KEY CRITERIA OF SUSTAINABLE HOSPITAL REFURBISHMENT: A STAKEHOLDER REVIEW

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Hospital refurbishment has taken a secondary role in the last decade, in favour of new build facilities. This has allowed the Client and the Design Team to build and specify with greater flexibility and from essentially a 'blank canvas'. Correspondingly, sustainability as an issue has been easier to plan and implement from the earliest briefing and design stage. The changing economic landscape has necessitated that the focus has now shifted to the refurbishment of the existing healthcare estate. Refurbishment is widely recognised as presenting unique challenges in its own right. Add to this the institutional and statutory requirements in the arena of sustainability and the unique functional characteristics of an operational hospital and these challenges are increased. Given the practical and economic challenges of refurbishment as an activity, weighed against a facility as multi-faceted and complicated as a hospital, a structured and prioritised process of decision making is required. A multi-criteria decision making (MCDM) approach is discussed as being most suitable for this process. A pilot study of a non-random sample of industry experts is analysed to establish a baseline knowledge platform of the key research variables and subsequent method of selecting criteria. The overall findings establish a good awareness of sustainable development and familiarity with key documentation and guidance, however knowledge of the capital investment appraisal process and the use of MCDM tools is shown to be very limited.

Keywords: hospitals, MCDM, refurbishment, stakeholders, sustainability.

INTRODUCTION

The time period spanning the latter half of the 1990s and into the first decade of the 21st century saw a huge amount of investment in the building of new infrastructure; notably with the construction of new hospitals under the Private Finance Initiative (PFI). In practical terms, and from the perspective of a new-build facility, the accessibility to funding, and the opportunity to plan, design, and build from what is essentially a 'blank canvas' presents the client and design team with the flexibility and opportunity to integrate all of the statutory, institutional, and desirable requirements, which includes the sustainability performance of the asset. Controversy of the PFI as a procurement vehicle aside, the fact remains that a raft of new-build PFI hospitals have been added to the NHS built estate. However, as positive as a programme of new-

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build facilities may be, the fact remains that, as stated by Sheth *et al.* (2008), the majority of the healthcare facilities which will be used in the 21st century have already been built. The size of the existing estate, coupled with the well recognised economic challenges faced by the NHS presents a complex web of challenges for providing a 'fit for purpose' healthcare service that is legislatively and institutionally bound to meet a myriad of targets. The most challenging of these targets are arguably, those within the scope of sustainability and sustainable development. Wilson and Kishk (2011) highlighted that to meet its functional and statutory requirements, it is from the extensive existing estate, and the refurbishment process, where the solutions to the sustainability agenda must be found. The interface between continued functionality of the hospital and the requirements of sustainability is a priority issue when it is considered that a high proportion of the existing healthcare estate was planned, designed, and built for, a very different social and healthcare landscape of yesteryear. It is significant to appreciate that in the region of '30% of all existing buildings in the existing healthcare estate pre-dates the actual formation of the NHS as a service in 1948' (Kirkham and Boussabaine. 2005). In terms of the objectives of this paper, and within the perspective of the wider research, it is therefore imperative that a model is developed which identifies and considers the complex combination of decision possibilities faced by the client and design team in the refurbishment process.

