CO-CREATION OF KNOWLEDGE AND VALUE FOR POST-OCCUPANCY DECISION MAKING

Poorang Piroozfar
A.E.Piroozfar@Brighton.ac.uk, @BEACON, SET, University of Brighton, UK
Kemi Adeyeye
O.Adeyeye@Brighton.ac.uk, @BEACON, SET, University of Brighton, UK
Micah Rosenkind
M.M.Rosenkind@Brighton.ac.uk, SET, University of Brighton, Watts Building, UK
Graham Winstanley
G.Winstanley@Brighton.ac.uk, CEM, University of Brighton, UK

ABSTRACT

Capital investment fund for schools increased from £683 million in 1996-97 to £8.2 billion in 2010-2011. Decentralisation, has led to devolving responsibilities to local authorities, bringing along more independence for the schools and at the same time an increase in the number of decision makers with a new set of agendas, criteria, concerns and priorities. School buildings on the other hand are prone to post-occupancy design and alteration. In addition to post-occupancy design decisions, many other operational and maintenance decisions need to be made on a day-to-day basis to ensure that all activities within a premise will be carried out flawlessly.

An ongoing research project focuses on post-occupancy design issues in schools in the UK. The research investigates the key factors in post-occupancy performance, in close collaboration with key stakeholders in school projects. It also outlines the maintenance and management of those premises and maps out the flow of information and the exchange of knowledge in this process. Using those findings it will then propose a decision support system to assist schools as well as local authorities in their post-occupancy design decisions.

This paper establishes the decision processes and investigates the relationships between the stakeholders and how those may have impacts on the decision processes. The main focus of this paper however, is on the collaborative work processes for all the stakeholders to co-create knowledge and value. Once established it will then be used to devise a decision support system which will act as a permanent hub to facilitate information flow and knowledge exchange for post-occupancy works in school buildings. The paper will conclude with the design criteria for such a platform.

Keywords: Co-creation of knowledge, Co-creation of value, Decision making processes, Post-occupancy design, School buildings.

INTRODUCTION

Buildings are subject to rapid change in functionality, fitness for purpose, performance requirements and efficiency. There has been a uniform call for more agility, mutual collaboration, and learning form the other industries' best practice over the past two decades [see for instance Eagan Report (1998), and Latham Report (1994)]. The respond to this change however, appears to be totally different in construction and manufacturing industries. Despite other industries in which the

product life tends to become shorter and shorter, in building industry the requirements alteration calls for physical and spatial improvement to extend the effective service life of the buildings. This has widely been acknowledged (see amongst the others Constantino and Sivo 1999) and often translates to post-occupancy building practices; what can be defined as continuous interventions to minimise obsolescence, dilapidation, deterioration, deficiencies in performance and sustainability of buildings (Douglas 2006).

A substantial amount of post-construction activities and resources are spent on the performance upkeep of buildings. Lack of engagement of designers, builders and sometimes even procuring clients with building performance may create one-off or chronic problems, which tend to persist, or result in innovation targets being missed, and true successes being overlooked - even in some of the best buildings (Bordass and Leaman 2005). The justification of this research project therefore, lies in identifying and minimising design-sourced problems in the post-occupancy stages of school projects.

In this context the aim of the study is to facilitate knowledge exchange and information flow for collaborative decision processes of stakeholders during post-occupancy works and to improve the existing practices.

The study focuses on post-occupancy design issues in primary and secondary schools in South East England. In close collaboration with major stakeholders in school projects, the research provides an overarching review of the key factors in post-occupancy performance, outlines the maintenance and management of these premises and maps out the flow of information and the exchange of knowledge in this process.

This paper aims to partially present some findings of this research project. It provides a brief review of key factors, and major players in post-occupancy processes. The decision processes during the major capital projects or minor maintenance and operational processes will then be established. It also investigates the relationship between the stakeholders and how this impacts the decision processes. The main contribution of this paper however, remains to be how the collaborative processes were streamlined for all the stakeholders to work together and co-create knowledge and value to devise a platform. Once designed, this platform in return will act as a hub to facilitate information flow and knowledge exchange as a decision support system for post-occupancy works in school buildings. The paper will finally conclude with what measures need to be taken into account, should co-creation of values be targeted, enhanced and used to design a common working platform for the stakeholders across the education sector.

