Economic justification of non-commercial buildings renovation or substitutional construction

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Abstract

Global crisis in economy has forced the owners of buildings into negligence of old buildings. Therefore we have many buildings which are crumbling. This may also happen to new buildings, as the owners too many times do not work responsible or economical. Lack of owners’ knowledge how to work with buildings, how to maintain them regularly and when to rehabilitate them, is many times the reason of new and old buildings’ negligence. Unfortunately the owners are not aware of the fact that outlook of building reflects owners’ relationship to maintenance and rehabilitation of the buildings. There have existed many neglected buildings all over the world already before the global crisis which are neglected because of many reasons. This raises the question until when is it economically justified to maintain older buildings and the construction of new building is not worth of money. The aim of the research is to find an optimal multicriteria decisive model of economic justification of non-commercial buildings renovation or substitutional building. The value of buildings decreases due to lack of maintenance; therefore certain buildings are less worth if they are not maintained and renovated. At existing buildings are present many factors which are reducing the value of buildings or real estate. In practice we know three types of deterioration or obsolescence of buildings or real estate, which reduce the value of buildings. In the model these are treated as criteria: physical deterioration, functional obsolescence, and economic obsolescence. The model considers buildings which service for public purpose and are not protected as cultural heritage. We have developed theoretical multicriteria decisive model of economic justification of non-commercial buildings renovation or substitutional construction. Thus it will be possible for owners of non-commercial buildings to decide regarding to criteria of physical deterioration, functional and economic obsolescence about renovation or substitutional construction if any of these are identified as economic justified.

Keywords: non-commercial building, physical deterioration, functional obsolescence, economic obsolescence, renovation, substitutional construction.
1. Introduction

Non-commercial buildings in the public ownership are not maintained and renovated as they should be because of general saving in public sector. Thus older buildings begin to diladaptate and the costs of renovation in the future consequently increase. This is also going to happen to newer non-commercial buildings as the owners do not act responsible or economically. The reason of diladaptation of old and new non-commercial buildings is also owners’ lack of knowledge, they do not know how to work with buildings, how to maintain them regularly and when to rehabilitate them. This raises the question until when is it economically justified to maintain and renovate older non-commercial buildings.

Non-commercial buildings, also called buildings of social standards or public buildings, are buildings which are built for non-commercial activities. Among these are buildings for activities of public administration and defence, activities of compulsory social security, education, health care, social assistance, cultural activities, entertainment and recreation. (Pšunder M., Klanšek U., Šuman N., 2009).

Many factors reduce the value of buildings or real estate at existing non-commercial buildings. In practice we know three types of deterioration or obsolescence of buildings or real estate, which reduce the value of buildings. In the model these are treated as criteria:

1. Physical deterioration: the reduction of buildings’ value, caused for the reason of the consequence of use and deterioration of condition.

2. Functional obsolescence: the reduction of buildings’ value, caused for the reason of bad construction, structure or material, which cause reduced usefulness of real estate.

3. Economic obsolescence: the reduction of building’s value caused by influences resulting from environment. These can be changes in standardisation, legislation, infrastructure or urban design of environment.

We do not consider the criteria of profit in deciding whether to renovate non-commercial building or to demolish it as we do at economic buildings. There exists public benefit which brings some profit but not directly. At renovation of that kind of buildings it is only public interest to renovate or build substitutional building with economic use of public sources. For that reason we do not consider the profit.

We have developed multicriteria decisive model in order to estimate economic justification of renovation or substitutional construction of non-commercial buildings. It is the definition of time limit in the buildings’ lifetime until when is it economic justified to renovate or rehabilitate. Thus it will be possible for owners of non-commercial buildings to decide regarding to criteria of physical deterioration, functional and economic obsolescence about renovation or substitutional construction if any of these are identified as economic justified. The model does not consider buildings which are
subjects of cultural heritage as they are specific and have to be renovated in accordance with requestments and guidance of institutes for heritage protection.

2. Theoretical Basis

There are not any multicriteria decisive models of economic justification of renovation or substitutional construction of non-commercial buildings developed in scientific data bases. Vanier et al (2006) have developed decisive model for management of buildings’ funds.

