Complex Model for Assessment of Ex-industrial Building Conversion Options Into Lofts

Mindaugas Daukšys[1*], Justas Pilipavičius[2], Ala Daugėlienė[1]

[1]Kaunas University of Technology, Faculty of Civil Engineering and Architecture, Studentu st. 48, LT-51367 Kaunas, Lithuania*
[2]JSC "Lidl", Naugarduko str. 102, LT-03160 Vilnius, Lithuania.

**Corresponding author: mindaugas.dauksys@ktu.lt*

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Industrial decline and a changing real estate market have led to large numbers of industrial buildings becoming outdated, redundant or obsolete, implicating social and economic problems. A solution may be found through the conversion of abandoned industrial buildings into housing, as it is an attractive adaptation option, given the tight housing market in Lithuania. Now that loft apartments have become a trendy style of living, there are also barriers to lofts development, which invariably concern cost. Therefore the loft conversion developers should perform complex analysis and versatile evaluation of ex-industrial building in order to determine the success of investment project. The objective of the research presented in this paper is to develop a complex assessment model for ex-industrial property conversion options. To that end, firstly a review of the literature is conducted to identify the existing lofts conversion practice and explore their social and economic feasibility. Afterwards, a model for the assessment of non-residential property conversion options is presented. Based to the theoretical assumptions and a study of the existing practice three alternatives are suggested and implicated in the multiple criteria evaluation: hard loft, new hard loft and soft loft. The findings of a certain case study investigation revealed the best option for ex-industrial building transformation into living space, providing the best financial benefit of investment project, - so-called new hard loft.

Keywords: *conversion, ex-industrial building, loft, real estate development.*

1. Introduction

Economic decline in Lithuania and a changing real estate market have led to large numbers of industrial buildings becoming outdated, redundant or obsolete. Obsolescence is perceived as a problem of economic and social decline. Economically, a vacancy of building affects its owner directly. For society, an abandoned building presents problems of insecurity and social uncertainty and may bring about criminality ranging from vandalism and graffiti to break-ins, illegal occupancy and fires (Remøy and Voordt, 2007). At the same time such redundant buildings also have indirect effects through the negative image that they give to the surrounding area. A solution may be found through the conversion of abandoned industrial buildings into housing, as it is an attractive adaptation option, given the tight housing market in Lithuania.

Adaptability as a mean of increasing usability and extending buildings functional lifespan has been discussed in architecture since the 1960s (Remøy and Wilkinson, 2012). It is broadly interpreted with definitions referring to "change of use", maximum "retention" of original structure and fabric, and extending "useful life". Adaptation can occur "within use" and "across use"; for example, a factory building can undergo adaptation and remain a factory (within use adaptation) or it may change use to residential and be classed as "across use" adaptation (Ellison and Sayce, 2007). Remøy and Wilkinson (2012) analyzed sustainable adaptation of vacant office buildings and defined conversion, or fitting a new use to an existing building, as a form of sustainable development for buildings that have outlived their original use and become obsolete. They distinguished three drivers for buildings conversion to housing - social, economic and environmental. Social driver is the renewed appeal for city center living and planning policies that reinforce this interest. The economic reason for the interest in adaptation is the growing perception that old buildings are often cheaper to convert to new uses than to demolish and rebuild (Coutts, 2012; Bullen, 2007). These conversion projects will only be interesting to developers if they are economically feasible. The environmental importance of this trend is that extending the useful life of existing buildings supports the key concepts of sustainability by lowering material, transport and energy consumption and pollution.

The conversion of non-residential property such as factories, warehouses or office blocks into apartments have taken place across a wide range of cities in Europe, North America, Australia and Asia (Hamnett, 2009). This process was first identified in research papers of Zukin (1982, 1989) in her analysis of the SoHo area of downtown Manhattan. It involved the conversion of old industrial buildings in the former garment area into large, open plan residential 'lofts', often of 2000 square feet or more floor area. According to Hamnett (2009) loft conversions can be seen as a specific physical form of central and inner city gentrification associated with the transformation of previous industrial and commercial urban uses to 'post-industrial' residential uses. The consequent demand for central and inner city residential property is very strong and it becomes profitable for developers to convert ex-industrial or commercial property to residential.