BACKGROUND

In UK pre-university education, the responsibility lies with the central government but requires equal commitments down to the local authorities and the school management teams. Capital investment fund for schools increased from £683 million in 1996-97, to £3.8 billion in 2003-04 and £8.2 billion in 2010-2011.

Building Schools for the Future (BSF), was a new investment programme launched by the former Department for Education and Skills DfES in 2005-2006 to help boost education in deprived and low-performing areas in England. BSF was primarily targeting secondary education. It was followed by its counterpart for primary schools in March 2006: the Primary Capital Programme (PCP). The main aim of BSF (and PCP) was to provide school buildings for the 21st century at the scale that has not been

seen since Victorian times. It was designed to rebuild or refurbish all secondary schools in England over a 15-year period at a cost of £45 billion, with local authorities participating in a series of 15 'waves'. Even at its peak, this was believed to be an immensely ambitious programme (House of Commons 2007).
The new coalition government believed that BSF had not been able to fulfil its targets; hence an overhaul to England's school building programme was announced in July 2010 (DfE 2011a). This affected all school building programmes especially the BSF. Nevertheless, the Department for Education (DfE), are still committed to creating a world-class state education system by giving greater autonomy to schools, improving parental choice, offering more support for the poorest, whole system improvement, and great quality provision for children (DfE 2011b).

SETTING THE SCENE

The main focus of this study is post-occupancy activities in school premises. These activities can range from day-to-day operational tasks, one-off or regular maintenance works to major construction works. Post-occupancy building work, referred to as any work proposed or carried out on an existing building, includes building adaptation work as well as operational and management activities. It involves four independent but interacting areas and agents including: stakeholders, processes, information (and knowledge) and decisions (and actions). Figure 1 further clarifies the context of this study:

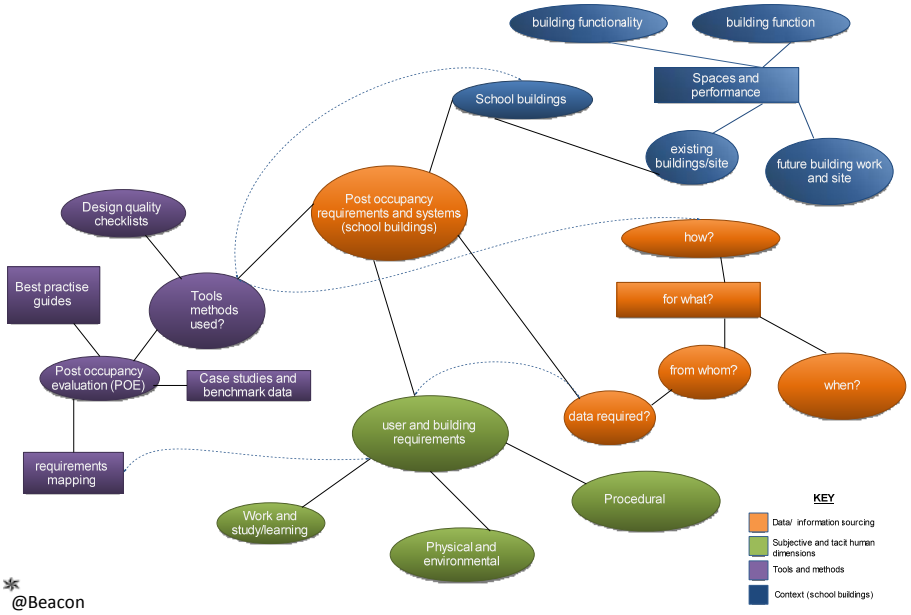

Figure 1: The scope of study

POST-OCCUPANCY DESIGN PROCESSES

The decision mechanisms for post-occupancy work are supported by post-occupancy evaluation (POE). A POE provides feedback on how a spatial environment performs in provision of support for the occupying organisations and individuals (Oseland 2007). Preiser (2002) defines POE as a process of systematically evaluating the performance of buildings after they have been built and occupied for some time.

