

An integrated model for assessing the use of buildings: case of municipality owned cultural buildings

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Structure of paper

- *Literature review and gaps of research*
- *Problem*
- *Objectives*
- *Methodology*
- *Results and suggestions*

Literature review



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- Local authorities often manage a large number of public assets consisting of a variety of building types used for provision of social and economic infrastructure services (eg. infrastructure objects, schools, health care institutions, social housing and the surrounding land). Real estate portfolio management is especially difficult due to the variety of the purpose of the property use, differences in the requirements for its maintenance and needs of its users.
- The key issue is the strategic asset management ensuring the rational use of resources, assuring transparent services for the society, and protecting societal needs. However, presently only about 25% of major European cities are able to provide data on the amount and value of their public buildings. Rational management of municipal real estate needed to ensure that public interests met.
- An overview of literature and good practice has shown that countries are moving towards centralized asset management (e.g. Denmark - “Danish Buildings and Property Agency”; Finland - “Senaatti”; UK - Government Property Unit (GPU), etc.) that allows better management of state property. For example, Canada reported that developed asset information system that contains a detailed data on inventory of assets, a property search engine and a geographic map that shows the available assets, their use, size, value and other relevant information.

Literature review



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- An analysis of the research in area of sustainable urban development revealed that current studies usually focus on research of simple problems existent at lower hierarchical levels: rational ways of production, the selection of contractors and construction sites, energy efficiency in buildings, etc.
- There is a lack of new knowledge-based methods and tools, by which municipalities be able to analyze the current management processes of buildings and make impartial decisions to improve the buildings' end-use efficiency. Therefore, this research focuses on management processes of public buildings and the integration of new knowledge for improving the efficiency of decision-making that requires the integration of different types of information.

Problem

- Municipal assets can be divided into economic and social infrastructure (see Figure). The buildings of the economic infrastructure are mostly managed by companies and buildings of social infrastructure is the concern of municipalities.

State economy infrastructure

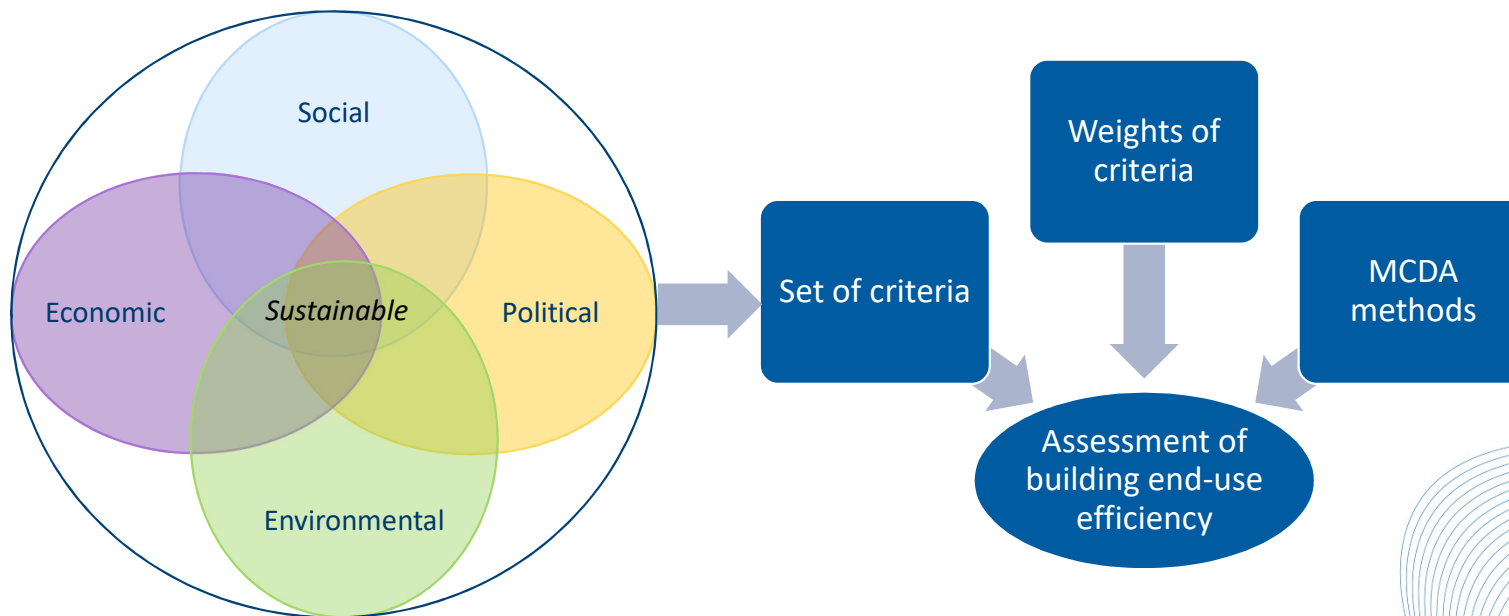
- Water, sewage supply companies' buildings and infrastructure;
- Electricity, heat production companies' buildings and infrastructure;
- Public transport companies' buildings and infrastructure;
- Streets and roads infrastructure;
- Other buildings used for state economy purpose

Social infrastructure

- Buildings of educational institutions: universities, schools, kindergartens, sports schools, etc.;
- Hospitals, clinics, social welfare/care buildings;
- Public safety authorities' buildings;
- Social housing;
- Museums, exhibition centers, concert halls, theaters;
- Buildings used for religious purposes;
- Administrative and operational support buildings and premises.

