Decision Making for Sustainable Rebuilding: A Theoretical Approach

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Abstract:
In facilities management, decisions regarding how and when maintenance and rebuilding are to be carried out are made on a regular basis. Typically, there is a compromise regarding cost, usability and the possibility of exploring new options. Many case studies indicate that a large number of these decisions are based on simple models and that they are not adequately investigated. This is a problem, especially in cases of public procurement, where a high level of transparency in decision making is desired. There is a need for a proper decision basis in order to build a society that is economically, socially and environmentally sustainable. A working method is proposed as a tool for the integration of costs and benefits in decision making on investments in sustainable re-building. The guideline gives an overview as to why, when and how impact assessments and project appraisals can be conducted on different levels on a scale from tactical decisions to strategic decisions. The proposed method can be used to prioritise actions that need attention and to decide which preventive measures are the most efficient from an economic point of view. This paper explores the practical application of the guideline and presents an economic analysis and valuation in sustainable rebuilding management. Finally, the prerequisites for impact assessment and project appraisal and how they can be used and accepted by the users and decision-makers are discussed.

Keywords:
Cost Benefit analysis, Decision making, Project Assessment, Retrofit, Transparency

1 Introduction

In Sweden, there is a great need for renovating and rebuilding residential houses built 40 years ago or more. However, we are concerned that real estate owners are taking fewer decisions to renovate/rebuild than they are able to. In this paper, we argue that these real estate owners are too short-sighted. Furthermore, we advocate the usage of developed decision support systems that take long-term factors, as well as soft factors, into account when deciding to start a renovating/rebuilding project. This paper is our theoretical starting point from which we explore the possibilities to improve the decision quality of renovating/rebuilding projects.

Between 1965 and 1975, about 1 million flats were built in Sweden as a political response to the serious lack of modern residential buildings. Since then, some of the buildings have been rebuilt for other purposes, and some have been renovated. Nevertheless, at least 600,000 flats are yet to be rebuilt or modernised. Although these old buildings are greatly criticised for their lack of quality, it is highly possible to upgrade them so that they meet modern sustainable demands. However, it seems that real estate owners generally prefer not to upgrade these buildings. It seems they are very short-sighted and that they only calculate the immediate investment costs, leaving all the long-term benefits outside their calculations.

Swedish technical papers confirm a hypothesis that a lack of decision ability hampers the beneficial rebuilding of the aforementioned 600,000 flats. There are many reasons to improve The Million Programme flats, the most visible and simple of which is to put an end to energy wasting.

They focus on the initial costs. They do not care that the house owners earn thousands [of kronor] on lower energy costs in their housing (Lundberg, 2010)

There is a need for a systems perspective to avoid suboptimisation.
(Axell *et al*., 2010)

Nilsson and Johansson (2011) state that in Sweden the majority of communities and real estate owners do not have long-term goals for making energy consumption efficient. Furthermore, they state that energy-efficiency methods have been available for a long time and that they are already profitable on a short-term basis. However, these measures are not taken because of a lack of knowledge, interest and incentives. Carlsson (2006), for example, shows that very few are aware of the life cycle cost (LCC) concept of decision making in the building process.

Björk-Ausin and Pettersson (2011), likewise, assert that although many reports state that energy-saving measures are profitable, these measures are not frequently taken. Furthermore, they claim that estimation must be accurate and that attitudes should change in the building sector: "Energy-saving measures should not be financed by raised rents; they should be financed by lower heating costs."

Lind and Lundström (2011) suggest that there is an appraisal/calculation dilemma as some of the benefits are on a society level and not on a company level. Companies driven on business lines are, therefore, not able to take some of the energy-saving measures.

In Sweden, 4 out of 5 real estate owners choose to build on the short term benefits: Instead of considering LCC, the lowest investment cost is the main issue (*Svensk Byggtjänst*, 2010). Interviews were made with the principle managers of 80 of the largest real estate owners in Sweden, representing almost 90% of Swedish multi-storey houses. Moreover, in order to get a perspective on the responses, 20 technical consultants and architect firms were interviewed regarding the reasons the long-term perspective does not outweigh the short-term perspective.

One of the explanations of this phenomenon is that managers favour short-term decisions, such as calculation of investment cost. They fail to show an effective long-term plan for their investments, and some believe that there is a tradition in working in this manner. However, when the costs are related to investments on energy and other technical installations, they are more willing to invest. Other such reasons include regulations and the possibility to save on heating costs. Nonetheless, a good apartment design and an apartment's surroundings do not encourage the investment costs at all.