There are two levels of performance management: performance upkeep and performance adjustment (see Figure 2).

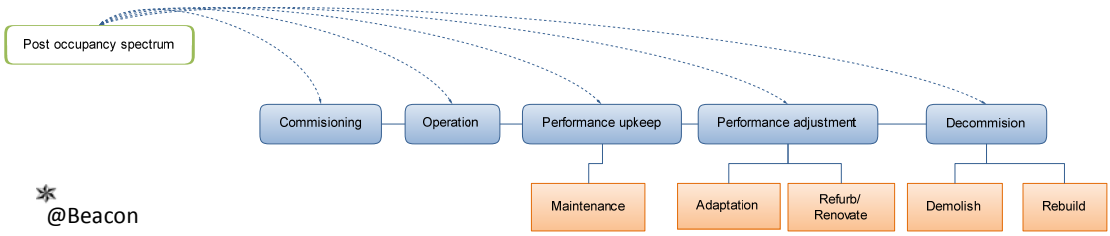

Figure 2: Post-occupancy spectrum (after: Douglas 2006)

The performance of every building deteriorates over time, resulting in loss of value. In certain instances, loss of value is inevitable due to: design and development briefs that give no flexibility to the design team, inappropriately high quality standards, and delays in decision making, the use of one-off design solutions, poor information supply and unmanaged change (Addy 2004). Addy also identifies people issues as: poor communication, conflicting agendas, fixed mindsets, recycling old ineffective solutions and the lack of collaborative working. The response to diminishing building performance depends on building users, asset and value expectations and statutory requirements.

Preiser and Vischer (2004) assert that performance evaluation is based on feedback and evaluation at every phase of the building ranging from strategic planning to occupancy, throughout the building's life cycle.

Whyte and Gann (2001) suggest a number of plausible benefits for conducting a POE:

- Applying design skills more effectively;
- Improving commissioning process;
- Improving user requirements;
- Improving management procedures;
- Providing knowledge for design guides and regulatory processes; and
- Targeting of refurbishment

Despite an increasing interest in building performance assessment and POE, such exercises are simply not undertaken, results not routinely available or used widely by most design and building teams (Bordass and Leaman 2005). POEs are carried out to fulfil a number of purposes (see for instance Whyte and Gann 2001, and also Hadjri and Crozier 2009). The focus of this research is obtaining performance feedback on quantitative (building) and qualitative (stakeholder) level. Vischer (2001) recommends procedural steps that reiterate the need for standardised data gathering, but also includes the requirement to balance qualitative and quantitative datasets, as well as establishing the nature of the focus group to which the information is to be disseminated.

POST-OCCUPANCY DESIGN FACTORS

The literature suggested that there are five factors with major effects on post-occupancy decisions including:

- Design intent and criteria (Perelman *et al.* 2001, Green and Simister 1999, Kelly *et al.* 2005)
- Design decision making (Kelly *et al.* 2005, Hitchcock *et al.* 1998).
- Information and knowledge processes (Bouchlaghem *et al.* 2004, McDermott 1999, Gigerenzer 1996, Galbraith 1977, Winch 2002, Björk 1999, Koutamanis *et al.* 2008, Quanjel and Zeiler 2007).
- Collaborative working practices (Bertelsen and Emmitt 2005, Emmitt and Gorse 2003, Kalay 2006)
- Performance monitoring (CIB 1993, Preiser *et al.* 1988, Giaini 1999, Cory 2001).

The findings from the study also proposed three additional factors, in addition to the five post-occupancy factors found in the literature, namely 'cost', 'quality' and 'lead-in time'.

CO-CREATION OF KNOWLEDGE AND VALUE

Collaboration between the stakeholders has been indicated in literature as a key to a successful post-occupancy performance of buildings. In this project, collaboration has been developed further into a facilitator for co-creation of knowledge and value to devise a platform to assist post-occupancy decisions.