The aim and objectives

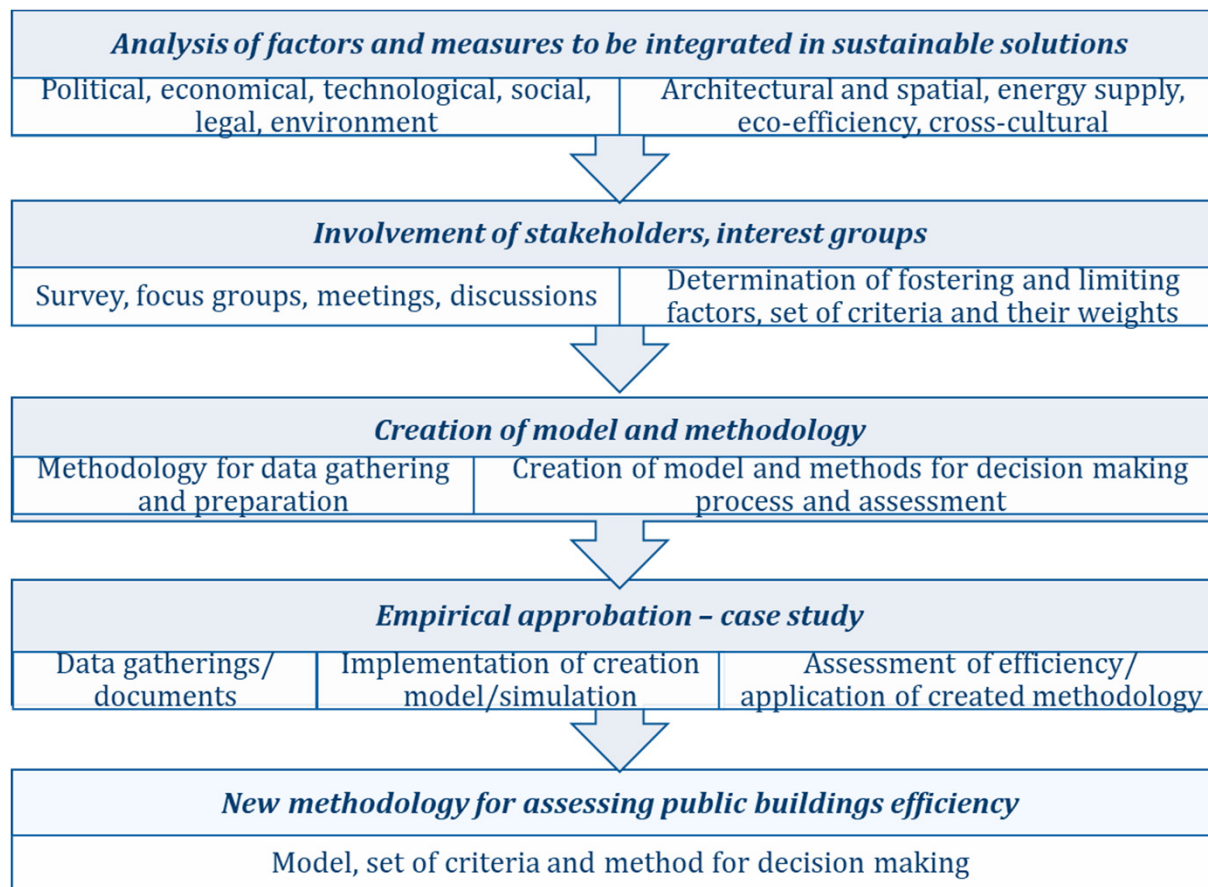
The aim of research is to analyze the possibilities of assessing the end-use efficiency of a building by applying sustainability criteria (political, economic, social and environmental) and multi-criteria methods.



