
Assessment of buildings redevelopment possibilities using MCDM and BIM techniques

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Abstract

The paper deals with abandoned former industrial buildings problem and buildings’ redevelopment possibilities with emphasis on sustainable development. A complex decision-making model for redevelopment of abandoned buildings, combining Building Information Modelling (BIM) and Multiple Criteria Decision Making (MCDM) techniques, is proposed. A case study of a former measurement equipment factory is presented. Ranking of possible redevelopment alternatives of the building using Weighted Aggregated Sum Product Assessment method with grey attributes scores (WASPAS-G) is proposed and the most rational projects are selected. While BIM techniques supports an effective selection process and allows implementation of full lifetime management strategy of a project and then of a real object.

Keywords: building conversion; industrial building; BIM; MCDM; WASPAS-G.

1. Introduction

Objectives and desirable beneficial results of redevelopment of assets are analyzed as a complex process with emphasis on sustainable development. The aspiration of sustainable development is not to build new urban areas, but to develop abandoned territories. Due to such development both the buildings are being modernized and the whole infrastructure is transformed, thereby making it more attractive to live or to invest [1,2].

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Complex decisions in construction can be supported by Building Information Modelling (BIM) methodology and different Digital Construction techniques [3]. The modelling can be treated as a new project quality ensuring technique [4, 5] and can be used in any project life cycle phase with all possible benefits both for new and existing buildings [6,7]. In the refurbishment and maintenance phases the changes of building must be evaluated with respect to both the building heritage and the sustainability [8]. Alternative building redevelopment solutions can be successfully assessed applying Multiple Criteria Decision Making (MCDM) methods [9,10].

The aim of the current research is to suggest a complex model for redevelopment of abandoned buildings, combining BIM and MCDM techniques. Different building redevelopment concepts are analyzed, including property refurbishment, conversion or dismantling an old structure and building a new one. It is proposed to apply complex criteria system, consisting of technological, economic and environmental sub-systems. Selecting the best alternative concept using Weighted Aggregated Sum Product Assessment method with grey attributes scores (WASPAS-G) is proposed. Digital construction techniques are suggested to be applied for supporting selection process and further implementing full lifetime management strategy of a project.

2. Methodology for assessment of buildings redevelopment decisions

2.1. Decision-making model using MCDM and BIM techniques

The current paper proposes a complex building redevelopment model of abandoned buildings (Figure 1).

When deciding abandoned manufacturing and industrial buildings redevelopment capabilities, it is necessary to determine what type of project is suitable for a particular structure. At first, diverse and comprehensive information about a building and its site should be collected and analyzed, including building location; technical state and depreciation of a building; site contamination; historical, cultural and architectural value; needs of the community.

Different building redevelopment concepts can be analyzed: refurbishment, conversion of assets, or dismantling an old structure and building a new one. It is suggested to select the best concept considering a set of quantitative and qualitative criteria, emphasizing sustainable development. Ranking of possible redevelopment alternatives of the building using MCDM methodology is proposed. BIM techniques support an effective selection process and further implementation of a project.

![Fig. 1. Complex building redevelopment decision-making model.](image)

#### Criteria system for assessment of buildings redevelopment

Demolition and new construction or reconstruction? Analyzing from the aspects of sustainable development, a decision is influenced by a number of technical, economic, social and environmental indicators, such as physical condition of load-bearing structures, historical and architectural value of the building, location, infrastructure, potentially contaminated areas, and others. Conversion of buildings is more appropriate because of the longer life of materials and reduced consumption of energy and other resources, reduced CO₂ emissions. However, such works are...
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