# A Client Support System for Post-occupancy Design Decisions in School Projects

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## Abstract

*In the UK, the budgetary allocation of publicly funded education is substantial. The capital investment fund for schools gradually grew from £683 million in 1996-97, to £3.8 billion in 2003-04, and subsequently to £8.2 billion for 2010-2011.*

*Like most buildings, schools and associated facilities are subject to dilapidation, obsolescence, deterioration and change during their service life. Therefore, they require constant upkeep and/or periodic adaptations to change the functionality or improve the performance of the building. This is why up-to-date knowledge and information flow on and about a building is crucial. Although data processing – collection, storage and retrieval – forms a part of a successful knowledge and information management which can guarantee a successful post-occupancy decision process, it is not always sufficient. What is more important is how the data informs decision and knowledge (knowing) processes.*

*This paper reports on some findings of a research project on post-occupancy design in school projects. First of all a brief overview of key factors, and major players in post-occupancy processes will be provided. We will then establish the decision processes. Decision Support Systems (DSS) will be critically reviewed to correlate the existing context with the means which will be used to offer the most efficient system to support the decisions in post-occupancy design in school projects. The main contribution of this paper however, remains to be the collaborative processes of decisions streamlined to be utilised for creating a post-occupancy framework using the concepts of knowledge and value co-creation. Some indications of the post occupancy design information toolkit (PODIT) which has particularly been developed for this project as a knowledge/value co-creation will be used to clarify on the application of the underlying theory to develop a practical toolkit for the stakeholders in school projects.*

**Keywords:** Building performance, Decision support systems, Knowledge and information management, Knowledge and value co-creation, Post-occupancy processes

# 1. Introduction

In the UK, the budgetary allocation of publicly funded education is substantial. The capital investment fund for schools gradually grew from £683 million in 1996-97, to £3.8 billion in 2003-04, and subsequently to £8.2 billion for 2010-2011.

Like most buildings, schools and their associated facilities are subject to dilapidation, obsolescence, deterioration and change during their service life. Therefore, they require constant upkeep and/or periodic adaptation to change the functionality and/or improve the performance of the building. Furthermore, unlike manufacturing industries in which the life cycle of the product tends to become shorter in many occasions due to the flow of work, pace of growth and other microeconomics and macroeconomics factors, in the building industry, new technologies, methods and materials are employed to extend the service life of buildings. This on its own highlights the importance of post-occupancy interventions to make constant improvements to the existing building stocks. In addition, environmental concerns and sustainability drivers call for better and longer use of the buildings as opposed to demolition existing buildings and replacing them with brand new ones. For all these reasons – and even if the demolition/rebuild was the ultimate solution – up-to-date knowledge and information flow on and about buildings and how they are managed are of paramount importance in assisting in making more informed decisions if and when any intervention in existing buildings is about to take place.

Although data processing – collection, storage and retrieval – plays a major role is a successful knowledge and information management, which can potentially contribute to a successful post-occupancy decision process, it is not always sufficient. Experience shows that in most of the cases the problem is not lack of data, information or knowledge. The problem lies where it comes to retrieval of the relevant data/information to the decision which is about to be made. What is even more important is how the data informs decision and knowledge (knowing) processes and how different parties participate in the decision process.

This paper reports on partial findings of a research project on post-occupancy design in school projects. It will first provide a brief overview of key factors, and major players in post-occupancy processes. It will then establish the decision processes. A quick review of Decision Support Systems (DSS) will be provided to correlate the existing context with the means which will be used to offer the most efficient system to support the decisions in post-occupancy design in school projects. The main contribution of this paper however, remains to be the collaborative processes of decisions streamlined to be utilised for creating a post-occupancy framework using the concepts of knowledge and value co-creation. Some indications of the post occupancy design information toolkit (PODIT) which has particularly been developed for this project as a knowledge/value co-creation will be used to clarify on the application of the underlying theory to develop a practical toolkit for the stakeholders in school projects.