Mass customisation and its evolution to co-creation

A paradigm shift from mass production to mass customisation took place as mass production's main market drivers resulted in fragmentation of the mass market hence the variation in customers' preferences. This however, could not phase out some benefits of mass production. The paradigm shift benefitted them in combination with the needs and demands of the niche market. This resulted in an amalgamation of the best of both worlds: the 'mass' factor of mass production paradigm and the 'customisation' factor of the craft production paradigm. Mass customisation was reportedly introduced during 1980s in major manufacture industries and ever since has evolved, adopted many concepts and adapted to new contexts and has moved forward. Originally being a totally standalone concept, 'co-creation' is one of the latest notions to interweave with mass customisation, facilitate it and in return be promoted by it. In this sense co-creation builds on mass customisation's capacities to take a step forward to engage the customer in the process of creation in a more interactive way before the actual production process starts. However, it is a highly individualised process, with each person's uniqueness affecting the process (Etgar 2007). Co-creation is a market strategy which sets out to enhance customer participation in the value-chain by developing its extensionality beyond the traditional definitions. This however does not necessarily mean that the target is 'value' only. Quite the contrary this can also be done through co-creation of knowledge equally effectively. Lawer (2006) suggests eight styles of firm-customer knowledge and value co-creation (Figure 3).

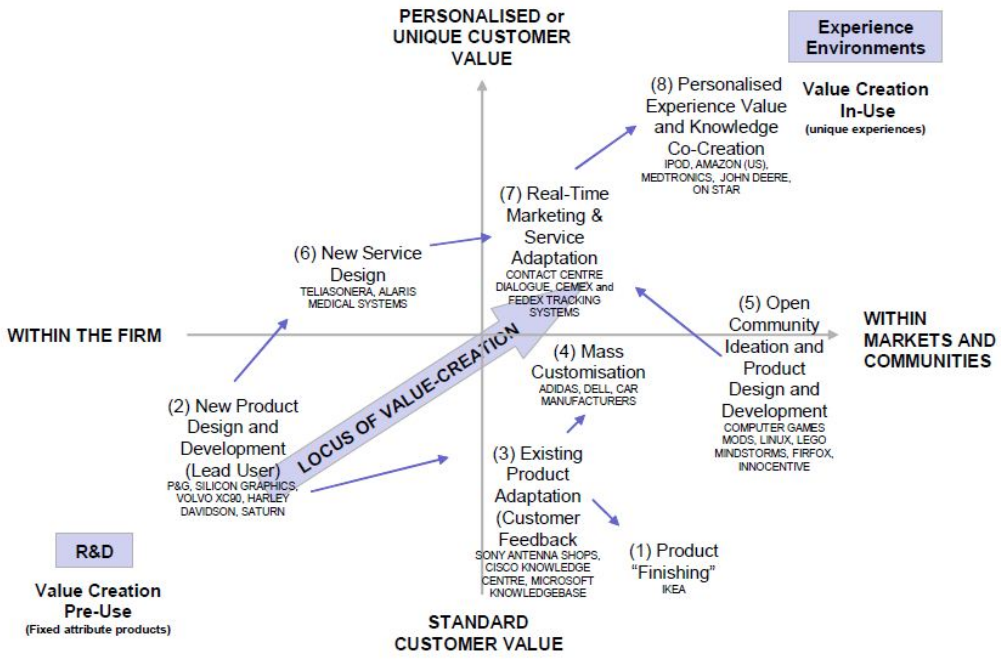

Figure 3: Eight styles of firm-customer knowledge and value co-creation (Lawer 2006)

Prahalad and Ramaswamy, who coined the term co-creation in 2000 probably for the first time, were primarily aiming at harnessing customer competence. As a strategy in market management, it seems to be capable of helping create mutual values through customer participation beyond immediate marketable values (Zwass 2010). Collective creativity is what Sanders and Stappers (2008) take co-creation to refer to. More opportunities for improvement of relationship experience and enhancement of co-creation with customers arise as suppliers learn more about their customers (Payne *et al.* 2007; Payne *et al.* 2009). Prahalad and Ramaswamy (2004) suggest the DART of co-creation, i.e. Dialogue, Access, Risk-Return and Transparency, if co-creation is going to be implemented successfully.