Clearly, the sustainable retrofit of the stock of residential buildings built during the Million Programme has become a societal problem. Today, the yearly rebuilding pace is 10,000-20,000 flats (*Sveriges Byggindustrier*, 2011). As mentioned before, around 600,000 flats are yet to be rebuilt, which means that it will take 30-60 years to upgrade all these flats to modern energy consumption standard. Relevant to this is the threat from the greenhouse effect, which makes the current situation seem like a very sad scenario.

Nevertheless, many actions could be taken to speed up the rebuilding pace: increasing productivity, subsidising rebuilding, or improving the company incentives. However, we believe that developing the rebuilding decision-making process of the real estate companies may be a first option to choose as this process contains various obstacles.

There are at least two categories of obstacles: 1) All relevant facts for decisions are not used; 2) The one who gains is not always the one who pays.

So far, we have demonstrated that most decisions on rebuilding are based on hard and short-term factors, which leads to the rebuilding projects having a very short and clear pay-off. Cash counts and soft factors are not allowed in the decision making, however. To make these factors (1) visible, we have built a four-sector model (Figure 1).

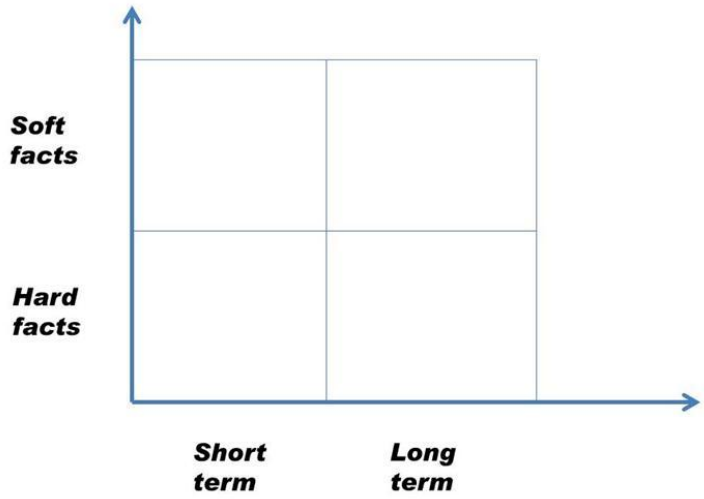

Figure 1. Factors for decision making.

The second category of obstacles is that the benefit of a measure is not always gained by the one who has paid for it. For example, if the tenant pays for the heating cost, and the

real estate owner improves the insulation, the latter has to pay for insulation, while the tenant will benefit from lower heating costs. On the other hand, society will benefit from lower CO_2 emissions.

Therefore, we believe that real estate owners are taking fewer decisions to renovate/rebuild than they have the possibility to do.

2 Literature Review

2.1 Decision making for rebuilding

RO-gruppen (1981), a Swedish research group, conducted an extensive development project concerning cost estimating and decision making for rebuilding projects. It developed a method based on normal investment theories. This method was said to be a support for real estate owners and project managers in the early phases of the rebuilding process. The annual cost was described in terms of capital cost, maintenance cost and operating cost. The group also argued that the choice of rebuilding measures was not only a result of economic analysis, but also a result of other factors, such as energy and resource saving, the tenants' requests, production demand, operation safety, flexibility for the future, and cultural aspects. Thus, they argued for something that we refer to as sustainable today. In spite of this project, many decisions in real estate companies still seem to be based on the lowest initial cost.

Although the literature on decision making is vast, it, nevertheless appears as if the decision makers are not aware of the possibilities to analyse which rebuilding projects should be chosen for realisation. Looking at the theories, we can distinguish different ways to look at decision making:

- *Numeric methods*. In course books, the traditional way is to use numeric models, such as the payback period, discounted cash flow, and internal rate of return. With the course of time, these models have developed, and they may be named as life cycle cost (LCC) and cost benefit analysis (CBA). Many other numeric models can be found in the OA-literature. They are all characterised by a mechanistic and deterministic view: future costs and benefits are possible to numerate and use in the calculations.