# 2. Review of exciting literature

A brief review of literature will be provided in the following sections:

## 2.1 Post-occupancy decision processes

Post-occupancy intervention decisions on one hand are informed by the process of design decision making (Kelly *et al.* 2005, Hitchcock *et al.* 1998) and on the other hand need to be supported by post-occupancy evaluation (POE). Preiser (2002) explains 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. A number of purposes are fulfilled by carrying out POEs (see Whyte and Gann 2001, Hadjri and Crozier 2009 among the others) and building performance assessment and POEs have attracted a lot of attentions recently. However, they are not yet very regularly carried out in practice, and the outcomes are not routinely available or widely used by most design and building teams (Bordass and Leaman 2005). The focus of this research is obtaining performance feedback on quantitative (building) and qualitative (stakeholder) level using a procedural approach. According to Vischer (2001) a procedural approach that reiterates 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 can be followed for this purpose.

## 2.2 Major role-players in post-occupancy decisions

According to the literature there are four major factors that can affect post-occupancy decisions these are:

- Design intent and criteria (Perelman *et al.* 2001, Green and Simister 1999, Kelly *et al.* 2005)
- 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).
- Performance monitoring (CIB 1993, Preiser *et al.* 1988, Cory 2001).
- Collaborative working practices (Bertelsen and Emmitt 2005, Emmitt and Gorse 2003, Kalay 2006)

The findings from the study also proposed three additional factors: cost, quality and (lead-in) time.

## 2.3 Co-creation

Co-creation is a market strategy which is known to have enhanced customer's role in the value-chain by developing its extensionality beyond the traditional definitions. The concept of co-creation

expanded even beyond the ‘value’ to ‘knowledge’ as co-creation of knowledge can equally effectively improve the customer’s participation in the value-chain. Coined by Prahalad and Ramaswamy in 2000, co-creation was primarily aiming to harness customer competence. It is capable of helping create mutual values for both the customer and the firm through customer participation beyond immediate marketable values (Zwass 2010). Prahalad and Ramaswamy (2004) later suggested the DART of co-creation (Dialogue, Access, Risk-Return and Transparency) for successful deployment of co-creation in a company. More opportunities for improvement of relationship experience and enhancement of co-creation arise as firm learn more about their customers (Payne et al. 2007; Payne et al. 2009). Sanders and Stappers (2008) use co-creation to refer to ‘collective creativity’. Lawer (2006) suggests eight styles of firm-customer knowledge and value co-creation (Figure 1).

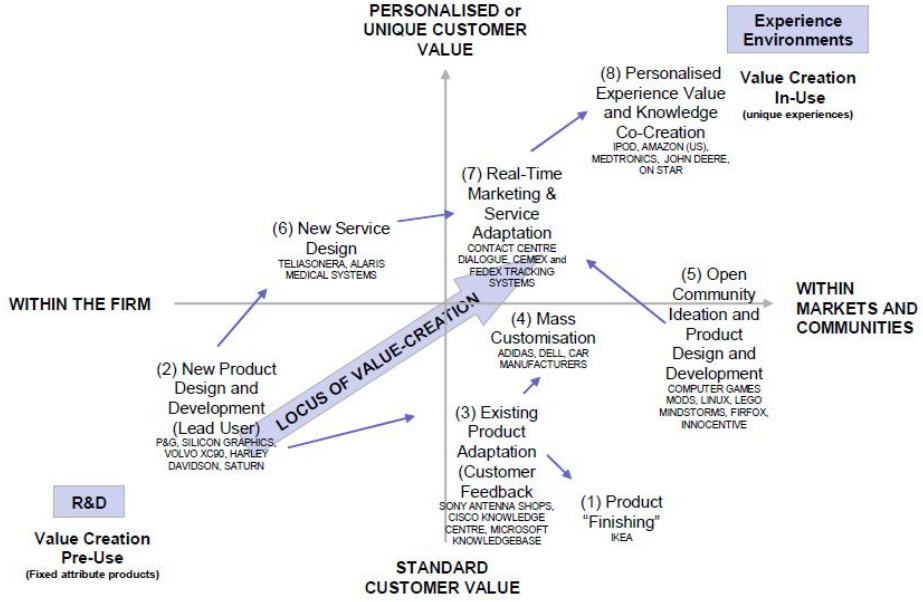


*Figure 1: Eight styles of firm-customer knowledge and value co-creation (Lawer 2006)*