The term "loft" has come to represent a desirable type of dwelling space (open, bright, modern) and is associated with a wide spectrum of building types. Lofts were originally popular amongst artists and bohemians because of their affordability and versatility. Now that loft apartments have become a trendy style of living and so popular, loft living is anything but affordable. But as consumer demand for loft-style homes continues to soar, there are also barriers to lofts development, which invariably concern cost. Therefore the developers should perform complex analysis and versatile evaluation of ex-industrial building that can determine the success of investment project. The objective of the research presented in this paper is to develop an assessment model for non-residential property conversion options, which enables developers increase the effectiveness of investment projects.

2. Methods

In order to understand the general and local aspects of non-residential property conversion into apartments, the complex methodology of the research was formulated. The research includes: the analysis of literature in order to determine the stages of development and challenges of non-residential property conversion; the identification of potential alternative decisions of lofts conversion based to the theoretical assumptions and a study of the existing practice and the formulation of conversion projects development model, which enables real estate developers evaluate and select conversion option providing with increased effectiveness of investment. This is followed by the application of developed model to a real case study by consideration of various conversion options and implementation of multiple criteria evaluation methods.

The developed assessment model for non-residential property conversion options is presented in Fig. 1. The authors suggest the proper ex-industrial building conversion alternative can be selected by performing four essential analyses - assessment of a building's technical condition, determination of the technical feasibility of converting a building to a residential use, evaluation of project attraction for the consumers and multi-criteria assessment of building's conversion alternatives.

Thus, first of all, the technical conditions of selected ex-industrial buildings have to be assessed. The determination of the present technical condition of a building is subject to qualified technical investigation and historical inspection. A building inspection should be requested by developers in their own best interest prior to initiation of investment project. Based on the results of the building inspection, the risk resulting from a loss or decrease in building functionality can be estimated. The risks can be expressed as costs associated with necessary repairs or reduction of building use as well as potential health hazards to the occupants and surrounding environment or even loss of life. It is possible to deduce forecasts of building technical development and model different strategies for repair, modernization, and conversion.

The second step in evaluating the ex-industrial buildings conversion options is the research on their adaptability to the residential premises. To determine the technical feasibility of converting a building to an alternative use the following criteria are considered: size and height of building, building structure, building envelope and cladding, internal space, layout and access, building engineering systems, acoustic separation, fire safety and means of evacuation.

All industrial buildings to be reconstructed into living premises should conform the complex of legal requirements for residential buildings, such as mechanical strength and stability, hygiene, health and environmental safety, noise insulation, energy saving and heat retention. One of the most important factors preventing conversion of industrial buildings into living space is their thermal insulation. As the thermal insulation of outdated industrial buildings is much worse than one required for residual use buildings. Problems with any of the above-mentioned requirements fulfilment may impact on the implementation of conversion; this is the way changing of building's use makes the designer's job more difficult. At the same time large spaces and high ceiling of industrial buildings are a positive feature for lofts: it implies the application of various non-standard solutions.

Another important factor, which can impact the adaptability of ex-industrial property, is manufacturing process previously held in the building and its residual damage to human health. Constructions of former industrial buildings and site soils, depending on the activities of the industrial object, may contain toxic, mutagenic or carcinogenic materials, which may eventually lead to health problems of residents of such premises (Labutyte, 2012). Therefore it is necessary to analyze the production processes, which took place in the building, their effects and possible residual harm for human health. It is obligatory to inquire about the history of the industrial building and to find out information about incidents and accidents that could have contaminated the premises. Design and construction of loft apartments should correspond to all sanitation conditions that are obligatory for residential buildings without any threat for human health for the following reasons: excretion of harmful gases; hazardous particles and gases occurrence in the air; dangerous radiation; water and soil pollution and poisoning of living organisms; inappropriate disposal of wastewater, smoke, solid or liquid waste; moisture of

building constructions or internal moisture of buildings. If pollution norms are exceeded, neutralization of pollutants and its costs should be considered and the following analysis carried out:

- Evaluation of the possibility of hazardous materials liquidation from the future housing site;
- Economic impact of cleanup on the profitability of the project.

Prior to the development of conversion projects, all possible options must be analyzed.