- *Nonnumeric methods*. In these methods, you make your decision without using figures. Amongst these methods are "The Sacred Cow," "The Competitive Necessity" or "The Operating Necessity" (e.g. Meredith and Mantel 2000). These ways of decision making go back to the original way of decision making without any calculations. The decision depends on soft factors, which are not too numerated. Multi criteria analysis (MCA) is another method.

- *Stochastic methods*. In reality, almost no decision is deterministic, but stochastic: risk ought to play a crucial role in decision making. In the decision making literature, many methods based on risk can be found, such as PERT, Monte Carlo Simulation, and the Successive Principle.

- *Normative vs. descriptive models*. A normative decision model is built on ideal assumptions regarding how decision making (rational decision making) should be, and it is mostly not a fruitful way of decision making. A descriptive model describes how decision making is made in reality, and coupled with that is satisfying decision making.

- *Personality*. Behavioural scientists suggest that the final decision very much depends on the personality of the decision maker. The Carl Jung typology profiles are often used as a model to understand how people make their decisions (e.g. Jung 1923).

2.2 Project appraisal

In project appraisal, two major types can be distinguished: *ex ante* appraisal and *ex post* appraisal (see Figure 2). *Ex ante* appraisal is conducted prior to decision making and aims primarily at selecting the best alternative, whereas *ex post* appraisal is conducted after a project has been completed and, for the most part, aims at lessons that can be learned from what has been done. In *in medias res* appraisal, the evaluation of a project in progress can also be made; this is referred to as a mid-term review. The methods used in conducting an appraisal are basically the same for all three types.

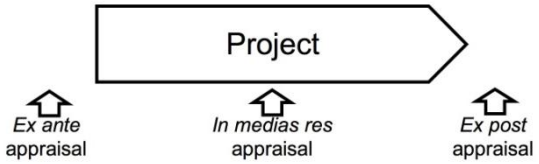

Figure 2. Project appraisal can be made in different phases
(Source: Persson, *et al*., 2005)

For decision making, *ex-ante* appraisal is applicable. Project appraisal can be employed for different purposes: projects may be appraised for selection among different projects at different buildings, or for determining the best approach for the retrofit of a specific building. An appraisal should be adapted to the life of the building.

2.2.1 Steps in project appraisal

Figure 3 shows the normal sequence of steps in a project appraisal. Initially, the owner of a building identifies that a building needs to be retrofitted or re-built in order to stop decay and save values that are worth saving. This forms the basis for performing a problem analysis, which leads to the definition of a project that addresses the potential risk of deterioration, the opportunities to save energy, and so forth. Furthermore, the involvement of stakeholders plays an essential role in achieving the necessary participation in the process of decision making. In the entire course of project appraisal, proper communication and involvement are the key components in securing the acceptance of the results. When the scope of a project is established and resources are allocated to conduct the investigation, different options to cope with the hazards are analysed based on possible strategic alternatives. Amongst these options are performing no action, performing minimal action, restoring the original standard, and improving the standard slightly or drastically. Thereafter, the effects of the various options are identified, quantified, qualified, and compared using a selected evaluation method.

Major evaluation methods are cost-benefit analysis, cost-efficiency analysis and multi-criteria analysis. The identification and quantification of effects are the main tasks of the parallel processes of impact analysis. By presenting the different options in a table of effects and establishing the advantages and disadvantages of the investigated project proposal, the preferred alternative can be selected. This method helps give transparency to the decision and show which factors are included in the analysis.

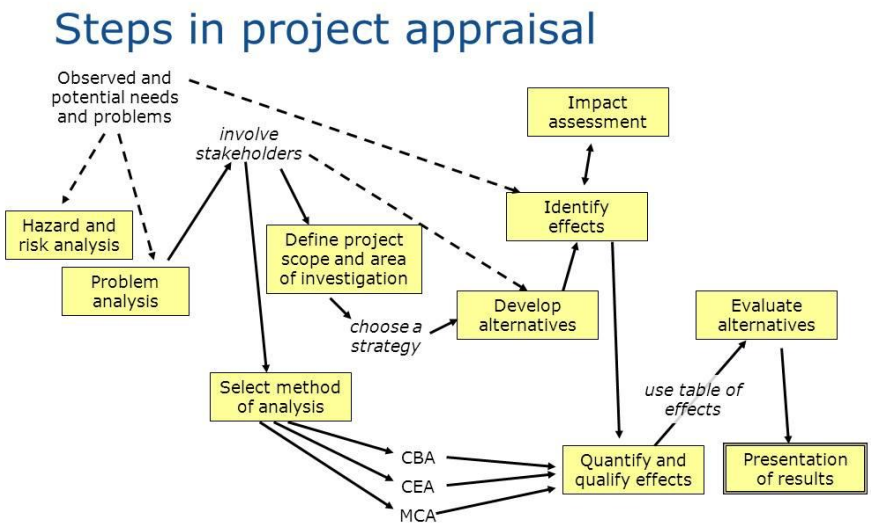

Figure 3. General model of steps in project evaluation (Adapted from Persson, *et al*., 2005)