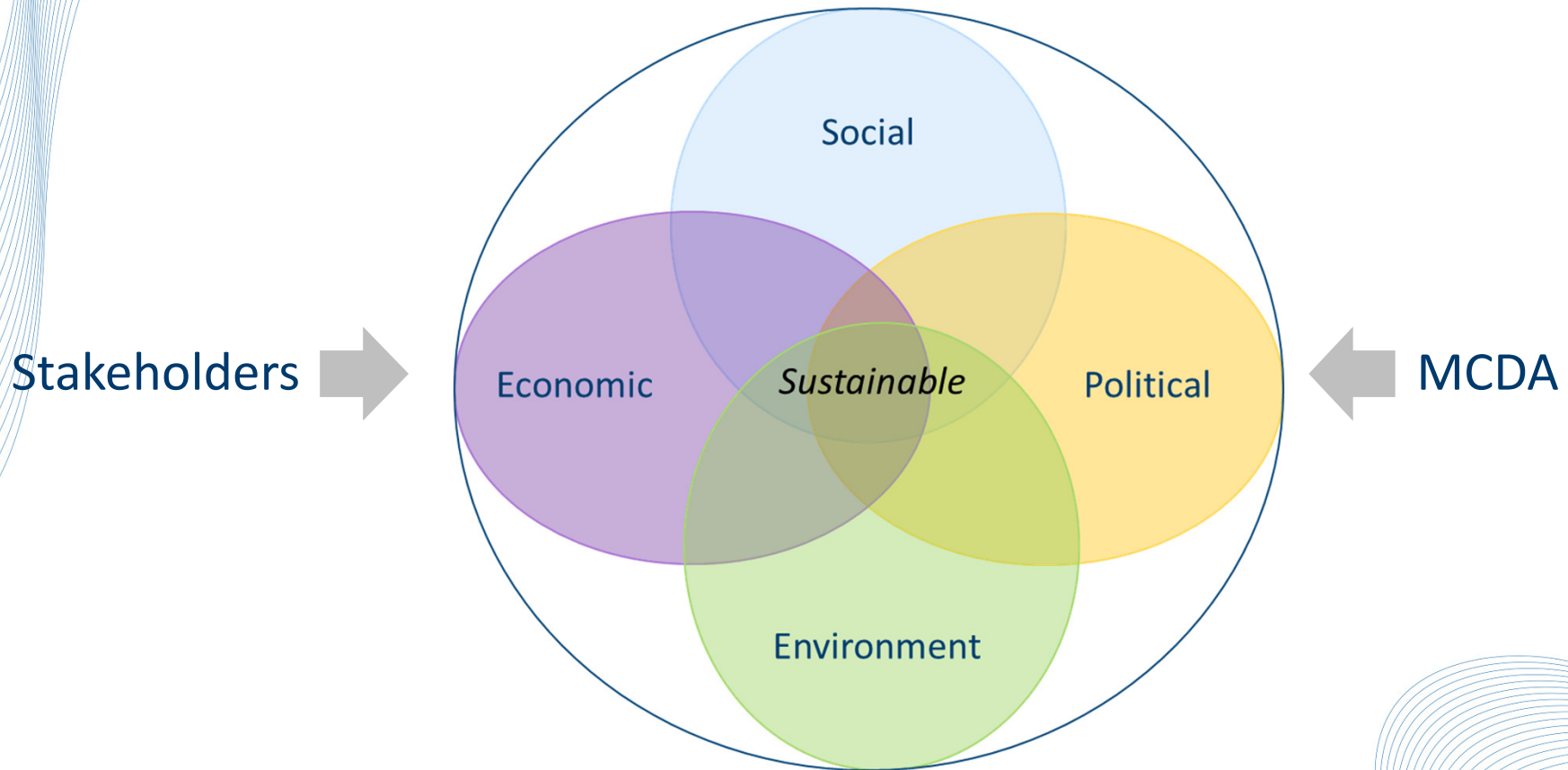
Research steps



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Sustainability categories



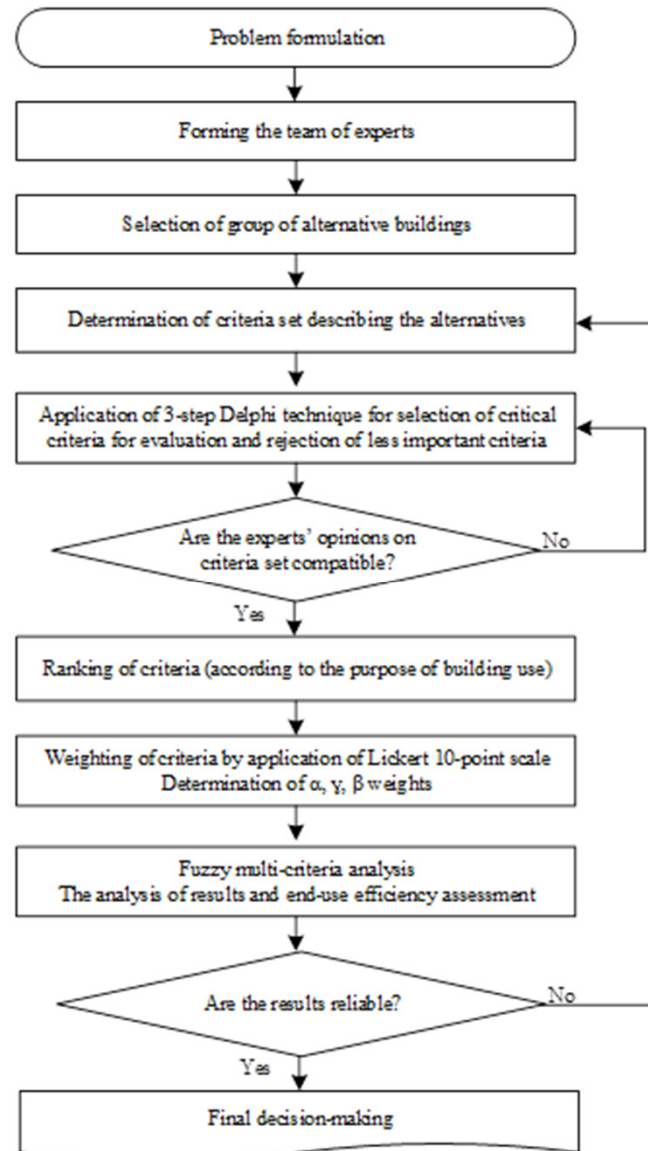
Research methods

- Buildings' data was gathered during the meetings and focus groups with responsible persons from municipality.
- The significances of the criteria were determined by the experts in three round Delphi study.
- Multi-criteria methods Qualiflex and Bayes Rule are used for the assessment of alternatives and the selection of the optimal.
- Calculation results are analyzed by systematizing and graphically displaying data.



