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A FRAMEWORK FOR REFURBISHMENT OF HEALTHCARE FACILITIES

A. Sheth¹, A.D.F. Price² and J. Glass³

ABSTRACT

Demolishing existing facilities and constructing new facilities is not a feasible solution to provide modern healthcare services and reducing the impacts of healthcare construction industry on the environment. Also, the National Health Service’s (NHS) focus on new construction in the recent past is responsible for the deteriorating existing building stock. An investigation of healthcare refurbishment reveals a need for a specific framework for existing buildings as the characteristics of new facilities and existing facilities are not similar. The function of the framework should be to assist with the refurbishment process. The research attempts to discuss current trends in refurbishment of healthcare facilities and possible solutions for the same. The methodology used is a literature review, web-based case studies, interviews, and observation site visits to several hospitals. A conceptual framework for refurbishment is proposed in the remainder of the paper. This work is a part of a research project related to existing healthcare facilities with energy as a key focus. It is identified that research in the area of refurbishment of existing hospitals has been neglected despite existing hospitals accounting for a significant portion of the NHS’s healthcare buildings stock.

KEYWORDS

energy, existing healthcare facilities, NHS, refurbishment, tools

INTRODUCTION

A significant amount of non-domestic buildings which will be standing in 2050 have already been built (Davies, 2009). Furthermore, the overall existing building stock remains largely untouched, replaced at slow rate, and many recent refurbishment projects have missed the opportunity to reduce emissions and carbon footprint (Carbon Trust, 2008). Recently, the research community has started to focus more on non-domestic buildings such as hospitals, offices, and superstores which are considered to be the most energy intensive buildings. Also, the growing importance being given to the existing facilities is in part due to increased recognition of 'whole-life cycle cost', economic efficiency, environmental impact, and sustainability (Kapoor et al., 2006, Monts and Blissett, 1982). The reason behind more consideration being given to 'whole-life value' as opposed to initial construction costs is emphasised by a buildings’ impact on the environment throughout its life-cycle. Until recently, the focus of healthcare construction has been on the development of new healthcare facilities with existing facilities being given greater attention in recent years (Sheth et al 2008). Also, it is reported that most hospitals today still fail to make patients feel comfortable (Lubell, 2008). Many new and recent healthcare buildings do not demonstrate sufficient high quality performance (Mason, 2006). Often, existing facilities are demolished, left untouched or undergo a change of use.

Although in the past some studies related to energy consumption have been completed such as Pedrini et al (2002), Chirarattananon and Taveekun (2004), Pan et al (2006), Neto (2007), etc. they are focused on general types of buildings and not related to existing healthcare facilities. Whereas, studies related to energy consumption by Yik et al (2001), Jenkins and Newborough (2007) focused on commercial buildings such as hotels, and Gieseler et al., (2004) focused on housing. Also, the studies by Adderley (1988), Lonnberg (2007), Yoshida et al., (2007), etc. relate to energy consumption of hospitals but they are not focused on refurbishment or existing buildings. The study by Lonnberg (2007) focused on energy saving possibilities using variable frequency drivers (VFD) for hospitals but lacks focus on design and physical built environment aspects of facilities.

Thus, this research aims to identify characteristics of refurbishment for existing healthcare facilities. The project is related to research into refurbishment of existing healthcare facilities with energy as one of the key parameters. This is a partial output of primary and secondary data collection as part of a three-year research project. To accomplish the research objectives, a literature review along with interviews and web-based case studies were conducted. In this paper, facilities considered for refurbishment and/or extension are discussed.

There has been a recent increase in applications of Building Information Modelling (BIM) and simulation based tools for speedy delivery of construction projects which have been considered within the scope of the reported study. In the following section, the research method is presented followed by a literature review including web-based (online available) case studies. With the help of secondary data collection, interviews, and web-based case studies, a framework for refurbishment was developed based on various approaches adopted during recent refurbishment projects. The information presented in Section 1 is supporting information for a conceptual framework presented in the remainder of the paper. The

¹ Research student, Department of Civil and Building Engineering, Loughborough University, A.Sheth@lboro.ac.uk
² Professor, Department of Civil and Building Engineering, Loughborough University, a.d.f.price@lboro.ac.uk
³ Senior Lecturer, Department of Civil and Building Engineering, Loughborough University, j.glass@lboro.ac.uk
conceptual framework is subsequently proposed based on the findings from primary and secondary data collection. The final section of the paper presents a discussion and conclusions.

RESEARCH METHOD

Following secondary data collection (via a literature review and web-based case studies) progress was made gathering primary data using a questionnaire survey; interviews with practitioners; and observations during various site visits. The aim behind the primary data collection was to corroborate findings of the secondary data collection. Also, the primary data collection helped to develop a better understanding of how refurbishment projects are implemented within the industry. The key objective behind the review was to identify practical approaches and shortcomings in the existing practices.

As part of the data collection, 43 questionnaire responses, group and individual interviews, and five site visits were conducted. Considering the limited timeframe and other research limitations (such as budget, resources) face-to-face interviews were conducted in the UK and an email-based questionnaire survey was used to reach the participants from the UK as well as USA. The email-based questionnaire helped to reach the selected audience irrespective of their location. During data collection stage the researcher contacted 250 registered architects with American College of Healthcare Architects (ACHA) and collected 35 responses from the USA; eight experts working on Private Finance Initiative (PFI) and NHS projects from the UK responded out of 60 selected for the survey. Also, 33 experts were contacted to conduct face-to-face interviews of which 11 interviews (with seven individuals and a group of four experts) were undertaken in the UK. Also, five site visits were made to ongoing refurbishment projects with the help of the interview participants. This helped to explore refurbishment and to experience the level of noise, construction dust, etc. with ongoing refurbishment projects.

To collect primary qualitative data, all the questions were open ended as suggested by Knight and Ruddock, (2008). The collected data was analysed manually and presented in this paper. With the help of spreadsheets the raw data was categorised for the ease of analysis. Categorising the data helped to develop conceptual schemes within the data which provided background information in the development of framework. The use of a spreadsheet proved to be useful during analysis to organise the raw data. The names and types of categories were derived with the help of literature, professional reading, and the information provided by the participants. Also, the development of a protocol to conduct interviews and a questionnaire survey helped to organise and categorise the data. To conduct interviews and a questionnaire survey the protocol comprised of three key sections was developed. The three key parts of the protocol were: a background section; a section on current trends in refurbishment with special focus on energy and carbon emission; and a section for feedback, comments related to refurbishment, research project, and client and government policies. The protocol was developed with consideration to principles of qualitative data and tested using a pilot study. During the pilot study a questionnaire was sent to seven selected respondents who agreed to participate in the survey. Also, the protocol was discussed with the researcher’s supervisors and three colleagues with different backgrounds from the researcher’s department before conducting the interviews. After the pilot study a revised questionnaire was sent to rest of the participants as discussed further.

Quantitative research is uni-dimensional whereas qualitative research is diverse (Knight and Ruddock, 2008) which helped to explore more key areas within the boundaries of the research. Within the scope of the research, it was very important to investigate how refurbishment projects are executed and the quality of those research projects rather than knowing how many refurbishment projects are executed. Also, during initial stages of investigation it was clear that refurbishment of existing facilities is very important, but the level, scope, and boundaries of refurbishment projects were not clear from the literature review. Thus a qualitative research methodology was employed as the data collected using qualitative methods is more detailed compared to quantitative methods (Brewer, 2007). Subsequently, the data was analysed to identify goals, objectives, drivers, and challenges related to refurbishment in the healthcare sector. Furthermore, in this work Leadership in Energy and Environmental Design (LEED), NHS Environmental Assessment Tool (NEAT), Building Research Establishment Environmental Assessment Method (BREEAM), etc. building certification tools are considered briefly as the research aim is not to develop another certification tool, but to integrate and/or to interface with existing tools. In this work, procedures from the literature and discussion of data collected during interviews are compiled together followed by a proposed conceptual framework to use during refurbishment. The web-based case studies, literature review, and interviews were used as a basis upon which to develop the conceptual framework.

PRIMARY AND SECONDARY DATA COLLECTION

On average an acute-care hospital consumes significantly more energy compared to a commercial office building of same size because of its round the clock operating schedule, air quality regulations, and clinical equipment etc. (Cassidy, 2010, Hirst, 1982). Furthermore, many existing hospitals are energy inefficient and need to be considered for energy refurbishment which may require improvement of the external envelope (CADDET et al., 2005). A case study of The Villa Street Medical Centre in London reported that “restoration and refurbishment are challenging but can bring derelict buildings back to life” (Mason, 2006). Traska (2007) explained refurbishment as “plastic enough to adapt to local need and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites.”
The current target for the NHS is to reduce carbon footprint by 10 per cent by 2015 compared to a 2007 base line (NHS, 2008). The European Parliament indicated a significant possibility to reduce energy consumption in existing buildings (Bizzarri and Morini, 2006). However, it will be difficult to achieve the carbon emissions target set by government if existing buildings miss the opportunities to reduce their carbon footprint during refurbishment (Davies, 2009). If refurbishment is considered appropriately with all other services in place, then existing infrastructure can be considered as an asset and feeder for a new development. A recent study by Traska (2007), related to designing renovation, reported that it is very important to engage 3D simulation and material prototypes for a complex project to test the performance of the emerging object.

**DRIVERS FOR HEALTHCARE CONSTRUCTION SECTOR**

Considering the size and scale of healthcare facilities, refurbishment can arise at any time because of various below mentioned reasons. The Community Hospital of the Monterey in Peninsula, California was upgraded and expanded several times before considering for major refurbishment after 50 years from inception of the facility (Lubell, 2008). The West Suffolk Hospital in London was refurbished because of development in clinical treatments and services (Astley, 2007). In some old buildings the presence of asbestos is considered as a driving factor for refurbishment and needs to be removed during refurbishment (Racine, 2010). A facility operating at full capacity may demand refurbishment sooner than other facilities which are not occupied to their maximum limit. For example, the Mental Health Care in Birmingham has been re-decorated three times over 11 years due to operating at full capacity (Mason, 2006). During the redevelopment of Meyer Hospital at Florence in Italy, four distinct areas were considered to reduce energy consumption and improve indoor air quality: insulation; energy saving and recovery; natural ventilation; and the building management system (BMS) (Gallo and Stefano, 2006). During an interview, design team members mentioned aging infrastructure is a key reason for the redevelopment scheme in the North-West of the UK. Also, it was mentioned that round the clock running nature of hospitals impose various challenges during redevelopment. The redevelopment scheme was to construct new facilities for clinical purposes and use existing facilities for administrative purposes. Also, there can be additional drivers depending on the Department of Health’s (DoH) policies and agenda. There can also be several drivers related to sustainability as presented by Manoliadis, (2006) which are categorised further into construction, administrative, and legislative drivers by Sheth et al (2008) in addition to drivers related to energy to achieve overall sustainability. Also, there can be additional drivers based on individual NHS Trust strategies and/or the design team strategy specific to a project. Furthermore, the drivers can be classified into strategy drivers and drivers based on principles, priority areas, and commitment presented by Sheth et al (2008).

**CHALLENGES FOR HEALTHCARE CONSTRUCTION SECTOR**

Structure, form, and orientation of existing buildings are particularly challenging in refurbishment projects, compared to construction of new facilities. For example, during refurbishment there is very limited scope to re-orient the building; orientation should still be considered wherever possible. There are various ways to re-orient buildings, such as re-planning existing layouts or internal spaces such as lobbies and waiting areas, and reducing energy consumption by making maximum utilization of available day light. For example, a visitor’s waiting area or reception/entrance can be re-located where it can receive natural day light, achieve improve indoor air quality, and is easy to access.

The West Suffolk Hospital refurbishment project in London had several physical challenges for refurbishment including low ceilings, external load bearing walls, inflexible supply systems, and overcrowded facilities (Astley, 2007). During the refurbishment of hospital services diversion can be challenging and impose additional limitations on refurbishment projects (NJHA, 2009). Considering existing building stock owned by the NHS, a building’s historical value which cannot be altered may impose some challenges during refurbishment such as the re-development of the Royal Hospitals site in Belfast, and refurbishment of St Nicholas’s Hospital in Great Yarmouth, UK.

During refurbishment of the Southend University Hospital in Rochford, the adjacent buildings were occupied, and access for construction was gained through the existing elevation with some modification (Laing O’Rourke, 2006). Nevertheless, existing buildings often suffer from a lack of as built /modified information such as drawings, plans, and operation and maintenance manuals. The Chiddenbrook Surgery in Exeter Devon, reported inadequate natural ventilation in summer (Reynolds, 2007). Other than the above mentioned challenges, there can be additional project specific challenges due to location, design, goals, objectives, and scope of work depending on the project brief.