Project stakeholders

The Part A of the Building Bulletins BB98 (DfES 2004) and BB99 (DfES 2006), depending on the size and type of projects, defines the client team as:

- Those responsible for providing pupil places and the school estate, usually the Local Authority and/or diocese;
- The fund holder(s), e.g. governors, bursar, Local Authority building officers etc.;
- Building professionals, e.g. architects;
- Senior school staff and governors, who will need to ensure the design is suitable for the individual needs of the school;
- Other stakeholders, for example local community groups who may wish to use the facilities; and
- The main users of the project, i.e. the staff and pupils.

For this research, further distinctions are made with the Local authority – the fund holder, as the Client; the designers, contractors as building professionals; and the schools, as represented by the facilities/premises officers, bursars, governors, business managers, head teachers, as the user group, generally referred to as 'user' in the paper.

RESEARCH METHODOLOGY

Subsequent to literature search, the primary data was obtained from a steering group (stakeholder forum) comprising of a sample of primary and secondary school representatives, local authority representatives and building professionals.
Invitations were sent to 60 randomly selected private and public, primary and secondary schools in the Sussex area (South East England). In addition, another 20 invitations were sent to the relevant local authority departments and building professionals. 2 design/academic experts were also invited to serve as advisers. The result is a total of 13 members in the steering group representing all identified stakeholders.
Following the data collection, visits were arranged to selected schools, and local councils and semi-structured interviews with school and council authorities were carried out. This was for ensuring that all the areas which might not have been covered in steering group meetings, were explored in enough depth.
At the same time, research meeting and directed studies were held to best explore the applications for devising the toolkit. Not only did this require a user friendly and intuitive GUI, it also needed to have an efficient database as well as a database management system.
Simulated and real cases for making decisions in post-occupancy design were selected to devise a model-base to test out the applicability of the devised prototype of the toolkit. The development of this prototype and its test stage in the third steering group and its concluding development into the design decision support toolkit will be reviewed.

CO-CREATION OF KNOWLEDGE AND VALUE FOR THE DECISION MAKING

The existing models

Across the South East England, the local authorities in charge of capital projects for schools are using different databases and database management tools1. Although one might argue that different users (or user groups) within different regions may hardly reach to the point at which they wish to use each other's managerial systems, the fact that this multiplicity in tools and technologies not only calls for bigger deviated investment by the local and central governments, it also causes confusion and prevents the employment of a common language between different user groups thereby limiting the sharing experience and abolishing the opportunities for co-creation of knowledge and value throughout a wider community of stakeholders.

The design criteria for the proposed model

The core concept deployed for designing a decision platform for this research was fuelled by co-creation of knowledge and value. Figure 4 illustrates this concept as it was tailored to the specifics of this project and its stakeholders. Using the principles of knowledge and value co-creation it was devised so that rather than being a system

[1] East Sussex County Council use 'C-Zone', West Sussex County Council utilise 'Grid for Learning' (WSGfL) while Brighton and Hove City Council have their own portal known as 'Wave', each of which has their own dedicated database and database management system.

designed around standard solutions, it was formed to best offer tailored solutions to unique client's problems and cases. To echo co-creation, it was decided that this process of knowledge building should take shape throughout working with communities of practice within the education sector. To elaborate on decision support systems (DSS) for the next stage, the decision mechanisms in school projects were investigated in steering group meeting. Furthermore, some external decision processes enforced by the funding bodies were elaborated on in the expert interviews with local authorities. To add the value of the existing knowledge, experts' knowledge in data collection and design stage were (and later on for standard DSS for post-occupancy in toolkit development stages will be) employed.