Kuriame
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2014–2020 metų
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Algorithm for the assessment of alternatives applied in case study



Team of experts



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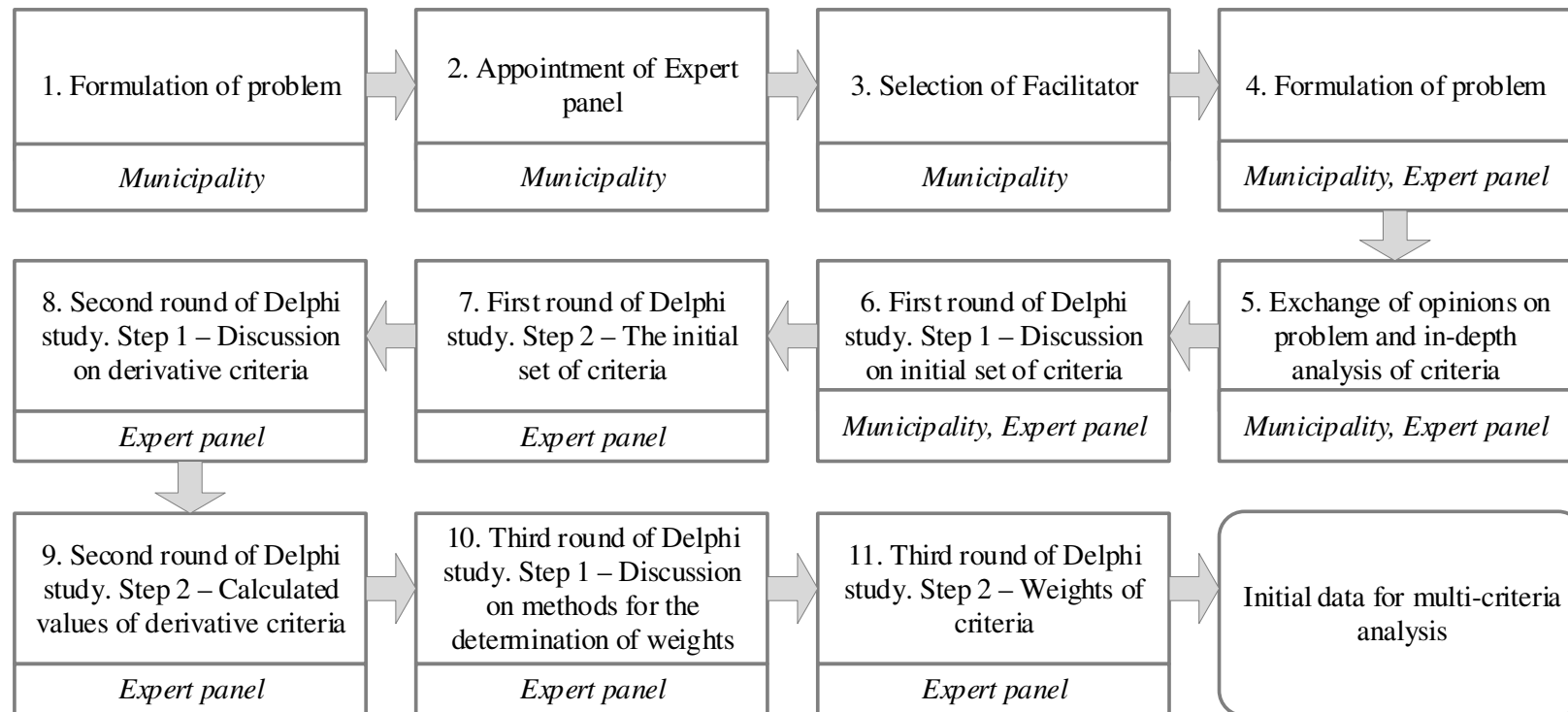
The expert's role in this Delphi study was to decide on a set of criteria that should be relevant and universal for application in other cases. Ten experts (see Table) of experienced and knowledgeable people from Vilnius Municipality and from academic institutions were selected for the panel. Experts were required to have: knowledge and experience in field of buildings' management, performed research on a national and international level, various analyses in the facilities management field, participated in international projects, and performed consultancies and expertizes on building use and construction. During the evaluation process, the main criteria for selection was that candidates had to have 5 or more years of experience in buildings management and masters' degree or higher). Participation in international activities was desirable but not an obligatory condition.

