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Sustainability focused decision-making in building renovation

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Abstract

An overview of recent research related to building renovation has revealed that efforts to date do not address sustainability issues comprehensively. The question then arises in regard to the holistic sustainability objectives within building renovation context. In order to deal with this question, the research adopts a multi-dimensional approach involving literature review, exploration of existing assessment methods and methodologies, individual and focus group interviews, and application of Soft Systems Methodologies (SSM) with Value Focused Thinking (VFT). In doing so, appropriate data about sustainability objectives have been collected and structured, and subsequently verified using a Delphi study. A sustainability framework was developed in cooperation with University of Palermo and Aarhus University to audit, develop and assess building renovation performance, and support decision-making during the project's lifecycle. The paper represents the results of research aiming at addressing sustainability of the entire renovation effort including new categories, criteria, and indicators. The developed framework can be applied during different project stages and to assist in the consideration of the sustainability issues through support of decision-making and communication with relevant stakeholders. Early in a project, it can be used to identify key performance criteria, and later to evaluate/compare the pros and cons of alternative retrofitting solutions either during the design stage or upon the project completion. According to the procedure of the consensus-based process for the development of an effective sustainability decision-making framework which was employed in this study, the outcome can also be considered as an outset step intended for the establishment of a Decision Support Systems (DSS) and assessment tool suited to building renovation context.

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Keywords: Sustainability; Building renovation; Decision support; Knowledge management; Soft Systems Methodology (SSM); Value Focused Thinking (VFT)

1. Introduction

Today buildings are responsible for 40% of energy consumption and 36% of CO₂ emissions in the EU (European

Commission [EC], 2014). New buildings generally need less than 3–5 l of heating oil per square meter per year while older buildings consume about 25 l on average (EC, 2014). Some buildings even require up to 60 l. Renovation of buildings is currently achieving increased attention in many European countries (Buildings Performance Institute Europe [BPIE], 2011), the primary reason is that about 35% of the EU's buildings are over 50 years old (Joint Research Centre [JRC], 2015), and thus they grow less attractive, if not maintained thoroughly during life time

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(for the reasons such as insufficient indoor air quality and thermal comfort). In retrofitting context via enhancing the energy efficiency (Energy Efficiency Watch [EEW], 2015) the total EU energy consumption can be decreased by 5–6% as well as CO₂ emissions by about 5% (EC, 2014). However improving energy efficiency and carbon emission parameters are not the only goals in building renovation¹ context. Energy and resource-conscious architecture are known as environmental friendly issues. Considering just them for a project is not sustainable if it is non-functional, much costly and malformed. Historical value, identity, aesthetic, integrity, innovation etc. are all rich unmeasured proofs why people still emphasize and keep living in their existing buildings over time that needs to be included in alternative renovation solutions. It hence calls for major considerations in this context so as to create a high-performance building (to be in consistence with sustainability in its full sense) via application of a holistic and integrated design process (where different stakeholders are involved), which make sure all design goals are met. Over the last few decades different methods have been developed to implement and evaluate the renovation existing buildings from technical and not-technical perspectives (Ma et al., 2012). Jensen and Malesa (2015) discussed that these methods have a narrow environmental or energy focus. Therefore, it leads to insufficiently understand and examine the sustainability objectives fulfilment and their greater chain of effects in aforementioned context (Ministry of Climate, Energy and Building – Danish government [SBi], 2014).

1.1. Sustainability development paradigm

Sustainability development refers to a dynamic process from one state towards another which means there is no exact definition about it, in fact every societies and cities are evolving by passing the time in order to become more superior or inferior (United Nation [UN], 2013). Hence our goals including visions, ambitions and technical feasibilities are all subjects to change (Brophy, 2014). The sustainability (Williamson et al., 2003) can be described as incontestable development of society and economy on a long-term basis within the framework of the carrying inclusion of the earth's ecosystems (UN, 2013). Similarly, developing major retrofitting alternatives for existing buildings to include sustainability initiatives can decrease operation and maintain costs; reduce environmental impacts; and can increase building adaptability, durability, and resiliency within other views. Due to this the buildings may be less costly to operate, may growth in value, last longer, and contribute to a preferable, healthier, and more convenient environment to the occupants who lives and

works in there. Enhancing indoor comfort quality, reducing moisture, and improving efficiency all can result in enhancing user's health and productivity (Bluyssen and Cox, 2002).

From sustainability perspective, there are factors that must be taken into the consideration all together in order to gain the ultimate goal which is known as “sustained prosperity” relevance to different stakeholders and so their various priorities. Hence, the optimal renovation solutions are a trade-off among a range of energy related and non-energy related factors that must be taken in account (Boeri et al., 2014). With sustainability moving up agendas across industry and government as well as enhancing sustainability awareness in public, being able to assess the sustainability impacts and opportunities of a project sounds crucial. Considering of where building design industry meets the sustainability solutions enables building designers to anticipate a larger demand for systematic strategies to upgrade existing building stock close at hand (Kamari et al., 2017b). Furthermore, the sustainability paradigm is based on the modern information and communication systems (Afgan and Carvalho, 2002). As such, it is of special interest to verify the need for the deep understanding of sustainability as the pattern with the agglomerated set of indicators defined by the respective criteria (Afgan, 2010). If human settlements are to carry out sustainability as a target, it is necessary to develop methods to set criteria, plan, design, and evaluation. It is also necessary having such methods as a scientific basis in terms of comparison between various projects (Nguyen and Altan, 2011), and for considering how they should be developed over time.

1.2. Rationalization of developing the decision-making support framework for sustainable retrofitting

The present paper, investigates the problem of knowledge management in building renovation corresponding to sustainability development paradigm. Otherwise, as a part of the RE-VALUE² research project (Value Creation by Energy Renovation, Refurbishment and Transformation of the Built Environment, Modelling and Validating of Utility and Architectural Value), this paper deals with its overall objective, which is to develop a holistic sustainability Value Map for building renovation purpose to support project development and to communicate the outcomes with the relevant stakeholders. The Danish research project RE-VALUE has been initiated to shed light on existing renovation methodologies, and the potential to further develop them into a model targeted retrofitting initiatives in Denmark. The aim is to make a full-scale demonstration of two renovation projects in areas with different residential compositions, and to study their effects

¹ In this paper, the term “building renovation” is used as the equivalent of “building retrofitting” in accordance with the “sustainable development paradigm”. The authors' intent is to fill the gap, which exists between these two terms in existing literature.

² Participated by Brabrand Housing Association – with energy renovation in the Aarhus suburb of Gellerup – as well as DEAS, an administration company on the private rental housing market (for more info: <http://www.revalue.dk>).

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