Using the Knowledge Transfer Partnership model as a method of transferring BIM and Lean process related knowledge between academia and industry: A Case Study Approach

Paul Coates
University of Salford
Greater Manchester, UK
S.P.Coates@pgr.salford.ac.uk

Yusuf Arayici
University of Salford
Greater Manchester, UK
Y.Arayici@salford.ac.uk

Lauri Koskela
University of Salford
Greater Manchester, UK
l.j.koskela@salford.ac.uk

Abstract

This paper looks at the vehicle of the Knowledge Transfer Partnership (KTP) between academia and business and how successful it is in reaching its range of objectives and developing theoretical and practical educational materials for BIM curriculums. The KTP operates by helping businesses improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK knowledge base. At the same time, it also helps to increase the business relevance of knowledge base research and teaching for the academic institutions.

For this paper, the KTP project between the University of Salford and John McCall Architects (JMA) in Liverpool is reviewed. This two year KTP focused on the implementation of BIM and Lean principles to JMA's architectural practice in social housing sector. The KTP project is 70% Government funded and 30% funded by JMA and undertaken under the Technology Strategy Board programme, enabling innovation in business. The initial aims and objectives of the KTP are assessed and evaluated against the actual knowledge transfer and implementation and the final outcomes of the KTP for the University, JMA and the KTP associate are highlighted.

Keywords

Building Information Modelling, Knowledge Transfer Partnership, Lean thinking, integrated design process, BIM Implementation

1. INTRODUCTION

KTPs are projects between Universities and companies through which academia share knowledge and assist in the development of the industry, in this case in BIM adoption and Lean implementation. The Lambert Review of Business-University Collaboration acknowledges that the Government's funding (in the UK) of knowledge transfer has helped to generate culture change and increased capacity to engage with business that delivers results (Lambert 2003). Businesses need to develop efficient processes, using the most current tools, technologies and techniques available. Collaboration using the KTP model also

creates an invaluable opportunity to develop high quality, accurate educational material for courses at the universities in both undergraduate and postgraduate levels.

There are three main objectives of a Knowledge Transfer Partnership:

1) To facilitate the transfer of technology and the spread of technical and business skills
2) To stimulate and enhance business relevant research and training undertaken by the Knowledge Base
3) To provide company based training for KTP Associates to enhance their business and specialist skills

Here we will look at the second of these objectives in relation to BIM and Lean. Creating educational opportunities is as much challenging as it is significant to educate and up skill people practising in the construction sector. Further, developing educational material and designing and developing curriculums for BIM and Lean from scratch is a big barrier. This is because, most of the sources of materials are either from research studies, which are only released via publication only, or vendor oriented material, which is biased towards proprietary BIM tools. In order to overcome this limitation in educational material development, one effective way is to undertake a KTP.

Both academia and business have something to contribute and gain in this commensurate approach to knowledge development. Knowledge transfer seeks to organize, create, capture or distribute knowledge and ensure its availability for future users. This concept of knowledge sharing forms the basis of the KTP schema. Using the knowledge gained from the KTP the University can develop course material. The mechanism of knowledge exchange which takes place as part of a knowledge transfer partnership is illustrated in Figure 1.