Experts	Education	Employment place and position (main)	Experience in employment activities (years)	Involvement in international activities
Expert 1	Higher, MSc	Municipality, member of Committee on the Environment and Energy	12	Yes
Expert 2	Higher, MSc	Municipality, member of Economic and Financial Committee	8	Yes
Expert 3	Higher, MSc	Municipality, member of City Development Committee	9	Yes
Expert 4	Higher, MSc	Municipality, member of Committee on Services and Urban Economy	16	Yes
Expert 5	Higher, MSc	Municipality, member of Committee on Social Affairs	14	Yes
Expert 6	Higher, MSc	Municipality, member of Committee on Health and Sports	7	Yes
Expert 7	Higher, PhD	Municipality, member of Committee on Education and Cultural Affairs	10	Yes
Expert 8	Higher, PhD	Municipality, member of Property Department of Municipal Administration	6	Yes
Expert 9	Higher, PhD	Municipality, member of Property Department of Municipal Administration	10	Yes
Expert 10	Higher, PhD	University, Assoc. Prof. Dr.	35	Yes

Delphi study steps for the selection of criteria and assessment of criteria weights



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Alternatives

- Based on object-related information, the panel of experts selected the group of building for analysis and assessment of end-use efficiency. The five buildings used for the cultural purpose selected.

Building 1



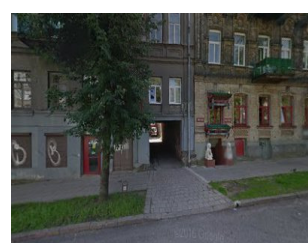
- UNESCO Heritage Area
- Commercially attractive part of town
- Distance to the center of Vilnius Old Town (Town Hall) - 900 m
- The building was built before 1940
- The reconstruction was completed in 2009

Building 2



- UNESCO Heritage Area
- Commercially attractive part of town
- Distance to the center of Vilnius Old Town (Town Hall) – 260 m
- The building was built between 1795 and 1860
- The reconstruction was completed in 2008

Building 3



- Commercially attractive part of town
- Distance to the center of Vilnius Old Town (Town Hall) - 900 m
- The building was built between 1860 and 1914
- The building is abandoned and reconstruction has not been carried out

Building 4



- The object is located away from the city center in residential district
- Distance to the center of Vilnius Old Town (Town Hall) – 7,2 km
- The building was built between 1959 and 1990
- Reconstruction has not been carried out

Building 5



- The object is located away from the city center, located in commercially attractive part of town
- Distance to the center of Vilnius Old Town (Town Hall) – 1,8 km
- The building was built between 1959 and 1990
- Reconstruction has not been carried out

Set of criteria



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No	Criteria	Measuring units	Optimality direction	Description
I.	Strategic (political)			
I1	Priority of activity	points		Premises activity priority according to Vilnius City Municipality goals. Score is from 1 to 5, with 5 being the highest priority.
II.	Economical			
	Income			
I2	Rental income fees	EUR/m ² per annum	max	Gross annual income of the Vilnius City Municipality from the rental of real estate. The total annual rental income from real estate is divided by the total floor space.
I3	Premises use incomes (eg. subtenancy)	EUR/ m ² per annum	max	Gross annual income comes from real estate subleases, as well as income from project services provided on-site. The gross annual income received is summed and divided by the total area of the premises.
I4	Incomes from investments	EUR/ m ² per annum	max	Funds invested by the tenant to improve the premises. The annual amount of money invested is divided by the total area of the premises.
	Expenditures			
I5	Management and exploitation	EUR/ m ² per annum	min	Expenses, including land and real estate taxes, costs of purchasing property maintenance services, depreciation allowances and other direct costs of owning, using, disposing of or selling real estate. The annual costs incurred are summed up and divided by the total area of the premises.
I5.1	Land taxes	EUR/ m ² per annum	min	Land and / or real estate tax shall be paid annually, calculated in accordance with the laws of the Republic of Lithuania on land tax and real estate tax law of the Republic of Lithuania at the time of valuation.
I5.2	Operating costs	EUR/ m ² per annum	min	The cost of securing the use of the property for operational purposes as well as a set of preventive maintenance (non-repair) measures to ensure that the property used according to the purpose within its intended useful life.
I5.3	Depreciation	EUR/ m ² per annum	min	The systematic allocation of the depreciable amount of an asset over its useful life. Calculated according to the Resolution of the Government of the Republic of Lithuania.
I5.4	Other expenditures	EUR/ m ² per annum	min	Other direct costs of operating, using, disposing of or selling property, including staff costs.
I6	Investments to the modernization and expansion	EUR/ m ² per annum	min	Investments in construction works, including repair, reconstruction, modernization of buildings, maintenance works of cultural heritage buildings, new construction as defined in the Law on Construction of the Republic of Lithuania. The total amount of investments for the current year is divided by the total floor space.
I7	Rental incentives	EUR/ m ² per annum	min	Rental incentives calculated as the difference between the rental price per square meter of the real estate market and the annual rent.
I8	Losses due to unused space	EUR/ m ² per annum	min	Losses due to insufficient occupancy of premises. The required occupancy of the premises is determined in accordance with the Hygiene Standards. The loss is calculated by multiplying the unused space of the premises by the market rent for the year. The indicator is measured in points ranging from 1 (low loss) to 5 (high loss).
I9	Inefficient use of the land plot	%	min	Insufficiently efficient and rational use of the land plot assigned to buildings. The expediency of use for a specific activity and the percentage of the land plots of the total assigned land are assessed. The indicator is measured in points from 1 (inefficient utilization) to 5 (efficient utilization, the entire plot of land is built up).