**REFURBISHMENT AIM, OBJECTIVES, GOALS**

As part of this research not only academic literature was used for secondary data collection, but also published case studies from books and the internet. In this section data gathered from the case studies and interviews are compiled to demonstrate the refurbishment process. The interviews and primary data collection helped to cover gaps in the literature review. Table 1 shows a list of points for consideration, followed by objectives and goals for refurbishments based on the data collection are presented. This is an output from the primary and secondary data collection, and is generated on the basis of learning from various projects as reported by interviewees and literature.
Table 1. Points to be considered during refurbishment

<table>
<thead>
<tr>
<th>For refurbishment</th>
<th>For existing buildings and users</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Communication between the design team, hospital staff, patients, and users is important.</td>
<td>1. User is aware of at least the next 10 construction moves/activities.</td>
</tr>
<tr>
<td>2. The use of BIM is suggested but should not be dominating.</td>
<td>2. It is difficult to locate mechanical services and utilities; be ready for surprises.</td>
</tr>
<tr>
<td>3. Any planned construction activity away from and with consideration to patients’ rooms will help the smooth running of a project.</td>
<td>3. There might be harmful fumes, gases released (e.g., at roof level) from existing building in use, which can affect ongoing work.</td>
</tr>
<tr>
<td>4. Provide details about where the construction team will be working.</td>
<td>4. Conduct a pre-investigation before starting any works.</td>
</tr>
<tr>
<td>5. No phasing plan is perfect, and there might be challenges to execute planned activities.</td>
<td>5. Be prepared to have back-up equipment to support running of mechanical plant.</td>
</tr>
<tr>
<td>6. Because of obstruction to existing users, be prepared to accept some unforeseen problems.</td>
<td>6. In some cases there may be a need to work with minimum available clear height, space, or time.</td>
</tr>
<tr>
<td>7. No scope of work for refurbishment is perfect.</td>
<td>7. Always carry out an investigation on completion of work, irrespective of scale of work.</td>
</tr>
</tbody>
</table>

An investigation revealed the following minimum objectives to be considered during the refurbishment and designing of a new healthcare facility. These objectives are based on the partial refurbishment of Waitakere Hospital in New Zealand (Fullbrook et al., 2006), several case studies published by the Commission for Architecture and the Built Environment (CABE) (Mason, 2006) and various web-based case studies, among others. The objectives are divided briefly into two parts; objectives related to design, and those related to construction.

**Objectives related to design:**

1. Provision of good public open spaces (waiting areas) and out of hours community use.
2. Good integrated design and a clear plan with clear circulation.
3. Incorporating natural lighting (maximum use of day light), natural ventilation, and consideration to energy efficiency.
4. Ample storage space, flexibility, and adaptability to make a facility future proof.
5. Improved performance when compared pre and post project performance results.

**Objectives related to construction:**

1. Consideration to users (patients, visitors, and staff).
2. Effective communication between design team, client, and users.
4. Sustainable (environment friendly) material and finishes must be considered.
5. The waste generated during the construction/refurbishment process must be disposed of safely.

For the success of any project it is very important for the members to share the same goals, follow minimum project objectives, and work as a team. During data collection one interviewee mentioned that due to the introduction of a company policy related to sustainable procurement; they had to reject many (almost 60 per cent) pre-approved company contractors. The research has revealed some minimum goals for existing buildings to be considered during refurbishment and/or throughout the life-cycle:

1. Consideration to overall sustainability.
2. Strategies and polices to minimize the energy usage.
3. Corporate commitment to cut down carbon emissions.
4. Ensure that facilities are operating efficiently during refurbishment.
5. Reduce dependency on crisis-management with a well planned programme.
6. Reduce the frequency of component failure.
7. Ensure facilities are maintained to comply with the health and safety regulation throughout refurbishment process.
8. Provide public transport access to the hospital to reduce car travel and need for a car park.

Effective project management is a key factor for successful refurbishment. All the above mentioned points can help to form a project’s aim, goals, and objectives. These points should be used while developing a refurbishment proposal for any existing healthcare facilities. Later, a conceptual framework is proposed which can be used to accomplish a project aim, goals, and objectives. The framework and above mentioned points should be used as a baseline or guidance during any refurbishment project and, there can be additional objectives depending on the specific requirements of a project.
DISCUSSION OF INVESTIGATION

In this section a refurbishment process is explained with the help of collected data. A hypothetical refurbishment process based on several real life examples, literature, and case studies is presented. The process helped to propose the framework in the following section. The investigation revealed that for successful refurbishment of healthcare facilities the first step is to develop a business case. For example, the business case for extension of Royal Devon and Exeter NHS Trust in Exeter, UK compared three possible solutions: do nothing, refurbish, or build a new 24 station dialysis unit. The comparison revealed that the refurbishment option was cheaper than a new construction (Reynolds, 2007) and helped to validate the business case.

Followed by the business case, a master plan should be developed. A proposed master plan during refurbishment for Dell Children’s Medical Centre on a brown-field site in the US (Cassidy, 2010) and during partial development of Waitakere Hospital in New Zealand (Fullbrook et al., 2006) helped both the projects. Although there was a lack of a design brief at the beginning of the Waitakere Hospital project, having a definite goal to present an ‘Eco-Hospital’ helped to develop a master plan. Similarly, during the research, the Belfast NHS Trust, explained that the development of a complete master plan can be beneficial and existing infrastructure can prove to be an advantage more than limitation if, considered effectively. The preparation of a master plan establishes the overall look of the facilities/premises and it can be in accordance with changing technologies which permits further upgrading. A proposed and phased master plan for hospitals can focus on areas that need renovation, design assistance, and complete refurbishments in near future. The plan also allows hospital managers to accomplish renovation objectives. Creating a master plan involves making an overall assessment of interior as well as exterior problems along with outlining possible solutions, estimated project costs and facilities performance, and developing a project plan.

While developing a proposal it is important to preserve the existing character of the campus and the buildings especially if the hospital campus is very old with some heritage buildings on the site. The existing buildings can be used effectively if, positive and negative points of these facilities are appropriately considered. Additional information related to occupancy (evaluation) and use of the building along with involvement of energy and/or facility managers will help to predict the energy consumption. At this stage detailed surveys related to the facility will help to highlight the priority areas to plan the future activities, and to decide the scope of work.

Early modelling of a building’s energy use is an important approach considering the condition of fabrics and envelope (floors, ceilings, walls, windows, and doors) of the building which can benefit refurbishment. While designing the Centre for Health and Healing in Portland, USA simulation studies were used (Gragg, 2007); these estimated that the building would use 61 per cent less energy than specified in the energy code. However, in reality the energy consumption was more than estimated because of inadequate inputs related to operational hours of the building to the energy model (Gragg, 2007). Also, before accepting or rejecting any strategy or feature, especially related to energy saving and design, alternative options should be considered and assessed. This approach will help to validate the proposal as well as to minimize facilities impact on the environment. Although primary consideration should be given to the thermal performance of envelope, a technical survey related to the existing building’s condition and post occupancy evaluation is very important (Carbon Trust, 2008).

To achieve successful commissioning for energy efficiency, all the activities must be planned well ahead and should not be allowed to slip. During the key stages of the development of a refurbishment proposal, simulation should be used to assess the performance and ensure that proposal will meet the design goals. For example, in the Ambulatory Care Building of a Children’s Hospital in Canada it was observed that the lobby can get hot and stuffy because of very low air flow on very warm sunny days (Phillips, 2004) which clearly indicates a lack of simulation studies or prior studies related to building form, internal heat gain, and orientation. During data collection one interviewee mentioned that “no former pre refurbishment building survey was done and now no one knows what is inside the wall”.

As part of the process, the plans should be turned into a BIM model (Day, 2010), for example during extension of Anderson Cancer Centre in the US a BIM model was developed from existing computer aided drawings (CAD) (Schneider, 2010). The reason for extension of the Anderson Cancer Centre was unpredicted demand where 12 storeys were added on the top of the existing 12 storeys towers. The model helped throughout the project and to speedup construction. The Akershus University Hospital in Norway was created using Industry Foundation Classes (IFC) and a BIM model to plan mechanical services, mechanical equipment related activities, and for visualisation (Building Smart, 2008). The same model was used for quantity take off, energy calculations, and other simulation studies. For better understanding and visualisation of healthcare facilities a BIM model is reported as very useful tool and can convey the design team message to end user (AUTODESK, 2008). BIM model can help a team member from non architectural background to visualise the end product (facility). Not only AUTODESK (one of the leading provider of various BIM based tools) has reported benefits of BIM but also, industry and various experts such as Schneider (2010), Cooper (2008), Fullbrook et al (2006), etc. have confirmed BIM as a tool to be used while developing healthcare facilities. Cooper (2008) reported that BIM can address the hospital’s changing infrastructure needs with focus on human issues by anticipating problems that need to be solved ahead of time.
In addition, while developing a proposal, the quality of the indoor environment should be considered. For example, while planning the Dell Children’s Hospital, in the US, interior light shelves were not permitted because they can act as a dust collector thus spoiling internal environmental quality (Cassidy, 2010). During an interview and a site visit to a recently completed healthcare project, it was observed that due to a lack of studies related to solar heat gain and thermal simulation of designs some offices were very cold even on sunny days and some offices needed to plug in heaters in winter despite having central heating. Also, the thermal comfort in such buildings is very poor despite modern specification of the building’s envelope. An appropriate study related to solar heat gains can help to save a significant amount of energy and improve thermal comfort. During the refurbishment of an ambulatory care centre in Canada, a concrete canopy was added to minimize the solar heat gained through south-facing double height transparent façade (Phillips, 2004). An effectively oriented (i.e. with consideration to sun-path) healthcare facility in Texas helped to maximise the utilization of daylight. It was reported that 80 per cent of the patients’ rooms and 35 per cent of the diagnosis and treatment rooms received natural daylight resulting in significant energy saving (Cassidy, 2010) and other health related benefits.

So, the refurbishment cycle is divided into four main phases: proposal, design, construction, and use. The measures for the Phase I and Phase II and summary of all the phases are presented below in tabular format (Tables 2-4). The tables are based on the “A Guide for Low Carbon Refurbishment” (Carbon Trust, 2008) and collected data from various sources such as interviews, web-based case studies, etc.

Table 2. Phase I- ‘Proposal’ during refurbishment of healthcare facility

<table>
<thead>
<tr>
<th>Measures</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Compliance with progressively tightening building regulations</td>
<td>1. Involvement of stakeholders and carbon champion</td>
</tr>
<tr>
<td>2. Provision of Energy Performance certificate (EPC)</td>
<td>2. Low carbon refurbishment commitment and vision</td>
</tr>
<tr>
<td>3. Better comfort, satisfaction, and productivity</td>
<td>3. Establish the current carbon footprint of buildings</td>
</tr>
<tr>
<td>4. Reduction in operation cost</td>
<td>4. Develop low carbon outline brief</td>
</tr>
<tr>
<td>5. Recruiting and retaining staff</td>
<td>5. Pre-refurbishment and post-refurbishment assessment</td>
</tr>
<tr>
<td>6. Benefits of commitments to reducing carbon emission</td>
<td>6. Set carbon targets for the refurbishment</td>
</tr>
<tr>
<td>7. Simple, way-finding design</td>
<td>7. Budget for low carbon elements</td>
</tr>
<tr>
<td>8. Life-cycle assessment</td>
<td>8. Empower and choose an appropriate design team</td>
</tr>
</tbody>
</table>

Table 3. Phase II- ‘Design’ during refurbishment of healthcare facility

<table>
<thead>
<tr>
<th>Measures</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Passive measures (day-lighting to reduce need for artificial light)</td>
<td>1. Keep the low carbon theme up front</td>
</tr>
<tr>
<td>2. Upgrading of building fabric (insulation, windows) to improve thermal performance</td>
<td>2. Develop an integrated low carbon design and whole life costing</td>
</tr>
<tr>
<td>3. Efficient heating, ventilation, and air conditioning (HVAC)</td>
<td>3. Allow flexibility in design</td>
</tr>
<tr>
<td>4. Low energy lamps and correct lighting levels</td>
<td>4. Encourage exploration of a wide range of low carbon options</td>
</tr>
<tr>
<td>5. Modern lighting equipments such as occupancy sensors</td>
<td>5. Use energy modeling data</td>
</tr>
<tr>
<td>6. Energy management system</td>
<td>6. Manage the budget and scope</td>
</tr>
<tr>
<td>7. On-site generation of energy for e.g. CHP or biomass boilers</td>
<td>7. Approved integrated design</td>
</tr>
</tbody>
</table>

Table 4. Phase III and IV summary- ‘Construction’ and ‘Use’

<table>
<thead>
<tr>
<th>Phase III Construction</th>
<th>Phase IV Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Selection of appropriate contractor and subcontractor</td>
<td>1. To make sure operator and occupants understand the building</td>
</tr>
<tr>
<td>2. Ensure effective project management</td>
<td>2. To conduct post-occupancy evaluation</td>
</tr>
<tr>
<td>3. Get buy-in from site works</td>
<td>3. To make changes depending on energy use and comfort conditions</td>
</tr>
<tr>
<td>4. Monitor site progress against objectives</td>
<td>4. Make the most of the low carbon building</td>
</tr>
<tr>
<td>5. Energy monitoring</td>
<td>5. Meet building regulations</td>
</tr>
<tr>
<td>6. Satisfaction of aim, objectives, and goals</td>
<td>6. Improved energy performance after refurbishment</td>
</tr>
</tbody>
</table>

THE PROPOSED CONCEPTUAL FRAMEWORK

Refurbishment projects often involve extensions or part demolition along with full or part refurbishment. It is thus extremely difficult to define boundaries as well as exact scope of work and definition of refurbishment project. In this research refurbishment has been defined as “any existing buildings more than three years old considered for part or full renovation, extension, and/or retrofit” with specific focus on buildings constructed from 1980s onwards. The reason being that review of literature and interviews revealed that buildings especially constructed in 1970s and 1980s are not easy to
maintain, poor in performance as well as aesthetics. However, considering the complexity of healthcare facilities, round the clock running and to be operational during refurbishment, it is not appropriate to consider refurbishment with a very narrow focus (energy) and limited scope. Hence, refurbishment is considered from energy as a key point of view, along with other possible construction considerations.

