

## **THE IMPROVEMENT OF THE NEW OFFICE BUILDINGS' ADAPTABILITY: GENERAL RECOMMENDATIONS**

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### ABSTRACT

Since buildings' adaptations are becoming an important part of architectural and urban practice, the criteria which can contribute to the buildings' adaptation potential are analysed in this paper. To make the adaptation process more successful, the multi-criteria models for evaluation of the potential of certain buildings for one or more types of adaptation are in use. In this paper, the criteria of five multi-criteria models intended for the evaluation of the adaptation potential of vacant office buildings are considered. It is noticed that there are many office buildings with low adaptation potential. Some of the criteria that make buildings less suitable for adaptation could not be changed beforehand, but a certain number of them could be influenced in advance. The criteria related to the development of the buildings' environment and infrastructure, or current market conditions cannot be determined in advance and will be the subject of consideration when starting the adaptation process. However, the building's potential for adaptation can be influenced to a large extent through design (e.g., avoiding tight-fitting building for one use only), during the construction of the building (e.g. high quality of the materials used), and during the exploitation (e.g. high maintenance level). This paper aims to present general recommendations for the improvement of the adaptability level of newly built office buildings to facilitate possible adaptation processes in the future and make a wider number of possible new uses for buildings, which results in extending the building's useful life.

KEYWORDS *\_ office buildings, improvement of adaptability, multi-criteria decision-making models*

## INTRODUCTION

Instability in the market of office buildings has been noticed around the world during the last twenty years. The consequence is an increase in the number of vacant office buildings. There are four possible ways of solving this problem: consolidation, renovation or upgrading, demolition, and new construction and transformation (Remoy, 2010). Conversion, as a type of transformation, is becoming increasingly common architectural practice. When it comes to office buildings, in most cases, various aspects of converting office buildings into permanent or temporary housing are considered. Several researches are focused on the characteristics of office buildings and their locations that contribute to successful conversion. Economic, functional, technical, legislative, cultural, architectural, and historical characteristics are the subject of those analyses (Remoy, 2010). In some research, the advantages and disadvantages of the status of protected building related to the conversion process were considered (Remoy & Van der Voordt, 2014), and in others, the issue of energy efficiency in the conversion process was analysed (Langston, Wong, Hui & Shen, 2008). The use of multi-criteria models for the evaluation of office buildings' potential for adaptation, which are in use in many different fields for decision-making, represents another field of research related to the conversion of (office) buildings. To improve the process of conversion in the future, the group of authors directs its research towards increasing the degree of adaptability of newly designed office buildings (Remoy & de Jong, 2011).

Given that the need for the purpose for which the building was designed can change during time, although the building, as physical structures, can mostly last longer, it can be assumed that, at some point in the life of that building, there will be a need for some type of transformation in order to continue using the building. The subject of the research presented in this paper is the desirable characteristics of newly built office buildings, which can positively influence the potential of these buildings for adaptation in the future and thus prevent vacancy. The research is based on a comparative analysis of multi-criteria models which are intended for the assessment of office buildings' potential for different types of adaptation: the *Conversion meter* model, the *TOBUS* model, the *ARP* model, the *iconCUR* model, and the *PAAM* model. The analysed models include a number of different criteria, in accordance with the purpose and a concept of the model, but a certain number of criteria have been observed that play a key role in all models. This paper is focused only on mutual criteria and indicators of these models as general recommendations for improvement of office buildings' potential for adaptation and discusses which of them could be implemented during design and construction.

The goal of the research is to form a set of general recommendations for the design and construction of office buildings which improve their potential for adaptations.

## PRESENTATION OF FIVE MULTI-CRITERIA DECISION-MAKING MODELS

### **As tools for the evaluation of office buildings' potential for different types of adaptation, five multi-criteria models are in use..The *Conversion meter* model**

This model was developed in the Netherlands and it is intended for evaluation of vacant office buildings' potential for conversion into residential buildings. The first version named the *Transformation meter* was created in the late 1990s as a consequence of the vacancy of a large number of office buildings in the Netherlands (Geraedts & Van der Voordt, 2004). The *Conversion meter* consists of several checklists of criteria and the assessment takes place in several steps. The first step is a review of databases of vacant office buildings. Within the second step, a "quick" assessment through four groups of "veto" criteria is suggested. Evaluation is continued through two checklists of "gradual" criteria, which relate to the location and characteristics of the building. Two last steps consider financial feasibility and potential risks and problems during the process of conversion of the particular office building (Geraedts, Van der Voordt & Remoy, 2017). The result is a sum of positive answers (each criterion carries a point) (Geraedts & Van der Voordt, 2007).