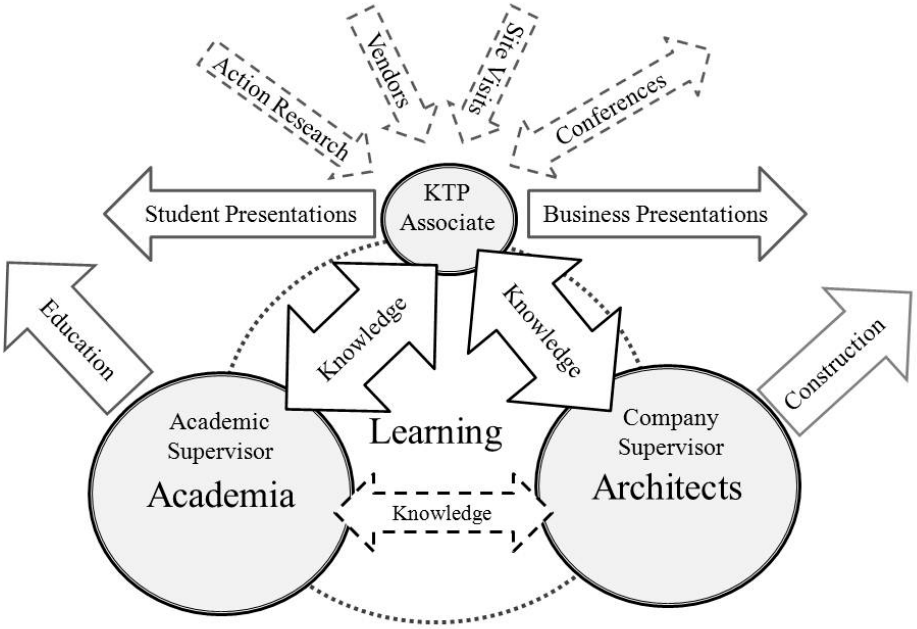

Figure 1 KTP knowledge transfer schema

For example, in the case of KTP project about BIM and Lean between the Salford university and John McCall Architects (JMA), academia needs to understand them both from a business and academic perspective. This knowledge needs to extend to a clear prediction of the skills businesses will require from future university graduates. This knowledge then needs to be integrated into existing and new course offerings.

Companies such as JMA face many challenges when adopting BIM and Lean. Firstly they need to become sufficiently informed of current technology and concepts to develop an appropriate plan of action. Secondly companies need to have a good understanding of their existing processes to ensure new methods and systems can be effectively and beneficially integrated. Particularly important is having an understanding of what gives the company its unique competitive advantage. This needs to be maintained through the disruption of innovation. Then companies need to develop a vision for their future and gain appropriate support for this concept. In line with lean principles new tools and processes need to be thoroughly tested before they are integrated into the company's production system.

2. THE BIM LEAN IMPLEMENTATION PLAN IN THE KTP PROJECT

The first objective of the KTP was to undertake a detailed analysis of the company's current process and situation. Through a series of interviews and research it was possible to produce process flow charts of the current process. Soft system analysis was the method chosen to gain an insight to the way JMA works. The conversion of tacit knowledge into a visual comprehendible form was seen as a critical stepping stone allowing transfer of knowledge in this project. The current technology used at the company was also evaluated and a report was written documenting this. Discussions were also undertaken with internal and external stakeholders to gain a deep insight into the organisation. Research and presentations were also given showing the benefits of Lean and BIM to the organisation. These advantages were also documented in several reports. Detailed strategies of how to adopt BIM and Lean were then produced. Suggested Lean Processes and procedures for JMA were documented using the A3 method. A report on the Key evaluation metrics was also written (Coates, P., et al 2010). The next step was to identify and undertake pilot projects using BIM and at the same time identify more potential efficiency gains. Running alongside this was a program of staff training, bringing staff up to speed on the new methods of operation. JMA BIM manual was also produced. Finally the whole project is to be reviewed and the lessons learn recorded and evaluated. Future potential benefits are also to be identified. The KTP project a two year project, is to be completed by January 2011.

3. KTP KNOWLEDGE REQUIREMENT AND KNOWLEDGE ACQUISITION ANALYSIS

At the outset of the project a knowledge analysis was undertaken to identify the areas of knowledge necessary to undertake the KTP (see Figure 2). This was achieved by analysing the original project plan. The precise areas of additional knowledge required will depend on the previous areas of expertise of the KTP associate. Some of the areas of knowledge were accessible through soft system research at the company (Checkland, P., et al 2006). Other areas required research outside of the company, particularly to establish current "best practice" for BIM and Lean. To better understand the application of BIM best practice, in this case the KTP associate visited practices in Finland and undertook telephone interviews with practices in the UK.