DESCRIPTION OF FRAMEWORK

Investigation revealed that refurbishment is time consuming and a lengthy process, but can be very effective if executed in well-planned phases (as indicated in Section 1.3 and with the help of Tables 2–4). Considering changing regulations and development in medical equipment, a refurbishment project executed over a five year span will be both ineffective and expensive. So, the refurbishment process is classified into three major categories: pre refurbishment, refurbishment, and post refurbishment. The resulting classifications and support systems for each phase are shown in Figure 1.

The focus of the framework is on the development of refurbishment proposal, so some construction related activities such as tendering, bidding, etc. are not considered, but are also important and related.

Also, the suggested process (support system) is in a hypothetical order because of the highly collaborative nature of the refurbishment process. The support system can be employed simultaneously by several team members during the process. The 'purpose' mentioned in the framework (see Figure 1) acts as the interface between ‘phases’ and the ‘support system’; it will help to promote a well-integrated process to ensure successful refurbishment of existing facilities.

The framework is divided into three columns; phases, purpose, and tools/process. The left column helps to define the phase and stage of a project, the middle column (purpose) denotes the purpose of the phase and the right column (tools/process) shows objectives of that specific stage and purpose. To understand the relation between three columns, refer to Figure 1. For example, during ‘Phase II’ of a project, and at stage 2 ‘options for energy and carbon emission’ the ‘purpose’ of that stage will be to ‘compare’ the project status and ‘develop’ the proposal with the help of ‘tools/process’ such as energy and carbon related targets which is a ‘support system’ for entire project.

The arrows indicated between ‘phases’ and ‘processes’ show the relation between them and tools to be employed during those phases. For example, the arrow between business case and pre-project survey indicates a need to conduct a facility survey before developing a business case for the facility. Moreover, the survey will provide various inputs for the business...
case to make it more exclusive which will ensure the success of refurbishment projects. Also, in the future, the connections between the phases and the process will be developed further. Moreover, a brief list of activities and tools is presented which will be developed further during the process to make it more exhaustive. With the help of Table 1 and the objectives presented in Section 1.3, aim, objectives, goals can be developed to be used as part of the framework.

Phase I: a pre-construction primary design phase, where most of the decisions related to end product will be taken. Table 2 and this phase will serve as guidance during the development of the refurbishment proposal. In this phase, various opportunities are provided to consider different options which can have an impact on the overall life-cycle of the facility. The design team members are key actors in this phase.

Phase II: an early construction phase where most of the decisions taken in the previous stage will be developed further and implemented with the help of Table 3. During this phase, there will be some physical data inputs such as solar heat gains based on the actual site location, from a site team, to be used for further development of the project. During this phase most of the activities will happen on site with less work in the design studio however, there will be a very limited scope to consider different energy saving and construction features in this phase. At this stage of the project, most of the activities will be taken over by the construction team.

Phase III: a late construction phase before handing over the facility to the client/users. Most of the proposed ideas are implemented during this phase. There are very few possibilities to make any changes at this point; any changes during this phase will lead to a delay in the delivery of the project. During this phase most of the activities will be led by the construction team, leaving little scope for the design team to take any decisions.

Phase IV: a post-construction phase that leads the project to completion. Also, this phase will help to justify the refurbishment proposal and can assess verify the strengths and weaknesses of the proposal. Moreover, the phase will help to provide some learning to be used on refurbishment proposals in the future. During this phase the facility manager is the leader and can corroborate design proposal (Phase I). During this stage the key step will be to convey design considerations related to energy saving, etc. to the facility manager. All other points mentioned previously in Section 1 such as project aim, objectives, and goals will be accomplished with the help of the framework to achieve successful refurbishment.

Table 4 will help and guide Phase III and Phase IV to develop objectives for both the phases. Information provided in Section 1 will help during different stages and phases of the framework such as business case, master planning, target setting and energy monitoring to be accomplished.

**DISCUSSION AND CONCLUSIONS**

It is concluded that research in the area of refurbishment of existing hospitals has been neglected and there is a need to develop approaches for the existing healthcare facilities to achieve overall sustainability. The major objective of this study is to propose a framework for refurbishment including other factors such as energy. Significant energy savings are easily achievable with more sophisticated planning and mechanical systems by reducing air volumes and using appropriate energy features. In this research, various ideas and strategies from various projects are compiled together to propose a competent refurbishment framework to be used for existing hospital refurbishment.

A brief overview of a proposed framework and its key components has been presented in this paper. This paper suggests that during refurbishment there are various opportunities to save energy and to provide improved indoor environmental quality. As the paper is an outcome of ongoing research, the framework will be developed further. In the later phase research will be focused on the integration of BIM and simulation tools related to energy and solar studies. The future research and development of the framework will look at interfacing various tools and methods during refurbishment to save energy throughout the life-cycle of the facility such as interface between BIM, energy simulation tool (e.g. IES, VE, Ecotect, etc.) and government targets. The main objective of the framework is to save energy without compromising patient comfort. Also, this should be one of the key objectives for every healthcare project. The proposed framework is for architects to understand the types of tools, process, and drivers related to refurbishment. Also, facility managers and client can use the framework to keep control over a process, such as by deciding driving factors, etc.
REFERENCES


Laing O’Rourke (2006) New Clinical Oncology Centre and Endoscopy Department Refurbishment. Rochford, UK, Southend University Hospital, NHS Trust.


CREATING A PROJECT-BASED LEARNING-LOOP WITHIN THE CONSTRUCTION PHASE OF HEALTHCARE INFRASTRUCTURE PROJECTS

J. R. Henderson¹, K. Ruikar² and A.R.J. Dainty³

ABSTRACT

Service delivery in the healthcare sector is profoundly affected by the built infrastructure provided to support it. In order for a hospital environment to function optimally, there is a need to investigate how a learning culture can be nurtured within the design, construction and occupancy of healthcare facilities in order that its effect on the healing process of patients can be managed. A large focus of attention within the research conducted by the Health and Care Infrastructure Research and Innovation Centre (HaCIRIC) is centred on learning from buildings in use and post occupancy evaluation (POE). Interestingly, however, there has been little focus on capturing lessons learnt from the construction phase of projects. This could be particularly important to informing the future buildability of healthcare projects. The aim of this research is to examine how lessons learnt arising from the construction phase can be captured and fed back to designers and in some cases the client. This is in order to create a learning culture and help improve the quality of future healthcare facilities/infrastructure. The paper reports on findings of an initial literature review that explores the potential benefits and challenges for embedding such a learning culture in project-based environments. Through this literature synthesis a significant case for improving project-based organisational learning within healthcare infrastructure is provided and recommendations for the need for further empirical investigation are made.

KEYWORDS

buildability, feedback, knowledge, learning, loop,

INTRODUCTION

The importance of the management of knowledge for the purpose of organisational learning has seen an increase in attention in recent years (Kamara et al. 2002). A large degree of the construction related organisational learning literature stems from the identification of underperformance within the industry by the Latham (1994) and Egan (1998) reports. As suggested by Hari et al. (2005), these reports acknowledge the need for the construction industry to better manage and share knowledge that resides in the supply chain, with the clients and internally within construction firms in order to improve both their efficiency and effectiveness.

At present, however, a vast amount of academic and industrial attention regarding organisational learning such as research conducted by Cooper (2001); Zimmerman and Martin (2001); Bordass and Leaman (2005); Way and Bordass (2005); Hadjri and Crozier (2009), is concerned with the drive to incorporate post occupancy evaluations as standard in order to assess buildings in use and inform the design of future buildings. Surrounding this push are the significant benefits learning from existing buildings would bring; however, there is now also a call for a change in emphasis from solely being POE orientated, to the utilisation of feedback at all stages throughout the life-cycle of a building (Bordass et al. 2005). This is due to the majority of benefits facilitated by POE arguably being attributed to generic knowledge management and organisational learning. Therefore the omission of learning from all stages of the supply chain greatly restricts the degree to which we are ‘knowledgeable’ and as a consequence, is a hindrance in improving the facilities that are built.

ORGANISING LEARNING AND KNOWLEDGE MANAGEMENT

Although broad in definition, organisational learning is seen to be the “process of improving actions through better knowledge and understanding” (Fiol et al. 1985). Other authors have narrowed down the breadth of the organisational learning concept by attempting to provide answers to the question of, how can knowledge be captured and reused, through the apparent consensus that it must be acquired, stored in some form of memory, and disseminated to others. In some instances, an additional stage of maintaining or validating the organisational memory is included. For example, Robey et al. (2000) view it as an organisational process, both intentional and unintentional, enabling the acquisition of, access to, and revision of organisational memory, thereby providing direction to organisational action.

Other authors (Kamara et al. 2003; Tan et al. 2006), have identified that there is an evident need for the capture of such knowledge to be as live as possible in order for the knowledge to not be lost as members of a project disperse to other projects, leave their organisation, or continually defer knowledge capture to a later point in time. Consequently, the definition subscribed to in this research is an adaption of that supplied by Boer et al. (2001) to include the need for a live capture element. This adapted definition of organisational learning therefore reads:

¹ Researcher, Loughborough University, Civil & Building Engineering, J.R.Henderson2@lboro.ac.uk
² Lecturer, Loughborough University, Civil & Building Engineering, K.D.Ruikar@lboro.ac.uk
³ Professor, Loughborough University, Civil & Building Engineering, A.R.J.Dainty@lboro.ac.uk
“individuals should, at the point of a learning opportunity being identified, use tools, mechanisms, methods, techniques and technologies provided by the organisation to support the identification, capture, codification, storage and dissemination of different learning occurrences, in order to transfer individual learning into organisational learning”.

Argyris (1977) identified three forms of organisational learning; single, double and triple-loop learning. Single-loop learning is said to be where organisations respond to changes in their internal and external environment by detecting and correcting errors, whilst maintaining the core organisational norms (Barlow et al. 1998). Therefore, single-loop learning is any activity where learning is present, but does not result in changes to organisational behaviours, beliefs, actions or activities. In comparison, double-loop learning is said to be where the current organisational norms and assumptions are questioned to establish a new set of norms (Barlow et al. 1998). It uses symptoms as indicators of problems and focuses on addressing the root causes so that an organisation can detect, uncover, and address the root causes of their underperformance and thus establish new ways of working (Kululanga et al. 1999; Argyris, 1992). Furthermore, triple-loop learning constitutes the questioning of essential principles on which the organisation is based, and thus challenging its mission, vision, market position and culture (Snell et al. 1998).

It has been noted by authors such as Love and Smith (2003, cf. Love et al. 2004), that construction organisations overly focus on detecting errors, and then correcting them, whilst maintaining their organisational norms. Similarly, Barlow and Jashapara (1998) identify that construction practice tends to be concerned with finding pragmatic solutions to problems as they arise, rather than double-loop learning. This is distinctly apparent during processes such as snagging and inspections where instances of rework are detected and then corrected without necessarily being fed back to those that could potentially eliminate their reoccurrence (i.e. designers). This clearly supports the notion that construction organisations are currently viewed as conducting single-loop learning in isolation. However, the repetition of failing strategies is not a healthy course of action, but it is one that the construction industry often tends to follow (Love et al. 2000), which has thus resulted in the tendency to ‘reinvent the wheel’ (Tan et al. 2006; Keegan et al. 2001; Carrillo, 2005). Consequently, this research aims to identify how a potential design-construction feedback loop could be used to promote a move away from such a single-loop learning culture to one which addresses current problems in order to improve the quality and value delivered (double-loop learning).