Set of criteria (continued)

No	Criteria	Measuring units	Optimality direction	Description
III. Social				
Social benefits				
I10	Number of service users	Unit/ m ² per annum	max	The indicator is used to measure social benefits from the use of real estate. Number of users of premises services per year. The total number of service users shall be divided by the total area of the premises.
I11	The part of service provided free of charge	%	max	The indicator is used to measure social benefits from the use of real estate. The proportion of users who receive free services is calculated as a percentage of the total number of users of the service per year.
I12	Execution of alternative services and/or short-term projects on the premises	Points	max	The indicator is used to measure social benefits from the use of real estate. Conducting additional innovative, exclusive, social value-added services and / or short-term projects on the premises. Score is from 1 to 5, where 5 - services providing the highest social value added and / or carrying out short-term projects creating the highest value added.
I13	The importance of the object in assessing potential social welfare losses	points	max	The indicator expresses the social loss resulting from the political / economic decision to use the property for another purpose. In this case, the user of the service loses the social service or the other alternatives offered cause inconvenience (socio-economic loss). This loss (cost) must be assessed if it is sufficiently significant in relation to the total costs and benefits of the solution.
IV. Energy efficiency and environment protection				
I14	Heat energy consumption for heating and hot water production	kWh/ m ² per annum	min	

Significances of criteria for different types of buildings

Significances of criteria for assessment of end-use efficiency of commercial and industrial buildings

Group of criteria	Criteria	Significances
I.	Strategic (political)	0,05
II.	Economic criteria	0,55
III.	Social criteria	0,1
IV.	Environmental criteria	0,3

Significances of criteria for assessment of end-use efficiency of health care buildings

Group of criteria	Criteria	Significances
I.	Strategic (political)	0,1
II.	Economic criteria	0,3
III.	Social criteria	0,4
IV.	Environmental criteria	0,2

Significances of criteria for assessment of end-use efficiency of buildings used for the purpose of education, sports, culture and crafts

Group of criteria	Criteria	Significances
I.	Strategic (political)	0,2
II.	Economic criteria	0,2
III.	Social criteria	0,4
IV.	Environmental criteria	0,2

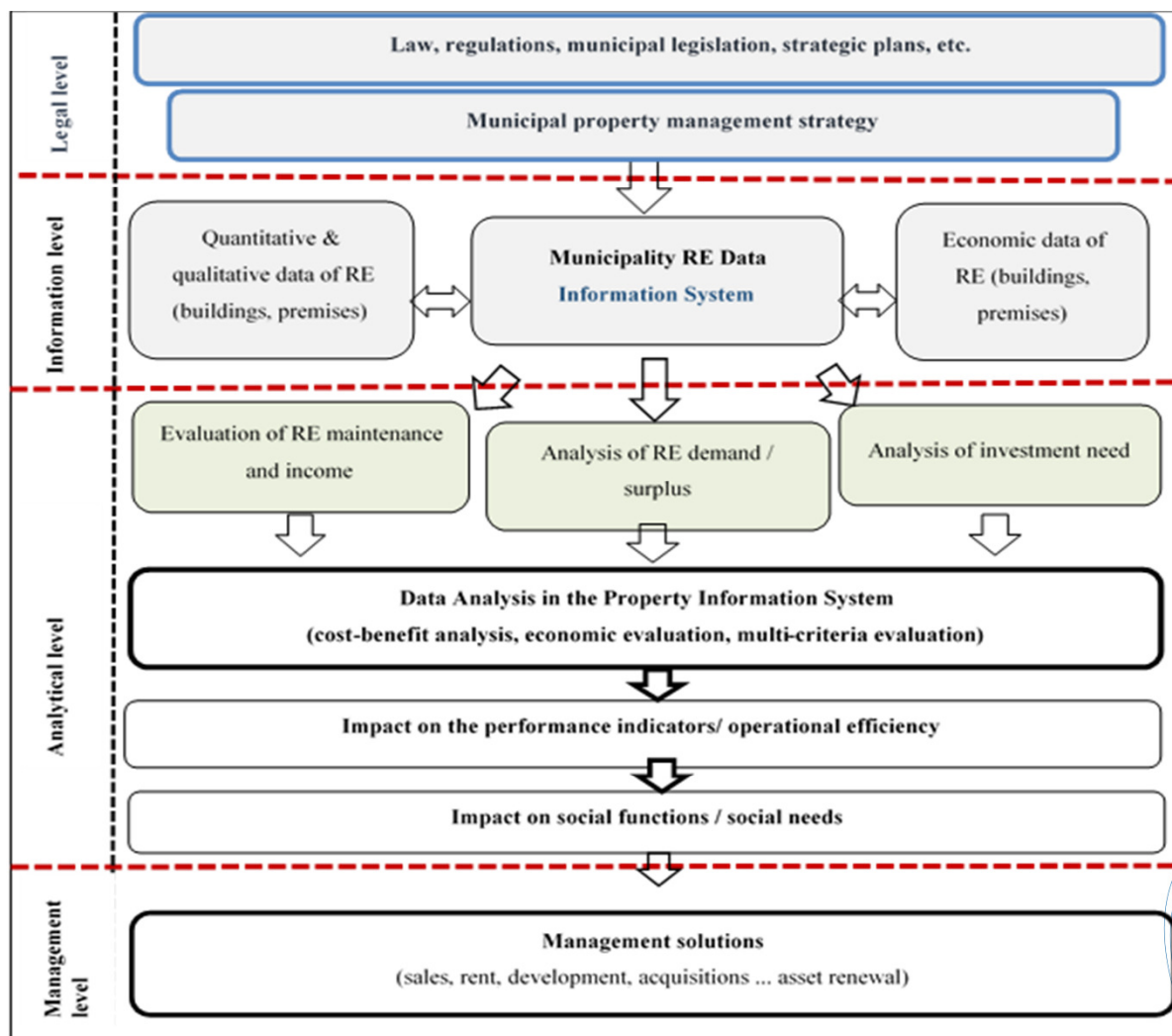
Significances of criteria for assessment of end-use efficiency of buildings used for the purpose of social services, charity, support, communities and religious communities