## 2.4 Project stakeholders

Part A of the Building Bulletins BB98 (DfES 2004) and BB99 (DfES 2006) define the client team as:

- Local authorities
- Governors, bursar
- Architects
- Senior school staff and governors
- Other stakeholders, e.g. local community groups, and
- The staff and pupils.

This may slightly vary for primary and secondary schools, from city/county to city/county and depending on the size of the school.

## 2.5 Decision support systems

First coined by Gorry and Scott Morton (1971), a decision support system (DSS) is a computer technology solution to support complex decision making and problem solving (Shim *et al.*, 2002). According to Shim *et al.* (2002) a classic DSS is formed of three components: database (and its management capabilities), modelling function, and the user interface. Ever since DSS has been adopted by and adapted to many disciplines introducing many improvements, including powerful tools i.e. data warehouses, OLAP, data mining and web-based DSS (Kimball, 1996, E.F. Codd & Associates, 1993, Thomsen, 1997), and evolution from individual standalone applications to highly interconnected networks of collaborative support systems [see among the others (Alavi and Keen, 1989, DeSanctis and Gallupe, 1987, Kinney and Panko, 1996, Warkentin *et al.*, 1997, McGrath and Hollingshead, 1994)].

# 3. Methodology

A literature search was carried out to identify and investigate different areas which may inform the research. This included:

- Post occupancy decision processes
- Major role player in post occupancy decisions
- Co-creation of knowledge and value
- School projects stakeholders in the UK
- Decision support systems (DSS)

Subsequently steering groups were formed to obtain primary data for the research. The steering groups comprised of a sample of primary and secondary school representatives, local authority representatives, building professionals and IT and information specialists. 60 private and public, primary and secondary schools in East and West Sussex (South East England) were selected using simple random sampling (SRS) method. 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 independent advisers. The result was a total of 13 members on the steering group representing all identified stakeholders.

Following the primary data collection, selected schools were visited, and school and local authorities were interviewed using semi-structured interviews. This was to acquire detailed and in-depth insight to all the areas which might not have been covered thoroughly in steering group meetings.

At the same time, search for finding the most viable solutions for toolkit development and directed studies were carried out and, research meetings were arranged to explore the applications of proposed toolkit. It was envisaged that such a toolkit requires a user friendly and intuitive Graphical User Interface (GUI), as well as an efficient database powered by an efficient database management system.

To ensure validity and applicability, level of use and complexity of the decision support system for post-occupancy projects proposed through this research, simulated and real cases of making decisions were designed and selected to devise a model-base to test out the first prototypes of the toolkit.

## 4. Findings and discussion

Based on the literature search 33 post-occupancy decision criteria were recognised and participants in first steering were asked to rate them based on their importance. The findings from the steering group meeting with reference to the literature were used to map and code the 33 post-occupancy decision criteria into different categories. This was informed by the decision structures, the structure and hierarchy of the stakeholders involved and the funding mechanisms both within the school and those allocated by external funding bodies. The participants in steering group 2 gauged those categories based on their priorities in running, managing and budgeting schools. A model was then devised based on the concepts of co-creation in combination with DSS for development of the first prototype of the toolkit (See Figure 2).