**DRIVERS FOR A CONSTRUCTION-DESIGN FEEDBACK LOOP**

Knowledge management and learning attempts within healthcare infrastructure are predominantly focused around the evaluation of buildings in use, known as post occupancy evaluations. Such tools include; AEDET (Achieving Excellence Design Evaluation Toolkit) and ASPECT (A Staff and Patient Environment Calibration Tool). An illustration of the makeup of such a feedback loop is shown in Figure 1.

![Figure 1: Post occupancy evaluation feedback loop. Source: Kamara et al. (2002)](image)

This section of the paper highlights a selection of benefits attributed specifically to learning being fed back from the construction stage to designers. These benefits are by no means a comprehensive list of the recognised benefits of knowledge management and organisational learning, nor are they seen as more advantageous than those attributed to the learning arising from POEs. They are those that are viewed to offer the potential to provide the greatest degree of untapped value to healthcare infrastructure projects and thus, should be sought to supplement existing learning and feedback loops rather than replace them. Figure 2 shows an illustrative view of the desired additional learning feedback loop between contractors and designers in particular, and in some cases, the clients and planning stage also.
IMPROVED DESIGN QUALITY

One of the most significant reasons for construction knowledge to be captured and utilised within the context of healthcare infrastructure is that identified by Carrillo and Chinowsky (2006). They acknowledge that construction knowledge is often tied to issues such as constructability, material management, and design intent; each of which are closely related to the design input. Therefore, the capture of construction knowledge appears to be a critical element in improving the design quality of future healthcare infrastructure. A similar, but more general view was previously voiced by Groak (1994, cf. Vakola and Rezgui, 2000) who argued that the need for learning has increased in importance within the construction sector because the use of lessons learnt arising from projects affects the quality of the final product.

Alarcón and Mardones (1998) state that design quality issues arise from:

- A lack of completeness of the information necessary to complete the project – e.g. inconsistencies, omissions, errors or a lack of clarity.
- Lack of design standards: A lack of standards in the design for similar projects, thus resulting in lower efficiency
- A lack of constructability resulting in a high amount of problems being detected during the construction phase.

It is therefore foreseen that an effective feedback loop could greatly assist in these three areas with it being able to positively affect the final point the greatest. As discussed further later in this paper, a significant benefit of a construction phase feedback loop would be the capture of unnecessary and avoidable rework instances so that design solutions in the future could be formulated to mitigate the reoccurrence of such events and thus improve the constructability of the design.

Similarly, the capture of instances where the completeness of design information is unsatisfactory could lead to, at the very least, an indication to the areas which could benefit from more time and effort being applied. This is beneficial due to the identification by many that even a slight increase in effort and expenditure targeted at the design phase of the project is capable of providing significant improvements (Macmillan, 2006; Bordass et al. 2004). Consequently, if additional effort was targeted in the areas in which it had been identified through the proposed construction-design feedback loop that the greatest degree of value could be extracted, then this would suggest that significant improvements in the quality of design could be received, and that the buildability of future healthcare facilities could be enhanced.

REDUCED REWORK

Rework in construction projects is referred to by Palaneeswaren (2006), as an unnecessary effort of redoing a process or activity that was incorrectly implemented in the first instance. Crumble (1991, cf. Love and Li, 2000), conducted a study which found the cost of non-conformance as being between 10% and 20% of the total project cost, with 46% of total deviation costs being created during the design stage, compared with 22% for construction deviations. A similar study conducted by Rhodes and Smallwood (2003, cf. Palaneeswaren, 2006) has more recently observed that the average cost of rework was 12.4% of the total project cost. These complimentary findings of the substantial cost of rework within construction projects suggests that this problem is one that is not subsiding as time progresses, but is in fact as apparent now, as it was over a decade ago.

Although the cost of constructing a new healthcare building is said to only constitute 2-3% of the total lifetime costs, the average cost of building a conventional hospital is in the region of £150million. Therefore the amount of funds exhausted on unnecessary rework could be as high as £18million per project. This is a substantial figure which could be allocated into the development of new/existing facilities, equipment, additional research, or generally improving the level of service provided within the healthcare sector.
The matter of rework has also been cited to not only stretch far beyond the direct cost implications of the contractor and the client, but to also include a range of less tangible costs. This is shown by Burati et al. (1992), who suggest that the increase in costs caused by rework may in fact be even higher because it is often the case that schedule delays, litigation costs and other intangible costs of poor quality are not included. In addition to these costs incurred during the construction stage, Hammarlund and Josephson (1991, cf. Love and Li, 2000) estimated quality failures that occur post project completion to be as much as 4% of the overall project, with these failure costs being 51% design related, 26% construction related and 10% material failure related. Therefore as a result, post project quality failures could represent a further unnecessary cost of up to £37.5 million. This signifies the importance of supplementing the use of post project evaluations that identify design related issues arising during the building in use, with that of a new framework to capture design issues arising during the construction stage in order to reduce the extent of unnecessary rework, improve design quality and delivery improved levels of value.

In the case of schedule delays in particular, this high degree of rework can have a detrimental knock-on effect to the occupant. For example, during the creation of new facilities, vital healthcare access is unnecessarily being withheld from those that require it. Alternatively, in the case of an extension or upgrade to an existing facility, such schedule delays result in ongoing difficulties in providing a high-class service due to the reallocation of patients, increased noise and disturbance levels, as well as generally increasing the levels of stress experienced by patients, relatives, visitors and staff. This is in line with recent study findings that highlight that the reduction of stress is a significant clinical goal because stress is a negative health outcome in itself and has a variety of harmful psychological, physical and behavioural effects which are proven to worsen outcomes (Ulrich, 2001).

The aforementioned findings of the potential unfavourable impacts of rework, combined with healthcare’s desire to continuously improve the quality of their built facilities, indicates the criticality of reducing such instances as far as is reasonably possible. This opinion is complemented by Willis and Willis (1996) who state that doing the job right the first time is the single most important factor for minimising the cost of designing and constructing world-class facilities.

**INTELLECTUAL CAPITAL AND INNOVATION**

Unlike one-off clients, healthcare providers can benefit greatly from the ongoing management of their intellectual assets in order to improve their knowledge and understanding of issues arising within one project and disseminating this knowledge to participants in future projects. However, in questioning the extent to which this holds true, the issue of how reusable this knowledge is in the event of shifts within healthcare delivery models is recognised. Nonetheless, within other industries such as manufacturing, where innovative delivery methods are arguably implemented on a more regular basis, knowledge is still viewed as a key corporate asset in assisting comparisons to be made between past and current trends in order to formulate future directional strategies.

The collation of such intellectual assets has also been stated as enabling improved levels of innovation (Robinson et al. 2001), which is shown through Stewart’s (1997) identification that an organisation’s ability to innovate depends on the knowledge and expertise possessed by its staff. Therefore, without the feedback of knowledge arising during the construction phase of a project, designers will be significantly restricted in learning from past projects, potentially resulting in a lack of innovative designs in the future. This improvement in the level of knowledge is also viewed as contributing to the continuation of innovative practises as more information can be gained to the reasons behind innovative designs falling short of expectations so that they can be adapted and continuously improved, rather than simply evaluating them as having failed and discarding them. This is due to the aforementioned identification of knowledge enabling innovation and thus presenting variation from previous norms. As such, this variation plays a critical role in exploratory learning where the goal is to go beyond what is already known, and to promote risk taking, experimentation and innovation (Vakola et al. 2000). As a result, this leads to the potential for a cycle of continuous learning and improvement to arise.

**CHALLENGES FACING THE CREATION OF A LEARNING-LOOP**

Although the importance of knowledge management and organisational learning has received much academic attention including studies from; Egbu and Botterill (2002), Tan et al. (2006), Carrillo et al. (2000), Lee and Egbu (2007) Love et al. (2004) and Kululanga et al. (1999), construction organisations have been slow on the uptake to implement such procedures (Hari et al. 2005; Love et al. 2004). Industry related reasons for construction organisations not taking the initiative to improve their learning have been cited in various forms, with the main challenges surrounding the following:

- The negative effects of short-term client-driven pressures on longer-term learning objectives (Keegan et al. 2001);
- Construction companies being strongly oriented towards projects, their contribution to them, and the successful completion of them (Gieskes et al. 2000);
- The multiple temporary alliances between independent project partners causing a state of simultaneous cooperation and competition (Gieskes et al. 2000) causing each participant to be protective of their knowledge (Barson et al. 2000); and,
• The UK construction industry predominantly consisting of small to medium-sized enterprises (SMEs), which have more pressing concerns than knowledge management such as survival and a lack of resources (Carrillo et al. 2000).

As a result, it is evident that if organisational learning and knowledge management benefits are to materialise, such initiatives need to be more client-led. This call for heightened client leadership has been recognised through the Latham Report (1994) and the Egan Report (1998). However, this shift in leadership will not erode the significant aforementioned industrial barriers to learning in itself, but it is evident from the previously identified drivers for knowledge management that clients have more to benefit from encouraging improved value and quality from their built facilities than arguably the construction organisations do from supplying such.

This being said, Bordass and Leaman (2005) suggest that at present, clients do not see the value in investing in learning initiatives such as post occupancy evaluations and capturing construction lessons learnt, as they are of the opinion that the transferred knowledge to designers would benefit future clients more than themselves. In the case of one off clients or clients of non-repetitive or unrelated projects then these opinions appear more robust due to the reduction in the client’s ability to continuously improve.

It is therefore apparent that for clients of relatively repetitive projects such as is the case for healthcare infrastructure (Abdou et al. 2003), there is a distinct need for a more client-led approach to learning from past buildings in order to continuously improve them in the future. However, although it has been recognised that the creation of a knowledge base and learning from multiple stages of previous projects (i.e. the construction phase and post project completion) has the potential to enable the continuous improvement of the built healthcare facilities provided, the formulation of a framework providing the proposed additional feedback loop is not without its complexities. Such further challenges facing the development of the proposed feedback loop will now be discussed.

DIFFICULTY IN TRANSFERRING TACIT KNOWLEDGE

A significant obstacle facing effective organisational learning is that of integrating new knowledge instances from the learning situation (often from individual’s schemas and belief systems) to collective organisational schemas (Rifkin et al. 1997). This highlights the difficulty of converting ‘tacit’ knowledge (which is personal and complex to communicate), into ‘explicit’ knowledge (which can be transmitted in formal, systematic language and is therefore sharable) (Nonaka, 1994). Love et al. (2004) state that this is the dilemma of transferring specific knowledge into general knowledge.

This brings into question the complexity regarding the ability to capture, validate, store and disseminate learning instances from a construction context in a way that is relevant and useful within a design context. As a result, it is an aim of this research to investigate which techniques (non IT related) and technologies (IT related) can be used to assist this knowledge management process, combined with an investigation into which format (text, audio, pictorial, statistical, video etc) has the greatest ability to assist the transfer of tacit knowledge.

This barrier is said to be heightened within the construction industry context compared to that of repetitive output industries such as manufacturing (Gieskes et al. 2000). This is because when the work characteristics in terms of output differ for each new project, organisations not only have the problem of how to convert tacit individual knowledge into explicit collective knowledge (Carrillo et al. 2000), but they also have the difficulty of determining what to relate the learning issues to in order for them to be relevant in future projects (Gieskes et al. 2000). It should be noted however, that healthcare infrastructure is viewed as being relatively more repetitive than other bespoke sectors within the construction industry (Abdou et al. 2003) and therefore this barrier may be reduced within this context.

UNSUPPORTIVE CULTURES

Organisational culture has been blamed for many problems relating to an organisation’s ability to learn, including; vertical silos within organisations which lead to a lack of awareness of what others have done; internal competition which inhibits efforts to share knowledge; and, knowledge hoarding (Hari et al. 2005; Gieskes et al. 2000). For example, an overly centralised organisational hierarchy has been viewed as potentially being damaging to project based learning due to this signalling that learning is not the responsibility of everyone but only a few ‘enlightened’ people within the organisation (Keegan et al. 2001). Consequently, this can cause the creation of a strong “us-them” culture between project leaders and subordinates, which is unsupportive to the exchange of knowledge and experiences (Gieskes et al. 2000).

