange and transfer of knowledge, technology and skills to the company partner who cannot access these from other sources and to provide practical industry experience back to the academic partner (Hope, 2016). For the KTP to work the company requires to identify a core strategic need and in collaboration with the academic partner develop innovative solutions to this need that can assist in business growth (Choudrie & Culkin, 2013).
Therefore, it is an approach that has also been extremely successful in encouraging practice-based learning at higher education level (Harris, Chisholm & Burns, 2013).
The KTP was created in the UK in 2003 as a government-led initiative to support and assist organisations and were formerly known as the Teaching Company Scheme (Choudrie & Culkin, 2013). They arose in the 1980s from UK government economic policy that has pursued a strategy of encouraging the creation of an economy that is knowledge (Edwards, 2007).
The partnership uses a recently qualified graduate known as an associate to work in the company generally for twenty-four months, but can be for a period of between six and thirty-six months, on a project of strategic importance to the business, whilst being supervised by university academics (Hope, 2016). It is important to note that a KTP can involve more than one associate (Choudrie & Culkin, 2013). As well the recently qualified graduate or graduates a KTP project will also involve an industrial supervisor and an academic who collaborate to share knowledge for mutual benefit (Edwards, 2007). In the arrangement the KTP associate holds a pivotal place in the collaboration and is central to the knowledge transfer capacities of such projects (Gertner, Roberts & Charles, 2011). Therefore, these collaborative arrangements are established for the purpose of allowing members of the host firm to work with academics and the associate or associates to resolve a business problem through the introduction of new technologies or management practices (Edwards, 2007).
In the UK governmental support for a KTP is provided through a subsidy for participating organisations: This subsidy contributes towards the cost of the academic institution's participation and the company makes up the balance of the project cost. Therefore, the subsidy is provided to cover the academic supervisor's time providing expertise to the project and attending meetings. However, the subsidy is not entirely provided externally and entirely by the government. It requires a vested interest from the organisation when diffusing an innovation. Therefore, from a monetary aspect the KTP risk is shared between the academic institution, the government funding agency and the company (Choudrie & Culkin, 2013).

III THE POTENTIAL BENEFITS OF KTPs TO ENHANCE BIM CAPABILITIES

BIM has developed over the last three decades into an important technology in the AEC sector in the capturing, storage, sharing and management of building information over the whole life cycle of a building (Jack & Cheng, 2015).
Choudrie & Culkin (2013) noted in their research that following completion of a KTP, there is usually significant increased profitability for the company as a result of the improved quality of operations and accessing of new markets.
Evidence in the research of Arayi, Egbu & Coates (2012) develop this further by noting that BIM implementation through a KTP project is a relevant alternative to addressing key construction sector issues, and offers solutions that increase productivity, efficiency, quality; reduce costs, lead times and duplications through the effective application of collaboration and communication amongst stakeholders on construction projects.
With regard to the academic institution KTPs lead to an enhancement in teaching and learning from subsequent course content development (Choudrie & Culkin, 2013). This is as a result of academics gaining access to the work-based environment where they can experience working alongside company staff on current projects, building knowledge which in can subsequently develop future research and the delivery of work-based case studies (Harris, Chisholm & Burns2013,).
This is confirmed in the research of Hope (2016) who observed that benefits to university's include the development of relevant and current teaching materials, the opportunity to initiate new research projects and publish research papers, all of which may contribute to funding and quality assessments

such as the UK Research Excellence Framework. Therefore, academic supervisors gain industrial experience allowing them to become more knowledgeable tutors (Coates, Arayici, Koskela, & Type, 2010).
The KTP process has also provided a sustainable and successful method for universities to engage with employers at post-graduate level (Harris, Chisholm & Burns, 2013).
The associate or associates employed on the KTP, also benefit from the opportunity to manage a challenging project and participating in a recognised career development programme, where on average of 73 per cent of associates have been offered employment by the company involved upon completion of their project (Hope, 2016).
Therefore, the KTP process can provide a range of benefits for each partner taking into account globalisation, continual technological innovation and the need for a competitive economy (Harris, Chisholm & Burns, 2013).
With regard to BIM Eadie et al (2014) observed that a KTP can facilitate more efficient implementation by learning through a bottom-up approach and dealing with resistance to change rather than top-down approach from management.
Therefore, partnership between industry and academia is one of growing importance as technologies continue to be developed and need to be implemented into the classroom as well as industry (Anon).

