



Value based building renovation – A tool for decision-making and evaluation



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ABSTRACT

Research on the barriers for building renovation in Denmark has revealed that an important obstacle is a lack of simple and holistic tools that can assist stakeholders in prioritisation and decision-making during the early stages of building renovation projects. The purpose of this article is to present a tool – RENO-EVALUE, which can be used as decision support for sustainable renovation projects, and for evaluation, during and after building renovations. The tool is a result from the European Eracobuild project ACES – “A concept for promotion of sustainable retrofitting and renovation in early stages”. This article presents the main result of a work package concerning benefits of renovation. RENO-EVALUE has been developed from four case studies on renovation projects in Denmark, tested and validated on the cases and in a Delphi study. The tool is value based by focusing on the different interests and values of the main stakeholders involved in building renovation. It is meant as a basis for dialogue among building professionals and building users and supports formulation of objectives for renovation projects. RENO-EVALUE can also be used for comparing alternative project proposals and to follow-up on a project and assess the results. The tool covers the four main parameters: Stakeholders, Environment, Organisation, and Economy. The evaluations are collected from different stakeholders by use of standardised information and interview templates. The test results of one case study of a social housing estate are presented.

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1. Introduction

Renovation of buildings is currently achieving increased attention in many European countries. A fundamental reason for this is an aging building stock following the huge increase in new building activities in the years following the Second World War. Throughout their life time, buildings deteriorate and become less attractive, if not maintained properly. The fact that we spend most of our time indoors indicates, why healthy and well-performing buildings are of a such importance, not only for our global society, but also for the health conditions of every single of us that spend most of our lifetime indoors. Other appealing reasons for building renovations are higher energy prices and the increasing focus on sustainability. There is an emerging need to reduce consumption of fossil energy resources and CO₂-emissions in order to avoid serious climate effects in the future [1]. Still higher demands on energy performance

of new buildings in EU-regulations and national buildings codes mean that the discrepancy in energy performance between existing buildings and new buildings becomes greater and greater. Even though the need for renovation of existing buildings is increasing, there are still fairly limited actual renovation activities going on in most countries. There are many different reasons for this, which has been shown in a number of research studies on barriers and incentives, see section 2.3.

This article is based on the joint European research project: “A concept for promotion of sustainable retrofitting and renovation in early stage” (ACES), in which the Technical University of Denmark, the Royal Institute of Technology, Sweden, and Frederick University, Cyprus were involved. It was based on the fact that approximately more than 40% of the total energy in Europe is spent within the buildings sector, which significantly contributes to greenhouse effects and air pollution. Moreover, it is estimated that approximately 85% of the 160 million buildings within the European Union are thermally inefficient [2]. Hence, it is crucial for the existing building stock to become refurbished. The ACES project was carried out from September 2011 to November 2013 and was part of the European

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Eracobuild programme with a particular focus on Value Driven Processes. The Danish part of the research received financial support from the Danish Energy Agency. The agency did not have any role in the research besides acceptance of progress and final reporting and participation with a representative in one round of a Delphi study. The agency has not had any involvement in the decision to submit this article.

The project was divided in a number of work packages and this article concerns WP2 on evaluation of the economic and environmental benefits of sustainable renovation of buildings. It is based on the view that the value of renovation is evaluated differently by different stakeholders, so it is important to highlight the main stakeholder's subjective viewpoints. The purpose of this article is to present the main findings and in particular the resulting tool called RENO-EVALUE. The use of the tool is illustrated by one of the case studies concerning a social housing renovation project during the early stages of design phase. The reason for developing the tool is that research on the barriers for building renovation in Denmark has revealed that an important obstacle is a lack of simple and holistic tools that can assist stakeholders in prioritisation and decision-making during the early stages of building renovation projects [3]. The article is structured with literature review in section 2. The methodology of the empirical study is explained in section 3. The findings are presented in section 4 with outlining RENO-EVALUE followed by a case study. The article is finished with discussion in section 5 and conclusion in section 6.