This view has since been supported by Hari et al. (2005) who believe that an organisation’s culture can be the biggest barrier to knowledge capture as their studies have discovered that many experienced construction professionals see knowledge as power and are reluctant to share it, people are reluctant to learn from others in what they describe as the ‘not invented here’ syndrome, and, people are scared to admit making mistakes. This once more shows the intricacy surrounding the proposed feedback loop as it is evident that a socio-technical approach is required and it is not as simple as merely recording the learning instances and passing these back to future designers.
PROJECT DESCRIPTION AND OBJECTIVES

This project is concerned with investigating how a framework can be developed which promotes a learning culture between the construction and design phases of healthcare infrastructure projects. It has been identified that there is currently a lack of learning within the construction of such projects, with learning currently being limited to that achieved through evaluating buildings in use in the form of post occupancy evaluations.

This proposed framework is foreseen to incorporate a socio-technical systems (STS) approach, which involves the interaction between people and technology to capture construction related lessons learnt. Such lessons of interest within this research are those that arise from the detection and correction of deviations from the initial design, plan, or procedures, and feeding these back to improve the knowledge base of designers. The framework aims to improve the integration between the two phases, whilst supporting the knowledge collated from post occupancy evaluations. This should assist in providing the feedback of a more complete, relevant and necessary knowledge base, which can then be utilised to continuously improve the quality of future designs.

It has been a persistent identification of authors (Bordass et al. 2005; McDermott, 1999) that the development of a learning culture through a new knowledge management programme should consist of identifying a key learning objective which is to provide the most significant increase of added value. This is in preference to attempting to collate a knowledge base consisting of multiple, unrelated learning instances as this inevitably results in the demise of such a knowledge management program due to the lack of focus and inability to support such a broad learning initiative.

Consequently it has been identified that a construction related learning objective which offers the potential to provide a high level of increased value is that of the reduction of rework. In addition to improving the value of healthcare infrastructures, this learning objective has also been identified as offering the ability to move away from the current construction focus of single loop learning towards a double-loop learning approach. This is due to the current situation of construction organisations solely being interested in the detection and correction of errors (single-loop learning), whereas the proposed feedback loop will consist of recording and feeding back the detection of errors so that their root causes can be identified and analysed in order to create new norms (double loop learning). As such this project aims to develop a framework which enables learnt experiences from one project to be applied to, and improve, multiple projects in the future.

It has also been recognised by many authors that knowledge management is closely related to organisational learning, as learning results in the alteration of the beliefs instilled in knowledge. It is therefore an aim of this research to identify methods of knowledge management in order to assist in developing a learning culture within healthcare infrastructure projects. This should facilitate a move away from single-loop learning towards instilling a continuous improvement double-loop approach, whilst assisting in reaching the desired potential of triple-loop learning within future healthcare infrastructure projects.

PROJECT OBJECTIVES

This proposed research endeavours to achieve the following objectives, in order to satisfy the overarching aim of the project detailed below:

- To identify the need/drivers for a design-construction quality loop
- To identify the barriers of creating a design-construction quality loop
- To investigate current practices (if any) designed to improve the feedback of poor design quality
- To investigate what knowledge is currently being captured and assess its usefulness if fed back to the design stage
- To identify the relevant techniques and technologies that assist the delivery of a design-construction quality loop
- To identify the makeup of a new design-construction quality loop framework (e.g. what information should be captured, in what format etc.
- Develop a business case of adopting this new approach and recommend a change strategy for the diffusion of this new approach

The above objectives are in line with the attainment of the overarching aim of this project, which is to investigate how a construction quality system can be used to capture construction related lessons learnt and feed them back to the design stage of future healthcare infrastructure projects. This is in order to assist in the improvement of the quality of future healthcare infrastructure designs.

PROPOSED METHODOLOGY

This paper is based on a double pronged initial review of existing literature. The first is a review of the need for, barriers against and current situation of knowledge management, organisational learning and feedback loops specifically within a healthcare infrastructure context. The second phase consists of a review of generic construction industry literature in order
to benefit from a much wider source of related material. This literature review has concentrated on identifying the gap in knowledge which is currently apparent concerning the absence of feedback within construction projects. It has also touched on the potential positive effects such a framework should be able to deliver relating to healthcare issues such as; improved value, enhanced design constructability, condensed timescales, and reduced patient stress levels to name a few. It is anticipated that the proposed empirical research would aim to identify further, and more categorically, the specific healthcare benefits expected from the development and adoption of such feedback.

This empirical research will be broken down into two distinct cycles. The first will consist of a case study approach comprised of multiple methods such as interviews, workshops, shadowing and observation. It is also anticipated that field experiments will be utilised in order to assess the differing formats of feedback (i.e. text, audio, pictorial etc.) in terms of their effectiveness in transferring explicit knowledge. The results from this investigation cycle are foreseen to facilitate the formulation of a socio-technical framework which is based on the live capture and storage of learning experiences within the construction stage and disseminating them for reuse within the design stage. It is recognised that in many cases, such rework related construction knowledge is currently being captured during processes such as snagging and inspections where errors of poor quality are recorded remotely and electronically using advancing snagging software and remote computing technologies. Therefore such processes and technologies will be investigated in order to identify how such knowledge that is residing in the supply chain and is arguably already being captured, can be structured, stored, validated and shared in a framework which is mutually beneficial to designers and contractors, and thus greatly improve the utilisation of such knowledge.

This development stage will then be followed by a second cycle of research which aims to test and evaluate the effectiveness of the developed framework. Such a trailing stage is foreseen to consist of the feedback loop being applied to live cases of rework instances being identified so that a greater degree of the learning instance and its context can be captured. This will offer the opportunity to develop a business case of adopting this new approach within healthcare, combined with the formulation of a recommended change strategy for the diffusion of this new approach and thus achieving the full range of the aforementioned research objectives.

CONCLUSIONS

This paper presents an initial exploration into the need for and barriers against the formulation of a learning culture through the development of a feedback loop framework between construction organisations and design teams in order to improve the quality of future healthcare infrastructure designs.

It has been identified that additional benefits to those attributed to the current sole form of a knowledge feedback loop (post occupancy evaluation) have the potential to offer both added value and enhanced quality to healthcare facilities. This is critical in further supporting and improving the delivery of the healthcare service, as can be seen through De Jager’s (2007) assertion that the delivery of the healthcare service is profoundly affected by the built infrastructure provided to support. Such benefits include; reduced levels of rework, thus reducing the time and cost taken to deliver healthcare infrastructure projects; better design quality, as designers are able to learn from buildability issues arising during the construction stage of past designs but are not presently captured; enhanced levels of innovation due to an increase in knowledge regarding the success and failures of past innovations; and, the collation of a more usable knowledge base which can be utilised in order to ensure the continuous improvement of the built environment that supports the delivery of healthcare services.

Although such benefits arising from a move away from the current single-loop learning culture towards a double-loop learning approach have undoubted positive implications, it is faced with a high degree of complexity. This consists of generic barriers to knowledge management and organisational learning such as; short term project focus of participating organisations; the fragmentation of the supply chain leading to relationships of compliance and competition; and, the lack of disposable resources held by participating organisations due to them being predominantly SMEs. In addition, it has also been discussed that there are also arguably more sizable challenges in the form of; a need for a supportive organisational culture to be developed, and the difficulty of transferring context specific tacit knowledge into reusable and sharable explicit knowledge. Consequently, this paper has highlighted the need for further research to be undertaken within this area in order to extract the evident valuable benefits of a more integrated supply chain. A proposed research methodology which aims to satisfy such research needs has been provided. However, due to this research being in the early stages of development, no research findings have been presented at this stage.
REFERENCES


COOPER, I., (2001) "Post-occupancy evaluation - where are you?" Building Research and Information, 29:(2), 158-163.


LEE, C.C. and EGBU, C.O., (2007) "Information technology tools for capturing and communicating learning and experiences in construction SMEs in developed and developing countries", ITcon 12.


PALANEESWARAN, E., (2006) "Reducing rework to enhance project performance levels", Proceedings of the one day seminar on recent developments in project management in Hong Kong, May 12.


REAL OPTIONS AND SCENARIO PLANNING AS A WAY TO GAIN INSIGHT INTO FLEXIBILITY IN HEALTH CARE REAL ESTATE MANAGEMENT, A FIRST EXPLORATION

M. van Reedt Dortland1, G. Dewulf2 and A. Blanken3

ABSTRACT

Real estate management in health care faces many uncertainties, and more specific in the Netherlands even more because of changing regulations regarding the financing of capital costs. Therefore we propose, based on literature and a survey, to use scenario planning in combinations with the real option approach to deal with these uncertainties. The survey shows that limited use is made of future uncertainties and options for flexibility in the responded Dutch hospitals. Real options provide insight for real estate managers into opportunities for flexibility when making strategic decisions in real estate management, such as choosing for a building organisation form.

KEYWORDS

flexibility, project coalition, real options, scenario planning

INTRODUCTION

Real estate managers in health care often have little experience with building projects since for example a hospital has a lifecycle of 30 years. Besides, the primary process depends greatly on the building. Most health real estate is very specific in use, which increases the risk when the primary process changes or demand doesn’t meet the supply. Therefore, flexibility is needed. We propose to use a method that provides insight into the impact of choices made, such as the choice of the procurement of building projects. This method regards flexibility as real options. In combination with scenario planning, an organisation is able to develop robust real estate strategies. This method has been applied in several sectors, but is unknown in the management of health care real estate. The aim of this research is to discover how choices within real estate management can be regarded as real options. Our first exploratory action to answer this question is conducting a survey.

Our research focuses on the relationship between building organisation forms, contract forms and the real options that decision makers in health care have. The type of project coalition is strongly related to the contract form and the way collaboration between parties takes place. The attention for types of project coalition and contract form is a result of the attention it receives in literature, the so called “contractcentred approach” (Madhok 1995).

This paper first describes the professionalization trend of real estate, then it explores literature on the real option theory, scenario planning and the application of these two. The results of the survey are presented and conclusions are drawn on the applicability and usefulness of the proposed method.

UNCERTAINTIES AND THE NEED FOR FLEXIBILITY

As stated by Miller (1992), there are three areas in which businesses have to deal with uncertainties. These are external uncertainties, uncertainties within the sector and uncertainties within and specific to the organisation. In the Netherlands, the health care sector until recently could not be regarded as a private industry because it relied on governments’ finance. However, this all changed since the national government established a liberalisation policy. The new regulations implemented in 2008 were of major influence: the abolishment of remuneration for all capital costs by the national government. Capital costs include the interest rates and writing-off. Instead, all costs which are made by a health care organization are incorporated in the price of a treatment, paid by the health insurance companies. In this way, health organizations become dependent on their production and suddenly profit-making becomes important. The idea behind this is an increase in customer directness, more efficient management, and more efficient real estate management (Raad voor de Volksgezondheid en Zorg, 2006). However, the final content of these regulations is still uncertain. Besides, since the former Netherlands Board for Healthcare Institutions (Bouwcollege) doesn’t guarantee loans from banks, it becomes more difficult for health care organisations to obtain loans, or only against a high risk premium. The uncertain economic circumstances (credit crisis) add to this problem, which is an additional uncertainty.

Other uncertainties are more predictable, such as demography. Social trends can be recognised, such as individualisation, information and internationalisation, but how and to what extent these trends have influence on health organisations is difficult to predict. New insights into the healthcare profession as well as technical innovations have a major impact as

1 PhD candidate, Construction and Management Engineering, University of Twente, m.w.j.vanreedtdortland@utwente.nl
2 Professor, Construction and Management Engineering, University of Twente, g.p.m.dewulf@utwente.nl
3 Post-doc, Construction and Management Engineering, University of Twente and Ministry of Finance, a.blanken@minfin.nl
well. Real estate that is flexible in many ways is needed to deal with the problems resulting from uncertainties. The recent developments also demand more competences from real estate managers in health care. Especially when starting a building project. Decisions made then have a large impact on the real estate strategy during the lifetime of the building.

**CORPORATE REAL ESTATE MANAGEMENT**

The Dutch policy regarding health care liberalisation forces health organizations to make a professionalization step in real estate management. The professionalization of real estate took place in other sectors as well. Peter Krumm (1999) described this for multinationals and Pity van der Schaaf (2002) compared the development for public buildings in different countries. Corporate Real Estate Management is the management approach that deals more strategically with real estate. The main issue in CREM is that real estate is recognised as a fifth capital asset besides employees, capital, technology and information. This means that real estate is not simply a cost generating component of the organisation, but it also has to facilitate the primary process and can even create added value. An optimal real estate strategy is accomplished when the future and current supply and demand of real estate is met. De Jonge et.al. (2008) describe various methods to develop such a strategy, see Figure 1.