The other step in the assessment of adaptability of industrial building to the residential use is the analysis of the project attractiveness for the client. Most of industrial buildings can be converted into the living space; however, not all of them are worth such conversion. The loft wave, which becomes more and more popular, together with the proponents of this lifestyle involves those people who are chasing fashion as well.

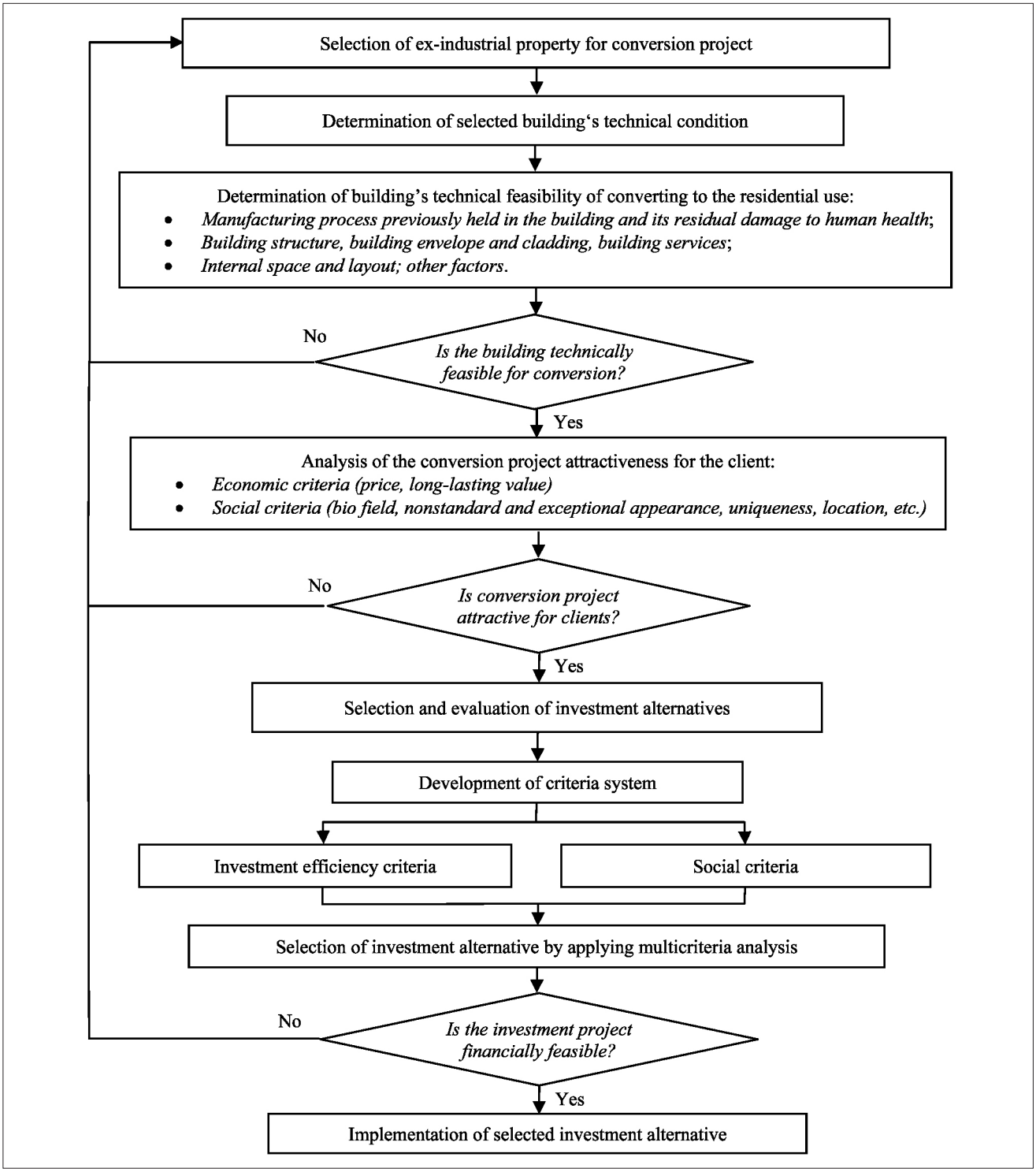

Fig. 1. *Complex model for assessment of ex-industrial building conversion options into lofts*