2.3 Multilevel explanation of project success

The definition of project success has been addressed by many researchers (Bannerman, 2008; Shenhar, *et al*., 2001; Bacharini, 1999). Bannerman has introduced a model that explains how project success can be defined on different levels. He argues that acknowledging the realities of practice, such a reference framework, would accommodate multiple expectations and perceptions that arise from different stakeholders' perspectives at different positions of interest and time.

3 Research Methodology

In facilities management, decisions regarding how and when maintenance and rebuilding are to be carried out are made on a regular basis. Typically, there is a compromise amongst cost, usability and the possibility of exploring new options. As we have seen, many case studies indicate that a large number of these decisions are based on simple models and that they are not adequately investigated. This is a problem, especially in cases of public procurement, where a high level of transparency in decision making is desired. There is a need for a proper decision basis in order to build a society that is economically, socially, and environmentally sustainable. In this paper, a method is proposed as a tool for the integration of costs and benefits in decision making on investments in sustainable re-building. The purpose is to give an overview as to why,

when, and how impact assessments and project appraisals can be done on different levels on a scale from tactical to strategic decisions.

This research is at an early stage, and its aim is to test a hypothesis on how decision making can be improved. In order to investigate the hypothesis, the method introduces a model with different levels in the decision-making process. By further investigation, different real estate companies and their decision making in practice project appraisal are followed. By using a multilevel approach, we hope to be able to better understand and explain how the real estate companies make decisions. Furthermore, it can prove possible to assist real estate companies regarding which methods to use in project appraisal for different purposes.

4 Findings and Discussion

We have adopted a descriptive model (Table 1) in our investigations, which is based on the findings of Bannerman (2008). The expectation is to find most project appraisals to be on level 2 to 4 as these are most commonly used for describing project success. In this research approach, we have added levels 6 and 7 in order to accommodate the aspects of society when evaluating the result of a project.

Table 1 Project success at different levels of projects (Adopted from Bannerman 2008)

		Valuation criteria	**Example**	**Stakeholder**
Society	7	Very long term benefits	Greenhouse effect	External
	6	Direct benefits	Environmental issues	
Organisation	5	Strategic success	Market & industry impact	External
	4	Business success	Business plan, goals	Internal
Product	3	Delivery success	Investment, Maintenance and operation	Client/User
Project	2	Project management	Project scope time/cost/quality	Project management
	1	Process management	Sub-project and process	Technical

The levels proposed for inclusion in this research are:

1. Process: discipline-specific technical process that is employed in the project.

2. Project: the project management parameters set for the execution of the project in the form of time, cost and quality goal.

3. Product: the delivered product suitability to the client/user, both in direct and long-time terms of operation and maintenance.

4. Organizational business: the direct value of the product as part of the business plan and goals.

5. Organizational strategy: the market and industry impact of the project and resulting product.

6. Society direct: the shorter-term impacts on society.

7. Society very long term: the very long-term impact on society.

In further proposed research, the two models shown in Table 1 and Figure 2 will be combined to investigate the project appraisal. This will investigate if and how different owners place their emphasis.

Table 2. Proposed table for analyzing decisions in construction retrofit

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
Hazard and risk analysis							
Problem analysis							
Select analysis method							
Defining project scope							
Develop alternatives							
Identifying effects							
Impact analysis							
Quantify and qualify effects							
Present result in Table of Effects							

5 Conclusion and Further Research

The proposed method of analysis can be used to find recommendations regarding how to prioritise actions that need attention and to decide which preventive measures are the most efficient from an economic point of view in a broader context. This paper explores the practical application of the methods of project appraisal, economic analysis and valuation in sustainable rebuilding management. We discuss the prerequisites for impact assessment and project appraisal and how they can be used and accepted by the users and decision-makers.

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