IV BIM BARRIERS TO SUCCESSFUL IMPLEMENTATION OF KTPs TO ENHANCE BIM CAPABILITIES

Peattie (1993) cited in Edwards (2007) observes that many of the barriers to the successful delivery of a KTP project include process difficulties linked with the control and delegation of responsibilities in any partnership. Context issues and the extent to which the nature of the firm influences the innovation process were also highlighted as well as content issues linked with knowledge communication.
This was also noted by Gertner, Roberts & Charles (2011) who observed that developing a shared understanding among the partners to facilitate knowledge transfer was an issue.
Contractual difficulties and fears over confidentiality in the KTP agreement can also result in inadequate knowledge exchange (Hope, 2016). This is also confirmed by Xianbo (2017) who noted that conflicts over intellectual property (IP) rights for knowledge and innovation can be an issue.
Facilitating the important role of the associate partner as focal point to drive the project and to transfer knowledge between university and industry was identified as a potential issue.(Gertner, Roberts & Charles, 2011).
Another potential barrier to a successful KTP project is the competence of the associate in the knowledge transfer process and that they must become competent in both the university and industry community through the adopting of a dual identity (Gertner, Roberts & Charles, 2011).
There may also be a reluctance of academia to get involved as Choudrie & Culkin (2013) observed in their research that the main beneficiaries of a KTP are the company rather than the academic institution. Xianbo (2017) also noted that higher education institutions are rated as low importance as a source of knowledge for innovation.
Harris, Chisholm & Burns (2013) record that academics are still reticent and employers still, in the main, fail to see the advantages of KTPs.
The research of Eadie et al (2014) observed a number of barriers to BIM implementation generally which include lack of senior management support, cost of implementation (software and training),scale of culture change required, other competing initiatives, lack of supply chain buy-in, staff resistance and ICT literacy, legal uncertainties, ownership and intellectual property, contractual arrangements, product liability risks, professional indemnity insurance and authenticity. However, the research of Eadie et al (2014) further identified that the main barriers by those already using BIM were concerns about return on investment and a general lack of vision of benefits, the scale of culture change required within the organisation and then the lack of flexibility" and cost of training, barriers that could be overcome by the promotion of BIM.
In comparison the three least important barriers for those who already implementing BIM were, legal uncertainties, staff resistance and lack of staff ICT literacy and technical expertise.
The three least important barriers for those who had not implemented BIM were the lack of senior management support", other competing Initiatives and the cost of training, which indicates that senior management generally are supporting the move towards BIM adoption.
However, effective knowledge transfer between higher education institutions and industry is inhibited by the inherent barriers which exist in the transfer of knowledge such as lack of relevant tacit knowledge on behalf of the researchers who create knowledge; the ineffective documenting and disseminating of knowledge created which inhibits diffusion of knowledge; the lack of adequate motivation within practitioners to change their current mindset and behaviour patterns and the ineffective contextualisation and adaptation of knowledge by practitioners restricting effective

utilisation of new knowledge by industry (Xianbo, 2017).

V PRELIMINARY SURVEY AND DATA ANALYSIS

In order to elicit the key drivers and barriers for the use of the KTP process to enhance BIM adoption a preliminary electronic survey was issued to professional members on Linkedin. The survey was produced using LimeService. Using data analytics within LimeService, the results of the survey have been analysed to determine the means ranking of the key drivers and barriers to KTP.

In total 19 surveys were completed and returned. The largest AEC sector to return the survey was Construction with 11 survey responses (58%), followed by Architectural and Surveying with 7 survey responses (37%), then Engineering with 1 survey response (5%). Respondents were then asked to identify their knowledge of KTP. Overwhelming the majority of the respondents had previous experience of KTP , 68%, and only 32% of the respondents had previous/ current experience of KTP.

Table 1 identifies the level of knowledge and understanding that the respondents have regarding KTP.