![Fig. 1. DAS framework de Jonge et.al. (2008)](image)

Besides costs, a knowingly taken decision on real estate considers the end-user and the organisational strategy (Evers, 2002). In order to do this, a long term real estate strategy has to be developed, which is aligned to the organisational needs and goals, expressed in the organisational strategy (Nourse, 1993). On a day to day basis the operational level should be considered as well, thus real estate strategies act on both the short and the long term. To cover these aspects CREM operates at the managerial levels of facility management, general management, asset management and cost control. Further, CREM looks at a complete portfolio instead of individual buildings. A hospital can be regarded as a portfolio of functions. CREM deals with issues such as the type of ownership of buildings (e.g. sell, rent or purchase) and outsourcing of services. Management of real estate becomes a more demanding task, leading to the appointment of real estate managers within the organisation.

Krumm (1999) and De Vries (2007) distinguish the various added values of real estate. One important added value is flexibility. However, it is questionable how flexibility can be improved. Flexibility is a broad concept with different definitions. One way to deal with flexibility is the real option theory, developed by Myers. The basic idea of the theory is that flexibility (the real option) is valued when trading stocks. Merton and Scholes won their Nobel price with real options, which have a financial background. Some authors explain that real options also can be used as a way of thinking to obtain insight into how opportunities for future flexibility can be created by current actions (Miller and Lessard, 2001; Ford et.al., 2002; Miller and Waller, 2003; Alessandri et.al., 2004; Cornelius, 2005; Winch, 2010). First, this paper proposes to view flexibility in health care real estate management from a real options perspective. Second, it gives an idea of how real options can be translated to the context of real estate management in health care. The theoretical background of the different concepts are elaborated further. The analysis of a small survey provides an inventory of what options are perceived by health organisations in the care. The paper concludes with a discussion on the applicability of real options, and recommendations for further research.
PROJECT COALITIONS AND FLEXIBILITY

The management of real estate is roughly divided into three main topics, namely the realisation, maintenance and exploitation of a building. Within real estate management many actors play a role, where the role is dependent on the project coalition form and the contract form. The project coalition says something about the way in which the tasks in the building process are divided between the different participants in the building process. Project coalitions being distinguished are

- Traditional,
- Design and Build (D&B),
- Design, Build and Maintain (DBC),
- Design, Build, Construct and Maintain (DBCM),
- Design, Build, Construct, Maintain and Operate (DBCMO)
- Design, Build, Construct, Finance and Maintain (DBCFM)
- Design, Build, Construct, Finance, Maintain and Operate (DBFMO)

The contract form includes the legal recording of the contractual agreements between the participants, based on the project coalition (Leidraad aanbesteden, 2010). The project coalition and the contract form under which the construction, maintenance and exploitation are defined, determines already what kind of flexibility can be realised in the project, since this is intrinsic in the type of collaboration. However, some types of flexibility can be additionally determined and might work out differently than in first instance was agreed upon.

Blanken (2008) identifies several types of flexibility that can be used when analysing the performance of a contract form. These are design, service and financial flexibility. They apply to the strategic, tactical and operational level. To improve the possibilities for contractors to have more flexibility, Blanken recommends making concession contracts more complete by considering contingency adaptability, as argued by Luo (2002). However, it happens that agreements made in contracts still do not result in the desired effects. Faems et.al. (2008) state that additional factors are important related to contracts. The first one is to consider, besides complexity, the actual content of a contract. Secondly, comparing the application of the contracts with the design of the contract shows that contracts can be applied in different ways. Lastly, in most researches only attention is paid to the relational processes at the managerial level while treating the operational level as a black box. Concluding from this, looking only at completeness of contracts is not sufficient to create flexibility. In relation to contracts other factors are important, but also the insight into how flexibility can be created by making certain decisions which are written down in contracts.

It is assumed in this research that flexibility is a result of decisions made before or during a building project. The research aims to obtain insight into what decisions enable flexibility and which factors influence the outcome of flexibility. This insight has two advantages: first, the client can better consider what options there could be and use these to anticipate on future developments. Second, Dewulf and Bright (2008) state that in the cooperation between client and contractor, “the incentives in public-private partnerships are easily quantifiable and able to be captured in terms of cost-containment over time for the private partner; and more nebulous and difficult to achieve in terms of quality gain-including asset flexibility-over time for the public authorities” (p. 136). Real options help to make flexibility more explicit for clients. It improves the position of the client towards the other party. In the following paragraph the concept and applicability of real options is further elaborated.

REAL OPTIONS

Investments can be made now and in the future. However, future is uncertain. A real option is the opportunity to invest later on in an asset by doing a small investment now that is not higher than the potential value of the asset in the future. Real options can roughly be divided in call and put options: to invest or not to invest. Having these opportunities creates flexibility in the assets to invest in. Other options are the option to abandon, defer, alter scale, switch or compound options (Ford, 2002)

The idea of options were first launched by Black and Scholes (1973) who applied them to finance. Trigeorgis (1996) and Dixit and Pindyck (1998) extended the idea to real options. The real option approach is used in a variety of industries, described both in financial as in management literature (Leiblein, 2003). A distinction can be made between a quantitative and qualitative approach. We argue in this paper for a qualitative use in the context of health real estate management for two reasons:

1. Real options as a relatively easy to use decision support aid.
2. Uncertainties with low predictability exclude quantitative methods.

These reasons are elaborated below.
Triantis and Borison (2001, p. 10) make a distinction between different ways in which real options are used in decision making. 1) as a way of thinking: ‘real options are used primarily as a language that frames and communicates decision problems qualitatively’, 2) as an analytical tool: they are used ‘primarily to value projects with known well specified option characteristics’, 3) as an organizational process: ‘real options is used, as part of a broader process, as a management tool to identify and exploit strategic options.’ Usability 2 has a quantitative application and its use requires specific knowledge on quantitative models, which is not always present in organisations. Since in first instance we think health organisations mainly need insight into their opportunities and the conditions to operationalise them, we find a useful application of real options by using it for the purpose of usability 1, ‘a way of thinking’, also called ‘the option lens’ (Bowman and Hurry 1993). We follow the approach of Miller and Lessard who state that in option literature often the risk is “priced”, while they see more usability in the ‘managerial process of recognizing, shaping, and realizing these options’ (p. 442).

The process of discussing and thinking about real options could also result in the (unintentional) use of real options ‘as an organizational process’, usability 3. The purpose is to obtain insight into what effects certain investments have on the future use of real estate. Real estate management has close relation to the organisational strategy. Therefore thinking about real options and how to create these options in the collaboration within a project coalition also necessitates thinking about the organisational strategy.

Health organisations deal with uncertainties that have both a higher and lower predictability and a higher and lower impact. Knight (1921) makes a distinction between risks and uncertainties. Risks are predictable and quantifiable. The risk is defined as the multiplication of the probability times the effect of a certain event. Uncertainties however, cannot be predicted but only estimated. Alessandri (2004) illustrates the effect of the type of risk or uncertainty on the decision making process. In case of a high predictability quantitative methods are applicable. When the risk is high as well as the uncertainty, managers rely on judgment and experience to justify decisions that have acceptable outcomes. All methods are applicable, while the qualitative approach of real options is useful in case of uncertainties with a high impact and low predictability. Because of these uncertainties, the combination with scenario planning is useful, which is described in the following paragraph.

![Fig. 2. Alessandri et. al. 2004](image)

**SCENARIO PLANNING AND DECISION MAKING**

Miller and Waller (2003) propose to use a combined method of real options in a qualitative way and scenario planning. The aim of their method is managing risks across ‘the full range of exposures across a firm’s portfolio of businesses’. The method prescribes the way to identify uncertainties that could affect all the businesses of a firm.

Due to uncertainties it is difficult to assess the future. Scenario planning is a method to cope with these uncertainties. The health assets have to facilitate the primary process of the organisation at all times. As a result of the aforementioned uncertainties, the primary process of health care is expected to change. Not only is it important to study various plausible scenarios in order to develop a strategy, the process of developing scenario is also important (Jonge, 2008). It is a guideline and a tool to support decision-making during the design and implementation of the strategy for several reasons (Chermack, 2004): first, it limits the problem of bounded rationality in decision making. Second, in decision making there is a tendency to consider only external variables, while scenario planning implies that internal variables are encountered as well. Third, the stickiness of information transfer is reduced since much communication between decision makers is needed. Shared understanding is a result of this and a natural thinking tool for use in a strategic conversation (Van der Heijden, 1999).

Increased interaction between decision makers and the involvement of external, remarkable people increases original thinking and the eruption of new insights. Friction of information and knowledge is increased for the same reason. The existence of a
potential opportunity is called by Bowman and Hurry (1993) a shadow option within the bundle of resources tied to a firm. Shadow options could be converted into real options.

Scenario planning is a useful tool for real option planning for three reasons. First, scenarios can help to identify options in the future. Second, it gives insight in the moment to decide when a shadow option should be converted into a real option. Third, scenarios can provide an important input in the process of evaluating strategies (Cornelius, 2005).

The topic of scenario planning has not been incorporated in the survey that is presented in the next section. Since there was no need to consider future uncertainties before the changing regulation in 2008, scenario planning was not very common. An example of current application of scenario planning is provided in box 1. Gelre hospital is the first hospital being build under the new regulation and shows that scenario planning is a useful method. Its’ possibilities could be further explored when combined with the real option way of thinking and applied to real estate management. This could be done by linking health care concepts to the effects on real estate. Real estate strategies including project coalitions could be assessed in the different scenarios and evaluation criteria defined in terms of flexibility. This enables the formulation of the different real options under different scenarios.

**Box 1**

Scenario planning in Gelre hospitals

The scope and depth of scenario planning depend on the character and relative size of the project (Bellers, 2008). The methods of scenario development vary. Notten et. al (2003) made a typology based on goal, process design and scenario content.

The goal of the scenario is decision making to convince financers, as opposed to exploratory scenarios. Gelre developed four extreme scenarios based on two variables which are the extent of economic growth and intensity of competition. The scenarios in the businesscase of Gelre are used as arguments in favour of health care concepts that the organisations will apply under different circumstances. The effect on supply and demand of these concepts and the effect on the required loan should convince financers. Scenario variables are summarized under four general topics: political, medic technical, economic and social variables, with specified aspects within these areas that are relevant to the organisational strategy.

The typology of process design of the scenario is based on the method and type of data collection. Within Gelre this is mixed, with quantitative forecasts of demography and more exploratory and qualitative data on the other aspects. The content of the Gelre scenario can be typified as simple since two variables are used.

**METHODOLOGY**

Our research is aimed at exploring how real option strategies can be used for strategic decision-making in health care real estate management. The first question we have is in what way real options are applicable in real estate management of health organisations. For this purpose a survey was undertaken.

Within literature the definition of real options can be found. However, the aim of the research is to discover how the analogy of real options can be applied to real estate management in a practical way. For this purpose workshops and surveys are useful. Within a workshop the focus is more on the process which has a learning effect for the participants. However, we start this research with a survey to inventorise the current situation regarding project coalitions and real options in the Dutch health sector. The results are presented in this paper.

Within the real option theory the following options can be distinguished: abandon, defer, alter scale, switch or compound options. The presence of these options gives insight into the flexibility in a project coalition and a contract. In the survey we asked whether these options were available during the realisation and exploitation phase of the project.

The survey was divided into four parts with the following subjects:

1. General questions about the organisation: size, turnover, number of beds, organisation of real estate management within the organisation, number of locations, age of the building(s)
2. Respondents were asked if they had plans for renovation or building development. We asked for the type of project coalition applied, for obtaining knowledge on the link with the real options. We asked if multiple buildings were combined in one project since this might create options. The option of changing function was investigated by asking if other functions can be located in the building. In order to know more about the background of the choices made, we asked for consideration made by the organisation on external level, industry level, organisational level and project level.
3. The third part contained questions related to real options within the project coalition. We asked whether the client made agreements with the contractor on options to stop, make adaptations to the design, expand, shrink and postpone the project, and extend and shorten the duration of the project. The respondents were asked to quantify the extent on a scale of 1 to 5. Whether and to what extent these options were exercised was also answered by the respondent on a scale of 1 to 5. The same scale was used for questions on options during the exploitation phase of
the project. Respondents were asked to what extent they had considered the option to enlarge or diminish the building in technical sense, the option to change spaces within the building and the economic feasibility of the technical flexibility. We also asked for the extent of realisation of the options and the apparent feasibility.

The survey was spread out among hospitals. We will conduct the survey in the care sector as well. There were 14 respondents of which 8 were employed in a hospital. We collected data from 7 hospitals.

RESULTS

The hospitals that responded the survey were all planning or realising a building project. Most buildings date from 1980-1989 or older. Most buildings are being planned to be renovated or newly build and projects range from 14 to 80 million euro’s. One third of the buildings has ones been renovated. The project coalition most applied is traditional. Others are DB, DBM, BM for technical installations and the building itself traditional, DBM with optional F and O.