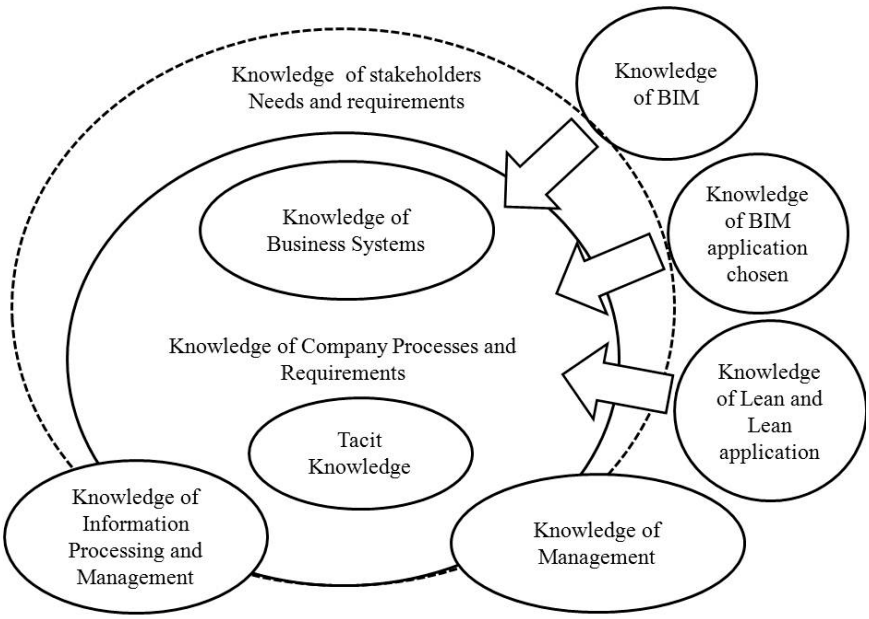

Figure 2 Analysis of Knowledge Requirement

Action research formed a major element of the KTP. Action research is simply a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out.

3.1. THE APPLICATION OF KNOWLEDGE

It is critical that methods are setup to continually and effectively disseminate the knowledge gain through the KTP projects.

a) Deliverables issued to relevant parties
b) Recorded monthly and weekly meetings to share information and knowledge
c) Minutes
d) Presentations to JMA, the University of Salford and external parties

The final stage of the project plan is concerned with the overall evaluation and dissemination of the project. This will take place in the last few months of the KTP.

3.1.1. TANGIBLE COMPANY BENEFITS

The benefits achieved for John McCall Architects out of this KTP were as follows:

a) Input into the JMA quality system
b) A SWOT analysis was produced for the company
c) The company developed many lean process improvements as part of the KTP
d) The company develop a better knowledge of the concept of BIM
e) The company and its new Lean / BIM approach was promoted at many exhibitions and venues (Marketing)
f) Staff were trained in operation skills to use BIM software
g) Software tools to be used underwent a rigorous process of evaluation
h) More efficient and cost effective processes adopted by the company

i) Development of the knowledge management database

3.1.2. TANGIBLE UNIVERSITY BENEFITS

The benefits achieved for the University out of this KTP were as follows:

a) Flow charts and process diagrams of existing processes
b) A SWOT analysis of the company
c) Powerpoint presentations developed show the benefits of BIM to all the different disciplines within the construction process
d) Powerpoint presentations explaining Lean principles and their application to architectural practice
e) Development and use of systematic BIM authoring tool review process and presentations
f) Documentation of Lean efficiency gains and the efficiency gains by adopting BIM
g) Developing a set of Key Performance indicators for the project
h) Development of a database system to structure information residing outside of the BIM graphical model
i) Presentation at the University to other students concerning the project
j) Observation and awareness of the issues concerning the piloting projects
k) Awareness of the training methods and material developed to train members of staff at JMA
l) Review and dissemination of the project
m) Presentation at several conferences and several journal papers written
n) KTP Associate teaching involvement with MSc students
o) The KTP also contributes to the Research Assessment exercise (RAE) rating of the educational department involved.
p) Identify new research themes and undergraduate and post graduate projects

From these deliverables the university has been able to develop material for new and existing courses.