Table 1 – Levels of knowledge with AEC sector on KTP

Response	Frequency
No Knowledge	6 (32%)
Limited Knowledge	7 (37%)
Fair Knowledge	3 (16%)
Good Knowledge	2 (11%)
Excellent Knowledge	1 (4%)

Collectively the respondents had no - limited knowledge of KTP (69%), with (31%) of respondents have fair - excellent knowledge. This data highlights the need for Institutions offering KTP to do more to make the AEC sector aware of this provision.

Table 2 presents the findings on the respondents' level of knowledge of BIM

Table 2 – Levels of knowledge with AEC sector on BIM

Response	Frequency
No Knowledge	0 (0%)
Limited Knowledge	3 (16%)
Fair Knowledge	13 (68%)
Good Knowledge	3 (16%)
Excellent Knowledge	0 (0%)

Table 2 identifies that the majority of the respondents had fair knowledge in BIM (68%), whilst 16% have limited knowledge and 16% have good knowledge. No respondent felt that they had either no knowledge or excellent knowledge.

Data analysis was conducted in the survey response to ascertain the means ranking of the key drivers and key barriers of using KTP to enhance BIM.

Table 3 – Ranking of Drivers of KTP to enhance BIM adoption

Driver	Rank
Improved Quality of Operations	1
Improved Collaboration	2
Enhance Communication	3
Efficiency of BIM implementation	3
Improved Efficiency	5
Increased Productivity	6
Access to New Markets	7
Reduced Costs	8
Increased Profit	9

Table 3 identifies the highest-ranking (moderate) drivers for using KTP to enhance BIM is Improved quality of operations, improved collaboration between project stakeholders and enhanced communication between project team members.

The lowest ranking (slight to moderate) barriers related to reduced cost and increase in profit. These finding suggests that cost is not a key driver and that the benefits of improved quality, collaboration and communication outweigh the cost of implementing at KTP.

Table 4 – Ranking of Barrier of KTP to enhance BIM adoption

Barrier	Ranks
Transfer of Knowledge	1
Competence of Associate	1
Lack of Senior Management Sup-	3
port	3
Unknown Cost	3
Competing Initiatives	6
Technical Expertise	7
Delegation of Responsibilities	7
Staff Resistance	9
Shared Understanding	9
Lack of Vision	9
Cultural Change	
Issues of Conflict	12
Dissemination of Knowledge	13
IPR	13
Reluctance of Academic	13
Contractual/Legal Issues	16
Return on Investment	17
ICT Literacy	18

Table 4 identifies the highest ranking barrier to KTP to enhance BIM adoption. The results show that the highest ranking barriers (moderate barriers) are the ability to effectively transfer the knowledge and the relative competence of the associate employed by the KTP, then lack of senior management support and the unknown costs. These barriers suggest that there is still insufficient understanding on how KTPs operate and how knowledge is captured and utilised effectively. The lowest ranking barriers (a slight to moderate barrier) to using KTP to enhance BIM adoption included ICT literacy, Return on Investment and Contractual Issues. These lowest ranking barriers show that the technical and legal and financial aspects of KTP were not major deterrents in implementing a KTP.

VI CONCLUSION

In the analysis of the preliminary survey it has highlighted there is a clear linkage between the levels of knowledge of KTPs within the AEC sector and the ranking of barriers to the use of KTPs to enhance BIM adoption. The survey as previously outlined recorded that a combined total of 69% respondents have limited or no knowledge of KTPs which is reflected in the response to the main barriers to the use of KTPs to enhance BIM adoption being the ability of a KTP to effectively transfer knowledge, the competence of the associate appointed, the unknown cost and competing initiatives. Therefore, the survey has identified a clear need for the AEC sector to be better informed about the adavantages of using the KTP process and confirms the research of Xanibo (2017) outlined earlier which identified lack of adequate motivation within industry to change their current mindset and behaviour patterns which restricted effective utilisation of new knowledge such as BIM and its adoption. The preliminary survey also highlights and confirms literature that academia need to be more proactive in promoting the advantages of the KTP process to the AEC sector to enhance BIM adoption.

However, the preliminary survey has identified the requirement for a larger a survey across the AEC sector in Northern Ireland to obtain more comprehensive and detailed data and identify how the KTP process to enhance BIM adoption within the AEC sector can be promoted and implemented more effectively. There is also the potential of carrying out a similar survey in the Republic of Ireland and to subsequently compare and contrast results.

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