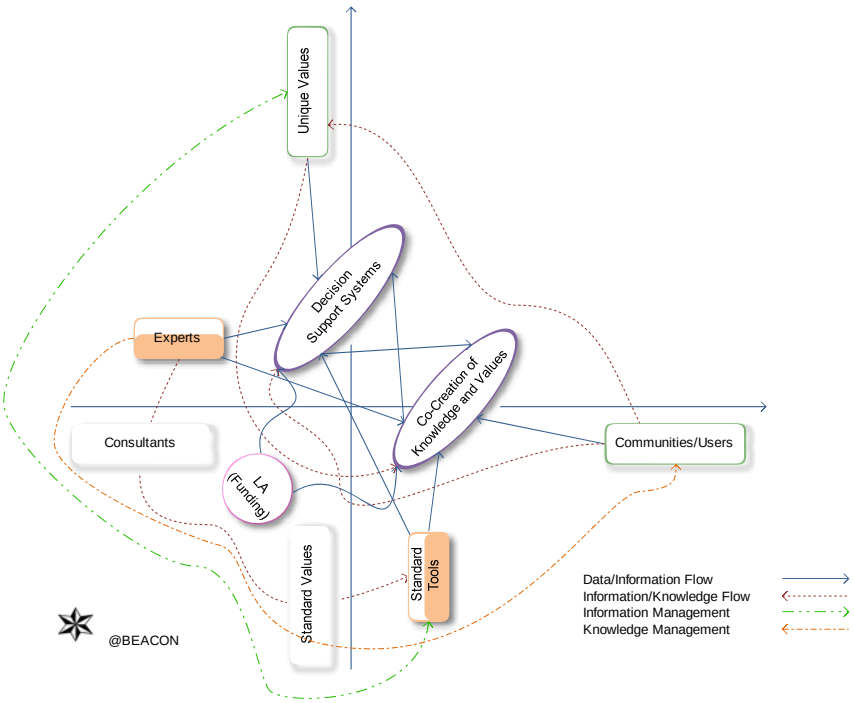


*Figure 2: Development model for PODIT based on knowledge co-creation and DSS*

Results from the steering groups also helped us map the decision criteria and which requirements are expected by different stakeholders if a DSS is to be employed efficiently. Those findings were then used as the 'context' (decision criteria) and the 'ends' (requirements) in combination with the model as the 'means' to develop the first prototype of the application. Two different interfaces of the first prototype can be seen in figures 3 (data entry or the model interface) and in figure 4 (project planner or scheduler):