![Figure 1: Proposed framework for making decision (Vanier and Lounis 2006)](image)

Figure 1 represents the framework of decisive model for management of buildings’ funds. It is the model devoted to specify the building which most needs certain works. Model is based on the proportion of funds invested and benefits which can be defined thought costs and benefit’s analysis. The model uses the structure of analytic hierarchy process (AHP) which is multi-criteria decisive ethnic used for creating measurements. AHP method uses objective mathematics for the procedure of subjective and personal preferences of individual or groups at making decisions. AHP method works on premise that complex problems can be treated with their structuring in simple and understandable structure. (Vanier and Lounis 2006).

During the process of multicriteria deciding we have to develop a model for selected decisive problem, which will ensure objective valuation of variants according to the aims of the problem. There are many methods to support multicriteria deciding. Some of them are appropriate for simple decisive problems with small number of criteria; the others are provided to the most difficult problems and are also more complex. (Bohanec, 2006).

3. Multicriteria model of renovation or substitutional construction of non-commercial buildings

At selected multicriteria decisive model of economic justification of renovation or substitutional construction of non-commercial buildings only one building is treated. Model is based on the fact that
renovation has priority over renewal which is also the aim of sustainable development worldwide. Figure 2 represents the whole procedure of multicriteria deciding about renovation or substitutional construction of selected non-commercial building.

Firstly we prepare document of investment project identification for decision about renovation or substitutional construction. This document involves analysis of the investor’s situation and justified reasons for need for implementation of investment intention, investments aims and cost estimate. After implementation of this document we have to prepare pre-investment concept of renovation variant of existing building or substitutional building variant. This is small-scale elaborate, by which investor wants to justify planned construction. He proves in elaborate the need of construction and that he has all necessary financial sources which are planned to be spent for construction and that investment is economic justified. Pre-investment concept is very interdisciplinary, thus it requests cooperation of many professionals. Thus approach to make this concept has to be team approach. Next step is to prepare investment program which is almost the same, however more detailed handled. Investment program includes only one variant of existing building renovation and one substitutional building variant. On the basis of this ideal project has to be made for each variant of existing building and substitutional building. In respect of these elaborates we get all necessary data for further judgement by multicriteria decisive model.

After preparation of document of investment project identification, pre-investment concept and investment program we have to make group of 3-5 professionals from the scope of civil engineering and real estate estimation who will estimate by multicriteria model which decision is better for investor.

Criteria of multicriteria deciding have been defined on the basis of equation which has been developed on the basis of determination of building’s value after certain time. Building loses value because of physical deterioration, functional and economic obsolescence. Thus we have mathematically formulated the value of building or fixed property after the certain time as (Kovačec, Pšunder, Soršak, 2010):

\[ V(t) = V_i - d_{PHY} - d_{FUN} - d_E \]  

(1)

Where is:

\( V(t) \) – value of real estate after the certain time;

\( V_i \) – initial value of real estate;

\( d_{PHY} \) – extent of physical deterioration for which the value of real estate is reduced;

\( d_{FUN} \) – extent of functional obsolescence for which the value of real estate is reduced;

\( d_E \) – extent of economic obsolescence for which the value of real estate is reduced.
Figure 2: Multicriteria decisive model of renovation or substitutional construction for non-commercial building
Multicriteria deciding is made after Table 1, where all criteria and sub criteria are indicated. The group of professionals firstly defines and expresses those criteria. When they conclude defining criteria and sub criteria, they begin to estimate benefits of criteria and sub criteria for all variants of renovation and substitutional construction and define weighting individually.

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Renovation of the building – Variant 1</th>
<th>Substitutional building – Variant x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main criteria ((k))</td>
<td>Sub-criteria ((k_p))</td>
<td>Sub-criteria weighting ((u_{kp}))</td>
</tr>
<tr>
<td>PHYSICAL DETERIORATION ((a_1))</td>
<td>Quality of the building ((y_1))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remaining life time ((y_2))</td>
<td></td>
</tr>
<tr>
<td>FUNCTIONAL OBSOLESCENCE ((a_2))</td>
<td>Construction’s condition ((y_3))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Condition of built materials ((y_4))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost of maintenance ((y_5))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energetic efficiency ((y_6))</td>
<td></td>
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<td></td>
<td>Cost of heating ((y_7))</td>
<td></td>
</tr>
<tr>
<td>ECONOMICAL OBSOLESCENCE ((a_3))</td>
<td>Location ((y_8))</td>
<td></td>
</tr>
<tr>
<td>BUILDING’S VALUE ((a_4))</td>
<td>Value of the building ((y_9))</td>
<td></td>
</tr>
</tbody>
</table>