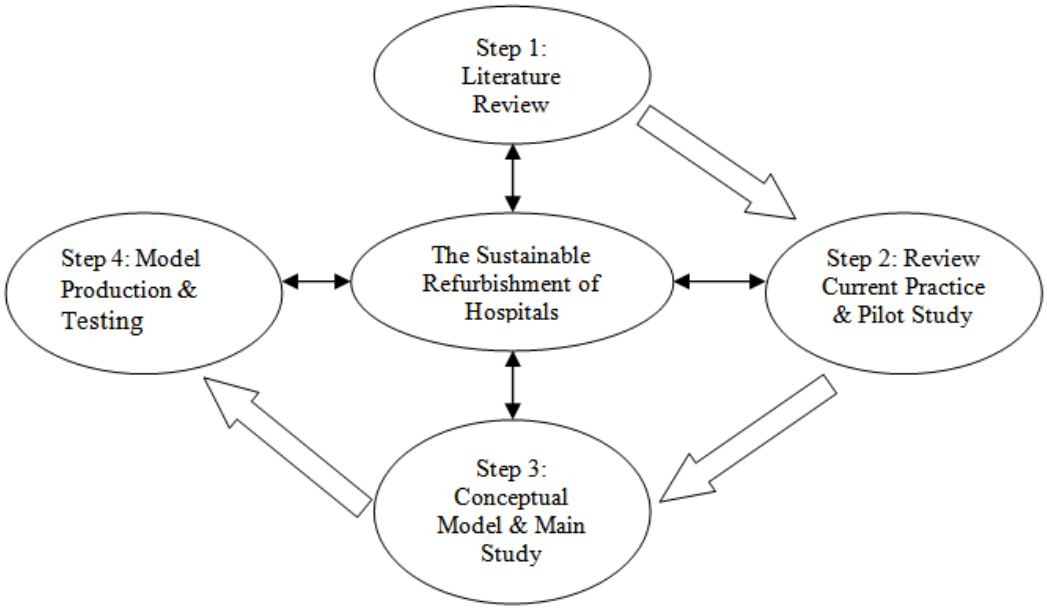

Figure 1: Methodological framework (adapted from Maxwell, 2005)

The main objective of this paper is to ascertain the need for a formalised and measured decision making process to be undertaken by the correct actors and within the optimum time frames of the refurbishment appraisal process. A review of the literature has shown that there is no standardised or measured process by which the client, the design team, and other industry professionals can compare a 'best fit', and best 'value for money' alternative, based on reasoned criteria. Primary data has been collected by means of a pilot study, which is a critical step in the methodological process shown in Figure 1. The final model (Step 4) is ultimately an exercise in 'measured trade-offs' to use the specification process in balancing the functionality/sustainability interface. Multi Criteria Decision Modelling (MCDM) techniques have been identified as best suited for this objective. The starting point in building such a model is to establish the main evaluation criteria and the relevant sub-

criteria, which will in turn allow for the subsequent mathematical construction of the weighted and ranked model. The research identifies the Department of Health's 13 sustainability issues (HTM 07-07. 2009) as the 'main criteria' level, and utilises Braunshweig *et al.*s (2000) reduction method to allow the subjective recognition of the relevant sub-criteria by the decision maker (Figure 2) although it is noted that this excludes potential staff and patient criteria outwith the DoH issues.