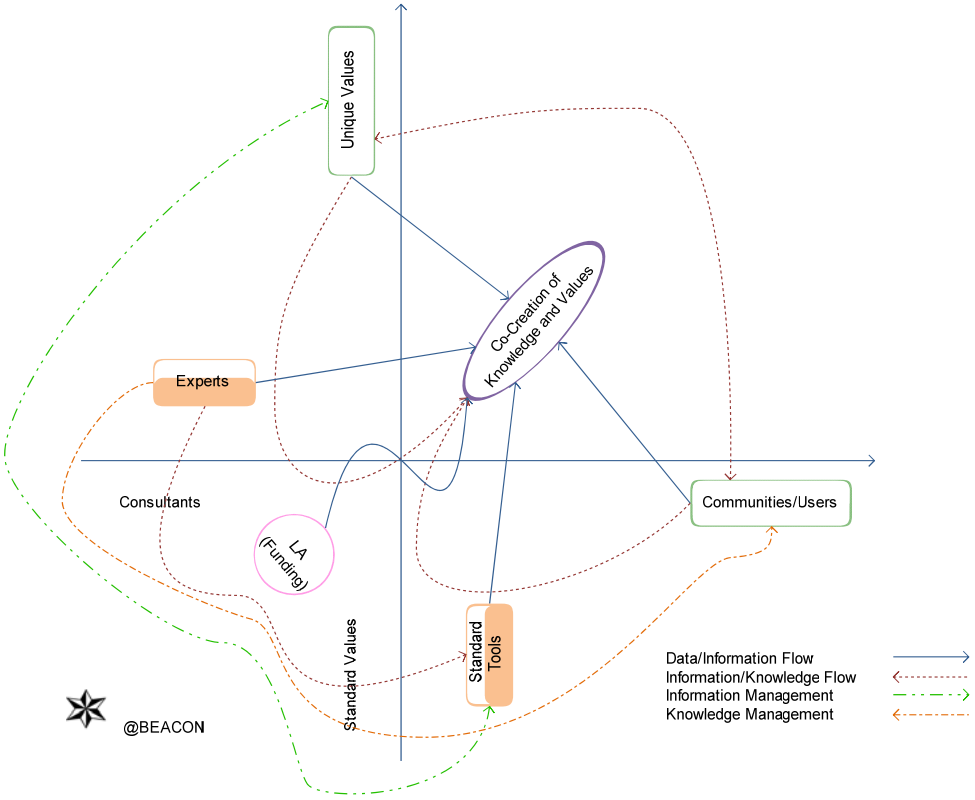

Figure 4: The knowledge co-creation model for developing PODIT toolkit

DISCUSSION

The steering group came to an agreement that consensus on value is most likely to be achieved if the user teams are effectively consulted and their knowledge of managing and maintaining the building is taken into consideration.

The study also found that POE for school project stakeholders is more than mere assessment of the quality or performance of design. The emphasis is on how design decisions and specifications affect operation and maintenance processes.

More importantly, the information gathered at the appraisal stages was considered vital. The group stated that the condition survey will be more useful if it is a living document, rather than something produced periodically. Some members of the group stated that documentation on the condition of their building is often 2-4 years out of

date, which might be a long time depending on the building development plan. This confirmed a need for a real-time system reinvigorated by the timely feedback process, updatable and providing a common platform for sharing knowledge and information on alike or reasonably similar projects to support decision processes.
The most important finding of this study by the toolkit development stage was the pressing need for a system to assist in the streamlining the information flow (particularly upwards, from the schools to the LA) and management of knowledge to facilitate design decisions. A simple model was utilised to capture the findings from this study (Figure 5).
The model identifies the need for decision processes to be more integrated, collaborative and inclusive. It also acknowledges that decision making in post-occupancy processes, is an evolving process. Allowing sufficient lead-in time, information and knowledge gathering and also making the condition survey a living document will help improve the briefing process and will ensure that user performance expectations are considered.