After determination of criteria and sub criteria weighting and after determination of unity of benefits we start with calculation of benefit for each individual variant, thus renovation and substitutional construction, after following equations:

\[ b_{1\text{a1}} = \left( u_{p1}(y_3) \times b_1(y_3) + u_{p1}(y_4) \times b_1(y_4) + u_{p1}(y_5) \times b_1(y_5) + u_{p1}(y_6) \times b_1(y_6) + u_{p1}(y_7) \times b_1(y_7) \right) / 100 \]  

\[ b_{1\text{a2}} = \left( u_{p1}(y_3) \times b_1(y_3) + u_{p1}(y_4) \times b_1(y_4) + u_{p1}(y_5) \times b_1(y_5) + u_{p1}(y_6) \times b_1(y_6) + u_{p1}(y_7) \times b_1(y_7) \right) / 100 \]  

\[ b_{1\text{a3}} = \left( u_{p1}(y_3) \times b_1(y_3) \right) / 100 \]
After that we calculate the final benefit for variant of renovation after the following equation:

\[ b_{\text{final}} = \left( u_{\text{w1}} * b_{\text{w1}} + u_{\text{w2}} * b_{\text{w2}} + u_{\text{w3}} * b_{\text{w3}} \right) / 100 \]  

(5)

In general we write down the calculation of benefit for individual variant as:

\[ b_{\text{variant1}} = \left( u_{\text{x1}} * b_{\text{x1}} + u_{\text{x2}} * b_{\text{x2}} \right) / 100 \]  

(6)

\[ b_{\text{variant2}} = \left( u_{\text{x3}} * b_{\text{x3}} + u_{\text{x4}} * b_{\text{x4}} \right) / 100 \]  

(7)

\[ b_{\text{variant3}} = \left( u_{\text{x5}} * b_{\text{x5}} + u_{\text{x6}} * b_{\text{x6}} \right) / 100 \]  

(8)

\[ b_{\text{variant4}} = \left( u_{\text{x7}} * b_{\text{x7}} \right) / 100 \]  

(9)

\[ b_{\text{variant5}} = \left( u_{\text{x8}} * b_{\text{x8}} \right) / 100 \]  

(10)

\[ b_{\text{x}} = \left( u_{\text{x1}} * b_{\text{x1}} + u_{\text{x2}} * b_{\text{x2}} + u_{\text{x3}} * b_{\text{x3}} + u_{\text{x4}} * b_{\text{x4}} \right) / 100 \]  

(11)

When we get final benefit for the example of renovation of existing building and substitutional construction we compare both benefits and choose the one with the higher value. Thus we get the decision through multicriteria model whether to renovate the building or to construct substitutional building. If we get the result to renovate the building again we check the equation from Figure 2 under renovation. If we have an example to construct a substitutional building, we check the equation from Figure 2 under substitutional building. In the case that proposed decision does not comply with conditions from equations on Figure 2, we check investment program and study the whole investment of selected solution again. In the case that we get negative result, the appropriate solution is the opposite of proposed, which should be checked according to equations.

4. Conclusion

It is possible by the use of multicriteria decisive model to determine in which time period of building’s lifetime is it wisely and economic justified to make decision not to maintain and rehabilitate the building anymore but to demolish it and build the new or substitutional building according to criteria, namely physical deterioration, functional and economic obsolescence in conjunction with building’s value.

According to intensity of construction in the past years we can expect more obsolete buildings and real estate for which decisions about renovations or substitutional construction will have to be made in the right moment. Considering the criteria of obsolescence and deterioration in connection with
building’s value and profit or benefit and the new model it will be possible to improve quality of decisions of renovations or demolitions of obsolete non-commercial buildings.

This model will be further developed in the way to determine final input parameters and verify multicriteria decisive model on practical cases at non-commercial buildings.

5. References