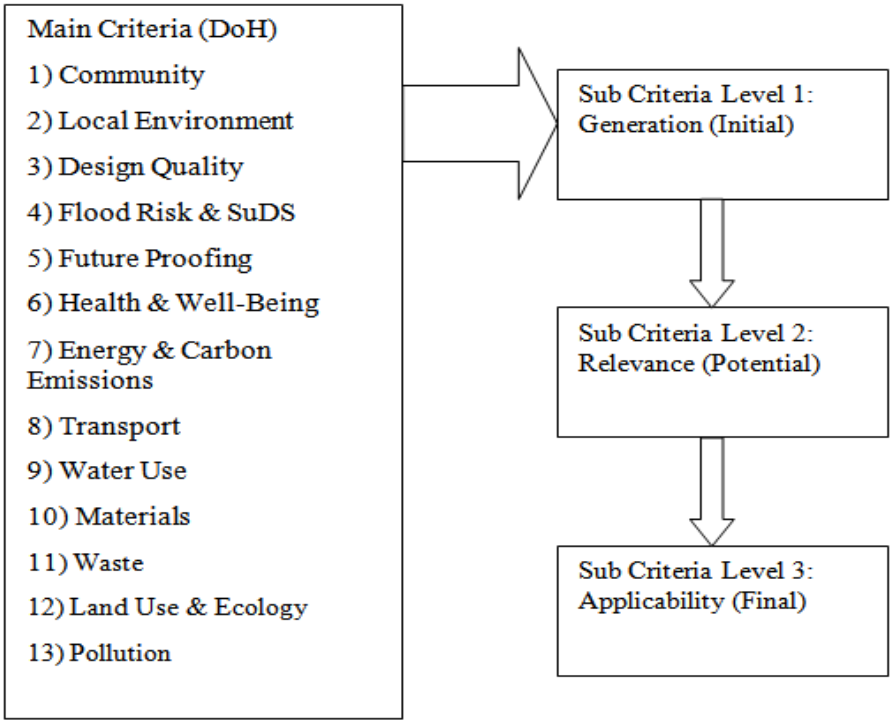

Figure 2: Sustainability 'Main Criteria' and relationship to the 'Sub-Criteria' process

THE CHALLENGE OF REFURBISHMENT IN THE FUNCTIONING HOSPITAL

The challenge of the generic refurbishment process is well understood and documented, and can be cited as the prevalence of 'uncertainty' in the actual works. (Egbu and Lee. 2006) (Quah. 1998) This uncertainty fuels one of the main design team and contractor challenges which is the potentially large number of variations as the work proceeds. Azlan-Shah (2010) clarifies this even further in focusing on the technical challenges of 'matching up' the evolving requirements within the constraints of the existing building, especially in regard to the more 'fixed' aspects such as building orientation, form, and thermal mass etc.

The unique characteristics of the hospital

The hospital is a unique facility amongst all other buildings. This can be demonstrated by understanding that in the standard acute facility, the hospital can in fact be an incorporation 'of all other buildings'. Offices, catering, living accommodation, factories, laboratories, transport depots etc. The modern hospital is a functioning combination of all of these building types. In addition to this uniquely multi-faceted facility, the key point which sets the hospital apart from all other building types, are the 'healthcare specific service requirements'. This is most easily demonstrated by referring to the healthcare specific publications such as the Health Building Notes (HBN) which set the required standards in regard to the planning and design of the

facility, and the Health Technical Memoranda (HTM) which have a similar role in setting healthcare specific standards, but focusing on the more detailed specification at the component level (Space for Health 2012). Although these very specific publications provide guidance on the requirements of the actual built asset, the other key point to understand, is that the hospital can be a constantly functioning facility. All of the building 'sub-types' and the requirement for a fit for purpose provision of service have the potential for operational requirement to be delivered 24 hours a day, 7 days a week, for 365 days in the year. This in itself is an enormous logistical challenge. When the necessity to undertake refurbishment works is introduced, the logistical challenges become far more pronounced, especially given the potentially fragmented nature of separate refurbishment activities or works packages being undertaken simultaneously.

THE REQUIREMENT FOR AN MCDM APPROACH

The hospital has been identified as a unique and highly complex facility. When the uncertainties of the refurbishment process are added to this, the proposed project is already starting from a position which has many inter-related, and often conflicting, criteria. This 'multi-criteria' starting point presents a logical progression to the use of multi-criteria decision modelling (MCDM) techniques. Loken (2005) makes the point that the Decision Maker (DM) is primarily concerned with finding the 'optimal solution', which may only really be possible if measured against a single criterion. The volume of financial and technical considerations within the refurbishment process makes this completely impractical. Triantaphllou (2000) recognises this and highlights the key advantage of MCDM which seeks to ascertain the 'best alternative' when presented with multiple sets of decision criteria. Bouyssou (2000) captures the over-arching essence of decision making techniques in describing them as…"A set of explicit and well-defined rules to collect, assess and process information in order to be able to make recommendations in decision and/or evaluation processes". Although Bouyssou (ibid) clearly recognises the limitations and imperfections of any 'single' MCDM method, a process of 'weighted evaluation' is the most practical and inclusive given the nature of the refurbishment issues, and the composition of the DM team. The critical mechanic of this system, is the comparison of 'every' criteria, to 'every' criteria, which are subjectively ranked, as proposed by Kirk and Dell'Isola (1995) which then allows alternatives to be developed in weighted terms.