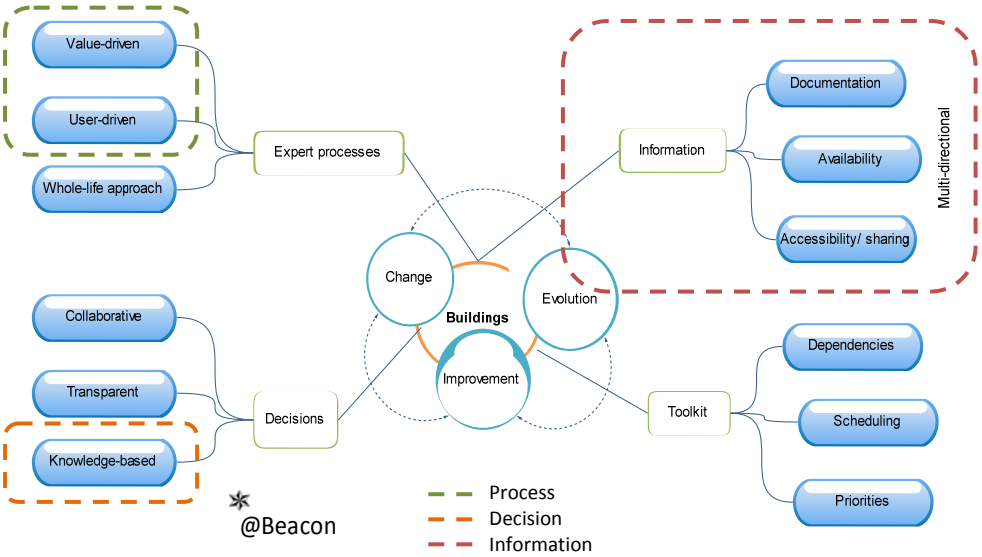

Figure 5: PODIT data/information/knowledge capture model and the agents involved in co-creation of knowledge and value

CONCLUSION

The paper reported on the findings of a study on the impact of post-occupancy processes on the decision process in school buildings with special reference to the concepts employed to develop a proposed toolkit. The principles of co-creation of knowledge and value, as suggested in manufacture and service industries, were investigated to inform the underlying design platform for the toolkit.

The qualitative and quantitative data from steering group meetings, confirmed that a real-time updateable support system for decisions is required for making the most reasonable decisions where multi-criteria and multi-agent decisions are inevitable. Adding to that, quality and competence of decision, is highly dependent on user-friendliness of the system, its offerings around the projects with as many different data-entry, querying, data-categorisation and data-mining tools and techniques as possible. This had a double-edged sword nature. On one hand the simplicity of the

interface was required to be adhered to very strictly and on the other hand not only the comprehensiveness was not supposed to be compromised but also a sensible variation throughout the toolkit was necessary to accommodate as many different categories of users as possible. A diagrammatic model that demonstrates the co-creation model developed for this platform was presented and discussed in this paper.
Based on the findings specific to this research a prototype toolkit will be designed and developed to:

- Provide the ease of use and integrate necessary and right amount of information avoiding being burdensome
- Pin-point and deconstruct the (recurring) problems and alert to pragmatic considerations for one-off problems
- Act as a support system to make right, timely and efficient decisions
- Seamless updating, not as a separate process making the condition survey a living document
- Document product and material performance for knowledge transfer
- Create condition reports, job packages and expenditure/budget reports in as close a format to what is commonly used across the schools as possible

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REFERENCES

Addy, N. (2004), Planning the path to best value, Construction Productivity Network, Workshop Report E4135, CIRIA.
Bertelsen, S. and Emmitt, S. (2005), “The client as a complex system”, Proceedings IGLC-13, July 2005, Sydney, Australia
Bordass, B. and leaman, A., (2005), Making feedback and post-occupancy evaluation routine 1: A portfolio of feedback techniques, Building Research & Information, 33(4), pp. 347.
Bouchlaghem, D., Kimmance, A.G., Anumba, C.J. (2004), Integrating product and process information in the construction sector, Industrial Management & Data Systems, 104(3), pp.218-33.
CIB (1993), Building Pathology: A State-of-the-Art Report, CIB Report Publication 155, CIB Working Commission W86, June 993. Holland: International Council for Building.
Cory, C.A., (2001) Utilization of 2D, 3D, or 4D CAD in Construction Communication Documentation, 5th International Conference on Information Visualisation (IV’01), pp. 219-224.
DfE (2011a), Overhaul to England’s school building programme, Department for Education Official Website, available at:
http://www.education.gov.uk/schools/adminandfinance/schoolscapital/a0061486/overhaul-to-englands-school-building-programme, (Last accessed on 25-08-2011)