According to the Internet survey, conducted in March-April of 2011 by Lithuanian daily "Lietuvos Rytas", more than a third of respondents (38%) would eagerly purchase loft-type apartments because of their affordability. The uniqueness of the project was indicated as the second important reason (35%) for the popularity of investing into former industrialized areas and lofts apartments. Since lofts attract people due to their nonstandard and exceptional appearance, the places where they are located should also look exceptionally like, for example, water tower, clock tower on the upper floor of a factory or the upper floor of a skyscraper. Therefore, the past activities in buildings are very important for conversion project's liquidity in the context of attractiveness to the client in such a way that not so many people would like to live in former prison, psychiatric hospital or crematorium. Moreover, the number of industrial buildings in the central or picturesque parts of the city is limited, and, in the course of time, they acquire a long-lasting value.

The main problem faced by people living in lofts in Lithuania is the real estate taxation applicable to commercial premises, which, under the laws of the Republic of Lithuania, is obligatory for all owners of commercial premises without consideration that commercial activities are not carried out any more. Besides, changing the use of real estate property from industrial to residential is a lengthy and complicated process. Therefore, consumers, purchasing a loft apartment with remaining industrial use, face limited opportunities to buy it. All the mentioned aspects must be considered in depth prior to decision on investing in conversion of any industrial building.

Hence, in the last step the authors recommend an assessment of different ex-industrial building's conversion options in regard to the financial benefit for developers and cost-efficiency and functionality of the conversion itself. To determine the value and the utility degree of different ex-industrial building conversion alternatives under consideration and to establish the priority order of their implementation, multi-criteria decision-making methods (MCDM) can be used effectively. The authors suggest applying TOPSIS method for selection of conversion alternatives for ex-industrial buildings, according to research of Antucheviciene et al. (2011), who presented evaluation of different methods and measuring objective congruence (incongruence) of the obtained results and proved that the final decision should be adopted by giving the priority to the results of COPRAS and TOPSIS methods. A set of criteria was developed according to the economic and social aspects of non-residential property adaptation. The TOPSIS method, like most of the MCDM methods, needs the criteria weights, which can be determined by pairwise comparison method AHP (Analytic Hierarchy Process) or ranking expertise method. Based on the judgments of experts, the weights of the criteria are determined, and the concordance of expert judgments is verified. Once the alternatives for lofts conversion are selected, it can be implemented for the ex-industrial property conversion assessment regarding its economical feasibility.

3. Results

Proposed non-residential property conversion model is applied to the case study to determine an adequate lofts conversion option providing efficient investment for developers. The case study is the complex of ex-industrial buildings "Kauno Pieno Centras" located on the riverside in the inner city (Fig. 2). The building of Central Dairy (total floor area 2622 m^2) is selected for lofts conversion analysis (Fig. 3).

The first step in assessment of selected ex-industrial building is determination of the present technical condition according to the qualified technical investigation and historical inspection. The complex was built in 1936. Since the start of Kaunas Dairy Centre operation to its suspension in 2007 the main production activity carried out in the facilities was milk production, mainly the production of ice cream.

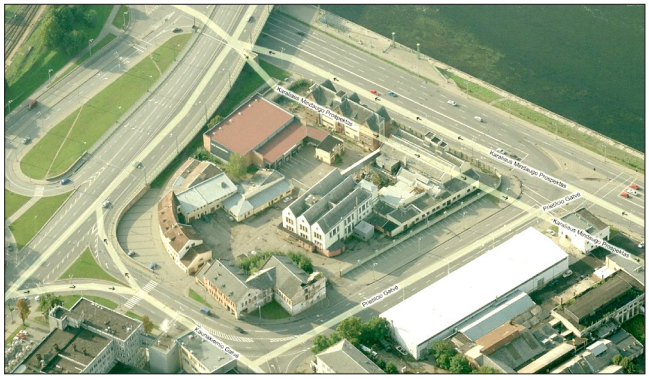

Fig. 2. *Complex of buildings "Kauno pieno centras" (www.bing.com/maps/)*

Fig. 3. *Central Dairy building*

Based on the results of the building inspection, the general physical depreciation of selected buildings complex can be defined according to the general wear and tear rates of separate building's structures. Although it was estimated that general physical depreciation rate of Central Dairy is 59,6%, it is still suitable for the future development, repair, modernization or conversion.