In the article renovation will be used as a general term for improvements of the performance of existing building. Renovation can be part of planned maintenance and improvement. This can be in the form of rebuilding, refurbishing or retrofitting a building as part of modernization or adaptation to changing use. It can also be in the form of restoration or preservation of cultural heritage like historic or listed buildings. The main focus is on renovation of buildings, which involves a considerable improvement in their energy performance [4]. Building renovation is defined more specific in section 2.1.

2. Literature review

2.1. The need for building renovation

40% of total energy consumption in European Union is used in buildings [5]. Besides that, it is being estimated that people globally spend approximately 70% of their time in buildings [1], which explains why healthy and well-performing buildings should be of importance to us. Spending most of our time in buildings demands comfortable facilities and optimal building design, where users and visitors easily can adapt to surroundings, and the other way around. However, buildings age and become less energy-efficient through their lifetime, which means that they also have to be maintained and operated properly, in order to extend their lifetime expectancy and maintain property value. If not done so, buildings will slowly, but surely, become outdated and energy inefficient because of external influences and deterioration of building materials and components.

The need for renovation of buildings can also be related to problems with indoor climate. It has for a long time been generally recognised that bad indoor climate can lead to health problems. In 1983 the World Health Organisation defined a pathological picture termed Sick Building Syndrome or the indoor climate disease [6]. There is a large body of research dealing with indoor climate and health effects. Our initial needs and stakeholder analysis also revealed that problems with indoor climate can be a reason for building renovation – not only in older buildings but also in fairly new buildings [7].

Building renovation is the process of fixing or replacing existing parts of the building to improve its performance, either to its original state or better [4]. At the same time, building renovations also provide the possibility to change building design/layout, functions, architectural expression etc. to match users' current and/or future needs. Combining multiple disciplines introduces complexity to building renovations, and because of that, interdisciplinary expertise is required to deal with most renovation projects.

Building renovations usually address several challenges in a specific property at the same time and therefore contribute with multiple benefits. Today, focus is mostly on energy-efficiency and deterioration, but there are also non-energy benefits of building renovations such as improvement of indoor climate, better daylight conditions, improved working spaces etc. In office buildings for instance, indoor climate is considered very important and can directly be linked to employee performance. Earlier research has shown that productivity can be increased 6–9 % by improving indoor air quality, which means that investments in indoor climate are also business investments [1]. Improving building design through renovations should therefore not only be a financial issue, but also the question of added value and better indoor climate conditions.

2.2. Barriers and incentives

Even though there are many benefits of building renovations, several international research studies have analysed the barriers for initiating renovation projects. The World Business Council for Sustainable Development (WBCSD) has produced a number of reports about energy efficiency in buildings with a global outlook. In Ref. [8] they state that several barriers stand in the way of rapid progress ranging from market and policy failures, through professionals' inadequate knowledge and understanding, to the behaviour of building users. Their modelling work indicates that measures with a substantial impact are unlikely to meet normal financial investment requirements and are therefore unlikely to be implemented. Furthermore they identify several structural obstacles that significantly inhibit the likely take-up rate even of financially attractive investments.

A European ERABUILD project on building renovation and modernisation conclude in their final report [9] that the barriers in general are the lack of knowledge and information and the lack of cost effectiveness and funding. For owner-occupiers and private landlords the lack of knowledge and information, and funding, are seen as the main problems. An additional barrier for private investors is that they do not profit themselves from the investment made in rented out buildings – often called the landlord/tenant dilemma [4,10]. In relation to opportunities, Itard et al. [9] regard that they are going to be generated by governmental actions and market processes. Demands of owners and occupants (e.g. with regard to comfort) have been changing and are going to change in the near future, which will have a positive effect on sustainable renovation.

In the UK, the Better Buildings Partnership has produced reports about low carbon retrofitting. The partnership identifies barriers in the following five areas [11]:

1. Commercial, including failure to provide a compelling and viable business case for investment in retrofit and the inherent split incentive between owners and occupiers.
2. Roles and Processes, including no defined process to designate individuals within an organisation with the responsibility and authority to identify, plan and deliver energy saving and carbon reduction interventions.

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