DfE (2011b), Departmental information, Department for Education Official Website, available at: http://www.education.gov.uk/aboutdfe/departmentalinformation, (Last accessed on 25-08-2011)
DfES (2004), Building Bulletin 98: Briefing Framework for Primary School Projects, Department for Education and Skills, Edinburgh: TSO (The Stationery Office)
DfES (2006), Building Bulletin 99: Briefing Framework for Primary School Projects, 2nd Ed., Department for Education and Skills, Edinburgh: TSO (The Stationery Office)
Douglas, J. (2006), Building Adaptation, Second Edition, Oxford: Butterworth-Heinemann.
Emmitt, S. and Gorse, C. (2003), "Construction Communication", Oxford: Blackwell Publishing
Galbraith, J. R. (1977). Organization Design. Reading, MA: Addison-Wesley. In: (Winch, 2002).
Gigerenzer, G., (1996), Rationality: why social context matters. In Interactive Minds: Life-span Perspectives on the Social Foundation of Cognition, edited by P Baltes, UM Staudinger, 319.46, (Cambridge: Cambridge Univ. Press).
Green, S.D. and Simister, S.J. (1999), Modelling client business processes as an aid to strategic briefing, Construction Management and Economics (1999) 17, 63± 76.
Hadjri, K. and Crozier, C. (2009) "Post-occupancy evaluation: purpose, benefits and barriers", Facilities, Vol. 27 Iss: 1/2, pp.21 – 33.
House of Commons (2007), Sustainable Schools: Are we building schools for the future? 7th Report of Session 2006–07, Volume I, Education and Skills Committee
Kalay, Y. E. (2006), The impact of information technology on design methods, products and practices, Design Studies, 27(3), 357-380.
Kelly J., Hunter, K., Shen, G. and Yu, A., (2005), Briefing from a facilities management perspective, Facilities, 23 (7/8), pp.356 - 367
Koutamanis, A, Halin, G. and Kvan, T. (2007), "Information standardization from a design perspective", CAADRIA 2007, CAADRIA, Nanjing.
Oseland, N. A., (2007) British Council for Offices Guide to Post-Occupancy Evaluation. London: BCO
Perelman, L.C., Paradis, J. and Barrett, E. (2001), The Mayfield Handbook of Technical and Scientific Writing, New York: The McGraw-Hill Companies.
Preiser, W.F.E., Rabonowitz, H.Z. and White, E.T. (1988), Post-occupancy Evaluation. Van Nostrand Reinhold Company, New York.
Preiser, W.F.E. (2002), "Toward universal design evaluation", 17th Conference International Association for people-environment studies; culture, quality of life and globalization: problems and challenges for the new millennium, Corunna, Spain .
Preiser, W.F.E. and Vischer, J.C. (eds) (2004) Assessing Building Performance, Butterworth-Heinemann, Oxford.
Quanjel, E., Zeiler, W. (2007), "Design Collaboration and Team working, in: Information and knowledge management - helping the practitioner in planning and building", Proceedings of the CIB W102 3rd International Conference, Stuttgart, Germany, pp.51-60.
Vischer, J. (2001), Post-Occupancy Evaluation: A Multifaceted Tool for Building Improvement, Learning from our Buildings: A State-of-the-practice Summary of Post-occupancy Evaluation, National Academy Press, Washington, DC, pp.23-34.
Whyte, J., Gann, D.M. (2001), "Closing the loop between design and use: post-occupancy evaluation", Building Research and Information, Vol. 29, No.6, pp.460-2.