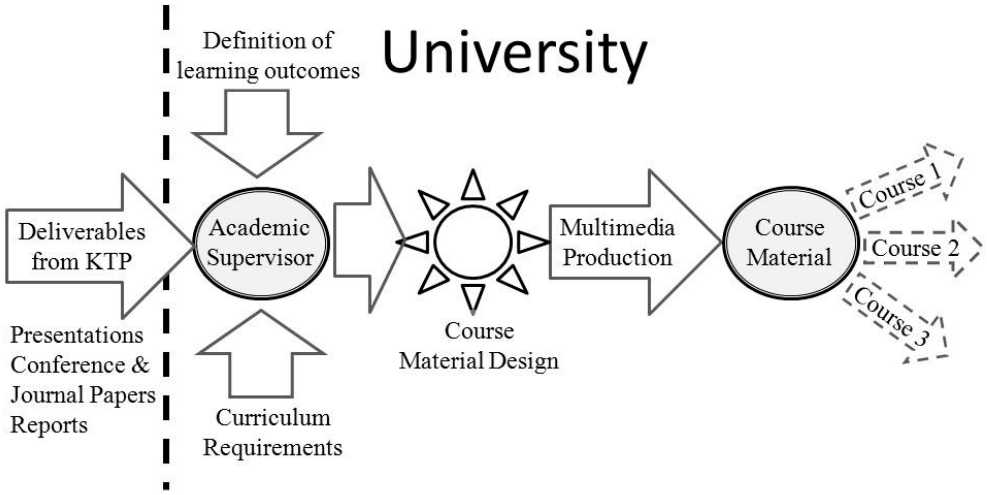

Figure 3 Converting KTP knowledge into course material

3.1.3.TANGIBLE ASSOCIATE BENEFITS

Although the primary beneficiaries of the KTP are business and academia, the KTP associate as the main conduit of knowledge between the University and the business is also in a position to benefit to the knowledge gained.

a) The KTP associate has gained a unique knowledge in an area of development and innovation in Lean and BIM
b) Access to experts both in the academic and business fields
c) Development of presentation and project management abilities
d) Makes the KTP associate more employable at the end of the KTP

5.00 TRANSFERRING KNOWLEDGE INTO THE BIM / LEAN CURRICULUM

What is clear is that BIM is not just another CAD; it is the shift from presenting information about the building to representing this information. BIM is a technology which allows its users to see old thing in new ways and facilitates prototyping in the design process. BIM also offers a platform for interoperability and integrated project delivery.

Development of successful education depends on more than just curricula development. Supporting curricula development there needs to be knowledgeable tutors, a body of research and reference material and the appropriate environment in which to learn. Through the KTP the academic supervisors gain industrial experience allowing them to become more knowledgeable tutors. Developing on from this is the aggregation of learning communities. The conference and journal papers produced during the KTP also added to the body of knowledge stored on the Universities websites, that maybe referred to by future students. As part of the KTP many of the deliverables were in the form of rich pictures which are more likely to be understood and easily assimilated by future students.

By applying concepts of BIM and lean simultaneously allows for the adoption of BIM with a greater understanding of the efficiencies to be gain and how the technology integrates within the construction process. The development of curricula and learning material very much depends on a prediction of the future. Using the BIM maturity index maybe one way of considering future development (Succar, 2009).

To consider BIM and Lean in terms of a single discipline result in a sub optimal understand of the concepts. Universities have addressed this in different ways. Some universities integrate BIM into Architecture courses, some run Architectural Technology or Architectural IT courses, other see BIM and Lean as an element to be incorporated into project or construction management courses. BIM and Lean are equally relevant to subjects such as Engineering, Quantity surveying or Facilities Management. To achieve the maximum benefit from course material develop it should were possible meet the needs of multiple courses. If BIM and Lean are to provide integrated solutions such competencies should be developed as learning outcomes for educational programmes (Onur, 2009).

In deciding the methods of student knowledge acquisition as part of the BIM curriculum should be considered. Guidance on the best methods to used are indicated on the retention rate pyramid (see Figure 4). Bloom’s taxonomy of the cognitive domain suggests that higher levels of learning and activity cannot be addressed before the lower levels are covered. (Bloom 1956) Figure 5. This should also be considered when developing the curriculum.

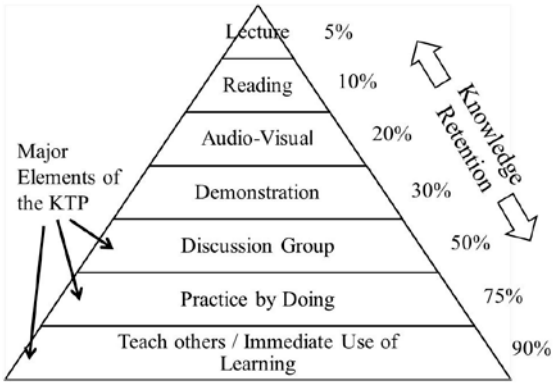

Figure 4 Analysis of best methods of knowledge acquisition (Steve Draper)