### **The *TOBUS* (Tool for selecting Office Building Upgrading Solutions) model**

The *TOBUS* is a multi-criteria model which is used for assessing the current state of an office building and evaluating the potential for different types of adaptation and the financial feasibility of these processes, but does not elaborate on the implementation phase. This model is the result of joint research by experts from Denmark, France, Greece, Switzerland, and the Netherlands and it is developed within the European research program *JOULE III* (Balaras, 2002). Given that this model considers many aspects of different methods of renovation, it enables the better organization of the adaptation process through two main tasks: diagnostics, which involves assessing the current state of the office buildings, and interventions, which define the renovation method. In order to facilitate the application of the *TOBUS* model, the *TOBUS* software has been developed with databases related to Switzerland (so, that version of software corresponds only to that country), but with the possibility to be easily adapted for the use in other countries (Flourentzou, Genre & Roulet, 2002).

### **The *ARP* (Adaptive reuse potential) model**

The *ARP* model is a multi-criteria model intended for evaluation of the potential of office building conversion and it is based on the estimation of the physical life of a building and its current age (Langston & Shen, 2007). The physical life is assessed through the list of criteria related to the environment, the building's constructive characteristics, and the way it is used. The useful life of the building is considered as the building's physical life reduced by several types of obsolescence, which are the basic criteria of the model: physical obsolescence (maintenance of the facility), economic obsolescence (location of the facility), functional obsolescence (flexibility of the facility), technical obsolescence (energy required to provide user comfort), social obsolescence (position of the building type on the market), legal obsolescence (quality of the original design) and political obsolescence (changes within the regulations). The "obsolescences" are evaluated as a percentage, from 0% to 20%. The final result is given on the diagram and as a percentage (Wilkinson, Remoy & Langston, 2014).

### **The *iconCUR* model**

This model uses multiple criteria to consider the possibilities of an existing office building at any point in its life. The main criteria of the *iconCUR* model are:

- Condition, which refers to the physical characteristics of the building and is defined through design standards, maintained service level, and regulatory compliance
- Utilization, which refers to occupancy characteristics of the building and it is considered through demand or relevance, fitness for purpose and user satisfaction, and
- Reward presented through the collective utility and stakeholder interests. Collective utility refers to net benefits from building for all stakeholders and it is analysed through economic performance, culture and heritage, and environmental values. Stakeholder interests express the strength of engagement with the property's deliverables through short-term perspective, medium-term perspective, and long-term perspective.

This model is visually presented through the spatial model, which has the shape of a cube. Each vertical edge of that cube is one of the potential interventions. The building is placed into this cube through coordinates (which are the values of previously described criteria from 0 to 5) and the result is the distance of the building from vertical edges. The valorization system of the *iconCUR* model uses an algorithm that enables hierarchy among the criteria (Langston & Smith, 2012).

### The PAAM (Preliminary Assessment Adaptation Model) model

The PAAM is a multi-criteria model which is intended for the evaluation of office building potential for extension. In order to develop this model, six groups of building characteristics which are important for all types of adaptations, were considered: the attributes of economic category (current value, investment value, yields, increase in value post adaptation, construction and development costs, convertibility), the attributes of physical category (building height or number of storeys, floor plate size, shape of floor plate, service core location, elasticity or ability to extend laterally or vertically, degree of attachment to other buildings, access to building, height of floors, structure, floor strength, distance between columns, frame, deconstruction, expandability, flexibility, technological and convertibility, reusability or recyclability), the attributes in relation to location and land use (transport, access to airports, motorways, train stations, public transport nodes, buses and trams, land uses, existing planning zones, rezoning potential, density of occupation), the attributes of legal category (ownership, occupation, building codes, fire codes, access acts, health and safety issues, convertibility), the attributes of social category (community benefits/ historic listing, transport noise, retention of cultural past, urban regeneration, aesthetics, provision of additional facilities, proximity to hostile factors, stigma, age) and the attributes of environmental category (internal air quality, internal environment quality, existence of hazardous materials, sustainability issues). According to analyzed statistical data, three main criteria for the PAAM model are physical and size, land and social factor, and their influence (weighting factor in percentages). The result is a qualitative description (Wilkinson, 2014).

### GENERAL RECOMMENDATIONS FOR THE IMPROVEMENT OF THE NEW OFFICE BUILDINGS' ADAPTABILITY

In *Table 1* mutual criteria with their indicators from five analysed multi-criteria models are presented.