Group of criteria	Criteria	Significances
I.	Strategic (political)	0,3
II.	Economic criteria	0,1
III.	Social criteria	0,5
IV.	Environmental criteria	0,1

Buildings' end-use efficiency assessment model



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Initial data for assessment



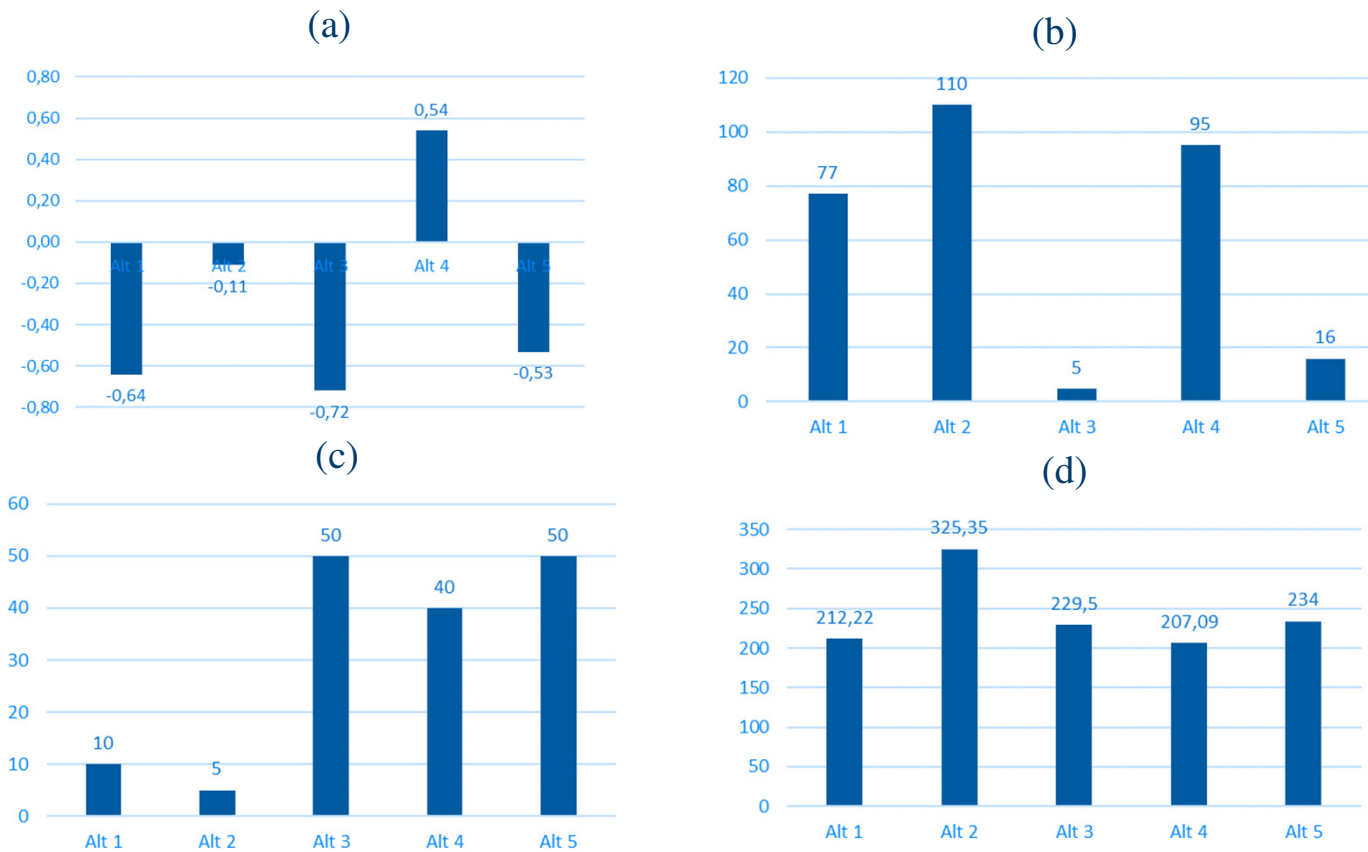
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No	Criteria	Measuring units	Optimality direction	Theatre 1	Theatre 2	Theatre 3	Theatre 4	Theatre 5
I. Strategic (political)								
I ₁	Priority of activity	points		4	4	4	5	4
II. Economical								
<i>Income</i>								
I ₂	rental income fees	EUR/m ² per annum	max	3,6	0,15	0	0,29	0,29
I ₃	premises use incomes (eg. subtenancy)	EUR/ m ² per annum	max	20	65	27	32	15
I ₄	incomes from investments	EUR/ m ² per annum	max	10,15	35	4,7	15,15	6,11
<i>Expenditures</i>								
I ₅	Management and exploitation	EUR/ m ² per annum	min	0	0	55,09	0	0
I ₆	Investments to the modernization and expansion	EUR/ m ² per annum	min	0	0	0	0	0
I ₇	Rental exemptions	EUR/ m ² per annum	min	93,24	110,64	54,68	29,76	44,76
I ₈	Losses due to unused space	EUR/ m ² per annum	min	1	2	3	1	1
I ₉	Inefficient use of the land plot	%	min	5	5	4	5	4
III. Social								
I ₁₀	Number of service users	Unit/ m ² per annum	max	77	110	5	95	16
I ₁₁	The part of service provided free of charge	%	max	10	5	50	40	50
I ₁₂	Execution of alternative services and/or short-term projects on the premises	Points	max	4	2	2	3	1
I ₁₃	Importance of activities in terms of possible loss of social welfare	Points	max	3	4	1	5	2
IV. Energy efficiency and environment protection								
I ₁₄	Heat energy consumption for heating and hot water	kWh/ m ² per annum	min	141,48	216,90	153,00	138,06	156,00