The second step in evaluating the ex-industrial building conversion options is determination of the technical feasibility of converting to the residential use. The following criteria were considered:

- *Manufacturing process previously held in the building and its residual damage to human health* – milk production processes, which took place previously in the dairy, do not belong to the hazardous activities; the building corresponds to all sanitation conditions that are obligatory for residential premises without any threat for human health.
- *Building structure, building envelope and cladding, building engineering systems* – all structures of central dairy building conform main construction requirements for residential buildings, such as mechanical strength and stability, hygiene, health and environmental safety, noise insulation; at the same time building's envelope, cladding and all engineering systems need to be renovated or rehabilitated.
- *Internal space and layout* - large spaces and high ceiling (6 m height) of the Central Dairy imply the application of various non-standard solutions: it can be split up into the separate apartments with installed entresols.
- Other criteria – positive decision on the change of real estate property use from industrial to residential; advantageous location in the inner city of Kaunas, on the riverside, etc.

After the technical feasibility of converting is assessed, the social factors of conversion are evaluated. There are certain characteristics that are essential to loft living, which can attract or repel the potential clients: popular style of living, open space and versatility. In our case, the Central Dairy building can be represented as a perfect option for lofts apartments with high ceilings, large windows, exposed building materials and open concept living (Fig. 4). Another great aspect of analyzed option is the opportunity for eclectic design and decorating. Besides, the floor plan can be altered at any time.

Fig. 4. *Internal space of Central Dairy*

Located in the inner city of Kaunas the building offers the location and opportunities of city life with far more space than average apartment and, possibly, a shorter commute to work. Furthermore, manufacturing process previously held in the complex gives a positive image of building itself due to the sentimental feelings for living in former ice-cream factory.

The case study investigates the selection of Central Dairy building conversion option that provides cost-efficiency and functionality of the conversion as well as financial benefit for its developers. Based to the theoretical assumptions and a study of the existing practice three potential alternative decisions for Central Dairy conversion are suggested and implicated in the multiple criteria evaluation. The alternatives include *hard loft* (alternative A1), *new hard loft* (alternative A2) and *soft loft* (alternative A3). All the selected options are evaluated according to the general development project – to create 2467 m^2 of living space in the Central Dairy building by constructing 23 loft apartments with utility premises in the basement and 50 parking spaces around the building.

The A1 alternative – a *hard loft* is defined as a space transformed from an old, non-residential building like a warehouse, mill or factory to a residential dwelling (Dolan, 2012). A true hard loft is characterized by high ceilings, open spaces, concrete ceilings and floors, exposed brick walls, duct work, electrical and plumbing, large windows and an urban location.

The A2 alternative – a *new hard loft* is built to look and feel like hard lofts but offering advantages of modern building practices and materials (Paterson, 2013). These lofts share the same characteristics of the true hard lofts (such as high ceilings, exposed brick and duct work, large windows etc.) but they are more habitable and comfortable than true hard lofts. New-builds embrace proper heating, electrical, plumbing and high efficiency windows and doors. Essentially, new hard lofts have the best of both worlds.

The A3 alternative – a *soft loft* approaches new hard loft in that it is newly constructed, but with some of the characteristics of a hard loft such as high ceilings, big windows and open concept floor plans (Paterson, 2013). This type of lofts typically gain some of the subtleties - instead of concrete floors they may have broadloom or hardwood; instead of exposed ductwork and piping these areas are encased in drywall; they may have upscale kitchens and baths. Soft lofts have more in common with traditional apartments than a true hard loft.

For the comparison of suggested alternatives a criteria system was developed and adapted for calculations that were performed to determine the priorities of loft conversion alternatives. The following criteria were taken into consideration including development project net present value (NPV) C1, internal rate of return (IRR) C2, profitability index (PI) C3, complexity of the development C4, duration of construction project C5 and the attractiveness of the project to market C6. Initial data for multiple criteria decision-making was derived from the findings of the calculations on investment projects financial feasibility and in-depth analysis of selected loft conversion options as well as market demand in Lithuania. Criteria C1, C2 and C3, representing the investment efficiency, are calculated for the expected duration of conversion project from two to three years and project funding by equity financing (60 %) and bank loan (40 %) with discount rate of 5 %. The criteria C1,

C2, C3 and C6 are expected to reach their maximum values, while criteria C4 and C5 are targeted to minimum. The initial data for multiple criteria evaluation of loft conversion alternatives are presented in Table 1.