MCDM versus existing methods

There are a vast number of sustainability assessment methodologies, many of which have the flexibility or version to accommodate healthcare. Similarly there are many which are focused on, or amenable to the refurbishment process. However, there are few which capture the refurbishment of healthcare facilities. The NHS is restricted to a narrow choice of assessment methods as part of the funding approval processes, guided by the capital investment procedure within the HM Treasury Green Book 'Appraisal and Evaluation in Central Government' (2011). This in turn is the main reference document for the Capital Investment Manual (1994) and the more recent Scottish Capital Investment Manual (2010). The majority of the NHS building works are subject to Building Research Establishment Environmental Assessment Method (BREEAM) assessment, the Achieving Excellence Design Evaluation Toolkit (AEDET), and reference to the Activity Data Base (ADB). Other methodologies have been adopted, albeit on a far smaller scale, such as the Leadership in Energy and Environmental Design (LEED) system, and many of the smaller value refurbishment

projects are ignored completely. Although these systems 'do exist', it is widely felt within industry that they ‘are not suitable’ for application to hospital refurbishment. This is proved by the Building Research Establishments (BRE) withdrawal and current redevelopment (in 2012) of the BREEAM Healthcare (Refurbishment) assessment. As effective (or otherwise) as these methodologies may be, there is one fundamental difference when compared against the MCDM technique. To achieve a set 'rating' score, almost every method provides guidance on specification and element or component selection. However, critically, there is no process of deriving the best specification or design alternative based on a weighted, calculated, and measured selection process. Given the complex nature of the hospital refurbishment process, and as stated earlier, the challenging economic parameters, it is proposed that a model which has the capacity to prioritise specification choices and design decisions would be of great benefit to the client and design team at the early planning and outline proposal stages. The capability of extracting the subjective expert judgement of the design team and the clinical and operational requirements of the client, and then enabling an objective prioritised system of 'trade offs' to be established 'specific to the facility in question' will be of great value to the project delivery. This value is in turn measured against value for money and the requirement to attain the functional and sustainability standards required by the facility and the wider NHS.

Drawbacks and limitations of MCDM

The potential for using MCDM techniques, and the value of doing so has been discussed. However, notwithstanding the benefits of quantifying and prioritising the vast amount of possible criteria, Trianttaphllou (2000) identifies what he terms the 'decision making paradox'. This paradox recognises that given the sheer number of existing and continually developing models, the only true way to establish which method to use is by means of a multi-criteria decision making process. The looped impossibility of this scenario highlights the fact that ultimately, the decision making process is founded on a subjective platform. This seems contrary to the objectives of many of the methods used. The 'criteria' itself, which is naturally the backbone of the MCDM process presents its own limitations. The MCDM process cannot be considered as a 'black box' which will provide ready made solutions. The end result is only as good as the quality and relevance of the data or criteria which is fed into the model. Zavrl *et al.* (2009) expand on this point in recognising that the criteria itself is governed by its ease of availability, or as modelled by Braunschweig *et al.* (2001) and shown earlier in Figure 2, the criteria selection process follows 'generation', to 'relevancy', and finally 'applicability'. This may seem straightforward enough, but caution must be observed in understanding whom the parties are that select the criteria. The clearest example related to this research, is the identification of four distinct expert groups, namely; design team professionals, healthcare professionals, sustainability professionals, and academic professionals. This limits the criteria to that which is prioritised by these respective disciplines and could, it may be argued with some validity, create restrictive parameters to the models results.

A PILOT STUDY

The criteria selection process has been discussed, although it has also been shown that there are variables out with the criteria itself which have an effect on the efficacy and validity of the decision making process. This includes the current tools and systems in use, and the appraisal and procurement process itself. In addition to the main objective to ascertain 'the need' for an MCDM approach, 2 further key objectives of the pilot are

to ‘establish the knowledge base of targeted professionals in the area’, and to ‘inform the content, direction, and format of the main surveys construction’.