Analysis of initial data



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Comparative analysis of object related indicators: (a) – benefit-cost ratios (BCR); (b) – number of service users; (c) – the part of service provided free of charge; (d) – energy consumption for lighting, heating and hot water preparation.

Derivative indicators



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	Criteria	Measuring units	Max/Min	Weights	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
	Strategic (political)			0,2					
x ₁	Priority of activity	points	Max	0,2	4	3	4	5	4
	Economic criteria			0,2					
x ₂	Benefit-cost ratio (BCR): $((I1+I3)-(I4+I7))/(I4+I7)$		Max	0,15	-0,64	-0,11	-0,72	0,54	-0,53
x ₃	Land plot use efficiency	points	Max		5	5	5	5	5
	Social criteria			0,4					
	<i>Social benefits of RE use</i>			0,3					
x ₄	Number of service users	units/m ² per annum	Max	0,15	77	110	5	95	16
x ₅	The part of service provided free of charge	Proc.	Max	0,1	10	5	50	40	50
x ₆	Execution of alternative services and/or short-term projects on the premises	points	Max	0,05	4	2	2	3	1
x ₇	Importance of activities in terms of possible loss of social welfare	points	Max	0,1	3	4	1	5	2
	Environmental criteria			0,2					
x ₈	Energy consumption for lighting, heating and hot water preparation	kWh/ m2 per annum		0,15	212,22	325,35	229,5	207,09	234

Priority orders



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Criteria	Weights	Ranked values (Simplified Modified Qualiflex, Paelinck 1978)				
		A1	A2	A3	A4	A5
x_1	0,2	4	3	4	5	4
x_2	0,15	2	4	1	5	3
x_3	0,05	5	5	4	5	4
x_4	0,15	3	5	1	4	2
x_5	0,1	3	2	5	4	5
x_6	0,05	5	3	3	4	2
x_7	0,1	3	4	1	5	2
x_8	0,2	4	1	3	5	2
	Σ	3,45	3,15	2,65	4,7	2,95
	Rank	2	3	5	1	4

$A4 > A1 > A2 > A5 > A3$

Criteria	Weights	Normalized weighted values and ranks (Bayes rule, Arrow, 1949)				
		A1	A2	A3	A4	A5
x_1	0,2	0,160	0,120	0,160	0,200	0,160
x_2	0,15	-0,178	-0,031	-0,199	0,150	-0,147
x_3	0,05	0,050	0,050	0,040	0,050	0,040
x_4	0,15	0,105	0,150	0,007	0,130	0,022
x_5	0,1	0,020	0,010	0,100	0,080	0,100
x_6	0,05	0,050	0,025	0,025	0,038	0,013
x_7	0,1	0,060	0,080	0,020	0,100	0,040
x_8	0,2	0,195	0,127	0,180	0,200	0,177
	Σ	0,463	0,532	0,333	0,947	0,404
	Rank	2	3	5	1	4

$A4 > A1 > A2 > A5 > A3$

Concluding remarks

- An original model was proposed for asset efficiency assessment. This model evaluates different environmental factors. Important attention is paid to the economic efficiency of the property and to ensuring social needs. The novelty of proposed model strengthened by the inclusion of social benefits and possible social losses as are very important factors. For example, the importance of the object is assessed through potential social welfare losses (e.g. a library is closed/unused - property no longer used for social purposes). Or, premises for seniors' hobbies and leisure may not be used effectively, but social benefits are high. These criteria depicted in the proposed model and used in case study.
- The study revealed that it is rational to use multi-criteria methods to assess the end-use efficiency of buildings. Multiple criteria decision aiding methods give the possibility to improve the assessment process. The proposed approach enables fast and simple assessment. The proposed model is versatile and therefore can be applied for different cases.
- In future research the results will be verified applying other methods (e.g. CoCoSo-F method).

Sources



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