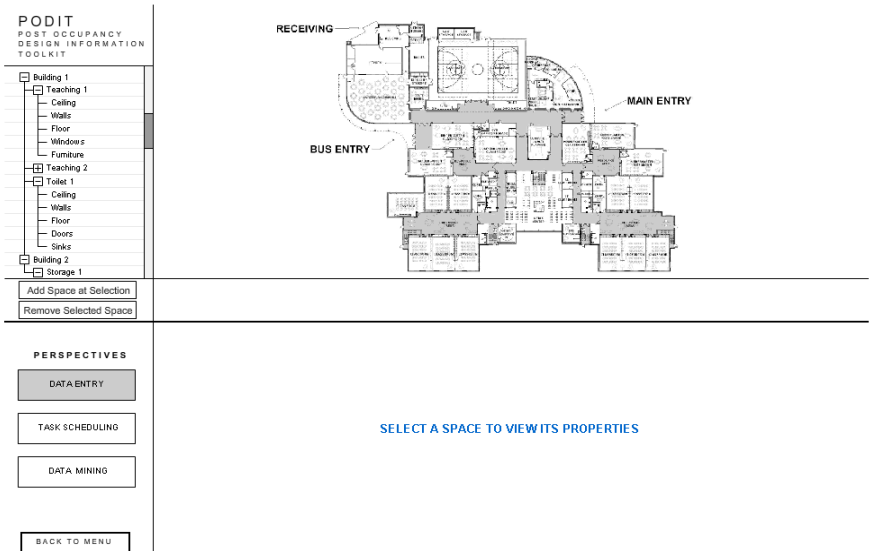


*Figure 3: PODIT data entry interface*

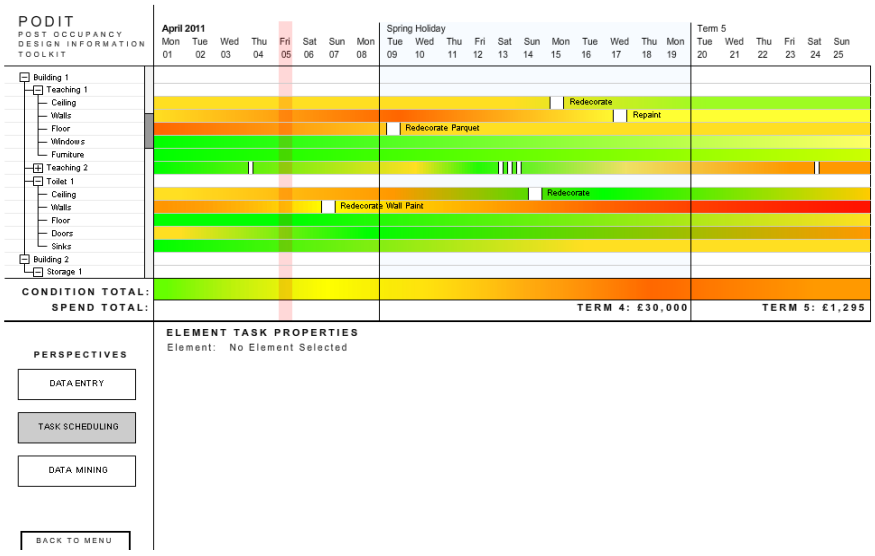


*Figure 4: PODIT project planner (scheduler) interface*

Third steering group was formed to gauge the response of the potential users to the application. A Demo was given and the members were asked to utilise and test different capabilities of the application and provide feedback. This was collected using a questionnaire to establish the function priorities as perceived and expected by the users, followed by a one-to-one semi-structured interview to monitor their needs and the software requirements in more depth. Some of the findings from this stage include:

- The traffic light system worked very well for visualising the outstanding tasks, jobs, etc.

- The scheduler interface was found very useful as it enabled the user to have a visual overview of the school project, the outstanding tasks and the overall condition of the building with break-downs to the level of buildings and spaces.
- The users liked the ability to navigate in the school model using a combination of visual (map) interface and datasheet (tree) interface being able to switch between the two.
- The need for the condition survey to become a live document (this was mentioned in both previous steering groups)
- Discrepancies between the 'priority' (1: immediate, 2: within 2 years, 3: within 5 years, 4: over 5 years) and the 'condition' (A: good, B: satisfactory, C: poor, D: bad) in the condition survey and the need to distinguish between them quite clearly to prevent further confusion for the user or clash between the proposed system and the current practice. There were some concerns about the time brackets for priority and the need for more accuracy.
- There were also concerns about sensitive data, the amount of work to initially launch the system and interests in data sharing between different parties as the same level or belonging to different levels.
- The budget interface was considered necessary, so was the job packages interface (these two were not developed, at this stage, to the same level of details of other interfaces, due to time restraints).
- Sorting function for the condition survey as well as the output format (spread sheets, .pdf files, etc.) were also highlighted as important to ensure that the system complies both with the legal and liability requirements, and also the current practice is fulfilled and can be succeeded in terms of timeliness, data-share, accuracy of the system.

## 5. Conclusion

This paper reported on the development of the first prototype of a decision support system and its test in the framework of this research project on post-occupancy decision processes in school projects. The collaborative processes were focused on so that the stakeholders can work together using this platform for co-creation of value and knowledge which can feed into the decision processes. This was then explained as to how it developed into an application which can facilitate the decision processes in post-occupancy decisions in school projects.

The feedback received at this stage of the project was very positive. There is still more work to do and improvements to make before the final prototype can be put forward for testing in the last steering group meeting. The feedback from the third steering group will be used to improve the different interfaces of the toolkit, and to add or amend some interfaces which will keep up with existing common practice and also accommodate new options to help improve on the usability and choice for different type of users based on their preferences, needs, requirements and specific tasks.

The next step for this project will be to use the comments, requirements and needs of the users through the feedback provided in the first toolkit demo to improve the appearance, functionality, intuitiveness, ease of use and navigation as well as to ensure that all the aspects required and highlighted in this meeting and previous meetings are fully met.

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