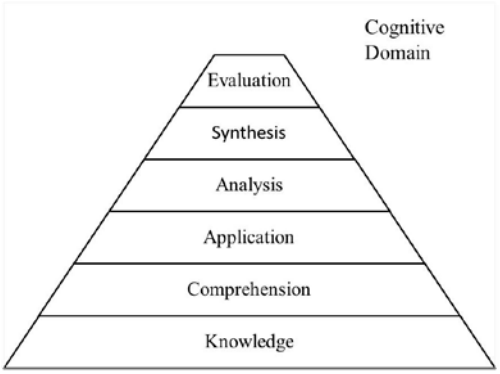

Figure 5 Bloom's taxonomy of cognitive domains

6.00 CONCLUSION

The vehicle of the Knowledge Transfer Partnership has allowed senior academics from the University of Salford to get a more direct experience of the issues and challenges addressed when transitioning to BIM and Lean. Academics are able to see what is happening in the business setting and are able to ask questions to those directly involved. This gives an immediacy and accuracy to the insights gained. Numerous deliverables were produced which can be used at a later date by the University. New knowledge has a limited shelf life and it is hoped that through the connections made through the KTP ongoing links between academia and industry will be forged.

The John McCall practice has also benefited from the academic understanding of BIM and Lean related issues effectively allowing them enter the Lean and BIM arena with a more mature level of knowledge. Although described as a knowledge transfer partnership through action research new insights have been gained and new knowledge created.

Acknowledgement

The KTP is part funded by Government; KTP is a Technology Strategy Board programme, enabling innovation in business. The University of Salford is a participant KTP Knowledge Base providing expertise and resources to businesses via a strategic project.

References

Arayici, Y. Coates, P. Koskela L. Kagioglou, M. Usher C. O'Reilly, K. (2009). BIM Implementation for an Architectural Practice, Managing Construction for Tomorrow International Conference, October 2009, Istanbul Turkey

Bartholomew, D. (2008). Building on Knowledge, developing expertise, creativity and intellectual capital in the construction professions, Wiley-Blackwell ISBN 978-1-4051-4709-5

Bloom, B. S. (ed.) (1956). Taxonomy of Educational Objectives, the classification of educational goals – Handbook I: Cognitive Domain New York: McKay

Christensen, C. (2003). The innovator's solution: creating and sustaining successful growth. Harvard Business Press. ISBN 1-57851-852-0

Checkland, P.B. & Poulter, J. (2006). Learning for Action: A short definitive account of Soft Systems Methodology and its use for Practitioners, teachers and Students, Wiley, Chichester. ISBN 10 0-470-02554-9

Cheng, R. Questioning the Role of BIM in Architectural Education http://www.aecbytes.com/viewpoint/2006/issue_26.html

Coates, P. Arayici, Y. Koskela K. Kagioglou, M. Usher, C. O'Reilly, K. (2010). The key performance indicators of the BIM implementation process, ICCBE 2010, Nottingham, UK

Horne, M. Roupe, M. Johansson, M. (2005). Application of Building Information Modelling for Visualisation in AEC Education, CONVR2005 5th Conference of Construction Applications of Virtual Reality, ADETTI/ISCTE, Durham, 12-13 September

Paterson, J.J.G. Kouider, T. Scott, J.R. (2006). Building Information Modelling (BIM) – Developing Methodologies for Undergraduate Teaching at Concept and Detail Design Phases Adaptables2006, TU/e, International Conference On Adaptable Building Structures, Eindhoven The Netherlands 03-05 July 2006

Ibrahim, M. (2007).Teaching BIM, What is missing? The challenge of integrating BIM based CAD in today's architectural curricula, ASCAAD 2007, Alexandria, Egypt

Lambert, R. (2003) Lambert Review of Business – University Collaboration, HN Treasury, Public Enquiry Unit http://www.lambertreview.org.uk

Lockyer, L. Bennett, S., Agostinho, S. and Harper, B. (eds) (2009). The Handbook of Research on Learning Design and Learning Objects: Issues, Applications, and Technologies, New York, NY, Hershey

Mokhtar, A. (2007). BIM as Learning Media for Building Construction, CAADRIA 2007 - The Twelfth, Conference of the Association for Computer Aided Architectural Design in Asia, April 18-22, Nanjing, China

Onur, S. (2009). IDS for ideas in Higher Education Reform, First International Conference on improving construction through integrated design solutions CIB IDS 2009 VTT Symposium 259

Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders, Automation in Construction 18 (2009) 357 - 375