We asked how many locations the organisation owns, which range between 1 and 4. The questions were filled in with one specific location in mind. The following paragraphs present the results of the survey. The survey was divided in three parts, each representing a different potential real option. This same division is used under the headings. The first real option is the way in which building projects are procured: each building separate or within one project. The second type of option is the design of the building: the possibility to change the use of the building. The third type of option can be found in the collaboration with the contractor during the exploitation and realisation phase. In each paragraph the results are compared with findings from literature.

OPTIONS IN A PORTFOLIO STRATEGY

In literature we find that establishing a portfolio of construction projects in one project has advantages since it provides economies of scale (Bult -Spiering, 2006), and might offer the probability to negotiate more real options with the contractor. Bult-Spiering shows that in Germany in the education sector, projects of different organisations can be combined. However, the survey showed that this was rarely done within the cure. However, within the care this approach could be more evident since often these organisations have many locations. We want to investigate this during the following survey.

THE OPTION OF MARKetable BUILDINGS

Another real option in real estate is the possibility to use the building for another use than it was meant for in the first place. An additional investment has to be made for this opportunity, but it prevents vacancy of the building which will cause even more costs. The survey showed that most buildings are suitable for other uses. These uses are other type of healthcare and research, hotel and/or care on commercial base, office, school, apartments, nursing departments, birth-/carehotel, shop. These alternative uses serve the following goals: preservation of income, high ability to push off, increase of production and renting.

Respondents were asked what measures they had taken to change the function of the building, both technical and organisational. The measures from which they could choose were the footprint and foundation, the technical installations, the excess roads, organisational and financial. Measures to change the function were taken on technical installations. Organisational measures were taken in five cases while footprint and foundation, excess roads and financial measures were taken respectively in 2, 3 and 3 hospitals. Interesting for future research would be to examine why other than technical measures are less taken, together with the potential real options of the measures.

OPTIONS IN REALISATION AND EXPLOTATION PHASE

We distinguished several options during the realisation and exploitation phase. To ensure that the understanding of buildings phases and project coalitions were equal among the respondents, we provided a scheme with buildings phases and a list of definitions of the building organisations forms. Based on the main real options described by Amram & Kulatilaka (1999) and Trigeorgis (1993), we asked to what extent, on a scale of 5, the client made agreements with the contractor on the following options during the realisation phase: option to stop, option to make adaptations to the design, option to make the project smaller or larger, postponing, and reducing or extending the duration of the project.

The survey also contained questions on planned outsourcing of facilities, which could be done in an integrated project coalition. In literature (Bult-Spiering and Dewulf 2006) is stated that more flexibility can be enforced within integrated contracts. Other advantages are cost reduction and more attention for life cycle costs. The real options in this are the added value of these advantages when investing in an integrated project coalition. Points of consideration are, amongst others, the output specifications, duration of the contract and consideration of which facilities to incorporate (Beek et.al. 2010).
The most often mentioned options agreed upon were the option to stop, to make adaptations to the design and the options to shrink the project. In most cases there was more opportunity for options, based on the extent to which agreements were made. However, these options only have been exercised to a small extent. The options which were exercised to a larger extent than agreed upon, were in some cases the option to make adaptation to the design and the option to extend the project. In three cases the reason for this was that the project was still in the initiative phase, so there had not been an opportunity to exercise the options. A reason for the difference in one case was a change in the management. Another hospital had adopted a traditional project coalition in which no agreements were made on these subjects.

It appeared that options in the operational phase were incorporated in a few hospitals. Respondents were asked to point at a scale of 1 to 5 to what extent they considered the following issues: 1) the option to expand the building in technical sense in case of an increased demand; 2) The option to make more ad hoc adaptations to the building; 3) the economic feasibility of the options. Most issues were ranked between 3 to 5. Also the cases with a traditional project coalition displayed this high consideration of flexibility. The high flexibility can be the result of a very flexible design which is not necessarily dependent on a certain project coalition. Therefore additional investigation is necessary how adaptations can be made and what role the contract plays here. Although only 3 hospitals filled in the questions on realisation of options and economic feasibility, the rate was very positive.

Respondents were asked if they have their facilities outsourced or in house. Six have their facilities partly outsourced, while three have them in house. The same division can be seen between organisations that want to outsource more or want to retain the status quo, but these are not the same organisations. A wide range of reasons for outsourcing is mentioned in the survey. One interesting reason for not outsourcing at all are costs, which contradicts with literature. Therefore, it would be interesting to know what causes this reasoning by real estate managers. Another reason for not outsourcing is autonomy of organisation, an interesting reason that is not mentioned in literature. Others mention reasons which can also be found in literature (Leidraad aanbesteden 2010), namely focus on core tasks, financial transparency as part of DBM, competitive working, learning from market operators and quality.

CONCLUSION

In this paper we discussed the uncertainties that health care organisations have to deal with, which is reflected in the real estate strategy. We further showed how scenario planning can be useful to deal with uncertainties and to gain insight in opportunities that these uncertainties can create. We propose to use scenario planning in combination with real options theory as a way of thinking. This approach is not new, but in the context of real estate management in health care it has not been applied yet. An exploratory survey among hospitals was undertaken to find out what options are considered by health organisations or are already (unconsciously) present. For this purpose the survey questions included topics about type of project coalition applied and alternative usability of the real estate. Additionally we asked for plans regarding future building projects and if they considered sourcing out facilities when applying an integrated project coalition.

The real option of the marketability of buildings was widely recognised among the respondents. However, the advantage of the option to create more flexibility by outsourcing facilities was not perceived by all. Considerations relating to real options in the realisation and exploitation phase were made to a large extent. The survey shows that flexibility, as expected, is a big issue in real estate management. Still, many hospitals have a traditional project coalition, which might have less real options than for example integrated project coalitions. However, this should be learned from practice. Nevertheless, within the health care much can be gained by more exploration of the possibilities of other project coalitions.

The use of scenario planning increases since banks demand business cases in which future demands should be incorporated. However, including real options could have added value by further supporting decision making on real estate. However, in order to become effective, scenario planning and real option thinking should be institutionalised in the organisation. This demands further development.

Further research should look for a more tangible method for applying scenario planning in combination with real options. In addition, there are probably more real options than defined in this paper. Further investigations should reveal what necessary conditions are for exercising real options.
REFERENCES


ASSISTED LIVING FACILITIES FOR THE OLD – ASPECTS OF USE AND USABILITY

M. Andersson¹ and I. Malmqvist²

ABSTRACT

A growing number of old citizens and fewer working to support them is a reality in Sweden. More knowledge about assisted living facilities is crucial in creating appropriate care environments for the oldest. The study is part of a PhD project that explores use and usability in assisted living facilities for the old in Gothenburg, Sweden. This paper reports upon the observation study conducted November 2009-February 2010 in five facilities in Gothenburg, along with the other methods used in the PhD project. The aim of this study is to observe the daily use and thereby identify factors in the physical environment, affecting usability. Some preliminary findings are accounted for. Semi-structured interviews and a questionnaire survey are scheduled for 2011-2012. The city of Gothenburg and Chalmers finance the project and are the primary users of the results.

KEYWORDS

assisted living for the old, care environment, eldercare, usability

PROJECT OUTLINE

BACKGROUND

Swedish eldercare consumes today almost 20% of the municipal budget in Sweden and 61% of this by assisted living. Only 1% of the total population lives in assisted living (SKL 2008). By 2009-12-31, there were about 5200 residents in assisted living in Gothenburg out of a population of 507328 (Lokalsekretariatet 2010, Gothenburg Statistics 2010). The share of the population 65 years or older is expected to increase from 18% in 2008 to 25% in 2050, the group 80 years or older from 5% to 9% in the same time span (SCB 2010). The need for eldercare in Sweden is therefore expected to increase 2010-2050 (SKL 2005). The prognoses for Gothenburg and EU are similar (Gothenburg Statistics 2010, SKL 2009). Being responsible for the eldercare, this will have great implications on the municipalities’ economy and planning (Swedish Government 1990). The Government’s aim is to increase the number of persons and part of the population living in ordinary housing, introduce new housing concepts and develop specialized institutional care for the elderly (Swedish Government 2008).The PhD project is underway 2009-2013 and includes 35 assisted living facilities for the old, situated in Gothenburg and managed by the City of Gothenburg 2010-01-01.

RELEVANCE AND EXPECTED OUTCOME

The aim of the study is to increase knowledge about assisted living facilities for the old from an architectural research perspective. In Sweden there are few similar scientific evaluations within architectural research and in Gothenburg no such studies has been made. The project puts the question: “How are the studied physical environments used and how do the environments affect the usability?” More knowledge about assisted living for the old out of a user perspective is asked for by the municipal sector, being responsible for the welfare of the old (Law 2001:453) and by the construction clients, commissioning the physical environments. Expected outcome of the project is a) to enable better architectural programming in eldercare, and similar building projects, b) to facilitate physical resource planning in eldercare and c) to substantiate guidelines for appropriate property management possible.

DEFINITIONS

An old or elderly person is in this article defined as 65 years or older. This definition is used by the Swedish Government and other official institutes (Swedish Government 2008, SKL 2008). It has also been the age of retirement in Sweden until 2005, when the law was changed (Swedish Government 2003). The age group in assisted living are 80 years or older, referred to as older old by official statistics and by official organs in Sweden.

Laws governing person-related data collected in the project are the Secrecy Act (Law 1980:100) and the Law on Person-Related Information (Law 1998:204).

The Swedish term “särskilt boende” corresponds to the English “assisted living”. The term “sheltered housing” is also used, along with “special housing”. Assisted living is used commonly in both UK and the USA and is used as the sole term in this article. After an application to the municipality, a so called Aid Assessment is conducted. This leads to an Assistance Decision, e.g. to provide assisted living. The City of Gothenburg manages 92 buildings with assisted living.

¹ MSc Architecture, PhD student, Architecture, Chalmers University of Technology, morgan.andersson@chalmers.se
² PhD Architecture, Chalmers University of Technology, inga.malmqvist@chalmers.se
facilities for the old in Gothenburg. The vast majority of them are operated by municipal eldercare, with the exception of handful private institutions. The project includes facilities built 1960-2006, representing 90% of the buildings. The size ranges from 300-15000 sqm with an average size of 5703 sqm. Measurements are in square meters, sqm (SS 021053).

The concept of Usability is defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.” (ISO 9241-11). Efficiency means that the artefact allows the user to perform easily and with use of little resources. Effectiveness describes the ability of the artefact to deliver a certain desired effect. Satisfaction would mean the degree of congruence between the ideal vision of the function and the subjective experience of the outcome, also described as the user’s feelings and attitudes towards the artefact and its effects (Alexander 2006). The concept was originally developed for technical products (Schackel 1991, Keinonen 1997), but applications on the built environment are being developed (Rasila et al 2010). Granath and Alexander (2006) suggest a widening of the concept by introducing context, culture and situation in the evaluation. The Norwegian researchers Monica Jensø and Tore Haugen discuss usability in healthcare settings in a conference article (Jensø & Haugen, 2004). They point out that the construction and user processes have different perspectives on usability and argue that we can study the usability of buildings by setting up the criteria and parameters, studying usability from the various parties’ perspective, consider the time factor and study buildings in their context.

THE RESEARCH AREA

Within Swedish architectural research, few similar studies have been made and very little research has been done in the architectural academies in KTH, Chalmers and Lund. Architecture research about assisted living has been conducted at KTH (Andersson 2005), Lund University (Åhnlund et al 1995, Åhnlund & Ohara 1998) and at Chalmers (Almberg & Paulsson 1991, Paulsson 1998, 2002, 2008, Almberg 1997). Research about geriatric care environments has also been conducted (Fridell 1998). The Centre for Ageing and Supportive Environments - CASE - at Lund University is conducting interdisciplinary research about older people and home environments. At Chalmers, there is current research on housing issues, old persons living conditions, assisted living and handicap. A Research Center for Healthcare Architecture has been started during 2009 at Chalmers on initiative from Professor Peter Fröst. Besides Stockholm, Gothenburg and Lund, multi disciplinary research with a sociological approach is conducted at Linköping University in the National Institute for the Study of Ageing and Later Life – NISAL. Catharina Nord is here doing research within the architectural field, concerning the design of future housing for the oldest old with extensive help needs. A study about assisted living has also been made (Lövgren 2002). On many academies in Sweden, research about old people, quality of life and care environments is carried out within the medical and sociological fields.

A literature search made 2010-03-31 on “assisted living” gave 455 hits. 14 of these were considered applicable to this project and included some kind of assessment of the physical environment, overview or relevant methods. The others dealt with quality of life, supportive technology, independence, medication, workplace issues, etc. A search on “special housing” gave 26 hits: 1 contained a questionnaire survey to eldercare nurses and 2 dealt with ordinary housing. Finally, a search for “sheltered housing” produced 78 hits of which 11 were applicable. Only 3 hits were related to Sweden.