METHODOLOGY

A brief questionnaire was offered to 33 professionals from within the disciplines of healthcare, design and construction, sustainability, and academia. The questions were primarily quantitative in nature and were designed to evaluate levels of experience in various healthcare facility building types, and their relationship to the fields of refurbishment and sustainability, respectively. Respondents were also queried on their knowledge and experience with the appraisal and procurement processes for works relating to healthcare, and the most commonly used tools/systems and technical guidance documents as identified from the literature review and secondary data collection. An assessment of the respondent’s experience of using MCDM methodologies was also sought. Elements of qualitative response were also made possible, primarily for feedback on the format and applicability of the pilot study itself. The 'purposeful sampling' strategy described has the deliberate goal of engaging the industry experts in the given fields. Table 1 demonstrates the groupings and related professional characteristics for the pilot. Cresswell (1998) identifies two methods of sampling, of which the pilot questionnaire claims a hybrid mixture of both. The 'stratified purposeful' approach is key in the context of the research, as it is understood that the optimum scenario in regards to both timing and stakeholder engagement lays in the initial financial and technical appraisal processes. Given the over-riding factor of the public purses requirement to achieve best 'value for money', this places the early decision making opportunities within the realm of the expert professionals. This supports the second methodology of 'criterion sampling' which demands that the study population achieve a minimum standard of professional knowledge and/or experience which, in effect, is the qualification gateway for the respondent’s participation.

Table 1: Sampling methodology for the Pilot Study

Professional Strata	Sample Characteristics
Healthcare Professional	Client / Clinician
Design Team Professional	Designer / Constructor
Sustainability Professional	Consultant
Academic Professional	Researcher

LIMITATIONS OF THE STUDY

The study was subject to practical limitations deemed necessary to provide parameters to the research aims. As described above, the sample population was limited to four distinct professional disciplines. The general public (both patients and visitors) has been considered to possess limited technical expertise in the planning, design, and construction process (generally) and as such were omitted from the more specialised format of the questionnaire. It is accepted that the focus on professionals does not encompass the full model, and especially in regards to the criteria such as (but not limited to) *community*, and *health and well-being*, there seems an obvious conflict. It is reiterated however, that the targeted decision makers, and the envisaged intervention point of the model in the appraisal process supports this approach. The inclusion of legal and technical guidance and documentation has been limited to the most commonly used, as supported by the literature review and secondary data

collection. The 'main criteria' (Figure 2) are taken from the Department of Health's own guidance. These criteria are focused on the planning, design, construction, and operation of a healthcare facility, and do not take account of the far wider sustainability agenda, and as such are representative of sustainability 'in this context only'. The over-arching appraisal and procurement processes have been restricted to the study populations experience with the *HM Treasury Green Book*, the *Office of Government Commerce* (OGC) Gateway process (although recognised as archived), and the *Scottish Capital Investment Manual* (SCIM). This approach has limited the surveys appreciation of the relationship and connectivity's to the various Public Private Partnering arrangements.

SURVEY RESULTS AND DISCUSSION

From an evenly distributed invitation to 33 professionals from selected 'strata' (table 1), 17 complete responses were returned. This represents a 55% response rate. Of this percentage, the majority (8 responses) were from the Design Team Professional category. Healthcare Professionals followed with a response rate of 5, and en equal 2 responses for both Sustainability and Academic respondents. There were 2 incomplete responses which were disregarded due to insufficient data. The results demonstrated that the majority of the population sample was experienced in their field with more than 10 years' experience and that this experience was based mainly on the standard acute, and specialist acute hospital. This is a significant observation, as the smaller scale facilities such as the GP Surgery, the health centre, or specialised community hospitals make up a large proportion of the existing NHS estate. The sample was also queried on their experience of the refurbishment process in regard to the range of facilities, of which the only *Good* response was for the standard acute hospital. The GP Surgery, health centre, and community hospital shows either '*no experience'* or '*slight experience'* which gives weight to the observation that a large part of the health portfolio is considered in different terms of scale and/or importance. The question arises at this point, that the distinction and interpretation of what refurbishment as an activity consists of, is essential to classify within the wider decision making process. The prevalence of the Public private Partnership (such as PFI etc.) has separated the refurbishment process in the sense that the consortium are obligated to undertake the Facilities Management of the asset, and as such, may have differing drivers from the standard health authority decision making process. The overall knowledge and experience with the main legislation in regards to building/technical standards, the health technical memorandums and building notes, and the clinical output specification was shown to be '*Moderate'* to '*Good'*, however this does not reflect the samples awareness in optimising the decision making process and subsequent specifications. Before considering this issue in greater detail, it was considered logical to assess the knowledge base and experience in regard to the main existing tools and processes which are (for the most part) encouraged or mandatory for refurbishment works to be undertaken on a health facility. The most positive response for the *Activity Data Base* (ADB), the *Building Research Establishment Environmental Assessment Method* (BREEAM), and the *Achieving Excellence Design Evaluation Toolkit* (AEDET) was that they were 'good reference documents'. The criticism was more wide ranging, and respondents felt that (especially in relation to refurbishment), these tools were 'unsuitable for application to an existing building', and were seen to be an exercise in 'box-ticking'. This experience and viewpoint is representative of the industry experts frustration at 'undertaking assessments for the sake of the assessment itself', while possessing the knowledge that the process in regard to hospital