**Table 1:** Mutual criteria of the analysed multi-criteria models

Criteria	Indicators
Building location	Traffic infrastructure connectivity (availability of bus, train, etc.)
	Distance from different types of content (hospital, bank, etc.)
Building characteristics	Possibility of modifying the building's physical structure
Energy consumption	The energy required to achieve comfort for the users
Quality of interior space	Different types of comfort factors (temperature balance, level of noise, etc.)
Financial feasibility	The current condition of the building
	Necessary additional work
	Value of the building after the intervention
Market	Demand for a new use
Stakeholders	Interests of stakeholders

### DISCUSSION

In *Table 1*, as a mutual criteria and general recommendations for improving newly built office buildings' potential for adaptation, seven criteria are singled out: building location, building characteristics, energy consumption, quality of interior space, financial feasibility, market, and stakeholders. Building location, in terms of traffic infrastructure connectivity and distance from different types of contents, which are recognized as the indicators for this criterion, is one of the most important parts of each analyzed model. Buildings that are located in the city center surrounded by many different contents and well-connected with other parts of the city, according to models' assessments, have far more

chances for successful conversion compared to office buildings in nonfunctional or industrial areas. In the design phase, the choice of a suitable location is the result of many factors and the question remains to what extent it is possible to include this criterion in the general recommendations for the improvement of office buildings' potential for adaptation. At the time of design, a choice can be made following the recognized guidelines, but the status of the location at the time of potential conversion is uncertain. On the other hand, building characteristics, in terms of the possibility of modifying the building's physical structure, could be completely applied, as a recommendation, during the design process. Buildings that are not "tight-fit" (designed strictly by the minimum necessary spatial requirements of primary purpose) may be adapted for space requirements of new use without unnecessary expenses and in a shorter period of time. When it comes to energy consumption, in terms of indicators that refer to the amount of energy which are required to achieve comfort for the users, given that energy-saving methods are constantly improved, and the default level of user comfort changes over time, the question is of what extent it is possible to influence this aspect so that in the future it contributes to office buildings' potential for adaptation. In any case, the recommendation is to design the building by the latest standards at the time of design, but differences in standards that arise over time must be taken into account. More strict standards, applied in other countries, might also be analyzed and, at some point, applied. Since the next criterion, quality of interior space, refers to different types of comforts as the indicators, a similar approach, as for a previous one, applies to it. Financial feasibility, as a criterion, is considered through the following indicators: the condition of the building at the time of adaptation consideration, necessary additional work (to adapt a building for a new purpose, for example), and value of the building after the intervention. The condition of the building is, to a great extent, the consequence of the level of maintenance during the period of exploitation of the building. The additional work may be related to the building's structural flexibility (which was considered within the second criterion), but it, mostly, depends on differences between spatial needs and legislative requirements. The new value of the building may be a consequence of many factors, including market conditions (which may not be influenced on). Regarding this criterion, planning of high level of maintenance could be used as a general recommendation. The criteria which are related to market conditions and stakeholders' interests are completely out of influence during the design and construction period.

The summarized guidelines which could be used as a general recommendation for the improvement of the new office buildings' adaptability are presented in *Table 2*.

**Table 2:** Guidelines for the improvement of the new office buildings' adaptability

Criteria	General recommendations
Building location	Buildings should be located in the parts of the city with many different contents available and well-connected with other parts of the city or in such location envisioned in the future urban plan.
Building characteristics	Buildings should not be designed strictly by the minimum necessary spatial requirements of primary purpose (avoid "tight-fit").
Energy consumption	Buildings should be designed in accordance with the latest standards at the time of design, but differences in standards over time are possible.
Quality of interior space	Buildings should be designed in accordance with the latest standards at the time of design, but differences in standards over time are possible.
Financial feasibility	A high level of maintenance should be planned during the design and construction period.
Market	Out of influence during the design and construction period.
Stakeholders	Out of influence during the design and construction period.

## CONCLUSIONS

Building transformations are one of the methods to cope with the problem of vacancy of (office) buildings which affects a significant number of cities (Remoy, 2010). To improve the adaptation process in the future, the mutual criteria of five multi-criteria models for evaluation of the building's potential for different types of adaptation are considered as a possible general recommendation that could be implemented during the design and construction phases of new (office) buildings. The following criteria are analysed: building location, building characteristics, energy consumption, quality of interior space, financial feasibility, market, and stakeholders. It is concluded that guidelines within the criteria "building characteristics", referring to flexibility of physical structure, and "financial feasibility", referring to a high level of maintenance, could be completely applied, those contained in the criteria "building location", "energy consumption" and "quality of interior space" could be partly applied and, the criteria "market" and "stakeholders" are out of influence. The improvement of newly built (office) buildings is of great importance and it should be the subject of further research.

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