Table 1. *Initial data*

Criteria	Dimensions	Optimization direction	Alternatives		
			A1 (hard loft)	A2 (new hard loft)	A3 (soft loft)
C1	thousand LTL	max	118	881	920
C2	%	max	4	16	11
C3	-	max	1.04	1.17	1.14
C4	points	min	4	7	8
C5	months	min	6	12	15
C6	points	max	5	8	4

The subjective weight of the attributes was determined by using expert pairwise evaluation as a subjective approach. Pairwise evaluation of the criteria provided by experts is presented in Table 2.

Table 2. *Subjective weights of criteria*

	Criteria						Total
	C1	C2	C3	C4	C5	C6	
Weight	0.193	0.183	0.213	0.113	0.133	0.163	1.00

Multicriteria analysis of selected alternatives was performed applying TOPSIS method. By applying this approach the efficiency of the alternatives of loft conversion has been determined and following priorities for the alternatives was obtained: A2, A3, A1. The calculation results are given in Table 3.

Table 3. *Data obtained by applying TOPSIS approach*

	Alternatives		
	A1 (hard loft)	A2 (new hard loft)	A3 (soft loft)
Efficiency value, %	35	100	59
Priority order	3	1	2

The findings of study suggest real estate developers that they can have the best financial benefit by converting Central Dairy building into new hard lofts.

4. Conclusions

Currently, loft-type apartments have become a trendy style of living, reflecting social and financial status of the owner. Loft conversions have grown in popularity for a number of social and environmental factors, including the growing interest in sustainability and energy efficiency. Located in attractive locations, once-abandoned industrial buildings have become a marketable product for real estate developers. Therefore, businessmen and real estate agents are eagerly investing in lofts.

Most of ex-industrial buildings can be converted into the living space; however, such conversion projects will only be interesting to developers if they are economically feasible. Consequently, loft conversion developers should perform complex analysis and versatile evaluation of ex-industrial building that can determine the success of investment project. Thus the complex model for assessment of non-residential property conversion into loft is presented in the paper.

The developed model provides real estate developers with a needed support in defining the adaptability of ex-industrial building for conversion as well as selecting appropriate loft conversion option in order to increase the effectiveness of investment project. The proper conversion alternative can be selected by performing four essential stages of analysis – assessment of building's technical condition, determination of building's technical feasibility for loft conversion, evaluation of project attractiveness for consumers and selection of the most efficient conversion alternative by implementation of multi-criteria decision-making methods.

Proposed model was applied to the case study – Central Dairy conversion into residential use investment project. Three ex-industrial building conversion alternatives were suggested and implicated in the multiple criteria evaluation: hard loft, new hard loft and soft loft options. The findings revealed that the best option for the selected ex-industrial building transformation into living space, providing the best financial benefit of investment project, is new hard loft.

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Mindaugas DAUKŠYS – Assoc. Professor at Kaunas University of Technology, Department of Civil Engineering Technologies.
Main research area: Real estate management, construction management, construction technologies.
Address: Studentu st. 48, LT-51367, Kaunas, Lithuania.
Tel.: +370 37 300479
E-mail: mindaugas.dauksys@ktu.lt

Justas PILIPAVIČIUS – MSc., Project Manager in the Joint Stock Company "Lidl".
Main research area: Real estate development, real estate management.
Address: Naugarduko str. 102, LT-03160, Vilnius, Lithuania.
Tel.: +370 693 00683
E-mail: justas.pilipavicius@gmail.com

Ala DAUGĖLIENĖ – PhD, Lecturer at Kaunas University of Technology, Department of Civil Engineering Technologies.
Main research area: Real estate management, facility management, construction management and economics.
Address: Studentu st. 48, LT-51367, Kaunas, Lithuania.
Tel.: +370 37 300487
E-mail: ala.daugeliene@ktu.lt