refurbishment is arguably, not fit for purpose and ignores the 'case by case' approach required when considering an existing and unique built asset.

The case for Multi Criteria Decision Modelling

The study population were asked to rank the main criteria (Figure 2) in order of importance; 1 being the most important, and 13 the least important. The caveat was made that there may be conflicts in this process, and it was to be undertaken to the best of the respondent's ability. This is a critical aspect of the pilot study; as immediately, the sample are required to participate in a very basic form of multi criteria analysis and ranking. Space was left for additional comments to be made on the process, and practically all comments described the 'overlap' amongst criteria, and the difficulty in prioritising because of the integrated nature of the criteria themselves. These observations are validated by the generally *Good* to *Excellent* level of awareness felt by the respondents on the interpretation of sustainability within their respective disciplines. A multi criteria approach is, by necessity, a process of 'trade-offs' and 'best fit' scenarios when faced with a sizeable and often conflicting set of criteria. The comments that the existing tools and methodologies related to the issues of refurbishment and sustainability (respectively) are viewed as good 'guidance' documents, supports the idea that there is no well understood or standardised decision support system in common use. Figure 3 demonstrates one of the pilots key findings, as the lack of experience or knowledge with MCDM techniques points to a gap in understanding and utilisation of a measured and calculated methodology.

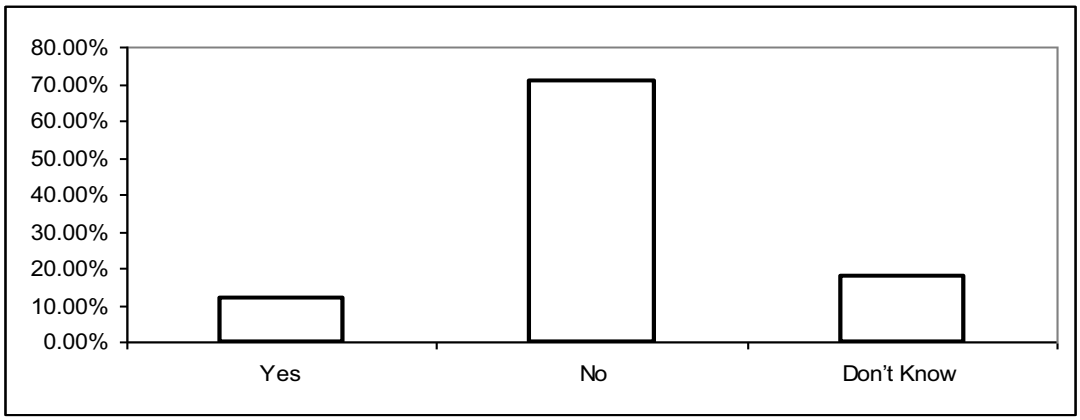

Figure 3: Respondents experience in participation of an MCDM process

This is a salient point in providing the contextual validation for the research project and directs further research into the reasons 'why' such a high proportion of experts have such limited experience with these logically fundamental appraisal tools. Figure 2 identifies the 13 issues stated as the 'main criteria', but it must be understood that each of these criteria encompasses a range of 'sub-criteria' as derived by the decision makers and stakeholders using the reductionist approach offered by Braunschweig *et al.* (2000). In the prioritising exercise described above, the 2 clear leaders were the issues of '*Health & Well-Being'* (7 rated as highest priority) and '*Energy & Carbon Emissions'* (6 rated as highest priority) These results will inform the selection of a sub-criteria branch selected for the models creation and testing for the purposes of the research.