THEORY AND METHOD

The project puts the question: “How are the studied physical environments used and how do the physical environments affect the usability?” In this PhD project, mixed research strategies are used to answer that question. The research approach is mainly qualitative and four main methods are used in the project: Observation, interviews, questionnaires and document studies. Participant observation, semi-structured interviews and document studies are mainly qualitative methods (Patton 2002). The observation study and the interviews constitute an exploratory case study (Yin 2003). The questionnaire survey is mainly a quantitative method (Ornstein 1988). This means that the project uses different sources of data, along with a combination of qualitative and quantitative methods (Flyvbjerg 2006, Groat & Wang 2002). Results from the observation study are triangulated with results from the interviews, questionnaires and from the document studies (Stake 1995, 2005). The analysis of the data follows a flow-model of the data organization: Data collection - data reduction - data displays – conclusion/verification – analysis (Miles & Huberman 1994). The documentation from the observations and interviews are processed and analyzed using Excel as a computerized qualitative data analysis tool (Meyer & Avery 2009). Textual accountancies and analyses are processed in Word.

The two first studies are designed as one case study in two parts with five cases, i.e. five assisted living facilities for the old in Gothenburg. Five assisted living facilities for the old in Gothenburg are chosen for the case study. The facilities vary in terms of size, location and original purpose (Table 1). Each case contains several analysis units, equivalent to the 14 care units (Yin 2009). The analysis units constitute the physical and organizational background to each session in the observation study and to every round of interviews in the interview study (Illustration 1). By observing how residents and staff use the common unit areas, a number of problems, related to the physical environment, are defined. This method is mainly qualitative (Patton 2002). Question areas based on these problems, on basic assumptions and on pre-conceived knowledge are further penetrated and developed in the semi-structured interviews, where also apartments are included. A mixture of deep-interviews and group-interviews will be conducted. Residents and staff from the five facilities will
participate. Both individual and group interviews will be conducted. Thick descriptions are used to display complex interrelationships (Geertz 1973, Patton 2002, Stake 1995). The questionnaire survey will give quantifiable results from a large number of respondents in thirty other facilities in the third and last study. The survey aims to obtain quantifiable material with a high degree of external validity by triangulating results from the case study and to compare material within the study (Groat & Wang 2002).

The purpose of documents is to a) illustrate, b) support theories and hypotheses, c) to give background to prevailing circumstances and d) give validity to obtained data. A great number of documents are identified and of various types: Visions, goals, policies on each level; time schedules; individual care plans; routines for contacting the property manager’s helpdesk; birth year and moving-in date for each resident and practices concerning Aid Assessment procedures on district committee level. Three main groups of documents are identified or used in the project:

1. **Pictorial representations of the environment:** Photos, drawings and other depictive media, historical or up-to-date provide both quantitative and qualitative data. Photos are used in combination with the other methods (Fangen 2005).

2. **Other descriptive documentation about the premises and activities:** Data about the buildings, routine descriptions and some medical data.

3. **Governing documents:**
   1) Supra-national and national documents: Plans, laws, regulations and agreements.
   2) Regional and Municipal: Regional health care policies, regional and municipal policies, guidelines and plans.
   3) Local: Documents are identified on a) district committee level, b) facility level and c) unit level.

The philosophical foundations for the qualitative research methods are found in phenomenology, applied as a social science methodology and as a base for empirical research, focusing on the meaning of a phenomenon rather than on the phenomenon itself. It also implies an inductive approach, based on empirical data rather than theories (Szklarski 2009).

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<th>CASE/FACILITY</th>
<th>ANALYSIS UNIT/CARE UNIT</th>
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Table 1. Facilities, analysis units and observation schedule. Size in square meters BRA (SS 021053).
The project design is best described in a bottom-up perspective. If one theoretical point of departure would be Grounded Theory, the other would be the testing of precise hypotheses (Fangen 2005). In this project, a precise, but initially open, question is posed. The many questions deriving from the observation study are then transformed into more precise topics in the interviews. In the questionnaire survey, few and important questions are explored. The project is explorative and the formulation of the problem initially flexible in order to develop a deeper understanding out of the context (Fangen 2005, Dewalt & Dewalt 2002, Miles & Huberman 1994). The process is dynamic in the sense that each step in the process is dependent on the previous. The bases of the project are own experiences, collected data, existing research and the experience and knowledge of residents and staff. A basic assumption is that the physical environment interacts with the people in it and either supports or counteracts the intended purpose. Another is that the interpretation and evaluation of the physical environment prerequisites people using them or, in other terms, use is a prerequisite for experiencing and thus interpreting and assessing architecture.

PARTICIPANT OBSERVATION STUDY 2009-2010

The goal of this study is to identify factors in the physical environment related to use and usability by observing the daily use of common areas in the care units. The aim is also to find answers to questions that are essential to designing and building special housing in the future to meet its objectives in the best way. Examples of questions asked in the study are: What kinds of activities are performed? How often? How many are involved in the activities? Do they require specific conditions, such as extra equipment or reshuffle? Is there undesirable use, such as use of space for transport or by others who do not belong to the unit? The experience and knowledge derived from observation of the study, can then be translated into questions about spatial aspects such as: What is the room shape and proportions? Is there room for more variation? Is it possible to equip with more appropriate furniture? What materials are used? Are there good acoustic conditions? Is there a passage to other rooms? Those aspects are relevant for future projects. It is also relevant to question whether the activities currently carried out are relevant in the physical context. In other words - on the physical environment is designed in such a way as to prevent or hinder certain intended uses. These questions will be further explored in the interviews.

The purpose is to study how common areas are used and the units are studied at 20 occasions, covering all days of the week and all parts of the day, amounting to a sum of 146 hours (Table 1). The degree of participation is moderate, allowing the observer to interact, without actively participating in the action (Dewalt & Dewalt 2002). Interaction in this context means for instance having conversation or adapting to the situation by moving around. Paper, pen and camera were used.

PRELIMINARY FINDINGS

This study is in the initial analysis phase, but some preliminary findings are apparent. We can see that manning and responsibilities differ between the studied facilities, for instance, the workload of the night staff. The lighting differs regarding quantity, quality and routines. An integrated plan makes it difficult to close the kitchen area and lock out the sound from the dish washer. Variations in coloring and materiality of walls, floors and furniture are observed. This affects both the acoustic environment and the visual legibility, given the fact that all old people suffer from some visual impairment, e.g. lens confusion (Woodrow 2002, Brunström 2004). The use of common unit areas differs and some distinctions are obvious: There are differences regarding number of residents and also variations during the course of the

Illustration 1. Research Design.
day. These variations coincide to a great extent between the facilities and are connected with the routines on the unit. The use of the common areas seem to be more intense and more evenly spread over the day on dementia units, while on somatic units, more concentrated to meals or other common activities.

Rather surprising is that localities and equipment differ very much between the facilities. The open plan makes it for instance difficult to prevent demented residents to access drawers with knives etc. Some dementia units have smaller drawing and dining rooms, than the somatic units on the same facility. This is notable, since they are supposedly more used. Staff areas differ regarding access to restrooms, documentation areas and report rooms. Waste disposal and sanitary equipment also differ to a surprisingly high degree. On one facility, there are separate areas for all these functions and a clean, cooled, separate waste room, accessible from the outside. On another dementia unit, there is no room for documentation, which has lead to a provisory, where a third of the drawing room has been transformed into an office. On the same unit, the lack of waste disposal area has led the staff to use a store room, mixing waste and used diapers with clean goods, very close to the dining room. This is undoubtedly one of the most important findings in the study. Smell is a sense that gives us bad or good feelings. Bad smell from diapers or garbage in a dining room is evidently something that evokes and reinforces bad feelings and memories. All the differences between the facilities are to be viewed against common regulations and a common employer, the City of Gothenburg.

TWENTY FOUR HOURS IN AN ASSISTED LIVING FACILITY FOR THE OLD

A winter workday in Morängatan started at 06:45 with a report in the common staff room on second floor. The night staff report what has happened during the night to representatives from each unit. Some of the day staff start at 06:45 and some at 07:00. They return at 07:00 to their own units and report to the rest of the staff. At 07:20, everybody goes to the residents apartments to help some of them with the morning toilet. There are sounds from the rooms – radios and televisions, someone screaming, conversations. Some doors are open, some are closed. This routine is similar on all units, dementia and somatic. Most residents, but not all, are helped to the breakfast table. They come by wheelchairs and walkers. At 08:00 a delivery man from the technical department delivers the lunch and evening meal for two days. One of the staff takes care of it in the kitchen. At 08:25, most of the residents are up and sit by the dining tables. One of the staff is preparing the breakfast in the kitchen, at the same time keeping an eye on the residents in the adjoining dining room. Kitchens and dining rooms are integrated.

Breakfast is served At 08:40. Most of the residents are gathered. Some eat in their rooms and some are being fed. The staff talks to the residents, but the residents don’t talk much to each other. Subdued sounds accompany the meal. By 09:30 everybody has had their breakfast and the dining room is empty. Some residents go back to their rooms and a couple of them to the drawing room. The TV is on. Between 09:30 and 10:30 the staff has their morning break for half an hour. During this time it is very quiet and calm in the unit.

Coffee is served At 11:00 in the drawing room to some of the residents. They talk to each other and to the staff. By 12:00, the washing up is done and the staff starts helping the resident to the toilet. At 12:30 the staff starts to prepare lunch in the kitchen.

Lunch is served at 13:00 and all residents who can and so wish, come to eat in the dining room, either assisted or by themselves. Evening staff starts at 13:00 or 14:00 and by 14:00 the dining room is empty. Before 16:00, when the day staff gets off, the evening staff gets their afternoon break. When they get out, they start helping the residents to the toilet and some of them are now put to bed.

Evening meal is served at 17:00. There are fewer in the dining room than at lunch. Residents are continuously helped to bed and some sit in the drawing room, watching TV. Coffee and sandwiches are served at about 20:00 to those who wish. After the coffee it is very calm on the unit. Most residents have gone to bed. Some staff go home at 20:00 and some at 21:15.

The four night staff arrives at 21:00. They get report from the evening staff in the common staff room on second floor. The last of the evening staff leaves at 21:15 and the night staff returns to the base unit. Three of the staff have a common base unit for the 5 somatic units and one staff works the two dementia units. All residents sleep or at least sit in their own apartments. The lighting is in night mode.

The first night round is made between 21:00-22:00. All residents are looked after. At 03:00 a more extensive round is made, where diapers are changed and water or lemonade is administrated. The last round at 05:00 is a check-up. There are only occasional alarms from residents during the night. The staff watches TV or reads, but have no meal. You get very tired between 04:00-06:00. At 06:45 it starts all over with report to the next day staff.
DISCUSSION AND CONTRIBUTION

Several research-studies in Sweden and in Europe state the importance of skillful and detailed programming or briefing before the design-phase (Blyth & Worthington 2001, Fristedt & Ryd 2001). Less effort put in the programming-phase often results in changes done soon after the delivery of the built facility. With high costs for correcting mistakes, the importance of briefing or programming has become more evident for Construction Clients. The City of Gothenburg has therefore a major interest in such research-findings that can bring forth relevant prerequisites concerning the assessment of the requirements – requirements of care providers, staff and residents. The city has therefore established a Research & Development Unit, to promote better conditions for the elderly of the city. There is an increasing interest in detailed aspects concerning the context between different spaces and the conditions for multiple uses of spaces. There is also a lack of knowledge of how well existing facilities for assisted living are serving their purpose, and of the aspects affecting the use. The studies in this project are expected to contribute to this knowledge.

Many research studies concerning assisted living environments for the old focus on medical or social aspects of eldercare. An overview of eldercare research in the Nordic countries has been made by Martha Szebehely (2005). Medical studies focus on health aspects and are often limited to either staff or residents/patients while social sciences study interaction and behavior. However, the focus of this research is to study use and usability. The daily use of the studied environments out of an architecture perspective represents the core and the coherence of the research project and the common denominator for the studies included in the project. The aim is not to study any particular group or phenomenon, but to apply the concept of usability on these specific environments in a Swedish context. The results are expected to be transferable and comparable to similar conditions both in Sweden and elsewhere. This observation study has identified areas of interest, related to use and usability of assisted living facilities for the old. By observing use, analyzing documentation and the outcome of interviews and questionnaires about use and perceived usability, the project is expected to provide relevant answers to the research question.
REFERENCES


Flyvbjerg, Bent. (2006). Five misunderstandings about case study research *Qualitative Inquiry*, vol 12, nr 12, april 2006, pp. 219-245.


Lokalsekretariatet (2010). *Göteborgs Stads Lokalsekretariat*.


SKL (2005), *Sveriges Kommuner och Landsting (SALAR, Swedish Association of Local Authorities and Regions)*.