Figure 4 is presented as the second key finding of the pilot, in assessing the knowledge of level and experience with the UK standard capital investment processes.

The inference from both figures 3 and 4 supports the research objective of integrating a calculated decision making process within the time frames and requirements of the capital investment guidance documents. It is proposed that a fundamental disconnection exists between the functional and service needs, the sustainability requirements, and the best 'value for money' option when considering the activity of hospital and healthcare facility refurbishment.

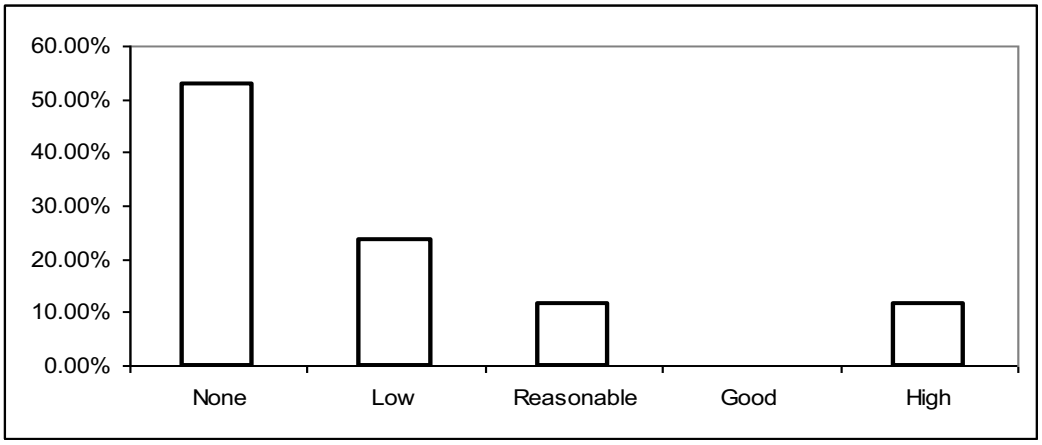

Figure 4: Respondents level of knowledge of the capital investment appraisal process

The guidance within capital investment documents is very clear in demanding that the over-riding factor in the process is ensuring the best *value for money* from the preferred option. This however, must also meet current (and potentially future) legislative and institutional requirements in regards to sustainable development, and it is unclear from reviewing the documents themselves, where the decision making process is formalised in this regard.

SUMMARY AND WAY AHEAD

It has been shown that the activity of refurbishment is generally a unique process with specific challenges, most notably in the area of 'risk'. Undertaking this activity in the arena of healthcare adds more layers of complexity and risk by the nature of the facility and its service and functional requirements. Sustainability has been discussed as a key evolving issue in regards to legislation and institutional requirements. The current assessment methodologies have been questioned in their suitability in achieving a 'best fit' scenario unique to an existing facility, and in achieving best value for money throughout the capital investment appraisal process. Given the number of variables and often conflicting criteria, an MCDM approach has been suggested, although a pilot study of industry experts has demonstrated a lack of knowledge and experience in both MCDM techniques, and the appraisal process itself.

This paper informs and validates the undertaking of a 3 year PhD research programme to develop an integrated decision support model to optimise the sustainable refurbishment of hospitals and healthcare facilities. Secondary and primary data will be used in creating a prototype model to demonstrate the decision making process from start to finish. To this end, a further paper is planned to conceptually model the process. The final output for the research will be a user friendly software based interface which will interactively prove the process from start to finish.

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